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LOCKHEED · CALIFORNIA COMPANY

P-3C UPDATE I

FRONT AND BACK COVERS

Patrol Squadron Nineteen, the "Big Red" squadron, is currently based at NAS Moffett Field. The squadron's primary mission is Anti-Submarine Warfare with secondary missions of Aerial Mine Warfare, Electronic and Photo Intelligence gathering, Shipping Surveillance and Reconnaissance, and Search and Rescue. To accomplish its missions, the squadron flies the P-3C "Update" Orion, the newest and most sophisticated version of the Fleet's standard land-based fixed-wing patrol aircraft.

VP-19 was originally commissioned as reserve unit VFB-907 at Livermore, California, in 1946, and moved to NARF Alameda, in December of the same year. The squadron was activated during the Korean conflict and deployed to Japan flying the famed P4Y-2 aircraft. In addition to patrolling the waters west of Japan, the squadron flew night flare-dropping missions over Korea, illuminating enemy targets for night fighting U.S. ground forces. Because of the use of red-tinged flares, the squadron was tagged, "Big Red".

In 1953 the squadron was designated VP-19 and received 12 P2V-5 aircraft as a new training cycle began. Patrol Squadron Nineteen transitioned to the P-3A Orion in 1963 and moved to NAS Moffett Field.

Late in January 1968 the squadron deployed to MCAS Iwakuni, Japan where they flew P-3B's. This deployment was highlighted by 8200 flight hours, many of which were flown in Vietnam Operations and the USS Pueblo Crisis.

Shortly after redeploying to NAS Moffett Field in early August, VP-19 was named winner of all major awards given to Pacific Fleet P-3 squadrons for the years 1967-1968. The awards included the Battle Efficiency "E", the Captain Arnold Jay Isbell Trophy for Excellence in ASW and the Chief of Naval Operations Maintenance Trophy.

The squadron was awarded the Meritorious Unit Commendation for service during the deployment to Adak, Alaska in 1969 and again for the deployment to Iwakuni, Japan in 1970. The squadron also received the Meritorious Unit Commendation for the period 1 June 1971 through 20 July 1971 while based at NAS Moffett Field.

In November 1971 the squadron deployed to NAS Cubi Point, Philippines, to provide ocean surveillance of the South China Sea. The squadron returned to NAS Moffett Field in May of 1972. From 1 June 1973 to 1 December 1973 the squadron deployed to Naha, Okinawa. On their return to Cubi Point in November of 1974 ocean surveillance and ASW support were the routine, highlighted by the successful support participation in the Vietnam refugee evacuation.

The squadron returned to Moffett Field in May of 1975, and completed transition to the P-3C Orion "Update" in February 1976. VP-19 participated in Operation Valiant Heritage, the largest Pacific Fleet Readiness exercise in a decade.

In May of 1976, VP-19 deployed to Naval Station Adak, becoming the first squadron to operationally employ the P-3C Orion "Update" aircraft.

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P-3C Update I

INTRODUCTION

The P-3C aircraft is a flying workhorse with thinking ability and memory. And, thanks to the refusal of technology to remain static, the thought processing and memory recall is greater today than it was 6 years ago when efforts were begun to increase the effectiveness of an already proven weapons system. Today's P-3C possesses an improved aircraft computer system that enables P-3C crews to perform ASW missions more effectively.

The production configuration of P-3C aircraft has been changed by Engineering Change Proposal (ECP) 822 at SerNo 159503 (Lockheed Serial 5620). This change, designated Update I, affects the P-3C baseline system as noted in Table 1.

Special assistance in preparation of this article was provided by Don Christopher, Project Representative; Jack Miller, Service Representative; Dick Pond, Service Representative; and Ed Pottorff, Avionics Administrator, P-3 Field Service; and Donald B. Daniel, Senior Design Specialist, Military Avionics Design and Integration Engineering Department, who contributed the Navigation section.

Figure 1 shows the location of new and relocated equipment. The P-3C Update I modifications discussed in this article provide improved system performance in the areas of:

- Data Processing, Storage, and Retrieval
- Navigation
- Acoustic Processing
- Operational Program
- System Test Program

DATA PROCESSING

Prior to P-3C Update I, the P-3C baseline system used the AN/ASQ-114 computer with a core memory size of 65,536 thirty-bit words. Because the complete complement of this memory was used by the existing operational program, no addition to or enlargement of the program could be accomplished. Therefore, many software functions considered of lower priority were eliminated. These severe restrictions were eliminated by the addition of Logic Unit 4 (LU-4) for P-3C Update I.

LOGIC UNIT 4 Logic Unit 4, MX-9360/AYA-8B, consists of a Drum Auxiliary Memory Subunit (DAMS), a Data Multiplexer Subunit (DMS), Auxiliary Display Logic (ADL), Spare Computer Channel (SCC), Maintenance Control Panel (MCP), and Power Supplies. (See Figure 2.)

Logic Unit 4 (LU-4) is larger and heavier than the other three logic units (44.4 x 26 x 14 inches and 265 lbs). The unit has two cooling fans, one for the Magnetic Drum Memory (MDM) and one for the logic and power supplies. The incoming cooling air is cleaned with filters installed in the logic unit's air inlets. The air inlets are located on the aisle side of the logic unit, just behind its access door.

Table 1. P-3C Update I Equipment Additions and Changes

SYSTEM	NAME/STATUS	LOCATION
COMPUTER CP-901(V)4/ASQ-114(V)	COMPUTER (MODIFIED)	NO CHANGE IN LOCATION
DATA ANALYSIS LOGIC UNIT MX-9360/AYA-8	LOGIC UNIT 4 (ADDED)	RACK D3 (LOWER) (LOWER MTT DELETED) PWR CONTROL AT TACCO
OMEGA NAVIGATION SET AN/ARN-99(V)	OMEGA (ADDED)	RACK G1 CONTROL AT NAV/COM
MAGNETIC TAPE TRANSPORT RD-319A/AYA-8	MTT (MODIFIED)	IN LIEU OF UPPER MTT RD-319/AYA-8
AUXILIARY DISPLAY IP-886/ASA-66 & C-7444/ASA-66	DISPLAY AND CONTROL (ADDED)	BETWEEN SS-1 AND SS-2
SONAR COMPUTER RECORDER GROUP AN/AQA-7	AQA-7(V)4 MODIFIED	VARIOUS UNIT RELOCATIONS
LOWER MTT RD-319/AYA-8	DELETED	---
LORAN EQUIPMENT AN/ARN-81	DELETED	---
MC-2 ALTIMETER AT NAV/COM STATION	DELETED	---
AAU-28/A ALTIMETER-TRANSMITTER	MOVED	RELOCATED FROM RACK D-3 TO NAV/COM STATION

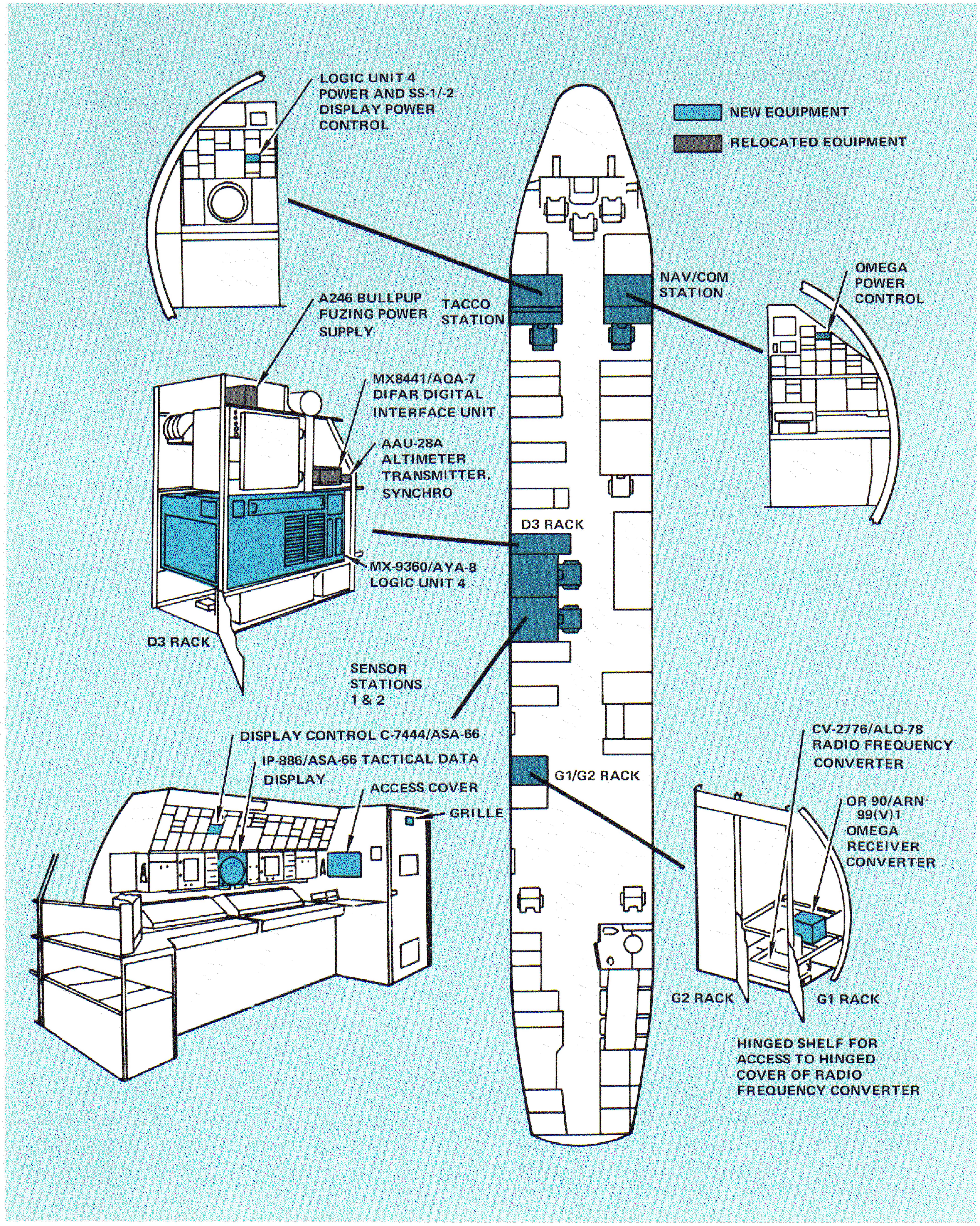

Figure 1. Location of New and Relocated Equipment

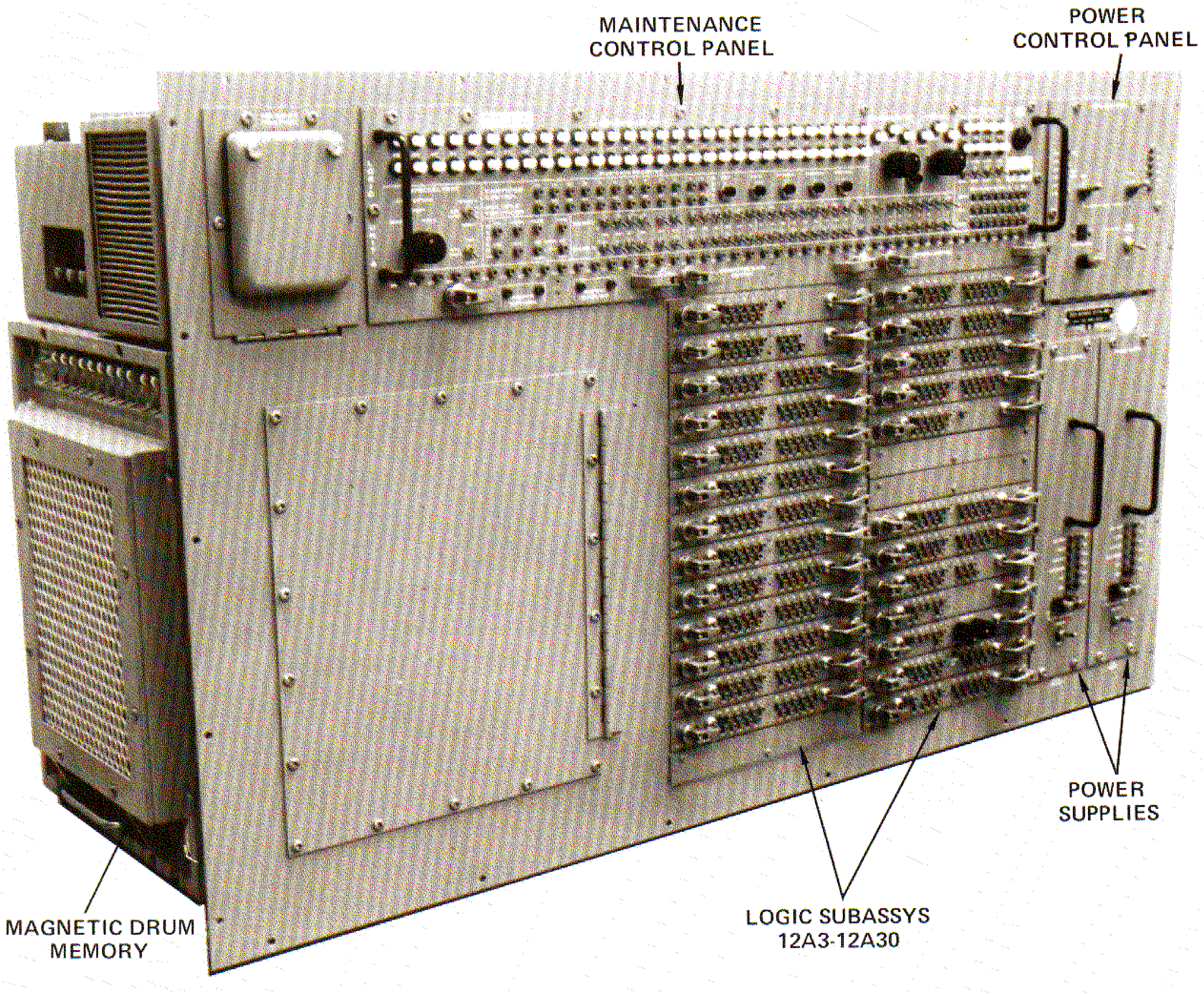

Figure 2. Logic Unit 4

The addition of Logic Unit 4 expands the P-3C System capabilities by adding peripheral channel capability currently used by the Auxiliary Display and Omega Navigational Set, and expands the system memory for Update I improvements and growth.

System memory is increased by the MDM and Magnetic Drum Controller (MDC) logic, which comprise the DAMS. The drum memory has a total capacity of 393,215 thirty-bit, usable computer words and one preamble word, presuming that the drum's entire memory capacity is used for writing one total record. The controller logic provides data buffering and drum controls so that data transfer speed is compatible with the CP-901 Computer, using Channel 15.

Input/Output capability is increased by the addition of the DMS and the SCC subunits. The DMS provides an 8-channel program selectable interface for peripheral equipments via computer Channel 13. The SCC contains the interface logic, data line drivers, and line receivers for computer Channel 14.

Logic Unit 4 contains two identical (but not redundant) power supplies: PS1 for the DAMS, MCP, and SCC; and PS2 for the DMS and ADL.

If PS1 is powered down, the PS2 voltages are automatically used to supply the MCP and SCC. The Logic Unit 4 power supplies have been redesigned and are not interchangeable with the Logic Units 1, 2, and 3 power supplies. The new power supplies do not have jacking hardware, but are held in place by the four front plate fasteners. The new power supply design is a DC to DC converter with a +5V feedback, overvoltage and overcurrent protection.

The Logic Unit (excluding the MDM) design utilizes existing modules from Logic Units 1, 2, and 3, plus four new module types that are detailed below.

Module type 17 is a summing amplifier and line driver used in the ADL subunit X and Y analog subassemblies. Module type 35 is a gating and shift register used in the DAMS data path subassemblies. Module type 46 is a character display read-only memory module used in the ADL subunit data control assembly. Module type 47 is a line driver/line receiver module used in the DAMS data control and instruction control 1 and 2 subassemblies.

Drum Auxiliary Memory Subunit (DAMS) The DAMS performs all rapid access bulk data storage functions for Logic Unit 4. Additional memory capacity is provided to augment the computer's 65k word core capacity. This enables the computer to store an operational program that is larger than its core capacity, and allows rapid access to segments of the operational program as needed.

Characteristics of the DAMS are:

- 393, 215 word capacity (maximum)
- 41k word/second data transfer rate (average)
- Dual 32-word buffers
- Memory protect capability
- Average access time is 6.5 milliseconds (msec), maximum access time is 13.28 msec
- Error rate less than 1 bit in 10^{10} bits transferred

The Magnetic Drum Memory (MDM) contains 384 addressable tracks with 1024 possible word addresses/tracks as specified by a 19-bit data word address. This results in an address capable of specifying the position of any one of 393,215 words.

The average DAMS data transfer rate is 41k words/second. The computer single channel maximum sustained transfer rate is approximately 83k words/second. It is important that the DAMS transfer rate be less than that of the computer, otherwise the computer might not keep up with the data transfer. If the dual 32-word DAMS buffers are full, no data storage area is available until the computer empties one of the DAMS buffers. Under these circumstances, a heavy time penalty of 12.5 msec would be imposed upon the data transfer when the next data word passes under the MDM read head with no DAMS storage area available. The DAMS transfer rate allows the transfer of a program of 48k words, 75% of the computer core capacity, in less than 2.0 seconds.

Dual 32-word data buffers are provided so that precise synchronism between the computer and the drum is not required. During normal operation, the computer is loading or unloading one of the buffers while the drum is unloading or loading the other buffer, depending upon the operational instruction. The purpose of the buffers is to accommodate the differences between the computer data rates and timing and those of the MDM.

The MDM is divided by the MDC into 12 equal memory sections, each having 32,768 addressable word locations. Each memory section is provided protection to prevent new data from being written over existing data. This protection is provided by control switches located on the memory protect panel or by computer command. If the memory protect switch for a specific area is in the PROTECT position, the computer cannot write new data in that area nor can it change the protection status for that area. If, however, the memory protect switch is in the NOT PROTECT position, the status can be changed via the computer output command.

The MDM is a hermetically sealed unit that consists of a lightweight medium-capacity rotating drum, floating magnetic heads, head select circuitry, signal distribution hardware, motor, and bearings. The assembly is pressurized with nitrogen to provide an inert laminar gas layer for the floating heads.

The characteristics of the MDM are summarized as follows:

- 48 data heads, each containing 8 channels (tracks)
- One timing head
- Bit density of 1960 bits per inch (bpi)

- Drum speed of 48,000 ±50 rpm
- 384 data tracks plus 10 spare tracks, complete with heads, are available for depot level modification in case of track failure.
- Each data track contains 1024 addressable word locations plus 158 word locations reserved for testing only.
- Two accelerometers for monitoring bearing performance.
- Two overtemperature sensors
- One pressure sensor
- Track spacing is 0.020 inches
- Drum running torque is 25 inch-ounces
- Drum length is 13.9 inches
- Drum height is 8.69 inches
- Drum weight is 19.0 lbs

The MDC receives the 30-bit parallel word from the computer via the MCP. The 30-bit word is divided into two 15-bit bytes and a parity bit (odd) is added to each byte. The resulting 32-bit word is divided again into four 8-bit bytes. The four 8-bit bytes are transmitted serially to the MDM. The MDM divides the 8-bit bytes into 1-bit bytes and stores the data serially on the drum using Modified Frequency Modulation encoding.

The DAMS continuously monitors its operations and equipment condition and reports status to the computer. The DAMS will detect illegal instructions, illegal combinations of instructions, address errors, attempted writing in a protected section, MDM speed error, MDM overtemperature, MDM pressure loss, MDM clock error or loss, track select errors, and parity errors.

The DAMS also has a diagnostic testing capability to detect and isolate equipment malfunctions.

Data Multiplexer Subunit (DMS) The DMS is a computer-controlled interface subunit that provides Logic Unit 4 with eight input/output data multiplexer channels to interface with the computer via Computer Channel 13. Seven channels provide input/output signal paths for equipment and one channel is used for test purposes.

The DMS has a 30-bit data input/output interface to the computer over Computer Channel 13. Six of the eight data multiplexer channels can interface DMS input/output data with other equipments (peripherals) external to Logic Unit 4. Using the DMS Test Loop Channel 0, Computer Channel 13 data are returned to Computer Channel 13 input lines through a minimum of DMS logic. DMS Channel 2 is devoted exclusively to the ADL and the ADL diagnostic loops (both of which are totally within LU-4). On the six channels that can interface with external equipments, the DMS provides the following computer interface capabilities:

- 30 bits of data via IDR/IA Transfer (Input Data Request/Input Acknowledge)
- 26 bits of data via EI/IA/EIE Transfer (External Interrupt/Input Acknowledge/External Interrupt Enable)
- 30 bits of data via ODR/OA Transfer (Output Data Request/Output Acknowledge)
- 29 bits of data via EFR/EF Transfer (External Function Request/External Function)

Presently, the input subassemblies (12A22 and 12A23) for DMS Input Channels 5 and 6 are not installed in LU-4, but may be added later as needed for system expansion.

The DMS performs the preceding functions in accordance with instructions from the computer. The computer has a repertoire of 11 instructions that it can use to control DMS operation; i.e., configure or program the DMS. Only one of the eight input channels can be enabled at one time for IDR/IA transfers.

Only one of the eight output channels can be enabled at one time for ODR/OA or EFR/EF transfers. Any or all of the peripheral channels can be enabled for EI transfers. In addition, any or all of the unselected (enabled) input channels (IDR/IA) can be monitored by the DMS and if an IDR is detected, the computer is informed via an external interrupt word specifying the unselected channel with an IDR waiting.

The computer can request the DMS configuration at any time and it is sent via DMS STATUS EI on Channel 13. The configuration of the DMS or the "DMS Status" is defined as follows:

- DMS Input Channel – Channel selected for input to computer.
- DMS Output Channel – Channel selected to receive computer output.
- EI – Capabilities (Enabled/Disabled) of Individual DMS Channels.
- IDR Monitor EI – Capabilities of Individual Unselected Input DMS Channels.

The 11 instructions that the computer can send to the DMS are as follows:

- No DMS Operation
- Select DMS Input Channel
- Select DMS Output Channel
- Select DMS Input and Output Channels
- Enable DMS CH EI Capabilities
- Enable IDR MONITOR EI Capabilities
- Enable DMS CH EI and IDR MONITOR EI Capabilities
- Select DMS Input and Output and Enable EI and IDR MONITOR EI Capabilities
- DMS Status Request
- Set DMS Channel Test
- Reset DMS Channel Test

If more than one computer Channel 13 input request is generated simultaneously, the words are sent to the computer by the DMS according to priority. In addition, if peripheral equipments generate simultaneous input requests (EI's from any channel, IDR MONITOR EI's from unselected input channels), the inputs are sent by the DMS according to priority.

Any on-going or pending input by the DMS will be cleared by a Power Monitor (PM) EI until the PM EI is acknowledged by the computer. In all other cases the DMS will complete an input operation before allowing the highest priority input to be sent to the computer.

The DMS has diagnostic testing capability to detect and isolate equipment malfunctions. Two types of tests are used: the DMS loop test (DMS CO) and the DMS Channel test.

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Channel 14 Spare Computer Channel (SCC) The SCC subunit of Logic Unit 4 provides an interface between the CP-901 computer and a peripheral equipment. The subunit consists of two subassemblies, one input interface subassembly and one output interface subassembly. The following access capability to the computer is provided to a peripheral equipment via Computer Channel 14 of Computer Group 3:

- 30 bits of Data Input
- 30 bits of Data Output
- 4 Input/Output Request Controls (IDR, EI, ODR, EFR)
- 4 Input/Output Acknowledge Controls (IA, EIE, OA, EF)

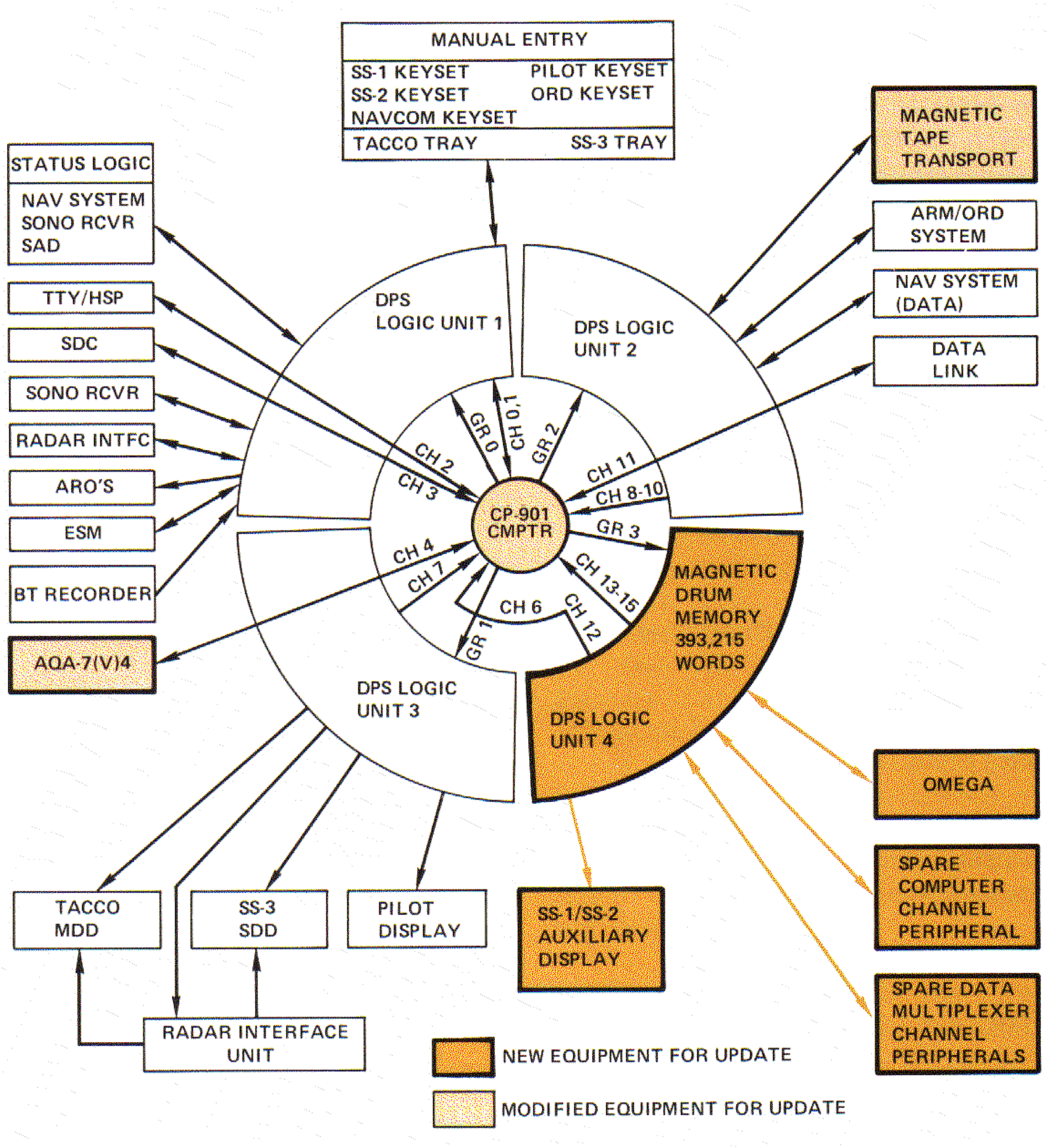


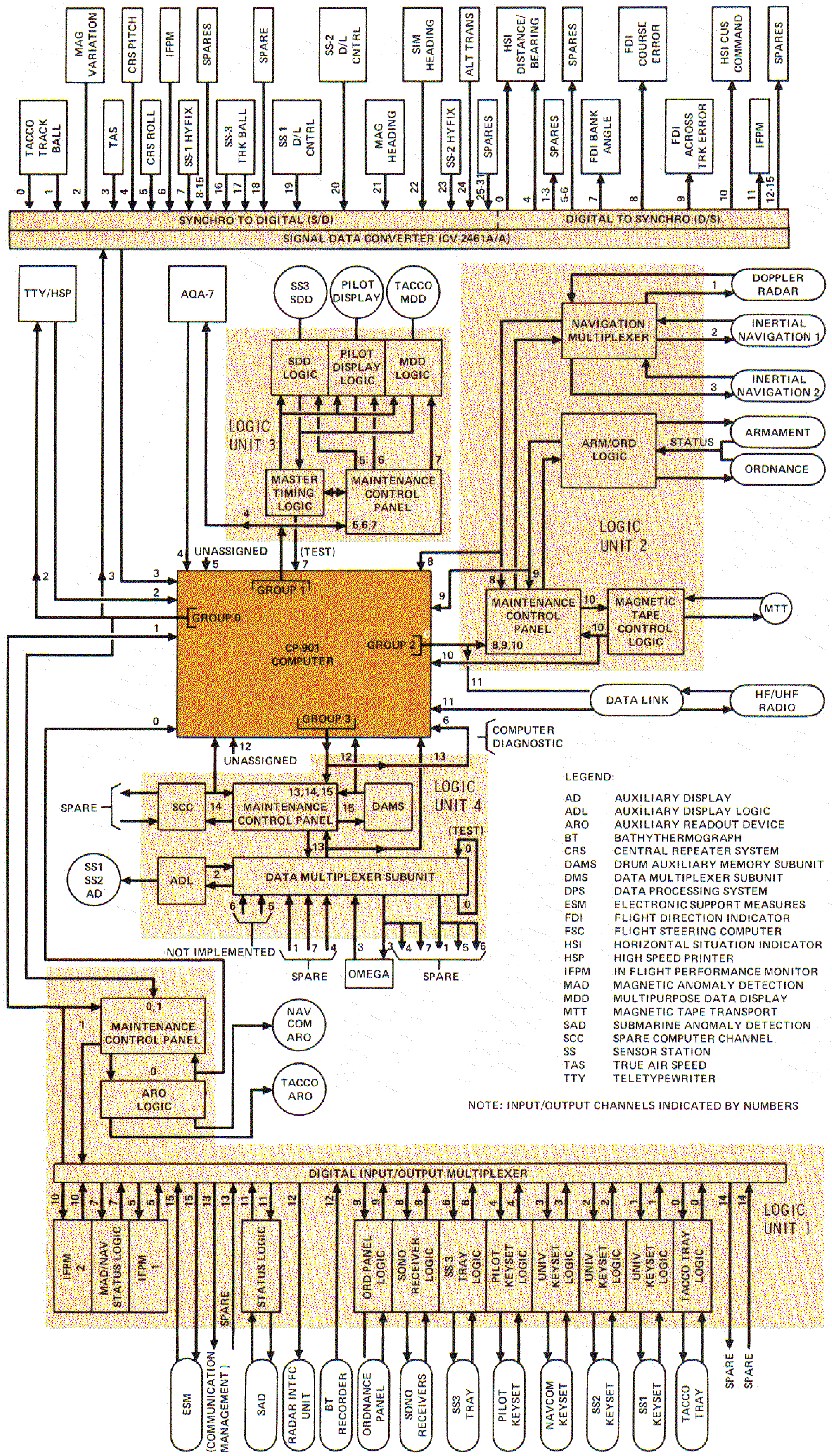
Figure 3. Data Processing Functional Flow Diagram

The SCC subunit does not impose any data word coding or data transfer procedural requirements upon communications between the computer and a peripheral equipment.

The primary purpose of the SCC is to provide MCP off line and verify capability for Channel 14.

MODIFIED COMPUTER CP-901(V)4/ASQ-114 The Update I modifications to the baseline computer have increased the input/output (I/O) capability of the central processor, and the self-test bootstrap capability of the non-destructive readout memory. Figure 3 depicts the functional flow of the Update systems and relates the new and modified equipments with the data processing system. A more detailed block diagram is shown in Figure 4.

The modified computer's I/O capability is increased by use of the fourth (Group 3) group of channels (12, 13, 14, 15) for which provisions were made in the baseline computer. These channels interface the computer with Logic Unit 4, which has a drum memory capacity of up to 393,215 words. The increased memory provides capacity for added operational program size. In order to add diagnostic testing and program loading (bootstrapping) functions to the Magnetic Drum



LEGEND:

AD	AUXILIARY DISPLAY
ADL	AUXILIARY DISPLAY LOGIC
ARO	AUXILIARY READOUT DEVICE
BT	BATHYTHERMOGRAPH
CRS	CENTRAL REPEATER SYSTEM
DAMS	DRUM AUXILIARY MEMORY SUBUNIT
DMS	DATA MULTIPLEXER SUBUNIT
DPS	DATA PROCESSING SYSTEM
ESM	ELECTRONIC SUPPORT MEASURES
FDI	FLIGHT DIRECTION INDICATOR
FSC	FLIGHT STEERING COMPUTER
HSI	HORIZONTAL SITUATION INDICATOR
HSP	HIGH SPEED PRINTER
IFPM	IN FLIGHT PERFORMANCE MONITOR
MAD	MAGNETIC ANOMALY DETECTION
MDD	MULTIPURPOSE DATA DISPLAY
MTT	MAGNETIC TAPE TRANSPORT
SAD	SUBMARINE ANOMALY DETECTION
SCC	SPARE COMPUTER CHANNEL
SS	SENSOR STATION
TAS	TRUE AIR SPEED
TTY	TELETYPEWRITER

NOTE: INPUT/OUTPUT CHANNELS INDICATED BY NUMBERS

Figure 4. P-3C System and Interface Block Diagram

Memory (MDM), it was necessary to add the Read Only Memory (ROM) to the basic CP-901 computer. This was accomplished by replacing the 512-word core rope memory in the computer with a 1024-word semi-conductor ROM.

AN/ASA-66 AUXILIARY DISPLAY The Auxiliary Display (AD) is a display unit identical to the present Pilot's Display, mounted between Sensor Stations 1 and 2. It is controlled from the CP-901 computer, through the DMS and Auxiliary Display Logic (ADL) subunit of Logic Unit 4.

The main function of the ADL is to translate computer output words into visual displays on the Auxiliary Display for Sensor Station 1 and Sensor Station 2 operators. This provides the acoustic station operators with a tactical presentation to aid in data analysis. It also eliminates the time-consuming relay of instructions between the TACCO and the acoustic station operators, which are subject to misunderstandings.

The CP-901 computer is the source of all on-line inputs to the Auxiliary Display system via Computer Channel 13 and Data Multiplexer Subunit Channel 2. The computer also may request diagnostic data from the ADL. The ADL is an interface and timing subunit which accepts, processes, and time-sequences computer or manually generated binary coded data to present conics (vectors, azimuth vectors, and circle), alphanumerics and special characters on the ASA-66 display at Sensor Stations 1 and 2. The Maintenance Control Panel (MCP) on LU-4 enables the operator to perform manual tests on DPS 4 and contains the ADL timing and diagnostic controls.

MODIFIED MAGNETIC TAPE TRANSPORT The P-3C Update I RD-319A/AYA-8 Magnetic Tape Transport (MTT) shown in Figure 5 consists of a modified version of the RD-319/AYA-8 Magnetic Tape Transport used in the baseline system. The modification includes the addition of a separate erase head and a new method of measuring the amount of the tape remaining. These improvements, along with the addition of the Drum Auxiliary Memory, have permitted the elimination of one of the two MTT's from the baseline system.

Since greater demands will be made on the single remaining MTT, several changes have been made to improve its reliability, performance, and maintainability.

Addition of Erase Head A full tape-width direct current erase head has been added on the improved version MTT. The erase head is of the non-contacting type; i.e., the head does not contact the tape surface. This design prevents any possibility of tape tracking errors caused by tape contact with the erase head. In addition, it removes one source of frictional wear from the tape path.

Use of a full tape-width erase head ensures that erasure is complete with one pass by the head, and eliminates the need for a second tape run to verify erasure. The erase head location precedes that of the write head on the tape path. During each write operation, the erase head is energized to ensure that all old data have been erased from the tape before new data are recorded.

An erase switch has been added near the tape head connector on the front of the MTT. This switch enables the operator to erase a segment of the tape around the load point. An interlock is provided so that erasure cannot take place unless the write permit ring is installed on the tape reel and the MTT is set to operate in a forward condition. This prevents accidental erasure of a program tape.

Change to Light Emitting Diodes in All Tape Path Sensors

In the RD-319A, all sensing system incandescent lamps have been replaced with light emitting diodes (LED's). The LED's have a considerably longer operating life than do incandescent lamps.

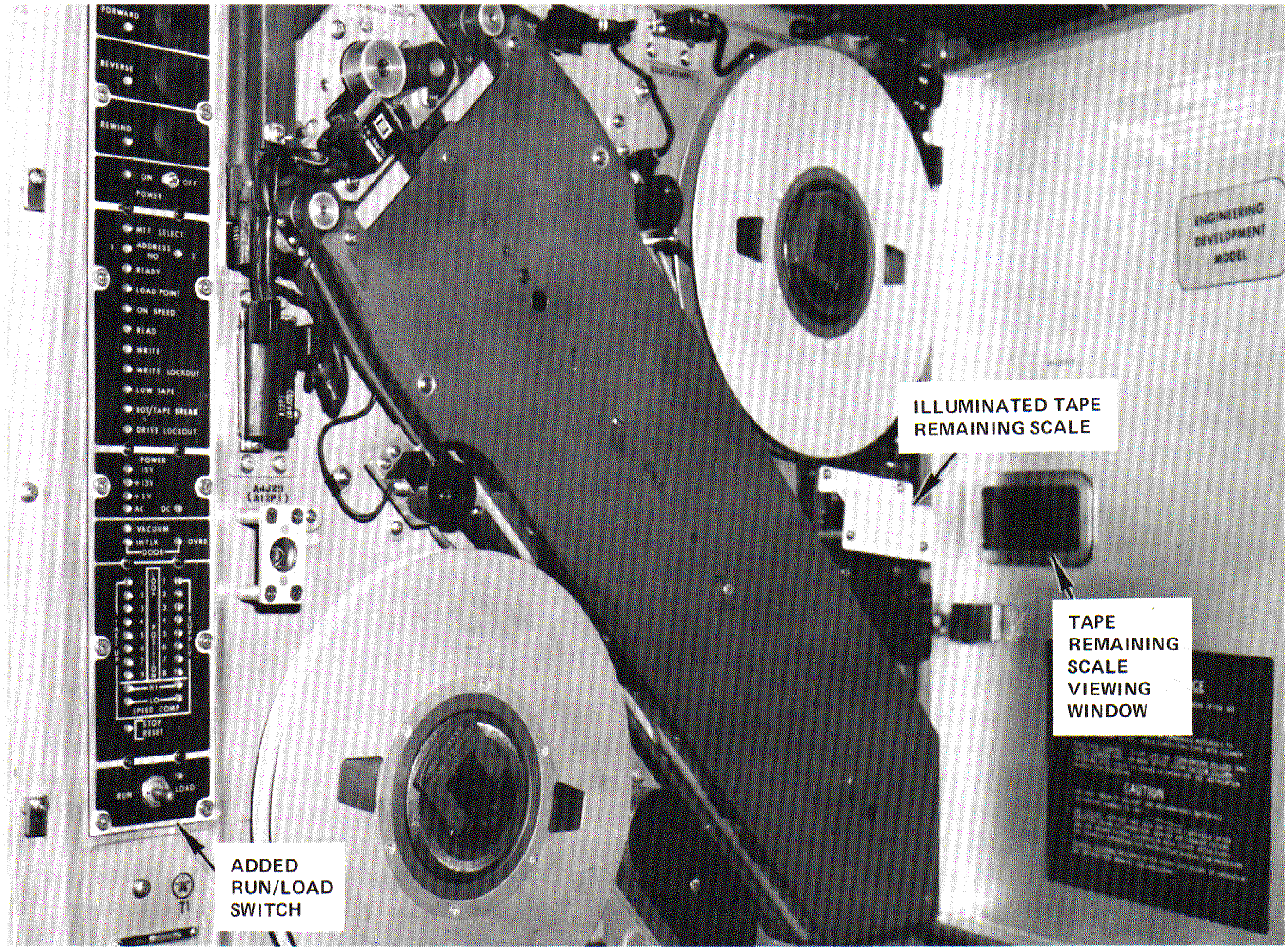
Redesign of Read/Write Amplifiers and Data Control Logic

The read preamplifier has been changed to include one operational amplifier stage with fixed gain in lieu of two stages of adjustable gain. This redesign makes possible direct interchangeability of read/write cards with fixed adjustment, and as an additional benefit, the interchangeability of tapes from one machine to another without reading problems.

The Data Control module has been completely redesigned to minimize noise sensitivity and to improve pulse stability. The timing for data is now derived from a 3.9 MHz crystal oscillator.

Blower Motor Redesign The operating altitude requirement for the MTT has been reduced from 30,000 feet to 15,000 feet, since the MTT is operated in a pressurized cabin of the aircraft. This operating requirement recognizes the increased air density in the pressurized aircraft. This, in turn, permits the use of lower speed cooling fans. Consequently, the higher-speed dual blower, which provided pressure differential for the vacuum

Figure 5. RD-319A/AYA-8 Magnetic Tape Transport



column and tape cleaners as well as cooling air for the power supply, has been replaced with a lower-speed vacuum blower to serve the vacuum column only. The RD-319A power supply now has its own separate blower. The prime benefits of this change are a lower noise level and increased blower life.

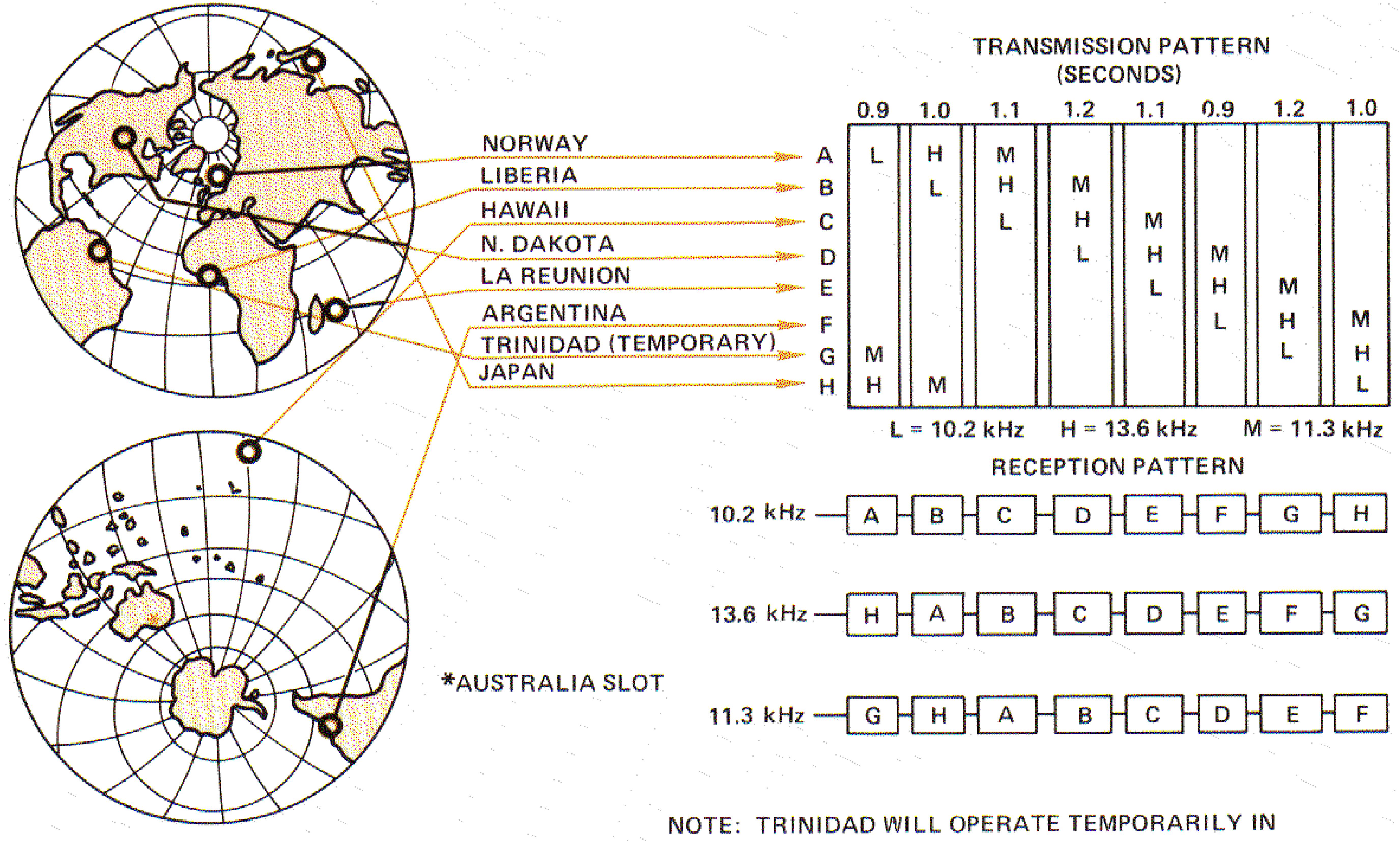
Tape Handling Improvements Tape path adjustments have been improved for RD-319A MTT's, and a gauge has been provided to facilitate the adjustment of the reel height relative to the vacuum column. Also, a special tool was made to permit easy adjustment of the tachometer which is installed perpendicular to the vacuum column. The guide rollers of the tape cleaners have been changed to fixed type guides.

Elimination of Dual Servo Drive Brake In case of a tape loop fault, the vacuum column sensors lock out the tape transport drive. This feature makes the drive servo brake unnecessary. On the RD-319A MTT, some reel chatter will occur when the tape is not in motion, since the dual brake has been eliminated. This condition is normal.

Control Logic Improvement A run-load switch was added to prevent a possible runaway reel condition during tape loading. This switch simulates a broken tape condition. The power failure brakes are applied when this switch is in the *load* position and the door switch is in either the interlock or the override positions. The run-load switch can also function as an emergency shutdown switch, since it applies the power failure brakes regardless of tape motion or MTT select commands.

Other improvements to the MTT include:

1. Replacement of the mechanical reel direction sensors with electronic integrators (on the reel servo logic board).
2. Redesign of the MTT Power Supply for improved reliability and better maintainability. The redesigned power supply consists of three separate power supply assemblies, each with a separate transformer and rectifier system operating directly from the 400-Hz input. This separation eliminates interference from one power supply to another. It also permits the fault isolation circuitry to trace a fault directly to the power supply at fault. Connectors now replace the old soldered connections, eliminating a tedious soldering task when power supply replacement is necessary. Also the new design has improved airflow within the power supply, providing more efficient power supply cooling.
3. The tape-remaining sensor in the improved version has been changed to eliminate tape remaining indications at LU-2, although the meter has not been removed. Instead, a window has been added in the MTT front cover to make an illuminated tape remaining scale (Figure 5) visible during normal MTT operation. Also, a non-adjustable photo sensor provides the low tape warning signal at the MTT Control Panel.
4. The service life of the incandescent lamp in the capstan has been increased by reducing its operating voltage.
5. The tape break sensor was modified to eliminate the connector and to replace the incandescent lamp with an LED.
6. The write lockout sensor was changed from an incandescent bulb to an LED. This circuit assembly was redesigned to eliminate the reel direction sensor circuitry.
7. The new door has a single positive latch in a more accessible location, compared to the previous dual latching method on the RD-319 MTT.
8. The disposable air filter for the tape compartment has been changed to a reusable type that can be washed, thus eliminating costly replacements.
9. Extender cards have been designed to provide access to all interconnection pins in the electronics housing in order to facilitate servicing. Also, extender cables have been designed to permit the circuit cards in the power control assembly to be connected externally to the assembly for troubleshooting.



NOTE: TRINIDAD WILL OPERATE TEMPORARILY IN SLOT G IN 1976. SLOT G WILL BE ASSIGNED TO THE AUSTRALIAN STATION WHEN IT BECOMES OPERATIONAL.

Figure 6. Omega Broadcast Sequence (February 1976)

NAVIGATION

P-3C Update I has improved P-3C navigation by augmenting the existing combination of inertial and doppler navigation systems with an Omega Navigation Set AN/ARN-99.

AIRBORNE OMEGA NAVIGATION SYSTEM Airborne Omega is a global navigation system that provides position fixing information by measuring the phase of radio signals from eight radio transmitters and correcting the error of its internal dead reckoning (DR) computations. The radio signal may not be continuously available; therefore, the system is mechanized to continuously DR and to correct the DR computation when signals are re-acquired. Figure 6 shows the locations of the Omega transmitting stations.

Presently, the Omega system is operational with seven stations in a "full up" status. The eighth station, planned to be located in Australia, will not be operational for at least another two or three years. During 1976, the Trinidad station has been operating in the Australian station's transmitting time slot.

Omega Fundamentals Each of the eight Omega stations transmits a sequence of three continuous wave (CW) signals, or "bursts," that generate a field pattern of expanding concentric circles around the transmitter. The first burst is transmitted at 10.2 kHz, the second at 13.6 kHz, and the third at 11.33 kHz. The duration of each burst is about 1 second; specifically, the total span of a burst varies between 0.9 and 1.2 seconds with a non-transmission time between bursts of 0.2 second. This Omega transmission pattern repeats every 10 seconds. These signals are translated into Omega "lanes", the width of each being equal to one Omega signal wavelength.

Figure 6 shows the specific broadcast transmission time and frequency relationships between the Omega stations. The eight stations are represented as letters A through H on the left of the transmission pattern, and pulse length is represented in seconds across the top. The separation line between bursts represents the 0.2 second period of nontransmission. Notice that at any point in time (except during the 0.2 second off-time) three bursts are being transmitted, one from each of three stations on three separate frequencies. To receive the simultaneous signal bursts on each of the three frequencies, the Airborne Omega system uses three receivers, each tuned to one of the Omega frequencies.

Thus, there are eight stations, each of which transmits signal bursts sequentially on three frequencies – a total of 24 bursts in each 10-second period. Each Omega transmitting station uses an atomic clock to generate all three frequencies. Each frequency is time-synchronized, which means that at each station and on each frequency the signal's respective sinusoid will rise from zero at Omega time-zero. This not only synchronizes the eight transmitters to Omega time but to each other as well.

Omega receivers use a reference oscillator to measure the difference in phase between itself and the incoming CW bursts. This oscillator is not as precise as the atomic clock of the transmitting stations. If the oscillator is stable over a 10-second interval, the phase difference between pairs of stations can be measured to produce hyperbolic Omega measurements. Some Omega receivers use a very high quality crystal reference oscillator. In such systems, a computer can use phase measurements between the oscillator and three different transmitters to calibrate the oscillator's frequency and drift rate. Position fixing by this method, which makes direct phase measurements from three or more stations, is called Rho-Rho (it is also called circular or Direct Ranging). The P-3C Update I Omega is a Rho-Rho system.

Navigation with Omega depends on two factors: (1) the phase stability of very low frequency (VLF) signals propagated over long distances, and (2) the ability to predict the phase at any time of day and at any location. The selection and the ultimate choice of the very low frequencies for Omega stem from the fact that relatively low power can cover large distances and propagation phase delays are usually predictable.

Omega Error Sources There are eight basic error sources that affect the accuracy of the Omega navigation system. The explanation of some of the error sources is complex and beyond the scope of this article. In general, signal phase velocities in the VLF range are primarily dependent upon the status of the VLF waveguide which, in turn, is dependent upon the shape and height of the earth's ionosphere. The first of these eight error sources is called the diurnal effect. It is principally associated with the sun's position. The sun's radiation adjusts the height and shape of the ionosphere. During daytime, the ionization region lowers to an altitude of approximately 70 km, thereby increasing the phase velocity. At nighttime the ionization decays and the ionosphere moves up to an altitude of around 90 km, thereby reducing the signal phase velocity. This effect is seasonal and nonlinear during transition periods (sunrise and sunset).

A second error source is ground conductivity. Great differences in signal phase velocities exist between sea water and ice. Ice has high signal attenuation and slows the phase velocities, while sea water and earth have low attenuation. The earth has been mapped for conductivity, and presently up to 16 levels of ground conductivity are used in signal propagation prediction models.

A third error source is the different signal frequencies themselves, which are nonlinear across the VLF spectrum. A fourth error source is excitation of the planet earth, which is a function of frequency, ground conductivity, the waveguide mode, ionosphere profile, ionosphere height and direction of transmission. A fifth source is the earth's magnetic field, which influences the signal attenuation rate and relative phase velocities at the various frequencies employed. A sixth error source is latitude effect. The seventh error source is radio frequency noise which includes random noise, impulse noise, EMI, and precipitation static. The eighth error source is signal phase error within the receiver.

P-3C OMEGA The P-3C Omega System is an integrated Omega-DR (dead reckoning) navigation system that incorporates new hardware and software concepts. Data from the AN/ARN-99(V)-1 Omega Receiver/Converter is processed in the CP-901 central computer and displayed on the NAV/COM and TACCO Auxiliary Readouts (ARO's). This provides the P-3C with the performance of an autonomous Omega set without the expense, weight, and power consumption of an installation with its own computer and Control-Indicator. Figure 7 illustrates how periodic Omega position update can "bound" the continuous growth of Geographic Navigation (GEO NAV) errors.

Omega system design goals have been directed toward producing a geodetic accuracy of 1 nmi during the day and 2 nmi at night. Good signal propagation prediction is essential if these goals are to be achieved. Computerized airborne Omega receivers contain real time propagation prediction capability; however, with the current knowledge of propagation prediction, it is optimistic to expect to meet or exceed the design goals more than 68 percent of the time over 68 percent of the earth.

Unlike LORAN A, which is used on the basic P-3C, Omega is an ambiguous system. That is, Omega measures only the fractional portion that exceeds the whole number of lanes (of which there are many) between the Omega transmitter and the receiver. As a result, the same data (the fractional measurement) will be detected by an Omega receiver and transferred to the computer if the receiver is moved exactly one whole lane toward or away from the Omega transmitting station. Like the inertial navigation systems, Omega must be initialized with a present position. If the error in the initial position is less then ±36 nmi, the Omega measurements will correct for this error. If the initial position error is greater than ±36 miles, Omega will converge upon an erroneous position.

Benefits of the Computerized Omega Concept The AN/ARN-99(V)-1 Omega (Antenna-Coupler Plus

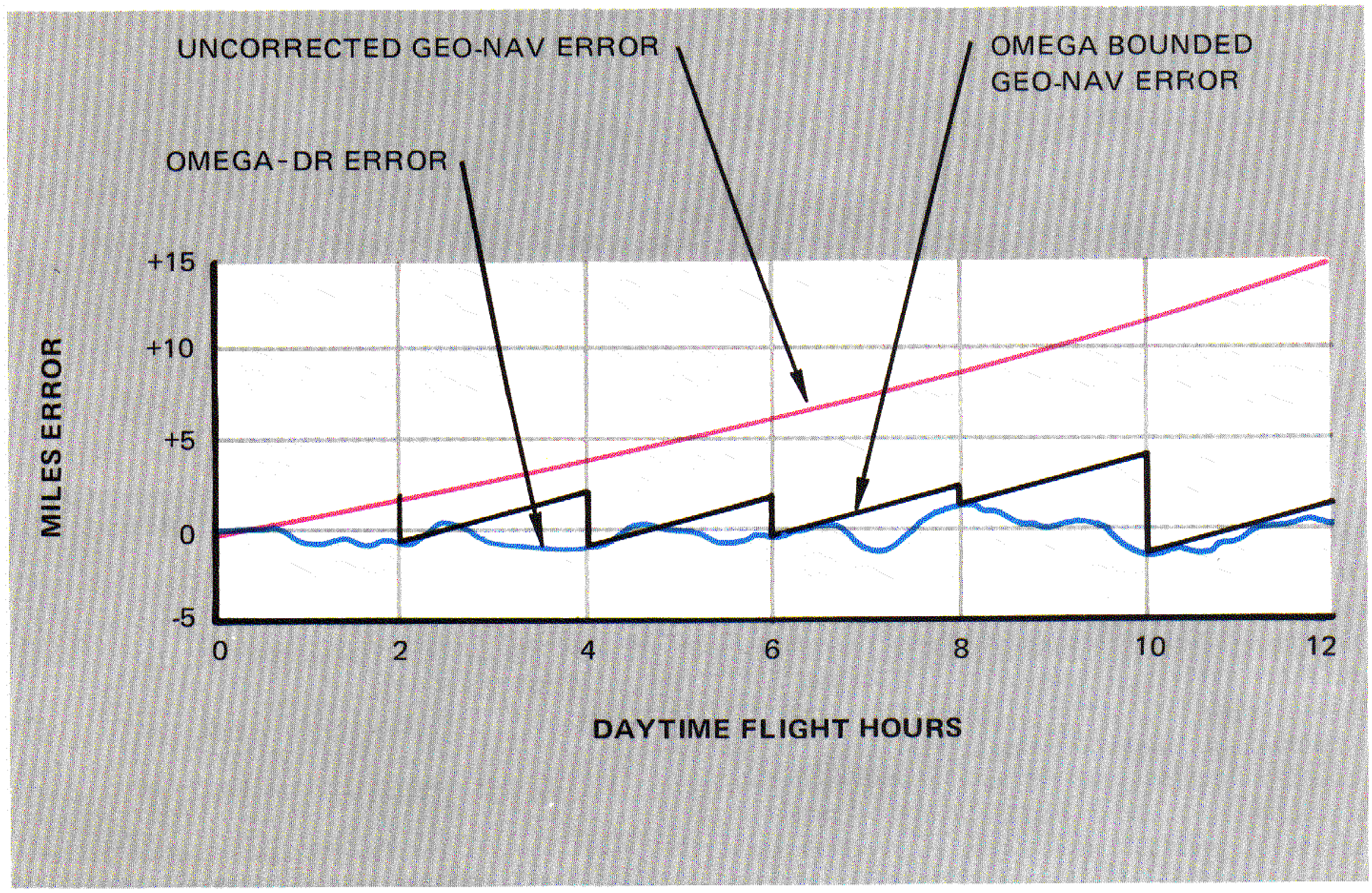


Figure 7. GEO-NAV Error Bounded with Updated Omega-DR Fix

Receiver-Converter) shown in Figure 8 is essentially a receiver. The data it outputs to the central computer are digital numbers. (If listed and viewed by a human they would appear to be random numbers.) The computer contains apriori knowledge of the Omega signal format. Using the apriori knowledge and cross-correlation techniques, the computer synchronizes its software processing to Omega transmitter time and then performs the navigation data extraction process.

The advantages of computerizing a navigation set are significant and include:

- Improved Performance
- Reduced Parts Count
- Improved Reliability
- Growth Capability Without Hardware Modification
- Improved Built-In-Test Capability

Software in the CP-901 computer perform the following functions:

- Antenna switching
- Automatic synchronization
- Burst phase filtering
- Phase tracking filtering
- DR Navigation
- Real time propagation prediction
- Kalman combinational filtering
- Receiver-converter calibration and test

Receiver-Converter Calibration and Test Each time the Omega Program is restarted, the computer program performs a series of tests to assure that the receiver-converter is functioning properly. Each of the three receivers is tested and calibrated for scale factor, bias, and phase. These latter tests are continued in flight to assure that temperature variations do not introduce undesired position errors. In flight, the computer checks the receiver's calculated oscillator frequency, and will indicate through the high speed printer if the frequency is outside specified tolerances.

The antenna-coupler shown in Figure 8 is not tested by the computer. It contains four ferrite rod loop antennas which are connected in differential pairs to produce the effect of two perpendicular rods. The signals from the two antenna pairs are amplified by separate bandpass amplifiers and then sent via a special magnetically shielded transmission line to the receivers.

P-3C OMEGA SYSTEM OPERATION The P-3C Omega-DR System is comprised of the AN/ARN-99(V)-1 Navigation Set (shown in Figure 8) and software contained in the CP-901 computer. Omega outputs are displayed on the ARO at the NAV/COM and TACCO stations. Inputs to Omega are made via the Universal Keysets.

Omega is initialized by data inserted into the computer during preflight. Initialization requires a

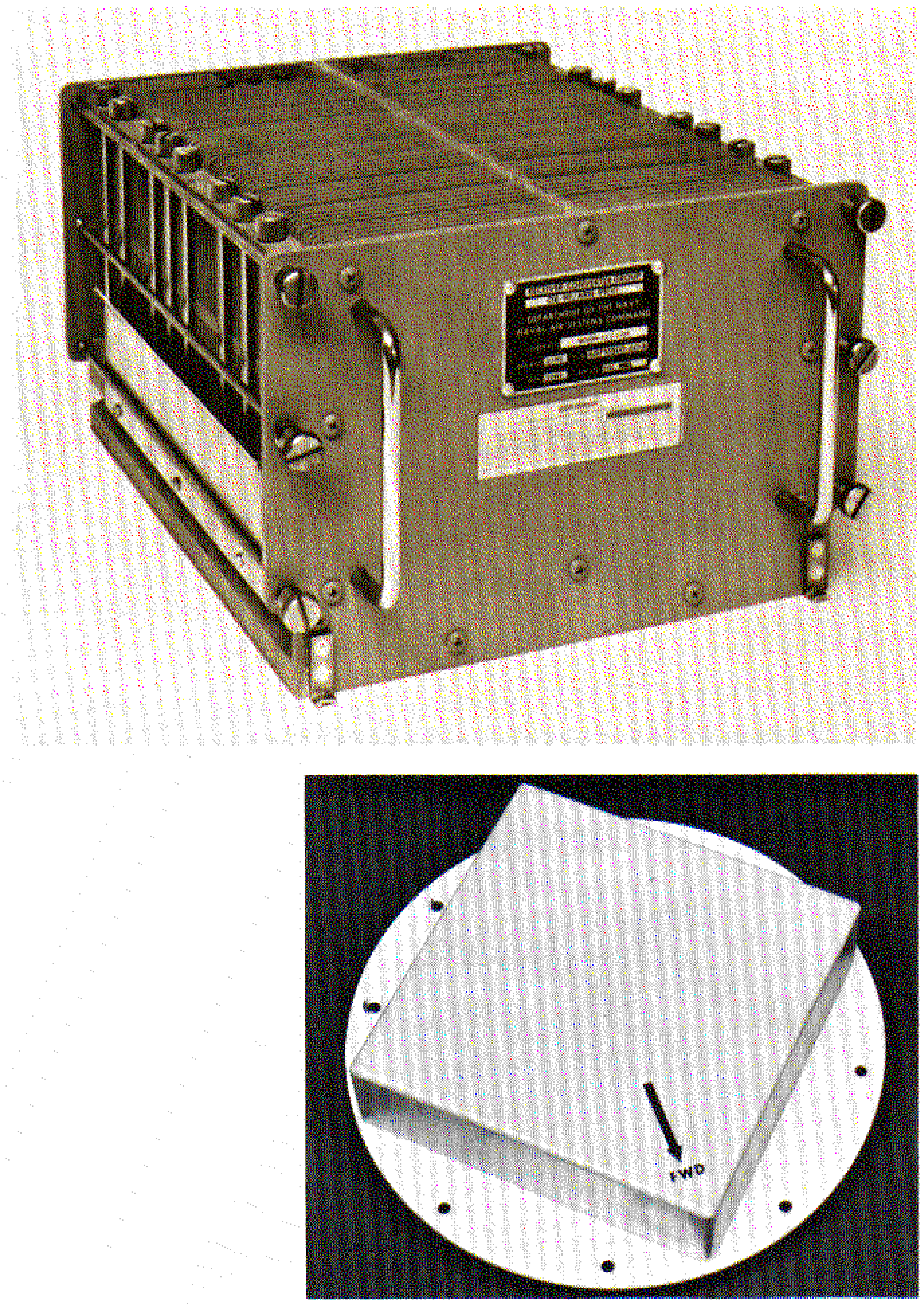


Figure 8. AN/ARN-99(V)1 Omega Navigational Set (Receiver-Converter Above, Antenna Below)

present position estimate of ±36 miles, date, and Universal Coordinated Time (UCT) (Zulu). The Omega functions provided by the keyset (Figure 9) are:

1. Restart
2. Omega Fix Accept
3. System Drift Accept

The keyset also provides the capability to display and modify the Omega tableau, shown in Figure 10, on the Auxiliary Readouts.

The Omega tableau informs the NAV/COM and TACCO operators of the current status of the Omega System. Line 4 indicates two important parameters. The X following POS indicates the DR aiding source. That is, Inertial (1), Inertial (2), Doppler (D), or Air Data (A). Doppler and Air Data are used only after both inertial units are disabled.

Line 4 also displays Omega "AMB", which is an indication of the status of the Omega computations. The meanings of the "AMB" indications are as follows:

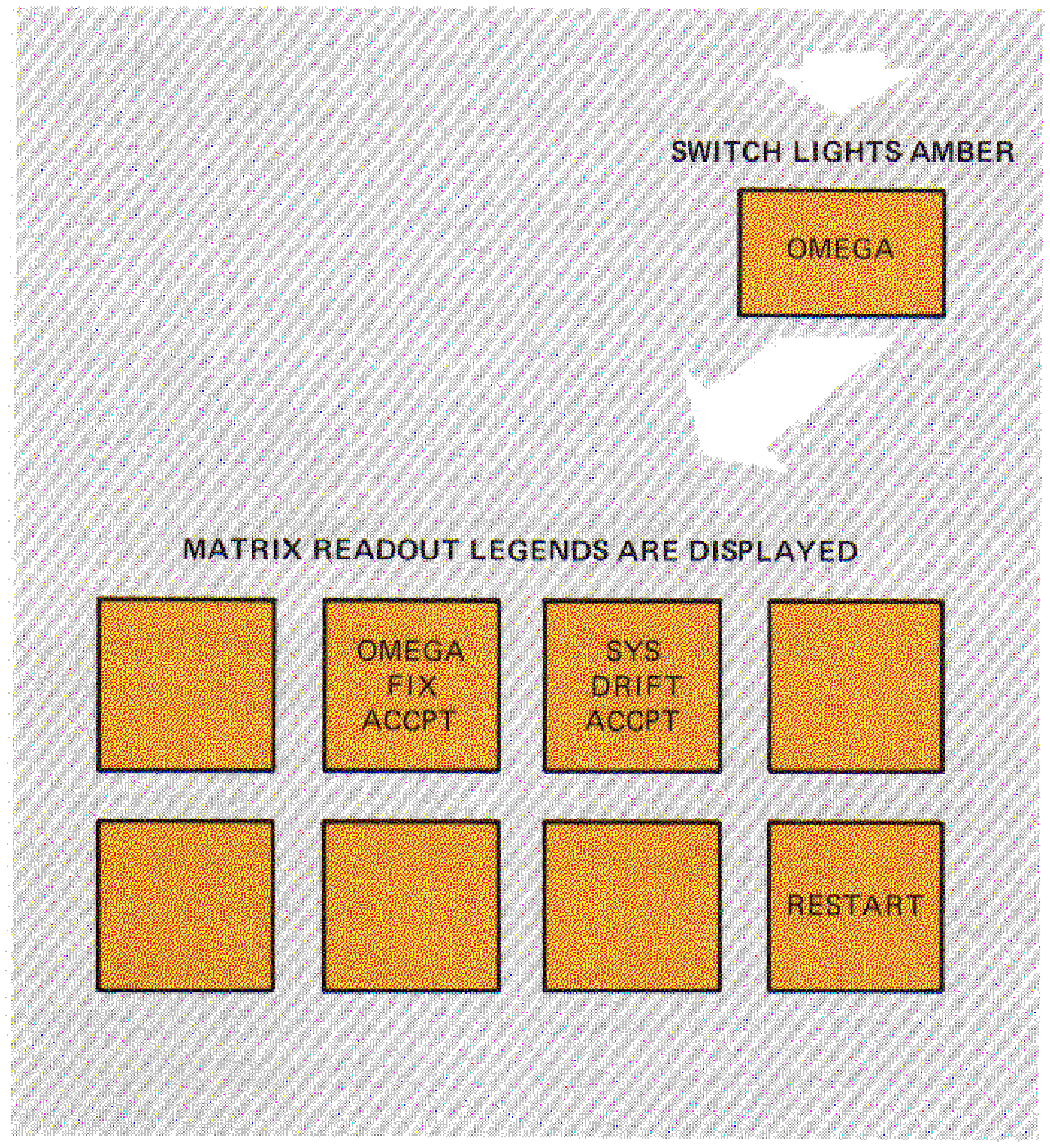
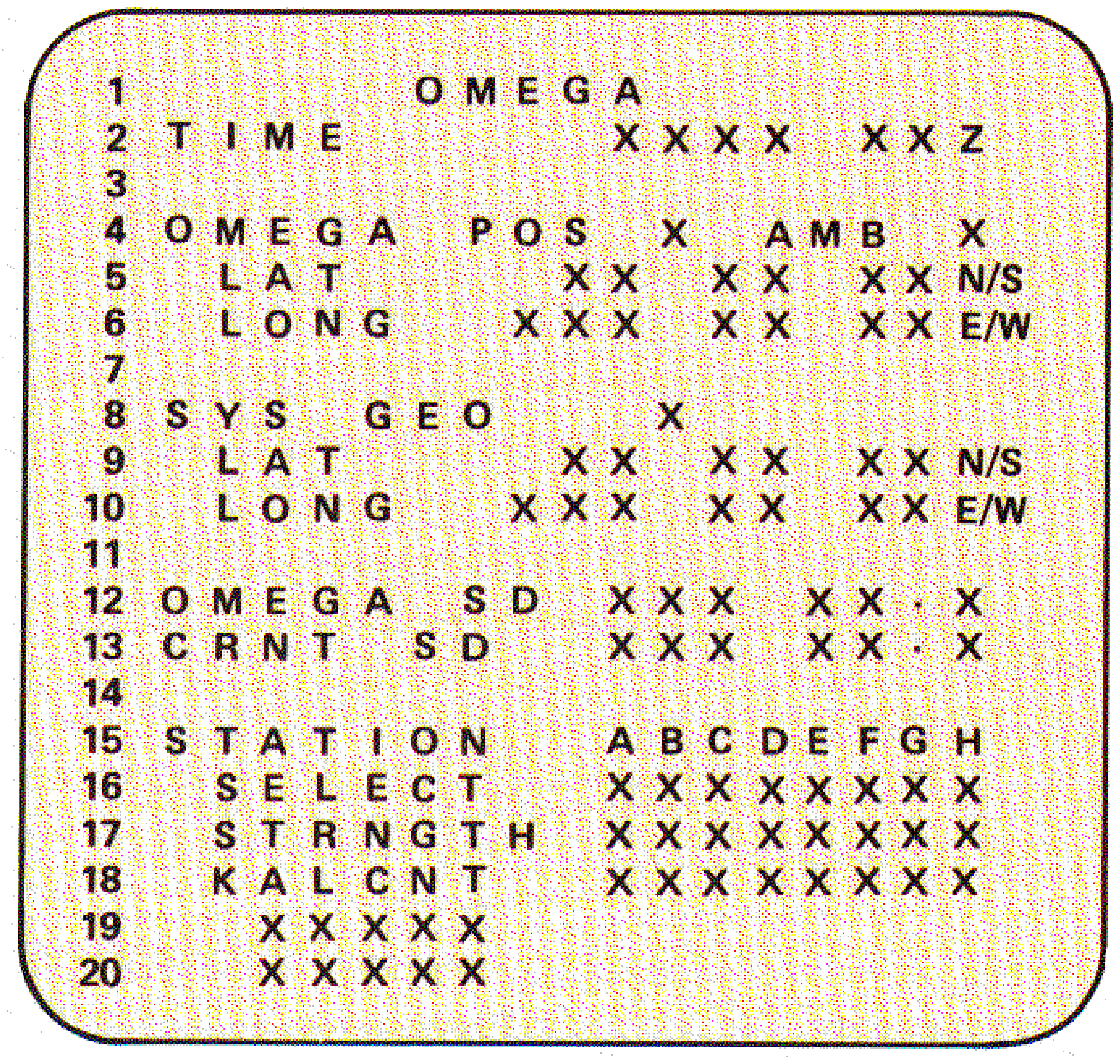


Figure 9. Omega Function on Universal Keyset



```
1           OMEGA
2  TIME              XXXX  XXZ
3
4  OMEGA   POS   X   AMB   X
5    LAT          XX   XX   XX N/S
6    LONG        XXX   XX   XX E/W
7
8  SYS   GEO         X
9    LAT          XX   XX   XX N/S
10   LONG        XXX   XX   XX E/W
11
12 OMEGA   SD      XXX   XX·X
13 CRNT    SD      XXX   XX·X
14
15 STATION         ABCDEFGH
16   SELECT        XXXXXXXX
17   STRNGTH       XXXXXXXX
18   KALCNT        XXXXXXXX
19     XXXXX
20     XXXXX
```

Figure 10. Omega Tableau

3 – Indicates the computer answer is ambiguous and that the solution is unreliable.

2 – Also indicates an ambiguous solution (this rarely appears).

1 – Indicates some of the Omega signals are weak and the solution *may* be ambiguous.

BLANK – Indicates the computer judges that the Omega fix is unambiguous and accurate.

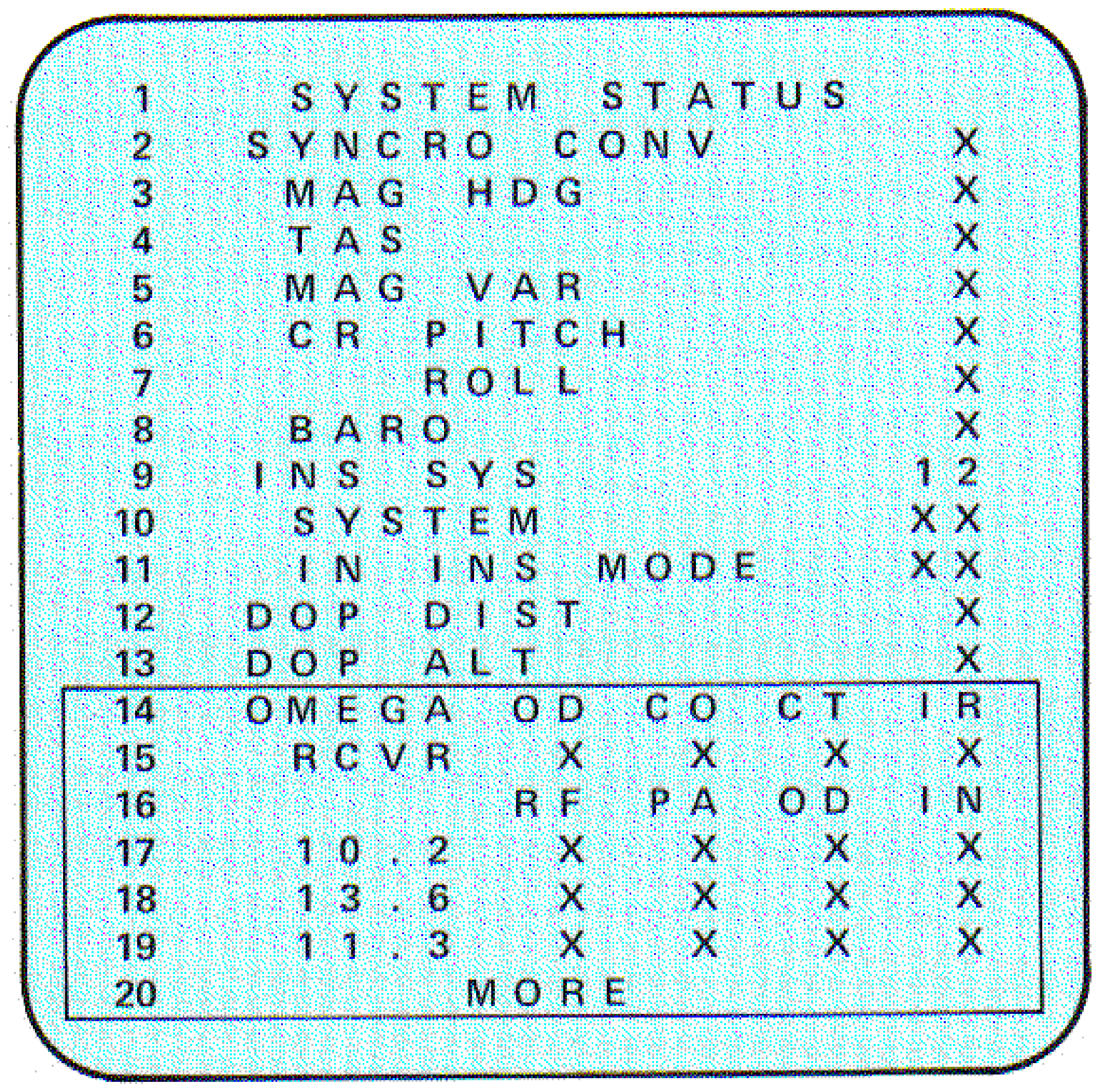
If sufficient signals are available, position uncertainties up to ±36 miles can be resolved. The minimum requirements for ambiguity resolution are 4 Kalman Filter* updates, during each 10-minute period, on three frequencies from one station. Also, a requirement is a position variance of less than 4 nmi. When these minimums are met or exceeded, AMB will be BLANK, indicating accurate Omega positions.

**The Kalman Filter is a recursive maximum likelihood estimation technique based on the assumption of normal statistics and linear relationships on the various errors. This technique was named after Dr. R. E. Kalman.*

On Restart, AMB 3 will be displayed on Line 4. On Line 19 "TEST" will be displayed until all built-in tests (BIT) have been passed. Next, "SYNC" will be displayed until synchronization to the Omega signal format has been accomplished.

After Sync is accomplished, "BURST" will be displayed on Line 19. This indicates that individual Omega bursts are being processed. Line 18 (KALCNT - Kalman Filter Count) indicates the dump rate into the Kalman filter, if AMB (Line 4) indicates 1 or blank. KALCNT indicates the stations being processed if AMB is 2 or 3. A "1" appears when a station is used to update the Kalman Filter.

Omega is most reliable when AMB is blank. It is probably giving good results when AMB 1 is indicated; however, position error may exceed 2 miles. In both cases, unique and peculiar combinations of sudden phase anomalies, plus radio frequency noise can cause Omega to converge on an incorrect position (i.e., blunder) even though the computer judges it has sufficient inputs for an unambiguous answer.



```
 1     SYSTEM STATUS
 2   SYNCRO CONV               X
 3     MAG HDG                 X
 4     TAS                     X
 5     MAG VAR                 X
 6     CR PITCH                X
 7          ROLL               X
 8     BARO                    X
 9   INS SYS                  12
10     SYSTEM                 XX
11     IN INS MODE            XX
12   DOP DIST                  X
13   DOP ALT                   X
14   OMEGA  OD   CO   CT      IR
15     RCVR  X    X    X       X
16           RF   PA   OD     IN
17     10.2  X    X    X       X
18     13.6  X    X    X       X
19     11.3  X    X    X       X
20          MORE
```

Figure 11. System Status Tableau (page two)

Line 16 gives the operator the ability to de-select the Omega Station which he judges should not be used. This and his ability to restart the Omega or reject Omega data, is the operator's only control over the Omega System.

Each time an Omega Restart is initiated, the operational program executes a series of tests. If there is a failure during restart, the probable source of the failure will be indicated in System Status Tableau (page two) on the Auxiliary Readouts (see Figure 11). A failure is indicated by the presence of a 1 in lines 15, 17, 18, or 19 and by Omega alerts on the Projection Readouts (PRO's).

Lines 17, 18, and 19 indicate failures of RF amplifiers (RF), phase angle to digital converters (PA), Output Data (OD), and Input Data (IN). If only one RF amplifier has failed the system will continue to operate with the "WEAK OMEGA" PRO illuminated.

Line 15 indicates failures of oscillator drift (OD), coherence (CO), phase counter (CT), and interrupts (IR). Oscillator drift is a maintenance cue and does not mean the system has failed. It indicates that the oscillator has drifted off frequency because of a natural aging process. The system will probably continue to operate properly for several additional flights; however, maintenance action should be considered. The other three cues indicate failure but they could be temporary. Restart Omega several times to see if the failure will clear.

Omega Alerts OMEGA FAIL and WEAK OMEGA alerts are displayed on the Projection Readouts (PRO's).

OMEGA FAIL is a hardware failure alert. It is displayed any time a failure occurs that aborts the Omega program. If the OMEGA FAIL alert is displayed, the system must be re-initialized before Omega signal processing can be reattempted.

WEAK OMEGA alert is displayed if the signal strength is not at an acceptable level from three stations. Display of this alert can also be tied to display of the weak Omega Ambiguity marker after the Omega program shifts from double to single frequency processing. The WEAK OMEGA alert is displayed until sufficient station measurements are processed in the Kalman Filter to establish a good Omega position and eliminate ambiguity. When the Omega Ambiguity marker is blank, the "WEAK OMEGA" PRO alert is also cleared.


UPDATE

ACOUSTIC PROCESSING

In the P-3C Update I, the acoustic system has been modified with the addition of equipment and programs to provide an improved capability in detection and operator aids. The hardware changes to the AN/AQA-7(V)4 DIFAR are shown in Figure 12.

MODIFICATIONS Eight modifications have been made to the AN/AQA-7 SONAR Computer/Recorder system in order to increase the acoustic capability of the total weapon system. These modifications are discussed in the following paragraphs.

Vernier Translator and Solid State Time Compressor The two frequency multiplier storer units of the baseline systems have been replaced with a single Metal Oxide Semi-conductor Time Compressor (MOSTIC) unit. These time compressors require no field alignment. The new unit includes a Vernier Frequency Translator to provide a higher resolution spectrum analysis capability. The operator, by positioning his cursor, can select a narrow band of frequencies (vernier window) for spectral analysis, using the same number of resolution elements as the analysis of full band data.

Bearing Bias Correction When the ambient noise field around the DIFAR sensor is omnidirectional, the average values of the processed noise data in the North/South and East/West channels are zero. When nonisotrophic (directional) noise is present, however, the average values of the noise in the directional channels (North/South or East/West) become nonzero and a bias is introduced into the computed signal bearings. This bias can be corrected by computing the noise in the directional channels, and by correcting the noise mean before bearing computation. The operator will control selection of this mode by depression of the Bearing Bias Correct (BBC) switch to enable display of corrected or uncorrected data.

Automatic Threshold At present, the operator must manually adjust the Automatic Line Integration (ALI) threshold which sets the minimum ALI signal level printed on the grams. This adjustment is necessary because the dynamic range of the ALI data is much greater than the dynamic range of the gram display. The Automatic Threshold feature will employ exponentially weighted moving-window averagers to estimate the mean and standard deviation of the ALI data, and establish a suitable threshold based on these two parameters. Thus, the operator will be relieved of making manual threshold adjustments in response to varying target signal strengths.

Doppler Bearing Tracker The Track Bearing function of the AQA-7 presently enables the operator to select, via the Line Select Brackets, a signal frequency for which the bearing is to be displayed on the Signal Data Recorder and the Degree Indicator. The bearing of the strongest ALI bin (cell) within the bracket is displayed. However, a target frequency with changing doppler may move outside the bracket window so that bearing readouts are no longer for the signal of interest.

The Doppler Bearing Tracker (DBT) will establish a threshold, based on the noise mean and standard deviation estimates obtained from exponentially weighted moving window averagers. If the strongest ALI bin within the DBT exceeds the threshold, the bracket positions would be automatically shifted in frequency to retain the target frequency in the center of the brackets. This would preclude loss of bearing track due to doppler shifts. The frequency tracking function occurs with either DIFAR or LOFAR.

Cardioid Processing (Steered Omni/Steered DIFAR) A cardioid (heart-shaped) directional response pattern can be synthesized by combining the omni and directional hydrophone signals from an SSQ-53 DIFAR sonobuoy. The advantages of the cardioid response pattern over the omnidirectional hydrophone response pattern are two-fold. A detection gain is obtained in the direction of the maximum signal response of the cardioid pattern, and rejection of interfering noise is obtained in the direction of the cardioid's null. At present, the Directional Listening Unit of the AQA-7 forms a steerable cardioid pattern, but the resultant signal is only used by the operator for aural monitoring. This "cardioid" signal will be used to replace the omni-signal in DIFAR processing, thus realizing an improvement in signal detection and the rejection of noise interference. The null can be steered either by the operator or by the CP-901 computer.

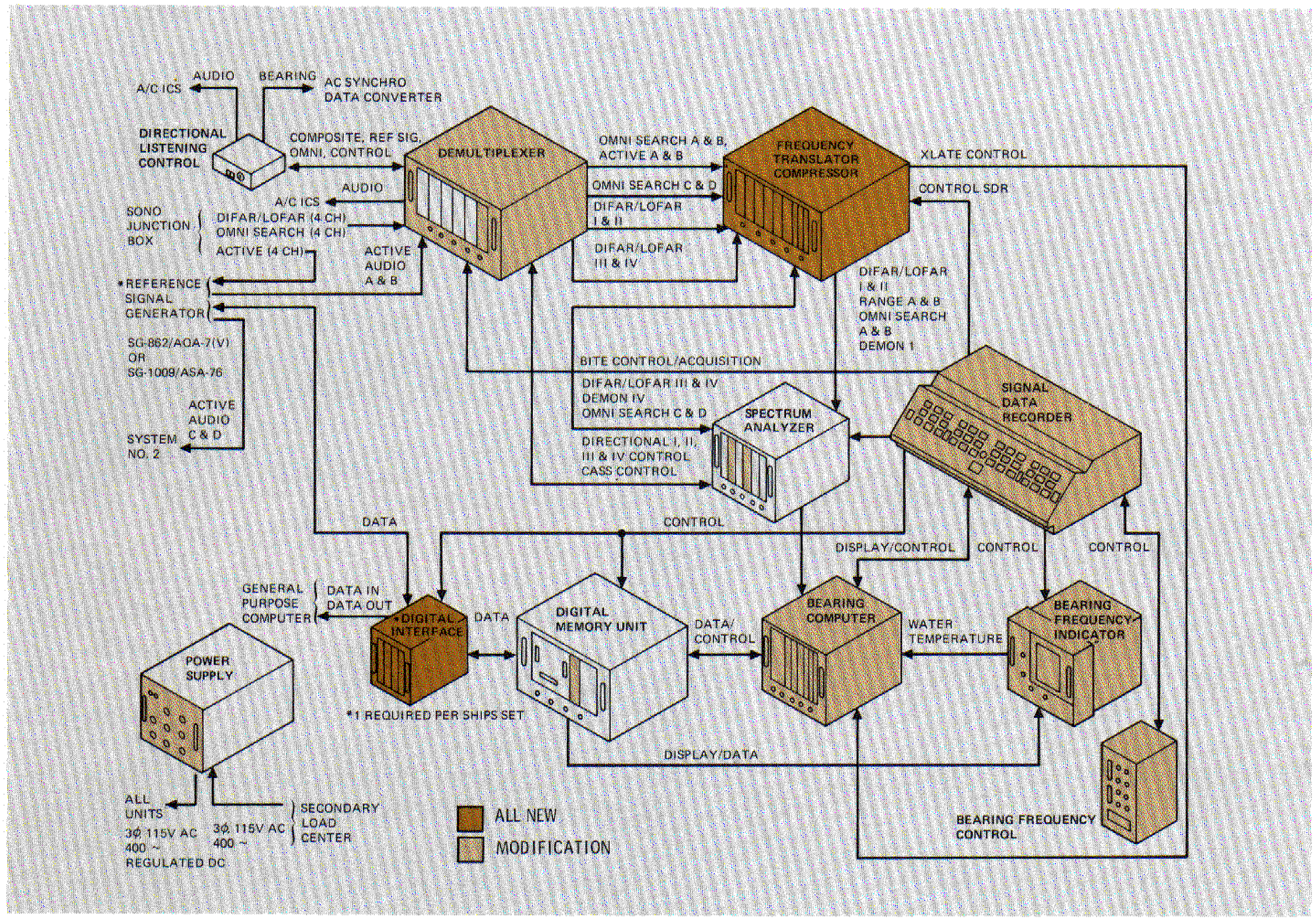
Digital Sweep Frequency Generator The spectrum analyzer quantizer has been modified to include a Digital Sweep Frequency Generator in lieu of the relatively unstable Voltage Controlled Oscillator used in pre-Update equipment. This provides the necessary degree of frequency readout accuracy for the Passive Acoustic Detection (PAD) software program. This very accurate frequency readout allows identification of identical signal frequencies that are detected by DIFAR equipment installed on different aircraft. An additional advantage is that the Digital Sweep Frequency Generator's start and frequency steps are programmable, thus providing complete control by the DIFAR's internal computer.

CASS Improvements The Command Activated Sonobuoy System's (CASS) existing processor quantizes the input audio signal. In processing of active CW pulses, the high-level reverberation return tends to capture the output of the quantizer, thus suppressing target signal returns. This deficiency will be eliminated by using more quantizing bits for the input audio. The new MOSTIC unit will provide the increased quantity of digital storage required for additional quantization and linear processing.

The display dynamic range is increased by transferring to the Bearing Frequency Indicator all of the bits of intensity range data that are currently available in DIFAR.

Alphanumeric Display on Bearing Frequency Indicator (BFI) and Signal Data Recorder (SDR) Prior to Update I, acoustic sensor operators manually annotated the grams to indicate contacts acquired and to indicate the harmonic relationship of various frequency lines to the appropriate contacts. These "bookkeeping" operations diverted the operators attention from the tactical situation.

Figure 12. Interconnecting Scheme Showing Improved Configuration, AN/AQA-7(V)4



In the P-3C Update I acoustic subsystem, the central computer can automatically annotate grams and BFI trace data that formerly were annotated manually by the operator after the signals were detected. These data are displayed or printed as alphanumerics on the AQA-7 BFI and the SDR. This feature was made possible by modifying the Digital Interface Unit to write computer-generated data into the AQA-7 memory.

The Passive Acoustic Detection (PAD) software program provides for computer/DIFAR communications so that acoustic data can be made available to the computer. The PAD program enables the computer to automatically process acoustic data used to detect target-generated frequency lines, and to monitor contacts that have been acquired by the acoustic subsystem. This enables the computer to make the previously-mentioned alphanumeric presentation of processed data or detection cues on the BFI and SDR. The PAD program also enables the computer to edit destruction data, and eliminates all lines from the presentation to the operator that are caused by artifacts or that do not satisfy apriori criteria.

Programmed with PAD, the computer also analyzes the harmonic relationship of detected lines to form harmonically-related families of lines. This task would consume a large portion of the operator's time and effort if he performed it by mental/visual means. PAD also enables the computer to maintain and update the contacts in the files, to alert the operator to changes in contact status, and to alert the operator to the acquisition of a new contact.

Tactical Auxiliary Display In addition to the improvements to the DIFAR, an auxiliary display is installed between the acoustic operators' stations. The additional data made available to the acoustic operators by this display serves to better integrate them into the tactical situation. The auxiliary display is shown in Figure 13.

OPERATIONAL PROGRAM

Update I has restructured the Operational Program to be more efficient and to provide a more flexible, centralized control program. In addition, the restructured Operational Program provides new elements in support of Update I equipments. Subsequently, the restructured Operational Program has been modified to incorporate further improvements. Addition of the memory drum and redesign of the executive program module permit addition of new modules to the Operational Program without requiring redesign of the entire program.

A degraded mode capability of the Operational Program enables the computer to sense drum track and core memory failures, and then to continue program operation. The program reallocates tasks to serviceable memory storage areas at load time. The improved MTT (one per aircraft now) is used for the initial program load. At that time a copy of the program is written on the drum memory. The program may be reloaded from the drum memory more quickly than from the program tape in case of program degradation or loss.

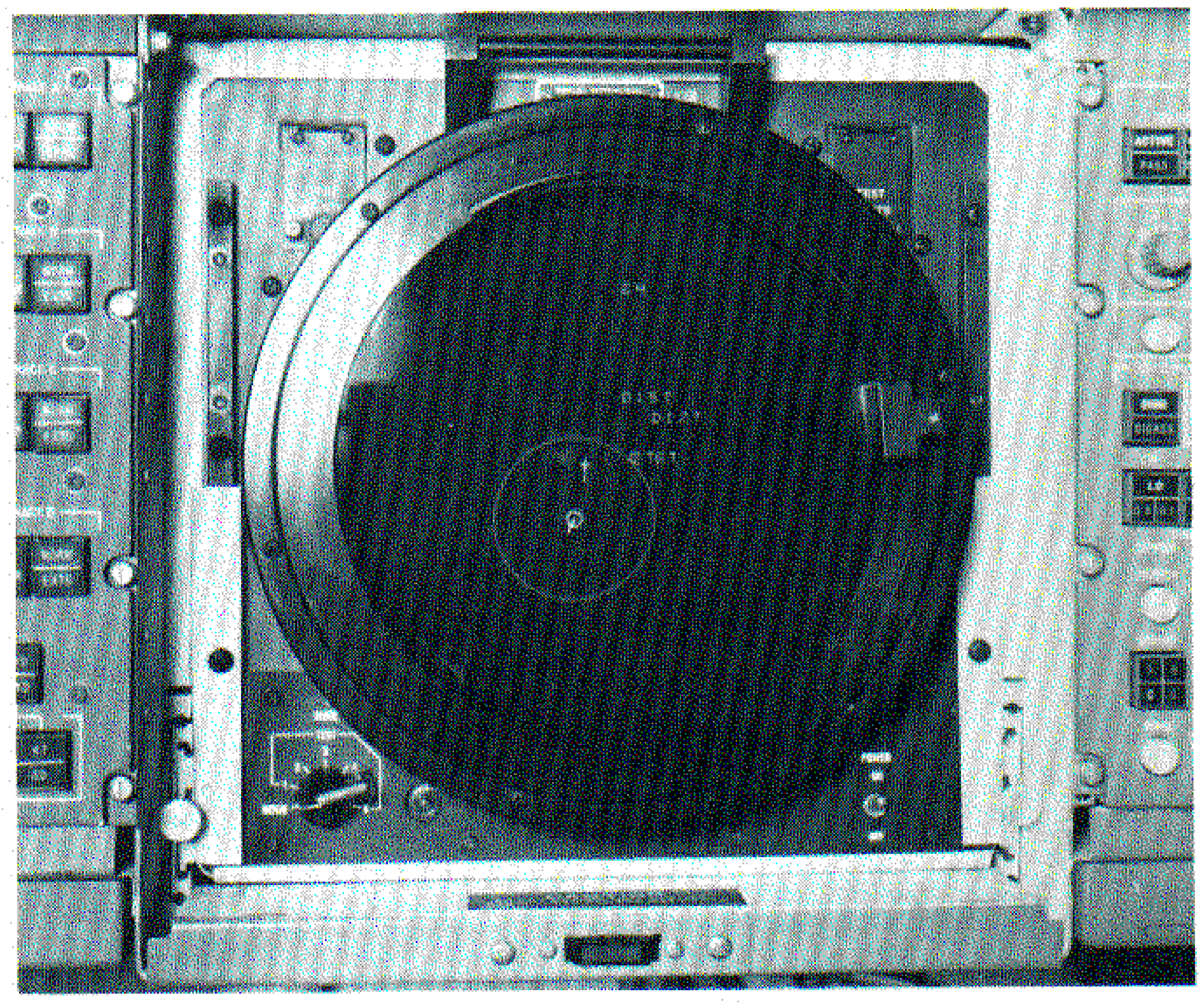


Figure 13. Auxiliary Display

In addition, the Operational Program enables the computer to extract and display in the System Status Tableau the results of automatic tests, BITE status, or operator inputs concerning equipment go/no-go status of the preflight Sygnog. These data, along with a communications check of all active computer channels, inform the TACCO of the capabilities of the entire Weapons System.

Additional software modules have been incorporated in the Operational Program to improve the navigational capability of the aircraft. The new Update I Omega navigation system and program module provide an automatic world-wide bounded navigation system. In the Update I aircraft, the Omega receiver replaces the LORAN receiver. The Omega position and GEO NAV position are available for display to the operator, along with Omega System drift and Omega Time (which may be used to update the GEO NAV functions under operator control). Steering has been improved to provide greater flexibility and ease in directing the aircraft during tactical steering modes. Accurate display presentation and dead reckoning navigation capabilities at high latitude are increased by algorithm improvements.

The P-3C Update I incorporates an improved tactics and tracking program module. Preconstructed sonobuoy tactical patterns with associated control functions and sonobuoy management are available. Generated tracks, probability contours, computed intersections, dynamic projection, and automatic fly-to-point assignments greatly enhance the value of the tactical aids package.

Electronic Support Measures (ESM) processing has been updated to enable the system to classify contacts by using ESM apriori signature data loaded in the computer via preflight data insertion tape. Improvements in ESM signal processing flow, modifications to operator functions and the addition of new functions have improved the utility of ESM processing, operator interface, and display of ESM data.

The Operational Program provides automatic CASS control under operator direction. The acoustic program module includes Passive Acoustic Detection (PAD), which uses the computer to detect and monitor acoustic targets automatically. Additionally, the computer provides automatic bearing tracking of the computer detected targets with presentation to the TACCO.

The Update I Auxiliary Display is used to present the SS-1 and SS-2 operators with a tactical plot of the aircraft and the sonobuoy field, with buoy RF assignment and tuning data indicated. TACCO-designated track and aircraft RF horizon circle are available for presentation. The display can also be used to present tableau data relative to system status, PAD parameters, and the Command Active Sonobuoy System as an alternate to the tactical plot for operator monitoring and modification.

The P-3C Update I Weapon System has the capability to accept insertion of a Tactical Support Center-generated program tape with preflight briefing data into appropriate program tactical operator tables and tableau. Preflight data include Navigation Preflight Data, Navigation Track Required Data, Flight Plan Fly-to-Points, Acoustic Detection Parameters, Communications Parameters, ESM Apriori Information, ESM Library, Sonobuoy Inventories, Weapons Inventories, Data Link Parameters, PAD Apriori Information, and PAD Artifact Information.

The P-3C Update I Operational Program includes an improved error detecting and reporting package to ease classification and investigation of program faults and degradation.

SYSTEM TEST PROGRAM

The P-3C Update I System Test Program (STP) consists of a redesigned executive or control program, programs redesigned because of modified equipment, and non-Update programs modified only for linkage to the control program.

The new Update I programs have incorporated standardized message formats, including expected and received codes with an indication of the specific data bits checked in the comparison. The program step of mainline (no-fault logic flow) and error routine is printed out. For Sygnog, the message includes the function(s) that have failed. For Diagnostic programs the name of the failed signal and the replacement or isolation cue is printed out. Each of the operator key depressions are now standardized in the new Update I programs.

To eliminate the frequent complaint that non-Update Sygnog and Diagnostic programs do not test identically, the Update Sygnog and Diagnostic programs have identical mainlines, step number for step number. The only difference is the message printout. In cases where lengthy operator procedures are required in the diagnostic programs, these are eliminated or made optional in the Sygnog mainline. Diagnostic programs do further fault isolation and testing after branching from the mainline. The new Update I programs include programs for Drum Auxiliary Memory Subunit (DAMS), Data Multiplexer Subunit (DMS), Auxiliary Display Logic (ADL), Omega, and Logic Unit 4 Power Monitor.

Programs redesigned because of modified equipment include: Magnetic Tape Transport (MTT), Synchro Data Converter (SDC), Tape Duplication, and the Control Program. The Tape Duplicator program uses the new Update I Drum Memory and the modified MTT to copy tapes, as opposed to the 2-MTT configuration on non-Update aircraft. The redesigned control program now requires additional control keys to be depressed in the control key check. This assures the operator that all control keys used in program selection and control are functional.

The non-Update programs in Automatic, Simultaneous, Diagnostics, and Special Tests have only been minimally modified to run in the new control program environment. Key depressions and message printouts will be the same as on the pre-Update STP tapes for these programs. The Special Test tableau contains a new selection labeled "DRUM STORE". Upon depression of this selection, the program will go through procedures necessary to store the backup STP on the drum. The backup STP is loadable from the drum via Bootstrap manual/B settings on the Computer MCP. It contains HAWK II, Channel 10 Computer Peripheral Interface Test, Magnetic Tape Controller (MTC) diagnostic, the MTT diagnostic, and elements of the control program necessary to support the above. This was included to provide a means of troubleshooting the Magnetic Tape Transport System when the failure(s) did not allow a program to be loaded into the computer. Once this program is loaded on the drum, the operator is directed to use drum memory protect switches to protect the program.

P-3C UPDATE II AND III

With Update II, it is planned to add the Infrared Detection System (IRDS), Sonobuoy Reference System (SRS), AQH-4(V)2, and Harpoon Aircraft Command Launch Control System (HACLCS) to the P-3C Update I production aircraft configuration. Incorporation of these features is scheduled to begin with P-3C aircraft Lockheed Serial Number 5653.

Update III, the next generation P-3C, is referred to as P-3C Proteus. This change projects incorporation of the advanced Proteus (acoustic data processor) and ASCL (new sonobuoy receiver) systems in the P-3C. The Proteus flying test bed (SerNo 153443) is now in the design stage. ▲▲

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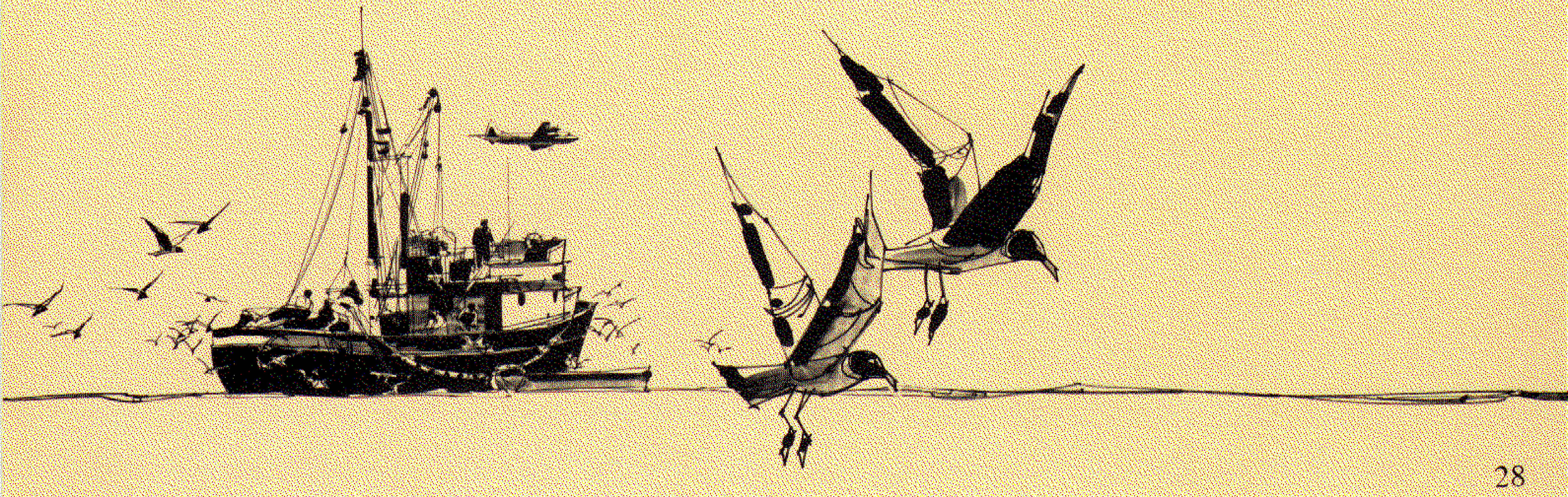
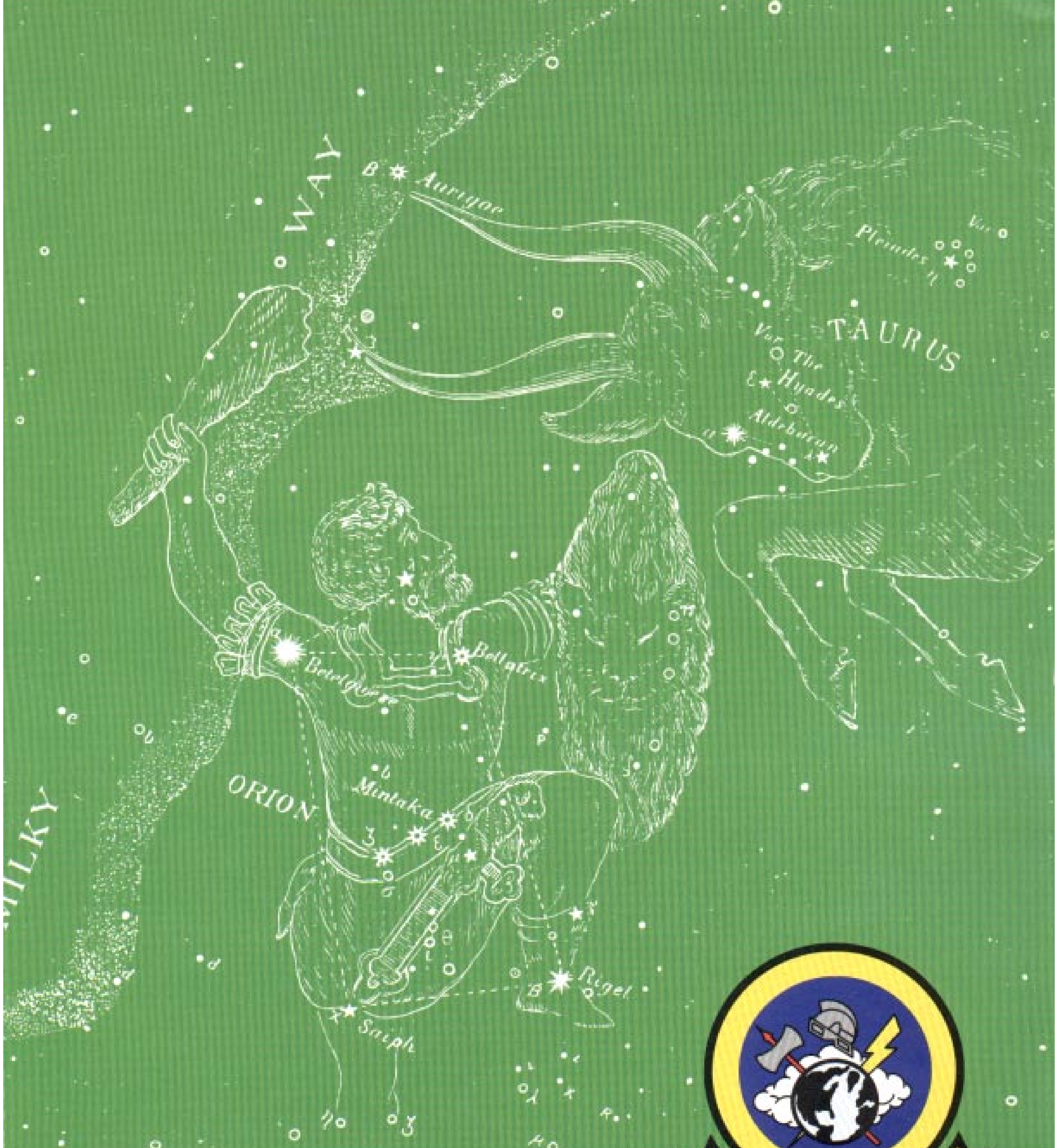
P-3C Update I

NOMENCLATURE

ABBREVIATION/ACRONYMN	MEANING
ADL	Auxiliary Display Logic
ALI	Automatic Line Integration
BFI	Bearing Frequency Indicator
bpi	Bits per inch
CW	Continuous Wave
DAMS	Drum Auxiliary Memory Subunit
DBT	Doppler Bearing Tracker
DMS	Data Multiplexer Subunit
DR	Dead Reckoning
EF	External Function
EFR	External Function Request
EI	External Interrupt
EIE	External Interrupt Enable
ESM	Electronic Support Measures
IA	Input Acknowledge
IDR	Input Data Request
KALCNT	Kalman Filter Count
LED	Light Emitting Diode
MCP	Maintenance Control Panel
MDC	Magnetic Drum Controller
MDM	Magnetic Drum Memory
MOSTIC	Metal Oxide Semiconductor Time Compressor
MTC	Magnetic Tape Controller
MTT	Magnetic Tape Transport
OA	Output Acknowledge
ODR	Output Data Request
PAD	Passive Acoustic Detection
PRO's	Projection Readouts
ROM	Read Only Memory
SCC	Spare Computer Channel
SDR	Signal Data Recorder
UCT	Universal Coordinated Time





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