MIL-N-81678B(AS)
14 February 1977

MILITARY SPECIFICATION

NAVIGATIONAL SET, OMEGA
AN/ARN-99(V)

SUPERSEDING
MIL-N-81678A(AS)
3 January 1974

This specification has been approved by the Naval Air Systems Command, Department of the Navy.

1. SCOPE

1.1 Scope - The equipment covered by this specification shall perform a navigation function by utilizing information from the Very Low Frequency global OMEGA navigation system, automatically and continuously with minimum operator assistance. The set also has the capability of providing processing functions, according to specific applications, for other navigational and display equipments when the necessary computer program and interfaces are provided.

1.2 Classification - The equipment covered in this specification shall consist of the following items:

Receiver-Computer Group	OR-133(V)/URN	3.5.1
Control-Indicator	ID-1776/ARN-99(V) & ID- /ARN-99(V)	3.5.2
Antenna-Coupler	AS-2623/ARN-99(V) & AS-2623A/ARN-99(V)	3.5.3
Mounting Base, Electrical Equipment	MT-4738/ARN-99(V)	3.5.4

These items can be interconnected in the various system configurations defined in Table I. See Specification MIL-N-81675(AS) for AN/ARN-99(V)1.

1.3 Associated Equipment - This equipment shall operate with the associated equipment listed in Paragraph 6.6.

2. APPLICABLE DOCUMENTS

2.1 General - The following documents of the issue in effect on the date of invitation for bids or request for quotation unless otherwise specified, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-C-172	Cases; Bases, Mounting; and Mounts, Vibration (for use with electronic equipment in aircraft)
MIL-W-5088	Wiring, Aircraft, Installation of
MIL-E-5400P	Electronic Equipment, Airborne, General Specification for
MIL-T-5422F	Testing, Environmental, Aircraft Electronics Equipment

Beneficial comments(recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC-5826

Configuration AN/ARN-99 (V)	Receiver-Computer Group OR-133(V) /URN (8K Memory) ***	OR-133(V)2/URN (16K Memory)	Control Indicator ID- /ARN-99(V)	ID-1776 /ARN-99(V)	Antenna-Coupler AS-2623/ ARN-99(V) or AS-2623A/ ARN-99(V)	Mounting Base MT-4738/ ARN-99(V)
* (V) 1					X	
(V) 2	X		X		X	X
** (V) 3						
(V) 4		X		X	X	X

* See Specification MIL-N-81675 (AS)

** No (V)3 Configuration Exists at Present Time

*** Complete designation of Receiver-Computer Group has not been assigned.

TABLE I

2. APPLICABLE DOCUMENTS (Cont'd)

Military (Cont'd)

MIL-C-6781	Control Panel; Aircraft Equipment, Rack or Console Mounted
MIL-P-7788	Plate, Plastic, Lighting
MIL-M-7793	Meter, Time Totalizing
MIL-E-17555	Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of
MIL-T-18303	Test Procedures; Preproduction and Acceptance for Aircraft Electronic Equipment, Format for
MIL-N-18307	Nomenclature and Identification for Electronic, Aeronautical and Aeronautical Support Equipment including Ground Support Equipment
MIL-T-23103	Thermal Performance Evaluation
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirements for
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities
MIL-M-81288	Mounting Bases, Flexible Plastic Foam
MIL-C-81511	Connectors, Electrical, Circular, High Density Quick Disconnect, Environment Resisting, and Accessories, General Specification for
MIL-N-81675	Navigational Set, Omega AN/ARN-99(V)1
MIL-C-81774	Control Panel, Aircraft, General Requirements for

Naval Air Systems Command

AR-5	Microelectronic Devices Used in Avionic Equipment, Procedures for Selection and Approval of
AR-8	Versatile Avionic Shop Test System Compatibility General Requirements for
AR-9	Versatile Avionic Shop Test Program, General Requirements for
AR-10	Maintainability of Avionics Equipment and Systems, General Requirements for
AR-34	Failure Classification for Reliability Testing, General Requirements for

2. APPLICABLE DOCUMENTS (Cont'd)

Naval Ordnance Systems Command

WS-8506	Requirements for Digital Computer Program Documentation

STANDARDS

Military

MIL-STD-203	Aircrew Station Controls and Displays for Fixed Wing Aircraft
MIL-STD-250	Aircrew Station Controls and Displays for Rotary Wing Aircraft
MIL-STD-411	Aircrew Station Signals
MIL-STD-461	Electromagnetic Interference Characteristics, Requirements for Equipment
MIL-STD-704A Notice 2	Electric Power, Aircraft, Characteristics and Utilization of
MIL-STD-781 Notice 1	Reliability Tests, Exponential Distribution
MIL-STD-783	Legends for Use in Aircrew Stations and on Airborne Equipment
MIL-STD-785	Reliability Program for System and Equipment Development and Production
MIL-STD-794	Parts and Equipment, Procedures for Packaging and Packing of
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MS-17322	Meter, Time Totalizing, Miniature, Digital, 115 Volt, 400 Hertz

Federal

FED-STD-595	Colors

2.1.1 Availability of Documents

(a) When requesting specifications, standards, drawings, and publications, refer to both title and number. Copies of this specification and applicable specifications except WS-8506 required by contractors in connection with specific procurement functions may be obtained upon application to the Commanding Officer, Publications and Forms Center, Code 105, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

(b) Copies of Weapons Specification WS-8506 may be obtained upon application to the Commanding Officer, U.S. Naval Ordnance Station, Central Technical Document Office, Louisville, Kentucky 40214. Reference the Invitation for Bid (IFB) or Request for Quotation (RFQ) procurement number in your request.

3. REQUIREMENTS

3.1 Preproduction - This specification makes provisions for preproduction testing.

3.2 Parts and Materials - In the selection of parts and materials fulfillment of major design objectives shall be the prime consideration. In so doing, the following shall govern:

(a) Microelectronic Technology shall be considered, and microelectronic items shall conform to requirements specified herein.

(b) Other parts and materials requirements shall conform to Specification MIL-E-5400.

(c) Nonrepairable subassemblies shall be used in accordance with Specification AR-10 and as outlined in Specification MIL-E-5400.

(d) When previously produced models of this equipment did not use nonrepairable subassemblies, the design shall not be changed to employ nonrepairable assemblies without the approval of the procuring activity.

3.2.1 Nonstandard Parts and Materials Approval - Approval for the use of nonstandard parts and materials (including electron tubes, transistors, and diodes) other than microelectronic devices shall be obtained as outlined in Specification MIL-E-5400. Microelectronic devices shall be approved as outlined in AR-5.

3.2.2 Microelectronic Modular Assemblies - When used, Microelectronic Modular Assemblies shall meet the requirements of Specification AR-5.

3.2.3 Modules - The electronic portions of the equipment shall be functionally modularized in accordance with Specification AR-10. Plug-in subassemblies shall be so designed as to preclude improper interchange or insertion.

3.3 Design and Construction - The equipment shall conform to all the applicable requirements of Specification MIL-E-5400 for design, construction and workmanship, except as otherwise specified herein.

3.3.1 Total Weight - The total weight of the equipment, excluding cables, shall be a minimum consistent with good design. Table II is a list of maximum system weights.

3.3.2 Reliability - The contractor shall conduct a reliability program using MIL-STD-785 as a guide. On a reorder from a supplier who has previously produced the equipment, the program previously used may be continued unless otherwise indicated in the contract or order.

3.3.2.1 Operational Stability - The equipment shall operate with satisfactory performance, continuously or intermittently for a period of a least 3000 hours without the necessity for readjustment of any controls which are inaccessible to the operator during normal use.

3.3.2.2 Operating Life - The equipment shall have a minimum total operating life of 20,000 hours with reasonable servicing and replacement of parts. Parts requiring scheduled replacement shall be specified by the contractor.

3.3.2.3 Reliability in Mean Time Between Failure (MTBF) - The equipment, including any Built-in-Test provisions, shall have 1000 hours of mean (operating) time between failures when tested and accepted as outlined under the requirements of Paragraph 4.4.3.

3.3.2.4 Time Totalizing Meter - The Receiver-Computer Group shall include a time totalizing meter conforming with the applicable requirements of Specification MIL-M-7793 and MS-17322-10. Meter shall be located on Interconnecting Box J-3213/URN.

3.3.3 Cabling and Connections

3.3.3.1 Cables and Connectors - The equipment shall provide for use of cables and connectors in accordance with Specification MIL-E-5400. Quick disconnect circular connectors shall conform to the applicable requirements of Specification MIL-C-81511.

3.3.3.2 Interconnection Cabling - The equipment shall be capable of satisfactory operation using external wiring in accordance with the applicable requirements of Specification MIL-W-5088. The external wiring shall be unshielded, except that a minimum number of the individual wires may be shielded when demonstrated as necessary to meet interference control requirements. External cables and that portion of the connectors attached to the cables shall not be supplied as part of the equipment.

TABLE II

WEIGHT PER SYSTEM

ARN-99	Total Weight
(V) 2	82.35 LBS
(V) 4	82.75 LBS

3.3.4 Control-Indicator, Interconnecting Box and Mounting Base

3.3.4.1 Control-Indicator - The Control Indicator shall conform to the applicable requirements of Specification MIL-C-6781 and MIL-C-81774. The Indicator shall be designed to assure operability and safety to minimize error. Human Factors data shall conform to MIL-H-46855 and design requirements shall be in accordance with MIL-STD-1472. Legends shall conform to MIL-STD-783.

3.3.4.2 Interconnecting Box - The Interconnecting Box for the Receiver-Computer Group shall be designed for convenient disconnection from aircraft wiring and circuits, such as antenna cables, power wiring, etc.

3.3.4.3 Mounting Base - The Receiver-Computer Group shall have a mounting base conforming to the requirements of Specification MIL-M-81288.

3.3.4.4 Approval - The configuration of the Control-Indicator and Mounting Base shall be approved by the procuring activity prior to preproduction testing.

3.3.5 Interchangeability - The equipment shall meet the interchangeability requirements of Specification MIL-E-5400. No adjustments shall be required when replacing plug-in subassemblies.

3.3.6 Interference Control - The generation of radio interference by the equipment and the vulnerability of the equipment to radio interference shall meet the requirements of MIL-STD-461. The test methods that shall be complied with are CE01, CE02, CE03, CE04, CS01, CS02, RE01, RE02, RS01, RS02, CS06, and RS03. The test levels for the RS02 case test of the antenna-coupler shall be limited to the threshold of Antenna susceptibility. The antenna-coupler shall be exempt from the RS01 test over the frequency ranges 10.2 ± 0.5 kHz, 11.333 ± 0.2 kHz, and 13.6 ± 0.5 kHz. The Receiver-Computer Group shall be allowed +30db above the MIL-STD-461A Notice 1 CE-01 specification limit and +35db above the MIL-STD-461A Notice 1 RE-01 specification limit.

3.3.6.1 Electronic Counter-Countermeasures - The OMEGA Navigation Set shall have the capability of performing normal OMEGA navigation functions with reduced capability in the event of:

(a) Single or two frequency jamming, i.e., constant (CW) signal being transmitted by jamming station on any two of the three OMEGA frequencies.

(b) Reception of any or all Omega frequencies from a single jamming station not in synchronization with the OMEGA broadcast pattern. NOTE: Reduced capability shall be defined as a reduction in the capability to initialize the Omega Set from an initial position error of 36 miles to 8 miles and a reduction in system position accuracy that is related to the synchronous characteristics of the jamming station.

3.3.7 Provisions for Maintainability - The Maintainability Program built in test features, construction and packaging, provisions for test points and other maintainability parameters shall be as specified in Specification AR-10. (See also 3.4.13). A fault location indicator shall be contained on the Receiver-Computer Group WRA only.

3.3.7.1 Compatibility with VAST - The equipment shall be compatible with the Versatile Avionic Shop Test System (VAST) and shall meet the requirements of Specification AR-8. When required by contract, VAST Operational Test Program Sets shall be furnished in accordance with Specification AR-9. If Operational VAST Test Program Sets exist for the equipment, and changes to the equipment are made which will affect the fault diagnosis procedure, changes to the existing Test Program Sets shall be prepared as part of the equipment changes in accordance with Specification AR-9.

3.3.7.2 Maintainability Indices - The applicable maintainability indices established by Specification AR-10 shall not be degraded without specific approval of the Naval Air Systems Command.

3.3.7.3 Maintainability Terminology - When the location and access of the equipment is not known, only time and difficulty of removing the WRA from its mounting shall be considered in defining an LRA or HRA.

3.3.7.4 Maintainability Requirements - The equipment shall be such that all corrective maintenance can be accomplished by maintenance personnel who have attained the E-4 skill level and who have successfully completed appropriate training programs.

3.3.7.5 Organizational Maintainability - The characteristics of the equipment shall be such that it will be possible in 95% of the cases of failure, to perform all corrective organization maintenance actions, other than combat damage repair, within a period not exceeding 30 minutes (the 30 minute corrective action time shall include all elements except aircraft access time). As here applied, an organizational corrective maintenance action includes the following:

(a) Verification of a fault

(b) Location of the fault to the antenna-coupler, control-indicator, interconnecting box, or one of the modules of the receiver-computer group.

(c) Correction or repair

(d) Check out of the repair.

3.3.7.6 Packaging Requirements - The Receiver-Computer Group shall be packaged in modular form so that all subassemblies shall be of the plug-in module type, except the Interconnecting Box J-3213/URN, and are easily removable without special tools for maintenance.

3.3.7.6.1 Module Arrangement - Module arrangement will be such that access to each module does not require the removal of adjacent modules.

3.3.7.6.2 Keying - Modules and connectors shall be keyed to prevent the insertion of a connector or module into an improper location within or on the equipment.

3.3.7.6.3 Base Plate Pin Configuration - The assignment of functions on the pins of the base plate module plugs, Interconnecting Box J3213/URN, shall be so configured as to provide adequate separation between power and ground pins. The configuration shall facilitate the use of meter and oscilloscope probes without danger of short circuits.

3.3.7.6.4 Loose Hardware - Non-captive hardware (screws, nuts, washers) shall not be used in those areas where organizational maintenance and/or module replacement may be required except for the five horizontal module compression screws.

3.3.8 Nomenclature, Nameplates and Identification Marking - Nomenclature and serial number assignment, nameplate approval and identification marking shall be in accordance with Specification MIL-N-18307.

3.3.9 Standard Conditions - The following conditions shall be used to establish normal performance characteristics under standard conditions and for making laboratory bench tests:

Temperature:	Room ambient (25°C ± 10°C)
Altitude:	Normal ground
Vibration:	None
Humidity:	Room ambient up to 90% relative humidity
Input Power Voltage:	115 ± 1.0 VAC, 400 Hz, and 27.5 ± 0.5 VDC

3.3.10 Service Conditions - The equipment shall operate satisfactorily under any of the environmental service conditions or reasonable combination of these conditions as specified in Specification MIL-E-5400 for Class 2 equipment, except as modified herein.

3.3.10.1 Vibration - The Receiver-Computer Group shall conform to the vibration requirements of Specification MIL-E-5400 curve IV with vibration isolators, and to curve I with an amplitude not exceeding 3g without isolators. The Antenna-Coupler shall conform to curve IV. The Control-Indicator shall conform to curve IV except the amplitude shall not exceed 5g.

3.3.10.2 Temperature-Altitude - The OR-133(V)/URN Receiver-Computer Group and AS-2623/ARN-99(V) & AS-2623A/ARN-99(V) antenna shall perform as specified in Specification MIL-E-5400 for Class 2 equipment except that intermittent operation of the Receiver-Computer Group shall be required at temperatures only 4°C above continuous operation. The ID-1776/ARN-99(V) & ID- /ARN-99(V) Control-Indicator shall meet the requirements for Class I equipment.

3.3.11 Warm-Up Time - The time required for the equipment to warm up prior to operation shall be kept to a minimum and shall not exceed 180 seconds under standard conditions and 300 seconds at extreme conditions including a maximum of 20 seconds from the time the power switch is actuated to apply 400 Hz power to the equipment. Equipment shall meet all performance requirements of Paragraph 3.4 after this time.

3.3.12 Input Electrical Power

3.3.12.1 Operating Power - The equipment shall meet all applicable requirements of MIL-STD-704Aand shall give specified performance from the following power sources with characteristics and limits as defined in MIL-STD-704A. The power required shall not exceed the specified amounts.

(a)	AC Power (Single Phase) Category B	115 volts, 400 Hz 405 VA
(b)	AC Power (Single Phase) Category B	26 volts, (reference phase) 1.5 VA
(c)	DC Power, 28 Volts Category B	55 watts warm-up 5 watts operating plus 5 watts for C/I relay

3.3.12.2 Lighting Power - Input power for edge lighting of the Control-Indicator shall be provided from a variable, zero to +28 VDC source.

3.3.12.3 Degraded Performance - Degraded performance will be permitted for voltage transients not exceeding 0.5 seconds during normal electric system operation except performance shall not be affected by short pulses of less than 100 microseconds. Operation shall return to normal with no resulting damage to equipment.

3.3.12.4 Warm-up Power - Warm-up power for the crystal oscillator heater shall not exceed 2 amperes at 27.5 volts.

3.3.12.5 Power Outage - In the event of power outage of duration greater than 200 microseconds, the navigational set shall re-enter the synchronization process. All time and position data shall be retained in memory and used as initial condition data when navigation set accomplishes synchronization. No operator action shall be required to restore operation. When power returns, equipment shall dead reckon on available sensor inputs until resynchronization and tracking are accomplished. If dead reckoning in TAS-MAG heading mode, stored wind information shall be used if available in computer memory.

3.3.12.6 Overload Protection - Overload protection for the equipment shall be provided in the equipment. All parts and circuits of the equipment which are likely to carry an overload due to any failures or poor adjustments shall be proportioned to withstand such overload without permanent damage to the equipment or shall have suitable protective devices. Fuses or other non-automatic resetting protective devices shall not be used within the equipment.

3.3.12.7 Undervoltage Protection - The equipment shall not be damaged by voltages below the minimum specified herein and shall automatically resume normal operation when the voltage returns within limits. In order to avoid the necessity for commutator resynchronization and reacquiring signal phase track in the event of power failure, operation or partial operation must be maintained with as low a voltage limit as practical. In addition, synchronization, position and phase tracking shall be maintained through (50 usec or less) power supply loss.

3.3.13 Cooling

3.3.13.1 Thermal Conditions - The equipment shall operate satisfactorily under the thermal conditions specified herein. A thermal analysis shall be conducted in accordance with MIL-T-23103.

3.3.13.1.1 Receiver-Computer Group and Antenna-Coupler Unit - Receiver-Computer Group and Antenna-Coupler shall operate under all service conditions of Specification MIL-E-5400 Class 2 (except for modifications noted in paragraph 3.3.10) as enclosed units without the aid of any active cooling air. The Receiver-Computer Group shall be vented such that the surrounding local ambient temperatures will not be affected beyond MIL-E-5400 Class 2 ambients by the equipment's own heat dissipation since the unit depends on natural convection as the major cooling medium.

3.3.13.1.2 Control-Indicator - This unit shall operate under all conditions of service as specified in Specification MIL-E-5400, Class 1 without the aid of any active cooling system. The ambient air shall be allowed to enter through the bottom cover, traverse the unit as a natural convective stream and exit through the perforated top cover.

3.3.14 Color - The Receiver-Computer Group shall be lusterless gray, color number 36231 in accordance with FED-STD-595. The Antenna-Coupler shall be supplied unpainted. The color of the Control-Indicator shall be as specified in Specification MIL-C-6781 and in Paragraph 3.5.2.5.7.

3.4 Performance - Unless otherwise specified, values set forth to establish the requirements for satisfactory performance apply to performance under both standard and extreme service and input power conditions. When reduced performance under the extreme conditions is acceptable, tolerances or values setting forth acceptable variations from the performance under the standard conditions will be specified. The OMEGA Navigational Set shall be capable of performing the navigation functions specified herein, using the VLF OMEGA transmissions as available under all conditions where transmission signals are adequate in an automatic and continuous manner.

3.4.1 Operation - The computer of the AN/ARN-99(V) Omega Navigational Set is programmed to perform self test, preflight test, and mathematical computations necessary to obtain accurate navigational information which will aid the operator during flight. Once the system is energized, the computer will automatically initiate self test. Upon completing self test, the computer will then initiate preflight test. When preflight test is completed, specific indicators on the Control-Indicator will light to inform the operator the Airborne OMEGA Navigational Set is ready for operation whenever present position and time are inserted into the computer circuitry. Once inserted, the Airborne OMEGA Navigational Set is ready to receive and process the transmitted OMEGA signals.

The OMEGA 10.2 KHz, 11-1/3 KHz and 13.6 KHz signals transmitted by all of the VLF OMEGA stations within the coverage area are received through the loop antennas on the aircraft and supplied to the loop antenna coupler. The loop antenna coupler filters and amplifies the OMEGA signals for the antenna switching matrix circuit. The antenna switching matrix circuit sums and phase shifts the coupler output signals and then supplies these signals to the receiver circuit (receiver strips) in the receiver-computer. Each receiver strip is a single conversion superheterodyne receiver which uses RF and IF circuits. Each receiver strip amplifies and filters the signal and then supplies this signal to the correlator and digital converter circuits. The correlator and digital converter circuit obtains sine and cosine phase information from the receiver strip outputs and converts this information into digital form which will be compatible with the computer circuit. The sine and cosine information in digital form is supplied to receiver input/output circuits. The receiver input/output circuit counts and stores this information until instructed by the computer to transfer this information for further processing. When instructed by the computer, the software system will begin synchronization process to align the receiver input/output information with a known OMEGA transmission pattern. Once synchronization is obtained, the computer software system will continue to filter the signals through tracking filters and combinational filters until accurate positional information is obtained.

In order to obtain accurate positional information, the Airborne OMEGA Navigational Set must rely on heading and velocity information from sources external from the system. The Airborne OMEGA Navigational Set receives the necessary signals from equipment such as, but not necessarily limited to: Analogs of Inertially derived heading and velocity, Analogs of doppler derived velocity, Analogs of magnetic heading and airspeed. Signals from these external sources are inserted into the computer software system to aid in updating and determining accurate positional information. Only one velocity and heading source at a time are required. Once positional information is determined and acceptable by the software system, the positional information is shifted into the logic control circuit in the control-indicator. The logic control circuit conditions the input information and supplies this information into a shift register. The output from the shift register is then supplied to a decoder circuit. The decoder circuit decodes this digital information for display on the front panel to inform the operator the present status of the flight. Also, during flight, the operator can request specific information to be displayed by manipulating the appropriate controls on the appropriate Control-Indicator.

3.4.2 Functional Characteristics - The OMEGA Navigational Set shall have as its primary functional capability the following:

a) Station/Frequency Usage - The OMEGA Navigational Set shall have capability of operation with the OMEGA global system using all available minimal path signals from any of the eight (8) transmitting stations on the three (3) OMEGA frequencies of 10.2 KHz, 13.6 KHz and 11-1/3 KHz.

b) Automatic Station Synchronization - Provide automatic synchronization to the OMEGA broadcast pattern for purposes of recognizing and identifying a particular station transmission. Set shall remain synchronized to OMEGA boradcast signals even during periods of time when the OMEGA signals are not available and the set is operating.

c) World-Wide Capability - When operating with a completed VLF OMEGA transmitting system, the Navigational Set shall be capable of performing continuous navigation in all latitudes as long as vehicle heading in a known grid and velocity are furnished the set.

d) Tracking - Provide automatic search and lock-on capability for tracking up to eight (8) transmitting stations, using three (3) frequencies, simultaneously and without operator assistance.

e) Phase Measurement - Determine the phase (relative to the OMEGA broadcast pattern) of incoming signals segregated as to station and frequency, with the requisite phase measurement accuracy.

f) Rate-Aiding - Obtain and use velocity data derived from velocity sensor inputs.

g) Phase Corrections - Automatically provide VLF propagation corrections to the measured phase of the received OMEGA signals for each OMEGA transmitting station on three (3) frequencies.

h) Navigation Outputs - Provide appropriate navigation output, to display, based upon either or both of:

(1) Current OMEGA signals being received.

(2) Velocity sources of vehicle and velocity calculated from OMEGA signals.

3.4.3 Functional Arrangement - The standard functional arrangement of the OMEGA Navigational Set shall be according to Figure 1.

3.4.4 Dynamic Input Conditions - The Navigational Set shall have capability of phase tracking the incoming VLF OMEGA signals with the following characteristics:

a) Signal Strength - Navigational Set shall have the capability of operating over the dynamic input range of 100 db. Signal strength, at input to antenna, shall be between 5μ volts/meter and 500,000μ volts/meter. The navigational accuracy shall not be degraded when any two signals are separated as much as 60 db and no noise is present.

b) Noise - Navigational Set shall be capable of phase tracking input signals whose signal amplitude is no worse than 15 db below an ambient noise level of 50 μV/meter over a bandwidth of 100 Hz.

3.4.5 Automatic Synchronization - The Navigational Set shall have capability of automatic (no operator functions required) synchronization of the received signals to the OMEGA broadcast pattern to an accuracy of 0.05 sec with a resolution of 0.005 sec with a confidence factor of 0.9974. Synchronization shall be possible under the following minimum conditions at receiving locations:

a) Any two or more stations receivable on three (3) frequencies each station. At least one station shall have a SNR of at least 0 db, all other stations shall have a SNR of no less than -10 db on all frequencies.

b) Maximum time to acquire synchronization under above conditions shall be less than 180 seconds in 95 percent of cases.

3.4.6 Antenna Lobe Selection - The Navigational Set shall use a receiver input switching matrix to select the optimum loop antenna lobe for each OMEGA broadcast station. The switching matrix shall be capable of selecting the appropriate lobing patterns from the loop antenna. Selection for each received frequency shall be independent and shall remain selected until the next selection is made.

During synchronization process, the loop selection matrix shall electrically rotate the +A signal by -90 degrees so that the pseudo-omni configuration of (+A-90 degrees)+B is used.

3.4.7 Measurement Accuracy and Random Noise

3.4.7.1 Measurement Accuracy: The measurement accuracy of the Navigational Set, measured at the output of the burst measurement filters, shall be:

STATION SIGNAL SEPARATION	LOWEST TEST SIGNAL LEVEL	MEAN DIFFERENCE FROM ABSOLUTE	STANDARD DEV.
0 db	.5 v/m	± 1 CEC	1 CEC
20 db	.05 v/m	± 1 CEC	1 CEC
40 db	.005 v/m	± 1 CEC	1 CEC
60 db	.0005 v/m	± 1 CEC	2 CEC
60 db	.00005 v/m	± 2 CEC	3 CEC
60 db	.000005 v/m	± 3 CEC	5 CEC

3.4.7.2 Random Noise: The Navigational Set shall be capable of using signals in the presence of random noise (measured in a 100 Hertz bandwidth). Performance of the Navigational Set, measured at the output of the burst measurement filters with 500μV/meter of noise shall be:

SNR	MEAN DIFFERENCE FROM ABSOLUTE	STANDARD DEVIATION
+20 db	± 1 CEC	1.5 CEC
+10 db	± 1 CEC	1.5 CEC
0 db	± 1 CEC	2 CEC
-10 db	± 2 CEC	3 CEC
-15 db	± 3 CEC	5 CEC

3.4.8 Dynamic Phase Tracking - Each tracking filter shall be capable of tracking a steady-state phase velocity input of 200 knots (along the baseline) without velocity-aiding with a lag error not to exceed one percent of a carrier cycle. The acceleration characteristics of the set shall be such that it does not lose phase track under the following conditions: A vehicle traveling along the baseline and the wind changing in magnitude from 0 knots to 140 knots in 60 seconds and in a direction parallel to the baseline. The acceleration characteristics of combined set and velocity aid input shall be such that the lag error does not exceed 5 percent of a carrier cycle per channel under the following condition: A vehicle traveling along the baseline at 1,000 knots, an error in measured rate input of less than 10 percent (velocity sensor external to the Navigational Set) and reversing its direction on a three-degree-per-second turn. The Navigational Set shall recover from the effects of the above accelerations in less than two minutes after reaching a constant velocity. The requirements for dynamic phase tracking and measurement accuracy will be met for signal-to-noise ratios equal to or greater than -15 db.

3.4.9 Signal Acquisition - The equipment shall be capable of automatic signal acquisition under all signal amplitude conditions, signal-to-noise ratios and velocities specified herein. Acquisition time shall not exceed 5 minutes under any of the signal conditions specified herein. Acquisition is defined as the time required after the completion of synchronization, to meet the accuracy requirement of paragraph 3.4.7 of this specification.

3.4.10 VLF Propagation Corrections - The Navigational Set shall automatically provide phase corrections compensating for the phase variations between the OMEGA transmitting stations and the position of the aircraft. These phase corrections shall continuously update the lane position information. By inserting data (day, time of day, and position) prior to flight, no operator intervention or updating shall be required during flight regardless of unplanned changes in flight paths. The operator shall have the capability of inserting fixed offset position, in the AN/ARN-99(V)2 only, to compensate for observed minor errors in displayed position due to incorrect propagation predictions. This offset shall automatically be removed by the computer when the operator enters a new date and time.

The method employed in generating the phase corrections shall have at least the following accuracies:

(a) The maximum difference of predicted value minus plot value for any hour of the day shall not exceed 30.0 cecs.

(b) The mean of the differences over the twenty-four hour period shall not exceed 18.0 cecs.

(c) The standard deviation of the differences shall not exceed 9.0 cecs.

3.4.11 Navigation - The Navigational Set shall perform the following navigation functions:

3.4.11.1 OMEGA Input Signal Conversion - The Navigational Set shall treat each OMEGA signal burst as a separate measurement for purposes of navigation. Navigation performance shall be continuous for all latitudes, including polar regions when the system is provided with a stable heading source (such as a free gyro).

3.4.11.2 Navigational Accuracy - The Navigational Set shall provide position determination to an accuracy of approximately 1.0nmile (rms) daytime and 2.0nmiles (rms) nighttime when OMEGA input signals are no worse than: Minimum of 3 OMEGA stations, 3 frequencies each, with worst case SNR of -15 db on one station and no worse than -10 db SNR on the other two and the incoming Omega signals are within the predicted propagation limits.

3.4.11.3 Dead Reckoning - The Navigational Set shall provide dead reckoning navigation from the selected vehicle velocity/heading source during time OMEGA signals are not suitable for OMEGA navigation. No operator intervention shall be required for the Navigational Set to switch from OMEGA navigation to DR navigation and back to OMEGA navigation mode.

3.4.11.4 Rate Aiding - The Navigational Set shall use, in an optimum manner, velocity data from the vehicle velocity sensors for the purpose of rate aiding dynamic tracking of OMEGA signal phases. Rate aiding may be automatically derived from any one of the following velocity sources:

(a) Vehicle Inertial Measurement System
(b) Vehicle Doppler Radar System
(c) Vehicle True Airspeed System

The Navigational Set shall automatically select the "best" velocity source available based upon discrete status signals and operator mode control through use of the Control-Indicator. In addition, aircraft heading will be derived from the Magnetic Compass or Inertial Heading. The aircraft velocity vector will be determined from the appropriate combination of the velocity and heading sources.

3.4.11.5 Magnetic Variation - The Navigational Set shall have a table of world magnetic variations for latitudes between ± 73°. This table will be used to correct magnetic compass inputs to True Heading for purposes of Dead Reckoning navigation.

3.4.11.6 Wind Velocity and Ground Speed - The Navigational Set shall calculate the current wind velocity by differencing computed vehicle ground speed with the speed from the True Airspeed sensors. Ground speed shall be derived from either the Inertial or Doppler system or from the OMEGA derived velocity if neither Inertial nor Doppler data are available. The wind velocity shall be computed over a suitable period of time and stored for the following purpose:

> To provide ground speed and track angle for rate aiding and automatic dead reckoning when true airspeed and magnetic heading are the only external dead reckoning sensors installed and/or providing a usable output.

3.4.11.7 Computed Navigational Data - The Navigational Set shall provide facility for the following computed functions:

(a)	Present Position	- Current vehicle position in Latitude/Longitude coordinates
(b)	Way Points (Destination Points)	- Latitude/Longitude coordinates of up to 10 fixed and one moving (AN/ARN-99(V)2 only) way points
(c)	Line-of-Position	- Omega chart compatible, hyperbolic lines of position uncorrected by the propagation prediction.
(d)	Cross Track Error	- Perpendicular linear deviation of position from the desired course
(e)	Track Angle	- Current track angle made good
(f)	Ground Speed	- Current computed vehicle speed along the track

(g)	Bearing to Selected Way Point	- Magnetic bearing to operator selected way point
(h)	Range to Selected Way Point	- Range to operator selected way point
(i)	Wind	- Computed wind vector
(j)	Desired Track	- Computed track between two operator selected way points
(k)	Estimated Time Enroute	- Computed time, at current velocity, to operator selected way point
(l)	Status	- Data required to determine adequate Omega signal reception
(m)	Test	- Data required to determine adequate equipment operation

3.4.11.8 AN/ARN-99(V)4 Unique Requirements - In addition to the above requirements, AN/ARN-99(V)4 shall also provide the following.

3.4.11.8.1 The navigation set shall have the capability of operating in the manual heading and/or manual velocity input mode.

3.4.11.8.2 Grid mode navigation shall be included as an added capability.

3.4.12 Interface Requirements - The following paragraphs describe the interface of the AN/ARN-99(V) with the operating vehicle.

3.4.12.1 Functional Arrangement - The units of the Navigational Set shall be arranged according to Figure 2.

3.4.12.2 Signal Inputs - The Navigational Set shall be capable of receiving from the vehicle any or all of the following provided an appropriate Analog-Digital Data Unit and computer program are used:

(a) Inertial Measurement System - Analogs of velocity and heading related to True North coordinates.

(b) Doppler Radar System - Analogs of velocity related to the doppler coordinate system.

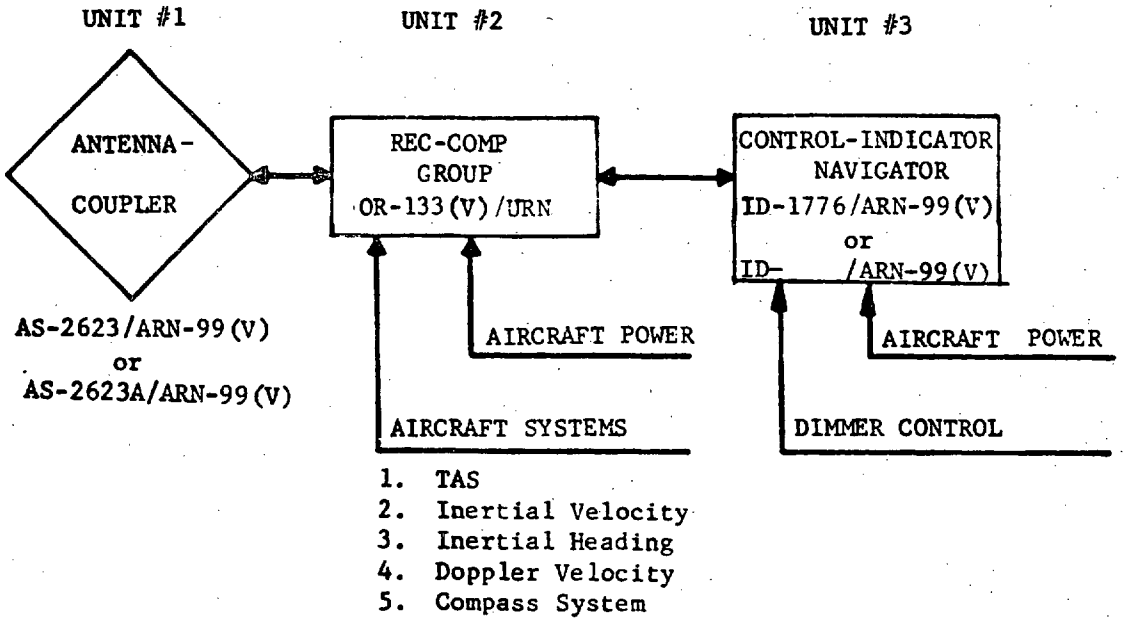


FIGURE 2- NAVIGATIONAL SET, OMEGA AN/ARN-99(V)2 AND (V)4

(c) Airspeed System - Analog signal related to True Airspeed.

(d) Heading - Analog signal related to Magnetic North.

(e) Status - Operating status signals of items (a) through (d) shall be provided so that Navigational Set may automatically switch rate aiding sources in the event selected rate aid sources become inoperative.

3.4.12.3 Electrical Interface Characteristics - The functional interfaces of the Receiver-Computer Group with other aircraft functions and systems shall be according to the specific vehicle application.

3.4.13 Self-Test - The Navigational Set shall have the following self-test capability. The test capability shall be completely self-contained within the Navigational Set and no equipment external to the Navigational Set shall be required.

(a) At power turn-on and prior to any other operation, a complete test of the Navigational Set shall be made on each of the functional areas.

(1) Each receiver channel (3)

(2) Input/Output

Receiver
Analog Signals (Rate Aid)
Computer

(3) Computer Logic

(4) Computer Memory

(b) Periodically during normal operation, although not to exceed 10 sec each of the functional areas shall be tested.

(c) No operator action shall be required to execute any of the above tests.

(d) Control-Indicator shall be tested by the Receiver-Computer with operator initiating test and verifying test function.

(e) In the event of detected failure within the Receiver-Computer Group, operator shall be informed via SYS MALF indicator.

(f) The BIT features shall be such that at least 95% of the equipment failures shall be detected.

3.5 Detail Requirements

3.5.1 Receiver-Computer Group OR-133(V)/URN - The Receiver-Computer Group shall meet the following requirements.

3.5.1.1 Functional Requirements - The Receiver-Computer Group shall perform the basic functions of:

(a) Antenna lobe selection

(b) Generation of precision frequencies for receiver local oscillator and calibration functions

(c) Processing of the three separate OMEGA frequencies

(d) Conversion of Receiver outputs to digital format

(e) Precision timing signals for navigation process

(f) Conversion of synchro heading signals and synchro and analog velocity signals to digital format

(g) Interface for control and display functions

(h) Processing capability for OMEGA navigation functions.

3.5.1.2 Form Factor and Configuration - The Receiver-Computer Group shall be enclosed in a conductively cooled package with overall dimensions not to exceed 20.19 inches by 10.25 inches by 7.70 inches exclusive of front plate handles, fasteners and connectors. This package shall be mounted on a mounting base as specified herein.

3.5.1.2.1 Memory Configuration - The Receiver-Computer Group shall have two memory configurations, either 8,192 or 16,384 words of core memory. The OR-133(V) / URN* shall contain 8,192 words and the OR-133(V)2/URN shall contain 16,384 words.

3.5.1.3 Weight - The weight of the Receiver-Computer Group shall not exceed 60.1 pounds for the OR-133(V) /URN*and 60.5 pounds for the OR-133(V)2/URN.

3.5.1.4 Input Power Requirements - The Receiver-Computer Group maximum primary input power requirements are as follows:

(a) AC Power (single phase), 115V, 400 Hz, Category B, 310 VA. Maximum power consumption (steady state) 250 watts.

(b) 28 VDC, Category B, 55 watts warm-up, 5 watts operating, plus 5 watts for Control-Indicator relay.

*Complete designation not assigned

(c) AC Power (single phase) 26V, 400 Hz, reference phase, Category B, 1.5 VA. Maximum power consumption 1.1 watt.

3.5.1.5 BITE - Built-In-Test circuitry shall be provided for the following functions:

(a) Precision Frequency Generator Count-Down Logic - Circuit shall detect if any of the frequency countdown chains are not coherent with the others. Event shall be detectable by computer and shall cause system to re-enter synchronization process.

(b) Computer Instruction Sequencing - Circuit shall detect that computer program is not sequencing in proper manner. Event shall cause SYS MALF indicator to be set ON.

(c) Test and Calibrate Signals - The navigation set shall provide test signals which ensure the receiver is functioning and shall provide the dual purpose of calibration of each receiver, automatically and without interference to normal operation for:

Scale factor
Bias
Receiver phase shift

3.5.1.6 Fault Isolation - The Self-Tests described in 3.4.13 and the BITE described above shall allow a maintenance operator to fault isolate problems within the Receiver-Computer to the first level disassembly of the unit in accordance with AR-10 when operated with suitable support equipment.

3.5.1.7 Electrical Connections - Connections to external functions shall be defined in Interconnecting Box J-3213/URN requirements.

3.5.1.8 Contents - The Receiver-Computer Group shall contain the following functional subassemblies:

Receiver, Radio 10.2 kHz	R-1880/URN	(See Note 1)
Receiver, Radio 11 1/3 kHz	R-1879/URN	(See Note 1)
Receiver, Radio 13.6 kHz	R-1878/URN	(See Note 1)
Converter-Phase Correlator	CV-3130/URN	(See Note 1)
Power Supply	PP-6990A/URN	
Interconnecting Box	J-3213/URN	
Core Memory Unit		
*8K = Used in OR-133(V) /URN	MU-601/URN	
16K = Used in OR-133(V)2/URN	MU-606A/A	
Memory Switching Unit	SA-1967/URN	
Memory Timing Unit	TD-1108/URN	
Arithmetic - Control Unit #1	CP-1156/URN	
Arithmetic - Control Unit #2	CP-1155/URN	
Arithmetic - Control Unit #3	CP-1154/URN	
Arithmetic - Control Unit #4	CP-1153/URN	
Analog-Digital Data Unit		
*Used in OR-133(V) /URN	J-3212/URN	
Used in OR-133(V)2/URN	J-3212A/URN	

*Complete designation not assigned

Note 1. These assemblies are also used in the AN/ARN-99(V)1 Omega Navigational Set (Specification MIL-N-81675).

3.5.1.9 Radio Receiver Modules

Radio Receiver	10.2 kHz	R-1880/URN
Radio Receiver	11 1/3 kHz	R-1879/URN
Radio Receiver	13.6 kHz	R-1878/URN

3.5.1.9.1 Radio Receiver Module Functional Requirements - Each of the three receiver modules shall be a heterodyne type receiver utilizing inputs from an orthogonal loop antenna. The RF tuning range shall be three fixed channels of 10.2, 11 1/3, and 13.6 kHz. The overall bandwidth shall be less than 100 Hz. Each receiver module shall provide RF and IF tuning for one of the respective incoming burst signals. Table II summarizes the signal characteristics for each receiver module. The performance of this equipment shall not be degraded by additional OMEGA signal transmissions. The overall spectrum of the OMEGA signals shall be comprised of time-multiplexed transmissions at 10.2, 11 1/3 and 13.6 kHz as transmitted in turn from eight stations. The selectivity of the receiver shall be such that its performance will not be degraded by any CW signal 500 Hz above or below 10.2 kHz and 13.6 kHz, and 200 Hz above or below 11 1/3 kHz have an amplitude as great as one volt/meter when the OMEGA signals are no greater than 500μ volts/meter.

TABLE II RADIO RECEIVER MODULES, SIGNAL CHARACTERISTICS

Band Center Frequency	Local Oscillator Frequency	Notch/IF Image Frequency	Intermediate Frequency
10.2 kHz	11 1/3 kHz	12.466 kHz	1.133 kHz
11 1/3 kHz	10.2 kHz	9.066 kHz	1.133 kHz
13.6 kHz	14.73 kHz	15.866 kHz	1.133 kHz

3.5.1.9.1.1 Receiver Input Switching Matrix - The Receiver Input Switching Matrix shall have the capability of providing each of the three receiver channels with the following inputs:

(a) No input
(b) Antenna Lobe A
(c) Antenna Lobe B
(d) In-phase test signal
(e) Quadrature phase test signal
(f) Antenna Lobe A - 90°

3.5.1.9.1.2 RF Amplifier - Each RF amplifier shall consist of bandpass filtering and limiting. The final stage shall be a heterodyning mixer down to the IF frequency. Image rejection shall be 75 dB (Min.).

3.5.1.9.1.3 Receiver Noise - The Receiver-Computer Group noise, reflected to the Receiver-Computer Group input, shall be no greater than 50 microvolts rms when measured in a rectangular bandwidth of 100 Hz.

3.5.1.9.1.4 Overload and Recovery Time - Each receiver RF section shall recover signal acquisition in less than 50 milliseconds after a signal causing saturation is removed.

3.5.1.9.1.5 IF Amplifiers - The IF amplifiers shall be tuned amplifiers operating at a frequency of 1.133 kHz having a bandwidth of 50 Hz or less.

3.5.1.9.1.6 Phase Shift - Each receiver channel shall provide stable operation over 60 dB range of carrier amplitude variation with less than ±0.5 cec phase shift, and over 100 dB range of carrier amplitude variation with less than ±1 cec shift.

3.5.1.9.2 Form Factor - Each receiver module shall have the following overall dimensions:

Length:	1.200 ± 0.002 inches
Width:	10.124 ± 0.010 inches
Height:	6.00 inches ± 0.04 inches plus 1.0 inch for the Guide Pins

3.5.1.9.3 Weight - The weight of each receiver module shall not exceed 2.2 pounds.

3.5.1.9.4 Contents - The contents of each module shall be

(a) Plug-in frame
(b) RF card assembly
(c) IF card assembly
(d) Shield

3.5.1.9.5 Interconnection - Each receiver module shall interconnect with the Receiver-Computer Group through Interconnecting Box, J-3213/URN.

3.5.1.10 Converter-Phase Correlator Module CV-3130/URN

3.5.1.10.1 Functional Requirements - This module shall provide the Precision Frequency Generator, Receiver Input Control functions and Phase to Digital Conversion for each Radio Receiver Module. The Converter-Phase Correlator Module shall contain the oscillator to provide simultaneous phase references for the various OMEGA signals. The characteristics of the oscillator shall be as follows:

(a) The frequency drift of the oscillator under continuous operation shall be chosen such that the Receiver-Computer Group will meet the performance requirements specified herein.

(b) The long-term frequency accuracy shall be better than one part in 10^8 per day, five parts in 10^8 per week. The frequency stability shall be within four parts in 10^7 of the nominal frequency within five minutes of application of power.

(c) The power for the heater circuits for the oscillator is derived from a 28 volt dc aircraft supply.

(d) A manual internal frequency or drift control shall be provided as a service adjustment, the use of which will enable depot level compensatory adjustments for slight variations in the oscillator frequency. This control shall permit adjustments of the oscillator over a range of $\pm$ 2 parts in 10^6.The overall oscillator accuracy shall permit signal acquisition after a minimum warm-up time.

The Receiver Input Control functions will be those listed in paragraph 3.5.1.9.1.1 The Phase to Digital Converter stage shall form a real-time product of the 1.133 kHz output from the IF amplifiers and Precision Frequency Generator basic timing circuitry. Each of the three RF channels shall have two outputs; one proportional to the sine of the measured phase and the other proportional to the cosine of the same phase. The phase to digital stage of the Converter-Phase Correlator Module will transfer the digital values of the sine and cosine of the measured phase to the Computer Section.

3.5.1.10.2 Form Factor - This module shall have the following overall dimensions:

Length:	2.100 $\pm$ 0.004 inches
Width:	10.124 $\pm$ 0.010
Height:	6.00 inches $\pm$ 0.04 inches plus 1.0 inch for the Guide Pins

3.5.1.10.3 Weight - The weight of this module shall not exceed 4.4 pounds.

3.5.1.10.4 Contents - The contents of this module shall be

(a) Plug-in frame (Two 1.05 inch frames are pinned together to form the Converter-Phase Correlator Module frame).

(b) Phase to digital circuit assembly card #1 (10.2 and 11 1/3 kHz phase to digital converters).

(c) Phase to digital circuit assembly card #2 (13.6 kHz phase to digital converter and $\pm$ 13 volt regulator circuit, reference paragraph 3.5.1.11).

(d) Frequency Generator assembly card

(e) Receiver digital data assembly card

(f) Precision Frequency Generator

3.5.1.10.5 Interconnection - The Converter-Phase Correlator Module shall interconnect with the Receiver-Computer Group through Interconnecting Box J-3213/URN.

3.5.1.11 Power Supply PP-6990A/URN

3.5.1.11.1 Functional Requirements - This module shall convert the 400 Hz input power into regulated d.c. outputs for the Receiver-Computer Group, Control-Indicator, and Antenna-Coupler. Voltages supplied by this module are:

Voltage	Tolerance	Ripple
+16 vdc	±0.32 vdc	Ripple voltage shall be less than 100 mv p-p on all voltages
+12 vdc	±0.6 vdc	
+ 5 vdc	±0.3 vdc	
- 6 vdc	±0.5 vdc	
-16 vdc	±0.32 vdc	
-25 vdc	±1.25 vdc	

3.5.1.11.2 Form Factor - The Power Supply module shall have the following overall dimensions:

Length:	4.365 ± 0.020 inches
Width:	10.124 ± 0.010 inches
Height:	6.0 inches ± 0.04 inches plus 1.0 inch for the Guide Pins

3.5.1.11.3 Weight - The weight of the Power Supply Module shall not exceed 12.6 pounds.

3.5.1.11.4 Contents - This module contains:

(a) Plug-in frame
(b) Heat sink
(c) Power, subassembly

3.5.1.11.5 Interconnection - This plug-in module shall interconnect to the Receiver-Computer Group through Interconnecting Box J-3213/URN.

3.5.1.12 Interconnecting Box J -3213/URN

3.5.1.12.1 Functional Requirements - The function of this subassembly shall be to provide the mechanical and electrical interconnections for the plug-in modules of the Receiver-Computer Group. It shall also provide the interconnections from the Receiver-Computer Group to the other

units of the OMEGA Navigational Set, AN/ARN-99(V). This subassembly shall also contain the time totalizing meter for the Receiver-Computer Group.

3.5.1.12.2 Form Factor - The overall dimensions of the Interconnecting Box shall not exceed, exclusive of front panel handles, fasteners and connectors.

Length:	19.69 inches	± 0.040 inches
Width:	10.25 inches	± 0.040 inches
Height:	7.70 inches	± 0.040 inches

Width at plug-in surface shall be 10.125 ± 0.010 inches.

3.5.1.12.3 Weight - The weight of the Interconnecting Box shall not exceed 14.3 pounds.

3.5.1.12.4 Contents - This module shall consist of the following:

(a) Front panel
(b) Base frame
(c) Bottom plate

3.5.1.12.5 Interconnection - This assembly shall have the following interconnections to the external functions:

Reference Designation	Receptacle Type	Function
1J1	*M81511/21EF01S1	Test (for Support Equipment Connections)
1J2	*M81511/21EF01P1	Test (for Support Equipment Connections)
1J3	M81511/02HB02P1 or M81511/02GB02P1	Power Input
1J4	M81511/21EB01S1	Power and Signals (Antenna-Coupler)
1J5	*M81511/21EF01P1	Avionics Interface
1J6	*M81511/21ED02S1	Control-Indicator

*Contacts, Part No. MS90461A23-28, are required where 28 AWG wire is used.

3.5.1.13 Computer

3.5.1.13.1 Functional Requirements - The computer shall have the capability of processing the necessary equations to allow the OMEGA Navigational Set to perform to the criteria set forth in Paragraph 3.4 herein. The computer section of the Receiver-Computer Group shall have the following characteristics:

3.5.1.13.1.1 Processing Capability - The Computer section shall have the following arithmetic and logical characteristics necessary to process, as a minimum, equations which resolve the OMEGA Navigation solution.

Type	General Purpose, Digital, Parallel Core Memory with serial, single-address arithmetic.
Clock Frequency	4.5 MHz (Min)
Memory Type	Magnetic Core, Non-volatile, random access, DRO (the memory shall be easily reloadable at the organizational level to accommodate changes in the propagation prediction equation and inclusion of the geographical coordinates of the OMEGA stations. Memory storage shall not be lost for any normal power turn-on/turn-off cycle or primary input power transients.)
Memory Size	8,192 or 16,384 sixteen (16) bit words with cycle time of 2.0 microseconds and access time of 1.0 microsecond
Instruction Addressing	Up to 65,536 words
Data Format	16-bit single precision or 32-bits double precision
Number System	Binary, fixed point fraction, with negative numbers in two's complement form

3.5.1.13.1.2 Organization - The computer section of the Receiver-Computer Group shall be organized into eight (8) separate plug-in assembly modules which shall interconnect to the Interconnecting Box J-3213/URN. Functionally this organization shall consist of:

(a) Memory (3 plug-in modules)
(b) Arithmetic Control (4 plug-in modules)
(c) Input/Output (1 plug-in module)

3.5.1.13.1.2.1 Core Memory Unit MU-601/URN - The Core Memory Unit (MU-601/URN) contains the magnetic memory core stack containing 8,192 sixteen (16) bit words.

Form Factor	Length:	2.580 ± 0.002 inches
	Width:	10.124 ± 0.010
	Height:	6.00 ± 0.04 inches plus 1.0 inch for guide pins

The weight of this module shall not exceed 5.2 pounds.

Contents Frame, core stack, drive circuit assemblies

3.5.1.13.1.2.2 Core Memory Unit MU-606A/A - The Core Memory Unit (MU-606A/A) contains the magnetic core stack containing 16,384 sixteen (16) bit words.

Form Factor	Length:	2.580 ± 0.002 inches
	Width:	10.124 ± 0.010 inches
	Height:	6.00 ± 0.04 inches plus 1.0 inch for guide pins

The weight of this module shall not exceed 5.6 pounds.

Contents Frame, core stack, drive circuit assemblies

3.5.1.13.1.2.3 Memory Switching Unit SA-1967/URN - The memory switching unit provides the memory (core) addressing capability for 16,384 sixteen (16) bit words.

Form Factor	Length:	1.050 ± 0.002 inches
	Width:	10.124 ± 0.010 inches
	Height:	6.00 ± 0.04 inches, plus 1.0 inch for guide pins

The weight of this module shall not exceed 2.2 pounds.

Contents Frame, two electronics circuit card assemblies.

3.5.1.13.1.2.4 Memory Timing Unit TD-1108/URN - The memory timing unit provides the timing control for the memory cycle and access.

Form Factor	Length:	1.050 ± 0.002 inches
	Width:	10.124 ± 0.010 inches
	Height:	6.00 ± 0.04 inches plus 1.0 inch for guid pins

The weight of this module shall not exceed 2.6 pounds.

Contents Frame, two electronic circuit card assemblies.

3.5.1.13.1.2.5 Arithmetic - Control Unit #1 CP-1156/URN - The Arithmetic and Control Unit #1 provides logic and control for the "A", "N" and "B" registers.

Form Factor	Length:	1.050 + 0.002 inches
	Width:	10.124 ± 0.010 inches
	Height:	6.00 inches ± 0.04 inches plus 1.0 inches for guide pins

The weight of this module shall not exceed 2.5 pounds.

Contents Frame, two electronic circuit card assemblies.

3.5.1.13.1.2.6 Arithmetic - Control Unit #2 CP-1155/URN - The Arithmetic and Control Unit #2 provides logic and control for the LNIX, TRANS I and Pre-Inst. decode.

Form Factor	Length:	1.050 ± 0.002 inches
	Width:	10.124 ± 0.010 inches
	Height:	6.00 inches ± 0.04 inches plus 1.0 inches for guide pins

The weight of this module shall not exceed 2.5 pounds.

Contents Frame, two electronic circuit card assemblies.

3.5.1.13.1.2.7 Arithmetic - Control Unit #3 CP-1154/URN - The Arithmetic and Control Unit #3 provides logic and control for the flag indicators, register decode and arithmetic registers.

Form Factor	Length:	1.050 ± 0.002 inches
	Width:	10.124 ± 0.010 inches
	Height:	6.00 inches ± 0.04 inches plus 1.0 inches for guide pins

The weight of this module shall not exceed 2.5 pounds.

Contents Frame, two electronic circuit card assemblies.

3.5.1.13.1.2.8 Arithmetic - Control Unit #4 CP-1153/URN - The Arithmetic and Control Unit #4 provides logic and control for the power interrupt, DMA control and "P" counter.

Form Factor	Length:	1.050 ± 0.002 inches
	Width:	10.124 ± 0.010 inches
	Height:	6.00 inches ± 0.04 inches plus 1.0 inches for guide pins

The weight of this module shall not exceed 2.4 pounds.

Contents Frame, two electronic circuit card assemblies.

3.5.1.13.1.2.9 Analog-Digital Data Unit J-3212/URN & J3212A/URN - The Analog-Digital Data Unit provides logic and control for the analog-to-digital conversion and digital-to-digital conversion.

Form Factor	Length:	1.050 ± 0.002 inches
	Width:	10.124 ± 0.010 inches
	Height:	6.00 ± 0.04 inches, plus 1.0 inch for guide pins

The weight of this module shall not exceed 2.3 pounds.

Contents Frame, two electronics circuit card assemblies

3.5.1.13.1.3 Input/Output Description - The analog-to-digital converter receives various analog signals from the system, converts them to a digital form which can be used by the computer, and sends them to the digital-to-digital converter, which additionally receives information from several other sources including the receiver, discrete inputs, the Control-Indicator, and external serial inputs. It also sends information to the Control-Indicator, the receiver, the serial data output, and the discrete outputs. The external serial data inputs and outputs provide information between the Navigation Set and other digital equipments. The Analog-Digital Data Unit shall be easily adaptable to accommodate up to eight (8) combinations of synchro (11.8 and 90 VAC RMS), AC or DC analog signals.

3.5.1.13.1.3.1 Analog-to-Digital Interfaces - A multiplexed, ratiometric, successive approximation, analog-to-digital converter is used to interface eight channels of analog information. A summary of A-D converter characteristics is given in Table III.

3.5.1.13.1.3.1.1 Excitation (Timing) Inputs - The A-D converter converts ac signals (including synchro) synchronously with respect to the ac excitation voltage. In order to establish the required synchronism for signals excited from different phases of reference voltage, two excitation inputs are provided to permit conversion on two separate time or phase relationships. The two excitation inputs EXCA and EXCB are selected as a function of channel number and are assigned as in Table III. Note that dc signals may also be converted synchronously to the ac excitation, since the dc signal is always available at full amplitude.

TABLE III A-D CONVERTER CHARACTERISTICS J-3212/URN, J-3212A/URN

Input Channels

Number and Type: Eight 3-wire differential as follows: (Two signal, one common)

Channel	Excitation	J-3212/URN Voltage Type	J-3212A/URN Voltage Type
0	A	90VAC Synchro	90VAC Synchro
1	B	90VAC Ratio	90VAC Ratio
2	A	90VAC Synchro	90VAC Synchro
3	B	90VAC Synchro	90VAC Synchro
4	A	*11.8VAC Synchro	*11.8VAC Synchro
5	A	11.8VAC Ratio	11.8VAC Synchro
6	A	11.8VAC Synchro	11.8VAC Synchro
7	A	11.8VAC Synchro	11.8VAC Synchro

*Note: One low level input channel is used internally for Built-In Test

Full Scale Voltages: 20 vdc (14 VRMS) for Low Level
127 VDC (90 VRMS) for High Level

Input Resistance/ "Fail Safe" Resistance: 200K/150K (20-volt scale)
280K/270K (127-volt scale0

Common Mode Range: ± 1/2 of full-scale input voltage

Common Mode Rejection: 60 dB min @ 400 Hz

A-D Converter

Type: Ratiometric, successive approximation

Digitizing Time: 48 microseconds

Max Conversion Rate: (Includes serial output time) 7700 words/sec (dc)
800 words/sec (ac)
(Note: All conversions are synchronized with the positive peak of the ac excitation voltage)

Output Format: 24-bit serial word at 500 kHz
(Note: Data is sign and magnitude for ratio data and octant + TAN/COT for angular data)

Bits	1-3	3-bit variable address
"	4-8	fixed address
"	9-20	12 data bits
"	21-23	octant coded polarity information
"	24	logic zero

Resolution: 12 bits + SIGN or OCTANT
0.84 arc-minute (angular data)
0.0244% of full scale (ratio data)

Accuracy (Max Error): 12 arc-minutes (angular data)
0.17% of full scale (ratio data)

3.5.1.13.1.3.2 Digital Interfaces - Serial digital and discrete logic functions shall have the following capability:

a) Serial Digital (Inputs and Outputs)
- Clock Rate - 500 KHz
- Clock Pulse Width - 220 nano sec
- Data Rate 28, 24 bit words every 5 mSEC (MAX)
- TTL logic levels
- Shift gate
- Mode Control
- Data line

b) Discrete Signals
- Eight input channels of +28 Vdc and +5 Vdc levels
- Four +28 output channels

Figure 3 defines the wave form characteristics of the serial digital interface as seen at the interface of the Receiver-Computer Group.

Figure 4 defines the wave form characteristics of the discrete data signals as seen at the interface of the Receiver-Computer Group.

3.5.1.13.1.3.2.1 Discrete Inputs - The Receiver-Computer Group has the capability to receive and multiplex eight discrete inputs under software control, as follows:

Name	Type	LOGIC "1"	LOGIC "0"
DISC IN #0 - #5	(28V)	VIN $\geq$ 13V	VIN $\leq$ 9V
DISC IN #6 - #7	(5V)	VIN $\geq$ 2.0V	VIN $\leq$ 0.9V

Note: DISC #7 is used internally for Built-In Test.

All of the discrete receivers recognize an open circuit as a logic zero.

3.5.1.13.1.3.2.2 Discrete Outputs - Two basic types of discrete outputs are provided: Set Discretes and DC Discretes. The Set Discretes are derived from the SET command, while the DC Discretes are obtained from a discrete word in the DMA storage area in the memory.

3.5.1.13.1.3.2.2.1 Set Discrete Outputs - The Set Discrete outputs are derived from the SET command, and, therefore last only one clock time (2 microseconds) and occur only when the SET command is given. The Set Discretes are supplied to a variety of driver circuits, including a latch which uses two discrete codes to set and reset the latch.

Name	Output Type
DC SET DISC OUT #4	Latching Driver
SET DISC OUT #5	Differential Line Driver
SET DISC OUT #6	Differential Line Driver

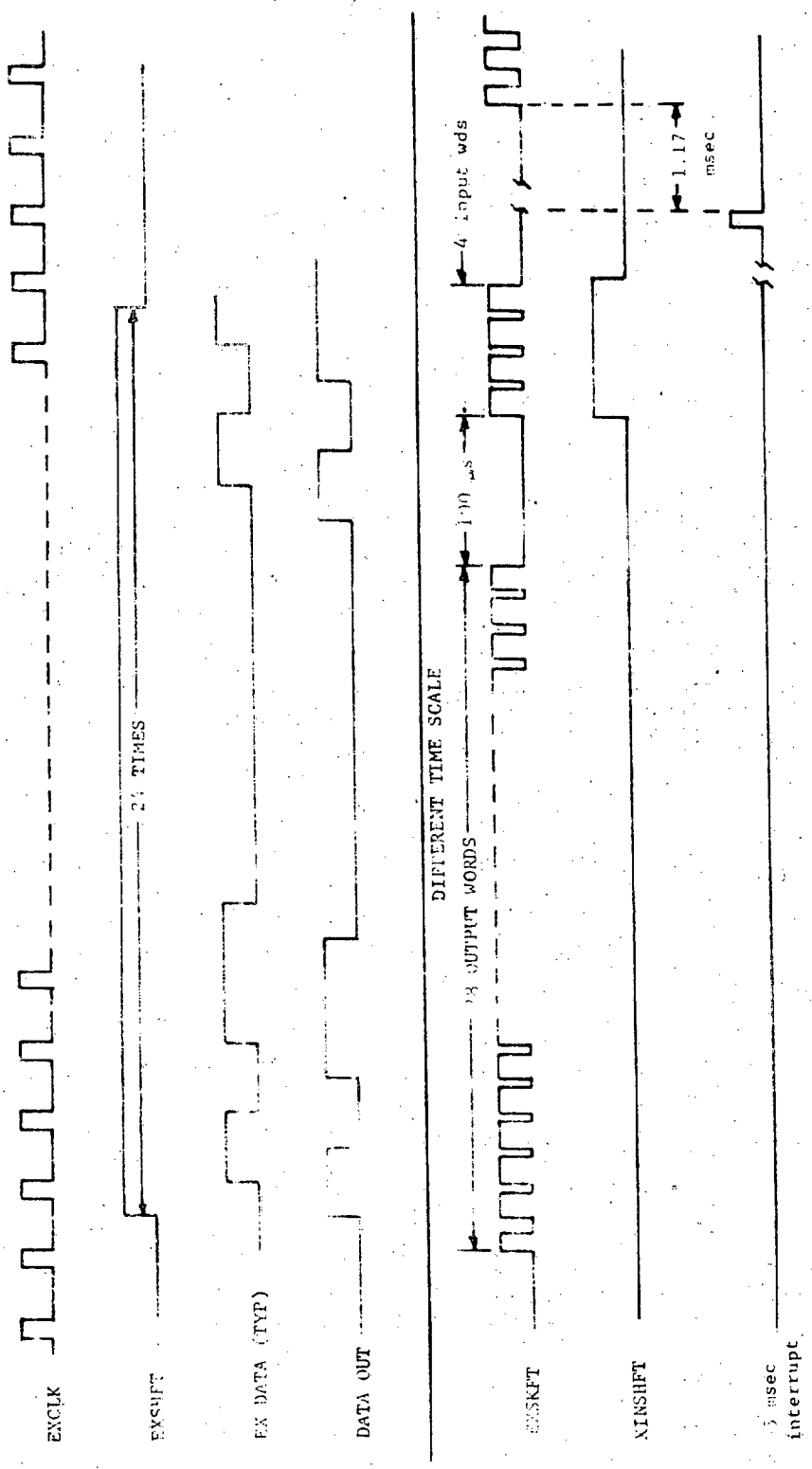
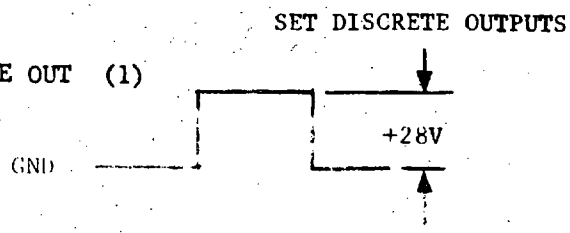


FIGURE 3 DIGITAL DATA INPUT/OUTPUT TIMING

DC SET DISCRETE OUT (1)

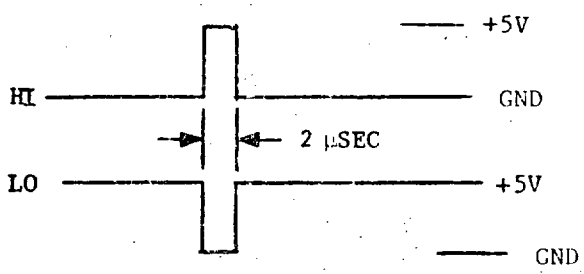


OPEN COLLECTOR OUTPUT CAPABLE OF DRIVING +28 VOLT 160 MA LOADS

SET COMMAND +28V

RESET COMMAND GND

DIFFERENTIAL LINE DISCRETE OUT (2)



SET COMMAND - HI WILL GO TO +5V FOR 2 μSEC
LO WILL GO TO GND FOR 2 μSEC
HI NORMALLY AT GND
LO NORMALLY AT +5V

FIGURE 4

3.5.1.13.1.3.2.2.2 DC Discrete Outputs - The DC Discrete outputs are obtained from bits 9 through 16 of a discrete word in DMA storage. The bits are loaded into latches once every 5 milliseconds at the same time a certain receiver discrete word is transmitted. The output remains in the state specified by the corresponding discrete word bit until the data is changed and the latches are updated.

Name	Output Type	Output Level
DC DISC OUT #0	Driver*	OPEN GND
DC DISC OUT #1	Driver*	OPEN GND
DC DISC OUT #2	Driver*	OPEN GND
DC DISC OUT #3	Driver*	OPEN GND

*Driver is open collector transistor capable of driving 28-volt 160-ma loads.

3.5.1.13.1.4 Arithmetic and Control - The logic mechanization of the computer shall allow adequate instruction capability and speed to perform the functions specified in Paragraph 3.4 herein.

3.5.1.13.1.5 Computational Accuracy - The computer section shall not degrade the absolute measurement accuracy of the Omega signal phase by more than 0.08 CEC.

3.5.1.14 Cabling - The Receiver-Computer Group shall operate satisfactorily with the Control-Indicator, as long as the interconnecting cable(s) has (have) a length not exceeding fifty feet.

3.5.2 Control-Indicator, ID- /ARN-99(V) and ID-1776/ARN-99(V)

3.5.2.1 Functional Requirements - The Control-Indicator performs the function of the man-machine interface for the OMEGA Navigational Set as detailed in Table IVA for ID- /ARN-99(V) and Table IVB for ID-1776/ARN-99(V).

3.5.2.2 Form Factor - The dimensions of the Unit shall not exceed 5.75 inches by 8.25 inches by 6.95 inches and shall conform to the panel rack mounting requirements of MIL-C-6781.

3.5.2.3 Weight - The weight of the Unit shall not exceed 12.5 pounds.

3.5.2.4 Input Power Requirements - The Control-Indicator primary input power requirements are as follows:

a) AC power(single phase), 115V, 400 Hz, Category B, 95 VA

b) Maximum power consumption (steady state) 85 watts.

TABLE IVA- CONTROL-INDICATOR FUNCTIONS ID- /ARN-99(V)

LEGEND	MEANING	DESCRIPTION	DEVICE TYPE
POWER	400 Hz Power Control Switch	Operation of this switch alternately energizes and deenergizes system power.	Switch
POS UNC	Position Uncertainty	System is operating in difference frequency mode.	Indicator Light
SYNC	Synchronization Mode	System is in synchronization mode.	Indicator Light
AMB	Position Ambiquity	Number of Kalman state vectors is greater than one.	Indicator Light
SYSTEM MALF	System Malfunction	Self-test has detected an error/out of tolerance condition.	Indicator Light
RATE AID FAIL	Rate Aid Failure	Any rate aid or heading input out of tolerance, or invalid situation.	Indicator Light
PANEL HOLD	Display data is held in time	Push ON, push OFF for display of unchanged instantaneous data after selecting from the following: 1. Aircraft position (POS) 2. Bearing-Range (BRG-RNG) 3. Course-Estimate Time Enroute (COURSE/ETE) 4. Cross Track Error (CTE) 5. Track Angle-Groundspeed (TRACK/G-SPEED) 6. Date-Greenwich Mean Time (DATE/GMT)	Switch-Indicator
NONE (Upper left display)	- -	Displays selected Omega station (A, B, C, D, E, F, G or H), or hemisphere (N or S).	Indicator

TABLE IVA (continued)

NONE (Upper right display)	- -	Displays selected Omega station (A, B, C, D, E, F, G or H), hemisphere (E or W), or direction (L or R).	Indicator
NONE (Lower left display)	- -	Displays up to 6 digits, decimal, and degree sign.	Indicators
NONE (Lower right display)	- -	Displays up to 6 digits, decimal, and degree sign.	Indicators
DIM	Dim panel lighting	Varies intensity of the front panel indicators.	Potentiometer
PANEL TEST	Test Control - Indicator panel indicators/readouts	Intiates test sequence which lights all panel indicators/readouts in a predetermined manner.	Switch-Indicator
CLEAR/DISPLAY	Clears programmed displays /Initiates display sequence	Pressing Clear when ON, causes Display and Insert only to be lighted and removes data from digital displays. Returns ON once Display or Insert sequence has been initiated. When Display is ON, the display sequence may be initiated by switch.	Switch-Indicator
ACCEPT/INSERT	Accepts inserted data/ Initiates insertion sequence	Pressing Accept when lighted, transfers data from entry routines to computational routines. Pressing Insert when lighted, intiates the entry sequence.	Switch-Indicator
ET	Enter Time	Informs operator that new date and time have not been entered since turn on. The indicator will go out when date and time are entered.	Indicator Light
EP	Enter Position	Informs operator that new aircraft position has not been entered since turn on. The indicator will go out when new position is entered.	Indicator Light

TABLE IVA (continued)

		INSERT	DISPLAY	
TAS/N/POS	TAS = True Air Speed	Selects True Air Speed System as rate aid source.	True Air Speed System selected as rate aid source if lighted.	Switch-Indicator
	N = North	Selects direction of input data.	Direction of input data.	
	POS = Position of aircraft	Initial position of aircraft. Fixpoint of aircraft.	Present position of aircraft.	
1/A/STATUS	1 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	A = Omega Station A	Omega Station A de-selection.	Associated with LOP display in pair selection.	
	STATUS = System Status	Allows operator to select: Various velocity and heading sources depending on computer program implementation	During Sync mode (SYNC status light on) number from 0-99 defines the synchronization process in terms of percentage complete. After Sync mode complete (SYNC status light out) numbers (for each OMEGA station A-H) denote relative signal strength received. Numbers range from 0-9 with 9 being max. signal strength	

TABLE IVA (continued)

		INSERT	DISPLAY	
1/A/STATUS (continued)	STATUS (continued)	Allows operator to manually deselect Omega stations A-H	Displays various velocity and heading sources depending on computer program implementation	
2/B/RZ-VEL	2 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point	Switch-Indicator
	B = Omega Station B	Omega Station B de-selection.	Associated with LOP display in pair selection	
	RZ-VEL = Moving Destination Velocity and Heading	Velocity and heading of rendezvous vehicle (Used with RZ-POS only).	Stored velocity and heading of RZ.	
3/C/RZ-POS	3 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	C = Omega Station C	Omega Station C deselection	Associated with LOP display in pair selection.	
	RZ-POS=Current Position of rendezvous vehicle	Current Position of rendezvous vehicle	Stored position of rendezvous vehicle	
HRS/W/BRG/RNG	HRS = Attitude Heading Reference System (AHRS) Heading	Selects heading from AHRS.	AHRS heading selected as system heading reference if lighted.	Switch-Indicator

TABLE IVA (continued)

		INSERT	DISPLAY	
HRS/W/BRG/RNG (continued)	W = West	Selectd direction of input data.	Direction of input data.	
	BRG/RNG = Bearing-Range	- - -	Computed Great Circle bearing (Mag) and distance from aircraft position to selected destination (Up to 10 fixed and 1 moving destination)	
4/D/COURSE/ETE	4 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	D = Omega Station D	Omega Station D deselection.	Associated with LOP display in pair selection	
	COURSE/ETE = Course (True)-Estimated Time Enroute	-------	Computed Great Circle course (true to selected destination and estimated time enroute, based upon current velocity to selected destination. (Up to 10 fixed and 1 moving destinations).	
5/E/DATE/GMT	5 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	E = Omega Station E	Omega Station E deselection.	Associated with LOP display in pair selection	

TABLE IVA (Continued)

		INSERT	DISPLAY	
5/E/DATE/GMT (continued)	DATE/GMT = Date and Greenwich Mean Time	Calendar year and Greenwich Time for use in OMEGA propagation prediction.	Current date and time.	
6/F/LOP	6 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point	Switch-Indicator
	F = Omega Station F	Omega Station F deselection.	Associated with LOP display in pair selection.	
	LOP = Line of Position	- - -	Hyperbolic line-of-position (uncorrected) of selected station pair (For display purposes 2 station pairs are selected from stations A-H). LOP is based upon lower lettered station minus higher lettered station.	
RZ/E/DEST-POS	RZ = Rendezvous	----------	Displayed data is associated with rendezvous point.	Switch-Indicator
	E = East	Selects direction of input data.	Direction of input data.	

TABLE IVA (continued)

		INSERT	DISPLAY	
RZ/E/DEST-POS (continued)	DEST-POS=Destination Position	Position of selected destination (up to 10 fixed destination points).	Stored position of selected destination.	
7/G/WIND	7 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed Destination Point.	Switch-Indicator
	G = Omega Station G	Omega Station G de-selection.	Associated with LOP display in pair selection.	
	WIND = Wind Velocity and Direction	- - -	Computed value of wind based upon difference between computed ground speed & TAS input.	
8/H/CTE	8 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	H = Omega Station H	Omega Station H de-selection.	Associated with LOP in pair selection.	
	CTE = Cross Track Error	- - -	Computed perpendicular distance from the desired track (between any two specified destination points).	
9/DOP/FOP	9 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	DOP = Doppler Radar Velocities	Selects doppler radar velocities as rate aid.	Doppler radar velocities selected as rate aid source if lighted	

TABLE IVA (continued)

		INSERT	DISPLAY	
9/DOP/FOP (continued)	FOP = Fixed Offset Position	Bias to A/C POS. Used when operator knows a fixed offset position exists in a localized area. (Bias applied to A/C position display only).	Stored offset position for aircraft position. (Value initialized to zero at entry of date and time).	
Ø/S/TRACK/ G-SPEED	Ø = Data or Fixed Destina-Point	Numeric data, fixed destination.	Fixed Destination Point.	Switch-Indicator
	S = South	Selects direction of data.	Direction of input data.	
	TRACK/G-SPEED =	- - -	Computed angle measured from true North to a line representing the track the aircraft is making good. Current computed speed of the aircraft along the track made good.	

TABLE IVB- CONTROL-INDICATOR FUNCTIONS ID-1776/ARN-99(V)

LEGEND	MEANING	DESCRIPTION	DEVICE TYPE
POWER	400 Hz Power Control Switch	Operation of this switch alternately energizes and deenergizes system power.	Switch
POS UNC	Position Uncertainty	System is operating in difference frequency mode.	Indicator Light
SYNC	Synchronization Mode	System is in synchronization mode.	Indicator Light
AMB	Position Ambiquity	Number of Kalman state vectors is greater than one.	Indicator Light
SYSTEM MALF	System Malfunction	Self-test has detected an error/out of tolerance condition.	Indicator Light
RATE AID FAIL	Rate Aid Failure	Any rate aid or heading input out of tolerance, or invalid situation.	Indicator Light
PANEL HOLD	Display data is held in time	Push ON, push OFF for display of unchanged instantaneous data after selecting from the following: 1. Aircraft position (POS) 2. Bearing-Range (BRG-RNG) 3. Course-Estimate Time Enroute (COURSE/ETE) 4. Cross Track Error (CTE) 5. Track Angle-Groundspeed (TRACK/G-SPEED) 6. Date-Greenwich Mean Time (DATE/GMT)	Switch-Indicator
NONE (Upper left display)	- -	Displays selected Omega station (A, B, C, D, E, F, G or H), or hemisphere (N or S).	Indicator

TABLE IVB (continued)

NONE (Upper right display)	- -	Displays selected Omega station (A, B, C, D, E, F, G or H), hemisphere (E or W), or direction (L or R).	Indicator
NONE (Lower left display)	- -	Displays up to 6 digits, decimal, and degree sign.	Indicators
NONE (Lower right display)	- -	Displays up to 6 digits, decimal, and degree sign.	Indicators
DIM	Dim panel lighting	Varies intensity of the front panel indicators.	Potentiometer.
PANEL TEST	Test Control - Indicator panel indicators/readouts	Intiates test sequence which lights all panel indicators/readouts in a predetermined manner.	Switch-Indicator
CLEAR/DISPLAY	Clears programmed displays /Initiates display sequence	Pressing Clear when ON, causes Display and Insert only to be lighted and removes data from digital displays. Returns ON once Display or Insert sequence has been initiated. When Display is ON, the display sequence may be initiated by switch.	Switch-Indicator
ACCEPT/INSERT	Accepts inserted data/ Initiates insertion sequence	Pressing Accept when lighted, transfers data from entry routines to computational routines. Pressing Insert when lighted, intiates the entry sequence.	Switch-Indicator
ET	Enter Time	Informs operator that new date and time have not been entered since turn on. The indicator will go out when date and time are entered.	Indicator Light
EP	Enter Position	Informs operator that new aircraft position has not been entered since turn on. The indicator will go out when new position is entered.	Indicator Light

TABLE IVB (continued)

		INSERT	DISPLAY	
INS/N/POS	INS = Inertial Navigation	Selects Inertial Navigation System as rate aid source.	Inertial Navigation System selected as rate aid source if lighted.	Switch-Indicator
	N = North	Selects direction of input data.	Direction of input data.	
	POS = Position of aircraft	Initial position of aircraft. Fixpoint of aircraft.	Present position of aircraft.	
1/A/STATUS	1 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	A = Omega Station A	Omega Station A de-selection.	Associated with LOP display in pair selection.	
	STATUS = System Status	Allows operator to select: Various velocity and heading sources depending on computer program implementation	During Sync mode (SYNC status light on) number from 0-99 defines the synchronization process in terms of percentage complete. After Sync mode complete (SYNC status light out) numbers (for each OMEGA station A-H) denote relative signal strength received. Numbers range from 0-9 with 9 being max. signal strength.	

TABLE IVB (continued)

		INSERT	DISPLAY	
1/A/STATUS (continued)	STATUS (continued)	Allows operator to manually deselect Omega stations A-H	Displays various velocity and heading sources depending on computer program implementation	
2/B/M-HDG	2 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point	Switch-Indicator
	B = Omega Station B	Omega Station B de-selection.	Associated with LOP display in pair selection	
	M-HDG = Manual Heading	Manual Heading	Manual Heading in Operation.	
3/C/M-VEL	3 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	C = Omega Station C	Omega Station C deselection	Associated with LOP display in pair selection.	
	M-VEL = Manual Velocity	Manual Velocity	Manual Velocity in Operation	
HRS/W/BRG/RNG	HRS = Attitude Heading Reference System (AHRS) Heading	Selects heading from AHRS	AHRS heading selected as system heading reference if lighted	Switch-Indicator

TABLE IVB (continued)

		INSERT	DISPLAY	
HRS/W/BRG/RNG (continued)	W = West	Selected direction of input data.	Direction of input data.	
	BRG/RNG = Bearing-Range	- - -	Computed Great Circle bearing (Mag) and distance from aircraft position to selected destination (Up to 10 fixed destination points)	
4/D/COURSE/ETE	4 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	D = Omega Station D	Omega Station D deselection.	Associated with LOP display in pair selection	
	COURSE/ETE = Course (True)-Estimated Time Enroute	----------	Computed Great Circle course (true to selected destination and estimated time enroute, based upon current velocity to selected destination. (Up to 10 fixed destination points)	
5/E/DATE/GMT	5 = Data or Fixed Destination Point	Numerica data, fixed destination point	Fixed destination point.	Switch-Indicator
	E = Omega Station E	Omega Station E deselection.	Associated with LOP display in pair selection	

TABLE IVB (continued)

		INSERT	DISPLAY	
5/E/DATE/GMT (continued)	DATE/GMT = Date and Greenwich Mean Time	Calendar year and Greenwich Time for use in OMEGA propagation prediction.	Current date and time.	
6/F/LOP	6 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point	Switch-Indicator
	F = Omega Station F	Omega Station F deselection.	Associated with LOP display in pair selection	
	LOP = Line of Position	- - -	Hyperbolic line-of-position (uncorrected) of selected station pair (For display purposes 2 station pairs are selected from stations A-H). LOP is based upon lower lettered station minus higher lettered station.	
GRD/E/DEST-POS	GRD = Grid	Grid, Mode, Navigation	Grid Mode now in Operation	Switch-Indicator
	E = East	Selects direction of input data	Direction of input data	

TABLE IVB (continued)

		INSERT	DISPLAY	
GRD/E/DEST-POS (continued)	DEST-POS=Destination Position	Position of selected destination (up to 10 fixed destination points).	Stored position of selected destination.	
7/G/WIND	7 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed Destination Point.	Switch Indicator
	G = Omega Station G	Omega Station G de-selection.	Associated with LOP display in pair selection.	
	WIND = Wind Velocity and Direction	- - -	Computed value of wind based upon difference between computed ground speed & TAS input.	
8/H/CTE	8 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	H = Omega Station H	Omega Station H de-selection.	Associated with LOP in pair selection.	
	CTE = Cross Track Error	- - -	Computed perpendicular distance from the desired track (between any two specified destination points).	
9/HLD/MAN H-V	9 = Data or Fixed Destination Point	Numeric data, fixed destination point.	Fixed destination point.	Switch-Indicator
	HLD = Hold Heading	Hold Heading	----------	

TABLE IVB (continued)

		INSERT	DISPLAY	
9/ HLD/MAN H-V (continued)	MAN-HV = Manual Heading and Velocity	Manual Heading and Velocity	Manual Heading and Velocity in Operation.	
Ø/S/TRACK/ G-SPEED	Ø = Data or Fixed Destina-Point	Numeric data, fixed destination.	Fixed Destination Point.	Switch-Indicator
	S = South	Selects direction of data.	Direction of input data.	
	TRACK/G-SPEED =	- - -	Computed angle measured from true North to a line representing the track the aircraft is making good.	
			Current computed speed of the aircraft along the track made good.	

3.5.2.5 Functional Characteristics - The Unit provides the capability of entering and displaying data for the Navigational Set.

3.5.2.5.1 Input Characteristics -

(a) Geodetic latitude and longitude coordinates of present position within a resolution of a tenth of a minute.

(b) Eleven Way Points (10 Way Points for AN/ARN-99(V)4) in latitude and longitude coordinates, each to within a resolution of a tenth of a minute.

(c) Calendar date and Greenwich Mean Time to within a resolution of one second.

(d) Ground speed to a one knot resolution and track angle to a one degree resolution for a moving destination, the latter being one of the selected destination points (AN/ARN-99(V)2 only).

(e) Fixed position correction to a tenth nautical mile resolution (see also paragraph 3.4.10) (AN/ARN-99(V)2 only).

(f) Code to select Magnetic/DG heading mode.

3.5.2.5.2 Output Characteristics - The OMEGA Navigational Set shall provide the following outputs which are to be selected and displayed at the option of the operator via the Control-Indicator. These outputs shall be integrated to provide a smooth readout.

(a) Geodetic latitude to within a resolution of a tenth of a minute.

(b) Geodetic longitude to within a resolution of a tenth of a minute.

(c) Great circle bearing (magnetic) to a preselected destination, or intercept point (AN/ARN-99(V)2 only), to within a resolution of one degree.

(d) Great circle range to a preselected destination, or intercept point (AN/ARN-99(V)2 only), to within a resolution of a tenth of a nautical mile.

(e) Computed and integrated ground speed to within a resolution of one knot.

(f) Computed and integrated wind speed and direction (true) to within a resolution of one knot or one degree, as applicable.

(g) Course (true) to selected destination to a resolution of one degree.

(h) Computed Track Angle (measured from True North) to a resolution of one degree.

(i) Estimated Time Enroute to selected destination within a resolution of one minute.

(j) Cross Track Error between any two selected destination points to a resolution of one tenth of a nautical mile.

(k) Lane Count, i.e., any two selected 10.2 kHz lanes, to within a resolution of one cec without VLF propagation corrections.

(l) Calendar data and Greenwich Mean Time. Year (0-99), Month (1-12), Day (1-31), and time to a resolution of one second.

3.5.2.6 Contents

3.5.2.6.1 Controls - The Unit shall provide for the functional selection of OMEGA controls, navigation control, Insert/Display, and keyboard control, and shall conform to the requirements of MIL-STD-203 and MIL-STD-250.

3.5.2.6.2 OMEGA Controls - These controls will provide the appropriate interface for:

(a) Power, off-on. (Only the 400 Hz power is controlled by the Control Indicator)

(b) Panel test.

(c) Hold. It shall be possible to freeze data so that different displays referenced to a specific time may be presented.

(d) Dim panel lighting.

3.5.2.6.3 Navigation Controls - These controls will provide for:

Selecting the destination to which the aircraft will be manually steered.

3.5.2.6.4 Insert/Display - These controls will provide selection of the parameters that are to be displayed or inserted into the computer.

Destination 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 - these positions will be used to insert and display the latitude, longitude, for the destinations. Range and bearing will be displayed for the position selected via the panel.

One rendezvous (moving destination) point may be inserted and displayed. (AN/ARN-99(V)2 only)

3.5.2.6.5 Keyboard - A keyboard shall be provided which shall provide for the selection of parameters to be inserted or displayed. Keyboard pushbutton characteristics and visual verification shall conform to MIL-C-81774. The paramters to be inserted shall be:

3.5.2.6.5.1 ID- /ARN-99(V)

(a) Latitude (N and S)
(b) Longitude (E and W)
(c) Greenwich Mean Time (GMT) and Date
(d) Fixed (FOP) Offset Position
(e) Rendezvous velocity and heading

3.5.2.6.5.2 ID-1776/ARN-99(V)

(a) Latitude (N and S)
(b) Longitude (E and W)
(c) Greenwich Mean Time (GMT) and Date
(d) Manual Heading
(e) Manual Velocity
(f) Manual Heading and Velocity
(g) Grid Mode Navigation

3.5.2.6.6 Displays - Data shall be displayed in two simultaneous decimal displays adequate to provide the resolution specified in paragraph 3.5.2.5. Punctuation in terms of decimal markers, angular degrees, shall be provided according to the type of information being displayed. The display shall be updated at least every second. The brightness of the display shall be variable through a dimming control.

3.5.2.6.6.1 Paired Displays - The parameters to be selected and displayed in pairs shall be:

3.5.2.6.1.1 ID- /ARN-99(V)

(a) Latitude and Longitude (POS) (DEST-POS) (RZ-POS)
(b) Bearing and Range to Destination (BRG-RNG)
(c) Track Angle and Ground Speed (TRACK/G-SPEED)
(d) True Course and Estimated Time Enroute (COURSE/ETE)
(e) Date and Greenwich Mean Time (DATE/GMT)
(f) Heading and Velocity of Moving Destination (RZ-VEL)
(g) N-S Offset and E-W Offset (FOP)
(h) Any two LOPs can be displayed at one time
(i) All station signal levels based on (0-9) relative scale
(j) Integrated Wind velocity and direction (WIND)

3.5.2.6.6.1.2 ID-1776/ARN-99(V)

(a) Latitude and Longitude (POS) (DEST-POS)
(b) Bearing and Range to Destination (BRG-RNG)
(c) Track Angle and Ground Speed (TRACK/G-SPEED)
(d) True Course and Estimated Time Enroute (COURSE/ETE)
(e) Date and Greenwich Mean Time (DATE/GMT)
(f) Any two LOPs can be displayed at one time
(g) All station signal levels based on (0-9) relative scale
(h) Integrated wind velocity and direction (WIND)
(i) Manual Velocity and Heading (MAN H-V)

3.5.2.6.7 Indicators - Separate indicators shall be provided to indicate the following information and faults:

(a) System Malfunction

(b) Position Uncertainty

(c) OMEGA Ambiguity

(d) Failure of Rate Aids

(e) Synchronization in process

The unit shall use a Class 2-W integrally illuminated panel meeting the requirements of Specification MIL-P-7788. The legends on the switches, lights and displays, except the "SYSTEM MALF", "POS UNC", "RATE AID FAIL", "SYNC" and "AMB" status lights, shall employ translucent aviation green color in accordance with Specification MIL-C-25050, and an opaque background in accordance with Specification MIL-STD-411. "SYNC", "SYSTEM MALF", "POS UNC", "RATE AID FAIL" and "AMB" legends shall employ translucent aviation yellow color meeting the requirements of Specification MIL-C-25050 and an opaque background in accordance with Specification MIL-STD-411. The alphanumeric displays shall be incandescent white with a green filter.

3.5.2.6.8 Electrical Connections - Connections to external circuits shall be provided as follows:

Reference Designation	Receptacle Type	Function
3J1	M81511/01ED02P1	Connects to Receiver-Computer Group
3J2	M81511/02HB02P1 or M81511/02GB02P1	Power

3.5.2.7 Panel Configuration - The configuration of the Control-Indicator shall be according to Figure 5A for ID-1776/ARN-99(V) and Figure 5B for ID- /ARN-99(V) and shall meet human factor requirements as specified in MIL-STD-1472.

3.5.3 Antenna-Couplers AS-2623/ARN-99(V) and AS-2623A/ARN-99(V)

3.5.3.1 Functional Requirements - The function of the Antenna Couplers AS-2623/ARN-99(V) and AS-2623A/ARN-99(V) is to provide reception, coupling and amplification of the OMEGA VLF transmissions for the Receiver-Computer Group.

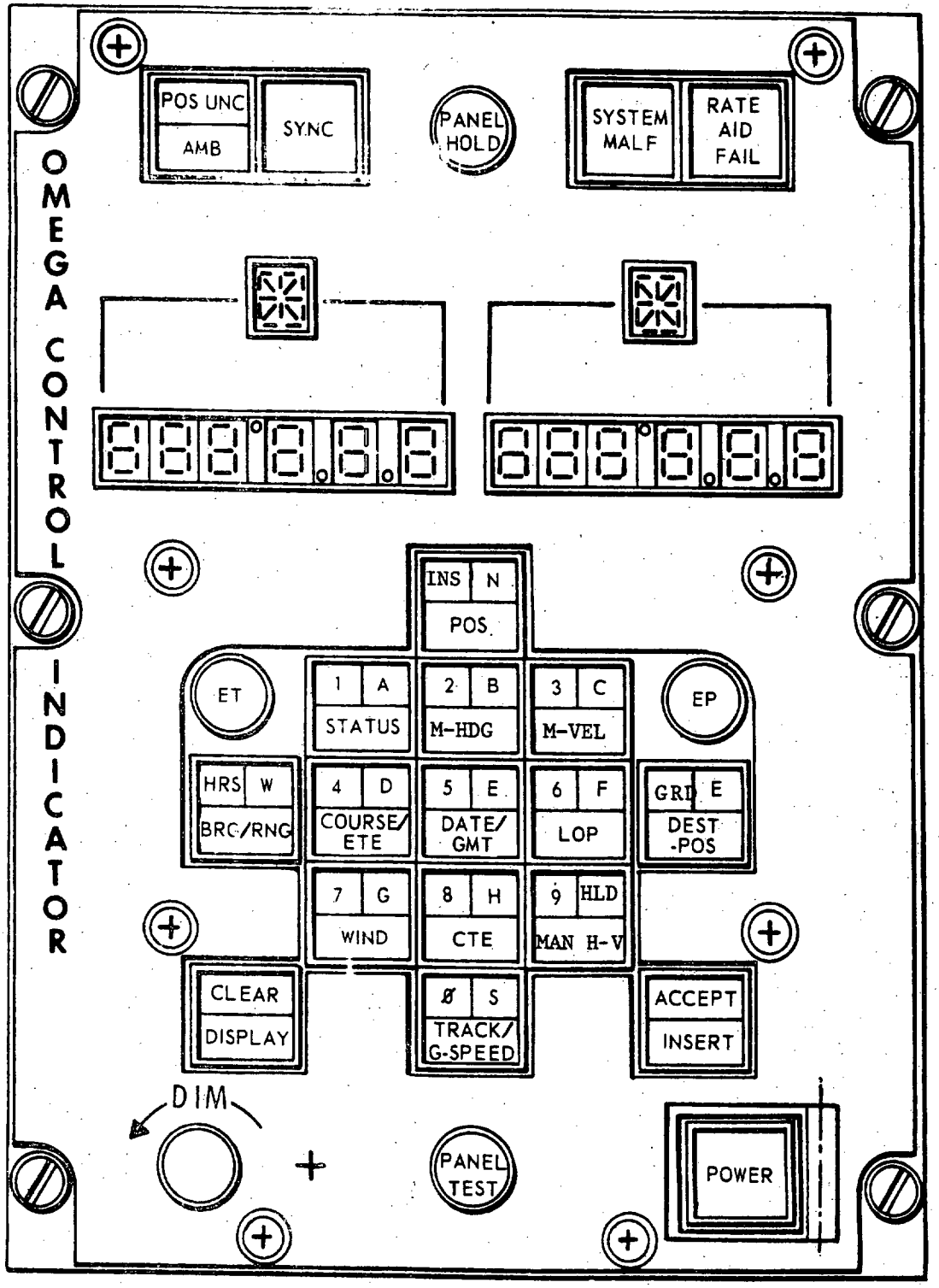


FIGURE 5A- CONTROL-DISPLAY UNIT, NAVIGATORS ID-1776/ARN-99(V)

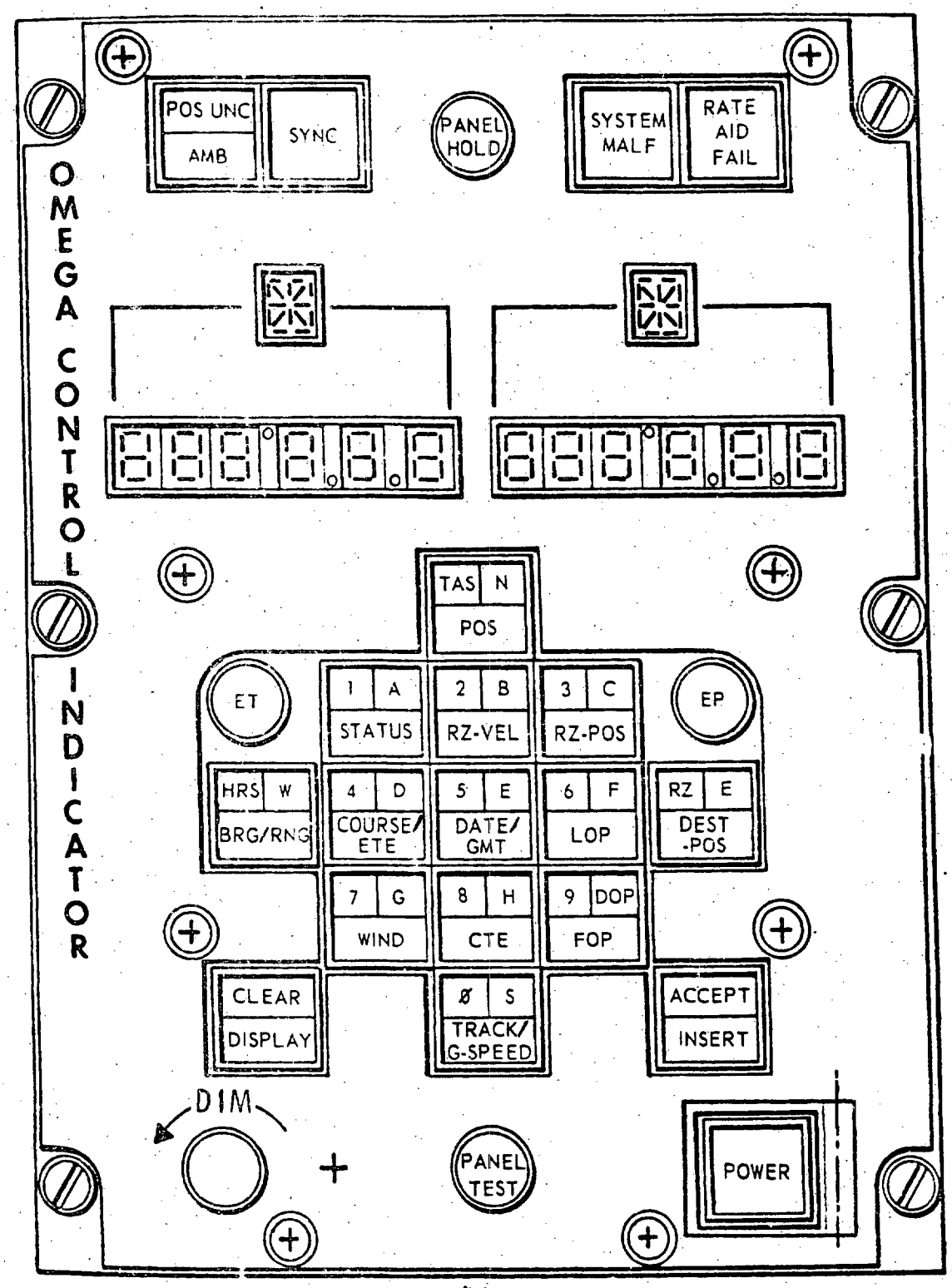


FIGURE 5B - CONTROL-DISPLAY UNIT, ID- /ARN-99(V)

3.5.3.1.1 Characteristics - The characteristics of the Antenna-Coupler are:

(a) Operating frequency - 10 kHz to 14 kHz

(b) Sensitivity - When subjected to random noise of $7\mu V/M(Hz)^{1/2}$ the input circuitry and preamplifier noise shall add less than 10% to the resultant noise output.

(c) Sensing elements - 4 ferrite core inductors forming two orthogonal lobe patterns.

(d) Effective height - Greater than 10 meters on each loop.

(e) Antenna pattern - $\pm 45^{\circ}$ to half power points on each loop.

(f) E field rejection - Greater than 50 dB on each loop.

(g) Null depth - Maximum to minimum ratio greater than 23 dB on each loop.

(h) Phase shift - Maximum phase shift change of 5 cec on each loop.

3.5.3.1.2 Power - Power for the Antenna-Coupler shall be +13V dc provided by the Receiver-Computer Group and shall not exceed 0.6 watt.

3.5.3.1.3 Antenna-Coupler Output - The output of each loop shall be two wires, balanced with respect to ground at an impedance not exceeding 260 ohms.

3.5.3.1.4 Loop Orientation - The output of the two loops shall be arranged such that the in-phase lobe (labeled +A) shall be at an angle of -135° from forward pointing corner, and the other lobe (labeled +B) at -45° from the same forward pointing corner.

(Note: The above assumes that the antenna is located on the bottom side of the aircraft and the + angles are measured clockwise (- angles measured counterclockwise) when viewed from above.)

3.5.3.2 Form Factor - The form factor of the Antenna-Coupler, exclusive of the connector, shall not exceed 6.30 inches, by 6.30 inches, by 2.00 inches centered on a 9.00 ± 0.04 inch maximum diameter by 0.125-inch thick circular mounting plate integral with the Antenna-Coupler.

3.5.3.3 Weight - The weight of the Antenna-Coupler shall not exceed 2.85 pounds.

3.5.3.4 Contents - The Antenna-Coupler shall contain a pair of orthogonally mounted ferrite rod loops and integral preamplifiers. The assembly shall be shielded through use of a Faraday screen. The AS-2623A/ARN-99(V) Antenna-Coupler in addition to the foregoing has a spark gap across each pair of inductors to reduce the possibility of damage to the Antenna-Coupler from high energy inputs caused by lightning.

3.5.3.5 Interconnection - The Antenna-Coupler shall interconnect with the Receiver-Computer Group through the following connector:

Designator	Receptacle Type	Function
2J1	M81511/04HB01P1	Power and Signals

3.5.3.6 Cabling - The Antenna-Coupler shall operate satisfactorily with the Receiver-Computer Group as long as the interconnecting cable has a length not exceeding one hundred feet.

3.5.4 Mounting Base - MT-4738/ARN-99(V)

3.5.4.1 Functional Requirements - The mounting base shall provide dynamic isolation for the Receiver-Computer Group from the vehicle.

3.5.4.2 Form Factor - The dimensions shall conform to the Class A or B mounting base dimensions of Specification MIL-C-172.

3.5.4.3 Weight - The weight of the mounting base shall not exceed 6.9 pounds.

3.6 Computer Programming Documentation - All Computer Programming documentation shall be in accordance with Weapons Specification WS-8506.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection - Unless otherwise specified, the supplier is responsible for the performance of all test requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the tests set forth in the specification where such tests are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Classification of Tests - Items covered by this specification shall be subjected to the following tests to determine compliance with all applicable requirements:

(a) Preproduction (First Article) Tests

(b) Initial Production Tests

(c) Acceptance Tests

(d) Life Tests

4.2 Preproduction (First Article)Tests - Preproduction tests shall be conducted by the contractor on an equipment representative of the production equipments to be supplied under the contract. Preproduction tests shall be accomplished under the approved test procedure of 4.6. The Government inspector and procuring activity shall be advised when tests are to be conducted so that a government representative may be designated to witness or supervise the tests when so desired. Contractors not having adequate facilities to conduct all required tests shall obtain the services of a commercial testing laboratory acceptable to the Government.

4.2.1 Preproduction (First Article)Test Data - The contractor shall submit all data collected in conducting these tests to the procuring activity for review.

4.2.2 Scope of Tests - Preproduction tests shall include all tests deemed necessary by the procuring activity to determine that the equipment meets all the requirements of this specification, other applicable specifications and the contract. Preproduction tests shall include environmental tests in accordance with the procedures of Specification MIL-T-5422.

Tests and evaluation in accordance with Section 4, Quality Assurance Provisions of Specification AR-10 shall be included in the preproduction tests.

4.2.3 Preproduction (First Article)Approval - Approval of the preproduction sample shall be by the procuring activity upon satisfactory completion of all tests. No production equipments shall be delivered prior to the approval of the preproduction sample. Prefabrication of production equipment prior to the approval of the preproduction sample is at the contractor's own risk. The approved preproduction sample shall be retained by the contractor for his use in the fabrication and testing of equipment to be submitted for acceptance. The preproduction sample shall not be considered as one of the equipments under the contract.

4.2.4 Production Equipments - Equipments supplied under the contract shall in all respects, including design, construction, workmanship, performance and quality, be equivalent to the approved preproduction sample. Each equipment shall be capable of successfully passing the same tests as imposed on the preproduction sample. Evidence of non-compliance with the above shall constitute cause for rejection and for equipment already accepted by the Government, it shall be the obligation of the contractor to make necessary corrections as approved by the procuring activity.

4.3 Initial Production Tests - One of the first ten production equipments shall be selected and sent at the contractor's expense to a designated Government laboratory for tests. This equipment shall be selected by the procuring activity after the equipment has successfully passed all individual tests. No other tests shall be conducted on equipment prior to starting the Initial Production Tests. The preproduction sample shall not be selected for this test.

4.3.1 Scope of Tests - This equipment may be subjected to any and all tests the procuring activity deems necessary to assure that the production equipment is equivalent to the previously approved pre-production sample in design, construction, workmanship, performance and quality and that it meets all applicable requirements.

4.3.2 Accessory Material - In addition to the complete equipment submitted for Initial Production Tests, the contractor shall also submit such accessory material and data necessary to test the equipment.

4.3.3 Initial Production Sample Approval - Approval of the Initial Production Sample shall be by the procuring activity upon satisfactory completion of all tests. Any design, material or performance defect made evident during this test shall be corrected by the contractor to the satisfaction of the procuring activity. Failure of the Initial Production Sample to pass any of the tests shall be cause for deliveries of equipment under the contract to cease until proper corrective action is approved and accomplished. Corrective action shall also be accomplished on equipment previously accepted when requested by the procuring activity.

4.3.4 Reconditioning of Initial Production Test Sample - On completion of the initial production test the equipment shall be reworked by the contractor by replacing all limited life or damaged items. After reworking, the contractor shall resubmit the equipment for acceptance.

4.4 Acceptance Tests - The contractor shall furnish all samples and shall be responsible for accomplishing the acceptance tests. All inspection and testing shall be under the supervision of the Government inspector. Contractors not having adequate facilities for conducting all required tests shall engage the service of a commercial testing laboratory acceptable to the procuring activity. The contractor shall furnish test reports showing quantitative results for all acceptance tests. Such reports shall be signed by an authorized representative of the contractor or laboratory, as applicable. Acceptance or approval of material during the course of manufacture shall not be construed as a guarantee of the acceptance of the finished product. Acceptance tests shall consist of the following:

(a) Individual Tests
(b) Sampling Tests
(c) Reliability Assurance Tests
(d) Special Tests.

4.4.1 Individual Tests - Each equipment submitted for acceptance shall be subjected to the individual tests. These tests shall be adequate to determine compliance with the requirements of material, workmanship, operational adequacy and reliability. As a minimum, each equipment accepted shall have passed the following tests:

(a) Examination of Product
(b) Operational Test
(c) Manufacturing Run in Test

4.4.1.1 Examination of Product - Each equipment shall be examined carefully to determine that the material and workmanship requirements have been met.

4.4.1.2 Operational Test - Each equipment shall be operated long enough to permit the equipment temperature to stabilize and to check sufficient characteristics and record adequate data to assure satisfactory equipment operation.

4.4.1.3 Manufacturing Run in Test - Each equipment shall be operated under the conditions specified herein for a period of ten hours without failure. A failure shall be defined as anything which causes malfunctioning of the equipment. Only those adjustments will be permitted which can be made by using such controls and adjustments that are accessible to the operator during the normal use of the equipment. This test shall be deleted if the reliability test includes a test on each equipment which consumes at least ten hours of operation.

Temperature:	Ambient room
Humidity:	Ambient room
Vibration:	Any selected frequency within the range of 20 to 30 cps (excluding resonant points) and a minimum amplitude of ± 3 g's.

The equipment shall be vibrated (without vibration isolators) for a period of ten minutes prior to the beginning of the ten-hour period of operation. Where feasible, the equipment shall be operated during this vibration period for the purpose of detecting flaws and imperfect workmanship. Operation within the specified limits of satisfactory performance is not necessarily required during the vibration period. The direction of vibration should be vertical to the normal mounting plane for five minutes and lateral to the plane for five minutes. Where it is not feasible to vibrate the equipment in two directions the vertical direction shall be used. During the ten-hour period of operation following the ten-minute vibration period, the equipment shall be mechanically cycled periodically through its various phases of operation. Should a failure occur, it should be repaired and the test started over, except that the ten-minute vibration period need not be repeated when it is certain the failure was not a result of the vibration. Should repetitive failures occur, corrective action shall be taken to eliminate this defect from future equipment. A record shall be kept of all failures. The ten-hour period specified above may be composed of two five-hour periods to conform with standard working hours.

4.4.2 Sampling Tests - Equipments selected for sampling tests shall first have passed the individual tests. Equipments shall be selected for sampling tests by the Government inspector in accordance with the following:

Quantity of Equipment Offered for Acceptance	Quantity to be Selected for Sampling Test
First 10	1*
next 50	1
next 75	1
next 100	1
	1 for each additional 200 or fraction thereof

*One out of first ten need not be selected and tested if initial production tests are conducted. Sampling Tests are not required when Reliability Assurance Tests are conducted.

4.4.2.1 Scope of Tests - As a minimum each equipment selected for sampling tests shall be subjected to the following tests:

(a) Complete operational test at ambient room conditions, making all necessary measurements to assure that all applicable specification requirements have been met.

(b) Operational test at certain environmental conditions. The conditions may vary for each equipment tested and should be based on results of the preproduction, initial production, individual and special tests.

(c) Manufacturing run in test specified in 4.4.1.3, except that the test duration shall be 120 hours with no restriction on the number of failures. However, each failure shall be analyzed as to cause and remedial action necessary to reduce the possibility of its recurrence in future equipment.

4.4.3 Reliability Assurance Tests - Reliability Assurance Tests shall be conducted using MIL-STD-781. Tests as required by both the Qualification Phase and the production Acceptance (Sampling) Phase shall be conducted. Classification of failure shall be in accordance with MIL-STD-781 and AR-34.

4.4.3.1 Qualification Phase - Prior to the acceptance of equipments under the contract or order, a minimum of three (3) equipments shall be tested as outlined in MIL-STD-781, under the section entitled "Qualification Phase of Production Reliability Tests". The maximum number of equipments to be used shall be those listed in Table 5 of MIL-STD-781. For the Qualification Phase, Test Level E shall be used. The Accept-Reject Criteria for Test Plan IV shall be used.

4.4.3.2 Reliability Production Acceptance Phase Tests - The equipment, throughout production, shall be tested as outlined in MIL-STD-781 (as modified herein) under the section entitled "Production Acceptance (Sampling) Phase of Production Reliability Tests", except that all equipments produced shall be tested. Test Level E of MIL-STD-781 shall be used.

4.4.3.2.1 All Equipment Test - Each equipment produced, except those submitted for the Reliability Qualification Test, shall be tested for 100 hours. Prior to the 100-hour test on each equipment, a burn-in period may be used at the option of the contractor. If the burn-in period is to be used; the details thereof must be included in the approved test procedures. To determine whether the MTBF is being met at any time during the contract the operating test hours and failures thereon (not counting burn-in failures or burn-in operating time) shall be totaled and the results compared with the reject line of Test Plan II of MIL-STD-781. (Extend the line as necessary to accommodate the data.) These totals shall accumulate so that at any one time the experience from the beginning of the contract is included. At the conclusion of each month the test results shall be sent to the procuring activity and to the Naval Air Systems Command, Attention: Avionics Division. At any time that the current totals of test hours and test failures plotted on Test Plan II curves show a reject situation, the procuring activity shall be notified. The procuring activity reserves the right to stop the acceptance of equipment at any time that a reject situation exists pending a review of the contractor's efforts to improve the equipment, the equipment parts, the equipment workmanship, etc., so that the entire compilation will show other than a reject decision.

4.4.3.3 Test Details - The test details such as the length of the test cycle, the length of the heat portion of the cycle, the performance characteristics to be measured, special failure criteria, preventive maintenance to be allowed during the test, etc., shall be part of the test procedures to be submitted and approved by the procuring activity prior to the beginning of the Qualification Test Phase of the Reliability Assurance Tests.

4.4.4 Special Tests - Special tests shall be conducted for the purpose of checking the effect of any design or material change on the performance of the equipment and to assure adequate quality control. The equipment selected for special tests may be selected from equipments previously subjected to the sampling or reliability assurance tests.

4.4.4.1 Special Test Schedule - Selection of equipment for special tests shall be made as follows:

(a) On an early equipment after an engineering or material change.

(b) Whenever failure reports or other information indicate that additional tests are required. (This will be determined by the procuring activity.)

4.4.4.2 Scope of Tests - Special tests shall consist of such tests as approved by the procuring activity. Tests procedures previously approved for the preproduction tests shall be used where applicable. When not applicable, the contractor shall prepare a test procedure and submit it to the procuring activity for approval prior to conducting the tests.

4.4.5 Equipment Failure - Should a failure occur during either the sampling, reliability assurance or special tests, the following action shall be taken:

(a) Determine the cause of failure.

(b) Determine if the failure is an isolated case or design defect.

(c) Submit to the procuring activity for approval, proposed corrective action intended to reduce the possibility of the same failure(s) occurring in future tests.

(d) Where practical, include a test in the individual test to check all equipment for this requirement until reasonable assurance is obtained that the defect has been satisfactorily corrected.

4.5 Life Test - The contractor shall furnish all samples and shall be responsible for accomplishing the life tests. The test shall be of 300 hours duration and shall be conducted on equipments that have passed the individual test. The life test shall be performed under the conditions specified in 4.5.1. The life test sample shall be selected by the Government inspector in accordance with the following. (Equipments which have successfully passed the Initial Production Test, Sampling Tests, Reliability Tests, or Special Tests may be selected for life tests.) (Test Life accumulated during the Reliability Test may be counted toward the Life Test provided the entire 300 hours are accumulated on a single equipment and equipment selected is in accordance with the table below.)

Quantity of Equipments Offered for Acceptance	Quantity to be Selected for Life Test
First 25	1
next 175	1
next 300	1
	1 for each additional 500 or fraction thereof

4.5.1 Test Conditions - The life test shall be conducted under the following simulated service conditions:

Temperature:	Normal room
Altitude:	Normal ground (0-5,000 ft.)
Humidity:	Room ambient
AC Voltage:	115 ± 5 volts (at lowest applicable frequency)
DC Voltage:	27.5 ± 2.0 volts

4.5.2 Test Periods - The test may be run continuously or intermittently. Any period of operation shall be of sufficient duration to permit the equipment temperature to stabilize. Periodically the equipment shall be turned on and off several times and put through its various phases of operation.

4.5.3 Performance Check - At approximately eight-hour intervals during the test, a limited performance check shall be made. The performance check proposed by the contractor shall be subject to approval by the procuring activity.

4.5.4 Test Data - The contractor shall keep a daily record of the performance of the equipment, making particular note of any deficiencies or failures. In the event of part failures, the defective part shall be replaced and the operation resumed for the balance of the test period. A record shall be kept of all failures throughout the test. This record shall indicate the following:

(a) Part type number

(b) The circuit reference symbol number

(c) The part function

(d) Name of the manufacturer

(e) Nature of the failure

(f) The number of hours which the part operated prior to failure.

4.5.4.1 Failure Report - In the event of a failure, the Government inspector shall be notified immediately. A report shall be submitted to the procuring activity upon completion of test. In this report, the contractor shall propose suitable and adequate design or material corrections for all failures which occurred. The procuring activity will review such proposals and determine whether they are acceptable.

4.6 Test Procedures - The procedures used for conducting preproduction tests, acceptance tests and life tests shall be prepared by the contractor and submitted to the procuring activity for review and approval. The right is reserved by the procuring activity or the Government inspector to modify the tests or require any additional tests deemed necessary to determine compliance with the requirements of this specification or the contract.

Specification MIL-T-18303 shall be used as a guide for preparation of test procedures. When approved test procedures are available from previous contracts, such procedures will be provided and may be used when their use is approved by the procuring activity. However, the right is reserved by the procuring activity to require modification of such procedures, including additional tests, when deemed necessary.

4.7 Reconditioning of Tested Equipment - Equipment which has been subjected to initial production, acceptance and life tests shall be reconditioned by the contractor by replacing all worn or damaged items. After reworking, the contractor shall resubmit the equipmment for acceptance.

4.8 Presubmission Testing - No item, part or complete equipment shall be submitted by the contractor until it has been previously tested and inspected by the contractor and found to comply, to the best of his knowledge and belief, with all applicable requirements.

4.9 Rejection and Retest - Equipment which has been rejected may be reworked or have parts replaced to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished the Government inspector.

5. PREPARATION FOR DELIVERY

5.1 General - All major units and parts of the equipment shall be preserved, packaged, packed and marked for the level of shipment specified in the contract or order in accordance with Specifications MIL-E-17555 and MIL-STD-794. In the event the equipment is not covered in Specification MIL-E-17555, the method of preservation for Level A shall be determined in accordance with the selection chart in Appendix D of MIL-STD-794.

6. NOTES

6.1 Intended Use - The equipment derives information (from the OMEGA Ground Station VLF signals) which is utilized to determine the geographical position of the vehicle.

6.2 Ordering Data - Purchasers should exercise any desired options offered herein, and procurement documents should specify the following:

(a) Title, number, and date of this specification.

(b) Selection of applicable levels of packaging and packing (see 5.1).

6.3 Precedence of Documents - When the requirements of the contract, this specification, or applicable subsidiary specifications are in conflict, the following precedence shall apply:

(a) Contract - The contract shall have precedence over any specification.

(b) This Specification - This specification shall have precedence over all applicable subsidiary specifications. Any deviation from the specification, or from subsidiary specifications where applicable, shall be specifically approved in writing by the procuring activity.

(c) Referenced Specifications - Any referenced specification shall have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications shall apply to the extent specified.

6.4 Performance Objectives - Minimum size and weight, simplicity of operation, ease of maintenance, and an improvement in the performance and reliability of the specific functions beyond the requirements of this specification are objectives which shall be considered in the production of this equipment. Where it appears a substantial reduction in size and weight or improvement in simplicity of design, performance, ease of maintenance or reliability will result from the use of materials, parts and processes other than those specified in Specification MIL-E-5400, it is desired their use be investigated. When investigation shows advantages can be realized, a request for approval shall be submitted to the procuring activity for consideration. Each request shall be accompanied by complete supporting information.

6.5 Type Designations - The type designation may be modified by the procuring activity upon application by the contractor for assignment of nomenclature in accordance with 3.3.8. The correct type number shall be used on nameplates, shipping records and instruction books, as applicable.

6.6 Associated Equipment - The following is a list of equipments which have interface with the AN/ARN-99(V) OMEGA Navigational Set.

6.6.1 Velocity Measuring Equipment

AN/APN-153(V)	Doppler Radar Navigation Set	or equivalent
A/A24G-9	True Airspeed Computer Set	or equivalent
AN/ASN-42	Inertial Navigation System	or equivalent

6.6.2 Aircraft Heading

AN/ASN-50	Attitude-Heading Reference System or equivalent
AN/ASN-42	Inertial Navigation System or equivalent

6.7 Definition

6.7.1 Hyperbolic - Hyperbolic Line-of-Position is defined as the difference of the phase measurement from one station less the corresponding phase measurement from another station.

6.7.2 S/N - The S/N ratio is defined as the ratio of the root mean square voltage amplitude of a continuous sinusoidal signal matching the average amplitude of the signal voltage during an OMEGA transmission to the standard deviation of noise voltage as observed in a rectangular bandwidth of 100 Hz.

6.7.3 Mean of the Differences - The mean of the differences shall be computed as follows:

$$\bar{d} = \left(\frac{1}{24} \sum_{i=0}^{23} di \right),$$

where di = difference at the ith hour GMT (i=0, 1, 2 - - - 23).

6.7.4 Standard Deviation - The standard deviation shall be computed as follows:

$$\left[\frac{1}{24} \left(\sum_{i=0}^{23} (di - \bar{d})^2 \right) \right]^{1/2}$$

6.7.5 "cec" - The "cec" is a phase unit of angular measurement which means "centicycle", e.g., 1 cec = 1 percent of a cycle = 3.6 degrees = 4 grades or, approximately, 0.06283 radian.

6.7.6 Bandwidth - Unless otherwise stated, the bandwidth is defined for use in this specification as the -3dB bandwidth.

6.7.7 Reference Phase - The phase of the AC power system which furnishes the excitation for the sources of synchro and/or analog signals providing inputs to the AN/ARN-99(V).

6.8 This specification is under the cognizance of AIR-53353C.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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DOCUMENT IDENTIFIER AND TITLE

MIL-N-81678B(AS) Navigational Set, Omega AN/ARN-99(V)

NAME OF ORGANIZATION AND ADDRESS

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?

☐ YES ☐ NO *(If "Yes", in what way?)*

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