INCH-POUND
MIL-D-70789A (AR)
15 June 1992
SUPERSEDING
MIL-D-70789 (AR)
7 February 1989

MILITARY SPECIFICATION

DYNAMIC REFERENCE UNIT (DRU)

This specification is approved for use by the U.S. Army Armament,Munitions and Chemical Command, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements, examinations and tests for a self contained inertial surveying system for use in weapon and target acquisition systems (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these docukents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

MILITARY

MIL-S-5002	-	Surface Treatment and Inorganic Coatings for Metal Surfaces of Weapons Systems
MIL-B-5087	-	Bonding, Electrical and Lightning Protection for Aerospace Systems
MIL-E-6051	-	Electromagnetic Compatibility Requirements, Systems

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army ARDEC,ATTN: SMCAR-BACS, Picatinny Arsenal, New Jersey 07806-5000 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 1220

MIL-H-6875 - Heat Treatment of Steel, Processes for
MIL-M-7793 - Meter, Time Totalizing
MIL-P-11268 - Parts, Materials and Processes Used in Electronic Communications Equipment
MIL-F-13926 - Fire Control Material, Manufacture and Inspection, General Specification for
MIL-F-14072 - Finishes for Ground Electronic Equipment
MIL-P-14232 - Parts, Equipment and Tools for Army Material, Packaging of
MIL-P-19834 - Plate, Identification or Instruction, Metal Foil, Adhesive Backed, General Specification for
MIL-C-38999 - Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification for
MIL-C-46168 - Coating, Aliphatic Polyurethane, Chemical Agent Resistant
MIL-H-46855 - Human Engineering Requirements for Military Systems, Equipment and Facilities

STANDARDS

MILITARY

MIL-STD-109 - Quality Assurance Terms and Definitions
MIL-STD-130 - Identification Marking of U.S. Military Property
MIL-STD-454 - Standard General Requirements for Electronic Equipment
MIL-STD-461 - Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462 - Electromagnetic Interference Characteristics, Measurements of
MIL-STD-463 - Definition and Systems of Units, Electromagnetic Interference Technology
MIL-STD-781 - Reliability and Design Qualification and Production Acceptance Tests: Exponential Distribution
MIL-STD-810 - Environmental Test Methods and Engineering Guidelines
MIL-STD-1275 - Characteristics of 28 Volt DC Electrical Systems in Military Vehicles

MIL-STD-1472 - Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-1474 - Noise limits for Army Material

MS18012 - Handles, Metal, Spring-Bail Type
MS27467 - Connector, Plug, Electrical Straight, Crimp Type, Bayonet Coupling, Series I
MS27468 - Connector, Receptacle, Electrical Jam Nut Mounting, Crimp Type, Bayonet Coupling Series I

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawing, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues shall be those cited in the solicitation.

DRAWINGS

US ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

78020 Microcircuits, Linear Quad Differential Line Receivers, Monolithic Silicon
9396270 - Dynamic Reference Unit

PUBLICATIONS

TECOM Report 86-LR(V)-41 24 Sep 86 - Firing Test of M109E4 Howitzer

TECOM Report 86-LR(V)-41 10 Mar 87 - Firing Test of M109E4 Howitzer

TECOM Report 87-LR(V)-2 28 Jan 87 - Road Shock and Vibration Test of M109E4 Howitzer

TECOM Report 87-LR(V)-1 14 Jan 87 - Road Shock and Vibration Test of MAPS Hardware in M113A1

MANUALS

NUCLEAR AND CHEMICAL

Nuclear Survivability Criteria for the Modular Azimuth Position System (MAPS), equipment survivability category: man in truck or signal shelter, equipment exposed

NBC Contaminants Survivability Criteria for Army Materiel

(Copies of other Government documents, drawings and publications required by the contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Non-Government publications. The following document (s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIARS-422 - Electrical Characteristics of Balanced Voltage Digital Interface Circuits

(Application for copies should be addressed to: Electronic Industries Association, 2001 Eye Street NW, Washington, DC 20006)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Y 145M - Dimensioning & Tolerancing

(Application for copies should be addressed to: American National Standards Institute, 1430 Broadway, New York, NY 10018-3308)

TECHNICAL MANUALS

28030/8530 SCC- Zilog Serial Communications Controller

(Application for copies should be addressed to: Zilog Inc., 210 Hacienda Avenue, Cambell, CA 95008-6609)

2.3 Order of Precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets or MS standards), the text of this document shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified, a sample shall be subjected to first article inspection (See 4.6 and 6.3).

3.2 Qualification. DRUs furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time set for opening of bids (See 4.5 and 6.4).

3.3 Fabrication. The Dynamic Reference Unit shall be manufactured in accordance with this specification and figures included in this specification.

3.4 General specification. The contractor shall be responsible for compliance to the requirements of paragraphs 4.2.2.1 to 4.2.2.3 of specification MIL-F-13926.

3.5 Item definition.

3.5.1 Item functions. The DRU shall be a self-contained inertial surveying system for use in U.S. Army weapon and target acquisition systems. The DRU shall provide, depending on the application, all or part of the following:

a. Horizontal Position in Universal Transverse Mercator (UTM) coordinates of nothing, casting, hemisphere and zone.

b. Horizontal Position in British National Grid coordinates of northing and casting.

c. Horizontal Position in Geodetic coordinates of latitude and longitude.

d. Altitude.

e. Angular Orientation consisting of Pointing Device Grid Azimuth or Geodetic Azimuth, Pointing Device Pitch and Pointing Device Roll or Cant.

f. Angular Orientation consisting of Vehicle Grid Azimuth or Geodetic Azimuth, Vehicle Pitch and Vehicle Roll or Cant.

g. DRU North, East, and Up velocities.

h. Angular Velocity consisting of Pointing Device Azimuth Rate, Pointing Device Pitch Rate, and Pointing Device Roll Rate.

Coordinate and reference frames shall be as defined in 6.6.

The DRU shall accept the following types of damping to improve inertial survey accuracy:

a. Odometer.

b. Zero-velocity updates (ZUPTS) when vehicle is stopped.

The DRU will be used in configurations in which both types of damping will be available, i.e., continuous odometer pulses when the vehicle is moving and ZUPTS whenever the vehicle is stopped. When a Vehicle Motion Sensor (VMS) is not used in the configuration, or odometer data is unavailable because of a malfunction, or when the DRU is commanded, periodic zero-velocity vehicle stops at regular intervals will be used to provide damping. This mode of operating shall be invoked automatically if odometer data becomes unavailable or erroneous because of a malfunction.

The DRU shall be interchangeable from prime system and vehicle to vehicle without requiring hardware changes, calibration procedures, vehicle driving constraints or unscheduled ZUPTS.

3.5.2 Configurations in which the DRU will be used. Several possible system applications for the DRU are depicted in Figures 1, 2, and 3. Figure 1 is an odometer aided inertial survey system with a Control and Display Unit (CDU) used for system control, data entry; and data display. Figure 2 shows a similar survey system with control, entry and display functions shared between the CDU and prime system equipment. In this configuration, the prime system can limit the ability of the CDU to control the DRU and enter data. Figure 3 is a zero-velocity aided inertial survey system without odometer input.

3.5.3 Operating modes. The DRU shall have two main operating modes: Align and Survey, with performance to survey accuracies (3.6.1.1). In addition, the DRU shall have two transport modes: Air Transport and Marine Transport. The transport modes allow the DRU to be transported, while operating with degraded performance, for extended periods without having to stop enroute or align the system at the destination. A position update at the destination is required to restore position accuracy after transport. To maintain survey accuracies while transporting the DRU by air or water, the Survey mode should be used and ZUPT requirements observed. Requirements for the operating modes are given in the following subsections.

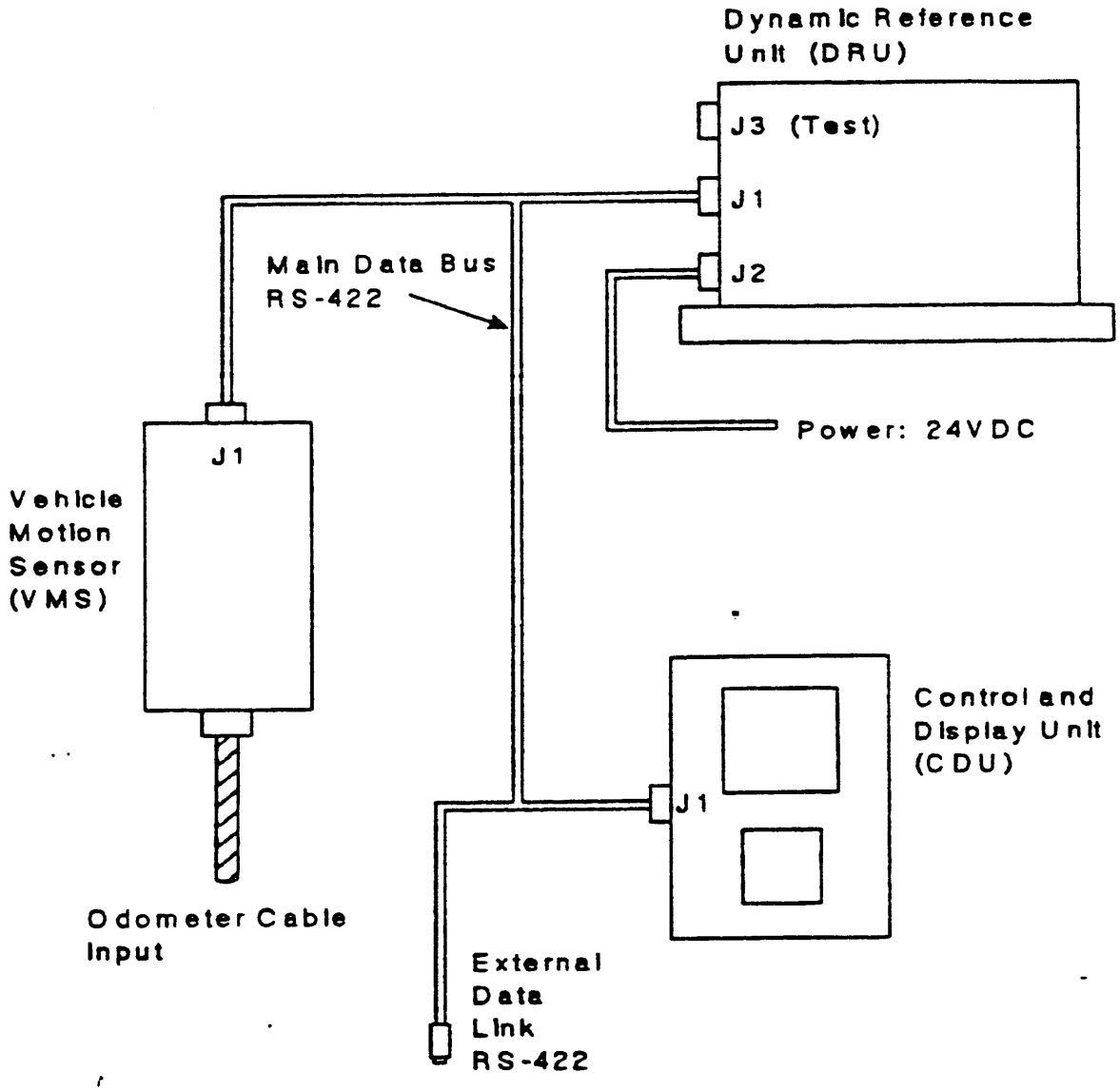
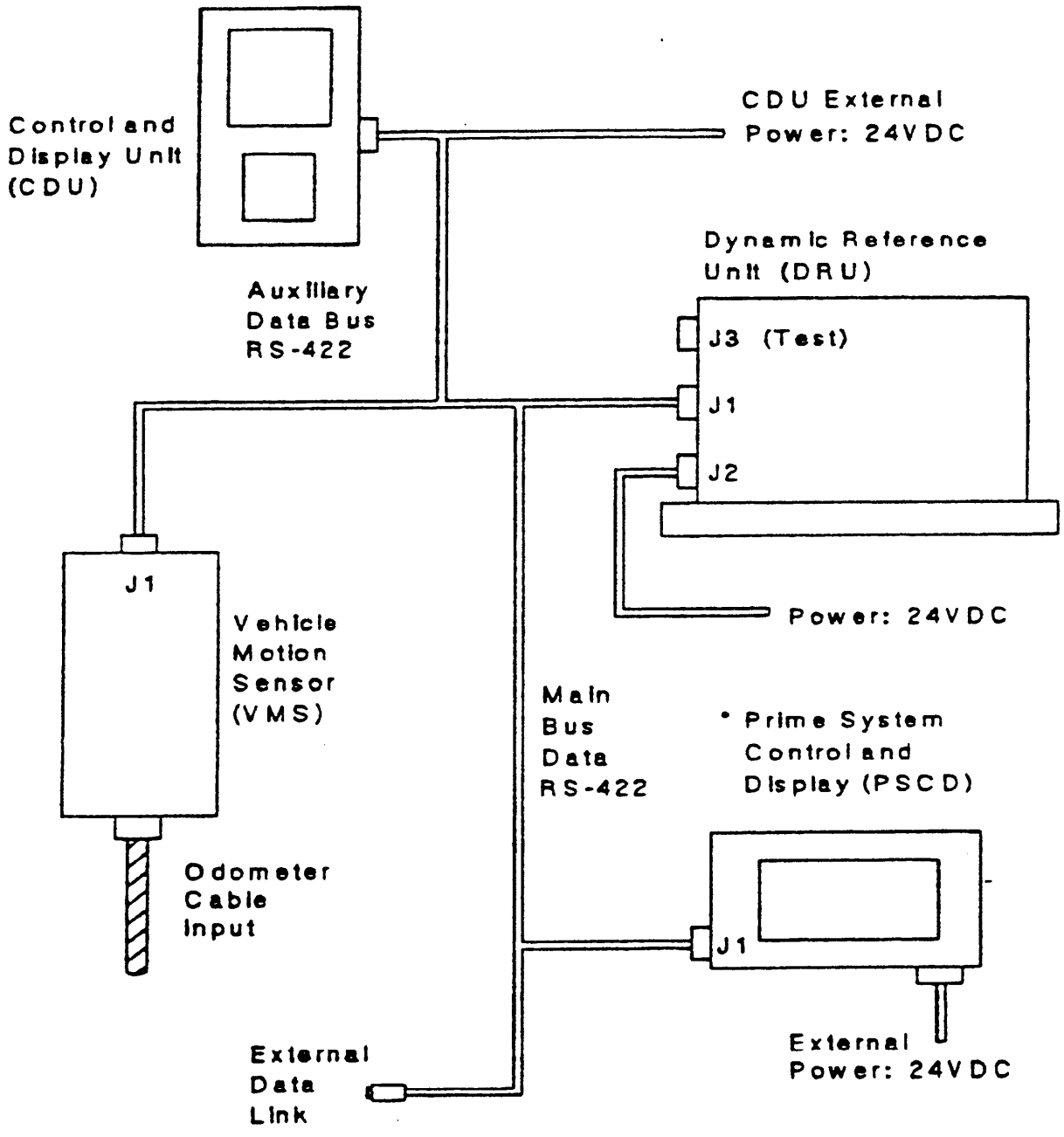


Figure 1
Configuration A
Odometer Aided Inertial Survey System



* Prime System may be disconnected from DRU during mission while power is still on.

Figure 2
Configuration B
Odometer Aided-Prime System Connected to Main Data Bus,
Control and Display Unit Connected to Auxiliary Data Bus.

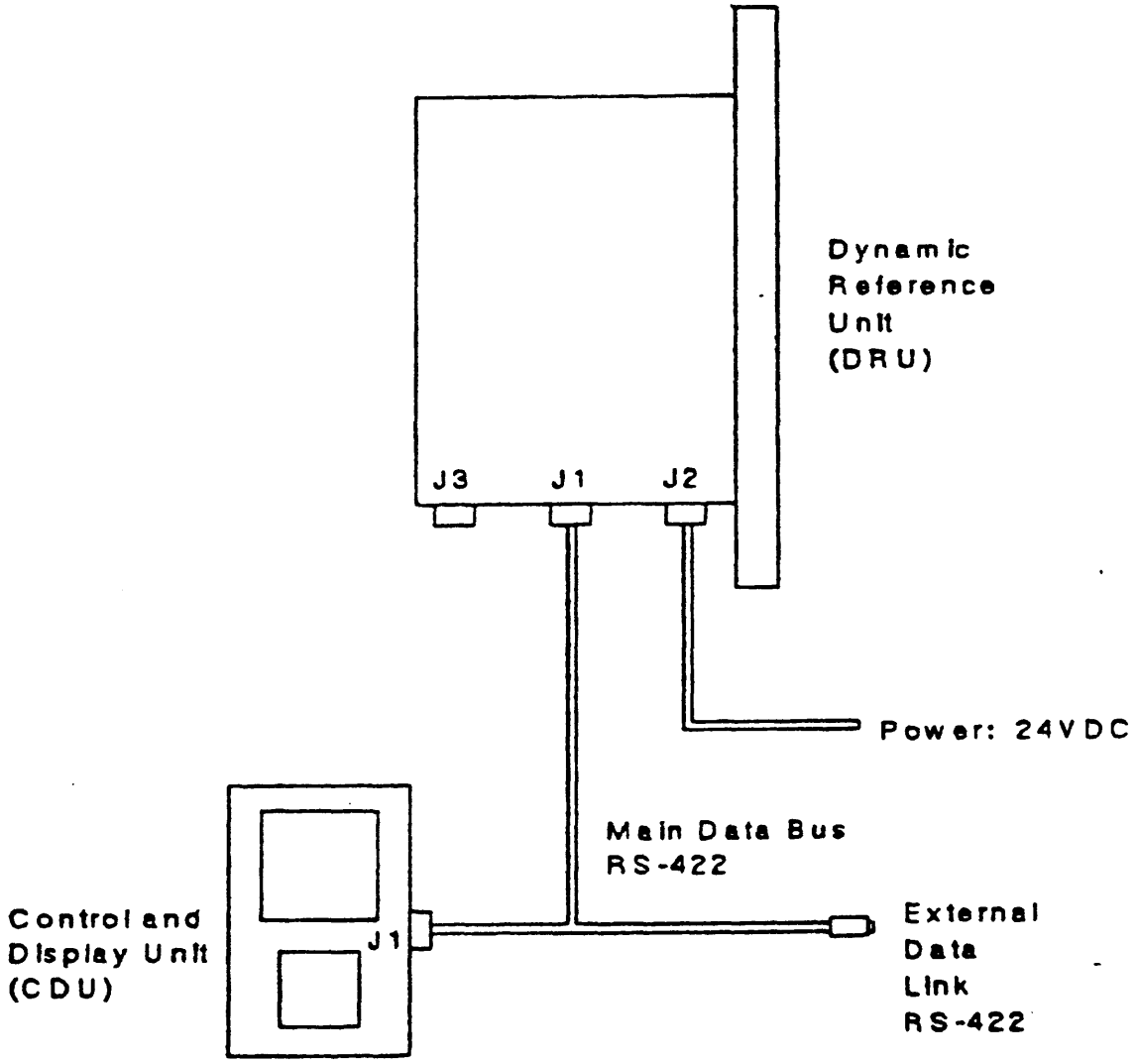


Figure 3
Configuration C
MAPS System Without Odometer Aiding (Exclusive ZUPT Mode)

3.5.3.1 Align. The DRU shall have two align submodes: Normal Align and Stored Heading Align. During Stored Heading Align, the vehicle will be stationary. During Normal Align the vehicle will usually be stationary during the entire alignment, but may be moved after 3.5 minutes (maximum) with degraded survey accuracies.

3.5.3.1.1 Initialization. Within 20 seconds after application of power or after receipt of a RESTART command, except where noted, the DRU shall:

a. Reset STATUS bits S1/4, S1/5, S2/2, S4/0, and S4/1 and set S1/7 (S1/7 shall remain reset for RESTART). shall determine whether the Configuration Data Present flag, Pointing Device Boresight Angles Present flag, and Vehicle Boresight Angles Present flags are set. If any these flags are reset, S1/7 shall remain set and S1/4, S1/5 and S2/2 shall remain reset until the appropriate data command(s) have been received by the DRU (3.5.8.9.1, 3.5.9.1.1, and 3.5.9.2.1).

b. Initiate BIT of itself, and if there is a failure set bit 7 of BUILT-IN-TEST DATA character D1.

c. Check if last shutdown was abnormal, and if so, set bit 0 of ALERT DATA character D1 and bit 1 of STATUS character S1 (Exception: These bits shall not be set again for RESTART if reset criteria were met and they were previously reset).

d. If a VMS is being used, initiate hardware BIT of the VMS. (Not rewired after receipt of a RESTART command if VMS BIT already has been performed). If there is a failure, set bit 1 of BUILT-IN-TEST DATA character D2, and bit 3 of STATUS character S1. If the VMS passes BIT, reset bit 3 of STATUS character S1. VMS BIT shall not be initiated before 3 seconds after application of power.

e. If a VMS is not being used, set bit 3 of STATUS character S1.

f. Set bit 4 of STATUS character S2 to indicate that the pointing device is in the travel lock position. (Exception: Travel lock discrete indicates that the pointing device is out of travel lock or an OUT OF TRAVEL LOCK command has been received). Determination of the travel lock state shall not be made before 3 seconds after application of power.

g. Respond to commands within 10 seconds after turn-on.

h. Reset bit 7 of STATUS character S1 when the DRU is ready to proceed to Align (Already reset for RESTART).

i. Set bit 5 of STATUS character S1 when the DRU enters Normal Align or Stored Heading Align. Set STATUS bit S2/2 when the DRU enters Stored Heading Align.

j. Set bit 7 of STATUS character S2 to indicate that a zero-velocity update has been initiated.

k. If initial parameters have not been received, set bit 6 of ALERT DATA character D2 for Normal Align. ALERT bit D2/6 shall be reset for a valid Stored Heading Align.

l. Be ready to accept and process initial parameters, if they are input, via the ACCEPT POSITION or ACCEPT GEODETIC DATA command.

3.5.3.1.1.1 Normal shutdown. If the previous shutdown was normal (30.4.6 D1/0), the DRU shall accept initial parameters at anytime during Normal Align if acceptance criteria are met. Up to the time new parameters are accepted the DRU shall use the current stored position. Initial parameters are input using the ACCEPT POSITION (30.1.1) or ACCEPT GEODETIC DATA (30.1.S) commands.

If initial parameters are input, the DRU shall perform reasonableness checks as specified in 3.10.5. If criteria in 3.10.5 are not met, the DRU shall reject the data, set the appropriate alerts as specified in 3.10.5 and continue Normal Align using current stored position. If, subsequently initial parameters are not input and accepted, when Normal Align is complete, bit 6 of ALERT DATA character D2 shall be reset.

If initial parameters are input and pass reasonableness checks as specified in 3.10.5, the DRU shall accept the data and reset bit 6 of ALERT DATA character D2.

If initial parameters are not input at anytime during Normal Align, the DRU shall use current stored position, and at the completion of Normal Align shall reset bit 6 of ALERT DATA character D2.

3.5.3.1.1.2 Abnormal Shutdown. If the previous shutdown was abnormal (30.4.6 D1/0), the DRU shall accept initial parameters at anytime within the first 3.5 minutes of Normal Align if acceptance criteria in 3.10.5 are met. On acceptance of the initial parameters, the DRU shall automatically RESTART and reset bit 6 of ALERT DATA character D2 and bit 0 of ALERT DATA character D1. If initial parameters are not received and

accepted within the first 3.5 minutes of Normal Align, bit 5 of STATUS character S1 shall be reset and bit 4 of STATUS character S1 shall remain reset. When both bits 4. and 5 of STATUS character S1 are reset, the proper operator response will be to command RESTART, and update position.

3.5.3.1.2 Normal alian. In the Normal Align mode, the DRU shall automatically align the navigation coordinate frame by determining the direction of the gravity vector and gyrocompassing. Normal Align shall be accomplished without entry of external orientation data. The DRU shall enter the Normal Align mode automatically after power turn on unless the last shutdown was accomplished with a STORED HEADING SHUTDOWN command. The DRU shall also enter the Normal Align mode on receipt of the RESTART command (30.3.3) if the DRU is stationary (see 30.3.3 for exceptions). Otherwise, bit 6 of ALERT DATA character D3 shall be set and the DRU shall remain in the present mode. Bit S of STATUS character S1 shall be set and bit 4 of STATUS character S1 shall be reset when the DRU enters the Normal Align mode.

During the first 3.S minutes (maximum) of Normal Align, and only during the first 3.5 minutes (maximum) of Normal Align, if excessive vehicle motion is detected or the vehicle prematurely proceeds on its mission, bit 3 of ALERT DATA character D2 shall be set, bit 5 of STATUS character S1 shall be reset, and bit 4 of STATUS character S1 shall remain reset. (When both bits 4 and 5 of STATUS character S1 are reset, the proper operator response will be to command RESTART.) After the first 3.5 minutes (maximum) of Normal Align have been completed, bit 4 of STATUS character S1 shall be set and bit 5 of STATUS character S1 shall remain set until Normal Align is completed.

STATUS bit S3/1 shall be set when the DRU determines normal align attitude data is valid (within 3 sigma of the specified accuracies) for use by the prime system.

If Normal Align is completed with the vehicle parked at one location the DRU shall meet the survey accuracies specified in 3.6.1.1. The vehicle may move after being in the Normal Align mode for 3.5 minutes (maximum). In which case, bit 2 of STATUS character S1 shall be set after each 3 minutes, 45 seconds of travel until a maximum of 15 minutes, plus 30 seconds for each travel period, of align time have been accumulated with the vehicle stopped.

Vehicle stops of less than 30 seconds or periods in which motion disturbances are present shall not count toward align time. If Normal Align is completed at the next vehicle stop, the DRU shall meet the survey accuracies specified in 3.6.1.1. If Normal Align is completed at more than one subsequent vehicle stop, or if

vehicle travel time exceeds 4 minutes between stops, the DRU shall meet the Normal Align and survey azimuth accuracies in 3.6.1.1, bug until a position update is performed, shall not be required to meet the position accuracy in 3.6.1.1. While in Normal Align, if the vehicle fails to stop within 6 minutes after completing the last ZUPT, STATUS bit S1/1 shall be set. STATUS bit S1/1 shall not be set prior to 6 minutes if the vehicle fails to stop at the 4 minute point.

Prior to completion of Normal Align, an input reasonableness test as described in 3.10.6.1 shall be performed. If the test is not passed, bits 4 and 5 of STATUS character S1 shall be reset and bit 4 of ALERT DATA character D2 shall be set.

When Normal Align is complete, bit 5 of STATUS character S1 shall be reset, and bit 6 of ALERT DATA character D2 shall be reset (if it has not already been reset).

3.5.3.1.3 Stored heading align. The DRU shall enter the Stored Heading Align mode on receipt of the STORED HEADING ALIGN command (30.3.8) at any time within the first 60 seconds of Normal Align or at turn-on if the previous shutdown was made with the STORED HEADING SHUTDOWN command. However, if the STORED HEADING ALIGN command is received more than 60 seconds after the start of Normal Align, or if the previous shutdown was abnormal, or if there has been a previous RESTART, or if bit 3 of ALERT DATA, character D2 is set, or if ALERT DATA D5/3 is set, the DRU shall not enter the Stored Heading Align mode and shall set bit 6 of ALERT DATA character D5. Bit 2 of STATUS character S2 shall be set, and bit 6 of ALERT DATA character D2 shall be reset when the DRU enters the Stored Heading Align mode. The Stored Heading Align mode shall use the last stored values of position coordinates and attitude at the time of shutdown. If the DRU receives an ACCEPT POSITION or ACCEPT GEODETIC DATA command while in the Stored Heading Align mode, the DRU shall reject the data and set bit 7 of ALERT DATA character D5. When the DRU determines stored heading attitude data is valid for use by the prime system, STATUS bit S3/1 shall be set. At the successful completion of Stored Heading Align, the DRU shall automatically enter the Survey mode, reset bit 2 of STATUS character S2, set bit 4 of STATUS character S1, and reset bit 5 of STATUS character S1. Stored Heading Align shall be completed within 90 seconds after initiation.

The DRU shall automatically revert to Normal Align, reset STATUS bits S2/2 and S3/1, and set bit 5 of ALERT DATA character D2 if it determines that the stored heading is invalid. The DRU shall make this determination by comparing stored Pointing Device pitch and roll to current Pointing Device pitch and roll values and stored Pointing Device azimuth to the Pointing Device azimuth

determined after coarse gyrocompass. The stored azimuth shall be considered invalid if excessive vehicle motion is detected during Align. The stored heading also shall be considered invalid if the DRU orientation (orientation 1 or 2, as specified in 3.5.3.2.2.1) during initialization differs from the orientation at the last shutdown.

When in the Odometer Mode and having successfully completed Stored Heading Align and entered the survey mode, the DRU is allowed to request ZUPTs, at the Exclusive ZUPT Mode interval (3.5.8.5), until a total of 5 minutes of stopped time has been accumulated.

3.5.3.2 Survey. During survey, the DRU shall provide position, orientation and angular rate parameters to the accuracies specified in 3.6.1.1. The DRU shall have two survey submodes: Odometer Mode and Exclusive ZUPT Mode. The DRU shall determine when the vehicle moves and shall immediately set bit 2 of STATUS character S3. The DRU shall determine within 5 seconds when the vehicle is stopped and shall reset bit Z of STATUS character S3. The DRU shall provide positions regernced to the spheriod designation stored/input during initialization. The DRU shall provide positions and grid azimuths in the British National Grid i$ the spheroid designation stored/input during initialization is No. 0. Otherwise the DRU shall provide UTM positions and grid azimuths in the normal zone or extended zone as designated by character D6 of the last received and accepted ACCEPT POSITION command (which may have been received prior to the last shutdown). An exception is when the Configuration Definition Flag for Azimuth (3.5.8.8g) is set. In which case the DRU shall provide positions In the British National Grid or UTM normal zone or extended zone, as designated, but azimuths shall be geodetic.

3.5.3.2.1 Positioning. When in the Survey mode, the DRU shall continuously determine position as it is moved. The DRU may be moved by movement of the transporting vehicle. While the vehicle is stationary or the DRU is operating in the Exclusive ZUPT Mode the DRU mounting surface may move with respect to the vehicle chassis. The DRU shall perform as specified herein with no external aiding except odometer signals or zero-velocity updates. The positions provided by the DRU shall be for the applicable vehicle (Orientation 1) or pointing device (Orientation 2) offset point (3.5.3.2.2.1 and 3.5.8.3).

3.5.3.2.1.1 Zero-velocity updates. The DRU shall utilize zero-velocity updates (ZUPTs) to control system errors. Zero-velocity updates shall be initiated automatically whenever the DRU determines that it is stationary. During survey, zero-velocity updates shall not exceed 30 seconds in duration

from the time the vehicle is stopped. A zero-velocity update shall be terminated upon detection of excessive DRU motion. Early termination of a zero-velocity update shall not degrade DRU performance. A zero-velocity update is either fortuitous or mandated. It is fortuitous if it is initiated without a request from the DRU, i.e., when bit 2 of STATUS character S1 is reset. It is mandated if it is initiated at the request of the DRU, i.e., when bit 2 of STATUS character S1 is set. When a mandated zero-velocity update is initiated, bit 2 of STATUS character S1 shall be reset. If excessive vehicle motion is detected, during the mandated zero-velocity update, bit 2 of STATUS character S1 and bit 1 of ALERT DATA character D2 shall be set. Bit 1 of ALERT DATA character D2 shall not be reset until a zero-velocity update is completed. Whenever a mandated or fortuitous zero-velocity update is initiated, bit 7 of STATUS character S2 shall be set and reset when the zero-velocity update is completed or interrupted. When either a mandated or fortuitous zero-velocity update has been completed, but the DRU remains stationary, the DRU shall initiate and attempt to complete additional zero-velocity updates. These additional zero-velocity updates shall be considered fortuitous.

In the Odometer Mode, the DRU may mandate ZUPTs, no more frequently than the Exclusive ZUPT Mode Interval (3.5.8.5), when severe road/terrain conditions, such as soft sand, mud, snow, or ice, result in excessive erroneous odometer data. The DRU may mandate a ZUPT when gyro parameters must be adjusted because of severe thermal rates. Neither of these exceptional conditions shall be interpreted as relief from the requirements that the DRU be interchangeable and operate as specified herein without external calibration, vehicle driving constraints, or unscheduled ZUPTs (3.5.1 and 3.5.3.2.1.4).

In the Odometer Mode, the DRU shall not require zero-velocity updates more frequently than once per hour of travel time to meet the accuracies specified in 3.6.1.1.1 and 3.6.1.1.2. In the Exclusive ZUPT Mode, the DRU shall not require zero-velocity updates more frequently than once per every 4 minutes of travel time to meet the accuracies specified in 3.6.1.1.3 and 3.6.1.1.4.

In either the Odometer Mode or Exclusive ZUPT Mode, the DRU shall inhibit zero-velocity updates on receipt of the INHIBIT ZERO-VELOCITY UPDATE command (30.3.12) and shall reinstate zero-velocity updates on receipt of the ENABLE ZERO-VELOCITY UPDATE command (30.3.13). These commands may be used during laboratory evaluation.

3.5.3.2.1.2 Exclusive ZUPT Mode. In the Exclusive ZUPT Mode, the DRU shall:

a. Use fortuitous and mandated ZUPTS to control inertial system errors.

b. Ignore odometer (WS) signals.

c. Set STATUS S1/3 (DRU in Exclusive ZUPT Mode).

d. Set STATUS S1/2 (Zero-velocity Stop Request) at the end of each Exclusive ZUPT Mode Interval (3.5.8.5).

e. Reset STATUS S1/2 (Zero-velocity Stop Request) when the mandated ZUPT is completed.

The DRU shall operate in the Exclusive ZUPT Mode when:

a. The Odometer/Exclusive ZUPT Mode Configuration Definition Flag (3.5.8.8a) is reset.

b. An EXCLUSIVE ZUPT MODE REQUEST command has been accepted (3.5.3.2.1.3).

c. The DRU is operating in the Air or Marine Transport mode (3.5.3.3 and 3.5.3.4).

d. A VMS malfunction or excessive erroneous VMS data is detected (3.5.3.2.1.3).

In addition, when the Odometer/Exclusive ZUPT Mode Configuration Definition Flag is reset, the DRU shall perform no VMS hardware or software built-in-test, and shall not respond to the ODOMETER MODE REQUEST and EXCLUSIVE ZUPT MODE REQUEST commands except to set ALERT DATA D5/6 (Invalid Mode Request).

When the Odometer/Exclusive ZUPT Mode Configuration Definition Flag is set and an EXCLUSIVE ZUPT MODE REQUEST command has been accepted, the DRU shall reset BUILT-IN-TEST (BIT) DATA D2/0 (VMS Drive) and D2/1 (VMS), and shall perform no WS hardware or software built-in-test until an ODOMETER MODE REQUEST has been received.

3.5.3.2.1.3 Odometer mode. If the Configuration Definition Flag for Odometer/Exclusive ZUPT Mode is set and the pointing device is in TRAVEL LOCK the DRU shall operate in the Odometer mode. Both acceptable VMS data and ZUPTS shall be used to aid the DRU when in the Odometer mode. The ZUPT request interval

shall be as specified in Configuration data (3.5.8.5). Bit 2 of STATUS character S1 shall be set to request a ZUPT. Bit 3 of STATUS character S1 shall be reset when the DRU is in the Odometer mode.

The DRU shall automatically transition from the Odometer Mode to the Exclusive ZUPT Mode when the pointing device is out of TRAVEL LOCK.

In the Odometer mode, the DRU shall respond to the ODOMETER MODE REQUEST and EXCLUSIVE ZUPT MODE REQUEST commands when the vehicle is stopped. If the vehicle is moving the DRU shall set bit 6 of ALERT DATA character D5.

When operating in the Exclusive ZUPT Mode, to respond to an ODOMETER MODE REQUEST command, the DRU shall:

a. Perform built-in-test of the VMS. If the VMS fails built-in-test the DRU shall remain in the Exclusive ZUPT Mode.

b. Enter the Odometer mode.

c. Reset bit 3 of STATUS character S1.

d. Ignore invalid VMS data and use acceptable VMS data to aid the inertial sensors.

e. Reset bits 1 and 0 of BUILT-IN-TEST character D2 (if they are not reset).

The DRU shall automatically transition from the Odometer Mode to the Exclusive ZUPT Mode when a VMS malfunction or a significant amount of erroneous VMS data is detected. When the VMS is determined to be faulty, the DRU shall:

a. Immediately set bit 2 of STATUS character S1.

b. Set bits 1 and 0 of BUILT-IN-TEST character D2.

c. Perform a VMS hardware built-in-test. If the VMS successfully passes hardware built-in-test, bits 1 and 0 of BUILT-IN-TEST character D2 shall remain set. If the VMS fails hardware built-in-test, bit 1 of BUILT-IN-TEST character D2 shall remain set and bit 0 of BUILT-IN-TEST character D2 shall be reset.

3.5.3.2.1.4 Odometer scale factor and boresight. The nominal odometer scale factor and nominal vehicle boresight angles will be furnished to the DRU as configuration data (3.5.8). No external calibrations shall be required prior to a

mission for the DRU to perform as specified herein. During the performance of missions, the odometer scale factor may experience long and short term variations from the-nominal value resulting from changes in vehicle tire pressure, loading, wheel/track slippage, vehicle turns, and from terrain conditions. While the DRU to vehicle chassis alignment is usually stable within a survey leg, it may vary from one leg to the next because of equipment variations such as antennae being raised and stowed. Short term variations in DRU to direction of travel alignment may result from vehicle movement such as turning or crabbing.

3.5.3.2.2 Orientation. The DRU shall provide vehicle orientation attitudes (Vehicle Grid Azimuth or Geodetic Azimuth, Vehicle Pitch, Vehicle Roll or Cant) and pointing device orientation attitudes (Pointing Device Grid Azimuth or Geodetic Azimuth, Pointing Device Pitch, Pointing Device Roll or Cant). The DRU shall output Geodetic Azimuth when the Configuration Definition Flag for azimuth is set (3.5.8.8g), and Grid Azimuth when the flag is reset. The DRU shall output Vehicle Roll when the Configuration Definition Flag For Vehicle cant/roll is set (3.5.8.8h), and Vehicle Cant when the flag is reset.

The DRU may be mounted to any part of a prime system needing orientation data.
the prime system pointing device and vehicle coordinate frames. The nominal values of the vehicle and pointing device boresight angles shall be defined for a particular installation/vehicle by configuration data (3.5.8.1 and 3.5.8.2).

The orientation attitudes may be used for navigation during the travel phase of a mission; emplacement of a prime system upon arrival at a site; precise orientation of a pointing device during deployment; and automatic stowing of the pointing device. The pointing device, on which the DRU is mounted, may be elevated/rotated from its normal travel lock position during deployment as antennae are erected, weapons aimed, etc. The DRU shall be capable of Normal Align after being elevated/rotated from its normal travel position and shall continue to provide precise orientation data after prime system operations such as radar activation or weapon firing.

3.5.3.2.2.1 Alternate DRU orientation. The DRU shall provide the capability of transitioning between a prime system specific primary orientation (Orientation 1) and a prime system specific alternate (secondary) orientation (Orientation 2).

Orientation 1 shall be defined by: a DRU Coordinate Frane code, vehicle boresight angles, pointing device boresight angles, and position offset distances. Orientation 2 shall be defined by:

a DRU Coordinate Frame code, pointing device boresight angles, and position offset distances. Vehicle boresight angles are meaningless while the DRU is operating in Orientation 2.

Transitioning between Orientation 1 and Orientation 2 shall be triggered by one of the following conditions: current orientation attitudes crossing predetermined vehicle specific limits; transition of the travel lock discrete signal; or receipt of an IN TRAVEL LOCK or OUT OF TRAVEL LOCK command. The trigger condition shall be specified using mutually exclusive Alternate Orientation Configuration Definition flags (3.5.8.8m-r).

3.5.3.2.3 Angular rates. The DRU shall provide three pointing device rates: Pointing Device Azimuth Rate, Pointing Device Pitch Rate, and Pointing Device Roll Rate.

3.5.3.3 Air transport mode. If stationary and in the Survey Mode, upon receipt of an AIR TRANSPORT MODE REQUEST command the DRU shall: set STATUS S4/1 (DRU in Air Transport Mode); enter the Exclusive ZUPT mode; and set STATUS S1/3 (DRU in Exclusive ZUPT mode). Else, the DRU shall remain in the current mode and set ALERT DATA D5/6 (Invalid Mode Request).

Prior to take-off, the DRU shall operate in the Exclusive ZUPT mode and perform as in the Survey mode. The range of aircraft motion prior to take-off includes: that induced by loading and unloading equipment and personnel; engine starting and idling; and taxiing.

Upon detection of take-off, as determined by either altitude increasing significantly or high aircraft velocity (30 knots), the DRU shall: inhibit ZUPTs; inhibit ZUPT requests; fix altitude; set STATUS S3/0 (Altitude Fixed) and S3/4 (ZUPTs Inhibited). After take-off, the DRU shall set ALERT DATA D5/5 (Invalid Data Request) upon receipt of a RETURN SURVEY QUALITY command.

Upon receipt of a TRANSPORT MODE COMPLETE command, signaling the aircraft has landed, the DRU is stationary, and the transport phase has been completed, the DRU shall: reset STATUS S4/1 (DRU in Air Transport Mode) and S3/4 (ZUPTs Inhibited); set STATUS S1/1 (Position Update Request); enable ZUPTs; enable ZUPT requests; perform a ZUPT to control errors accumulated during transport (this ZUPT is “forced” in that inertial velocities may exceed the usual stop detection thresholds); release altitude; and reset STATUS S3/0 (Altitude Fixed). If the DRU was operating in the odometer mode prior to transport, the DRU also shall enter

the odometer mode and reset STATUS S1/3 (DRU in Exclusive ZUPT Mode). If, after completing the ZUPT, inertial velocities indicate the DRU is still moving, the DRU shall set ALERT DATA D3/1 (Excessive Rates).

While in the Air Transport Mode, the DRU shall set ALERT DATA D5/6 (Invalid Mode Request) upon receipt of the INHIBIT ZERO-VELOCITY UPDATES, ENABLE ZERO-VELOCITY UPDATES, EXCLUSIVE ZUPT MODE REQUEST, or ODOMETER MODE REQUEST commands.

3.5.3.4 Marine transport mode. If stationary and in the Survey mode, upon receipt of a MARINE TRANSPORT MODE REQUEST command the DRU shall: set STATUS DATA S4/0 (DRU in Marine Transport Mode); enter the Exclusive ZUPT mode; and set STATUS S1/3 (DRU in Exclusive ZUPT Mode); inhibit ZUPTs; inhibit ZUPT requests; fix altitude; set STATUS S3/0 (Altitude Fixed) and S3/4 (ZUPTs Inhibited). Else, the DRU shall remain in the current mode and set ALERT DATA D5/6 (Invalid Mode Request). NOTE: To prevent the DRU from misinterpreting low velocities of a docked marine vessel as a stopped condition, the MARINE TRANSPORT MODE REQUEST should be issued while the DRU is on land.

In the Marine Transport Mode, the DRU shall set ALERT DATA D5/5 (Invalid Data Request) upon receipt of a RETURN SURVEY QUALITY command.

Upon receipt of a TRANSPORT MODE COMPLETE command, signaling the DRU has returned to land, the DRU is stationary, and the transport phase has been completed, the DRU shall: reset STATUS S4/0 (DRU in Marine Transport Mode); and S3/4 (ZUPTs Inhibited); set STATUS S1/1 (Position Update Request); enable ZUPTs; enable ZUPT requests; perform a ZUPT to control errors accumulated during transport (this is “forced” in that inertial velocities may exceed the usual stop detection thresholds); release altitude; and reset STATUS S3/0 (Altitude Fixed). If the DRU was operating in the Odometer Mode prior to transport, the DRU shall also enter the Odometer Mode and reset STATUS S1/3 (DRU in Exclusive ZUPT Mode). If, after completing the ZUPT, inertial velocities indicate that the DRU is still moving, the DRU shall set ALERT DATA D3/1 (Excessive Rates).

While in the Marine Transport Mode, the DRU shall set ALERT DATA D5/6 (Invalid Mode Request) upon receipt of the INHIBIT ZERO-VELOCITY UPDATES, ENABLE ZERO-VELOCITY UPDATES, EXCLUSIVE ZUPT MODE REQUEST, or ODOMETER MODE REQUEST commands.

3.5.4 Electrical interface.

3.5.4.1 Connectors. Connectors shall conform to MIL-C-38999. Each external connector reference designation, part number, number of contacts, contact size, purpose of connector, and mating connector is defined in Table I. DRU signal connector J1 pin functions shall be in accordance with Table II. Terminations shall be as shown in Figure 4.

3.5.4.1.1 Shield grounding. Connecting cable external and internal shields will be grounded directly to the connector backshells. J1, J2 and J3 connector shells shall provide a path to the DRU chassis of less than 2.5 milliohms resistance from DC to 10 MHz.

TABLE I. PRU connector information.

Connector Reference Designator	Connector Part Number (Chassis Corm)	Number of Contacts	Contact Size	Connector Purpose	Mates with
J1	MS27468T19F35S	66	22D	Signal	MS27467T19F35P
J2	MS27468T15F15P	14	20	Power	MS27467T15F15S
		1	16		
J3*	MS27468T19F35SB	66	22D	Test	MS27467T19F35PB
	MS27468T21F35SA	79	22D	Test	MS27467T21F35PA

*Contractor may select either listed connector for J3.

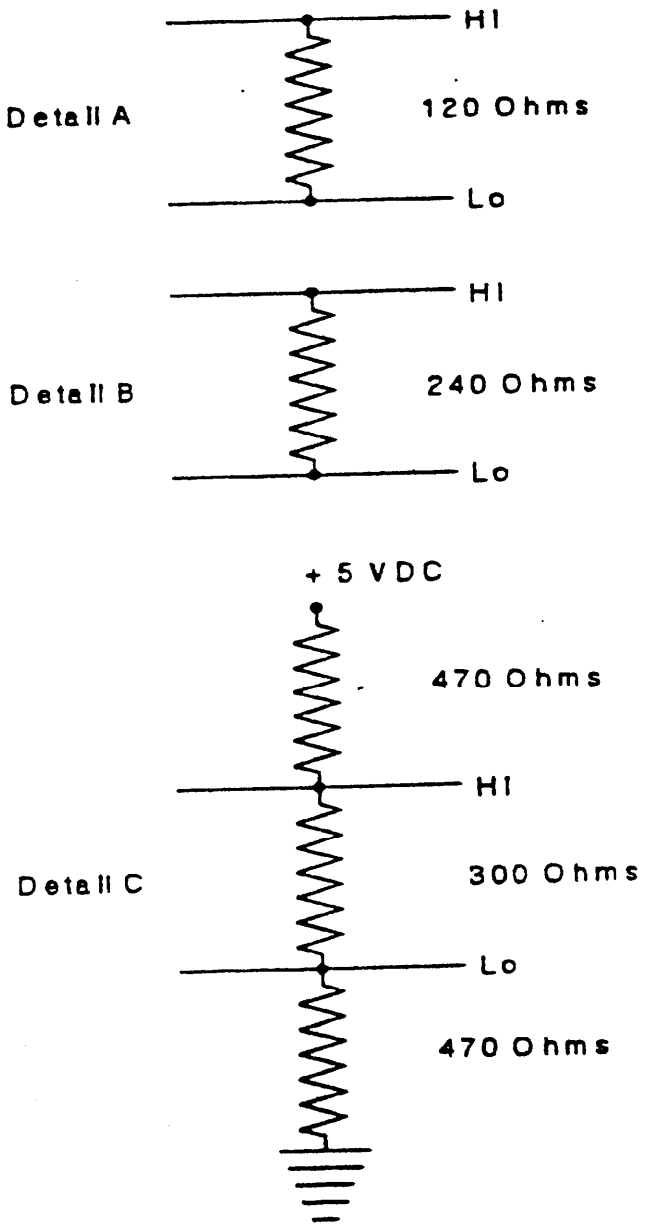


Figure 4
Terminations

TABLE II. J1 PIN function.

PIN	FUNCTION	TERMINATION (See Fig. 4)
1	Auxiliary Clock (RS-422) - Hi	A
2	Spare	
3	Spare	
4	Auxiliary Data Bus (RS-422) - Hi	B
5	Auxiliary Clock (RS-422) - Lo	A
6	Spare	
7	Spare	
8	Main Clock (RS-422) - Hi	A
9	Main Clock (RS-422) - Lo	A
10	Auxiliary Data Bus (RS-422) - Lo	B
11	Spare	
12	On Power Control	
13	On Power Control	
14	Signal Ground (for Config. Discrete)	
15	Spare	
16	Main Data Bus (RS-422) - Hi	B
17	Travel Lock Discrete (RS-422) - Hi	C
18	Travel Lock Discrete (RS-422) - Lo	C
19	Configuration Discrete 3	
20	Chassis Ground	
21	24 VDC Return	
22	24 VDC Return	
23	24 VDC Return	
24	Main Data Bus (RS-422) - Lo	B
25	Spare	
26	Signal Ground (for Config. Discrete)	
27	+ 15 VDC	
28	Configuration Discrete 4	
29	+ 15 VDC	
30	+5 VDC	
31	+5 VDC	
32	Signal Ground (for Config. Discrete)	
33	Configuration Discrete 1	
34	Spare	
35	Spare	
36	+5 VDC	
37	- 15 VDC	
38	- 15 VDC	
39	DC Return	
40	DC Return	
41	Signal Ground (for Config. Discrete)	
42	Configuration Discrete 2	
43	Spare	

TABLE II. J1 PIN function. (continued)

PIN	FUNCTION	TERMINATION (See Fig .4)
44	Spare	
45	DC Return	
46	Spare	
47	Spare	
48	Spare	
49	VMS BIT Cmd 2 (RS-422) - Hi	
50	VMS BIT Cmd 2 (RS-422) - Lo	
51	Spare	
52	+ 24 VDC	
53	Odometer Reverse (RS-422) - Hi	C
54	Odometer Reverse (RS-422) - Lo	C
55	Spare	
56	Spare	
57	VMS BIT Cmd 1 (RS-422) - Hi	
58	+ 24 VDC	
59	+ 24 VDC	
60	Spare	
61	Spare	
62	Spare	
63	VMS BIT Cmd 1 (RS-422) - Lo	
64	Odometer Forward (RS-422) - Hi	C
65	Odometer Forward (RS-422) - Lo	C
66	Spare	

3.5.4.2 Power. The DRU shall turn on when activated (3.5.4.2.1) if the steady state power voltage meets the criteria specified herein. The DRU shall always turn on when the steady state power voltage is 18.5 VDC and at any value above 18.5 VDC up to and including 36.0 VDC. Once on, the DFW shall not cycle off and on from IR voltage drop and shall operate as specified herein. The DRU shall always stay on when the steady state power voltage is 16.3 VDC and at any value above 16.3 VDC up to and including 36.0 VDC. The DRU shall be off when the steady state power voltage is 15.0 VDC or less.

The DRU shall operate as specified herein while operating from a power source functioning at the worst case limits of MIL-STD-1275, excepting initial engagement surges and cranking. The DRU shall not be damaged by input voltage polarity reversal. The DRU shall not be damaged by surges, spikes, ripple, starting disturbances or steady state voltages (≤ 100 VDC) as specified in MIL-STD-1275 for normal operation, single fault conditions and

multiple fault conditions. Loss of power shall not damage the DRU or affect the computer program or DRU calibration data. Special alignment procedures shall not be required after an unexpected power loss. Electrical overload protection shall be provided as specified in Requirement 8 of MIL-STD-454. Bonding of the DRU to the vehicle shall be in accordance with Class H of MIL-B-5087.

The power required for the DRU shall not exceed 150 watts including regulated power furnished to external devices (3.5.4.2.2.1), but not unregulated power (3.5.4.2.2.2).

Pin assignments for DRU power connector J2 shall be in accordance with Figure 5.

3.5.4.2.1 Power control. The method of power control shall be selected by means of a shorting jumper between pins C and D of J2. If no jumper is present, the DRU shall be activated upon application of system power and shall automatically initiate the startup and alignment sequence. With this type of power control the DRU shall deactivate when the primary power is outside the acceptable range (3.5.4.2); the receipt of a SHUTDOWN or STORED HEADING SHUTDOWN command shall only initiate storage of data. With this method of power control and after deactivation of the DRU has started, the DRU shall reset to the beginning of the startup and initialization sequence (3.5.3.1.1) when acceptable primary power is next applied. If a jumper is present between pins C and D of J2, the DRU shall be activated only by a momentary contact closure between pins 12 and 13 of J1 (Table II), and deactivated after receipt of a SHUTDOWN or STORED HEADING SHUTDOWN command or when the primary power is outside the acceptable range (3.5.4.2). The voltage appearing on J1 pins 12 and 13 shall not exceed the input power voltage. The current flowing through J1 pins 12 and 13 shall not exceed 5.0 milliamperes.

The DRU shall be able to reactivate within 5 seconds after power has been removed.

3.5.4.2.2 Power from DRU to peripheral equipment.

3.5.4.2.2.1 Regulated. The DC voltage and current requirements listed below shall be supplied by the DRU for external use, when the DRU is activated (3.5.4.2.1).

Voltage	Current	Maximum Ripple
+15 VDC	350 mA	150 mV pk-pk
-15 VDC	350 mA	150 mV pk-pk
+5 VDC	700 mA	100 mV pk-pk

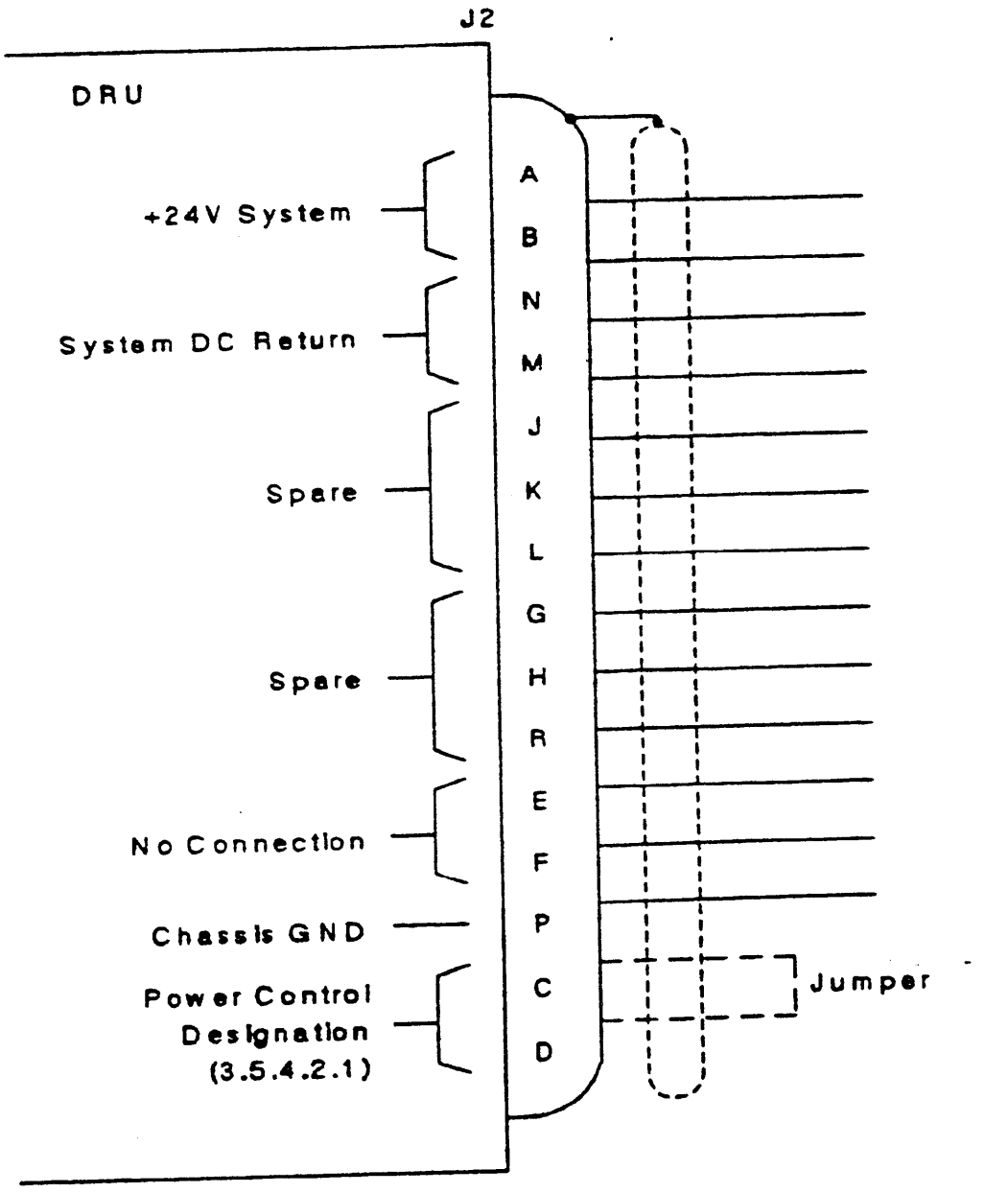


Figure 5
DRU External Power Wiring

The voltage outputs shall be within ±5 percent of the specified voltages including the effects of source and load regulation and ripple. Power supply outputs shall be protected from overloads and over voltages. The DRU shall not shutoff or indicate a failure when momentary current surges are required to charge capacitors, up to 5 microfarads in value, in external devices being powered by the DRU.

3.5.4.2.2.2 Unregulated. The DRU shall supply unregulated, 24 VDC, vehicle power for external use. This power output shall be activated only when the DRU is activated (3.5.4.2.1). The load power will not exceed 32 watts and the surge current shall not exceed 2.0 amperes. The DC returns, pins 21 through 23 in Table II, shall not connect to the DRU chassis at any point.

3.5.4.3 Internal test. Internal wiring and pin assignments for test connector J3 are at the discretion of the contractor. A contractor identification resistor shall be wired between pins 1 and 5 inside the DRU in accordance with Table III. J3 shall be covered by a cap which shall prevent contamination of the connector pins. The cap shall be secured to the DRU chassis to prevent loss.

TABLE III. Contractor identification resistor values.

Vendor	Resistance (ohms +5%)
Honeywell	4000
Kearfott	3000

3.5.4.4 Data interfaces. Data shall be transferred between the DRU and other prime system subsystems (such as CDU, VMS, or AFCS) via digital (two-state) signal circuits. Data will be formatted as binary coded digital data (commands and messages); pulse trains (serial data bus clocks and odometer signals); and a discrete (travel lock). The DRU shall be ready to receive or transmit data within 10 seconds of turn on.

3.5.4.4.1 Signal circuits. All signal cirucits, except on Power Control (3.5.4.2.1) and programming discretes (3.5.8.9), which connect the DRU and other prime system subsystems, shall be balanced differential voltage circuits in accordance with EIA Stamdard RS-422. All line drivers shall comply with the generator electrical characteristics specified in RS-422. All receivers shall comply with the requirements of Military Drawing 78020 device type 02.

The DRU shall not be damaged or malfunction when signal circuits are connected or disconnected with power on or off.

3.5.4.4.1.1 Logic levels. A binary logic "1" or "set" condition shall be represented by a positive voltage on the "Hi" line with respect to the "Lo" line. A logic "O" or "reset" condition shall be represented by a positive voltage on the "Lo" line with respect to the "Hi" line.

3.5.4.4.2 Data bus characteristics. The DRU shall have two, independent, hi-directional, half-duplex, synchronous, serial data buses. The two buses are labeled Main and Auxiliary. All commands and messages shall be transferred between the prime system and DRU via the data buses. Either bus may be used separately or both may be used simultaneously. The electrical characteristics, data protocols and data formats are the same for both data buses. The only difference between the two buses is that DRU response to data entry and mode change commands received over the Auxiliary Bus can be inhibited by the prime system using the Main bus (3.5.4.4.3.5). The data rate shall be 38.4 kilobits per second. Each data bus input/output shall be in a receive mode unless data is being transmitted by that particular bus. The DRU shall return a data bus to the receive mode and be able to receive a command, on the same data bus, within 1.0 millisecond after sending the end of the last bit of a message. The DRU shall not start sending a message until at least 1.0 millisecond has elapsed after receipt of the end of the last bit of the command which initiated the message.

3.5.4.4.2.1 Data Protocols. All serial data bus timing and data protocols shall be compatible with the Zilog 28030 Serial Communication Controller (SCC) used in the normal Synchronous Data Link Control (SDLC) mode. Data shall change after the falling edge and be valid on the rising clock edge. Prior to transmission of a command or message, the Cyclic Redundancy Check (CRC) generator and checker in the SW shall be preset to all "1"s.

3.5.4.4.2.2 Data encoding. All serial data bus data shall be encoded in the Non-return-to-Zero (NRZ) format compatible with the Zilog Z8030 SCC.

3.5.4.4.2.3 Clock. The DRU serial data buses shall operate properly when provided with 38.4 KHz $\pm$ 0.01 percent, symmetrical squarewave clock signals compatible with the Zilog Z8030 SCC used in the normal SDLC mode.

3.5.4.4.3 Command and message characteristics. Commmands to and messages from the DRU on either the Auxiliary or the Main Bus

shall have the following characteristics:

a. The prime system shall be the bus master which initiates commands to the DRU (slave). The DRU shall respond to commands within 10 seconds after application of power.

b. The DRU shall not initiate a message without a request (command).

c. The DRU shall send a message in response to each command received. The message shall be returned only on the bus over which the command was received.

d. STATUS (30.5) and ALERT (30.4.6) indications applicable to only one data bus (i.e. improper command received, error detected, etc.) shall be returned only on the applicable bus.

Commands and messages shall be constructed of 8-bit bytes (designated as characters).

f. The data field shall be constructed of a variable number of characters from a minimum of zero to a maximum of N. All other fields are of fixed character length.

g. Bit positions within a character are shown below:

most significant bit							least significant bit
7	6	5	4	3	2	1	0

h. The order of transmission" over the bus shall be most significant character (8 bit byte) first. The last significant bit within the character shall be transmitted first. In multiple or single character data words which do not assign all of the bits available, the least significant bit or bits within the least significant character shall be the unassigned bit or bits. The value(s) of unassigned bit(s) are unspecified.

3.5.4.4.3.1 Command and message format definition. Command and message formats are shown below:

F	C	D1 D2. . . . . ..DN INPUT COMMAND TO DRU	E1 E2	F
F	I	S1 S2 D1 D2 . . . . DN OUTPUT MESSAGE FROM DRU	El E2	F

DESCRIPTION OF SYMBOLS

a. F, flag. A fixed sequence to indicate start or end of message (01111110), 8 bits.

b. C, command. Binary code character defining required DRU response. Detailed descriptions of each command are found in Appendices A, B, & C. The command word consists of 5 bits. This character also contains a message sequence number which is 3 bits.

MESSAGE SEQ. NO.	COMMAND
M	L
S	S
B	B
XXX	XXXXX
765	43210

A message sequence number is assigned to each command by the prime system device generating the command. The message identifier shall contain the same message sequence number in the response to a specific command. The complete message identifier can be used by the prime system to correlate responses with requests.

c. D1, 2 . . . . N, data. There may be 0 to 35 data characters per input command or output message. The number and contents of data characters are defined in Appendices A through 1).

d. E1, E2, error detection code characters. The error detection code shall be a 16 bit Cyclic Redundancy Check (GRC) compatible with the synchronous data link control (SDLC) protocol as implemented in the Zilog 8030 serial communication controller (CRC-CCITT polynomial). Each message sent by the DRU shall contain the CRC code computed for the information being sent. Each command received by the DRU shall be tested for correct reception. If an error is detected, the DRU shall ignore the command, issue a STATUS DATA message indicating an Alert, and set ALERT DATA character D5 bit 0.

e. S1, S2, STATUS word. The DRU shall send its STATUS with every output message. The STATUS word contains 16 bits. Each bit indicates the presence or absence of a particular mode or condition. Additional STATUS information (S3 and S4) can be obtained by requesting the EXPANDED STATUS DATA message. 30.5 explains all of the STATUS conditions.

f. I, identifier. The identification character indicates the type of message being returned from the DRU. Descriptions of each message are contained in Appendix D. The identifier is 5 bits. The identifier character also contains an echo of the command message sequence number which is 3 bits.

ECHO OF MESSAGE SEC). NO.	IDENTIFIER
M S B	L S B
XXX	XXXXX
765	43210

g. X, Symbol. An X indicates a binary "1" or "0" in a command or identifier character.

3.5.4.4.3.2 Commands. Command code 6 (00110) is available for use by contractors (30.2.12). Other commands are divided into three categories. These categories are:

a. Those commands that transfer data from the prime system or CDU to the DRU. Detailed descriptions of these commands and data are found in Appendix A. These commands are:

(1) ACCEPT POSITION (NAVIGATION UPDATE) (30.1.1)
(2) ACCEPT POINTING DDEVICE BORESIGHT (30.1.2)
(3) ACCEPT CONFIGURATION DATA (30.1.3)
(4) ACCEPT VEHICLE BORESIGHT (30.1.4)
(5) ACCEPT GEODETIC DATA (30.1.5)

b. Those commands that request transfer of data from the DRU to the prime system or CDU. Detailed descriptions of these commands are found in Appendix B. These commands are:

(1) RETURN POINTING DEVICE RATE DATA (30.2.1)
(2) RETURN CONFIGURATION DATA (30.2.2)
(3) RETURN STATUS (30.2.3)
(4) RETURN NAVIGATION DATA (30.2.4)
(5) RETURN ATTITUDE DATA (30.2.5)
(6) RETURN ALIGN TIME TO GO (30.2.6)
(7) RETURN ALERT DATA (30.2.7)
(8) RETURN BIT DATA (30.2.8)
(9) RETURN TRAVEL LOCK DATA (30.2.9)
(10) RETURN POSITION DATA (30.2.10)
(11) RETURN POINTING DEVICE ATTITUDE DATA (30.2.11)

(12) COMMAND ASSIGNED TO SUPPLIER (30.2.12)
(13) RETURN POINTING DEVICE BORESIGHT (30.2.13)
(14) RETURN EXPANDED STATUS (30.2.14)
(15) RETURN SURVEY QUALITY (30.2.15)
(16) RETURN VEHICLE BORESIGHT (30.2.16)
(17) RETURN GEODETIC DATA (30.2.17)

c. Those commands that don't transfer any data but cause a mode or operation change in the DRU. A detailed description of these commands is found in Appendix C. These commands are:

(1) OVERRIDE ALERT (30.3.1)
(2) RESET DISTANCE (30.3.2)
(3) RESTART (30.3.3)
(4) INHIBIT AUXILIARY BUS CONTROL (30.3.6)
(5) ENABLE AUXILIARY BUS CONTROL (30.3.7)
(6) STORED HEADING ALIGN (30.3.8)
(7) SHUTDOWN (30.3.9)
(8) OUT OF TRAVEL LOCK (30.3.10)
(9) INHIBIT ZERO-VELOCITY UPDATES (30.3.11)
(10) ENABLE ZERO-VELOCITY UPDATES (30.3.12)
(11) IN TRAVEL LOCK (30.3.13)
(12) EXCLUSIVE ZUPT MODE REQUEST (30.3.14)
(13) ODOMETER MODE REQUEST (30.3.15)
(14) STORED HEADING SHUTDOWN (30.3.16)
(15) AIR TRANSPORT MODE REQUEST (30.3.17)
(16) MARINE TRANNSPORT MODE REQUEST (30.3.18)
(17) TRANSPORT MODE COMPLETE (30.3.19)

3.5.4.4.3.3 Data message definition. Identifier Code 12 is assigned to the message associated with the Supplier Assigned Command Code 6. Detailed descriptions of all data messages transferred from the DRU are found in Appendix D. The messages are:

(1) POINTING DEVICE RATE DATA (30.4.1)
(2) CONFIGURATION DATA (30.4.2)
(3) NAVIGATION DATA (30.4.3)
(4) ATTITUDE DATA (30.4.4)
(5) ALIGN TIME TO GO DATA (30.4.5)
(6) ALERT DATA (30.4.6)
(7) BUILT-IN-TEST (BIT) DATA (30.4.7)
(8) TRAVEL LOCK DATA (30.4.8)
(9) POSITION DATA (30.4.9)
(10) POINTING DEVICE ATTITUDE DATA (30.4.10)
(11) STATUS DATA (30.4.11)
(12) POINTING DEVICE BORESIGHT (30.4.12)

(13) EXPANDED STATUS DATA (30.4.13)
(14) SURVEY QUALITY (30.4.14)
(15) VEHICLE BORESIGHT (30.4.15)
(16) GEODETIC DATA (30.4.16)

3.5.4.4.3.4 Command rates and message response time. The DRU shall accept and process commands received on both data busses simultaneously at the rates and response times listed in Table IV. The two combinations of commands that are required to be processed simultaneously are: (1) 5 HZ commands received on both busses; (2) a 5 HZ command received on one bus and a 100 HZ command received on the other bus. The response times are measured beginning with transmission of the first bit of the command by the prime system and ending with receipt of the last bit of the message by the prime system. The DRU is not required to accept a new command on a particular bus until the message associated with a command previously received on that bus has been transmitted or until the required response time for the command previously received plus 10 milliseconds has elapsed with no message being sent. STATUS S2/1 shall be set within 1 second after receipt of a command that triggers any one of the following ALERTS: D2/0, D2/2, D3/5, D3/6, D3/7, D4/0, D4/1, D4/3, D4/4, D4/6, D4/7. STATUS S2/1 shall be set in the message responding. to a command which triggers any of the following ALERTS: D5/0, D5/1, D5/2, D5/5, D5/6, and D5/7. A STATUS DATA message shall be sent in response to any command which triggers a D5/0 or D5/1 ALERT. A change in STATUS triggered by receipt of a command shall be reported in the message returned in response to that command for the following STATUS bits: S1/0, S1/1, S1/5, S2/2, S2/4, S/6, S3/4, S4/0, and S4/1.

3.5.4.4.3.5 Data bus control. Provisions shall be made to inhibit the ability of the Auxiliary Bus to enter data into the DRU or change operating modes as follows:

a. Auxiliary Bus control shall be inhibited for 15 seconds after DRU turnon; i.e., the ability of the Auxiliary Bus to enter data into the DRU or change operating modes shall be inhibited for 15 seconds after DRU turnon. Status bit S1/0 shall be set on both data buses during this time period.

b. At any time after 15 seconds after turnon, Auxiliary Bus control shall automatically be enabled if no command has been received on the Main Bus during the previous two seconds. STATUS bit S1/0 shall be reset on both data buses when Auxiliary Bus control is enabled.

c. After the DRU is able to respond to comands (3.5.3.1.1.9),Auxiliary Bus control shall be enabled if the ENABLE AUXILIARY BUS CONTROL command is received on the Main Bus. In which case, STATUS bit S1/0 shall be reset on both data buses.

d. Once Auxiliary Bus control is enabled, it shall be inhibited if the INHIBIT AUXILIARY BUS CONTROL comand received on the Main Bus. In which case, STATUS bit S1/0 shall be set on both data buses.

e. When Auxiliary Bus control is inhibited the Auxiliary Bus shall respond only to the following commands:

(1) RETURN TRAVEL LOCK DATA
(2) RETURN ATTITUDE DATA
(3) RETURN CONFIGURATION DATA
(4) RETURN STATUS
(5) RETURN NAVIGATION DATA
(6) RETURN ALIGN TIME TO GO DATA
(7) RETURN ALERT DATA
(8) RETURN BIT DATA
(9) RETURN POINTING DEVICE RATE DATA
(10) RETURN POSITION DATA
(11) RETURN POINTING DEVICE ATTITUDE DATE
(12) RETURN POINTING DEVICE BORESIGHT
(13) RETURN EXPMED STATUS
(14) RETURN SURVEY QUALITY
(15) RETURN VEHICLE BORESIGHT
(16) RETURN GEODETIC DATA
(17) COMMAND ASSIGNED TO SUPPLIER (Optional)
(18) OVERRIDE ALERT

When Auxiliary Bus control is inhibited, receipt of an OVERRIDE ALERT command on the Auxiliary Bus shall reset only those ALERT DATA bits specific to the Auxiliary Bus.

If any other comand is received over the Auxiliary Bus while control is inhibited, the DRU shall send a STATUS DATA message, with status bit S2/1 set, over the Auxiliary Bus. Bit 1 in character D5 of the Alert Data, described in 30.4.6, shall be set.

f. When Auxiliary Bus control is enabled the Auxiliary Bus shall respond to all commands except INHIBIT and ENABLE AUXILIARY BUS CONTROL. Should either of those commande be received, the Auxiliary Bus shall indicate an ALERT in a STATUS DATA message and bit 1 of Alert Data character D5 shall be set.

3.5.4.5 Travel lock discrete. If the Configuration Definition Flag for travel lock discrete (3.5.8.8c) is set, the DRU shall use the travel lock discrete to determine whether the pointing device is in or out of travel lock. When the discrete signal to the DRU is a logic "0", the pointing device shall be considered to be in travek lock. When the discrete signal to the DRU is a logic “1”, the pointing device shall be considered to be out of travel lock.

3.5.4.6 Odometer interface. The DRU shall utilize odometer pulses representing incremental distance traveled in forward and reverse directions by the vehicle on which the DRU is mounted. Both the forward and backward direction pulses are nominally scaled to represent 0.165 feet per pulse. The pulses are 800 ± 60 micro-seconds in width and the frequency of the pulses varies from 0 to 711 pulses/second for a forward or backward speed of 0 to 80 miles per hour.

The DRU shall generate discrete test commands which will direct the VMS to perform BIT.

TABLE IV. Command rates and message response times.

COMMAND	MAXIMUM REQUEST RATE	RESPONSE MESSAGE	MAXIMUM RESPONSE TIME
ACCEPT POSITION	5/sec	STATUS DATA	130 msec
ACCEPT CONFIGURATION DATA	5/sec	STATUS DATA	130 msec
RETURN POINTING DEVICE RATE DATA	100/sec	POINTING DEVICE RATE DATA	9 msec
RETURN STATUS	5/sec	STATUS DATA	130 msec
RETURN NAVIGATION DATA	5/sec	NAVIGATION DATA	130 msec
RETURN ATTITUDE DATA	100/sec	ATTITUDE DATA	9 msec
RETURN ALIGN TIME TO GO	5/sec	ALIGN TIME TO GO DATA	130 msec
RETURN ALERT DATA	5/sec	ALERT DATA	130 msec
RETURN BIT DATA	5/sec	BIT DATA	130 msec
RETURN TRAVEL LOCK DATA	100/sec	TRAVEL LOCK DATA	9 msec
RETURN POSITION DATA	5/sec	POSITION DATA	130 msec
RETURN POINTING DEVICE ATTITUDE DATA	100/sec	POINTING DEVICE ATTITUDE DATA	9 msec
OVERRIDE ALERT	5/sec	STATUS DATA	130 msec
RESET DISTANCE	5/sec	STATUS DATA	130 msec
RESTART	5/sec	STATUS DATA	130 msec
ENABLE AUXILIARY BUS CONTROL	5/sec	STATUS DATA	130 msec
INHIBIT AUXILIARY BUS CONTROL	5/sec	STATUS DATA	130 msec
STORED HEADING ALIGN	5/sec	STATUS DATA	130 msec
SHUTDOWN	5/sec	STATUS DATA	130 msec
INHIBIT ZERO-VELOCITY UPDATE	5/sec	STATUS DATA	130 msec
ENABLE ZERO-VELOCITY UPDATE	5/sec	STATUS DATA	130 msec
IN TRAVEL LOCK	5/sec	STATUS DATA	130 msec
OUT OF TRAVEL LOCK	5/sec	STATUS DATA	130 msec
RETURN CONFIGURATION DATA	5/sec	CONFIGURATION DATA	130 msec
ACCEPT POINTING DEVICE BORESIGHT	5/sec	STATUS DATA	130 msec
RETURN POINTING DEVICE BORESIGHT	5/sec	POINTING DEVICE BORESIGHT	130 msec
RETURN EXPANDED STATUS	5/sec	EXPANDED STATUS DATA	130 msec
RETURN SURVEY QUALITY	5/sec	SURVEY QUALITY	130 msec
STORED HEADING SHUTDOWN	5/sec	STATUS DATA	130 msec
ACCEPT VEHICLE BORESIGHT	5/sec	STATUS DATA	130 msec
RETURN VEHICLE BORESIGHT	5/sec	VEHICLE BORESIGHT	130 msec

TABLE IV. Command rates and message response times. (continued)

COMMAND	MAXIMUM REQUEST RATE	RESPONSE MESSAGE	MAXIMUM RESPONSE TIME
EXCLUSIVE ZUPT MODE REQUEST	5/sec	STATUS DATA	130 msec
ODOMETER MODE REQUEST	5/sec	STATUS DATA	130 msec
ACCEPT GEODETIC DATA	5/sec	STATUS DATA	130 msec
RETURN GEODETIC DATA	5/sec	GEODETIC DATA	130 msec
AIR TRANSPORT MODE REQUEST	5/sec	STATUS DATA	130 msec
MARINE TRANSPORT MODE REQUEST	5/sec	STATUS DATA	130 msec
TRANSPORT MODE COMPLETE	5/sec	STATUS DATA	130 msec

The commands and correct VMS responses are as follows:

BIT Command		Odometer Signal (Pulses/sec)	
#1	#2	Forward	Reverse
1	6	355 ± 53	0
0	1	0	355 ± 53
1	1	0	0
0	0	Normal Operating Condition	

If the correct responses are not received during VMS BIT, bit 5 of STATUS character S2 shall be set and bit 1 of BUILT-IN-TEST DATA character D2 shall be set.

3.5.5 Travel lock. If the configuration has a pointing device (weapon, radar antenna, sensor pod, etc.), the DRU is normally mounted to the pointing device. When the pointing device is stowed for travel by physically clamping it to the vehicle chassis, It is said to be “in travel lock”. When the pointing device is unclamped and elevated/rotated, it is said to be “out of travel lock”.

The DRU shall provide continuous measurements of vehicle attitudes and Travel Lock Pointing Device References when the pointing device is in travel lock-and measurements of pointing device attitudes when the pointing device is in or out of travel lock.

If either the Travel Lock Discrete or Travel Lock Commands Configuration Flag is set (3.5.8.8), the DRU shall determine whether the pointing device is in or out of travel lock by the travel lock discrete (3.5.4.5} or by the IN TRAVEL LOCK command and OUT OF' TRAVEL LOCK command.

When the travel lock discrete is a logic "1" or on receipt of the OUT OF TRAVEL LOCK command, which will be issued just prior to the pointing device leaving travel lock, the DRU shall:

a. Freeze vehicle attitudes.

b. Freeze and store travel lock pointing device references (azimuth and pitch) in terms of the appropriate Orientation (1 or 2).

c. Reset bit 4 of STATUS character S2.

d. Enter the Exclusive ZUPT Mode.

e. If the vehicle moves, set bit 0 of ALERT DATA character D3.

When the Travel Lock Discrete is a logic "1" at DRU turnon, the DRU shall:

a. Reset STATUS S2/4 (Pointing Device in Travel Lock).

b. Enter the Exclusive ZUPT Mode.

c. If the vehicle moves, set ALERT DATA D3/0 (Motion with Pointing Device out of Travel Lock).

In this situation, vehicle attitudes and travel lock pointing device azimuth and pitch references may be set to any value within the allowable ranges. These parameters are not valid since the orientation of the pointing device in the travel lock position is unknown.

When the travel lock discrete transitions to a logic "O" or on receipt of the IN TRAVEL LOCK command, which will be issued after the pointing device is clamped to the vehicle chassis, the DRU shall:

a. Provide present vehicle attitudes.

b. Provide present pointing device azimuth asnd pitch for travel lock reference.

c. Set bit 4 of STATUS character S2.

d. Automatically enter the Odometer Mode, reset bit 3 of STATUS character S1, and use VMS data if the Configuration Definition Flag for Odometer/Exclusive ZUPT Mode is set (3.5.8.8a).

e. Reset bit 0 of ALERT DATA character D3 (if it has not already been reset).

If neither the Travel Lock Discrete nor Travel Lock Commands. Configuration Flag is set, the DRU shall assume the pointing device is always in travel lock.

3.5.6 Shot detect. The DRU shall detect gun firing if the Configuration Deflatlon Flag for shot detect (3.5.8.8e) is set. Upon detection of gunfire, the DRU shall set bit 3 of STATUS character S2. At the completion of the Shot Detect Interval (3.5.8.15), the DRU shall reset bit 3 of STATUS character S2 and update travel lock references for vehicle rotations which have occurred during gun firing. In making the updates, the DRU shall assume that the DRU and vehicle chassis are rigidly coupled and that the vehicle chassis does not move when the qun is out of travel lock except during gun firing.

3.5.7 Position updates. The DRU shall accept position updates while the vehicle is stationary upon receipt of an ACCEPT POSITION or ACCEPT GEODETIC DATA command on the data bus. The position data may be entered into the prime system manually or automatically from an externally referenced positioning system connected to the prime system computer. If the criteria for acceptance of data entry of input parameters have been met, the DRU shall accept updates in any of the following groupings and conditions:

When using an ACCEPT POSITION Ccmmand, operating in the Universal Transverse Mercator Grid and the BCU Parameters-Configuration Flag is reset:

a. DRU Hemisphere, DRU zone, DRU spheroid, BCU Hemisphere, BCU Zone (Normal/Extended Zone Designation), northing, casting, and altitude either in terms of the normal zone or extended zone, but only during the first 3.5 minutes of Normal Align.

b. DRU Hemisphere, DRU zone, BCU Hemisphere, BCU Zone (Normal/Extended Zone Designation), northing, casting, and altitude either in terms of the normal zone or extended zone.

c. DRU Hemisphere, DRU zone, BCU Zone (Normal/Extended Zone Designation), northing, and casting either in terms of the

normal zone or extended zone.

d. Altitude only.

When using an ACCEPT POSITION command, operating in the Universal Transverse Mercator Grid and the BCU Parameters Configuration Flag is set:

a. Hemisphere, zone, spheroid, northing, casting, altitude, and BCU spheroid, hemisphere and zone, but only during the first 3.5 minutes of Normal Align.

b. Hemisphere, zone, spheroid, northing, casting, and altitude, but only during the first 3.5 minutes of Normal Align.

c. Hemisphere, zone nothing, casting, and altitude.

d. Hemisphere, zone, northing and casting.

e. Altitude only.

f. BCU spheroid, hemisphere, and zone.

When using an ACCEPT POSITION command, operating in the British National Grid:

a. Spheroid, northing, casting, and altitude in terms of the British National Grid, but only during the first 3.5 minutes of Normal Align.

b. Northing, casting, and altitude in terms of the British National Grid.

c. Northing and casting in terms of the British National Grid.

d. Altitude only.

When using an ACCEPT GEODETIC DATA command:

a. Prime System (DRU) spheroid, latitude, longitude, and altitude, but only during the first 3.5 minutes of Normal Align.

b. Latitude, longitude, and altitude.

c. Latitude and longitude.

d. Altitude only.

When an ACCEPT GEODETIC DATA command is used to initialize/update the DRU, UTM positions shall be output in the normal zone and grid azimuths shall be output based on the prime system (DRU) spheroid and normal zone.

The DRU shall accept a spheroid update only during the first 3.5 minutes of Normal Align, else ALERT DATA bit D5/7 shall be set and the entire position update rejected. The DRU shall not accept any update in a grouping if one or more update(s) in the grouping is rejected. The DRU shall set ALERT DATA D5/7 if an invalid grouping is received. The DRU shall not accept partial updates of horizontal position. The DRU shall accept UTM coordinate updates in terms of the normal zone or extended zone regardless of the designation of the zone/extended zone for output messages.

When a parameter is not being updated, the input data will be set to the following specified values:

PARAMETER	VALUE
Horizontal Position	
DRU Hemisphere/Zone	()
Easting	1,048,575
Northing	16,777,215
Latitude	91° 0′
Longitude	181° 0'
Altitude	16,383
DRU Spheroid	15
BCU Hemisphere/Zone	0
BCU Spheroid	15

Positions input to the DRU shall be for the applicable vehicle (Orientation 1) or pointing device (Orientation 2) offset point. The DRU shall perform all operations needed to relate the offset point position to the DRU position.

STATUS bit S2/6 (Position Update in Progress) shall be set when the DRU is performing a position update and shall be reset upon completion or rejection of the update. (NOTE: Change in positions output by the DRU, during a position update, reflect the update process, not vehicle motion.) When STATUS bit S3/1 (Orientation Attitude Data Valid) is set, position updates shall be completed within 5 seconds after receipt of the update command. When STATUS bit S3/1 is reset, position updates shall

be completed within 60 seconds after receipt of the update command. NOTE: During initialization, the DRU must determine approximate azimuth before it can relate an offset position (zero reference point) to the DRU position for a position update.)

3.5.8 Configuration data. The DRU shall use configuration data to tailor its operation to the prime system requiremefits. This data includes alignment angles to vehicle and prime system payload being oriented (pointing device), offset distances between the DRU and prime system position reference point, and configuration definition flags.

Additional information such as nominal odometer scale factor and fuel consumption factor is provided for use as needed by a manufacturer's DRU design.

3.5.8.1 Software case boresight angles to vehicle. The DRU shall use the software case boresight angles to the vehicle, (X, β, γ, as defined in 6.6.3.3.1, to calculate Vehicle Pitch, Vehicle Cant, Vehicle Roll, Vehicle Grid Azimuth, and Vehicle Geodetic Azimuth.

3.5.8.2 Software case boresight and angles to Pointing device. The DRU shall use the software case boresight angles to the pointing device, A, B and r, as defined in 6.6.3.3.2, to calculate Pointing Device Grid Azimuth, Pointing Device Geodetic Azimuth, Pointing-Device Pitch, Pointing Device-Cant, Pointing Device Roll, Pointing Device Pitch Rate, Pointing Device Roll Rate, and Pointing Device Azimuth Rate. There shall be separate sets of pointing device boresight angles for Orientation 1 and Orientation 2 (3.5.3.2.2.1).

3.5.8.3 Position offset distances. The DRU shall use position offset distances to transfer positions to/from a reference point on the transporting vehicle. There shall be separate sets of position offset distances for Orientation 1 and Orientation 2 (3.5.3.2.2.1).

In Orientation 1, the position offset distances, AX, AY, and AZ, are in the vehicle coordinate frame and are measured from the DRU case reference frame origin. AX, the offset along the vehicle longitudinal axis, is positive if the offset point is forward of the DRU in the direction of travel and is negative if behind. AY, the offset along the vehicle cross axis, is positive if the offset point is to the right of the DRU, looking in the direction of forward travel, and is negative if to the left. AZ, the offset along the vehicle vertical axis, is positive if the offset point is above the DRU and is negative if below.

In Orientation 2, the position offset distances, ΔX, ΔY, and ΔZ, are in the pointing device coordinate frame. They are measured from the DRU case reference frame origin to the offset point on the pointing device when the pointing device pointing axis and cross-axis are level. ΔX, the offset along the pointing device pointing axis, is positive if the offset point is forward of the DRU in the direction of pointing and is negative if behind. ΔY, the offset along the pointing device cross-axis, is positive if the offset point is to the right of the DRU, looking in the direction of pointing, and is negative if to the left ΔZ, the offset along the pointing device vertical axis, is positive if the offset point is above the DRU and is negative if below.

3.5.8.4 Odometer scale factor. The nominal odometer scale factor is [(nominal number of VMS pulses/mile)/(32000 pulses/mile)] 1. The nominal odometer scale factor will be in the range of 0.750 to 1.250.

3.5.8.5 ZUPT intervals. The DRU shall request ZUPTs at the intervals specified in configuration data for both the Odometer and Exclusive ZUPT Modes of operation. The range for the Odometer mode shall be 2 - 63 minutes in increments of 1 minute. The range for the Exclusive ZUPT Mode shall be 2 - 15 minutes in increments of 0.25 minute.

3.5.8.6 Align time. The maximum Normal Align time shall be as specified in configuration data. The DRU shall indicate completion of alignment when the specified align time has been exceeded. The range for Normal Align shall be 3.5 - 34-0 minutes, in increments of 0.25 minute.

3.5.8.7 Fuel consumption factor. This factor is the change in vehicle pitch per unit distance travelled due to consumption of fuel. The units are microradians/kilometer travelled.

3.5.8.8 Configuration definition flags. The DRU shall use configuration definition flags as follows:

a. Odometer/exclusive ZUPT mode. This Flag indicates the type of aiding mode to be used by the DRU. When set the DRU shall-assume a VMS is connected and shall operate in the odometer mode (3.5.3.2.1.3). When reset the DRU shall operate in the Exclusive ZUPT Mode (3.5.3.2.1.2).

b. Tracked/wheeled vehicle. When set this flag indicates to the DRU that it is installed on a tracked vehicle. When reset it indicates a wheeled vehicle.

c. Travel lock discrete. When set the DRU shall use the travel lock discrete to determine if it is in or out of travel lock. When reset the DRU shall ignore the travel lock discrete.

d. Travel lock commands. When set the DRU shall use the IN TRAVEL LOCK and OUT OF TRAVEL LOCK commands to determine if it is in or out of travel lock. When reset the DRU shall not use the IN TRAVEL LOCK and OUT OF TRAVEL LOCK commands and shall set bit 6 of ALERT DATA character D5 if either command is received. When the Travel Lock Commands Flag is set, the DRU shall assume it is in travel lock at turn on. (NOTE: To prevent conflicts in determining travel lock status, the Travel Lock Discrete Flag and Travel Lock Commands Flag should not be set simultaneously.) If both the Travel Lock Discrete Flag and Travel Lock Commands Flag are reset, the DRU shall assume it is always in travel lock.

e. Shot Detect. When set the DRU shall detect gunfire and correct the travel lock references for vehicle rotations which occur during gun firing. When reset the DRU shall neither detect gunfire nor perform these corrections.

f. Pointing device boresight angles. When set the DRU shall use Pointing Device boresight angles entered via the ACCEPT POINTING DEVICE BORESIGHT command. When reset the DRU shall use the stored Pointing Device boresight angles in the selected configuration code, and shall set bit 7 of ALERT DATA character D5 if an ACCEPT POINTING DEVICE BORESIGHT command is received.

g. Azimuth. When set the DRU shall output geodetic azimuth. When reset the DRU shall output grid azimuth.

h. Vehicle cant/roll. When set the DRU shall output vehicle roll. When reset the DRU shall output vehicle cant.

i. Vehicle boresight angles. When set the DRU shall use vehicle boresight angles entered via the ACCEPT VEHICLE BORESIGHT command. When reset the DRU shall use stored vehicle boresight angles in the selected configuration code and shall set bit 7 of ALERT DATA character D5 if an ACCEPT VEHICLE BORESIGHT command is received.

j. BCU Parameters. When set the DRU shall: accept BCU spheroid, hemisphere and zone in the ACCEPT POSITION command; output BCU spheroid, hemisphere and zone in the NAVIGATION DATA Message; and output Pointing Device Grid Azimuth in terms of the BCU spheroid, hemisphere and zone. When reset the DRU shall accept the extended zone hemisphere and zone in the ACCEPT POSITION command; and output Pointing Device Grid Azimuth in terms of the normal spheroid and normal or extended hemisphere and zone.

k. Expanded alerts. When set, the DRU shall issue expanded ALERT DATA (D1-D6) in the ALERT DATA message. When reset the DRU shall return short ALERT data (D1-D5) in the ALERT DATA message.

If the Configuration Definition Present flag (3.5.8.9) is reset, the DRU shall return short ALERT data (D1-D5) in the ALERT DATA message.

l. Pointing device cant/roll. When set the DRU shall output Pointing Device roll. When reset the DRU shall output Pointing Device cant.

m. Orientation 2 based on travel lock. When set, the DRU shall transition between Orientation 1 and Orientation 2 with respect to travel lock state. Travel lock state may be determined by either the travel lock discrete signal or receipt of travel lock designation commands via the serial data bus. While in travel lock, the DRU shall align itself and operate as defined by the Orientation 1: Coordinate Grame code, vehicle and pointing device boresight angles, and position offset distances. When out of travel lock, the DRU shall align itself and operate as defined by the Orientation 2: Coordinate Frame code, Pointing Device boresight angles, and position offset distances.

When an out-of-travel-lock condition is detected, the DRU shall freeze the vehicle attitude and travel lock pointing device reference values in terms of Orientation 1 and transition to Orientation 2. Once transition is complete, the DRU shall store the travel lock pointing device reference values in terms of Orientation 2.

When reset, the DRU shall not change orientations based on travel lock state.

n. Orientation 1 - 2 based on Pointing device pitch/roll. This flag, used in conjunction with the “Orientation 2 Based on Pointing Device Attitude” and “Orientation 1 to Orientation 2 Direction of Traverse” flags, selects the angle that the DRU is to monitor in determining when it is to transition from Orientation 1 to Orientation 2.

When set, the DRU shall transition from Orientation 1 to Orientation 2 when the pointing device pitch, based on Orientation 1, crosses the 1-2 Threshold Angle in the direction specified by the 1-2 Direction of Traverse Flag.

When reset, the DRU shall transition from Orientation 1 to Orientation 2 when the pointing device roll, based on Orientation 1, crosses the 1-2 Threshold Angle in the direction specified by the 1-2 Direction of Traverse Flag.“

o. Orientation 2 - 1 based on pointing device pitch/roll. This flag, used in conjunction with the “Orientation 2 Based on Pointing Device Attitude” and “Orientation 2 to Orientation 1 Direction of Traverse” flags, selects the angle that the DRU is to monitor in determining when it is to transition from Orientation 2 to Orientation 1.

When set, the DRU shall transition from Orientation 2 to Orientation 1 when the pointing device pitch, based on Orientation 2, crosses the 2-1 Threshold Angle in the direction specified by the 2-1 Direction of Traverse Flag.

When reset, the DRU shall transition from Orientation 2 to Orientation 1 when the pointing device roll, based on Orientation 2, crosses the 2-1 Threshold Angle in the direction specified by the 2-1 Direction of Traverse Flag.

p. Orientation 1 to orientation 2 direction of traverse. This flag, used in conjunction with the "Orientation 2 Based on Pointing Device Attitude” and "Orientation 1-2 Based on Pointing Device Pitch/Roll” flags, controls whether the DRU transitions from Orientation 1 to Orientation 2 as the selected angle (pitch or roll) either increases or decreases as it crosses the 1-2 Threshold Angle.

When set to “11”, this flag indicates that the DRU shall transition from Orientation 1 to Orientation 2 when the direction of traverse causes the absolute value of the angle to increase as it crosses the Pk 1-2 Threshold Angle.

When set to “00”, this flag indicates that the DRU shall transition from Orientation 1 to Orientation 2 when the direction of traverse causes the absolute value of the angle to decrease as it crosses the ± 1-2 Threshold Angle.

When set to “01”, this flag indicates that the DRU shall transition from Orientation 1 to Orientation 2 when the *direction of* traverse causes the angle to numerically increase as it crosses the 1-2 Threshold Angle.

When set to “10”, this flag indicates that the DRU shall transition from Orientation 1 to Orientation 2 when the direction of traverse causes the angle to numerically decrease as it crosses the 1-2 Threshold Angle.

q. Orientation 2 to orientation 1 direction of traverse. This flag, used in conjunction with the “Orientation 2 Based on Pointing-Device Attitude” and "Orientation 2-1 Based on Pointing Device Pitch/Roll" flags, controls whether the DRU transitions from orientation 2 to orientation 1 as the selected angle (pitch or roll) either increases or decreases as it crosses the 2-1 Threshold Angle.

When set to "11", this flag indicates that the DRU shall transition from Orientation 2 to Orientation 1 when the direction of traverse causes the absolute value of the angle to increase as it crosses the ± 2-1 Threshold Angle.

When set to "00", this flag indicates that the DRU shall transition from Orientation 2 to Orientation 1 when the direction of traverse causes the absolute value of the angle to decrease as it crosses the ± 2-1 Threshold angle.

When set to "01", this flag indicates that the DRU shall transition from Orientation 2 to Orientation 1 when the direction of traverse causes the angle to numerically increase as it crosses the 2-1 Threshold-Angle.

When set to “10”, this flag indicates that the DRU shall transition from Orientation 2 to Orientation 1 when the direction of traverse causes the angle to numerically decrease as it crosses the 2-1 Threshold Angle.

r. Orientation 2 based on Pointing device attitude. When set, the DRU shall transition between Orientation 1 and Orientation 2 as the selected angle (pitch/roll) either increases or decreases as it crosses the respective Threshold Angle.

When reset, the DRU shall not transition between Orientation 1 and Orientation 2 as a function of pointing device pitch or roll.

3.5.8.9 Configuration selection. The DRU shall identify the configuration data to be used by the configuration code number programmed for the four configuration discretes on J1. An open circuit shall indicate a logic “0”. A connection to signal ground shall indicate a logic "1". The discrete input circuits shall require external drivers to source or sink no more than 2.0 milliamperes. The DRU shall contain 15 sets (configuration code numbers 0 through 14) of permanently stored configuration data. When configuration code 15 is selected, the DRU shall accept and use configuration data loaded using an ACCEPT CONFIGURATION DATA Command. The DRU shall maintain a Configuration Data Present

Flag which indicates whether valid configuration data has been loaded for configuration code 15, with an ACCEPT CONFIGURATION DATA command. Configuration data values are listed in APPENDIX F.

For configuration code numbers 0 through 14, upon receipt of an ACCEPT CONFIGURATION DATA command, the DRU shall set ALERT DATA D5/7 (Invalid Update Request) and not use data contained in the command.

3.5.8.9.1 Initializing configuration data. Upon turn on, the DRU shall determine the configuration code number from the configuration discretes on J1. For configuration codes 0 - 14 the DRU shall select and use the permanently stored configuration data applicable to the selected COnfiguration code number. For configuation code 15 the DRU shall select and use the configuration data previously entered via an ACCEPT CONFIGURATION DATA command, if the Configuration Data Present Flag is set. If the Configuration Data Present Flag, for configuration code 15, is reset, the DRU shall: Set Alert bit D5/3; set STATUS bit S1/7:reset STATUS bits S1/4, S1/5, and S2/2; and suspend Normal Alignment. When a valid ACCEPT CONFIGURATION DATA command is received, the DRU shall: store the configuration data in program alterable, non-volatile memory; set the Configuration Data Present Flag; override Alert D5/3; and continue Normal Alignment. The DRU shall retain and use the stored configuration data until it is changed (3.5.8.9.2) or cleared (3.5.8.10).

3.5.8.9.2 Changing configuration data. For configuration code 15 the DRU shall store and use new configuration data supplied by an ACCEPT CONFIGURATION DATA command.

3.5.8.10 Clearing temporary configuration data. Upon power-up the DRU shall clear all data loaded via an ACCEPT CONFIGURATION DATA command and reset the Configuration Data Present Flag when: The DRU detects a fault condition where the stored configuration data may have been altered; or the configuration code number at turnon, differs from the configuration code number present when the DRU was last shut off.

3.5.8.11 Configuration data output. Upon receipt of a RETURN CONFIGURATION DATA command, the DRU shall return the values of configuration data presently being used via a CONFIGURATION DATA Message.

3.5.8.12 DRU coordinate frome code. The DRU shall use a DRU Coordinate Frame Code to relate the case coordinate frame to the intermediate DRU Coordinate Frame (6.6.3.1.2). The codes are specified in Appendix I. There shall be separate DRU Coordinate Frame Codes for Orientation 1 and Orientation 2.

3.5.8.13 1-2 threshold angle. This angle is used in conjunction with the Orientation Changes Based on Pointing Device Pitch and Orientation Changes Based on Pointing Device Roll configuration flags. This is the pointing device pitch or roll angle in terms of Orientation 1 at which the DRU shall transition from Orientation 1 to Orientation 2 when crossed in the direction specified by the 1-2 Direction of Traverse flag. The ranges are -1600 to +1600 roils for pitch and -3199 to +3200 roils for roll.

3.5.8.14 2-1 threshold angle. This angle is used in conjunction with the Orientation Changes Based on Pointing Device Pitch and Orientation Change Based on Pointing Device Roll configuration flags. This is the pointing device pitch or roll angle, in terms of Orientation 2, at which the DRU shall transition from Orientation 2 to Orientation 1 when crossed in the direction specified by the 2-1 Direction of Traverse flag. The ranges are -1600 to +1600 roils for pitch and -3199 to +3200 mils for roll.

3.5.8.15 Shot detect interval. When the Shot Detect Configuration Definition Flag is set and the DRU detects a shot, the DRU shall set Shot Detect STATUS bit S2/3 for the Shot Detect Interval specified in configuration data. Travel lock reference shall be corrected for vehicle rotations which occur during gun firing at the end of the Shot Detect Interval.

3.S.9 Boresight angles.

3.5.9.1 Vehicle boresight angles.

3.5.9.1.1 Vehicle boresight angle entry. If the If the Vehicle Boresight Angles configuration flag is set, upon receipt of a valid ACCEPT VEHICLE BORESIGHT command, the DRU shall: store the received vehicle boresight angles in program alterable, non-volatile memory; set a Vehicle Boresight Angles Present flag, which indicates that vehicle boresight angles were received and stored; and use the new values. The stored vehicle boresight angles shall not be modified unless a new ACCEPT VEHICLE BORESIGHT command is received or they are cleared in accordance with 3.5.9.1.2. When the Vehicle Boresight Angles Present flag is reset, the DRU shall: set ALERT DATA bit D2/7; set STATUS bit S1/7; and reset STATUS bits S1/4, S1/5, and S2/2. ALERT DATA bit D2/7 shall not be reset until a valid ACCEPT VEHICLE BORESIGHT command has been received and processed.

If the Vehicle Boresight Angles configuration flag is reset, the DRU shall use the permanently stored values for vehicle boresight angles for the selected configuration code.

3.5.9.1.2 Clearing vehicle boresight angles. Upon power-up, the DRU shall clear the temporary stored vehicle boresight angles and reset the Vehicle Boresight Angles Present Flag when: the configuration code number at turnon differs from the configuration code number present when the DRU was last shut off; or the DRU detects a fault condition where the stored vehicle boresight angles may have been altered.

3.3.9.1.3 Output of vehicle boresight angles. Upon receipt of a RETURN VEHICLE BORESIGHT command, the DRU shall transmit the vehicle boresight angles presently being used in a VEHICLE BORESIGHT Message.

3.5.9.2 Pointing device boresight angles.

3.5.9.2.1 Pointing device boresight angle entry. If the Pointing Device Boresight Angles configuration flag is set, upon receipt of a valid ACCEPT POINTING DEVICE BORESIGHT command, the DRU shall: store the received pointing device boresight angles in program alterable, non-volatile memory; set a Pointing Device Boresight Angles Present flag, which indicates that pointing device boresight angles were received and stored; and use the new values. The stored pointing device boresight angles shall not be modified unless a new ACCEPT POINTING DEVICE BORESIGHT command is received or they are cleared in accordance with 3.5.9.2.2. When the Pointing Device Boresight Angles Present flag is reset, the DRU shall: set ALERT DATA bit D5/4; set STATUS bit S1/7; and reset STATUS bits S1/4, S1/S, and S2/2. ALERT DATA bit D5/4 shall not be reset until a valid ACCEPT POINTING DEVICE BORESIGHT command has been received and processed.

If the Pointing Device Boresight Angles configuration flag is reset, the DRU shall use the permanently stored values for pointing device boresight angles for the selected configuration code.

3.5.9.2.2 Clearing pointing device boresight angles. Upon power-up, the DRU shall clear the temporary stored pointing device boresight angles and reset the Pointing Device Boresight Angles Present Flag when: the configuration code number at turnon differs from the configuration code number present when the DRU was last shut off; or the DRU detects a fault condition where the stored pointing device boresight angles may have been altered.

3.5.9.2.3 Output of Pointing device boresight angles. Upon receipt of a RETURN POINTING DEVICE BORESIGHT command, the DRU shall transmit the pointing device boresight angles presently being used in a POINTING DEVICE BORESIGHT message.

3.5.10 British National grid. During initialization, if an ACCEPT POSITION command is receivd in which the least significant 4 bits of D8 designate spheroid No. 0 (Airy), the DRU shall output coordinates and grid azimuths in the British National Grid as described in the Ordnance Survey Information Leaflet, No. 72. The DRU shall also output pertinent messages in the British National Grid if it was doing so prior to the last shutdown and no ACCEPT POSITION command has been received that changed the spheroid. During initiation of, and while operating in the British National Grid, the DRU shall ignore characters D6 and D7 of the ACCEPT POSITION command during updates. Characters D22 of the NAVIGATION DATA message and D2 of the POSITION DATA message shall indicate a plus for the hemisphere and a zero for zone.

If the Configuration Definition Flag for Azimuth (3.5.8.8g) is reset, pointing device grid azimuths, vehicle grid azimuths, and travel lock grid azimuth references in messages shall be in terms. of the British National Grid. If the Configuration Definition Flag for Azimuth is set, all azimuths in messages shall be geodetic.

3.5.11 Normal Zone. If the DRU is operating in the Universal Transverse Medicator Grid, then, at anytime during a mission when character D6 of the last received ACCEPT POSITION command is A 61 or when the DRU crosses an extended zone boundary, the DRU shall output UTM coordinates and grid azimuths in the normal zone. That is, in terms of standard (normal) hemisphere and zone for the geographic position where it is located. Normal zone boundaries shall be in accordance with TM 5-241-8, Universal Transverse Mercator Grid. When the DRU crosses the equator or zone boundary, the DRU shall automatically reference the coordinates to the changed hemisphere/zone and set bit 3 of ALERT DATA character D6.

If the Configuration Definition Flag for Azimuth (3.5.8.8g) is reset, pointing device grid azimuths, vehicle grid azimuths, and travel lock grid azimuth references in messages shall be in terms of the hemisphere and zone in which the DRU is located. If the Configuration Definition Flag for Azimuth is set, all azimuths in messages shall be geodetic.

3.5.12 Extended zone. If the DRU is operating in the Universal Transverse Mercator Grid, then, at anytime during a mission when character D6 of the last received ACCEPT POSITION command designates a hemisphere and zone, the DRU shall output UTM coordinates and grid azimuths in terms of the extended zone and the spheroid designation stored/input during initialization.

The designated zone identifies the zone whose boundaries shall be extended 100 km into each adjacent zone (6.6.1.4). When the DRU crosses an extended zone boundary, the DRU shall automatically reference UTM coordinates and grid azimuths in terms of the normal hemisphere and normal zone in which it is located and set bit 3 of ALERT DATA character D6.

If the Configuration Definition Flag for Azimuth (3.5.8.8g) is reset, pointing device grid azimuths, vehicle grid azimuths, and travel lock grid azimuth references in messages shall be in terms of the extended zone. If the Configuration Definition Flag for Azimuth is set, all azimuths in messages shall be geodetic.

3.6 Performance.

3.6.1 General. Unless otherwise specified, values set forth to establish the requirements for performance apply to performance under any and all combinations of conditions and environments as specified herein.

3.6.1.1 Accuracy. Coordinate and reference frame transformation computations shall introduce no more than 0.1 meter position error and 0.01 mil orientation error.

Azimuth, Pitch, Roll, and Angular Rate accuracy requirements stated herein shall be met at any specified temperatures. Azimuth, Pitch and Roll accuracy requirements stated herein shall be met at any DRU case orientation.

Azimuth accuracies specified in 3.6.1.1.9.1 shall be met when operating at any latitude within the range of 65° south to 65° north. When operating in latitude ranges of 65° to 75° south or north, azimuth accuracies shall degrade no more than a factor of 0.42262 secant latitude.

Position accuracies stated herein shall be met at any specified temperatures. The position accuracy requirements specified herein apply when the DRU is aligned as specified in 3.5.3.1.2 and 3.5.3.1.3 and when the following conditions are applicable:

a. A position update is performed after Normal Align was completed at more than one vehicle stop.

b. A position update is performed after Normal Align was completed when travel time between vehicle stops exceeded four minutes.

Position accuracies stated in 3.6.1.1.1 and 3.6.1.1.2 shall be met when operating at any latitude within the range of 75° north to 75° south.

Azimuth accuracies stated in 3.6.1.1.9.1, 3.6.1.1.9.2, and 3.6.1.1.9.3 apply to Pointing Device Grid and Geodetic Azimuths assuming the DRU has been accurately aligned to the pointing device. Vehicle Grid and Geodetic Azimuths are approximations without accuracy specifications.

The following is a summary of accuracy requirements.

SUMMARY OF ACCURACY REQUIREMENTS

PARAMETER	LATITUDE 65°S-65°N	LATITUDE 65°S-75°S & 65°N-75°N
Normal Align	0.67 mils PE	0.283 Sec (Lat) mils PE
Survey Azimuth (Throughout the mission when normal align used for initialization)	0.97 mils PE	0.283 Sec (Lat) +0.3 roils PE
Stored Heading Align	0.1 roils RMS Relative to Stored Heading	
Pitch	0.34 roils PE	
Roll/Cant	0.34 roils PE	
Horizontal Position Odometer Mode	10 m CEP DIST $\leq$ 4 Km 0.0025 DIST CEP DIST $\geq$ 4 Km	
Altitude Odometer Mode	6.7 m PE DIST < 10 Km 0.00067 DIST PE DIST > 10 Km	
Horizontal Position Exclusive ZUPT Mode/Other	18m CEP DIST $\leq$ 27Km	18m CEP DIST S 63.9 Cos (Lat) Km
Altitude Exclusive ZUPT Mode/Other	10 m PE DIST $\leq$ 35 Km	

3.6.1.1.1 Horizontal Position odometer mode. Horizontal position error shall not exceed 10.0 meters Circuiar Error Probable (CEP) for total odometer distance traveled in the range of 0 to 4,000 meters from the last position update point. Within that distance range no more than 1.0 percent of the radial errors may exceed 26.0 meters.

Horizontal position error shall not exceed 0.25 percent of the total odometer distance traveled, CEP, for distances traveled exceeding 4,000 meters from the last position update point. For distances exceeding 4,000 meters, no more than 1.0 percent of the radial errors may exceed 0.65 percent of the odometer distance traveled.

3.6.1.1.2 Altitude odometer mode. Altitude error shall not exceed 6.7 meters Probable Error (PE) for total odometer distance traveled in the range of 0 to 10,000 meters from the last altitude update point. Within that distance range no more than 1.0 percent of the absolute values of altitude errors may exceed 26.0 meters.

Altitude error shall not exceed 0.067 percent of the total odometer distance traveled, PE for distances traveled exceeding 10,000 meters from the last position update point. For distances exceeding 10,000 meters, no more than 1.0 percent of the absolute values of altitude errors may exceed 0.26 percent of the total odometer distance traveled.

3.6.1.1.3 Horizontal Position exclusive ZUPT mode/other. When operating in the Exclusive ZUPT Mode with zero-velocity updates at 4 minute travel intervals, horizontal positioh error shall not exceed 18 meters Circular Error Probable (CEP) and no more than 1.0 percent of the radial errors shall exceed 47 meters for the following conditions:

a. Distance traveled in the range of 0 to 27,000 meters from the last position update point, latitude within the range of 65° south to 65° north.

b. Distance traveled in the range of 0 to 63,900 x Cos (latitude) meters from the last position update point, latitude within the range of 65° to 75° south or north.

This requirement shall also apply when operating in the Odometer mode with zero-velocity updates at 10 minute travel intervals throughout a mission.

3.6.1.1.4 Altitude, exclusive ZUPT mode/other. When operating in the Exclusive ZUPT Mode, with zero-velocity updates at 4 minute travel intervals, altitude error shall not exceed 10 meters PE and no more than 1.0 percent of the absolute values of altitude errors shall exceed 39 meters.

The specification applies when distance traveled is in the range of 0 to 35,000 meters from the last position update point and latitude is within the range of 75° south to 75° north.

This requirement shall also apply when operating in the Odometer mode with zero-velocity updates at 10 minute travel intervals throughout a mission.

3.6.1.1.5 Horizontal position, air transport mode. When operating in the Air Transport Mode, horizontal position error shall not exceed 1 nmi/h Circular Error Probable (CEP) Per hour of transport time after takeoff. Prior to takeoff, the appropriate Odometer Mode or Exclusive ZUPT Mode/Other requirements apply.

3.6.1.1.6 Altitude, air transport mode. When operating in the Air Transport Mode, altitude shall be fixed for the duration of the transport after takeoff. Prior to takeoff, the appropriate Odometer Mode or Exclusive ZUPT Mode/Other requirements apply.

3.6.1.1.7 Horizontal Position, marine transport mode. When operating in the Marine Transport Mode, horizontal position error shall not exceed 1 nmi/h Circular Error Probable (CEP) per hour of transport time.

3.6.1.1.8 Altitude, marine transport mode. When operating in the Marine Transport Mode, altitude shall be fixed for the duration of the transport.

3.6.1.1.9 Azimuth. When the DRU is mounted and aligned to a Pointing Device; Vehicle azimuths, grid or geodetic, are approximations without accuracy specifications.

3.6.1.1.9.1 Normal align. Upon completion of Normal Align from a cold start, the Pointing Device Grid or Geodetic Azimuth error shall not exceed 0.67 mil PE. No more than 1.0 percent of the absolute values of Pointing Device Grid or Geodetic Azimuth errors shall exceed 2.6 mils.

3.6.1.1.9.2 Stored heading. Upon completion of Stored Heading Align, the Pointing Device Grid or Geodetic Azimuth error with respect to stored heading shall not exceed 0.1 mil RMS.

3.6.1.1.9.3 Azimuth accuracy during survey. After completing a Normal Align and operating in the Odometer mode with only one zero-velocity update per hour, the Pointing Device Grid or Geodetic Azimuth error shall not exceed 0.97 mil PE for missions up to 24 hours in duration. No more than 1.0 percent of the absolute value of Pointing Device Grid or Geodetic Azimuth errors shall exceed 3.8 roils for missions up to 24 hours in duration.

The specification in 3.6.1.1.9.3 shall also apply when operating in the Exclusive ZUPT Mode with zero-velocity updates at 4 minute or less intervals.

3.6.1.1.10 Pitch. After completing Normal Align or after completing Stored Heading Align and thereafter throughout the mission, Pointing Device Pitch error shall not exceed 0.34 mil PE. No more than 1.0 percent of the absolute value of Pointing Device Pitch errors shall exceed 1.3 roils.

When the DRU is mounted and aligned to a Pointing Device; vehicle pitch is an approximation without accuracy specifications.

3.6.1.1.11 Roll/cant. After completing Noqmal Align or after completing Stored Heading Align and thereafter throughout the mission, Pointing Device Roll/Cant error shall not exceed 0.34 mil PE. No more than 1.0 percent of the absolute value of Pointing Device Roll/Cant errors shall exceed 1.3 roils.

When the DRU is mounted and aligned to a Pointing Device; vehicle roll/cant is an approximation without accuracy specifications.

3.6.1.1.12 Angular rates. After completing Normal Align or Stored Heading Align and thereafter throughout the mission, Pointing Device Grid or Geodetic Azimuth rate, Pitch rate, and Roll rate errors shall not exceed 0.5 mil per second RMS for rates in the range of -356 to +356 roils per second. Nonlinearity shall not exceed 1 percent.

Within the angular rate ranges of -3276.8 to -356 and +356 to +3276.8 roils per second, the error shall not exceed 2.5 percent of the instantaneous rate RMS.

3.6.1.1.13 Data Staleness. Data staleness is the delay between the time the DRU data is “valid” and the time transmission of the message, containing that data, is completed. Data staleness shall not exceed the maximum response time specified for each message in Table IV. See 6.8.3 for a description of data staleness.

3.6.1.2 Reaction time.

3.6.1.2.1 Initial alignment. In the Normal Align mode, the DRU shall be ready to survey within the time specified in configuration data (3.5.8.6), after application of power, when operated in the ambient temperature range of -50°F (-46°C) to +140°F (+60°C) and the vehicle is stationary for the entire period. Initial alignment reaction time includes the total time needed to energize, achieve thermal control, initialize position coordinates, align to level and North, perform initial BIT, and otherwise prepare the DRU for the survey mission. If Normal Align, is interrupted, reaction time may increase in accordance with 3.5.3.1.2.

3.6.1.2.2 Stored heading align. Stored Heading Align shall be completed within the time specified in configuration data (3.5.8.6) after receipt of the STORED HEADING command or after application of power if the DRU previously was shut down with a STORED HEADING SHUTDOWN command. Time to achieve Odometer Mode operation shall be in accordance with 3.5.3.1.3.

3.6.1.3 Mission length and duration. DRU survey missions may range from 0 to 100 km in length and a few minutes to 24 hours in duration. System errors shall be sufficiently controlled to maintain the accuracies specified in 3.6.1.1 when the DRU is operated during missions within the above ranges. Position updates at distances traveled no shorter than those specified in 3.6.1.1.3 and 3.6.1.1.4 are permitted to maintain accuracies in the Exclusive ZUPT Mode/Other.

3.6.1.4 Alignment conditions.

3.6.1.4.1 Off level. The DRU shall perform as specified herein when mounted in any orientation.

3.6.1.4.2 Base motion. The DRU shall perform as specified herein when the prime system vehicle, while nominally stationary, is subject to wind buffeting, normal crew movement, engine vibration, vibration from 60 Hz and 400 Hz engine/generator sets, and other sources of motion usually found on the battlefield.

3.6.1.5 Survey conditions.

3.6.1.5.1 Vehicle dynamics. The DRU shall perform as specified herein when operated within the following vehicle dynamic envelopes:

a. In ground vehicles, horizontal velocity within the range of 0 to 80 miles per hour. While being transported by helicopter, ground speed within the range of 0 to 200 knots.

b. In ground vehicles, vertical velocity within the range of 0 to 15 miles per hour up or down. While being transported by helicopter, vertical speed within the range of 0 to 2400 ft/min.

c. Acceleration (excluding shock and vibration) within the range of 0 to 1.5g (not including gravitational acceleration) in any direction due to vehicle starting, stopping and turning.

d. Vehicle pitch within the range of -40 to +40 degrees. Vehicle cant/roll within the range of -40 to +40 degrees. The relationships of vehicle pitch and cant/roll axes to DRU case coordinates may vary from installation to installation.

e. Angular velocities within the range of 0 to 200 degrees per second around any axis.

f. Angular accelerations within the range of 0 to 6000 degrees per (second squared) around any axis.

g. Shock and vibration generated by the transporting vehicle, which may be a tracked vehicle, tracked trailer, wheeled vehicle, wheeled trailer, helicopter, or helicopter lift of a palletized system. The DRU will be in the Exclusive ZUPT Mode when transported by helicopter.

h. Drop shock sustained when helicopter lifted pallet is set down on the ground (See 3.7.10.2).

3.6.1.5.2 Deployment. In addition to operating when subjected to the above vehicle dynamics, the DRU shall perform as specified herein when operated under the following conditions:

a. Shock and vibration generated by weapon firing.

b. Rotation and elevation of a pointing device. When mounted to a pointing device, the DRU may be elevated through an angle of 105 degrees or rotated 360 degrees in azimuth when the pointing device is erected.

c. Transported by aircraft while in the Air Transport Mode at altitudes of up to 70,000 feet.

3.6.2 Mechanical characteristics.

3.6.2.1 Mechanical envelope. The envelope of the DRU, excluding connectors, shall be in accordance with Figures 6 through 10 inclusive. Dimensions shall be maintained as specified, BIT indicators, DS1 and DS2, and the elapsed time meter, M1 shall be located as shown, and shall be covered to prevent access except during troubleshooting and maintenance actions. Handles shall be provided for lifting the DRU and shall be located as shown.

3.6.2.2 Mounting. The DRU mounting provisions and reference datums shall be in accordance with Figures 8 through 10.

3.6.2.3 Weight. The weight of the DRU shall not exceed 55 pounds.

3.6.3 Reliability. The DRU shall have a Mean-Time-Between-Failure (MTBF) of 4000 hours or greater.

3.6.4 Maintainability. The DRU shall be designed in accordance with the requirements contained herein to achieve ease and economy of maintenance.

3.6.4.1 Corrective maintenance. The DRU shall, upon occurrence of a single malfunction, be restored to operation, by replacement, within a meantime-to-repair (MTTR) of 30 minutes at the organizational level. Times include fault isolation, removal, and replacement, but do not include supply and administration time;

3.6.4.2 Preventive maintenance. The DRU shall not require any preventative maintenance other than cleaning of exterior surfaces to remove dust, dirt, and other foreign particles.

3.6.4.3 Adjustments/calibration. The DRU shall not require any adjustments or calibrations in the field that require operator interaction, nor shall the DRU require zero-velocity updates more frequently than stated herein.

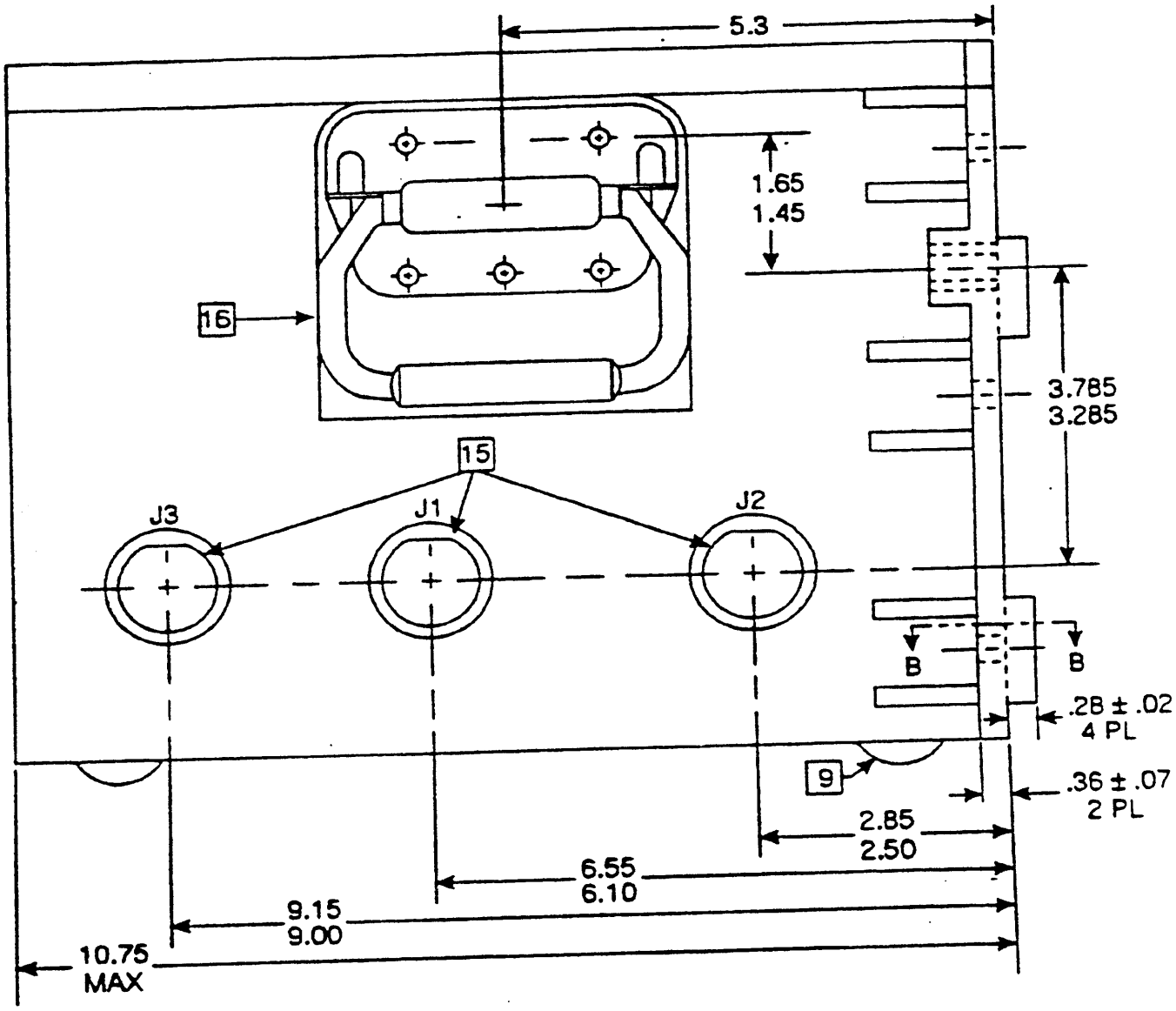


Figure 6
DRU Right Side

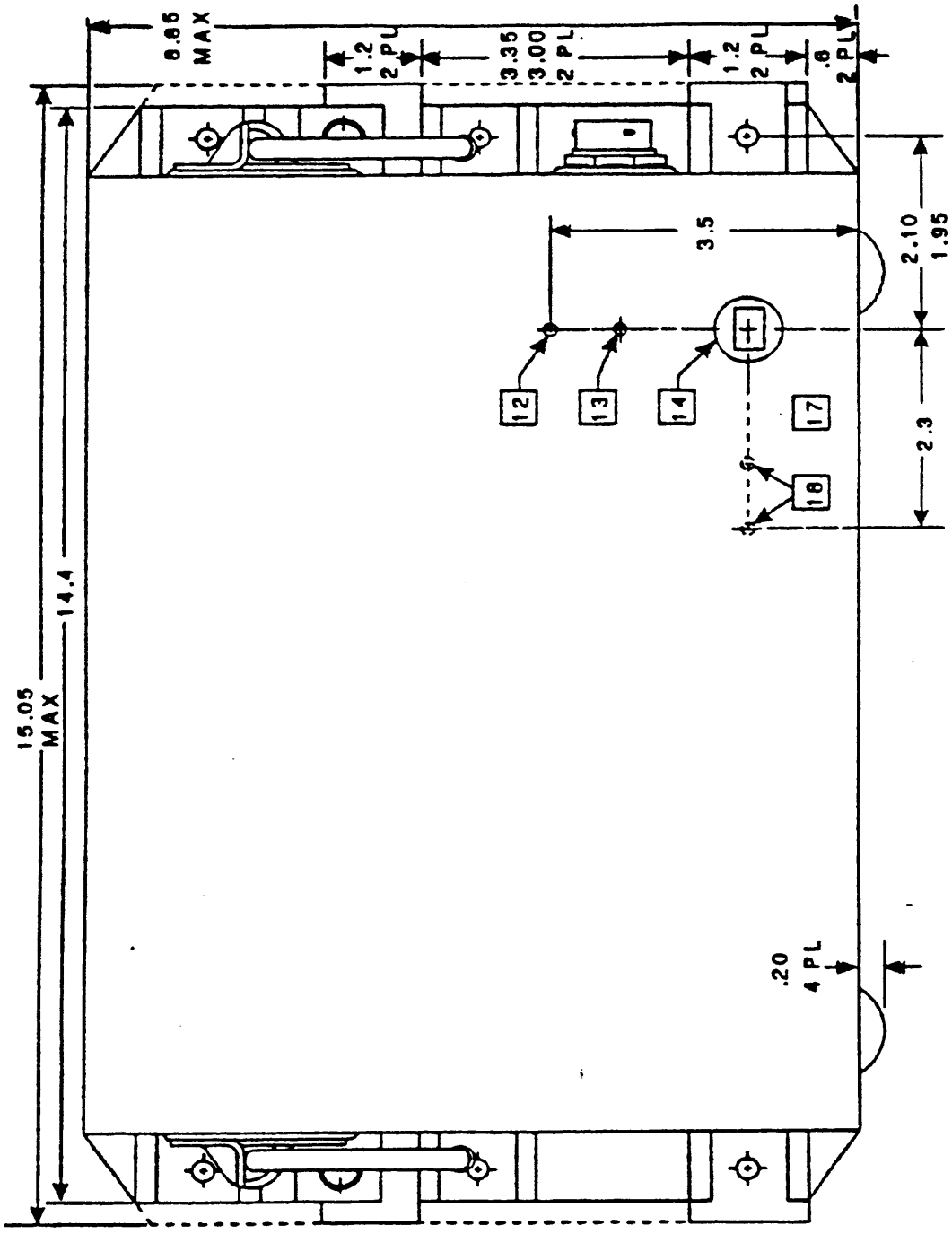


Figure 7
DRU Front

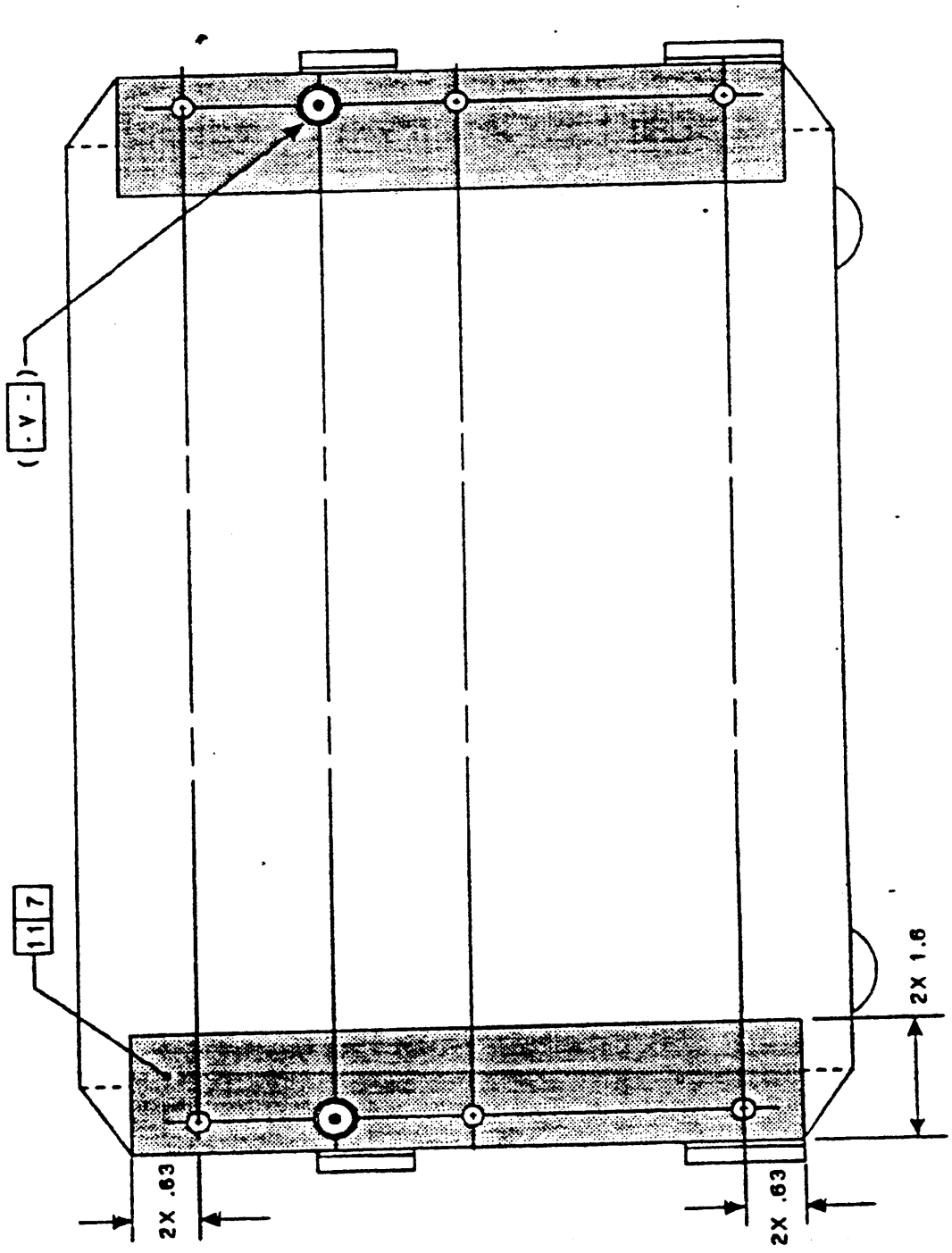


Figure 8
DRU Back/Mounting Surface

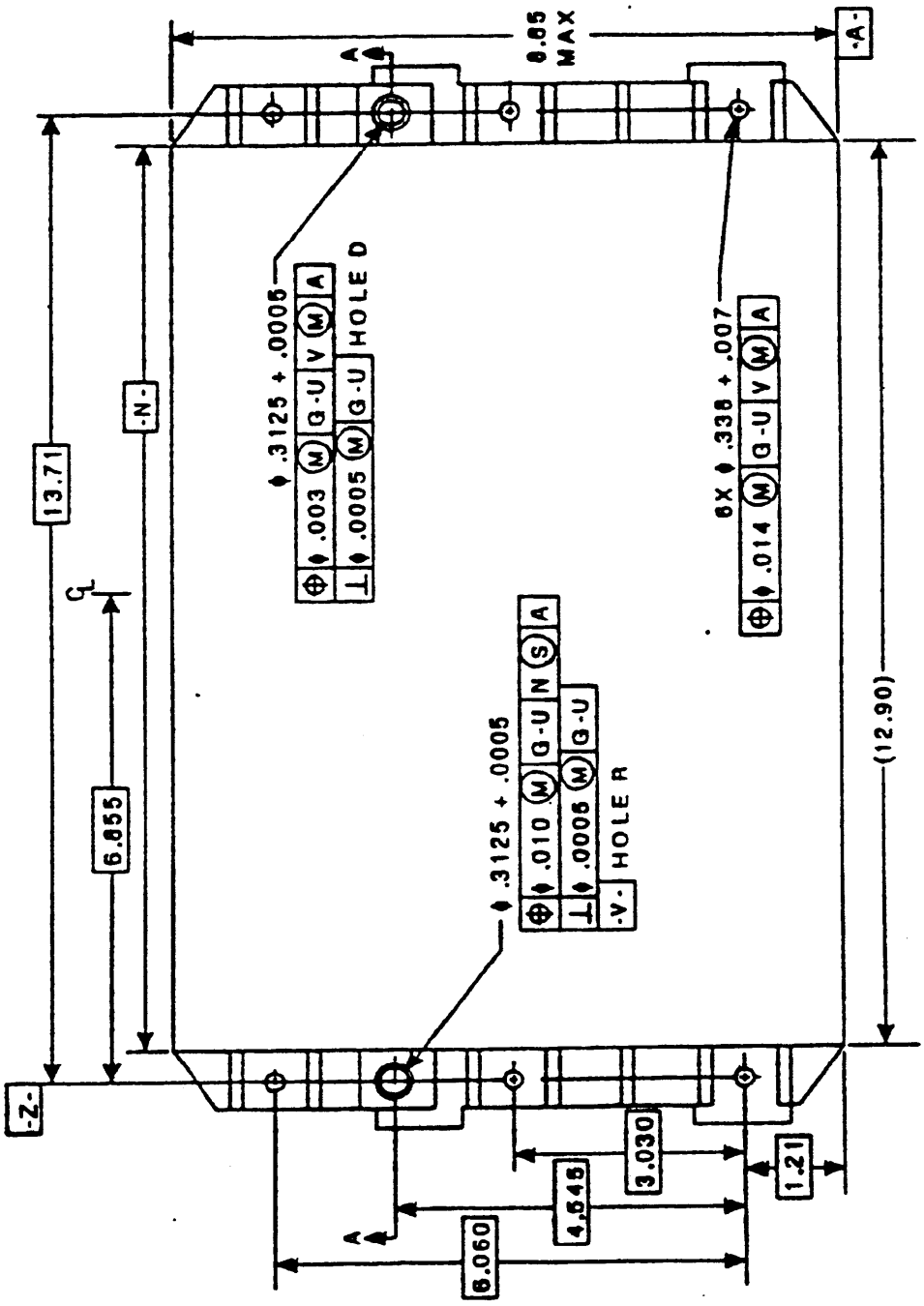
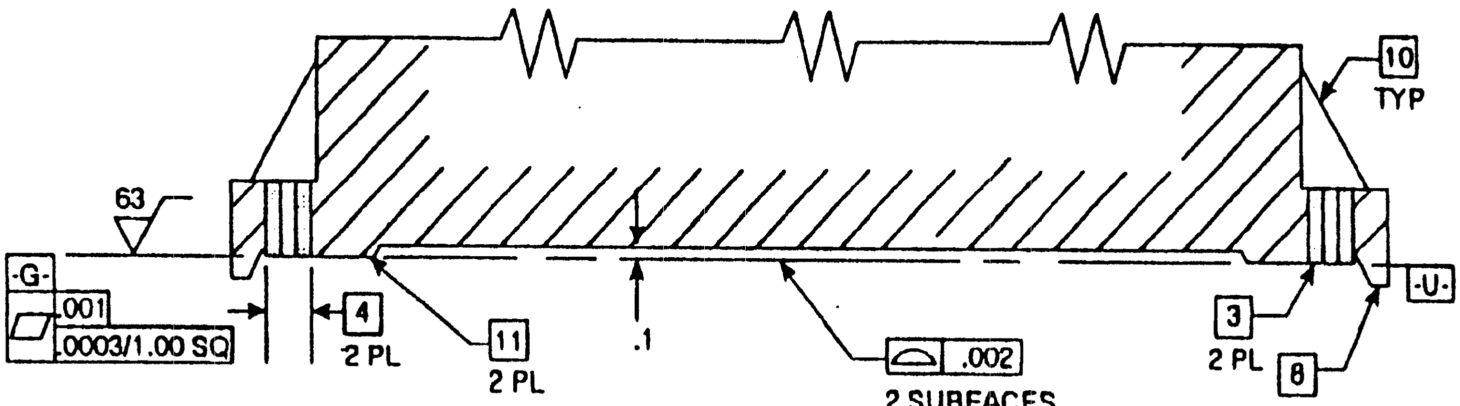


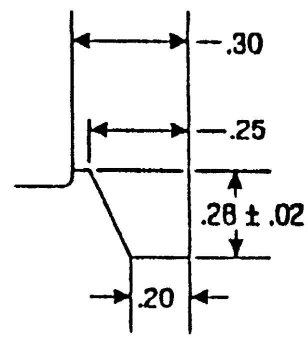
Figure 9
DRU Hole Locations



SECTION A-A

NOTES:

1. Dimensioning and tolerancing per ANSI Y14.5M 1982.
2. Material: coefficient of expansion compatible with AL alloy 6061-T651/QQ-A-250/11.
3. Shrink fit insert: cres type 17-4PH cond A/AMS 5643; heat treat to H1025/MIL-H-6875; passivate per MIL-S-5002.
4. Fit: .4975-.4978 DIA hole, .4983-.4980 DIA insert.
5. Dimensions are in inches.
6. Unless otherwise specified, tolerances on .X ± .1, .XX ± .01, .XXX ± .005.
7. Shading indicates percise mounting surface.
8. Protective ridges shall not interfere with mounting. Visual access required to verify proper mating of DRU and mount.
9. Shape of feet optional, height as specified. Feet shall be made of low wear material.
10. Gusset size and location optional, but shall not interfere with mating connectors and mounting bolts.
11. Mounting surface shall be free of paint for electrical bonding.
12. Bit indicator DS-1, green display, shall be labeled "PWR".
13. Bit indicator DS-2, green display, shall be labeled "DRU".
14. Elapsed time indicator, digital, shall be labeled "HOURS".
15. Connectors J1, J2, J3 to be installed with key location as shown in figure 6.
16. Handle to conform to MS-18012, without rubber coating.
17. Cover for DS-1, DS-2, and ETI not shown for clarity.
18. Alternate location for DS-1, DS-2, providing they are clearly labeled. See notes 12 and 13.



SECTION B-B
TYPICAL 4 PL

Figure 10
Section A-A, Section B-B, Notes

3.7 Environmental service conditions. Except as otherwise noted, the DRU shall operate under any combination of the environmental conditions specified below.

3.7.1 Temperature.

3.7.1.1 Operational. The DRU shall operate in ambient air and on a mounting surface with temperatures within the range of +140°F (+60″C) to -50°F (-46°C).

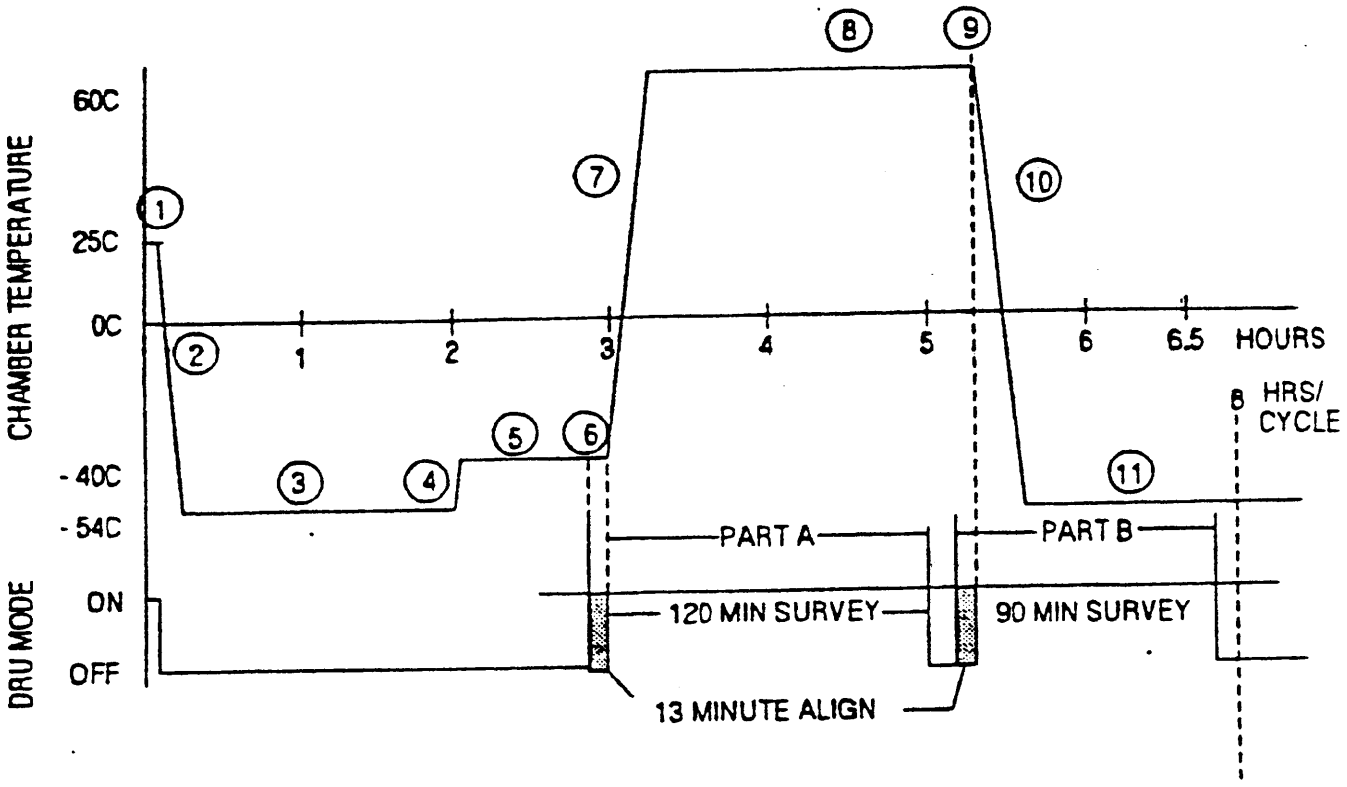
3.7.1.2 Temperature shock. The DRU shall not be damaged nor rendered inoperable when subjected to abrupt temperature changes from -60°F (-51°C) to +160°F (+71°C).

3.7.1.3 Storage and transportation. The,DRU shall withstand storage and transportation temperatures from +160° (+71W) to -60°F (-51°C) without any deterioration or adverse effects which may cause failure when the DRU is restored to operation.

3.7.1.4 Environmental stress screening (ESS) - temperature. Each sequence shall include a minimum of 10 temperature cycles with the last three cycles failure free. Temperature Cycling shall be performed. as shown in Figure 11. Alignments shall be performed with the DRU reference frames, x and y (Figure 27), approximately level. Azimuth, pitch and roll data at the conclusion of alignments shall be recorded. Position data during the survey mode shall be recorded every 5 minutes.

3.7.2 Altitude. The DRU shall operate at altitudes from -1000 meters to +10,000 meters. Non-operating, the DRU shall withstand exposure to altitudes from -1000 to +21,336 meters.

3.7.3 Humidity. The DRU shall not be damaged by operation, transportation, or storage in environments with ambient relative, humidity within the range of 1 to 100 percent.



① 5 MIN STABILIZE AT 25C

② 13 MIN RAMP 25C TO - 54C

③ 1 HR 44 MIN COLD SOAK AT - 54C

④ 2 MIN RAMP - 54C TO - 40C

⑤ 47 MIN COLD SOAK AT - 40C

⑥ 13 MIN ALIGN AT - 40C

⑦ 16 MIN RAMP - 40C TO 60C

⑧ 1 HR 49 MIN SOAK AT 60C

⑨ 5 MIN POWER OFF
13 MIN ALIGN AT 60C

⑩ 18 MIN RAMP 60C TO - 54C

⑪ 2 HR 58 MIN COLD SOAK AT - 54C

LOOP TO INTERVAL ③
REPEAT PROFILE FOR A TOTAL OF 10 TIMES

▮ = 13 MIN ALIGN

Figure 11
Temperature Cycling

3.7.4 Snow.

3.7.4.1 Falling snow. The DRU shall not be damaged and shall operate during and after exposure to falling snow with a rate of 3 inches per hour (76 mm/hr) and crystal size of 2.0×10^{-3} inch (0.05 mm) to 0.8 inch (20 mm) in diameter.

3.7.4.2 Blowing snow. The DRU shall not be damaged and shall operate during and after exposure to blowing snow with crystal size 8.0×10^{-3} inch (0.2 mm) to 1.6×10^{-2} inch (0.4 mm) diameter and winds of at least 16 fps (5mps).

3.7.4.3 Snowload. The DRU shall not be damaged and shall be operable after exposure to a snowload of 20 lbs/ft^2 (97.7 Kg/m^2).

3.7.5 Icing.

3.7.5.1 Frost. The DRU shall not be damaged and shall operate during and after exposure to frost of thickness 3 inches (76 mm) and specific gravity of 0.2.

3.7.5.2 Rime. The DRU shall not be damaged and shall operate during and after exposure to rime ice of thickness 6 inches (152 mm) and specific gravity of 0.2.

3.7.5.3 Clear glaze. The DRU shall not be damaged and shall operate during and after exposure to clear glaze ice of thickness 3 inches (76 mm) and specific gravity of 0.9.

3.7.6 Solar radiation. The DRU shall operate during and after exposure to solar radiation of 360 $BTU/ft^2/hr$ (1135 $watts/m^2$) for 4 hours at an ambient temperature of +125°F (+51.6°C) at *winds Of* 8.5 feet/see (2.6 m/see) or less. Maximum solar radiation will be higher by 4 $BTU/ft^2/hr$ per 1,000 feet (43 w/m^2 per 1,000 m) and ambient air temperatures will be lower by 5°F per 1,000 feet for ground elevations above 3,000 feet up to 15,000 feet.

3.7.7 Washdown. The DRU shall suffer no damage or leakage when exposed to high pressure water washdown.

3.7.8 Salt fog. The DRU shall not be damaged and shall operate without degradation to specified performance levels while being subjected to salt fallout of 5.7×10^4 $pounds/feet^2/year$ (2.8×10^{-3} $Kg/meter^2/year$).

3.7.9 Fungus. The DRU shall not be damaged and shall operate after exposure for 90 days to the fungi of MIL-STD-810, Method 508.3.

3.7.10 Shock.

3.7.10.1 Operational (Gunfire). The DRU shall not be damaged and shall operate during and after repeated gun firing shock in the M109 Self Propelled Howitzer as described in the two TECOM Reports No. 86-LR(V)-41, Firing Test of M109E4 Howitzer. respectively. The DRU is trunnion mounted in the M109 application. Inquiries concerning the M109 mounting DETAILS./ should be directed to the procuring activity. Figures 12 through 14 were extracted from the referenced reports and provide an example of the shock spectra for the highest level charge (M203) fired in the M109.

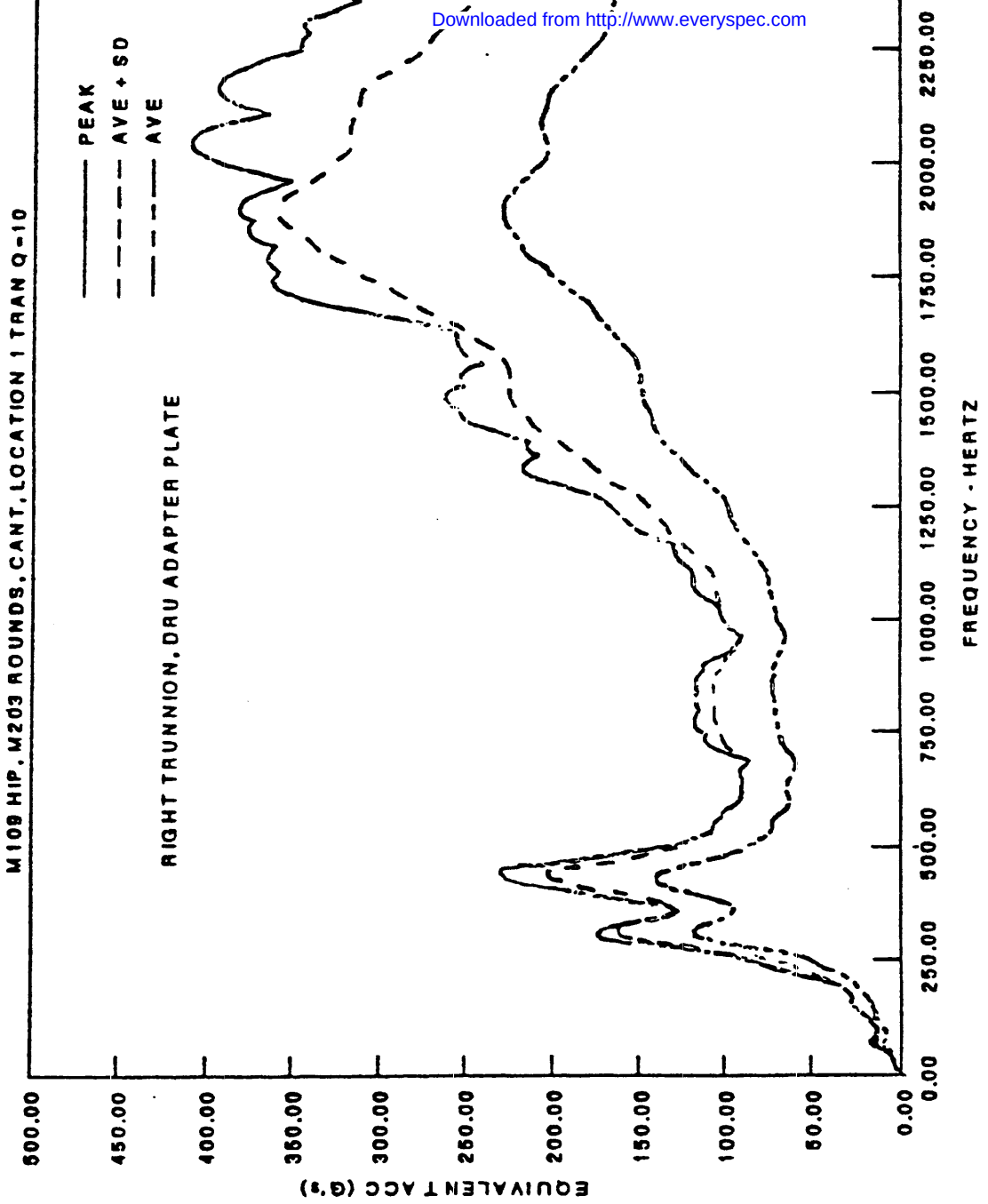


FIGURE 12. Typical firing shock composite spectrum - lateral axis.

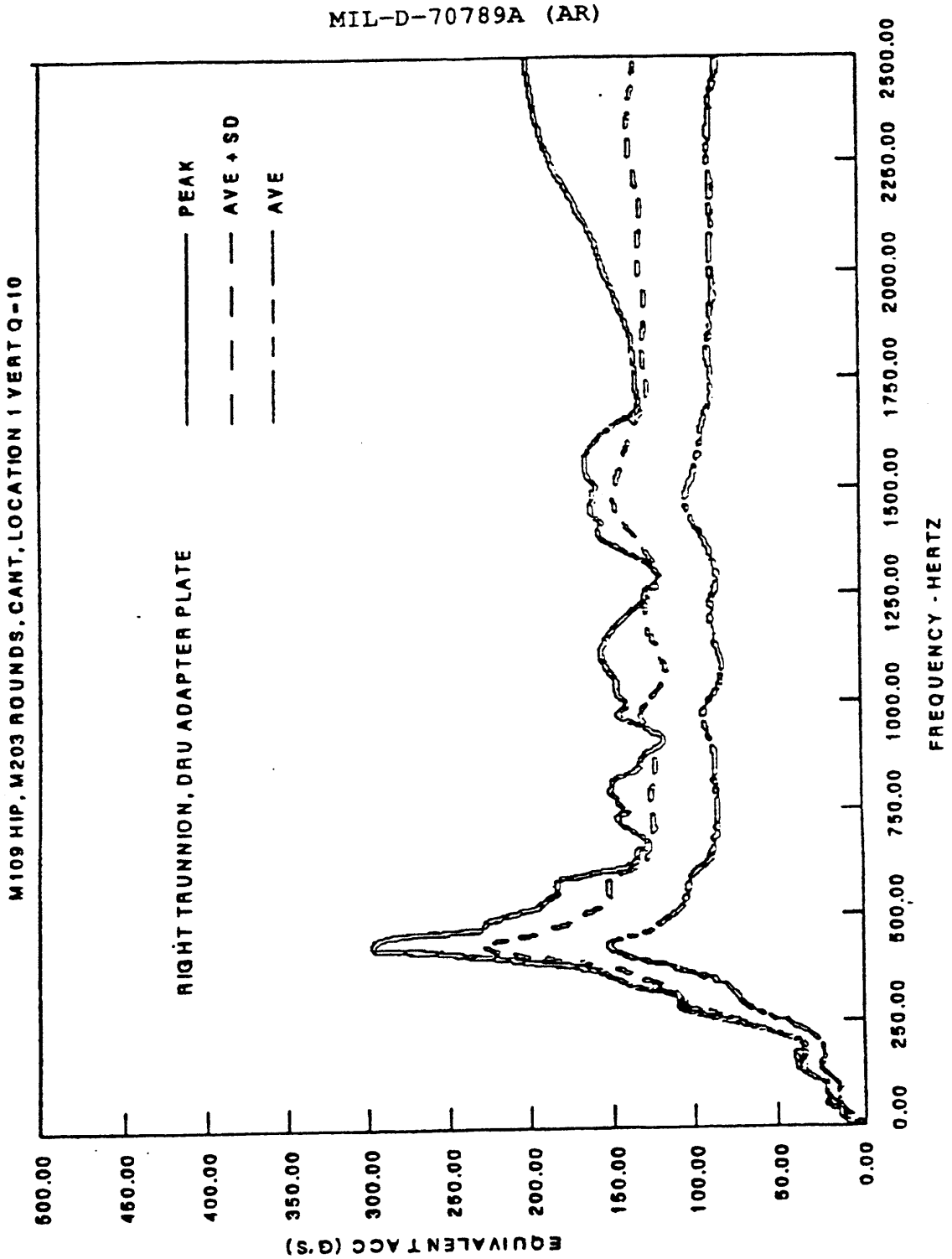


FIGURE 13. Typical Firing shock composite spectrum - vertical axis.

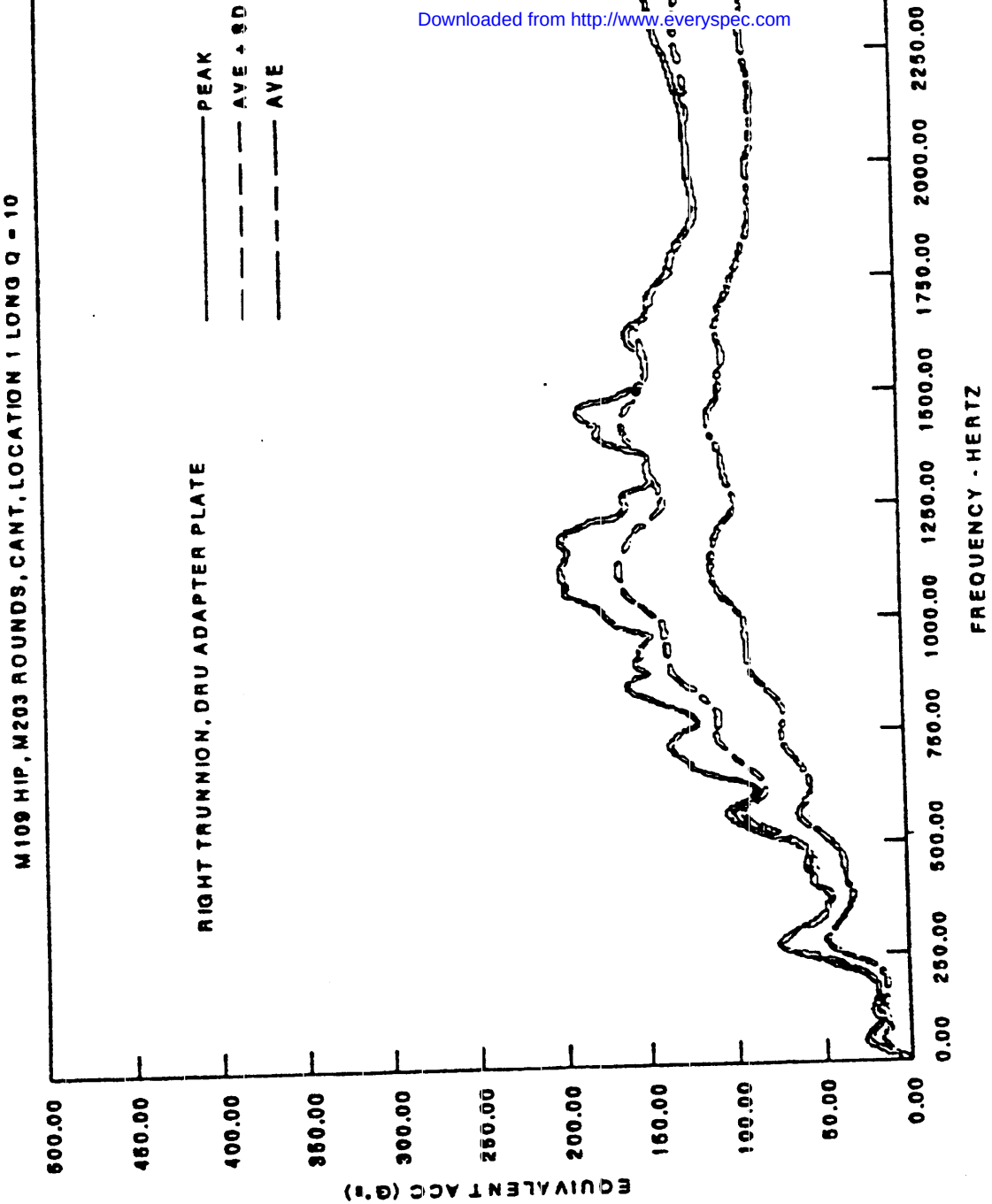


FIGURE 14. Typical firing shock composite spectrum - longitudinal axis.

3.7.10.2 Transportation. The DRU shall not be damaged and shall operate during and after shock test as specified in MIL-STD-810. Method 516.3, Procedure I, with a 40g shock pulse of 6-9 milliseconds duration.

3.7.10.3 Bench handling. The DRU shall not be damaged and shall operate after being subjected to Procedure VI of Method 516.3 Of MIL-STD-810.

3.7.11 Vibration. The DRU shall operate and not be damaged while being subjected to the vibration environment of the M109 Howitzer, M113 Armored Personnel Carrier, High Mobility Multi-purpose Wheeled Vehicle (HMMWV) and Commerical Utility Cargo Vehicle (CUCV) traveling over all types of roads and cross-country terrain. The vibration environment for the M109 and M113 shall be as described in TECOM Reports, No. 87-LR(V)-2, Road Shock and Vibration Test of M109E4 Howitzer, and No-87-LR(R)-1, Road Shock and Vibration Test of MAPS Hardware in M113A1. The DRU is trunnion mounted in the M109 and side-wall mounted in the M113. Inquiries concerning the mounting details should be directed to the procuring activity. Figures 15 through 17 were extracted from the M113 Test Report and provide an example of the vibration environment on paved road at 34 miles per hour.

3.7.1.2 Environmental strss Screening (ESS) - vibration. The DRU shall be subjected to random vibration at the minimum Power Spectral Density envelope shown in Figure 18 for 10 minutes in each of three orthogonal axes. The DRU shall be operating while being subjected to random vibration. At the conclusion of the last 10 minute random vibration on the third axis, the power to the DRU shall be cycled off and on and BIT performed.

3.7.13 Electromametic compatibility. The DRU shall meet the requirements for electromagnetic compatibility per MIL-STD-461, MIL-STD-462 and MIL-STD-463. The DRU shall meet the requirements of MIL-E-6051 for compatibility with the total system. In addition, the DRU shall experience no degradation in attitude reference under a 3 gauss magnetic field oriented vertically and in turn, horizontally.

3.7.14 Electromagnetic interference. The DRU shall meet all emission and susceptibility characteristics as established by MIL-STD-461, MIL-STD-462, and MIL-STD-463 for Class A3 equipments and subsystems. The DRU shall meet all applicable requirements for the following: CE01, CE03, CS01, CS02, CS06, RE02, RS01, RS02, and RS03. Field strengths for RS03 shall be:

Frequency Range	Average Field Strength (V/m)	Modulation*
14 KHz to 2 MHZ	25	CW
2 MHz to 20 MHz	50	CW, AM
20 MHz to 100 MHz	50	CW, AM, FM
100 MHz to 500 MHz	25	CW,AM
500 MHz to 1,000 MHz	50	CW, AM
400 MHz to 1,200 MHz	50	Pulse
1,200 MHZ to 18 GHz	200	Pulse

*Modulation frequencies and waveforms shall be selected for maximum potential susceptibility (i.e., instrument sending and control frequencies, clock frequencies, etc.). Parameters of fielded radars shall be considered in determining pulse modulation characteristics.

3.7.15 Electrostatic discharge. The DRU shall not be damaged and shall operate as specified herein after being charged to potential differences of up to 300,000 volts with respect to ground potential, across a capacitance of 1,000 pf, and subsequently being discharged to ground potential through a series resistance of 500 ohms. Circuit modules, repair parts, etc, shall not be damaged by electrostatic discharge generated by normal handling during maintenance.

3.7.16 Lightning.

The DRU shall not be damaged and shall operate as specified herein after being subjected to close lightning strikes at distances of 10 meters or greater. The idealized current waveform generated by severe lightning strike is shown in Figure 19. The field strengths at 10 meters are:

Peak Magnetic Field	3,200 A/m
Peak Electric Field	3 MV/m

Electric Field Spectral Density:

Frequency	Field Density
10 Hz	160 V/m/Hz
100 Hz	3 V/m/Hz
1 KHz	0.5 V/m/Hz
10 KHz	500 V/m/Hz
40 KHz	5 KV/m/Hz

The DRU is permitted to turn off, without damage or loss of data needed to reinintialize, when exposed to close lightning strikes.

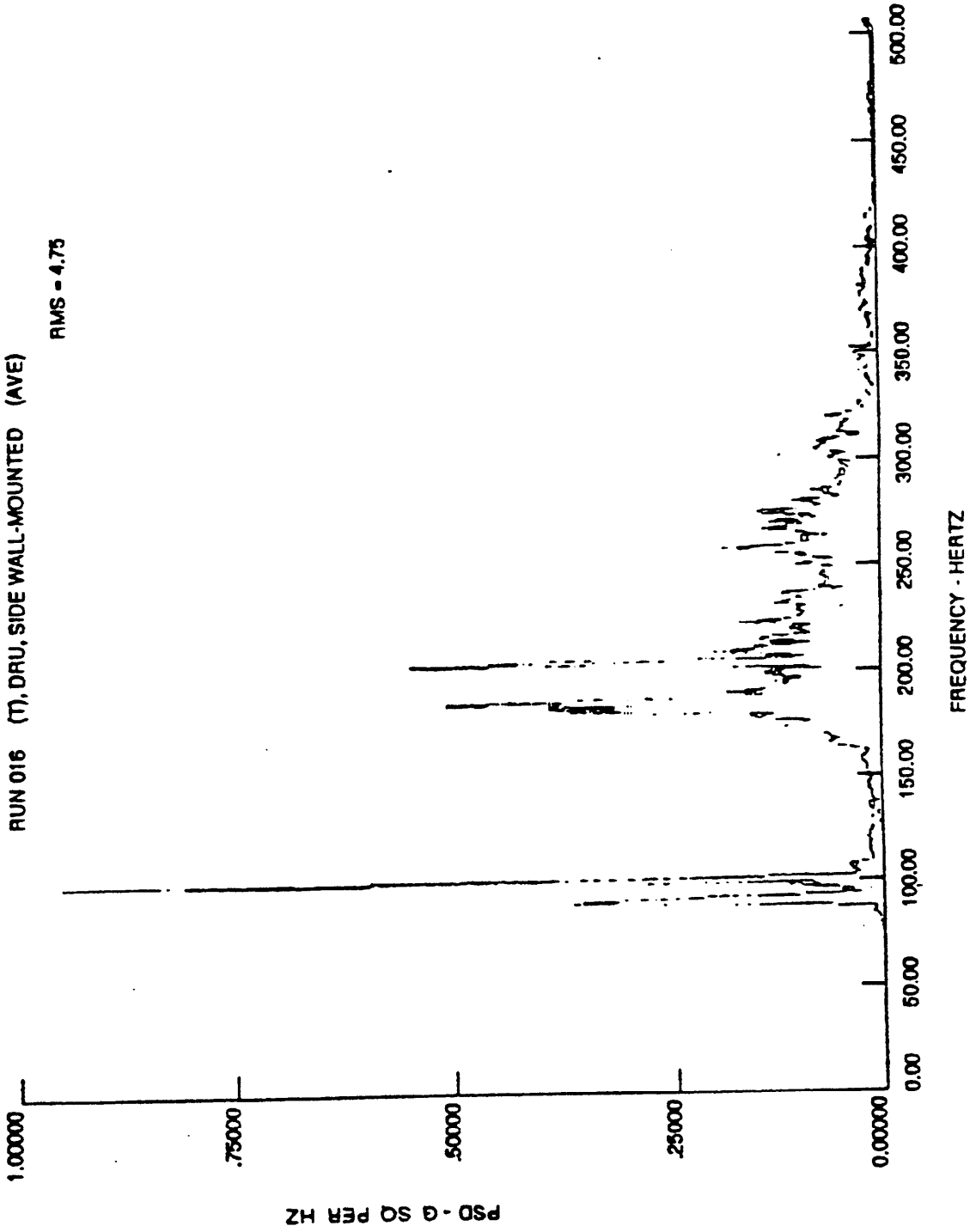


FIGURE 15. Representative maximum violation power spectral density - lateral axis.

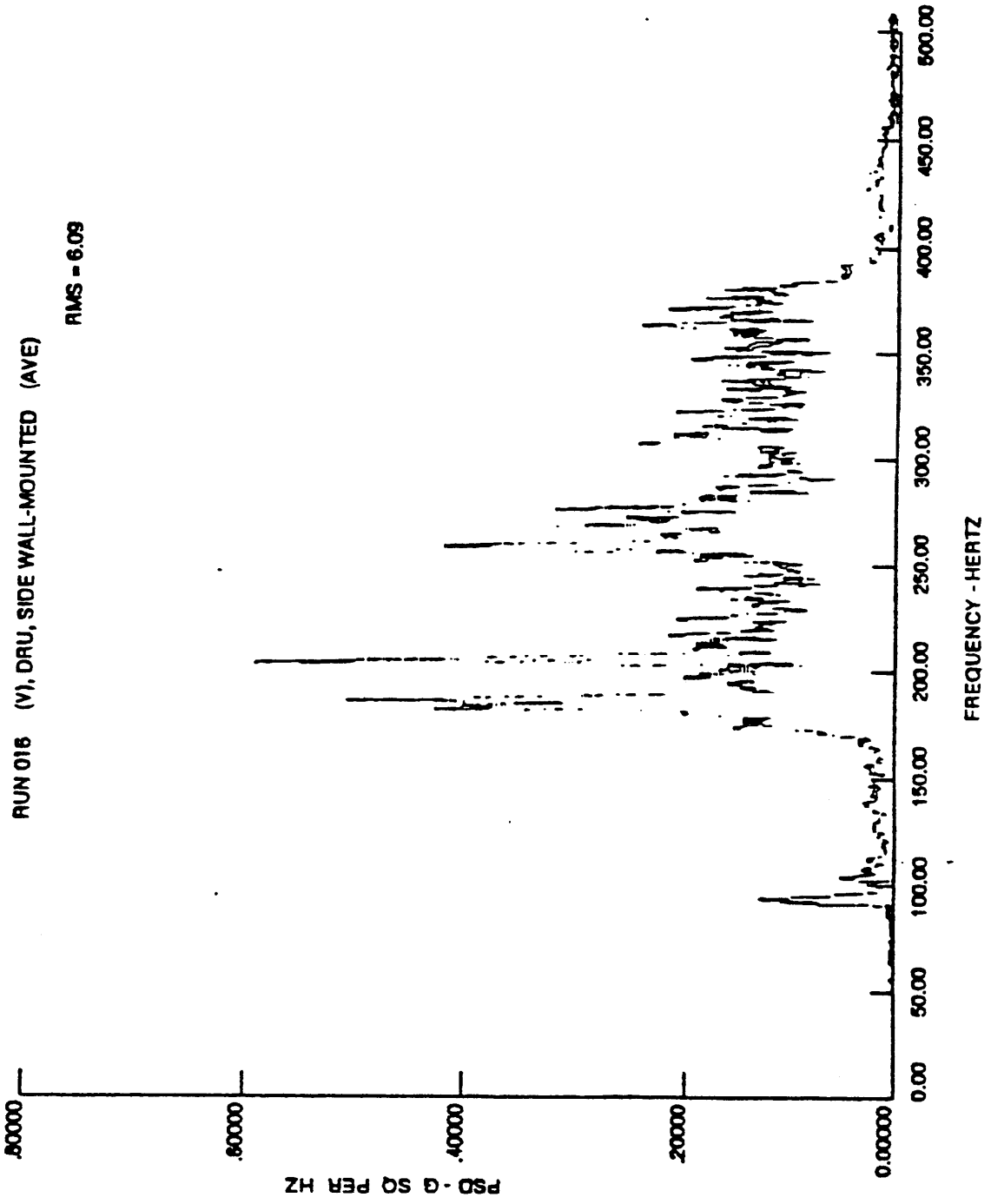


FIGURE 16. Representative Maximum Vibration Power Spectral density - vertical axis.

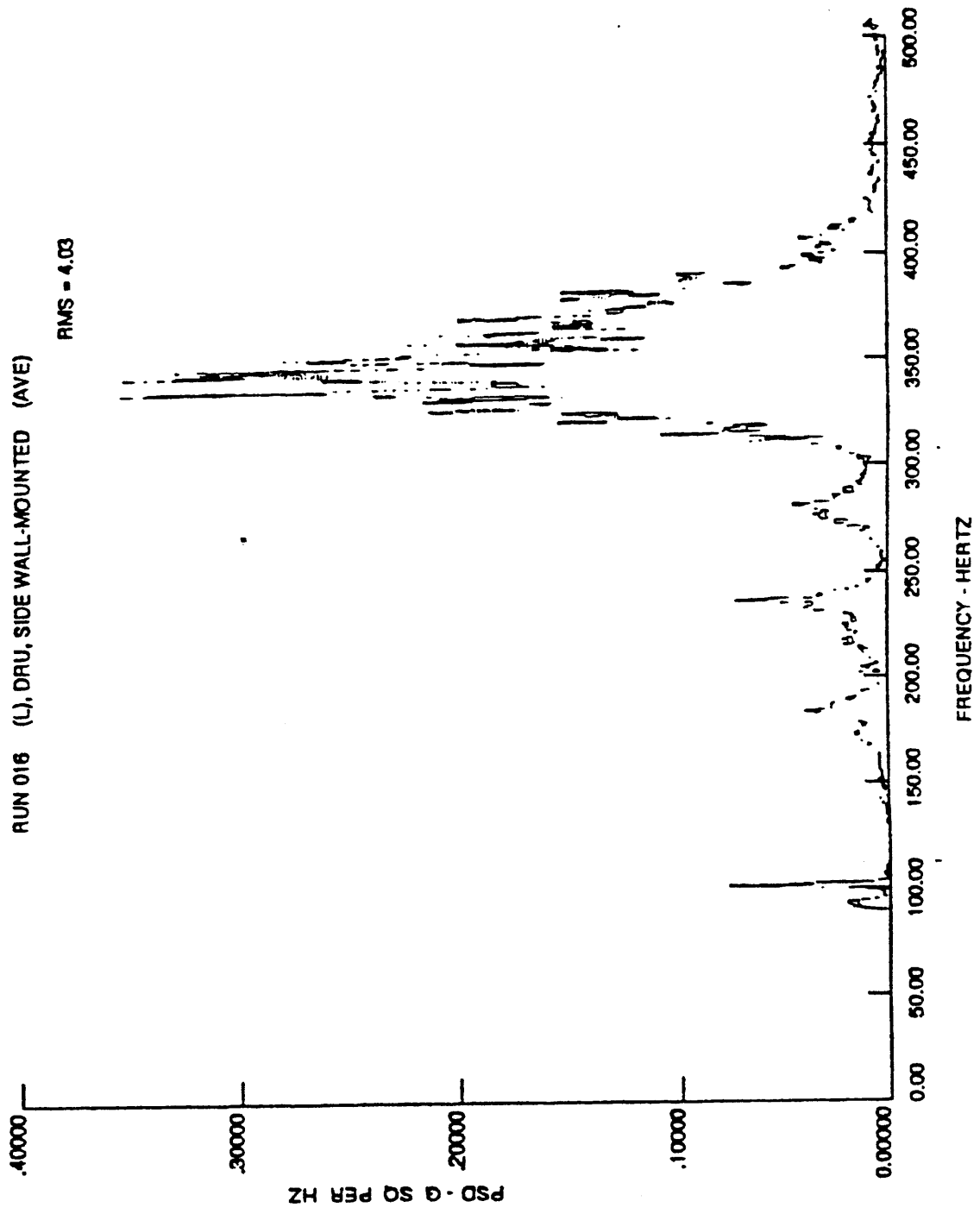


FIGURE 17. Representative maximum vibration power spectral density - Longitudinal Axis.

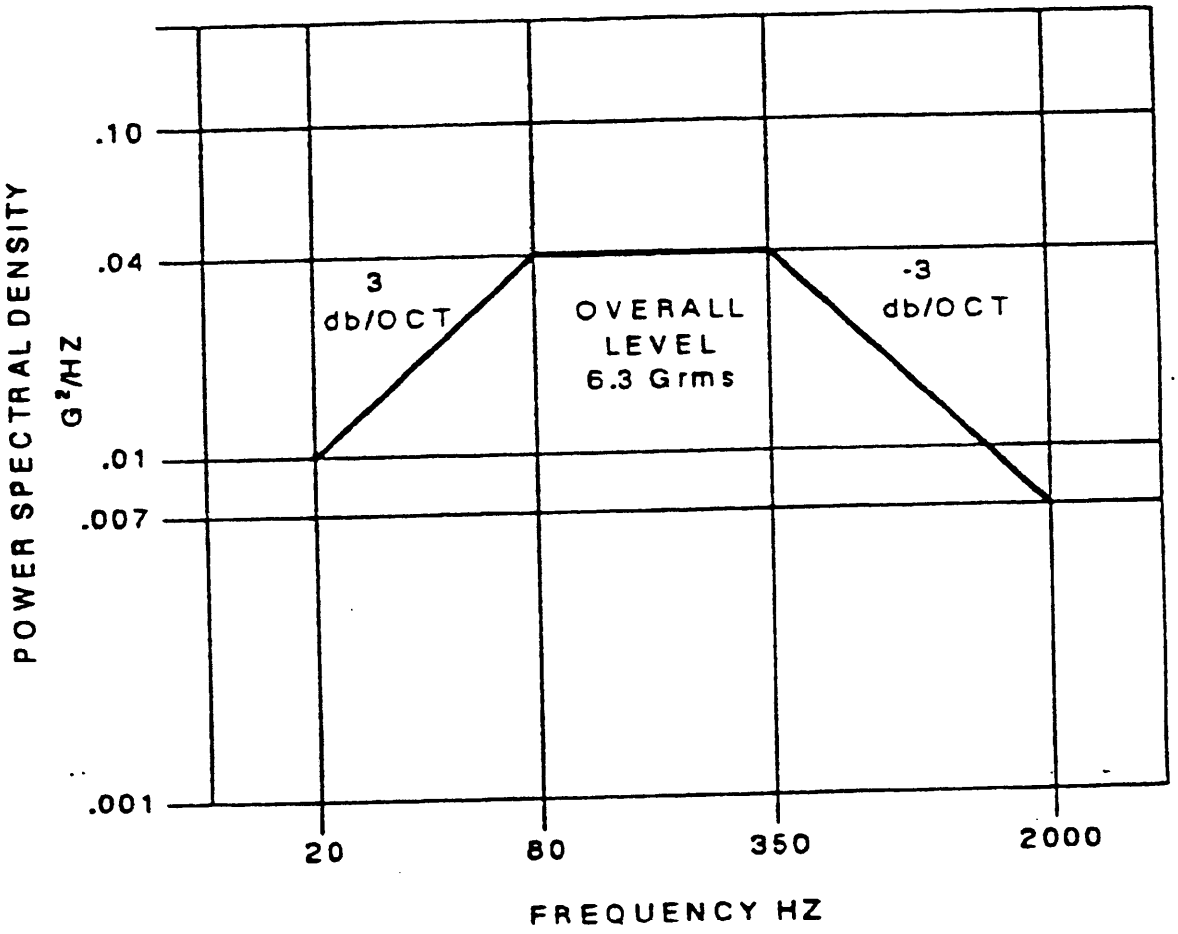


FIGURE 18. Random vibration spectrum.

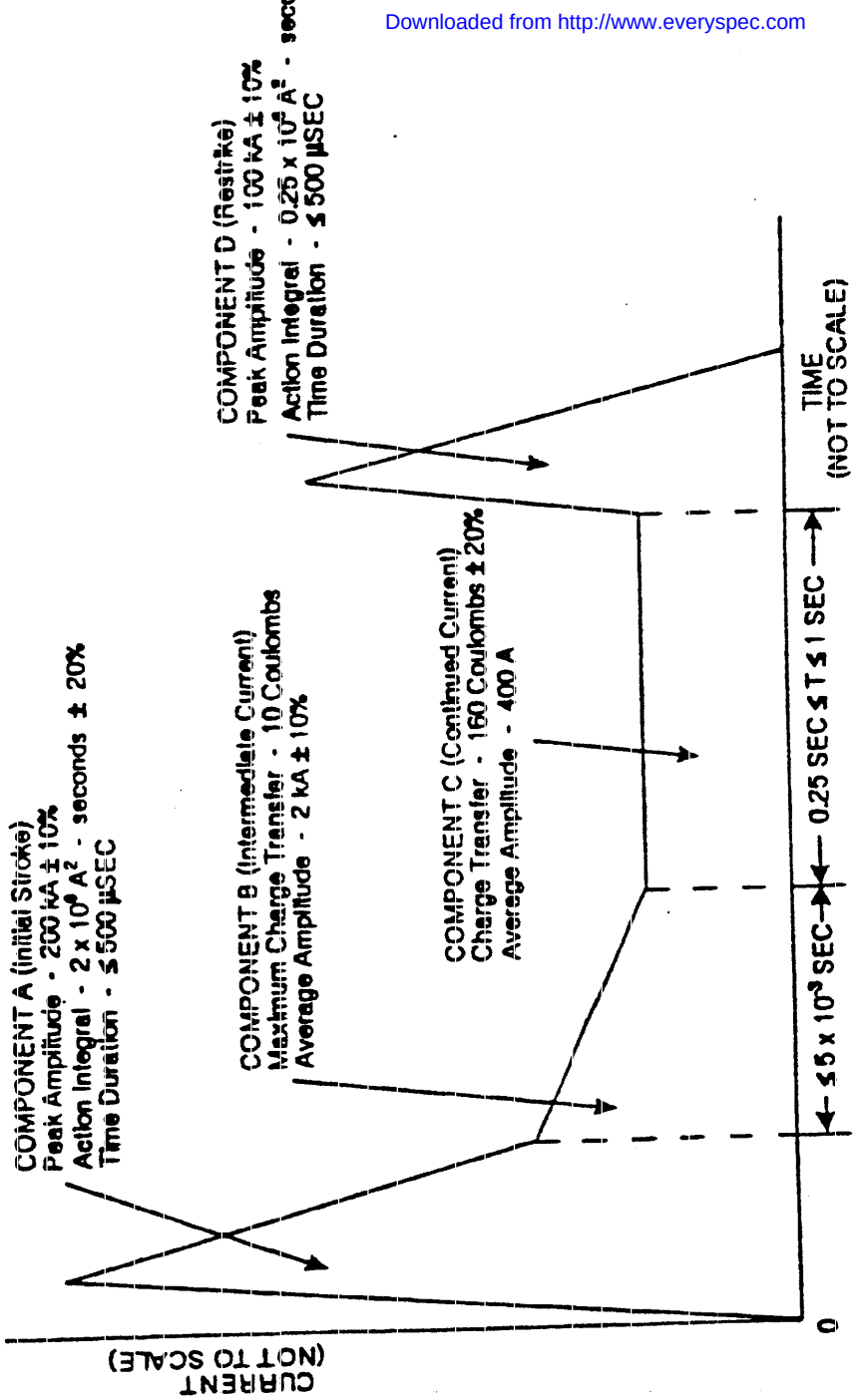


FIGURE 19. Lightning current pulse.

3.8 Design and construction.

3.8.1 Materials, processes, and parts. Materials, processes and parts shall be selected in accordance with MIL-P-11268.

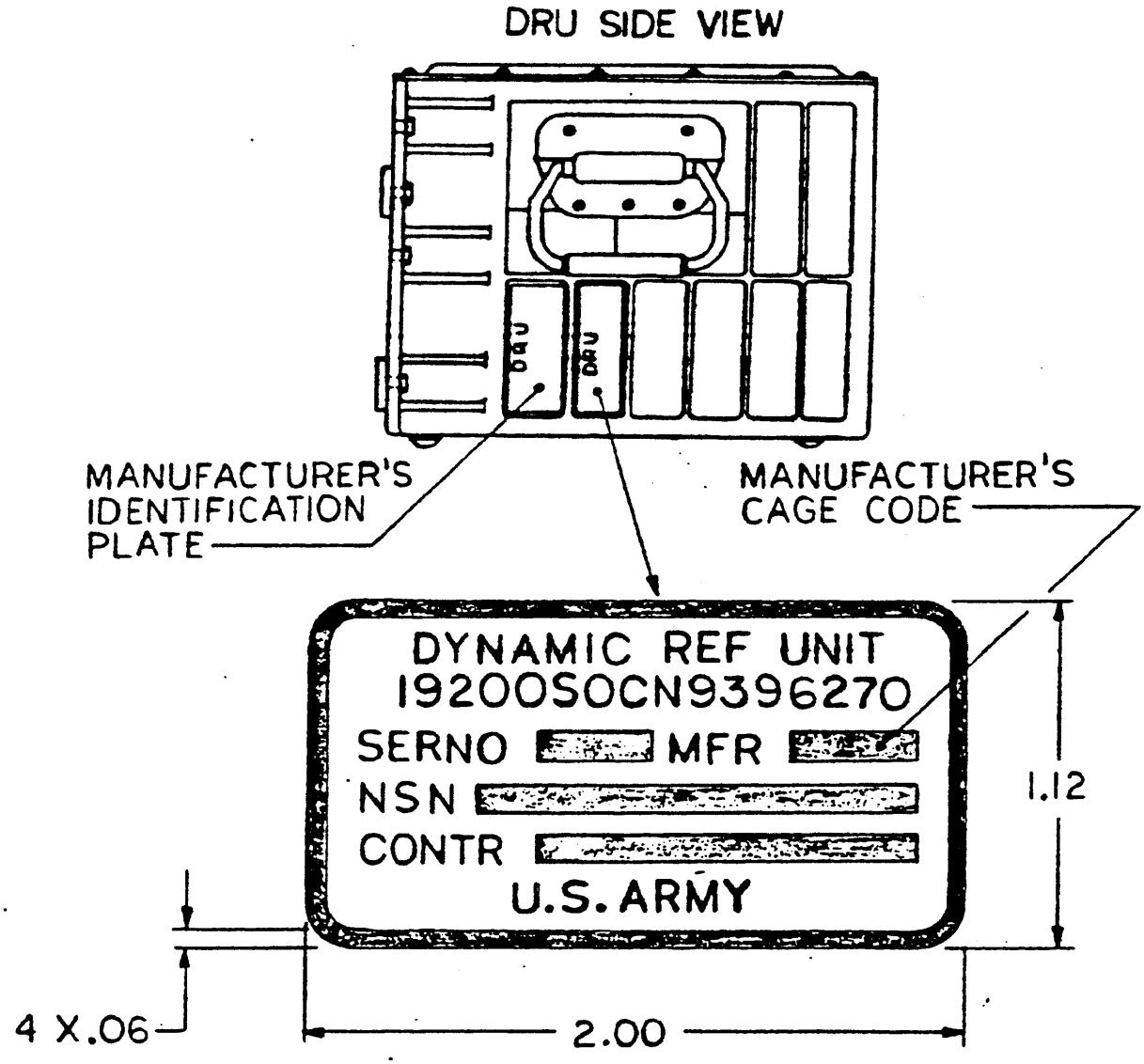
3.8.1.1 Elapsed time indicator. The elasped time meter shall be in accordance with Requirement 51 of MIL-STD-454 and MIL-M-7793.

3.8.1.2 Treatment and Painting. All surfaces of the DRU shall be cleaned and treated as specified in MIL-F-14072. The exterior surfaces shall be painted Green 383 with chemical agent resistant liphatic, polyurethane paint In accordance with MIL-C-46168. Selection and protection of dissimilar metal combinations shall be in accordance with MIL-F-14072.

3.8.1.3 Marking and identification. The name plate shall be in accordance with Figure 20. Other required marking shall conform to MIL-STD-130 and Requirement 67 of MIL-STD-454.

3.8.1.4 Grounding. Ground connection to the chassis and to other mechanical parts shall not be made to complete,electrical circuits, but only to eliminate high-potential AC points. The DRU shall be designed so that a DC power return circuit cannot be completed through the DRU chassis to a grounded vehicle chassis.

3.8.2 Nuclear Survivability. The DRU shall not be damaged after exposure to the nuclear environment as specified in “Nuclear Survivability Criteria for the Modular Azimuth Position. System (MAPS) equipment survivability category: man in truck or signal shelter, equipment exposed. The DRU is permitted to turn off, without damage, when exposed to nuclear events. After such a shutdown, the DRU shall not turn on until power has been disconnected and reapplied and when reinitialized shall perform as specified in 3.5.3.1.1.2 (Abnormal Shutdown). The position update shall not use stored data. Design margins shall be in accordance with the following:



NOTES:

1. DESIGN AND FABRICATE PER SECTION 3 OF MIL-P-19834B: PLATES, IDENTIFICATION, METAL FOIL, ADHESIVE BACKED, TYPE I, COLOR STYLE III.
2. LETTERS AND NUMBERS SHALL BE 1/8" HIGH AND LOCATED AS SHOWN.

FIGURE 20. Identification plate.

DESIGN MARGINS

ENVIRONMENT	Design Margin Categories I	II
Initial Radiation		
Neutron Fluence	2 to 10	> 10
Total Dose	2 to 10	> 10
Gamma Dose Rate		
Upset	2 to 10	> 10
Burnout	2 to 10	> 5
Latchup	2 tO 5	
EMP		
(Voltage, Current ratio	2 to 10	> 10
Corresponding Design Margin for Power Dissipation	6 to 20 dB	> 20 dB
Thermal		
Fluence	1.3 to 1.5	> 1.5
Air-Blast		
Peak Overpressure	1.3 to 1.5	> 1.5

Items are unacceptable when the design margin falls below the lower bound of Category I. If possible, the contractor shall avoid using items having design margins in the Category I range because there could possibly be significant hardness assurance/hardness maintenance impacts later in the life cycle (i.e., piecepart screens, lot sample testing. The contractor shall strive-to incorporate Category II parts. Category II items shall be identified as Category IIA or IIB. The former refers to items which are special design/fabrications to achieve the nuclear hardness levels; the latter refers to items for which no special processes were incorporated to achieve the items nuclear hardness.

3.8.3 NBC survivability. The DRU shall withstand the effects of an NBC contaminated environment as stated below:

3.8.3.1 Decontamination.

a. Following decontamination, exterior surfaces on which NBC contaminates remain, or desorbed or reaerosolized from, shall not result In more than a negligible risk to unprotected personnel working 1 meter away.

b. When exposed to neutron fluence from a nuclear detonation that results in a total dose of 2,600 cGy (rad), the neutron induced activity in the DRU shall result in no more than a negligible risk to unprotected personnel arriving 2 hours after

detonation and remaining at a distance of 1 meter for 12 hours. Risk levels are defined in "NBC Contaminants Survivability Criteria for Army Materiel".

c. No NBC contaminates or decontaminates shall be entrapped by the DRU.

d. Disassembly shall not be required to remove NBC contaminates or decontaminates.

3.8.3.2 Hardness. The DRU shall not be damaged by exposure to:

a. Ten g/m^2 of thickened droplets of mustard (HD) or soman (GD) chemical agents having a mass median diameter (PIBIID) of (2-5 mm) and unthickened G-Agent (VX) chemical agent having MMD of 250 micrometers.

b. 10^5 $spores/m^2$ of biological agent 1-5 micrometers in size.

c. Four g/m^2 of insoluble radioactive contaminants 37-200 micrometers in size and 185 GB g/m^2 gamma activity.

d. The following decontaminates for a period of 1 hour:

(1) Super-Tropical Bleach (STB)
(2) DS2
(3) DANC
(4) Soap and Detergent
(5) Sodium Hydroxide
(6) High Test Hypochlorite (Calcium Hypochlorite)
(7) Sodium Carbonate
(8) Beto-Propialootone (BPL)
(9) Formaldehyde (Formalin)
(10) Ethylene Oxide
(11) Peracetic Acid (PAA)

The equipment shall be hardened to ensure that degradation over a 30-day period of no more than 5 percent in reliability, availability, and maintainability caused by 5 exposures to NBC contaminates, decontaminates, and decontaminating procedures.

3.8.3.3 Compatibility. The DRU must have the ability to operate and be operated in a mission oriented protective posture of level four (4) (6.8.1.4).

3.8.4 Workmanship. Workmanship shall be in accordance with Requirement 9 of MIL-STD-454.

3.8.5 Interchangeability. Assemblies, and parts shall be interchangeable in accordance with Requirement 7 of MIL-STD-454.

3.8.6 Safety.

The DRU shall conform with Requirement 1 of MIL-STD-454.

3.8.6.1 Environmental safety. The DRU shall not produce nor emit toxic by products capable of damaging the health of operators or their environment.

3.8.6.2 Explosive atmosphere. The DRU shall preclude ignition or explosion when operated in hazardous atmospheres.

3.8.7 Human Performance/human engineering. The human performance and human engineering design principles of MIL-STD-1472; MIL-STD-1474, and MIL-H-46855 shall be applied to the DRU in order to achieve simple and error free ease of operation and maintenance. Areas requiring human factors engineering emphasis include, but are not limited to, personnel safety and equipment marking and nomenclatures.

3.8.8 Useful life. The DRU shall have a useful life of not less than 15 years under any combination of operation and storage.

3.9 Documentation. Documentation shall be in accordance with contract provisions.

3.10 Built-in-test. Ninety-Five percent of the total of all malfunctions occurring in the DRU shall be detected and indicated by Built-In-Test (BIT). A spurious BIT indication (BIT) indication of malfunction when there is no actual malfunction) shall be considered an undetected malfunction. The DRU shall not falsely indicate a VMS malfunction if a VMS is not being used in a particular configuration (3.5.8.8a).

3.10.1 Bit indications. Two BIT indicators (DS) shall be provided on the DRU case as shown in Figure 7. DS-1 shall indicate by a green display that the DRU is receiving proper primary power. DS-2 shall indicate by a green display that the DRU is operating correctly. The BIT indicators shall indicate a failed condition by a black or non-illuminated display. Additional BIT Information shall be provided via the serial data buses as follows: Failure of the DRU or VMS shall be indicated by setting bit 5 of STATUS character S2 and appropriate bits in the BUILT-IN-TEST Data message. Illegal operations or invalid input data shall be indicated by setting the appropriate ALERT DATA bits and STATUS S2/1.

3.10.2 System built-in-test at turn-on. At turn-on, the DRU shall monitor vehicle primary power and determine whether the voltage level is within the specified limits (3.5.4.2). If primary power is outside limits, the DRU shall remain off, and DS-1 shall indicate a failed condition. If power is acceptable, the DRU shall energize. The DRU shall also perform serial data bus circuitry BIT.

3.10.3 System built-in-test during initialization. After being energized at turn-on or when commanded to RESTART, the DRU shall perform BIT of itself. If the Configuration Definintion Flag for Odometer/Exclusive ZUPT Mode (3.5.8.8a) is set, the DRU shall perform VMS BIT (3.S.4.6) (see 3.5.3.l.ld for exception). If the Configuration Definition Flag for the Odometer/Exclusive ZUPT Mode is reset, the DRU shall not perform VMS BIT.

3.10.4 System built-in-test during a mission. The DRU shall continuously monitor vehicle primary power to determine whether the voltage level is within the specified limits (3.5.4.2) throughout the mission. If primary power is outside acceptable limits, the DRU shall shut off, and DS-1 shall indicate a failed condition.

The DRU shall monitor internal temperature. If the temperature is high enough to cause degraded accuracy, a status alert shall be indicated and bit 2 of ALERT DATA character D1 shall be set. Should the temperature become high enough to cause damage, the DRU shall automatically reenergize.

The DRU shall monitor its performance to determine if dynamic conditions have exceeded the DRU’s capability to maintain specified accuracies. If rate loops become saturated or other performance thresholds are exceeded, a status alert shall be indicated and bit 1 of ALERT DATA character D3 shall be set. The proper operator response for this condition shall be to perform an abnormal shutdown and realign the DRU.

If a VMS is used, the DRU shall continuously evaluate the validity of odometer data. Should odometer data be persistently in error or if there is a significant loss of odometer data, the DRU shall follow the procedures for VMS failure as described in 3.5.3.2.1.3.

3.10.5 Data entry checking. All data received by the DRU shall be tested for reasonableness before being accepted. Any data outside the allowable range shall be rejected, and an Alert indicated in a STATUS DATA message. Alert indications for unreasonable data are listed below:

Parameter	Allowable Range	Alert Char/Bit
Easting Northing	Allowable coordinates For Normal Zone, Extended Zone, and British National Grid.	D4/3, D5/2.
Altitude	-1,000 to +10,000 meters	D4/4, D512
Zone (D7, 30.1.1)	1 to 60 (N/A when operating in British National Grid).	D5/2
Zone (D6, 30.1.1)	0 to 60 (N/A when operating in British National Grid).	D5/2
Latitude	- 7 5° to +75°f	D4/3, D512
Longitude	-180°0′ to +180°0′	D4/3, D5/2

The specific out of range data values which indicate parameters are not being updated (see 3.5.7) shall not trigger an Alert. Except for the command assigned to suppliers (30.2.12). the DRW shall not accept any commands, data, (see 3.5.4.4.3.1) or changes to the computer software except those specified herein.

3.10.6 Input Parameter verification.

3.10.6.1 Normal align. During Normal Align the DRU shall accept and use any initialization parameters, input via the data bus, which meet the reasonableness criteria of 3.10.5. Also, the DRU shall perform an initial position reasonableness test. If earth rate measurements indicate that the position used for initialization is unreasonable or if instrument biases have shifted to the extent that the values appear to be unreasonable, bit 4 of ALERT DATA character D2 shall be set. In addition, bits 4 and 5 of STATUS character S1 shall be reset. If the alert persists even when the initial parameters are correct, the proper operator response will be to replace the DRU.

3.10.6.2 Position update. After the DRU has entered the Survey mode, it shall compare any position coordinates entered via the serial data buses to the present internal estimate of DRU position. If the position differences are within the following tolerance: 3 (DRU Estimated Error) +X meters, the DRU shall accept them and complete the update. If the difference for any one of the updated parameters exceeds the tolerance, the entire update shall be rejected and an alert indicated in the STATUS word. ALERT DATA Character D4, bit 0, shall be set for excessive horizontal position error if the difference exceeds 3 (DRU Estimated Error) +X meters but does not exceed 12 (DRU Estimated Error) +Y meters. ALERT DATA Character D4, bit 1, shall be set for excessive Altitude error if the difference exceeds 3 (DRU Estimated Error) +X meters but does not exceed 12 (DRU Estimated Error) +Y meters. ALERT DATA Character D4, bit 3, shall be set if the difference for horizontal position exceeds 12 (DRU Estimated Error) +Y meters. ALERT DATA Character D4, bit 4, shall be set if the difference for Altitude exceeds 12 (DRU Estimated Error) +Y meters. (When an entire update has been rejected, the operator will check whether an error was made in the keyboard entry or whether the vehicle is at the correct survey control point. He will exercise judgment to determine whether the update should be abandoned or whether he should follow procedures that will make the DRU accept the update An spite of the alert(s). In the extreme case, if ALERT DATA Character D4, bit 3 and 4 were set, the DRU shall accept an update if the data is reentered after RESTART is commanded). When an update has been rejected, the data shall be stored for comparison purposes in case the data is reentered. If the reentered data is not the same, or if the reentered data is “the same but the vehicle has been moved, the data shall be tested against the normal tolerance and either accepted or appropriate alert(s) set, i.e., the same as if the data were being entered for the first time. If the reentered data is the same and the vehicle has not been moved, the update shall be accepted if D4/3 and/or D4/4 were not previously set. Otherwise, the update shall be rejected and the same alert(s) set. If either D4/3 alert or D4/4 alert is inhibiting an update, the operator may accomplish a partial update by proper choice of update groupings (3.5.7). For example, if an update of grouping b. (3.5.7) was attempted and rejected because D4/4 was set, the operator may choose grouping c. and accomplish an update. If D4/0 were also set, the update would be accepted with only one reentry of data, assuming all other criteria for update were met.

The X and Y tolerance values are:

Coordinate	X(m)	Y (m)
Horizontal Position	10	150
Altitude	5	50

3.11 Alerts. The DRU shall indicate an alert condition when any of the conditions defined in 30.4.6 are present. The DRU shall provide this information in an ALERT DATA message (30.4.6) upon receipt of a RETURN ALERT DATA command (30.2.7). The OVERRIDE ALERT command is sent automatically by the Prime System/CDU upon receipt of the ALERT DATA. Upon receipt of the OVERRIDE ALERT command, the DRU shall reset all overridable alerts. In the case of non-overridable alerts, the alerts shall not be reset until the appropriate action has occurred. Table V provides information and requirements pertinent to alerts.

The ALERT DATA data field is either 5 or 6 characters depending on whether the Expanded Alerts Configuration flag is reset or set (3.5.8.8k). When the Expanded Alerts Configuration flag is reset any of the alert conditions in ALERT DATA character D6 shall not trigger STATUS bit S2/1.

ALERT DATA D6/6 and D6/7 are reserved for supplier use only and shall not be implemented by the system integrator.

TABLE V. Alerts.

Bit		Alert	Over-ridable	Data Bus Requirements	Action Required Before Reset
D1	7	Spare			
	6	Spare			
	5	Spare			
	4	Spare			
	3	Spare			
	2	DRU Over Temperature	No	Sets alert on both and buses.	Turn off DRU and let it cool down (DRU automatically turns off if temperature becomes dangerous)
	1	DRU Automatic Temperature Compensation In Process	NO	Sets alert on both data buses.	None. Reset by the DRU upon completion of required temperature compensation processing.
	0	Previous Shutdown Abnormal	No	Sets alert on both data buses.	ACCEPT POSITION or ACCEPT GEODETIC DATA command.

TABLE V. Alerts. (continued)

Bit	Alert	Over-ridable	Data Bus Requirements	Action Required Before Reset
D2 7	Vehicle Boresight Angles Not Present	No	Sets alert on both data buses.	ACCEPT VEHICLE BORESIGHT Command.
6	Align Initial Position Parameters Not Received	No	Sets alert on both data buses.	ACCEPT POSITION, ACCEPT GEODETIC DATA, or STORED HEADING ALIGN command. Automatically if Normal Align completed with stored parameters or Stored Heading Align from previous STORED HEADING SHUTDOWN command.
5	Stored Heading/ Attitude No Good	Yes	Sets alert on both data buses.	None. Resets. alert on receipt OVERRIDE ALERT command.
4	Unable to Complete Align	No	Sets alert on both data buses.	RESTART command.
3	Align Interrupt	No	Sets alert on both	RESTART command.
2	Position Update Interrupt	No	Sets alert only on the data bus which sent the ACCEPT POSITION or ACCEPT GEODETIC DATA command.	ACCEPT POSITION or ACCEPT GEODETIC DATA command. If S1/1 is not set, resets automatically after 60 seconds.
1	Zero-velocity Update Interrupt	No	Sets alert on both data buses.	Completion of a zero-velocity update.

TABLE V. Alerts. continued)

BIT	Alert	Over-ridable	Data Bus Requirenents	Action Required Before Reset
D2 0	Shutdown Interrupt	Yes	Sets alert only on the data bus which sent the SHUTDOWN or STORED HEADING SHUTDOWN command.	None. Resets alerts on receipt of OVERRIDE ALERT command.

TABLE V. Alerts. (continued),

Bit	Alert	Over-ridable	Data Bus Requirements	Action Required Before Reset
D3 7	Motion During Shutdown Request	Yes	Sets alert only on the data bus which sent the SHUTDOWN or STORED HEADING SHUTDOWN command.	None. Resets alert on receipt of OVERRIDE ALERT command.
6	Motion During Restart Request	Yes	Sets alert only on the data bus which sent the RESTART command.	None. Resets alert on receipt of OVERRIDE ALERT command.
5	Motion During Update Request	Yes	Sets alert only on the data bus which sent the ACCEPT POSITION or ACCEPT GEODETIC DATA command.	None. Resets alert on receipt of OVERRIDE ALERT command.
4	Insufficient Align Time	Yes	Sets alert on both data buses.	None. Resets alert on receipt of OVERRIDE ALERT command.
3	Position Update Beyond Range of Zone Extension	Yes	Sets alert only on the data bus which sent the ACCEPT POSITION command.	None. Resets alert on receipt of OVERRIDE ALERT command.
2	Verify Input Coordinates	Yes	Sets alert only on the data bus which sent the ACCEPT POSITION or ACCEPT GEODETIC DATA command.	None. Resets alert on receipt of OVERRIDE ALERT command.
1	Excessive Rates	No	Sets alert on both data buses	RESTART command.
0	Motion with Pointing Device Out of Travel Lock	Yes	Sets alert on both data buses.	None. Resets alert on receipt of OVERRIDE ALERT command.

TABLE V. Alerts. (continued)

Bit	Alert	Over-ridable	Data Bus Requirements	Action Required Before Reset
D4 7	DRU Spheroid Change	Yes	Sets alert only on the data bus which sent the ACCEPT POSITION or ACCEPT GEODETIC DATA command.	None. Resets alert on receipt of OVERRIDE ALERT command.
6	DRU Hemisphere/ Zone Change	Yes	Sets alert only on the data bus which sent the ACCEPT POSITION or ACCEPT GEODETIC DATA command.	None. Resets alert on receipt of OVERRIDE ALERT command.
5	Bcu Parameter Change	Yes	Sets alert on both data buses.	None. Resets alert on receipt OVERRIDE ALERT command.
4	Altitude Update Rejected	Yes	Sets alert only on the data bus which sent the ACCEPT POSITION or ACCEPT GEODETIC DATA command.	None. Resets alert on receipt of OVERRIDE ALERT command.
3	Horizontal Position Update Rejected	Yes	Sets alert only on the data bus which sent the ACCEPT POSITION or ACCEPT GEODETIC DATA command.	None. Resets alert on receipt of OVERRIDE ALERT command.
2	Spare			
1	Altitude Update Excessive	Yes	Sets alert only on the data bus which sent the ACCEPT POSITION or ACCEPT GEODETIC DATA command.	None. Resets alert on receipt of OVERRIDE ALERT command.
0	Horizontal Position Update Excessive	Yes	Sets alert only on data bus which sent the ACCEPT POSITION or ACCEPT GEODETIC DATA command.	None. Resets alert on receipt of OVERRIDE ALERT command.

TABLE V. Alert (continued)

Bit	Alert	Over-ridable	Data Bus Requirements	Action Required Before Reset
D5 7	Invalid Update Request	Yes	Sets alert only on the data bus which made the request.	None. Resets alert on receipt of OVERRIDE ALERT command.
6	Invalid Mode Request	Yes	Sets alert only on the data bus which made the request.	None. Resets alert on receipt of OVERRIDE ALERT command.
5	Invalid Data Request	Yes	Sets alert only on the data bus which made the request.	None. Resets alert on receipt of OVERRIDE ALERT command.
4	Pointing Device Boresight Angles Not Present	No	Sets alert on both data buses.	ACCEPT POINTING DEVICE BORESIGHT command.
3	Configura-tion Data Not Present	No	Sets alert on both data buses.	ACCEPT CONFIG-URATION DATA command.
2	Invalid Data Received	Yes	Sets alert only on the data bus that sent the invalid data.	None. Resets alert on receipt of OVERRIDE ALERT command.
1	Invalid Command Received	Yes	Sets alert only on the inhibited data bus.	None. Resets alert on receipt OVERRIDE ALERT command.
0	Undefined Command Received	Yes	Sets alert only on the data bus which sent the undefined command.	None. Resets alert on receipt of OVERRIDE ALERT command.

TABLE V. Alerts. (continued)

Bit	Alert	Over-ridable	Data Bus Requirements	Action Required Before Reset
D6	7 Supplier Reserved	Yes		None. Resets alert on receipt of OVERRIDE ALERT command.
	6 Supplier Reserved	Yes		None. Resets alert on receipt of OVERRIDE ALERT command.
	5 Supplier Reserved	Yes		None. Resets alert on receipt of OVERRIDE ALERT command.
	4 Supplier Reserved	Yes		None. Resets alert on receipt of OVERRIDE ALERT command.
	3 Boundary Crossed	Yes	Sets alert on both data buses.	None. Resets the alert upon receipt of an OVERRIDE ALERT command.
	2 DRU Using Previous VMS Calibration	Yes	Sets alert on both data buses.	None. Resets the alert upon receipt of an OVERRIDE ALERT.
	1 VMS Calibration Failed	Yes	Sets alert on both data buses.	None. Resets the alert upon receipt of an OVERRIDE ALERT.
	0 VMS Data Unusable	No	Sets alert on both data buses.	None. Resets alert upon completion of a ZUPT.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure that supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance requirements, however, this does not authorize submission of known defective material, either indicated or actual. nor does it commit the Government to acceptance of defective material.

4.1.2 General Provisions. The component and subassembly inspection requirements of MIL-F-13926 form a part of the quality assurance provisions of this specification. Definitions of inspection terms shall be as listed in MIL-STD-109.

4.1.3 Test equipment and inspection facilities. The manufacturer shall insure that test and inspection facilities of sufficient accuracy, quality and quantity are established and maintained to permit performance of required inspections.

4.1.4 Witness of inspection. The government reserves the right to witness any of the inspections set forth in this specification. The supplier shall notify the government at least 5 working days in advance of performing any inspection. Witness by the government does not imply certification or acceptance of inspection results.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.5).

b. First article inspection (see 4.6).

c. Quality conformance inspection (see 4.7).

4.3 Inspection conditions and Precautions.

4.3.1 Conditions. Unless otherwise specified all inspections shall be performed in accordance with the inspection provisions contained in the applicable Quality Assurance Provisions of MIL-F-13926 and the approved test plans and procedures. Test plans shall be prepared in accordance with the contract or purchase order.

4.4 Failures. The following failure, retest and rejection criteria will be used during all inspections unless otherwise specified.

4.4.2.1 Failure, retest and rejection criteria. The term FAILURE is defined to include part and component deterioration or breakage, damage evident from equipment inspection, and nonconformance to the requirements specified for performance, operational, or physical characteristics. A deviation beyond the tolerances established in this specification, in the approved test procedures, or in the equipment design is also considered a failure. The following shall be classified as failures:

a. Adjustment, replacement, or repair of a part or assembly.

b. The need to reprogram the DRU.

c. Any northing or casting error within a static survey run exceeding 2 meters/hour*.

d. Any altitude error within a static survey run exceeding 4 meters/hour*.

e. Any BIT failure indications.

f. Failure to complete alignment or necessity of restarting alignment.

*NOTE: These values may vary depending on the contractor's test equipment and DRU mechanization. Any variation must be approved by the Government.

Upon the occurrence of a failure, or whenever it becomes evident that an item will not meet a specified requirement or will not pass a test, the testing of the item for acceptance purposes shall be stopped.

After analyzing and reporting the failure, and taking corrective action in accordance with the quality program requirements, and with the approval of the Government, the. items shall be resubmitted for selection of samples and the test shall be repeated. My rework or modification of the equipment voids all prior inspections and the Government representative will make the determination whether or not to reperfom tests conducted previously. For failures occurring during retest further testing and implementation of corrective action shall not take place unless approved in writing by the Government representative.

4.5 Qualification inspection.

4.5.1 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (See 6.4) on sample units produced with equipment and procedures normally used in production.

4.5.2 Inspection routine. Sample units shall be subjected to the qualification inspections specified in Table VI in the order shown. Test methods shall be in accordance with paragraphs listed in Table VI.

4.5.3 Failures. Failures in excess of “those allowed in Table VI shall be cause for refusal to grant qualification.

4.5.4 Retention of Qualification. To retain qualification, the contractor shall forward a report at 6-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of:

a. A summary of the results of the tests performed for inspection of product for delivery (Quality Conformance Inspection, Table VIII), indicating as a minimum the number of lots that have passed, the number that have failed, and the grouP which they failed. The results of tests of all reworked lots shall be identified and account for.

b. A summary of the results of tests performed for periodic inspection (as specified in contract or purchase order), including the number and mode of failures. The summary shall include results of all periodic inspection tests performed and completed, during the 6-month period. If the summary of the tests results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

TABLE VI. Qualification inspection.

Inspection	No. of Sample Units	Requirement Paragraph	Method Paragraph	No. of Failures Allowed
Physical Examination	All	3.5, 3.8 & 3.10.1	4.8.1	0
Operational Demonstration	All	3.6	4.8.6.1	0
Design Verification	1	3.5,3.6,3.8 & 3.10	4.8.7	0
Human Factor	1	3.8.7	4.8.4	0
Low Temperature	All**	3.7.1.1 & 3.7.1.3	4.8.5.5	0
High Temperature	All**	3.7.1.1 & 3.7.1.3	4.8.5.4	0
Temperature Shock	1	3.7.1.2	4.8.5.6	0
Solar Radiation	1	3.7.6	4.8.5.7	0
Altitude	1	3.7.2	4.8.5.3	0
Washdown	1	3.7.7	4.8.5.11	0
Shock	1	3.7.10.2 & 3.7.10.3	4.8.5.14	0
Vibration	1	3.7.11	4.8.5.15	0
Humidity	1	3.7.3	4.8.5.8	0
Fungus	1	3.7.9	4.8.5.13	0
Salt Fog	1	3.7.8	4.8.5.12	0
EMI-EMC	1	3.7.13 & 3.7.14	4.8.5.16 & 4.8.5.17	0
Electrostatic Discharge	1	3.7.15	4.8.5.18	0
Lightning	1	3.7.16	4.8.5.19	0
Reliability Demonstration	2	3.6.3	4.8.6.2	
Maintainability Demonstration	Note 2	3.6.4	4.8.6.3	
Snow	1	3.7.4	4.8.5.9	0
Icing	1	3.7.5	4.8.5.10	0
Performance Demonstration	3	3.5, 3.6, 3.8 & 3.10	4.8.6.4	- 0
NBC Survivability	1	3.8.3	4.8.5.20	0
Nuclear Survivability	1	3.8.2	4.8.5.21	0
Explosive Atmosphere	1	3.8.6.2	4.8.5.22	0
Nuclear Hardness	1	3.8.3.2	4.8.8	0

**The temperature storage test shall be performed on 3 units.

Failure to submit the report within 30 days after the end of each 6-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the 6-month period that the inspection data indicates failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item.

4.6 First article inspection.

4.6.1 Sample. The contractor shall submit a first article sample as designated by the Contracting Officer for evaluation in accordance with provisions of 4.6.2. The first article sample shall consist of the assemblies, components and test specimens listed below in the quantities indicated.

NAME	Drawing Number	Quantity
Dynamic Reference Unit	9396270	3

4.6.2 Inspections to be performed. As determined by the Government, the first article assemblies, components and test specimens may be subjected to pny or all of the examinations and tests specified in this detail specification and be inspected for compliance with any or all requirements of the applicable drawings.

4.6.3 Rejection. If any assembly, component, or test specimen fails to comply with any of the applicable requirements, the first article sample shall be rejected. The Government reserves the right to terminate inspection upon any failure of any assembly, components or test specimen to comply with any of the requirements.

4.6.4 First article inspections and tests. Unless otherwise specified in the contract or purchase order or stipulated by the Contracting Officer, the article sample shall be subjected to all inspections and tests in Table VII and to all requirements of the applicable drawings. All units selected for First Article Inspection shall have successfully passed Quality Conformance Inspection.

TABLE VII. First article inspection.

Inspection	Number of Sample Units	Requirement paragraph	Method Para-graph
Design Verification	1	3.5,3.6,3.8 & 3.10	4.8.7
Low Temperature	3	3.7.1.1 & 3.7.1.3	4.8.5.5
High Temperature	3	3.7.1.1 & 3.7.1.3	4.8.5.4
Temperature Shock	1	3.7.1.2	4.8.5.6
Washdown	1	3.7.7	4.8.5.11
Shock	1	3.7.10.2 & 3.7.10.3	4.8.5.14
Vibration	1	3.7.11	4.8.5.15
EMI	1	3.7.14	4.8.5.16

4.7 Quality conformance inspection.

4.7.1 Examinations and tests.

a. Classification of characteristics. Quality conformance examinations and tests shall be as specified in, Table VIII. The contractor's quality program or detailed ispection plan shall provide assurance of compliance of all characteristics with the applicable drawing and specification requirements utilizing as a minimum the conformance criteria specified herein.

b. Alternative inspection provisions. Alternative quality conformance procedures, methods or equipment, such as statistical process control, tool control, other types of sampling procedures etc., may be used by the contractor when they provide, as a minimum, the level of quality assurance required by the provisions specified herein. Prior to applying such alternative procedures methods, or equipment, the contractor shall describe them in a written proposal submitted to the Government for evaluation (see 6.5.2). When required, the contractor shall demonstrate that the effectiveness of each proposed alternative is equal to or better than the specified quality assurance provision(s) herein. In cases of dispute as to whether the contractor’s proposed

alternative(s) provides equivalent assurance, the provisions of this specification shall apply. All approved alternative provisions shall be specifically incorporated into the contractor's quality program plan or detailed inspection system, as applicable.

4.7.2 Failures. All failures shall be reported and analyzed. A summary of all failures shall be provided to the government as required in the contract. In addition to paragraph 4.4 the following shall apply to failures occurring during ESS.

If no failures occur that require removal of the DRU from the temperature chamber, at the conclusion of the temperature cycling sequence, the standard deviation about the mean of the azimuth, pitch and roll data (20 recorded data each) shall be calculated. No datum shall be excluded, and a single calculation shall be made for each attitude, combining both high and low temperature data. If the standard deviation for azimuth exceeds 1.0 roil, or the standard deviation for either pitch or roll exceeds 0.5 roil, the unit shall be rejected and, after adjustment/repair, subjected to the entire random vibration and temperature cycling sequence.

If a failure(s) requires the DRU to be removed from the temperature chamber for adjustment, replacement or repair of a part or assembly, at the conclusion of the temperature cycling sequence, the standard deviation about the mean of the azimuth, pitch, and roll data shall be calculated using only the data recorded after the DRU is returned to the temperature chamber (a minimum of 6 recorded data each). Data recorded before removal(s) shall be excluded, but no datum shall be excluded from the calculations after the DRU is returned to the temperature chamber for the final temperature cycling sequence. A single calculation shall be made for each attitude, combining both high and low temperature data. If the calculated value of azimuth is 1.0 mil or less, and the calculated values for pitch and roll are 0.5 mil or less, the unit shall have passed the test. If any of these values are exceeded, the contractor shall be permitted at his discretion to perform additional cycles to increase the total sample size up to a total of 20 recorded data each. At the conclusion of each additional cycle, the standard deviation of the mean of each attitude shall be recalculated, conibining both high and low temperature data and excluding no datum of any attitude recorded beginning when the DRU was returned to the temperature chamber. If the recalculated value of the azimuth is 1.0 mil or less, and the recalculated values for pitch and roll are 0.5 mil or less, the unit shall have passed the test. If any, of these values are exceeded, the contractor shall be permitted to perform additional cycles to attempt to bring the results of the calculations within the stated specifications. If after

additional cycles, any of the calculated values exceed the stated specification, the unit shall be rejected and after adjustment/repair subjected to the entire random vibration and temperature sequence.

TABLE VIII. Quality conformance inspection.

NO.	CHARACTERISTIC	REQUIREMENT PARAGRAPH	TEST METHOD PARAGRAPH
	100% Inspection		
1.	Physical Examination	3.5, 3.8 & 3.10.1	4.8.1
2.	ESS-Vibration	3.7.12	4.8.2.1
3.	ESS-Temperature	3.7.1.4	4.8.2.2
4.	Quality Verification Test	3.5, 3.6, 3.8, 3.10, 3.11	4.8.3
	Major		
1.	Washdown	3.7.7	4.8.5.11

*Characteristics listed **as** major shall be tested using a sample of one unit selected randomly from each month's production or one from each 50 units produced, whichever occurs first.

4.8 Method of inspections.

4.8.1 Physical examination. The equipment shall be examined for the following defects:

a. Configuration not as specified. Configuration record incomplete or inaccurate.

b. Assemblies, parts or components missing or not as specified

c. Materials not as specified.

d. Safety devices missing or not as specified.

e. System interfaces not as specified.

f. Treatment and painting not as specified.

g. Workmanship not as specified.

h. Assembly incomplete or incorrect.

i. Identification marking missing, incomplete or not legible.

The presence of one or more defect(s) shall constitute a failure of the examination.

4.8.2 Environmental stress screening. The DRU shall be subjected to the ESS vibration and temperature tests according to Figure 21 and the following.

4.8.2.1 ESS vibration. The DRU shall be mounted on a vibration device capable of performing the vibration levels as specified. The DRU shall be subjected to the levels as specified in paragraph 3.7.12.

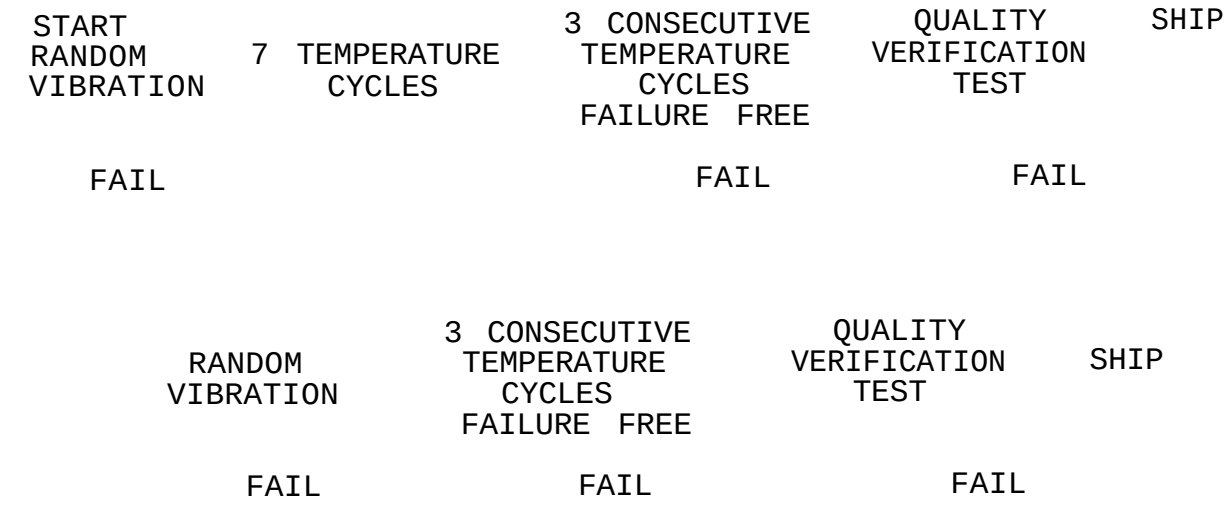
4.8.2.2 ESS temperature cycling. The DRU shall be placed in a temperature chamber and subjected to the cycles as specified in the requirements of paragraph 3.7.1.4.

4.8.3 Quality verification tests. Quality Verification Tests shall simulate normal operational conditions and verify BIT, modes of operating, updating of parameters, communication interfaces, VMS interface, discretes, power supply output, correct operation with high and low input voltages, turnon/turnoff and functional characteristics by measurement. Failure to meet specified values for any monitored parameter, any out of tolerance condition, or malfunction, shall constitute failure of the test and rejection of the DRU.

Quality Verification Tests shall include an azimuth alignment accuracy test. The data sample size shall be in accordance with the approved test procedure. No data shall be excluded from the RMS calculation. If the azimuth error is 1.0 mil RMS, or less, the unit shall have passed the test. If the azimuth error exceeds 1.0 roil, RMS, the unit shall be rejected.

Quality Verification Tests shall include pitch and roll accuracy tests. The data sample shall be in accordance with the approved test procedure. No data shall be excluded from a RMS calculation. If the pitch error and the roll error are 0.5 mil RMS, or less, the unit shall have passed the test. If either the pitch error or roll error exceeds 0.5 roil, RMS, the unit shall be rejected.

Quality Verification Tests shall include position drift and survey azimuth accuracy tests.



NOTE: A failure during any of the first 7 temperature cycles requires only a successful repeat of the failed cycle(s).

FIGURE 21. Test sequence of events.

4.8.4 Human factors examination. The equipmrent shall be examined by trained human factors engineers for compliance with requirements of 3.8.7.

Failure of the equipment to comply with the requirements of 3.8.7 shall constitute failure of this test.

4.8.5 Environmental tests.

4.8.5.1 General. Where a test calls for a simulated survey mission, the DRU shall be operated in the Exclusive ZUPT Mode with four minute "travel" periods between 30 second ZUPTS. The DRU shall be operated for equal time periods with the input supply voltage at the nominal level, the lowest specified limit, and the highest specified limit.

During a simulated survey mission the DRU shall be tested for: normal BIT, ALERT and STATUS indications; horizontal position and altitude values within approved limits; and azimuth drift within approved limits.

Failure to meet the specified value of any parameter shall constitute failure of the test.

4.8.5.2 Pre and post testing. Prior to and after each test, where the equipment is tested in a static mode (chamber and mechanical tests), a series of tests shall be performed to verify proper operation of the equipment. The equipment shall be inspected for physical damage, loose hardware, degradation of materials or any other defects after each test. Should the system set up remain the same from one major test to the next, the post-test verification test may serve as the pre-test verification test for the next major test.

4.8.5.3 Altitude. Low Pressure (altitude) tests shall be performed on the DRU in accordance with MIL-STD-810, Method 500.2, procedures I (non-operating) and II (operating). A simulated altitude of 40,O00 feet shall be maintained for 1 hour during the non-operating test. The operating test shall consist of a one hour simulated survey mission at a simulated altitude of 10,000 feet. The rate of altitude change shall not exceed 10 meters/second. The DRU shall meet the requirements of paragraph 3.7.2.

4.8.5.4 High temperature. A high temperature test shall be performed on the DRU in accordance with MIL-STD-810, Method 501.2, procedures I (storage) and II (operating). The storage test shall be conducted at a temperature of +160T for seven 24 hour periods (total of 168 hours). The temperature cycle for the operating test shall be in accordance with Induced Conditions as

listed in Table 501.2-I of MIL-STD-810 (omit humidity cycle). The operating test duration shall be a minimum of 72 hours and simulated survey missions shall be performed whenever the chamber temperature is +140°F or lower (see 3.7.1.1 & 3.7.1.3).

4.8.5.5 Low temperature. Low temperature tests shall be performed on the DRU in accordance with MIL-STD-810, Method 502.2, Procedures I and II. Procedure I (storage) test duration shall be a minimum of 72 hours at a stabilized temperature of -60°F. Procedure II (operational) shall include a 24 hour nonoperational cold soak at -60°F, followed by temperature stabilization at -50°F for a 6-hour simulated DRU survey mission (See 3.7.1-1 & 3.7.1.3).

4.8.5.6 Tempurature shock. Temperature shock tests shall be performed on the DRU in accordance with MIL-STD-810, Method 503.2, between the limits of -60°F (-51°C) and +160°F (+71°C). The DRU shall meet the requirements of 3.7.1.2.

4.8.5.7 Solar radiation. Solar Radiation tests shall be performed on the DRU in accordance with MIL-STD-810, Method 505.2, Procedure I and paragraph 3.7.6 using the HOT-DRY diurnal cycle. Perform a 6 hour simulated survey mission at the peak temperature for each of the three diurnal cycles.

4.8.5.8 Humidity. Humidity tests shall be performed on the DRU in accordance with MIL-STD-810, Method 507.2, Procedure III and 3.7.3. In the last hour of the fifth and tenth cycles, while maintaining current chamber conditions, perform a simulated survey mission.

4.8.5.9 Snow. A snow test shall be performed using a suitable environmental chamber or climatic test area to show that the DRU operates in snow in accordance with 3.7.4. Perform a simulated survey mission during the last hour of the test.

4.8.5.10 Icing. An Icing/Freezing Rain test shall be performed on the DRU in accordance with MIL-STD-810, Method 521.0 to prove that the DRU operates correctly when exposed to the Icing Conditions specified in 3.7.5. Perform a simulated survey mission during the last hour of the test.

4.8.5.11 Washdown. The DRU shall not be damaged nor leak when exposed to a water stream from a 1-inch diameter nozzle fed by a pressure of 50 ± 5 pounds per square inch for a period of 30 minutes. The stream shall be directed onto each face, except the DRU mounting surface, of the DRU from a distance of 3 feet, for equal periods. At the start of the test the DRU temperature shall be at least 10°C (18°F) higher than the water temperature.

Only the specified mating connectors or cover (J3) are permitted to cover connectors. Failure to operate as specified or evidence of damage or leakage shall constitute failure of the test. The DRU shall pass the requirements of 3.7.7.

4.8.5.12 Salt fog. Salt Fog tests shall be performed on the DRU in accordance with MIL-STD-810, Method 509.2 using the conditions specified in 3.7.8. Subject the DRU to three cycles of testing. A cycle consists of exposure to the salt fog for twenty four hours, followed by twenty four hours of drying out at room temperature. Perform a simulated survey mission during the last hour of each of the three drying out cycles.

4.8.5.13 Fungus. Fungus tests shall be performed on the DRU in accordance with MIL-STD-810, Method 508.3, for a period of 90 days. The DRU shall meet the requirements specified in 3.7.9.

4.8.5.14 Shock.

4.8.5.14.1 Transportation. Shock tests shall be performed on the DRU in accordance with MIL-STD-810, Method 516.3 Procedure I and paragraph 3.7.10.2. Peak Amplitude shall be 40g with a time duration of 6-9 msec. The DRU shall be operating in the Survey Mode when the shock pulses are applied. Run a one hour simulated survey mission after the six shock pulses have been applied to each axis.

4.8.5.14.2 Bench handling. Bench Handling tests shall be performed on the DRU in accordance with MIL-STD-810, Method 516.3, Procedure VI and 3.7.10.3.

4.8.5.15 Vibration. Vibration tests shall be performed on the DRU in accordance with MIL-STD-810, Method 514.3, Category 8, Procedure I. The DRU shall be subjected to a series of vibration profiles which are contained in Appendix G. Appendix G contains five vibration profiles for the DRU vertical axis ($\bar{Z}_c$) (V01 - V05), five for the DRU transverse axis (Y_c) (T01 - T05) and five for the longitudinal axis (X_c) (L01 - L05). All these profiles depict the DRU mounted on the M109. The DRU shall be subjected to a 54-minute vibration test using each of the vibration profiles. The total test time for each axis shall be 270 minutes. The total test time for the three axes shall be 810 minutes. During exposure periods the DRU shall be operating in the Survey Mode and ZUPTs shall not be performed. The procedure for verification of the performance (accuracy) criteria shall be detailed in the government approved test procedures. The DRU shall meet the requirements of 3.7.11.

4.8.5.16 EMI-EMC. The DRU shall be subjected to EMI-EMC tests in accordance with part 4 of MIL-STD-461, MIL-STD-462 and MIL-STD-463. Field strengths for RS03 shall be as specified in 3.7.14.

4.8.5.17 Magnetic compatibility. The DRU shall be tested, in a facility approved by the government, to ensure that exposure to a 3 gauss steady-state magnetic field, oriented vertically and horizontally in three orthogonal directions, shall not result in degradation in performance. The DRU shall pass the requirements of paragraph 3.7.13.

Any demonstrated sensitivity to applied external magnetic fields shall constitute failure of this test.

4.8.5.18 Electrostatic discharge. The equipment shall be connected to an electrostatic generator through a 1000 pf high-voltage cable. After being charged to a potential difference of 300,000 volts, the equipment shall be discharged through a 500 ohm resistor. The equipment shall be subjected to a total of 30 charge/discharge cycles using both positive and negative charging polarities and at least 3 different discharge points. Damage to or failure of the equipment to perform as specified, after exposed to the charge/discharge cycles, shall constitute failure of the test. The DRU shall meet the requirements of paragraph 3.7.15.

4.8.5.19 Lightning. The equipment shall be installed in a lightning discharge test facility and subjected to 10 lightning pulses, approximating Figure 19, at a distance of 10 meters. The equipment shall be operating in the Survey Mode when subjected to half the strikes and inactive for the remaining exposures. The DRU is permitted to shutdown when exposed to lightning strikes. This shutdown is defined as an abnormal shutdown.

4.8.5.20 NBC survivability. The DRU shall be analyzed or tested for conformance with the requirements in “NBC Contaminants Survivability Criteria for Army Materiel”. Testing shall be conducted at facilities approved by the government using accept/reject criteria established by appropriate Government Agencies. The DRU shall pass the requirements of paragraph 3.8.3.

4.8.5.21 Nuclear survivability. The DRU shall be analyzed or tested for conformance with paragraph 3.8.2. Testing shall be conducted at facilities approved by the Government.

4.8.5.22 Explosive atmosphere. Explosive Atmosphere tests shall be performed on the DRU in accordance with MIL-STD-810, Method 511.2, Procedure I and paragraph 3.8.6.2 at a simulated test altitude of 10,000 feet and a temperature of +140°F.

4.8.6 Demonstrations.

4.8.6.1 Operational demonstrations. The DRU, installed in a wheeled vehicle, shall be tested for two missions over a government approved test course. The time to traverse the test course shall be approximately 6 hours. In addition to the initialization point, the test course shall have 12 survey control points, spaced approximately equally in time, for measurement of DRU survey parameters. The conditions for each mission shall be:

CONDITION	MISSION 1	MISSION 2
Normal Align		
Odometer Mode		
Exclusive ZUPT mode		
Mounting, $a = 0, \beta = 0, \gamma = 0$		

The following parameters shall be measured and recorded.

a. Alignment time.

b. Time o-f each zero-velocity stop and duration of each zero-velocity stop.

c. Horizontal position, altitude, pointing device attitude (azimuth, pitch, roll) and distance traveled at the initialization point and each survey control point.

Using the above data, the position, altitude, and pointing device attitude (azimuth, pitch, roll) error characteristics shall be calculated.

The DRU shall meet the requirements of paragraph 3.6. Failure to meet the specified value of any parameter shall constitute failure of the test.

4.8.6.2 Reliability demonstration.

4.8.6.2.1 General. The DRU shall be tested as specified herein. The "accept" and “reject” criteria shall be in accordance with MIL-STD-781, Test Plan XXC. The upper and lower test MTBE’s shall be 4000 and 2000 hours respectively. The

contractor shall report, analyze and determine corrective action for all failures which occur during the reliability demonstration. The contractor shall treat all failures as chargeable. The government will score all failures. The DRU shall meet the requirements of paragraph 3.6.3.

4.8.6.2.2 Test conditions and procedures. The DRU reliability demonstration shall consist of two types of test cycles, a functional survey and a chamber test. One functional test cycle shall be performed for each six chamber cycles. The following performance parameters shall be measured and evaluated to determine if the DRU is functioning properly:

a. Horizontal Position.

b. Altitude.

c. Either Vehicle or Pointing Device Attitudes.

d. Initial Alignment Time.

Test records shall be maintained in accordance with MIL-STD-781, Appendix D, Section 30.

4.8.6.2.2.1 Chamber test. The DRU shall be used in COnfiguratiOn C, Figure 3, for chamber testing. The DRU shall be operated as a free inertial survey system with four minute simulated "Travel" periods between zero-velocity updates. The chamber test cycle shall be in accordance with Figure 22. The procedure for verification of the performance (accuracy) criteria shall be detailed in the government approved test procedures.

Chamber test conditions and procedures will be as specified in MIL-STD-781,Appendix B, Section 50.2 and Appendix D with the following changes:

a. Voltages.

(1) Maximum: 32 V.
(2) Minimum: 16.4 V.
(3) Nominal: 24 v.

At the start of the test the input voltage shall be adjusted above the minimum turn on voltage, and then reduced to the minimum operating voltage.

b. Gun fire shock. The DRU shall be exposed to simulated gun fire shocks as shown in Figure 22. The shock spectra shall be in accordance with Figures 23, 24 and 25, with an equal number of exposures in each axis. In the vertical ($\bar{Z}_c$)

and longitudinal ($\bar{X}_c$) axes tests, half of the shock pulses shall be applied using the magnitudes shown in the upper level curves of Figures 23 and 25 and half using the lower level curves. The acceleration levels of the test control signal shall not deviate from the specified requirements by more than +6-3dB over the entire test frequency range. However deviations of -6dB in the test control signal may be granted for frequencies greater than 500 Hz due to fixture resonance, test item resonance, or facility limitations. The cumulative bandwidth over which this reduction shall be allowed cannot be greater than 5% of the test frequency range (see Figure 26). In no case shall the acceleration levels be more than -6dB below the specified requirements. No deviation shall be granted for frequencies below 500 Hz. Tolerance levels in terms of dB are defined as:

$$dB = 20 \log (W_1/W_0)$$

where:

W_1 = measured acceleration level in g's.

W_0 = specified level in g's.

A separate Gun Fire Shock test may be conducted instead of performing the test shown in Figure 22. If a separate test is performed, the DRU shall be subjected to 32 shock pulses for each axis using the shock spectra in Figures 23, 24 and 25. The DRU shall be operating in the survey mode when the shock pulses are applied. ZUPTS are permitted between shock pulses. Verify that BIT and STATUS indications are normal after application of the pulses. Verify that position and altitude readings are stable and that azimuth drift is acceptable. After application of the 32 shock pulses to each axis perform a functional survey test followed by six chamber cycles. Continue this procedure until 24 chamber cycles have been completed. The next step is to apply the 32 shock pulses and continue repeating the procedure.

c. Temperature.

(1) Hot soak: +160°F (+71°C)
(2) Operating range: -50°F (-46°C) to +140°F (+60°C).

d. Vibration. The DRU shall be subjected to the vibration levels contained in Appendix H, for 15 minutes periods, at the intervals indicated in Figure 22. Appendix H contains five vibration profiles obtained from the DRU vertical axis ($\bar{Z}_c$) (V01 - V05) with the DRU mounted on the M109, five vibration

profiles obtained from the DRU longitudinal axis ($\bar{X}_c$) (L01 - L05), one obtained from the DRU vertical axis (CUCV VERT) with the DRU mounted on the CUCV, and one obtained from the DRU longitudinal axis (CUCV LONG) with the DRU mounted on the CUCV.

The DRU shall be vibrated for equal amounts of time in the vertical and longitudinal axes. In each axis, the DRU shall be vibrated for 50% of the time using the CUCV profile and 10% of the time using each of the five M109 profiles.

The acceleration power spectral density of the test control signal shall not deviate from the specific requirements more than permitted in Section II, Method 514.3 of MIL-STD-810.

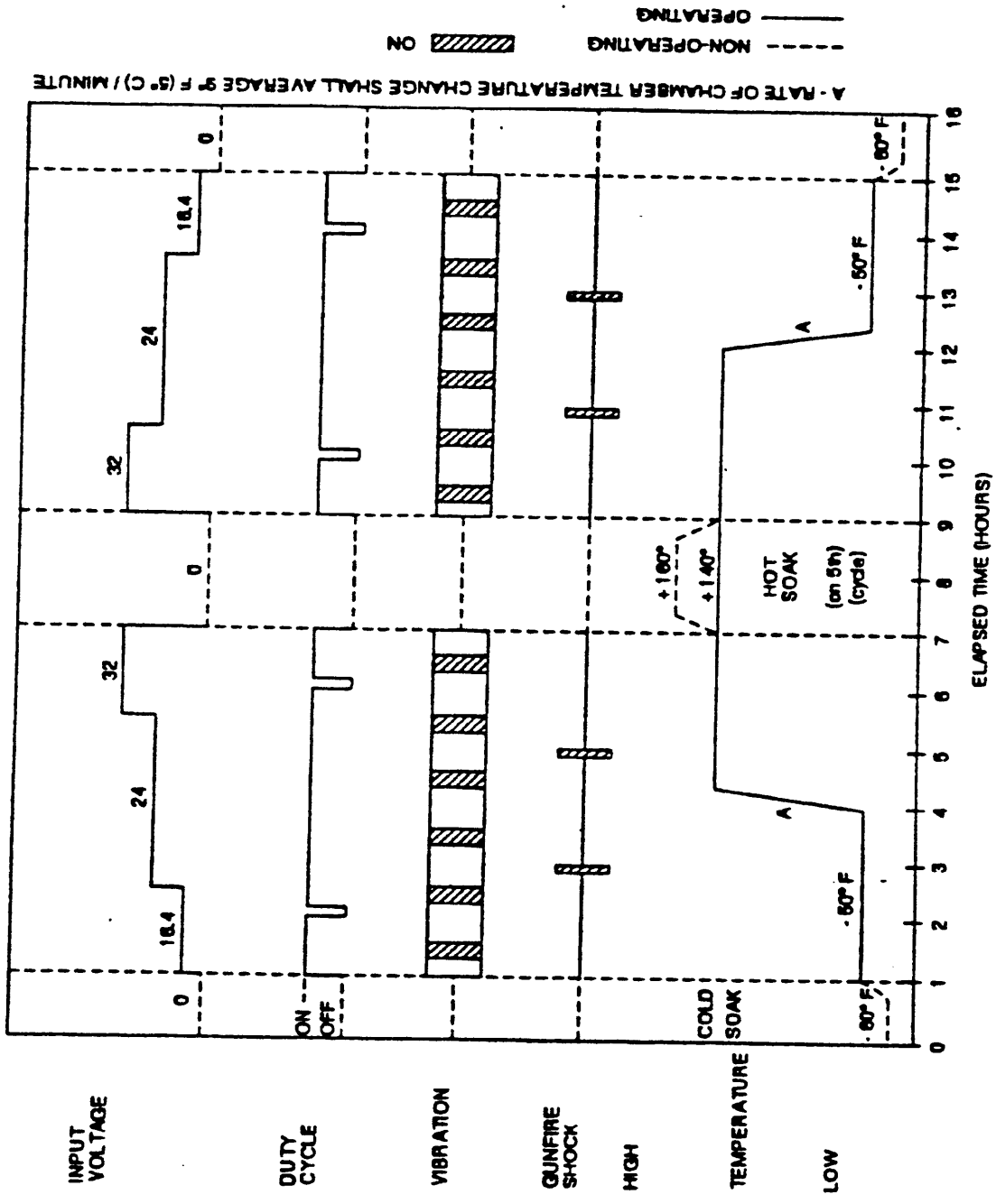
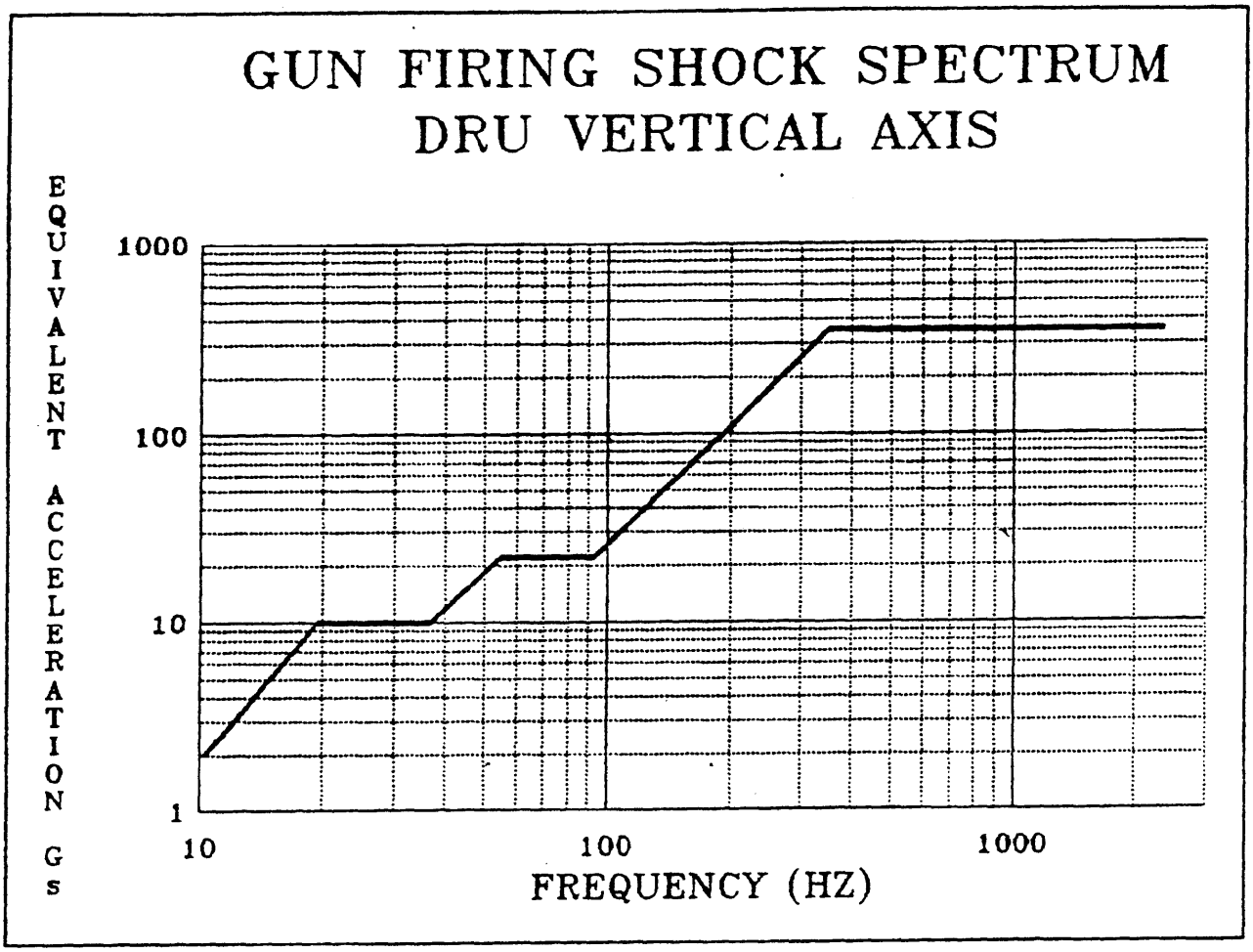


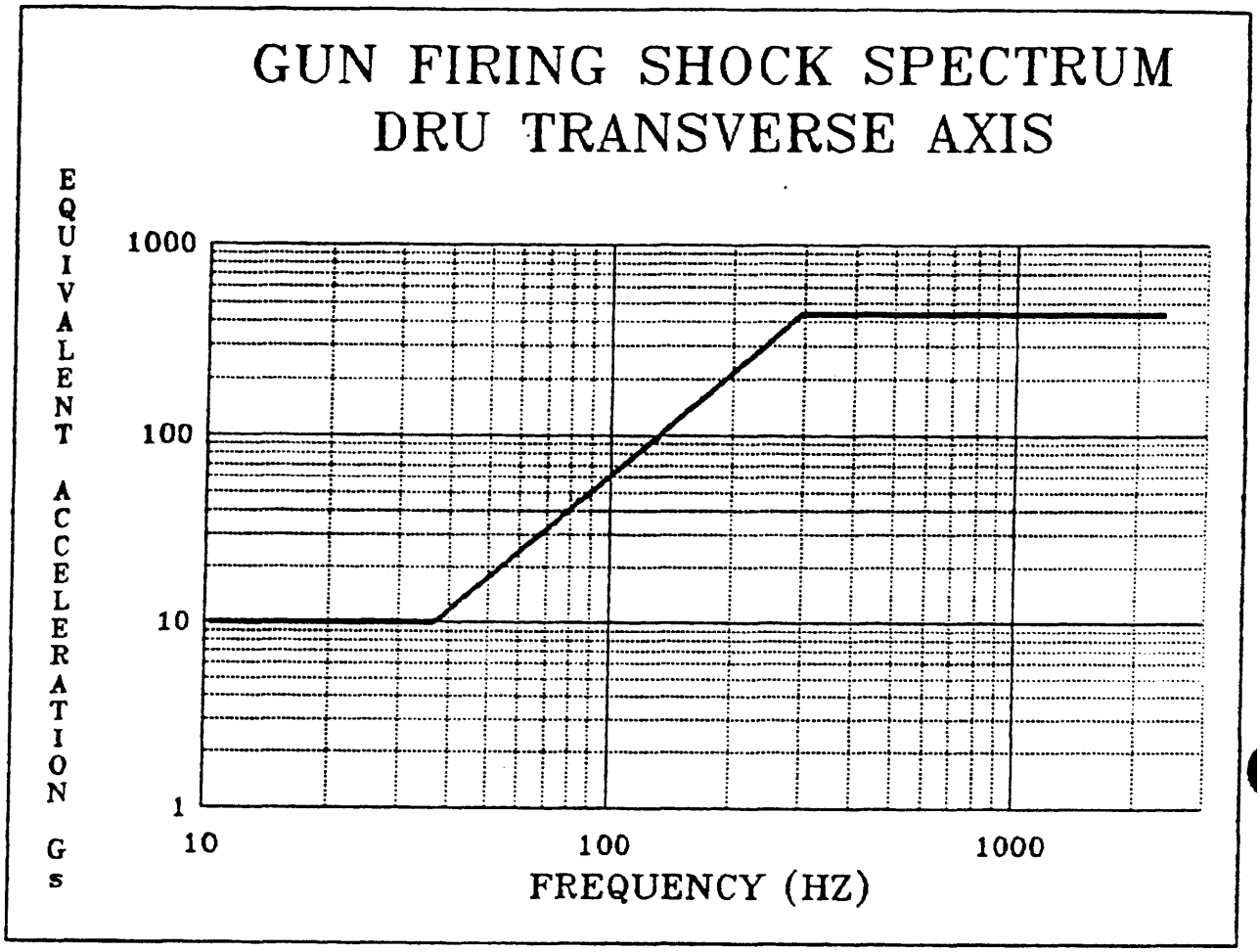
FIGURE 22. Chamber test cycle.



Spectrum Break Points

FREQUENCY (HZ)	ACCELERATION (Gs)
10.3	2
19.5	10
36.9	10
55.2	22
92.9	22
350.8	350
2359.7	350

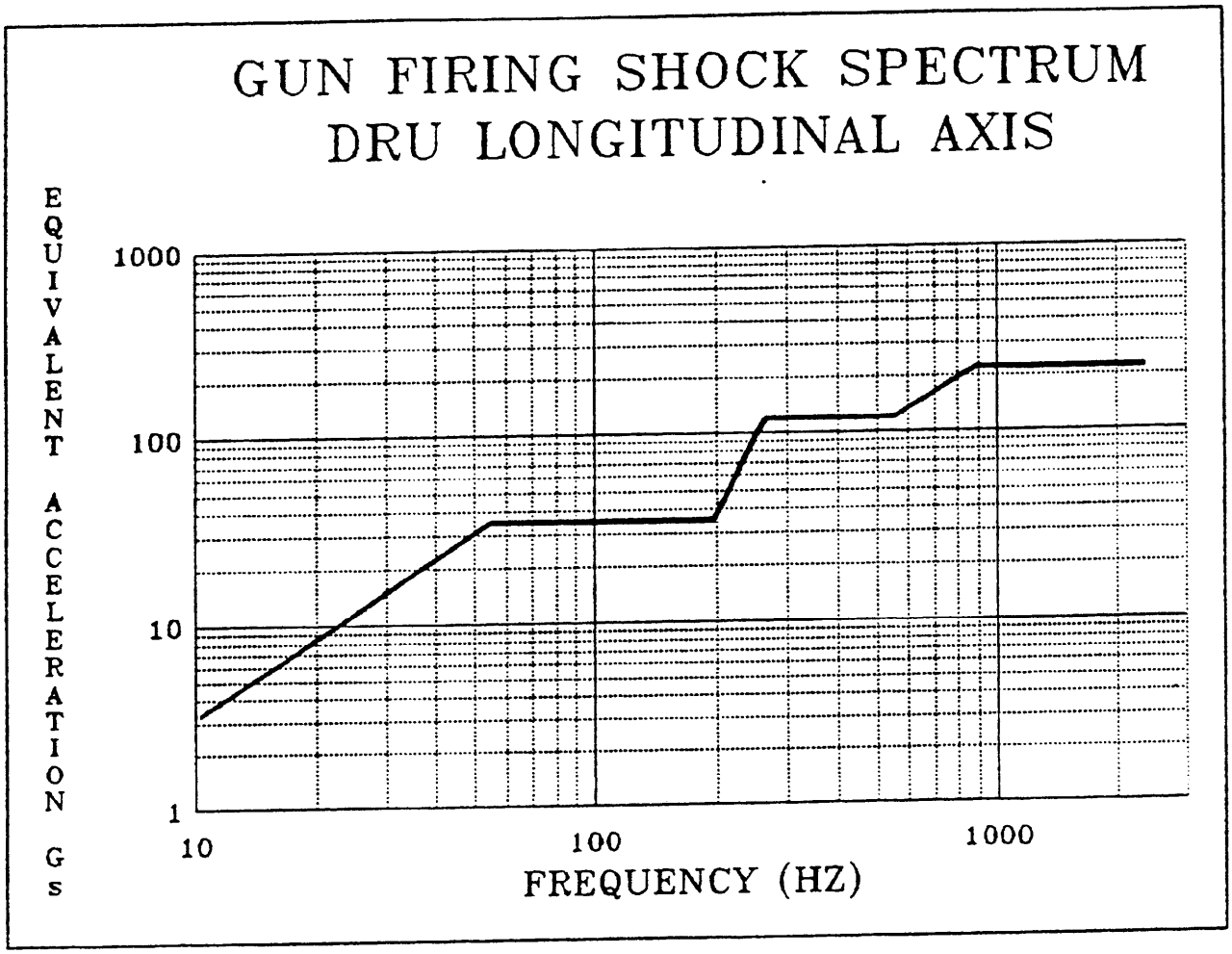
Figure 23
Gun Firing Shock Spectrum - Vertical



Spectrum Break Points

FREQUENCY (HZ)	ACCELERATION (Gs)
10.3	10
36.9	10
295.0	435
2359.7	435

Figure 24
Gun Firing Shock Spectrum - Transverse



Spectrum Break Points

FREQUENCY (HZ)	ACCELERATION (Gs)
10.3	3.3
55.2	35
196.9	35
262.8	120
556.8	120
883.9	220
2359.7	220

Figure 25
Gun Firing Spectrum - Longitudinal

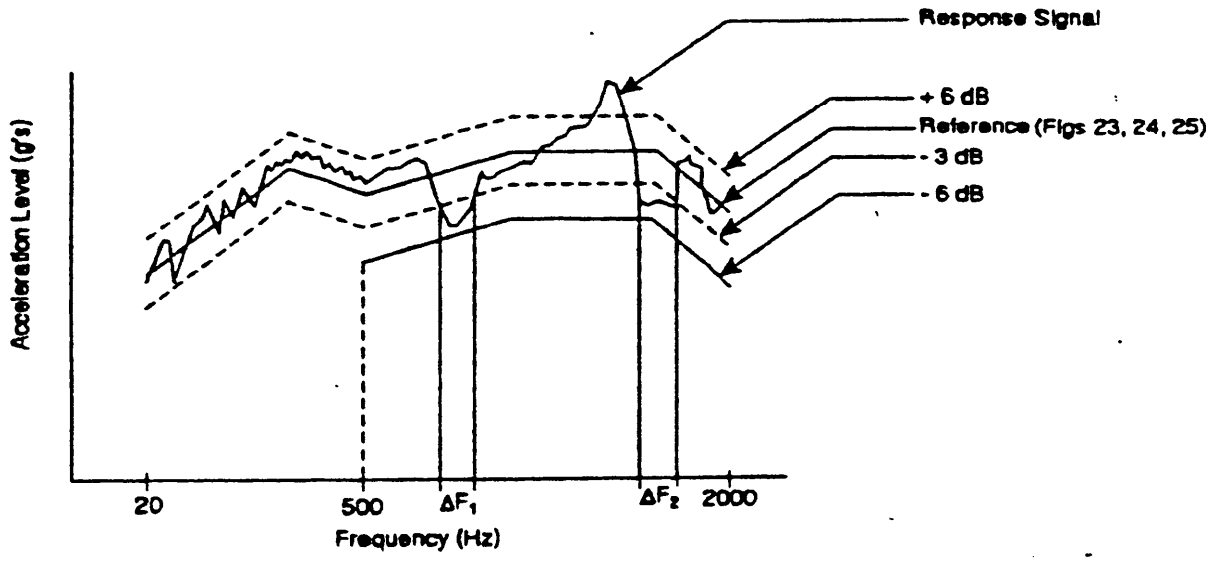


FIGURE 26. Gun firing shock tolerances.

4.8.6.2.2.2 Functional survey test. The DRU shall be used in Configuration A, Figure 1, for the functional survey test. The test conditions and procedures to be used are as follows:

a. Test conditions.

(1) The DRU system will be operated in a ground vehicle over a government approved test course.

(2) One functional survey test will be run in an eight hour period.

(3) The DRU system shall stop no more than once every hour for a planned zero-velocity update.

(4) The distance traveled per run shall be approximately 63 miles (100 km).

(5) The test course shall have 11 known survey points, including starting point, approximately 6.3 miles (10 km) apart.

b. Test Procedure. The functional survey test will follow the procedure as outlined below:

(1) Install system in vehicle.

(2) Warm up, initialize, and align system at starting point (15 min.).

(3) Take test data at each survey point.

(4) Turn off system and remove from vehicle.

The test data must meet accuracies as specified in 3.6.

4.8.6.2.2.2.1 Statistical Performance criteria. The following sets of data shall meet the statistical criteria established for survey parameters (3.6.1.1.1 through 3.6.1.1.11):

a. All accumulated data. (Initialization point excluded)

b. At least 98 percent of the individual missions containing 10 or more survey control points. All data obtained in an individual mission shall be used to compute that mission's statistics. (Initialization point excluded)

c. All the individual survey control points at which 20 or more measurements were made using essentially the same mission trajectory. Only errors exceeding the maximum (99 percent) individual error limits may be excluded from these calculations. (Alignment accuracy at the initialization point shall be included)

4.8.6.2.3 Failure criteria and definition.

4.8.6.2.3.1 Equipment failure and definintion. The term failure is defined as any malfunction which causes or may cause the system to be inoperable or to:

a. Fail to commence operation, cessation of operation or degradation of performance below designated levels.

b. Damage to the system if operation is continued.

c. Results in personnel or equipment safety hazards.

A pattern failure is defined as two or more occurrences of the same failure.

Malfunctions that require corrective action will be charged as a failure against the DRU. The following are counted as equipment failures:

a. A malfunction detected or corrected during the correction of another failure, provided the failures are totally unrelated.

b. Actual or incipient malfunctions detected during technical inspection at termination of test.

c. Failure to meet any accuracies specified.

d. Spurious BIT indicators (3.10).

The following malfunctions are not considered to be equipment failures:

a. Malfunctions caused by improper operational. procedures.

b. Malfunctions caused by abuse, unspecified operating conditions, or accidents.

c. Malfunctions resulting from failure of the vehicle or other associated equipment unless it is determined that the DRU contributed to the malfunction.

4.8.6.2.3.2 Action taken in event of an equipment failure. When a failure occurs, or whenever it becomes evident that the DRU will not meet a specified requirement, or will not pass a test, the testing shall be stopped. Failure action as defined in MIL-STD-781 shall be followed and augmented as follows. Occurrence of a pattern failure or design or software induced failure shall be a reject condition. When a reject condition has been reached, the contractor shall submit a plan for corrective action, validation of corrective action, and resumption of reliability testing for government approval.

4.8.6.3 Maintainability. Maintenance operations required during the Reliability Demonstration specified in 4.8.6.2 shall be accomplished to determine conformance to 3.6.4. In the event that the maintenance operations performed are insufficient to quantitatively assess the corrective maintenance specified in 3.6.4.1, the government shall perform or simulate additional maintenance tasks as required to complete the-assessment. Failure to maintain the DRU as specified in 3.6.4 shall constitute failure of this test.

4.8.6.4 Performance demonstration. The government may test the DRU for compliance to any of the criteria and characteristics as specified in 3.5, 3.6, 3.8 and 3.10, including accuracy at high latitudes and tolerance to gun firing shock. Actual or simulated installation conditions, environments, and operational scenarios may be used. Failure of the DRU to perform as specified shall constitute failure of the test.

4.8.7 Design verification. The DRU shall be tested to verify conformance to the design requirements specified in 3.5, 3.6, 3.8 and 3.10. The design characteristics to be verified shall include, but not be limited to, the following:

a. Alignment characteristics (3.5.3.1.2, 3.5.3.1.3, 3.6.l.l.9.1 and 3.6.1.1.9.2). Normal Align gyrocompassing tests over the specified operating temperatures with the DRU oriented at each of the cardinal headings. The DRU shall be turned off for 1 hour between gyrocompasses for tests performed at -50°F at each of the cardinal headings.

b. Zero-velocity characteristics (3.5.3.2.1.1 through 3.5.3.2.1.3).

c. Insensitivity to odometer calibration and alignment of DRU case to direction of travel (3.5.3.2.1.4).

d. Power source sensitivity, protection, and power consumption (3.5.4.2).

e. Power control characteristics (3.5.4.2.1).

f. Output power characteristics (3.5.4.2.2).

g. Signal circuit characteristics (3.5.4.4.1 through 3.5.4.4.1.1).

h. Data Bus, command and message characteristics (3.5.4.4.2 through 3.5.4.4.3.1, 3.5.4.4.3.5).

i. Acceptance and response to commands (3.5.4.4.3.2, 3.5.4.4.3.4, Appendices A, B, and C).

j. Message characteristics (3.5.4.4.3.3, 3.5.4.4.3.4. Appendices D and E).

k. Travel Lock Discrete characteristics (3.5.4.5).

l. Odometer interface characteristics (3.5.4.6).

m. Travel lock determination, shot detect, dynamic motion correction, and related Status and Alerts (3.5.5, 3.5.6).

n. Position update characteristics (3.5.7).

o. Configuration data (3.5.8).

p. Angular rate accuracy (3.6.1.1.12).

q. Sensitivity to off level alignment conditions (3.6.1.4.1).

r. Operation when pitched 90 degrees (3.6.1.5.2.b).

s. Interchangeability (3.8.5).

t. Built-In-Test accuracy, characteristics, and data checking 3.10 through 3.l0.6.2).

Failure to meet any specified requirement shall constitute failure of the test.

4.8.8 Nuclear hardness validation.

4.8.8.1 Tests and analyses. Tests and analyses shall be performed on the equipment in it; intended operating configuration to assure the system nuclear survivability as specifed in 3.8.2. Specific areas of consideration are discussed ih 4.8.8.2 through 4.8.8.5 inclusive.

Calibration certification of the facilities to be used are required by the Contracting Officers Technical Representative (COTR), 45 days prior to the nuclear test. Verification of the wave shape of the test simulator is required. Calibration and wave shape verification shall be supplied to the COTR by the contractor.

Simulation tests that do not reproduce all the required parameters of any stated environment must be extended through analysis to indicate the significance of that test and its relation to the threat environment.

4.8.8.2 Electromagnetic Pulse (EMP). The equipment in its intended deployment configuration(s) and operational modes, which are worst case for the nuclear EMP environments, shall be exposed at the specified threat levels. Ground-based systems and equipment shall be tested within the irradiation volume of an appropriate radiated-wave, ground-effect EMP simulator (e.g., the Harry Diamond Laboratories' Army EMP Simulator Operations (AESOP)). Placement of the system equipment within the simulator test volume must ensure for worst-case EMP coupling (i.e., by maximum allowable separation of the system equipment, and maximum extension of the system interconnecting cables paralleled to the electric field and perpendicular to the magnetic field). Current injection tests are necessary to verify the functionality of and hardness margin afforded by the protection devices employed at the equipment signal and power interfaces.

The equipment shall be exposed at threat level in the above orientations and in each operating mode of the equipment. The equipment shall meet the operational requirements of 3, upon completion of threat level tests. Where approved by the government, test data to satisfy the EMP requirements may be obtained by extrapolation of diagnostic test levels to threat level and current injection pulsing at the calculated level.

4.8.8.3 Initial nuclear radiation. For the purpose of design, but not validation testing, optical components, electronic pieceparts, and circuits for which nuclear test data are available, or for which an acceptable level of confidence has been established through mathematical analysis need not be subjected to further nuclear design testing. Acceptance of these optical components, electronic pieceparts, circuits and mathematical analysis will be determined by the procuring agency from data or analyses supplied to the government by the contractor. Nuclear survivability at the specified temperature extremes will be demonstrated by appropriate analysis and tests or, where acceptable, by analysis alone. The assembled equipment shall be tested for hardness to exposure to neutron fluence, total dose, and peak gamma dose rate.

4.8.8.3.1 Neutron Fluence. The equipment shall be exposed in such a manner that all optical components, electronic pieceparts and circuits receive the specified Neutron Fluence. The equipment shall be energized, if appropriate to examine worst case response. The equipment shall perform as specified in 3.

4.8.8.3.2 Total dose. The equipment shall be exposed in such a manner that all optical components, electronic pieceparts, and circuits receive the Total Dose specified. The equipment shall be energized during exposure and shall then perform as specified in 3. Except for the fiber optics and n-channel metal-oxide semiconductor (NMOS), verification of device hardness against permanent damage from gamma ray dose may be achieved by the gamma output which nomally accompanies the Neutron Flaaence. Gamma dose hardness of fiber optics and NMOS devices must be verified by Cobalt-60 irradiation in which the Total Dose specified is delivered in a steady-state exposure on the order of 20 seconds duration.

4.8.8.3.3 Peak Gamma dose rate. The equipment shall be exposed in such a manner that all optical components, electronic pieceparts, and circuits receive the Peak Gamma Dose specified. The equipment shall be energized during exposure and shall then perform as specified in 3.

4.8.8.4 Thermal radiation. The equipment in its intended deployment configuration(s), which are worst case(s) for the nuclear thermal and air-blast environments, shall be subjected to thermal radiation tests at appropriate thermal radiation levels over the entire exposed surface(s) of the equipment. In instances where only thermal radiation facilities that can be used provide these specified levels over only relatively small areas of the equipments surfaces, individual exposures will be required for each of the candidate surface and outboarded items (e.g., case, meters, knobs, antennas, cables) to ensure the thermal radiation survivability of the equipment. In such instances, thermal radiation tests of selected material samples (of the surfaces and items) may be appropriate. Following the thermal radiation tests, the equipment shall then meet the performance requirements stipulated in Section 3.

4.8.8.5 Nuclear air blast. The equipment in its intended deployment configuration(s) which are worst case(s) for nuclear thermal and air-blast environments, shall be subjected to air-blast tests at the appropriate air-blast simulation facilities that provide the specified air-blast levels. The equipment air-blast sensitivity(ies) as determined through appropriate analyses, drive the selection of the simulation environments to be used. The selected air-blast simulator(s) must be capable of providing the specified air-blast threat

environment characteristic(s) needed to demonstrate equipment compliance in meeting air-blast requirements. For equipment which is housed within an enclosure, the equipment must survive the induced shocks and accelerations that are transmitted through the enclosure when the enclosure is subjected to the specified nuclear air-blast environments. In both instances, for equipment exposed directly to the air-blast environment and for equipment protected within an enclosure, the equipment shall meet the operational requirements of Section 3 following the air-blast test.

Tests or analysis shall be performed to account for synergistic effects of thermal radiation received before the Nuclear Air-Blast.

5. PACKAGING

5.1 Packaging, packing and marking. Packaging, packing, and marking shall be in accordance with MIL-P-14232 and Packaging Data Sheet. The level of protection shall be as specified in the procurement document.

6. NOTES

6.1 Intended use. These self contained inertial surveying systems are designed to be used on weapon and target systems.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.2).

c. Requirements for submission of first article sample.

d. Applicable stock number.

e. Packaging requirements, if other than specifed in Section 5.

f. Serialization requirements, if applicable.

g. Certificate of conformance for each lot or shipment of product.

6.3 First article. When a first article inspection is required, the items should be first article samples. The first article should consist. of five units. The contracting officer should include specific instructions in acquisition documents regarding arrangement; for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Qualification. With respect to products requiring qualifications, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in the Qualified Products List (QPL) for the Dynamic Reference Unit whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is ARDEC, SMCAR-BAC-S, Picatinny Arsenal, NJ 07806-5000 and information pertaining to the qualification of products may be obtained fmm that activity.

6.5 Inspection equipment designed alternate inspection provisions.

6.5.1 Submission of designs for approval. Contractor designs for final acceptance inspection shall be approved by the Government prior to fabrication or procuring the equipment. The contractor is referred to MIL-HKBK-204 for guidance. Submission of design concept on inspection equipment is permisible for tentative approval. The completion date for design review will be based on the date of the final submission of designs and the required delivery schedule as stipulated in the contract. Submit designs as required to: Commander, U.S. Army Armament, Research, Development and Engineering Center, SMCAR-QAF-1, Picatinny Arsenal, NJ 07806-5000. This address will be specified on the Contract Data Requirements List DD Form 1423 in the contract. When the contractor submits inspection equipment designs to the government for approval, he shall give the following information. in his letter of transmittal:

a. The contract number.

b. The contract item (name model number, etc.).

c. The designs remaining to be submitted and the expected date of submittal.

6.5.2 Submission of alternative inspection provisions. Proposed alternative inspection provisions should be submitted by the contractor to the procuring contracting officer for evaluation and approval by the technical activity responsible for preparation of this specification.

6.6 Coordinate and reference frames.

6.6.1 Position.

6.6.1.1 UTM Position. Horizontal position in the Universal Transverse Mercator (UTM) coordinate system is defined by the hemisphere, numerical grid zone, Easting and Northing in accordance with TM 5-241-8, Universal Transverse Mercator Grid. The UTM coordinates can be referenced to several different spheroids.

6.6.1.2 Hemisphere.

6.6.1.2.1 Hemisphere (DRU). The DRU Hemisphere is the hemisphere where the DRU presently is located. It is input at the start of a mission. During the mission, the DRU must keep track of the hemisphere for the present location and output it when requested.

6.6.1.2.2 Hemisphere (BCU). The BCU Hemisphere is the hemisphere where the Battery Computer Unit is located. It is input to the DRU. When output is requested, the DRU repeats the last value input.

6.6.1.3 Universal transverse mercator (utm) arid zone.

6.6.1.3.1 Zone (DRU). The DRU UTM grid zone is the numerical designation for the zone in which the DRU is located. The numerical designation of the zone input at the start of a mission may represent the normal zone or the extended zone, depending on the coordinates available. When output is requested, the numerical designation of the zone in a message may represent the normal zone or the extended zoner depending on the coordinates associated with the zone. When normal zone or extended zone boundaries are crossed, the DRU will automatically change the numerical designation for the zone in output messages to that of the normal zone in which it is located.

6.6.1.3.2 Zone (BCU). The BCU Zone is the numerical UTM grid zone for the BCU location. It is input to the DRU. When output is requested, the DRU repeats the last value input.

6.6.1.4 Extended zone boundaries.

The boundaries for extended UTM zones are:

$$\lambda E = \lambda Z \pm 0\ 100{,}000/[R_e \times \cos(\phi)]$$

Where:

R_e = Ellipsoidal Radius of the Earth (meters)

λE = Geographic Longitude of Extended Zone Boundary (radians)

λZ = Geographic Longitude of the Normal Zone Boundary (radians)

ϕ = Geographic Latitude of the DRU (radians)

6.6.1.5 Spheroids. A spheroid code number, either in memory or input via the ACCEPT POSITION command during Normal Align; indicates which spheroid parameters are to be used by the DRU to compute coordinates and grid convergence. When output is requested, the DRU repeats the last value input. The parameters of the following reference spheroids shall be selected by entering the corresponding code number:

CODE NO.	SPHEROID .	SEMI-MAJOR AXIS (Meters)	INVERSE FLATTENING
0	BNG (Airy)	6377563.396	299.3249646
1	Clarke 1866	6378206.4	294.9786982
2	International (Hayford 1909)	6378388	297.0
3	Clarke 1880	6378249.145	293.465
4	Everest 1830	6377276.345	300.8017
5	Bessel 1841	6377397.155	299.1528128
6	Spare	6378137	298.257223563
7	Spare	6378137	298.257223563
8	GRS 1967	6378160	298.247167427
9	GRS 80/WGS 84	6378137	298.257223563
10	Airy	6377563.396	299.3249646
11	Modified Airy	6377340.189	299.3249646
12	Modified Everest	6377304.063	300.8017
13	WGS 1972	6378135	298.26
14	Hough	6378270	297.0
15	Indicates no change to presently selected spheroid.		

When spheroid code No. O is selected, the DRU will operate in the

British National Grid on the Airy spheroid.

6.6.1.5.1 Spheroid (BCU}. The BCU Spheroid code number indicates which spheroid parameters are being used by the BCU. The BCU spheroid is used to compute Pointing Device Azimuth output by the DRU. The code number is input to the DRU. When output is requested, the DRU repeats the last value input.

6.6.1.6 British National grid. The British National Grid has only one zone in the northern hemisphere. The zone is given the numerical designation of zero in output messages. It is assumed that the zone boundaries are never crossed. The British National Grid is defined in the Ordnance Survey Information Leaflet, No. 72, March 1983.

6.6.2 Altitude. Altitude is the distance between the present DRU position and the reference geoid (an equipotential surface of the earth approximated by mean sea level) measured along the local gravity vector (normal to the geoid). Altitude is positive when the DRU is above the geoid and negative when below. The DRU will accept starting and update altitudes for its present position. When requested, the DRU will output its present altitude.

6.6.3 Orientation. DRU orientation is defined by the relationship of the DRU case coordinate frame to an earth referenced coordinate frame. An intermediate DRU coordinate frame relates the case coordinate frame to the DRU mounting orientation. A suitable DRU coordinate frame and set of boresight angles should be selected for each installation to insure proper definition of orientation parameters during pointing device deployment (DRU rotation).

6.6.3.1 DRU reference frames.

6.6.3.1.1 Case coordinate frames. The DRU case reference frame is a set of right hand orthogonal axes, X_c, Y_c, Z_c, shown in Figure 27. The origin is located where the center axis of alignment hole R, labeled DATUM axis V in Figure 9 intersects the precision mounting surface, DATUM plane G-U, Figure 10. axis $x_=$ is along the intersection of the DATUM plane G-U and Section A-A, Figure 10, which passes through the centers of alignment holes R and D. Axis Y_c coincides with DATUM axis V in Figure 9. The axis Z_c is along the intersection of DATUM plane G-U and DATUM plane Z, Figure 9, which passes through the center of the mounting holes.

6.6.3.1.2 DRU Coordinate frame. The DRU corrdinate frame is an intermediate set of right hand-orthogonal axes, X_d, Y_d, Z_d, as shown in Figure 28a. The case coordinate frame is related to

the DRU coordinate frame by the unit rotation matrix [R].

Elements of the rotation matrix, Ri may have the values -1, of 1. Examples are shown in Figures 28b and 28c. The relationship between the case and DRU coordinate frames is specified by a coordinate frame code as listed in Appendix I. There are separate coordinate frame codes for Orientation 1 and Orientation 2.

6.6.3.2 Earth reference corrdinate frame. The earth reference coordinate frame is an orthogonal coordinate set (X_E, Y_E, Z_E). X_E points to: grid north, YE to grid east, and Z_E downward along the local vertical. Grid north equals geodetic north plus the grid convergence as described in TM 5-241-8, Universal Transverse Mercator Grid, and the Ordinance Survey Information Leaflet, No 72, March 1983. When operating in the extended zone, grid convergence is calculated in terms of its present position in the extended zone, hemisphere, and reference spheroid.

6.6.3.3 Orientation Parameters. The DRU orientation parameters are defined in terms of rotations between the earth reference, intermediate, and DRU coordinate frames as shown in Figure 29.

6.6.3.3.1 Vehicle boresight angles. A set of vehicle boresight angles, α, β, Y, relates the DRU coordinate frame to the transporting vehicle's coordinate frame. α is the horizontal angle between the vehicle longitudinal axis and the vertical projection of X_D onto the horizontal plane when the vehicle longitudinal axis and cross axis are level. α is measured clockwise from the vehicle longitudinal axis direction of travel and is always positive. β is the vertical angle between the vertical projection of X_D onto the horizontal plane and Xd when the vehicle longitudinal axis and cross axis are level. β is negative when X_D lies above the horizontal plane and positive when below. γ is the angle between the horizontal plane and Y_D measured in the Yd, Zd plane when the vehicle longitudinal axis and cross axis are level. γ is positive when Y_D lies below the horizontal plane and negative when above. a may have any value from 0 to +6399.9 mils. β may have any value from -1600 to +1600 mils γ may have any value from -3199.9 to +3200.0 roils. men the DRU is installed on a pointing device, the vehicle boresight angles are the angles when the pointing device is stowed for vehicle travel.

The vehicle boresight angles are nominal values because variations may occur with prime system manufacturing tolerances, with different weight distribution in the vehicle, with vehicle turning and crabbing, and inexact repositioning when a pointing

device is raised and then lowered.

6.6.3.3.2 Software case boresight "angles to pointing device. A set of pointing device boresight angles, A, B, r, relates the DRU coordinate frame to that of the pointing device. A is the horizontal angle between the axis of the pointing device and the vertical projection of $\bar{X}_D$ onto the horizontal plane when the axis of the pointing device and its cross axis are level. A is measured clockwise from the direction of pointing and is always positive. B is the vertical angle between the vertical projection of $\bar{X}_D$ onto the horizontal plane and $\bar{X}_D$ when the axis of the pointing device and its cross axis are level. B is negative when $\bar{X}_D$ lies above the horizontal plane and positive below. Γ the angle between the horizontal plane and $\bar{Y}_D$ measured in the $\bar{Y}_D$, $\bar{Z}_D$ plane when the axis of the pointing device and its cross axis are level. R is positive when $\bar{Y}_D$ lies below the horizontal plane and negative when above. A may have any value from O to +6399.9 roils. B may have any value from -1600.0 to +1600.0 roils. R may have any value from -3199.9 to +3200.0 mils. There are separate sets of pointing device boresight angles for Orientation 1 and Orientation 2.

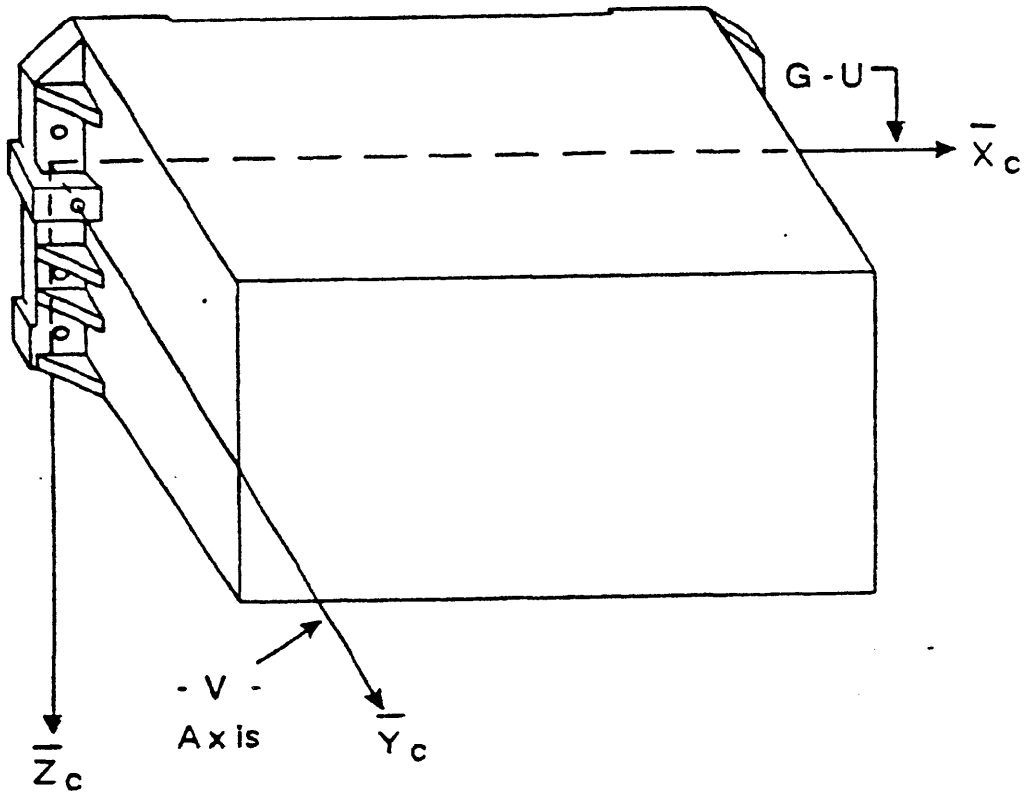
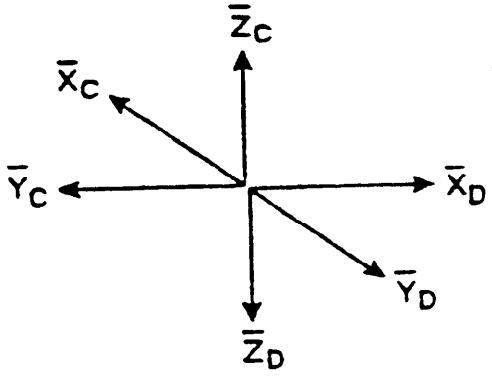


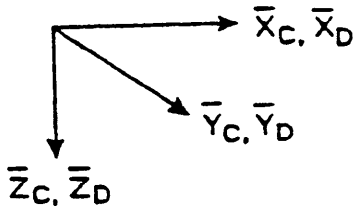
FIGURE 27. DRU case reference frame (normal mount).



a. Case to DRU Coordinate Frame Relationship

$$\begin{bmatrix} \bar{X}_D \\ \bar{Y}_D \\ \bar{Z}_D \end{bmatrix} = \begin{bmatrix} \\ R \\ \\ \end{bmatrix} \begin{bmatrix} \bar{X}_C \\ \bar{Y}_C \\ \bar{Z}_C \end{bmatrix}$$

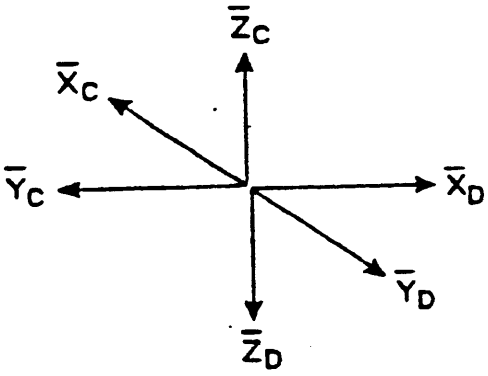
$$[R] = \begin{bmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{bmatrix}$$



b. Coincident Frames

$$[R] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Coordinate Frame Code = 00 (hex)



c. Non-Coincident Frames

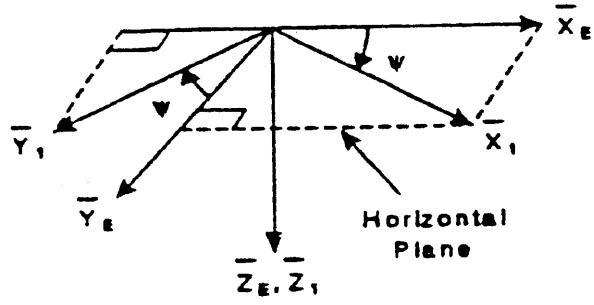
$$[R] = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

Coordinate Frame Code = 12 (hex)

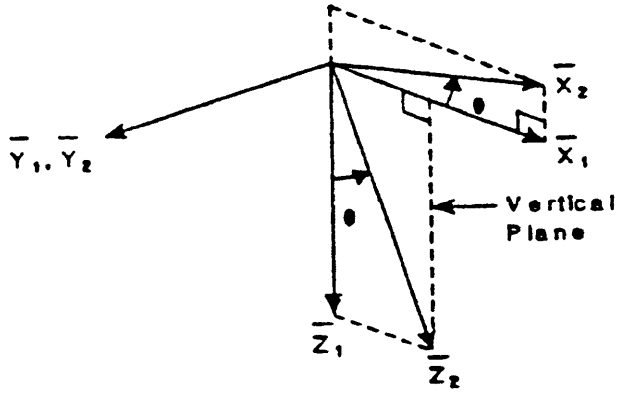
FIGURE 28.

$$\begin{bmatrix} \bar{X}_D \\ \bar{Y}_D \\ \bar{Z}_D \end{bmatrix} = \Phi \times \Theta \times \Psi \begin{bmatrix} \bar{X}_E \\ \bar{Y}_E \\ \bar{Z}_E \end{bmatrix}$$

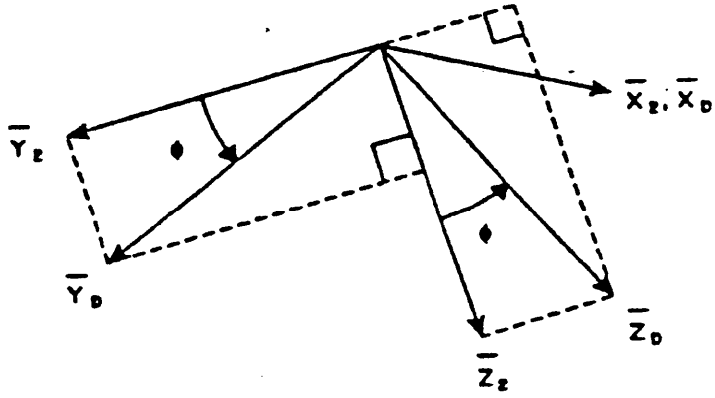
$$\Psi = \begin{bmatrix} \cos\psi & \sin\psi & 0 \\ -\sin\psi & \cos\psi & 0 \\ 0 & 0 & 1 \end{bmatrix}$$



$$\Theta = \begin{bmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{bmatrix}$$



$$\Phi = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\phi & \sin\phi \\ 0 & -\sin\phi & \cos\phi \end{bmatrix}$$



where:

ψ = Azimuth

θ = Pitch

ϕ = Roll

FIGURE 29. Orientation parameter definition.

6.7 Orientation Parameters.

6.7.1 Pointing device geodetic or grid azimuth. Pointing Device Geodetic or Grid Azimuth is the geodetic or grid azimuth of the axis of the pointing device in the direction of pointing and is the horizontal angle between geodetic or grid north and the vertical projection of the axis on the horizontal plane. Pointing Device Geodetic *or* Grid Azimuth is measured clockwise from geodetic or grid north and is always positive. It is permissible for Pointing Device Geodetic or Grid Azimuth to be in error when the pointing device's pointing axis is nearly vertical (± 5 degrees).

When the BCU Parameter Configuration Flag is reset, pointing device grid azimuth shall be calculated and output in terms of the DRU spheroid and normal or extended hemisphere and UTM zone. When the BCU Parameter Configuration Flag is set, pointing device grid azimuth shall be calculated and output in terms of the BCU spheroid, are and zone.

6.7.2 Pointing device Pitch. Pointing Device Pitch is the vertical angle between the projection of the axis of the pointing device on the horizontal plane and the axis. Pointing Device Pitch is positive when the axis in the direction of the pointing lies above the horizontal plane and negative when below.

6.7.3 Pointing device cant. Pointing Device Cant is the vertical angle between the pointing device cross axis immediately clockwise from the direction of the pointing and the projection of that cross axis on the horizontal plane. Pointing Device Cant is positive when the cross axis lies below the horizontal plane and negative when above.

6.7.4 Pointing device roll. Pointing Device Roll is the angle between the horizontal plane and the pointing device-axis immediately clockwise from the direction of pointing measured in a plane normal to the pointing device longitudinal axis. Pointing Device Roll is positive when the cross axis lies below the horizontal plane and negative when above.

6.7.5 Vehicle geodetic or arid azimuth. Vehicle Geodetic or Grid Azimuth is the geodetic or grid azimith of the longitudinal axis of the vehicle in the direction of travel and is the horizontal angle between geodetic or grid north and the vertical projection of the longitudinal axis on the horizontal plane. Vehicle Geodetic or Grid Azimuth is measured clockwise from geodetic or grid north and is always positive. On receipt

of an OUT OF TRAVEL LOCK command or discrete and until receipt of an IN TRAVEL LOCK command or discrete, Vehicle Geodetic or Grid Azimuth is frozen and equals the last value prior to receipt of the OUT OF TRAVEL LOCK command or discrete.

6.7.6 Vehicle Pitch. Vehicle Pitch is the vertical angle between the projection of the longitudinal axis of the vehicle on the horizontal plane and the axis. Vehicle Pitch is positive when the axis in the direction of travel lies above the horizontal plane and negative when below. On receipt of an OUT OF TRAVEL LOCK command or discrete and until receipt of an IN TRAVEL LOCK command or discrete, Vehicle Pitch is frozen and equals the last value prior to receipt of the OUT OF TRAVEL LOCK command or discrete.

6.7.7 Vehicle roll. Vehicle Roll is the angle between the horizontal plane and the vehicle cross axis immediately clockwise from the direction of travel measured in a plane normal to the vehicle longitudinal axis. Vehicle Roll is positive when the cross axis lies below the horizontal plane and negative when above. On receipt of an OUT OF TRAVEL LOCK command or discrete and until receipt of an IN TRAVEL LOCK command, Vehicle Roll is frozen and equals the last value prior to receipt of the OUT OF TRAVEL LOCK command or discrete.

6.7.8 Vehicle can t Vehicle Cant is the vertical angle between the vehicle cross axis immediately clockwise from the direction of travel and the projection of that cross axis on the horizontal plane. Vehicle Cant is positive when the cross axis lies below the horizontal plane and negative when above. Vehicle Cant = sinl [sin (Vehicle Roll) x cos (Vehicle Pitch)]. on receipt of an OUT OF TRAVEL LOCK command or discrete and until receipt of an IN TRAVEL LOCK command or discrete, Vehicle Cant is frozen and equals the last value prior to receipt of an OUT OF TRAVEL LOCK command or discrete.

6.7.9 Travel lock Pointing device geodetic azimuth or grid azimuth Reference When the pointing device is in travel lock, Travel Lock Geodetic Azimuth or Grid Azimuth Reference equals the present Pointing Device Geodetic Azimuth or Grid Azimuth. When the pointing device is out of travel lock, Travel Lock Geodetic Azimuth or Grid Azimuth Reference equals the value of Pointing Device Geodetic Azimuth or Grid Azimuth when the pointing device was last in travel lock. In the case where the pointing device is a weapon, the reference is corrected for any vehicle chassis in motion resulting from weapon firing.

6.7.10 Travel lock pointing device pitch reference. When the pointing device is in travel lock, Travel Lock Pitch Reference equals the present Pointing Device Pitch. When the

pointing device is out of travel lock, Travel Lock Pitch Reference equals the value of Pointing Device Pitch when the pointing device was last in travel lock. In the case where the pointing device is a weapon, the reference is corrected for any vehicle chassis motion resulting from weapon firing.

6.8 Definitions.

6.8.1 Characteristics of NHC contamination survivability NBC contamination survivability is the capability of a system and its crew to withstand an NBC-contaminated environment, including decontamination, without losing the ability to accomplish the assigned mission. Characteristics of NBC contamination survivability are decontaminability, hardness, and compatibility. To survive NBC contamination, material must meet criteria for all three.

6.8.1.1 Decontaminability. The ability of a system to be decontaminated to reduce the hazard to personnel operating, maintaining and resupplying it is termed “decontaminability.“ Key to this definition is the requirement to be able to reduce the hazard to personnel: Since the principal benefit of decontamination is to allow the crew to reduce its level of protection, decontaminability criteria must be related to the response of unprotected personnel. NBC contaminants could eventually breach the shield of the protective ensemble. Therefore, when operations permit, the contaminants should be removed where they present a hazard. Further, decontamination reduces the soldier’s vulnerability when the shield is dropped to satisfy basic physiological needs or to replace components of the NBC protective ensemble. Decontamination procedures are described in FM 3-5.

6.8.1.2 Hardness. The ability of a system to withstand the damaging effects of NBC contamination and any decontamination agents and procedures required to decontaminate it is termed "hardness." Although strongly related to decontaminability, hardness is a distinct characteristic; decontaminability refers to reducing the hazard to personnel as a result of decontamination efforts, while hardness refers to the condition of the equipment after it has been subjected to an agent decontamination.

6.8.1.3. Compatibility. The ability of a system to be operated, maintained, and resupplied by personnel wearing the full NBC protective ensemble is termed "compatibility" Even if a piece of equipment is completely hardened against NBC contamination and decontaminants and can also be easily decontaminated, it still must have the capability of bering operated effectively.while in an NBC contaminated environment.

6.8.1.4 Mission oriented Protective posture; level 4 (MOPP4). MOPP4 is a flexible system of protection against chemical agents which is used in chemical warfare to facilitate mission accomplishment. The soldier is required to wear individual protective equipment consistent with chemical threat. Level four requires the following protective equipment: fatigues, chemical protective overgarment or liner ensemble, protective mask, hood, gloves overboots and body armor. Use of this equipment is discussed in FM 3-4.

6.8.2 Error Parameters.

6.8.2.1 Circular error Probable (CEP). CEP is the radius of a circle, centered about true, such that any measured position, selected from the total sample population, has a 50 percent probability of lying inside the circle. CEP shall be computed as follows:

$$CEP = 1.1774 \quad \frac{RMs_n + RMs_e}{2}$$

Where:

RMS and RMS are the RMS errors in Northing and Easting, respectively.

6.8.2.2 Radial error. Radial error is the linear difference in horizontal position between the measured reference values for a single position measurement.

$$\text{Radial Error} = [(m_e - M_e)^2 + (m_n - M_n)^2]^{.5}$$

Where:

m and m are the measured Easting and Northing, respectively.

m and m are the reference Easting and Northing. respectively.

6.8.2.3 RMS error. RMS error is the square root of the mean of the sum of the squared errorsrelative to the reference value(s), for all measurements in the sample population. RMS error shall be computed as follows:

$$RMS_x = \left[\frac{\sum_{i=1}^{i=N} (X_i)^2}{N} \right]^{1/2}$$

Where:

N is the total number of measurements in the sample.

X_i is the error in the i'th measurement with respect to the reference value.

$X_1 = ml - M_1$ for linear or angular errors.

$$X_1 = \frac{100\ m}{S_1 - S^o}$$

$$Xi = (m, - M_t) - \frac{(m - M)}{T_1 - T_0} \text{ for drift errors.}$$

m_f is the i'th measurement in the sample. (m_0 is the initial measurement)

M_1 is the reference value associated with the i'th measurement.

$S_1 - S_0$ is the odometer distance traveled since the last position update.

$T_1 - T_0$ is the travel time since the last alignment.

6.8.2.4 Probable error (PE). PE is the equally likely deviation (50% probability) of a set of linear measurements about the true (reference) value. PE shall be-computed as:

$$PE = 0.6745 \times RMS_x$$

6.8.2.5 Standard deviation about the mean. The Standard Deviation about the Mean (o) is the measurement of the dispersion of the measurements in a sample about the arithmetic mean. σ shall be computed as:

$$\sigma = \left[\frac{\sum_{i=1}^{i=N} (m_i - \bar{m})^2}{N-1} \right]^{1/2}$$

Where:

N is the total number of measurements in the sample.

m_1 is the i'th measurement in the sample.

$\bar{m}$ is the arithmetic mean of the sample.

$$\bar{m} = \frac{\sum_{i=1}^{i=N} m_i}{N}$$

6.8.3 Data staleness.

The following is a description of the staleness of data transmitted in a DRU data message.

DRU attitude and angular rate data are updated on a fixed computational cycle (i.e. 200) Hz). Position and velocity data are updated at a slower rate (i.e. 12.5 Hz). There is a fixed computational delay between the time the raw inertial measurements are made and the time the update is made (i.e. 0.83 msec for attitude and angular rate data).

DRU communications are asynchronous with the computational cycles. Therefore, there will be a variable delay between the last parameter update and the start of a message. This delay will be linearly distributed in the range of O to the computation cycle interval (i.e. 0 to 5 msec for attitude and O to 80 msec for position.)

The time to transmit a message varies with the length of a message. The longest 100 Hz message has 12 data characters for a total of 136 bits or 3.54 msec of transmission time. The longest 5 Hz message has 26 data characters, totaling 264 bits, or 6.88 msec transmission time.

Data staleness = Fixed Delay + Update Delta + Transmission Time

As an example, the minimum and maximum data staleness for the longest attitude data message (100 Hz) are:

Delay Type	Minimum	Maximum
Fixed	0.83 msec	0.83 msec
Update	0	5.00 msec
Transmission	3.54 msec	3.54 msec.
Total	4.37 msec	9.37 msec

6.9 Acronyms and abbreviations.

A	Ampere
AC	Alternating current
AFCS	Automatic Fire Control System
AGPS	Automatic Gun Positioning System
AM	Amplitude modulation
BCU	Battery Computer Unit
BIT	Built-In-Test
BTU	British Thermal Unit
C	Centigrade
CCITT	International Telegraph and Telephone Consultative Committee
CDU	Control and Display Unit
CEP	Circular Error Probable
	Centimeter
COTR	Contracting Officer's Technical Representative
CRC	Cyclic Redundancy Check
CUCV	Commercial Utility Cargo Vehicle
CW	Continuous wave
dB	Decibels
DC	Direct current
DRU	Dynamic Reference Unit
E-field	Electrostatic field
EIA	Electronic Industries Association
EMI	Electromagnetic interference
EMP	Electromagnetic pulse
F	Fahrenheit
FM	Frequency modulation
fps	Feet per second
ft	Feet
g	Gram
G	Gravity
GHZ	Gigahertz
hr	Hour
Hz	Hertz
in	Inch
K	One thousand
KA	Kiloampere
kg	Kilogram

km	Kilometer
kv	Kilovolt
Lat	Latitude
lbs	Pounds
LSB	Least Significant Bit
m	Meter
M	Mil
ma	Milliampere
MHz	Megahertz
min	Minutes
m m	Millimeter
MMD	Mass median diameter
mps	Meters per second
MSB	Most Significant Bit
msec	Millisecond
MTBF	Mean-Time-Between-Failure
MTTR	Mean-Time-To-Repair
mv	Millivolt
Mv	Megavolt
N	North
NBC	Nuclear-Biological-Chemical
NMOS	N-Channel metal-oxide semiconductor
NRZ	Non-return to zero
PE	Probable Error
pf	Picofarad
pk-pk	Peak-to-peak
PSCD	Prime System Control Display
RMS	Root mean square
RTN	Return
S	south
SCC	Serial Communication Controller
SDLC	Synchronous Data Link Control
sec	Second
T	Time
TBD	To be Determined
UTM	Universal Transverse Mercator
V	volts
VMS	Vehicle Motion Sensor
W	Watt

6.10 Subject term (key word listing.

Fire Control
MAPS
Navigation
Positioning System

6.11 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian
Army-AR

Preparing Activity
Army-AR

(Project 1220-A446)

DRU APPENDIXES

DYNAMIC REFERENCE UNIT APPENDIXES

10. SCOPE

10.1 Scope

These appendices detail the commands that transfer data from the prime system or CDU to the DRU, from the DRU to the prime system or CDU and commands that do not transfer data but cause a mode or operator change, definition of Data Messages and description of STATUS Characters. They also contain the vibration test schedules. These appendices are a mandatory part of this specification. The information herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. COMMANDS

APPPENDIX A

COMMANDS TEAT TRANSFER DATA FROM THE PRIME SYsTEM OR CDU TO THE DRU

30.1 Commands that Transfer Data from the prime system and/or CDU to the DRU

30.1.1 Command: ACCEPT POSITION (NAVIGATION UPDATE)

From: Prime System To: DRU

Function: This user update command requests the DRU to accept the transmission of position (navigation) data from the prime system. The DRU accepts update data when the DRU is stationary.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS	FLAG(F)
01111110	XXX	00101	D1 - D11	16 Bits	01111110

Number of Data Characters: 11.

Data Format: Binary 2's Complement

Dl, D2, D3 Characters (24 bits unsigned) — Northing
Range: 0 .to 10,000,000 meters
Resolution: 1 meter

D4, D5 Characters (15 bits) — Altitude
Range: -16,384 to +16,383 meters
Resolution: 1 meter

M Character (7 bits)
Range: A 61 (Integer)
+ indicates northern hemisphere;
-, southern

If KU Parameters Configuration Flag reset: Zone number of Extended Zone (DRU ignores sign) or set s61 for Normal Zone. If KU Parameters Configuration Flag set: BCU Hemisphere and Zone

D7 Character (7 bits) — Hemisphere & Zone of DRU
Range: A 60 (Integer)
+ indicates northern hemisphere;
-, southern

D8 Character (most significant 4 bits) Range: 0 to 15 (Unsigned Integer)	If BCU Parameters Configuration Flag reset: Set to 0 (DRU ignores value) If BCU Parameters Configuration Flag set: BCU spheroid
M Character (least significant 4 bits) Range: 0 to 15 (Unsigned Integer)	Prime System (DRU) Spheroid
D9, D10, D11 Characters (20 bits unsigned) Range: 0 to 999,999 meters Resolution: 1 meter	Easting

****

30.1.2 Command: ACCEPT POINTING DEVICE BORESIGHT

From: Prime System To: DRU

Function: This Command enters pointing device boresight angles betveen the DRU mounting plate and prime system device being pointed. Use of this command is valid only when the Pointing Device boresight flag in configuration data is set.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	Flag(F)
01111110	XXX	10111	D1 - D13	16 Bits	01111110

Number of Data Characters: 13

Data Format: Binary 2's Complement

D1 Character (8 bits) — Reserved Spare
Range: 0
Resolution: WA

D2, D3 Characters (16 bits unsigned) — A as defined in 6.6.3.3.2 for Orientation 1.
Range: 0 to 6399.9 Mils
Resolution: 0,1 Mil

D4, D5 Characters (16 bits) — B as defined in 6.6.3.3.2 for Orientation 1_0
Range: -1600.0 to 41600.0 Mils
Resolution: 0.1 Mil

D6, D7 Characters (16 bits) — r as defined in 6.6.3.3.2 for Orientation 1_0
Range: -3199.9 to +3200.0 Mils
Resolution: 0.1 Mil

D8, D9 Characters (16 bits unsigned) — A as defined in 6.6.3.3.2 for Orientation 2.
Range: 0 to 6399.9 MilS
Resolution: 0.1 Mil

D10, D11 Characters [16 bits) — B as defined in 6.6.3.3.2 for Orientation 2.
Range: -1600.0 to +1600.0 Mils
Resolution: 0.1 Mil

D12, D13 Characters (16 bits) — C as defined in 6.6.3.3.2 for Orientation 2.
Range: -3199.9 to +3200.0 Mils
Resolution: 0.1 Mil

****

30.1.3 Command: ACCEPT CONFIGURATION DATA

From: Prime System To: DRU

Function: This command provides the DRU with data defined in 3.5.8 and other data desired by each supplier to optimize performance as a function of an installation/vehicle type.

DRU Response: STATUS DATA MESSAGE

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARCTERS(E)	FLAG(F)
01111110	XXX	00011	D1 - D35	16 Bits	01111110

Number of Data Characters: 35

Data Format: Binary 2's Complement

D1	Character (8 bits) Range: 0 Resolution: N/A	Reserved Spare
D2,	D3 Characters (16 bits) Range: -3199.9 to +3200.0 Mils Resolution: 0.1 Mil	1-2 Threshold Angle (3.5.8.1.3)
D4,	D5 Characters (16 bits) Range: -3199.9 to +3200.0 Mils Resolution: 0.1 Mil	2-1 Threshold Angle (3.5.8.14)
D6,	D7 Characters (16 bits) Range: -12.8 to +12.7 meters Resolution: 0.1 meter	Ax offset along the vehicle longitudinal axis for Orientation 1 (3.5.8.3)
D8,	D9 Characters (16 bits) Range: -12.8 to +12.7 meters Resolution: 0.1 meter	*AY* offset along the vehicle cross axis for Orientation 1 (3.5.8.3)
D10,	D11 Character (16 bits) Range: -12.8 to +12.7 meters Resolution: 0.1 meter	AZ offset along the vehicle vertical axis-for Orientation 1 (3.5.8.3)
D12,	D13 Characters (16 bits) Range: -12.8 to +12.7 meters Resolution: 0.1 meter	AX offset along the pointing device pointing axis for Orientatation 2 (3.5.8.3)

D14, D15 Characters (16 bits) Range: -12.8 to +12.7 meters Resolution: 0.1 meter	ΔY offset along the pointing device cross axis for Orientation 2 (3.5.8.3)
D16, D17 Characters (16 bits) Range: -12.8 to +12.7 meters Resolution: 0.1 meter	ΔZ offset along the pointing device vertical axis for Orientation 2 (3.5.8.3)
D18, D19 Characters (16 bits unsigned) Range: 2 to 15 minutes Resolution: .25 minute	ZUPT internal for Exclusive ZUPT node (3.5.8.5)
D20, D21 Characters (16 bits unsigned) Range: 2 to 63 minutes Resolution: 1 minute	ZUFT interval for Odometer Mode (3.5.8.5)
D22, D23 Characters (16 bits unsigned) Range: 3.5 to 34.0 minutes Resolution: 0.25 minute	Normal Align Time (3.5.8.6)
D24, D25 Characters (16 bits unsigned) Range: 1 to 10 seconds Resolution: 1 second	Shot Detect Interval (3.5.8.15)
D26, D27, D28, D29 Characters (32 bits binary)	Configuration definition flags (3.5.8.8 and Appendix J)
D30, D31 Characters (16 bits unsigned) Range: 0.750 to 1.250 Resolution: 0.001	Odometer Scale Factor (3.5.8.4)
D32, D33 Characters (16 bits) Range: -3276.8 to +3276.7 Microradians/kilometer {3.5.8.7) Resolution: 0.1 Microradian/kilometer	Fuel Consumption Factor (3.5.8.7)
D34 Character (8 bits) Range: 0 to 3F (HEX)	DRU Coordinate Frame Code for Orientation 1 (Appendix I)
D35 Character (8 bits> Range: 0 to 3F (HEX)	DRU Coordinate Frame Code for Orientation 2 (Appendix I)

****

30.1.4 Command: ACCEPT VEHICLE BORESIGHT

From: Prime System To: DRU

Function: This command enters vehicle boresight angles between the DRU mounting plate and the vehicle. Use of this command is valid only when the vehicle boresight flag in configuration data is set.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	ECHO SEQ (N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS	FLAG(F)
01111110	XXX	10100	D1-D7	16 Bits	01111110

Number of Data Characters: 7

Data Format: Binary 2's Complement l xcept D1 which is binary

D1 Character (8 bits) Command Subcode
value : 11

D2, D3 Characters (16 bits unsigned) α as defined in 6.6.3.3.1
Range: 0 to 6399.9 Mils
Resolution: 0.1 mil

D4, D5 Characters (16 bits) B as defined in 6.6.3.3.1
Range : -1600.0 to +1600.0 mils
Resolution: 0.1 mil

D6, D7 Characters (16 bits) Y as defined in 6.6.3.3.1
Range : -3199.9 to +3200.0 mils
Resolution: 0.1 mil

****

30.1.5 Command: ACCEPT GEODETIC DATA

From: Prime System To: DRU

Function: This user update command requests the DRU to accept position data from the prime System in geodetic coordinate form. The DRU accepts update data when the DRU is stationary.

DRU Response: STATUS DATA message

COMMAND STRUCTURE

FLAG(F)	Echo SEQ# (N)	COmMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS (E)	FLAG(F)
01111110	XXX	10100	D1-D19	16 Bits	01111110

Number of Data Characters: 19

Data Format: Binary 2's Complement

D1 Character (8 bits unsigned) — Command Subcode
Value: 14

D2, D3 Characters (16 bits unsigned) — Prime System Spheroid
Range: 0-15 (Integer)

D4, D5 Characters. (16 bits) — Latitude Degrees
Range: ±90 degrees
Resolution: 1 degree
+ Northern Hemisphere
- Southern Hemisphere

D6, D7, D8, D9 Characters (32 bits unsigned) — Latitude minutes
Range: O t 59.99999 arc minutes)
Resolution: $1/2^{24}$ arc minute

D10, D11 Characters (16 bits) — Longitude Degrees
Range: ±180 degrees
Resolution: 1 degree
+ East of Greenwitch
West of Greenwitch

D12,D13,D14,D15 Characters (32 bits unsigned) — Longitude Minutes
Range: O to 59.99999 arc minutes)
Resolution: $1/2^{24}$ arc minute

D16, D17, D18, D19 Characters (32 bits) Altitude
Range: -32,768 to +32,767 meters
Resolution: 0.01 meters

APPENDIX B

COMMANDS THAT REQUEST TRANSFER OF DATA FROM TEE DRU TO THE PRIME SYSTEM OR CDU

30.2 Commands that Request Transfer of data from the DRU to the Prime System and/or CDU

****

30.2.1 Cocnmand: RETURN POINTING DEVICE RATE DATA

From: Prime System to: DRU

Function: This command requests the DRU to transmit current Pointing Device angular rates to the prime system.

DRU Response: POINTING DEVICE RATE DATA Message

COmmAND STRUCTURE

FLAG(F)	SEquENCE NUmBER(N)	COmmAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	01101	NONE	16 Bits	01111110

****

30.2.2 Command: RETURN CONFIGURATION DATA

From: Prime System to: DRU

Function: This command requests the DRU to transmit the configuration data presently used by the DRU to the prime system.

DRU Response: CONFIGURATION DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: D1 Binary

D1 Character (8 bits) Command Subcode

Value: 7

****

30.2.3 COMMAND: RETURN STATUS

From: Prime System to: DRU

Function: This command asks the DRU to transmit current STATUS to the prime system.

DRU Response: STATUS DATA message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10000	NONE	16 Bits	01111110

****

30.2.4 Command: RETURN NAVIGATION DATA

From: Prime System to: DRU

Function: This data request command asks the DRU to transmit current navigation data consisting of: position, attitude, hemisphere, zone, spheroid, distance traveled, pointing device geodetic or grid azimuth, and vehicle attitudes to the prime system.

DRU Response: NAVIGATION DATA Message

COMMANDSTRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10001	NONE	16 Bits	0111110

****

30.2.5 Command: RETURN ATTITUDE DATA

From: Prime System to: DRU

Function: This command requests the DRU to transmit current attitude data to the prime system.

DRU Response: ATTITUDE DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER[N]	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	00001	NONE	16 Bits	01111110

*****+**********

30.2.6 Command: RETURN ALIGN TIME TO GO

From: Prime System To: DRU

Function: This data request command asks the DRU to transmit the amount of time remaining until Normal Align or Stored Beading Align is complete.

DRU Response: ALIGN

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE (C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10010	NONE	16 Bits	01111110

****

30.2.7 Command: RETURN ALERT DATA

From: Prime System to: DRU

Function: This data request command asks the DRU to transmit to the prime system, Alert Data that indicates a problem or error.

DRU Response: ALERT DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTER(D)	ERROR DET. CODE CHARACTERS	FLAG(F)
01111110	XXX	10011	NONE	16 Bits	01111110

****

30.2.8 Command: RETURN BIT DATA "

From: Prime System to: DRU

function~ This command asks the DRU to transmit Built-in-Test (BIT) data to the prime system.

DRU Response: BUILT-IN-TEST DATA message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	11111	NONE	16 Bits	01111110

****

30.2.9 Command: RETURN TRAVEL LOCK DATA

From: Prime System To: DRU

Function: This command asks the DRU for travel lock data.

DRU Response: TRAVEL LOCK DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	00000	NONE	16 Bits	20

****

30.2.10 Command: RETURN POSITION DATA

From: Prime System to: DRU

Function: This data request command asks the DRU to transmit current position data consisting of Spheroid, Hemisphere, Zone, Easting, Northing and Altitude to the prime system.

DRU Response: POSITION DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE (C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	01001	NONE	16 Bits	01111110

****

30.2.11 Command: RETURN POINTING DEVICE ALTITUDE DATA

From: Prime System TO DRU

Function: This command requests the DRU to transmit current Pointing Device Data to the prime system.

DRU Response: POINTING DEVICE ATTITUDE DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	01100	NONE	16 Bits	01111110

****

30.2.12 Command: ASSIGNED TO SUPPLIERS

Command code 6 (00110) may be used by each Contractor.

The Suppliers shall assign identifier Code 12 to the message associated with Command code 6.

****

30.2.13 Command: RETURN POINTING DEVICE BORESIGHT

From: Prime System to: DRU

Function: This command requests the DRU to transmit the pointing device boresight angles to the prime system.

DRU Response: POINTING DEVICE BORESIGHT Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 2

Data Format: Unsigned Binary

D1 Character (8 bits) Command Subcode

Value: 8

****

30.2.14 Command: RETURN EXPANDED STATUS

From: Prime System to: DRU

Function: This command requests the DRU to transmit the EXPANDED STATUS message to the prime system.

DRU Response: EXPANDED STATUS DATA message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: unsigned Binary

D1 Character (8 bits) Command Subcode

Value: 9

****

30.2.15 Command: RETURN SURVEY QUALITY

From: prime system To: DRU

Function: This command requests the DRU to transmit the SURVEY QUALITY message.

DRU Response: SURVEY QUALITY message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER (N)	COMMAND CODE(C)	DATA CHARACTERS (d)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: unsigned Binary

D1 Character (6 bits) Command Subcode

Value: 10

****

30.2.16 Command: RETURN VEHICLE BORESIGHT

From: Prime System to: DRU

Function: This command requests the DRU to transmit the vehicle boresight angles to the prime system.

DRU Response: VEHICLE BORESIGHT Message

COMAND STRUCTURE

ECHO FLAG (F)	COMMAND SEQ # (N)	CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERISTICS(E)	FLAG(F)
01111110	XXX	10100	D1	16 BITS	01111110

Number of Data Characters: 1

Data Format: Unsigned Binary

D1 Character Value (8 bits) 12 — Command Subcode

****

30.2.17 Command: RETURN GEODETIC DATA

From: Prime System To: DRU

Function: This command requests the DRU to transmit the GEODETIC DATE message.

DRU Response: GEODETIC DATA Message

COMMAND STRUCTURE

ECHO FLAG(F)	COMMAND SEQ#(N)	CODE(C)	DATA CMRACTERS(D)	ERROR DET. CODE CHARACTERISTICS(E)	FLAG(F)
01111110	XXX	10100	D1	16 BITS	01111110

Number of Data Characters: 1

Data Format: Unsigned Binary

D1 Character Value (8 bits) 13 — Command Subcode

APPENDIX C

COMMANDS THAT DON'T TRANSFER DATA BUT CAUSE A MODE OR OPERATION CHANGE

30.3 DRU Mode Change Command Messages (NO DATA TRANSFER)

****

30.3.1 Command: OVERRIDE ALERT

From: Prime System To: DRU

Function: The OVERRIDE ALERT command is sent by the Prime System/CDU to clear overridable alert indications.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS	FLAG(F)
01111110	XXX	01000	None	16 Bits	01111110

****

30.3.2 Command: RESET DISTANCE

From: Prime System To: DRU

Function: This user update command requests the DRU to reset to zero the total accumulated distance traveled by the vehicle.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	00111	None	16 Bits	01111110

****

30.3.3 Command: RESTART

From: Prime System To: DRU

Function: The purpose of the RESTART command is to allow the operator the capability of commanding Normal Align and to correct update data without cycling DRU input pover.

Upon receipt of this mode change command the DRU shall reinitialize vithin 2 seconds and perform Normal Align. The DRU may be commanded to restart while in any mode, but shall respond only if the DRU is not moving.

A RESTART shall be permitted when DRU motion is the result of one of the following Alert conditions:

a. ALERT DATA D2/4 (Unable to Complete Align)
b. ALERT DATA D2/3 (Align Interrupt)
c. ALERT DATA D3/1 (Excessive Rates)

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	11010	NONE	16 Bits	01111110

****

30.3.4 Deleted

30.3.5 Deleted

****

30.3.6 Command: INHIBIT AUXILIARY BUS CONTROL

From: Prime System To: DRU

Function: This command inhibits auxiliary bus control if the command is received on the Main Bus. The Auxiliary Bus control STATUS bit is set. The Auxiliary Bus responds only to commands that transfer data from the DRU when the Auxiliary Bus is inhibited. If an illegal command is attemped, bit 1 in ALERT DATA character D5 will be set. When inhibited, the Auxiliary Bus will respond to the following commands only:

(1) RETURN TRAVEL LOCK DATA
(2) RETURN ATTITUDE DATA
(3) RETURN CONFIGURATION DATA
(4) RETURN STATUS
(5) RETURN NAVIGATION DATA
(6) RETURN ALIGN THE TO GO DATA
(7) RETURN ALERT DATA
(8) RETURN BIT DATA
(9) RETURN POINTING DEVICE RATE DATA
(10) RETURN POSITION DATA
(11) RETURN POINTING DEVICE ATTITUDE DATA
(12) RETURN POINTING DEVICE BORESIGHT
(13) RETURN EXPANDED STATUS
(14) RETURN SURVEY QUALITY
(15) RETURN VEHICLE BORESIGHT
(16) RETURN GEODETIC DATA
(17) COMMAND ASSIGNED 70 SUPPLIER (Optional)

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARCTERS(E)	FLAG(F)
01111110	XXX	01010	NONE	16 Bits	01111110

****

30.3.7 Command: ENABLE AUXILIARY BUS CONTROL

From: Prime System To: DRU

Function: If this command is received on the Main Bus, the Auxiliary Bus control is enabled and the Auxiliary Bus control STATUS bit is reset. This command permits the Auxiliary Bus to respond to all commands except INHIBIT AUXILIARY BUS CONTROL and ENABLE AUXILIARY BUS CONTROL. If the operator attempts to execute either of these commands, the invalid mode request, bit 6 of ALERT DATA character D5 is set.

DRU Response: STATUS DATA Message

Command STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	01011	NONE	16 Bits	01111110

****

30.3.8 Command: STORED HEADING ALIGN

From: Prime System To: DRU

Function: The operator may select the Stored Heading Align mode rather than allowing the DRU too automatically sequence through Normal Align. The Stored Reading Align mode will allow the DRU to be ready for survey within the time specified in configuration data after receipt of the command. Valid stored data must be available to the DRU to enter and successfully complete Stored Beading Align.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	11011	NONE	16 Bits	01111110

****

30.3.9 Command: SHUTDOWN

From: Prime System To: DRU

Function: This command requests the DRU to store position data in a non VOLATILE memory before power is removed. Alert Data bit 7 of character D3 shall be set and the request ignored if the vehicle is moving when the command is received. ALERT bit 0 of character D2 shall be set if the vehicle is moving while the ShUTDOWN command is being processed.

Current position, attitudes, and any other data which are necessary to resume normal operation when power is turned on, shall be stored prior to removing power. If power control is enabled the SHUTDOWN Command also shall cause the DRU to be deenergized. The time to complete storage of data shall not exceed 4.5 sec beginning with receipt of the first bit of the command.

DRU Response: STATUS DATA Message

commAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	11110	NONE	16 Bits	01111130

****

30.3.10 Command: OUT OF TRAVEL LOCK

From: Prime System TO: DRU

Function: This command tells the DRU that the pointing device is about to leave travel lock.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: D1 Binary

D1 Character (8 bits) Command Subcode

Value: 6

****

30.3.11 Command: INHIBIT ZERO VELOCITY UPDATES

From: Prime System To: DRU

Function: This command shall inhibit zero-velocity updates. The command may be used during laboratory evaluation of attitude and position drift under static conditions. The inhibit command together with the enable command (30.3.12) may be used in vehicles that move very slowly during part of a mission.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(M)	COMMAND CODE(C)	DATA CHARACTERS(D]	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	01111	NONE	16 Bits	01111110

****

30.3.12 Command: ENABLE ZERO-VELOCITY UPDATES

From: Prime System To: DRU

Function: This command shall enable zero-velocity updates. The command may during laboratory evaluation of attitude and position drift under static conditions. The enable command together with the inhibit command (30.3.12) may be used on vehicles that move very slowly during part of a q ission. Upon turn-on, the DRU automatically shall enable zero-velocity updates.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01112110	XXX	10101	NONE	16 Bits	0111110

****

30.3.13 Command: IN TRAVEL LOCK

From: Prime System To: DRU

Function: The purpose of this command is to allow the operator to designate the travel lock status. The pointing device will be in travel lock when this command is initiated.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: Unsigned Binary

D1 Character (8 bits) Command Subcode

Value: 5

****

30.3.14 Command: EXCLUSIVE ZUPT MODE REQUEST

From: Prime System TO: DRU

Function: This command allows the operator to change the DRU mode of operation from the Odometer Mode to the Exclusive ZUFT Mode.

DRU Response: STATUS DATA MESSAGE

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: Unsigned Binary

D1 Character (8 bits) Command Subcode

Value: 1

****

30.3.15 Command: ODOMETER MODE REQUEST

From: Prime System To: DRU

Function: This command allow the operator to change the DRU mode of operation from the Exclusive ZUFT node to the Odometer Mode. Under certain conditions the DRU will not comply with the request the request (3.5.3.2.1.2, 3.5.3.2.1.3).

DRU Response: STATUS DATA MESSAGE

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAC(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: Unsigned Binary

D1 Character (8 bits)

Value: 2

****

30.3.16 Command: STORED BEADING SHUTDOWN

From: Prime System To: DRU

Function: This command requests the DRU to store position and attitude data in non-volatile memory before power is removed and to automatically enter the Stored Heading Align mode at the next power on. ALERT D3/7 shall be set and the request ignore if the vehicle is moving when the command is received. ALERT D2/0 shall be set If the vehicle is moving while the STORED BEADING SHUTDOWN command is being processed. Alert D3/4 shall be set and the request ignored if a STORED HEADING SHUTDOWN command is received prior to completing a normal Align or accumulating **a** total of 15 minutes stationary time after starting a Stored Heading Align.

Current position, attitudes and any other data which are necessary to resume normal operation when power is turned on, shall be stored prior to removing power. If power control is enabled, the STORED HEADING SHUTDOWN command also shall cause the DRU to be deenergized. The time to complete storage data shall not exceed 4.5 seconds beginning with receipt of the first bit the command.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: Unsigned Binary

D1 Character (8 bits) Command Subcode

Value: 15

****

30.3.17 Command: AIR TRANSPORT MODE REQUEST .

From: Prime System To: DRU

Function: This command allows the operator to change the current DRU mode of operation to the Air Transport Mode.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE(C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: Unsigned Binary

D1 Character (8 bits) Command Subcode

Value: 16

****

30.3.18 Command: MARINE TRANSPORT MODE REQUEST

From: Prime System To: DRU

Function: This command allows the operator to change the current DRU mode of operation to the Marine Transport Mode.

DRU Response: STATUS DATA Message

COMMAND STRUCTURE

FLAG(F)	SEQUENCE NUMBER(N)	COMMAND CODE (C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG(F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: Unsigned Binary

D1 Character (8 bits) Command Subcode

Value: 17

****

30.3.19 Command: TRANSPORT MODE COMPLETE

From: Prime System To: DRU

Function: This command allows the operator to terminate the current Air or Marine Transport Mode and return the DRU to its mode of operation prior to transport.

DRU Response: STATUS DATA Message. When the DRU is not in either the Air Transport or Marine Transport mode, the DRU shall set ALERT DATA bit D5/6 (Invalid Mode Request)

COMMAND STRUCTURE

FLAG (F)	SEQUENCE NUMBER(N)	COMMAND CODE (C)	DATA CHARACTERS(D)	ERROR DET. CODE CHARACTERS(E)	FLAG (F)
01111110	XXX	10100	D1	16 Bits	01111110

Number of Data Characters: 1

Data Format: Unsigned Binary

D1 Character (8 bits) Command Subcode

Value: 18

APPENDIX D

DEFINITION OF DATA MESSAGES

30.4 Definition of Data Messages

Ranges for data which have defined or absolute limits are given as the defined limits. Ranges for data which have no particular defined boundaries are given as the limits set by the data word size. Data words for some parameters include partial least significant bytes. Since the values of the unused bits are not specified, the positive numerical limit will fractionally increase if all bits in the byte are read.

****

30.4.1 Message: POINTING DEVICE RATE DATE

From: DRU To: Prime System

Number of Data Characters: 6

Data Format: Binary 2's Complement

<MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	01011	16 Bits	DI-D6	16 bits	01111110

The angular rate of DRU Azimuth, Pitch and Roll are contained in the six characters of the data.

D1, D2 Characters (16 bits) Range: -3276.8 to +3276.7 roils/second* Resolution: 0.1 roil/second		Pointing Device Azimuth Rate
D3, D4 Characters (16 bits) Range: -3276.0 to +3276.7 nils/second* Resolution: 0.1 roil/second		Pointing Device Pitch (Elevation Angle) Rate
D5, D6 Characters (16 bits) Ranges -3276.0 to +3276.7 nils/second* Resolution: 0.1 roil/second		Pointing Device Roll Rate

* For rates outside the data range, the value shall be fixed at +3276.7 for positive rates and -3276.8 for negative rates.

****

30.4.2 Message: CONFIGURATION DATA

From: DRU To: Prime System

Number of Data Characters: 36

Data Format: Binary 2's Complement

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	10010	16 Bits	D1-D36	16 bits	01111110

D1, D2 Characters (16 bits)
Range: -3199.9 to +3200.0 Mils
Resolution: 0.1 Mil
1-2 Threshold Angle (3.5.8.23)

D3, D3, D4 Characters (16 bits)
Range: -3199.9 to +3200.0 Mils
Resolution: 0,1 Mil
2-1 Threshold Angle (3.5.8.34)

D5, D5, D6 Character (16 bits)
Range : -12.8 to +12.7 meters
Resolution: 0.1 meter
ΔX offset along the vehicle longitudinal axis for Orientation 1 (3.5.8.3)

D7, D7, D8 Character (16 bits)
Range : -12.8 to +12.7 meters
Resolution: 0.1 meter
ΔY offset along the vehicle cross axis for Orientation 1 (3.5.8.3)

D9, D10 Character (16 bits)
Range: -12.8 to +12.7 meters
Resolution: 0.1 meter
ΔZ offset along the vehicle vertical axis for Orientation 1 (3.5.8.3)

D11, D12 Character (16 bits)
Range : -12.8 to +12.7 meters
Resolution: 0.1 meter
ΔX offset along the pointing device pointing axis for Orientation 2 (3.5.8.3)

D13, D14 Character {16 bits)
Range: -12.8 to +12.7 meters
Resolution: 0.2 meter
ΔY offset along the pointing device cross axis for Orientation 2 (3.5.8.3)

D15, D16 Character (16 bits) Range: -12.8 to +12.7 meters Resolution: 0.1 meter	62 offset along the pointing device vertlcd axis for Orientation 2 (3.5.8.3)
D17, D18 Character (16 bits unsigned) Range: 2 to 15 minutes Resolution: .25 minute	ZUPT interval far Exclusive ZUFT Hode (3.5.8.5)
D19, D20 Character (16 bits unsigned) Range: 2 to 63 minutes Resolution: 1 minute	ZUFT interval for Odometer Mode (3.5.8.5)
D21, D22 Character (16 bits unsigned) Range: 3.5 to 34.0 minutes Resolution: 0.25 minute	Normal Align Time (3.5.8.6)
D23, DZ4 Character (16 bits unsigned) Range: 1 to 10 seconds Resolution: 1 second	Shot Detect Interval (3.5.8.15)
D2S, D26, D27, D28 Characters (32 bits binary)	Configuration definition flags (3.5.8.8 and Appendix J)
D29, D30 Characters (16 bits unsigned) Range: 0.750 to 1.250 Resolution: 0.001	Odometer Scale Factor (3.5.8.4)
D31, D32 Characters (16 bits) Range: -3276.0 to +3276.7 Microradians/kilometer Resolution: 0.1 Microradian/kilometer	Fuel Consumption Factor (3.5.8.7)
D33 Character (8 bits unsigned) Range: 0 to 3F (HEX)	DRU Coordinate Frame Code for Orientation 1 (Appendix I)
D34 Character (8 bits unsigned) Range: 0 to 3F (EEX)	DRU Coordinate Frame Code for Orientation 2 (Appendix I)
D35, D36 Character (16 bits unsigned) Range: 0 to 15	Configuration Code Number for the configuration data being used by the DRU

XOTE: If the Configuration Data Present files is reset. the data returned in a CONFIGURATION DATA message *may* be invalid.

****

30.4.3 Message: NAVIGATION DATA

From: DRU To: Prime System

Number of Data Characters: 22

Data Format: Binary 2's Complement

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	00001	16 Bits	D1-D22	16 bits	01111110

The 22 characters of this message contain casting, northing, altitude, distance traveled, pointing device geodetic or grid azimuth, vehicle attitudes, and DRLI spheroid, hemisphere, and zone.

D1, D2, D3 Characters (24 bits, unsigned binary) Northing
Range: 0 to 10,000,000 meters
Resolution: 1 meter

D4, D5 Characters (15 bits) Altitude
Range: -16,384 to +16,383 meters**
Resolution: 1 meter

D6, D7, D8 Characters (17 bits, unsigned binary) Distance Traveled
Range: 0 to 1,310,710 meters**
Resolution: 10 meters

D9, D10 Characters (16 bits unsigned) Pointing Device Geodetic Azimuth or-Grid Azimuth
Range: 0 to 6,399.9 Mils
Resolution: 0.1 mil

D11, D12 Characters (15 bits) Vehicle Cant or Roll
Range : -1638.4 to +1638.3 mils**
Resolution: 0.1 mil

D13, D14 Characters (1S bits) Vehicle Pitch
Range: -1600 MilS to +1600 mils
Resolution: 0.1 mil

D15, D16 Characters (16 bits, unsigned binary) Vehicle Geodetic Azimuth or Grid Azimuth
Range: 0 to 6,399.9 mils
Resolution: 0.1 mil

D17 Character (MSH unsigned)
Range: 0 to 15

If BCU Parameters Configuration Flag reset: Set to 0
If BCU Parameters Configuration Flag set: BCU spheroid

D17 Character (LSH unsigned) Range: 0 to 15	Prime System (DRU) spheroid
D18, D19, D20 Characters (20 bits) (unsigned binary) Range: 0 to 999,999 meters * Resolution: 1 meter	Easting
D21 Character (7 bits) Range: -61 to +61 (Integer) + indicates northern hemisphere; -, southern	If BCU Parameters Configuration Flag reset: Extended zone or 61 for normal zone IF BCU Parameters Configuration Flag set: BCU Hemisphere and Zone
D22 Character (7 bits) Range: -60 to +60 (Integer) + Northern Hemisphere Southern Hemisphere	DRU Hemisphere & zone

* Actual limits are the UTM zone boundaries plus zone extension vhich are latitude and spheroid dependent.

** If the actual value of the parameter is outside the range, the output value shall be fixed at the appropriate positive or negative range limit.

****

30.4.4 Message: ATTITUDE DATA

From: DRU To: Prime System

Number of Data Characters: 12

Data Format: Binary 2's Complement

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA (D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	00010	16 Bits	D1-D12	16 bits	01111110

This data represents Pointing Device geodetic or grid azimuth, Pointing Device Pitch with respect to local level, vehicle cant or roll, and Pointing Device azimuth and pitch rates.

D1,	D2 Characters-(16 bits, unsigned binary) Range: 0 to 6,399.9 mils Resolution: 0.1 mil	Pointing Device Geodetic or Grid Azimuth
D3,	D4 Characters (15 bits) Range: -1600 to +1600 mils Resolution: 0.1 mil	Pointing Device Pitch (Elevation Angle)
D5,	D5, D6 Characters (15 bits) Range: -1638.4 to +1638.3 mils* Resolution: 0.1 Mil	Vehicle Cant or Roll
D7,	D8 Characters (15 bits) Range : -1600 mils to +1600 mils Resolution: 0.1 mil	Vehicle Pitch
D9,	D10 Characters (16 bits) Range: -5890.24 to +5898.06 mils/see* Resolution 0.18 mil/sec	Pointing Device Azimuth Rate
D11,	D12 Characters (16 bits) Range: -5898.24 to +5898.06 mils/see* Resolution: 0.18 mil/sec	Pointing Device Pitch (Elevation Angle) Rate

* For values outside the range, the output value shall be fixed at the appropriate positive or negative range limit.

****

30.4.5 Message: ALIGN TIME TO GO

From: DRU To: Prime System

Number of Data Characters: 2

Data Format: Binary

MESSAGE STRUCTURE

FLAG(F)	ECBO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111120	XXX	00111	16 Bits	D1-D2	16 bits	01111110

The two data characters represents

a. In Normal Align: the amount of time remaining until Normal Align is complete. When Normal Align is interrupted, ALIGN TIME TO GO shall be frozen until the DRU is stationary and alignment resumed. ALIGN TIME TO GO shall indicate a value of "0" vhen alignment is complete.

b. In Stored Heading Align: the amount of time remaining until Stored Heading Align is complete.

c. At completion of Stored Heading Align:

If the Odometer/Exclusive ZUPT Mode configuration definition flag is set, ALIGN TIME TO GO shall indicate the “stopped” time remaining until the DRU can operate in the Odometer Mode. When "stopped" time is not being accumulated, ALIGN TIME TO GO shall be frozen. When the DRU enters the Odometer Mode, ALIGN TIME TO GO shall indicate a value of “0”.

If the Odometer/Exclusive ZUPT Mode configuration definition flag is reset, ALIGN TIHE TO GO shall indicate a value of “0".

D1, D2 Characters (11 bits) Normal Align Time To Go
Range: 0 to 2047 seconds
Resolution: 1 second

****

30.4.6 Message: ALERT DATA

From: DRU To: Prime System

Number of Data Characters: 5 or 6 (The length of the data field is established by the Expanded Alerts configuration flag (3.5.8.8.k))
Data Format: Binary

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	00110	16 Bits	D1-D5 or D1-D6	16 bits	01111110

The presence of a "1" in a bit position of this data signifies that a problem exists that requires operator action

D1 Character

Bit Set	Problem
7	Spare.
6	Spare.
5	Spare.
4	Spare.
3	Spare.
2	DRU Over Temperature. DRU is too hot.
1	DRU Automatic Temperature Compensaton In Process. The DRU has performed a gyro PLC reset and realignment is in process.
0	Previous Shutdown Abnormal. During a normal shutdown, non-volatile DRU memory is updated with present position and azimuth. If power is removed prior to performing a normal shutdown, memory is not updated with this data. The next time the system is turned on, the operator is alerted that the stored data is invalid.

In addition, an abnormal shutdown shall be indicated when one or more of the following conditions exist at shutdown:

a. A Normal/Stored Heading Alignment was not completed.
b. Alert Data D2/4 (Usable to Complete align).
c. Alert Data D2/3 (Align Interrupt).
d Alert Data D3/1 (Excessive Rates).

D2 Character

Bit Set

7 Vehicle Boresight Angles Not Present. The temporarily stored vehicle boresight angles have been cleared by the DRU because of a configuration code conflict at turnon or detection of altered data during a mission.

6 Align Initial Position Parameters, Not Received. Indicates the operator did not enter the initial position parameters. DRU will align from previously stored position data. (position, altitude, spheroid)

5 Stored Reading/Attitude No Good. The DRU has determined that the stored headingfattitude is not usable.

4 Unable *To* Complete Align. Initial coordinate or instrument bias shift errors are too large to complete Normal Align. (3.10.6.1)

3 Align Interrupt. The DRU/vehicle has moved during first 3.5 min (max) of Normal Align.

2 Position Update Interrupt. The vehicle starts moving while a position update command is being processed.

1 Zero Velocity Interrupt. During a mandated zero-velocity update, the vehicle must be stopped. If motion is detected this bit shall be set.

0 Shutdown Interrupt. The vehicle is moving while a SHUTDOWN command is being processed.

D3 Character (Vehicle Motion)

Bit Set

7 Motion During Shutdovn Request. Same as above.

6 Motion During Restart Request. DRU will not accept the request because vehicle has not come to a full stop.

5 Motion During Update Request. DRU will not accept the request because vehicle is moving.

4 Insufficient Align Time. DRU has not completed a Normal Align or has accumulated less than 15 minutes stationary time before receiving a STORED HEADING SHUTDOWN command.

3 POSITION UPDATE BEYOND RANGE OF ZONE EXTENSION. The position in the update is outside the area covered by the designated extended zone.

2 Verify Input Coordinates. Input coordinates are more than 2,500 meters from the present DRU position.

1 Excessive Rates. The vehicle dynamics have exceeded the DRU linear or angular rate capability and survey data may be in error. It shall not be reset until a Normal Align and position update have been performed.

0 Motion with Pointing Device Out of Travel Lock. Indicates the Pointing Device is not in the travel lock position when the vehicle is moving.

D- Character, Data Update

Bit Set

7 DRU Spheroid Change. Due to a position update during Normal Align the DRU Spheroid was changed from what was in storage.

6 DRU Hemisphere/Zone Change. Due to a position update the DRU hemisphere or zone was changed.

5 BCU Parameter Change. A present position update command caused the BCU hemisphere, Spheroid, or Zone to change.

4 Altitude Update Rejected. During Survey the DRU rejected this update because the magnitude of the closure error exceeded 50 meters plus the DRU 12-Sigma altitude error estimate. During Normal Align the DRU rejected this update because it is out of the allowable range.

3 Horizontal Position Update Rejected. During survey the DRU rejected this. update because the magnitude of the closure error exceeded 150 meters plus the DRU 12-sigma error estimate for horizontal position. During Normal Align the DRU rejected this update because it is out of the allovable range.

2 Spare.

1 Altitude Update Excessive. This bit set indicates the magnitude of the closure error exceeds 5 meters plus the DRLl 3-sigma altitude error estimate.

0 Horizontal Position Update Excessive. This bit set indicates the magnitude Of the update closure error exceeds 10 meters plus the DRU 3-sigma error estimate for horizontal position.

D5 Character, Communication

Bit Set

7 Invalid Upon Request. Attempt to enter update data when the DRU cannot accept it.

6 Invalid Mode Request. DRU can recognize request but it cannot respond at this time.

5 Invalid Data Request. Data requested is not currently available.

4 Pointing Device Boresight Angles Not Present. The DRU did not receive the Pointing Device boresight angles or for an unknown reason the stored Pointing Device boresight angles were erased.

3 Configuration Data Not Present. The DRU did not receive the configuration data or for an unknown reason the stored data was erased.

2 Invalid Data Received. Data received was outside the allowable range.

1 Invalid Command Received. An invalid command was received on the Auxiliary Data Bus.

0 Undefined Command Received. An unrecognized command has been received.

D6 Character, Miscellaneous

Bit Set

7 Supplier Reserved
6 Supplier Reserved
5 Supplier Reserved
4 Supplier Reserved
3 Boundary Crossed. The DRU has crossed the equator or normal zone boundary or extended zone boundary.
2 DRU Using Previous VXS Calibration. Having been unable to establish (calibrate) the current DRU-to-Vehicle-Chassis alignment and VHS scale factor, the DRU is defaulting to the values obtained from the last successful VHS calibration performed on the current vehicle.
1 VMS Calibration Failed. The DRU has been unable to establish (calibrate) the current DRU-to-Vehicle-Chassis alignment and VHS scale factor. (Ref. 3.5.3.2.1.4 Odometer Scale Factor and Boresight)
0 VHS Data Unusable. As a result of severe terrain/road conditions, the data being received from the VMS is judged by the DRU to be unacceptable for damping DRU system errors. Severe terrain/road conditions are considered to be, but are not limited to: soft sand, mud, ice, and snow.

Note: Set spares to zero.

****

30.4.7 Message: BUILT-IN-TEST (BIT) DATA

From: DRU To: Prime System

Number of Data Characters: 2

Data Format: Binary

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1 , S2	DATA (D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	00100	16 Bits	DI-D2	16 bits	01111110

The presence of a “1" in any of the bit positions of this data indicates that the device represented by that bit is not functioning properly.

D1 Character

Bit Position	Device Tested
7	DRU
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

D2 Character

Bit Position	Device Tested
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	VMS
0	VMS Drive

****

30.4.8 Message: TRAVEL LOCK DATA

From: DRU To: Prime System

Number of Data Characters: 12

Data Format: Binary 2's Complement

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1, S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	00011	16 Bits	D1-D12	16 bits	01111110

The pointing device geodetic Azimuth or grid azimuth and pointing device pitch angles representing the travel lock position are stored in memory. If the pointing device is moved from travel lock the reference data is used for returning to the travel lock position.

D1, D2 Characters. (16 bits, unsigned binary) — Pointing Device Geodetic Azimuth *or* Grid Azimuth
Range: 0 to 6399.9 mils
Resolution: 0.1 mil

D3, D4 Characters (15 bits) — Pointing Device Pitch
Range: -1600 mils to +1600 mils
Resolution: 0.1 mil

D5, D6 Characters (16 bits, unsigned binary) — Travel Lock Pointing Device Geodetic or Grid Azimuth Reference
Range: 0 to 6,399.9 mils
Resolution: 0.1 mil

D7, D8 Characters (15 bits) — Travel Lock Pointing Device Pitch Reference
Range: -1600 to +1600 mils
Resolution: 0.1 mil

D9, D10 Characters (16 bits) — Pointing Device Azimuth Rate
Range: -5898.24 to +5898.06 mils/see*
Resolution: 0.18 mil/second

D11, D12 Characters (16 bits) — Pointing Device Pitch Rate
Range: -5898.24 to +5898.06 mils/see*
Resolution: 0.18 mil/second

* For rates outside of the range, the output value shall be fixed at -5898.24 for negative rates and +5898.06 for positive rates.

****

30.4.9 Message: POSITION DATA

From: DRU To: Prime System

Number of Data Characters: 10

Data Format: Binary 2's Complement

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	01000	16 Bits	D1-D10	16 bits	01111110

These ten characters of data represent the spheroid, hemisphere, zone, coordinates and altitude.

D1 Character (ME unsigned) — Spheroid
Range: 0 to 15

D2 Character (7 bits} — Hemisphere and Zone
Range: -60 to +60, (Integer)
+ indicates northern hemisphere;
- indicates southern

D3, D4, D5 Characters (20 bits) — Easting
Range: 0 to 999,999 meters (unsigned binary)*
Resolution: 1 meter

D6, D7, D8 Characters (24 bits, unsigned binary) — Northing
Range: 0 to 10,000,000 meters
Resolution: 1 meter

D9, D10 Characters (15 bits) — Altitude
Range: -16~384 to +16,383 meters**
Resolution: 1 meter

* Actual limits are the UTM zone boundaries plus zone extension which are latitude and spheroid dependent.

** For altitudes outside the range, the output values shall be fixed at -163B4 for negative altitudes and +16383 for positive altitudes.

****

30.4.10 Message: POINTING DEVICE ATTITUDE DATA

From: DRU To: Prime System

Number of Data Characters: 6

Data Format: Binary 2's Complement

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	01010	16 Bits	D1-D6	16 bits	01111110

These six data characters represent the Pointing Device Attitudes.

D1, D2 Characters (16 bits, unsigned binary) Pointing Device
Range: 0 to 6399.9 mils Geodetic Azimuth
Resolution: 0.1 mil or Grid Azimuth

D3, D4 Characters (16 bits) Pointing Device
Range: -1600.0 to +1600.0 mils Pitch
Resolution: 0.1 mil

D5, D6 Characters (16 bits) Pointing Device
Range: -3199.9 to +3200.0 mils Cant/Roll
Resolution: 0.1 mil

****

30.4.11 Message: STATUS DATA

From: DRU To: Prime System

Number of Data Characters: 0

Data Format: Binary

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	00000	16 Bits	None	16 bits	01111110

****

30.4.12 Message: POINTING DEVICE BORESIGHT

From: DRU To: Prime System

Number of Data Characters: 12

Data Format: Binary 2's complement

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA (D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	01101	16 Bits	D1-D6	16 bits	01111120

This message contains the values of the pointing device boresight angles stored in the DRU.

D1, D2 Characters (16 bits unsigned)
Range: 0 to 6399.9 Mils
Resolution: 0.1 Mil
A as defined in 6.6.3.3.2 for Orientation 1.

D3, D4 Characters (16 bits)
Range: -1600.0 to +1600.0 Mils
Resolution: 0.1 Mil
B as defined in 6.6.3.3.2 for Orientation 1.

D5, D6 Characters (16 bits)
Range: -3199.9 to +3200.0 Mils
Resolution: 0.1 Mil
r as defined in 6.6.3.3.2 for Orientation 1.

D7, D8 Characters (16 bits unsignd)
Range: 0 to 6399.9 Mils
Resolution: 0.1 Mil
A as defined in 6.6.3.3.2 for Orientation 2.

D9, D10 Characters (16 bits)
Range: -1600.0 to +1600.0 Mils
Resolution: 0.1 Mil
B as defined in 6.6.3.3.2 for Orientation 2.

D11, D12 Characters (16 bits)
Range: -3199.9 to +3200.0 Mils
Resolution: 0.1 Mil
r as defined in 6.6.3.3.2 for Orientation 2.

NOTE: If the Pointing Device Boresight Angles Present flag is reset, the data returned in a POINTING DEVICE BORESIGHT message may be invalid.

****

30.4.13 Message: EXPANDED STATUS DATA

From: DRU To: Prime System

Number of Data Characters: 2

Data Format: Binary

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N}	IDENTIFIER(I)	STATUS S1,S2	DATA (D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	11111	16 Bits	S3-S4	16 bits	01111110

See 30.5 for definition of S3 and S4.

****

30.4.14 Message: SURVEY QUALITY

From: DRU To: Prime System

Number of Data Characters: 14

Data Format: Binary

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(1)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	01111	165 Bits	D1-D14	16 bits	01111110

D1, D2 Characters (16 bits)
Range: 0 to 2047 meters
Resolution: .0625 meters

DRU Estimated Horizontal CEP

D3, D4 Characters (16 bits)
Range: 0 to 2047 meters
Resolution: .0625 meters

DRU Estimated Vertical Probable Error.

D5, D6 Characters (16 bits)
Range: 0 to 2047 roils
Resolution: .0625 mils

DRU Estimated Reading Probable Error

D7, D8 Characters (16 bits)
Range: 0 to 2047 meters
Resolution: .0625 meters

Odometer Damped Eiorizontal CEP Specification (0.25% x distance travelled since last position update)

D9, D10 Characters (16 bits)
Range: 0 to 2047 meters
Resolution: .0625 meters

Odometer Damped Vertical Probable Error - Specification (0.067% x distance travelled since last altitude update)

D11, D12 Characters (16 bits)
Range: 0.1 to 10.0
Resolution: .0625

Estimated Horizontal Spec Multiplier

D13, D14 Characters (16 bits)
Range: 0.1 to 10.0
Resolution: .0625

Estimated Vertical Spec Multiplier

****

30.4.15 Message: VEHICLE BORESIGHT

From: DRU To: Prime System

Number of Data Characters: 6

Data Format: Binary 2's complement

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	10000	16 bits	D1-D6	16 BITS	01111110

This message contains the values of the vehicle boresight angles stored in the DRU.

D1, D2 Characters (16 bits, unsigned binary) α
Range: 0 to 6399.9 miles
Resolution: 0.1 mil

D3, D4 Characters (16 bits) β
Range: -1600.0 to +1600.0 mils
Resolution: 0.1 mil

D5, D6 Characters (16 bits) γ
Range: -319909 to 3200.0 mils
Resolution: 0.1 mil

NOTE: If the Vehicle boresight Angles Present flag is reset, the data returned in a Vehicle b0RESIGHT message may be invalid.

****

30.4.16 Message: GEODETIC DATA

From: DRU To: Prime System

Number of Data Characters: 29

Data Format: Binary 2'S Complement

MESSAGE STRUCTURE

FLAG(F)	ECHO SEQ#(N)	IDENTIFIER(I)	STATUS S1,S2	DATA(D)	ERROR DET. CODE (E)	FLAG(F)
01111110	XXX	10001	16 Bits	D1-D29	16 bits	01111110

D1, D2 Characters (16 bits) — Latitude Degrees
Range: ± 90 degrees
Resolution: 1 degree

D3, D4, D5, D6 Characters (32 bits) — Latitude Minutes (unsigned binary)
Range: 0 to 59.99999 arc minutes
Resolution: $1/2^{24}$ arc minute

D7, D8 Characters (16 bits) — Longitude Degrees
Range: ±180 degrees
Resolution: 1 degree

D9, .D10, D11, D12 Characters (32 bits) — Longitude Minutes (unsigned binary)
Range: 0 to 59.99999 arc minutes
Resolution: $1/2^{24}$ arc minute

D13, D14, D15, D16 Characters (32 bits) — Altitude
Range: -32,768 to +32,767 meters
Resolution: 0.01 meters

D17, D18, D19, D20 Characters (32 bits) — Velocity North
Range: ±32,767 meters/see
Resolution: $1/2^{16}$ meters/see

D21, D22, D23, D24 Characters (32 bits) — Velocity East
Range : ± 32 767 meters/see
Resolution: $1/2^{16}$ meters/see

D25, D26, D27, D2B Characters (32 bits) — Velocity Up
Range: ± 32 767 meters/see
Resolution: 1/2 6 meters/see

D29 Character (8 bits unsigned) — DRU Spheroid
Range: 0 to 34
Resolution: 1

APPENDIX B

DESCRIPTION OF STATUS CHARACTERS

30.5 Status Characters

The presence of a "1" in any of the bit positions indicates that the mode or condition listed below exists. The conditions which cause setting or resetting of the bits are described in Table 30.5. At turn-on, all STATUS bit positions, except S1/7, shall be reset to "0". Each bit position shall not be set to "1" until the specified set condition is encountered.

S1 Character	
BIT POSITION	MODE OR CONDITION
7	DRU In Startup Mode.
6	Spare.
5	DRU In Normal Align Or Stored Heading Align mode.
4	DRV In Survey Mode.
3	DRU In Exclusive ZUPT Mode.
2	Zero-Velocity Stop Request.
1	Position Update Request.
0	Auxiliary Bus Control Is Inhibited.

S2 Character	
BIT POSITION	MODE OR CONDITION
7	Zero-Velocity Update In Progress.
6	Position Update In Progress.
5	The DRU, VMS, Or VHS Drive Has Malfunctioned.
4	Pointing Device In Travel Lock.
3	Shot Detect.
2	DRU In Stored Beading Align Mode.
1	DRU Alert.
0	Spare.

S3 Character	
BIT POSITION	MODE OR CONDITION
7	Spare.
6	VHS Damping In Process.
5	VHS Calibration Completed.
4	ZUPTS Inhibited.
3	DRU Zone Extension Enabled.
2	DRU In Motion.
1	Orientation Attitude Data Valid.
0	Altitude Fixed.

S4 Character	
BIT POSITION	MODE OR CONDITION
7	Spare.
6	Spare.
5	Spare.
4	DRU Shutdown Complete
3	Supplier Reserved.
2	Supplier Reserved.
1	DRU In Air Transport Mode.
0	DRU In Marine Tranport Mode.

Table 30.5. Status BIT Activation Condition

CHAR/ BIT	SET CONDITION	RESET CONDITION
S1/7	Turn-on.	DRU operations are sufficient for proceeding with Normal Align.
6	Spare *	Spare
5	DRU enters NORMal Align, or Stored Beading Align mode.	DRU is net in an align mode.
4	DRU enters survey mode.	DRU is not in survey mode.
3	DRU determines it is operating in the Exclusive ZUPT mode.	DRU determines it is operating in the Odometer Mode.
2	DRU determines it needs a zero-velocity stop.	zero-velocity update completed or zero velocity update not needed at the present time.
1	DRU determines it needs a position Update.	position update accepted
0	Receipt of INHIBIT AUXILIARY BUS CONTROL command.	receipt of ENABLE AUXILIARY US CONTROL Command or Main us inactivity.

Table 30.5. Status BT Activation Conditions (continued)

CHAR/ BIT	SET CONDITION	RESET CONDITION
S2/7	Zero-velocity update initiation.	Completion or interruption of the zero-velocity update.
6	Receipt of a position update.	Completion or rejection of a position update.
5	DRU determines the DRU, VMS, or VMS Drive has failed.	Failure corrected.
4	Pointing device is in travel lock.	Pointing device is out of travel lock.
3	DRU has detected a gun shot.	Completion of Shot Detect Interval delay.
2	DRU enters Stored Heading Align mode.	DRU enters survey or Normal Align mode.
1	Setting of an ALERT DATA bit.	Resetting of all ALERT DATA bits.
0	Spare	Spare

Table 30.5. Status BIT Activation Conditions (continued)

CHAR/ BIT	SET CONDITION	RESET CONDITION
S3/7	Spare	Spare
6	DRU starts VMS Damping.	DRU stops VMS Damping.
5	DRU completes a full DRU-to-Vehicle-Chasis alignment.	DRU performs a ZUPT.
4	Receipt of INHIBIT ZERO-VELOCITY UPDATES command.	Receipt of ENABLE ZERO-VELOCITY UPDATES command.
3	DRU is operating in Extended Zone mode.	DRU is operating in Normal Zone mode.
2	Motion detected by the DRU.	Motion no longer detected by the DRU.
1	DRU attitude data is valid and can be used for Prime System operations.*	DRU attitude data should not be used for Prime System operations.
0	DRU enters either the Air/Marine Transport Mode.	Receipt of TRANSPORT COMPLETE command.

* In Normal Align, Orientation Attitude Data Valid STATUS, S3/1, shall be set when the DRU estimated azimuth accuracy is 1.0 mil PE. In Stored Heading Align, S3/1 shall be set upon successful competition of Stored Heading Align. When set, S3/1 shall be reset only by power down or a RESTART Command.

Table 30.5. Status BIT Activation Conditions (continued)

CHAR/ BIT	SET CONDITION	RESET CONDITION
S4/7	Spare.	Spare.
6	Spare.	Spare.
5	Spare.	Spare.
4	The DRU has completed its shutdown processing and is ready to have pover removed.	The DRU has not completed its shutdown processing and is not ready to have pover removed. Removal of pover at this time shall result in an abnormal shutdown.
3	Supplier Specified.	Supplier Specified.
2	Supplier Specified.	Supplier Specified.
1	Receipt of an AIR TRANSPORT MODE REQUEST command.	Receipt of a TRANSPORT MODE COMPLETE command.
0	Receipt of a MARINE TRANSPORT MODE REQUEST command.	Receipt of a TRANSPORT MODE COMPLETE command.

APPENDIX F

CONFIGURATION DATA

		CONFIGURATION DISCRETE			
CONFIGURATION CODE: 0		1 = 0	2 = 0	3 = 0	4 = 0
PRIME SYSTEM: PALADIN					
DRU COORDINATE FRAME CODE:					
	Orientation 1:	00			
	Orientation 2:	00			
VEHICLE BORESIGHT ANGLES:	α:	0.0	mils		
	β:	0.0	mils		
	γ:	0.0	mils		
POINTING DEVICE BORESIGHT ANGLES:					
	Orientation 1:				
	A:	0.0	mils		
	B:	88.9	mils		
	Γ:	0.0	mils		
	Orientation 2:				
	A:	0.0	mils		
	B:	88.9	mils		
	Γ:	0.0	mils		
ZRP OFFSET DISTANCES:					
Orientation 1 (Vehicle):					
	ΔX:	3.1	meters		
	ΔY:	-2.1	meters		
	ΔZ:	-2.2	meters		
Orientation 2 (Pointing Device):					
	ΔX:	0.0	meters		
	ΔY:	0.0	meters		
	ΔZ:	0.0	meters		
ZUPT INTERVALS:	EXCLUSIVE ZUPT MODE:	4.0	minutes		
	ODOMETER MODE:	60.0	minutes		
	NORMAL ALIGN TIME:	15.0	minutes		
	SHOT DETECT INTERVAL:	3.0	seconds		
VMS SCALE FACTOR:		1.0			
FUEL CONSUMPTION FACTOR:		-42.0	microradians/km		
1-2 THRESHOLD ANGLE		0.0	mils		
2-1 THRESHOLD ANGLE		0.0	mils		

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	1
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	1
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	1
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	1
D29/2	TRACKED/WHEELED VEHICLE	1
D29/1	SPARE	0
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	1

CONFIGURATION CODE: 1	CONFIGURATION DISCRETE 1 2 3 4: 0 0 0 1		
PRIME SYSTEM: ALTERNATE HOWITZER IMPROVEMENT PROGRAM (HIP)			
DRU COORDINATE FRAME CODE:			
Orientation 1:	00		
Orientation 2:	00		
VEHICLE BORESIGHT ANGLES:	α:	0.0	mils
	β:	0.0	mils
	γ:	0.0	mils
POINTING DEVICE BORESIGHT ANGLES:			
Orientation 1:			
	A:	0.0	mils
	B:	88.9	mils
	Γ:	0.0	mils
Orientation 2:			
	A:	0.0	mils
	B:	88.9	mils
	Γ:	0.0	mils
ZRP OFFSET DISTANCES:			
Orientation 1 (Vehicle):			
	ΔX:	3.1	meters
	ΔY:	-2.1	meters
	ΔZ:	-2.2	meters
Orientation 2 (Pointing Device):			
	ΔX:	0.0	meters
	ΔY:	0.0	meters
	ΔZ:	0.0	meters
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:		4.0	minutes
ODOMETER MODE:		60.0	minutes
NORMAL ALIGN TIME:		15.0	minutes
SHOT DETECT INTERVAL:		3.0	seconds
VMS SCALE FACTOR:		1.0	
FUEL CONSUMPTION FACTOR:		-42.0	microradians/km
1-2 THRESHOLD ANGLE		0.0	mils
2-1 THRESHOLD ANGLE		0.0	mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	1
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	1
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	1
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	1
D29/2	TRACKED/WHEELED VEHICLE	1
D29/1	SPARE	0
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	1

		CONFIGURATION DISCRETE 1 2 3 4	
CONFIGURATION CODE: 2		0 0 1 0	
PRIME SYSTEM: FIREFINDER BLOCK II B			
DRU COORDINATE FRAME CODE:			
	Orientation 1:	03	
	Orientation 2:	03	
VEHICLE BORESIGHT ANGLES:	α:	0.0	mils
	β:	0.0	mils
	γ:	0.0	mils
POINTING DEVICE BORESIGHT ANGLES:			
Orientation 1:			
	A:	0.0	mils
	B:	0.0	mils
	Γ:	0.0	mils
Orientation 2:			
	A:	0.0	mils
	B:	0.0	mils
	Γ:	0.0	mils
ZRP OFFSET DISTANCES:			
Orientation 1 (Vehicle):			
	ΔX:	1.00	meters
	ΔY:	0.45	meters
	ΔZ:	-0.86	meters
Orientation 2 (Pointing Device):			
	ΔX:	0.0	meters
	ΔY:	0.0	meters
	ΔZ:	0.0	meters
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:		4.0	minutes
ODOMETER MODE:		60.0	minutes
NORMAL ALIGN TIME:		15.0	minutes
SHOT DETECT INTERVAL:		0.0	seconds
VMS SCALE FACTOR:		1.0	
FUEL CONSUMPTION FACTOR:		0.0	microradians/km
1-2 THRESHOLD ANGLE		0.0	mils
2-1 THRESHOLD ANGLE		0.0	mils

CONFIGURATION DEFINITION FLAGS:		
026/7	ORIENTATION 2 BASED ON TRAVEL LOCK	0
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATIOJU 2 - 1 DIRECTION OF TRAVERSE	00
D26/O	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/O	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/O	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D291S	SHOT DETECT	0
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	0
D29/2	TRACKED/VHEELED VEHICLE	0
D29/1	SPARE	0
D29/O	ODOMETER/EXCLUSIVE ZUPT MODE	1

	CONFIGURATION DISCRETE 1 2 3 4	
CONFIGURATION CODE: 3		
Prime system: M-998 HMMWV (FAT VEHICLE)		
DRU COORDINATE FRAME CODE:		
Orientation 1:		00
Orientation 2:		00
VEHICLE BORESIGHT ANGLES:	α:	0.0 mils
	β:	0.0 mils
	γ:	0.0 mils
POINTING DEVICE BORESIGHT ANGLES:		
Orientation 1:		
	A:	0.0 mils
	B:	0.0 mils
	r:	0.0 mils
Orientation 2:		
	A:	0.0 mils
	B:	0.0 mils
	r:	0.0 mils
ZRP OFFSET DISTANCES:		
Orientation 1 (Vehicle):		
	ΔX:	0.0 meters
	ΔY:	0.0 meters
	ΔZ:	0.0 meters
Orientation 2 (Pointing Device):		
	ΔX:	0.0 meters
	ΔY:	0.0 meters
	ΔZ:	0.0 meters
ZUPT MATERIALS: EXCLUSIVE ZUPT MODES		4.0 minutes
ODOMETER MODE:		60.0 minutes
NORMAL ALIGN TIME:		15.0 minutes
SHOT DETECT INTERVAL:		0.0 seconds
VMS SCALE FACTOR:		1.0
FUEL CONSUMPTION FACTOR:		0.0 microradians/km
1-2 THRESHOLD ANGLE		0.0 mils
2-1 THRESHOLD ANGLE		0.0 mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	0
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCE/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTIITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D2917	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	0
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	0
D29/2	TRACKED/WHEELED VEHICLE	0
D29/1	SPARE	0
D29/0	ODOMETER EXCLUSIVE ZUPT MODE	1

CONFIGURATION CODE: 4	CONFIGURATION DISCRETE 1 2 3 4	0 1 0 0	
PRIME SYSTEM: M-1009 CUCV (FAT VEHICLE)			
DRU COORDINATE FRAME CODE:			
	Orientation 1:	00	
	Orientation 2:	00	
VEHICLE BORESIGHT ANGLES:	α:	0.0	mils
	β:	0.0	mils
	γ:	0.0	mils
POINTING DEVICE BORESIGHT ANGLES:			
	Orientation 1:		
	A:	0.0	mils
	B:	0.0	mils
	Γ:	0.0	mils
	Orientation 2:		
	A:	0.0	mils
	B:	0.0	mils
	Γ:	0.0	mils
ZRP OFFSET DISTANCES:			
	Orientation 1 (Vehicle):		
	ΔX:	2.15	meters
	ΔY:	-0.47	meters
	ΔZ:	-0.97	meters
	Orientation 2 (Pointing Device):		
	ΔX:	0.0	meters
	ΔY:	0.0	meters
	ΔZ:	0.0	meters
ZUPT INTERVALS:	EXCLUSIVE ZUPT MODE:	4.0	minutes
	ODOMETER MODE:	60.0	minutes
	NORMAL ALIGN TIME:	15.0	minutes
	SHOT DETECT INTERVAL:	0.0	seconds
VMS SCALE FACTOR:		1.0	
FUEL CONSUMPTION FACTOR:		0.0	microradians/km
1-2 THRESHOLD ANGLE		0.0	mils
2-1 THRESHOLD ANGLE		0.0	mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	0
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	0
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	0
D29/2	TRACKED/WHEELED VEHICLE	0
D29/1	SPARE	0
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	1

CONFIGURATION CODE: 5	CONFIGURATION DISCRETE 1/0 2/1 3/0 4/1		
PRIME SYSTEM: M-1009 CUCV (FAT VEHICLE)			
DRU COORDINATE FRAME CODE:			
Orientation 1:	00		
Orientation 2:	00		
VEHICLE BORESIGHT ANGLES:			
α:	0.0	mils	
β:	0.0	mils	
γ:	0.0	mils	
POINTING DEVICE BORESIGHT ANGLES:			
Orientation 1:			
A:	0.0	mils	
B:	0.0	mils	
Γ:	0.0	mils	
Orientation 2:			
A:	0.0	mils	
B:	0.0	mils	
Γ:	0.0	mils	
ZRP OFFSET DISTANCES:			
Orientation 1 (Vehicle):			
ΔX:	0.0	meters	
ΔY:	0.0	meters	
ΔZ:	0.0	meters	
Orientation 2 (Pointing Device):			
ΔX:	0.0	meters	
ΔY:	0.0	meters	
ΔZ:	0.0	meters	
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:	4.0	minutes	
ODOMETER MODE:	60.0	minutes	
NORMAL ALIGN TIME:	15.0	minutes	
SHOT DETECT INTERVAL:	0.0	seconds	
VMS SCALE FACTOR:	1.0		
FUEL CONSUMPTION FACTOR:	0.0	microradians/km	
1-2 THRESHOLD ANGLE	0.0	mils	
2-1 THRESHOLD ANGLE	0.0	mils	

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	0
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	0
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	0
D29/2	TRACKED/WHEELED VEHICLE	0
D29/1	SPARE	0
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	1

	CONFIGURATION DISCRETE	
	1 2 3 4	
CONFIGUMTION CODE: 6	0 1 1 0	
PRIME SYSTEM: NBC RECON		
DRU COORDINATE FRAME CODE:		
Orientation 1:		TBD
Orientation 2:		TBD
VEHICLE BORESIGHT ANGLES:	α:	TBD mils
	β:	TBD mils
	γ:	TBD mils
POINTING DEVICE BORESIGHT ANGLES:		
Orientation 1:		
	A:	TBD milS
	B:	TBD mils
	r:	TBD mils
Orientation 2:		
	Α:	TBD mils
	Β:	TBD mils
	Γ:	TBD mils
ZRP OFFSET DISTANCES:		
Orientation 1 (Vehicle):		
	ΔX:	TBD meters
	ΔY:	TBD meters
	ΔZ:	TBD meters
Orientation 2 (Pointing Device):		
	ΔX:	0.0 meters
	ΔY:	0.0 meters
	ΔZ:	0.0 meters
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:		TBD minutes
ODOMETER MODE:		TBD minutes
NORMAL ALIGN TIME:		TBD minutes
SHOT DETECT INTERVAL:		0.0 seconds
VHS SCALE FACTOR:		TBD
FUEL CONSUMPTION FACTOR:		TBD microradians/km
1-2 THRESHOLD ANGLE		TBD mils
1-1 TRESHOLD ANGLE		TBD mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	TBD
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	TBD
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	TBD
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	TBD
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	TBD
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	TBD
D28/3	EXTENDED ALERT DATA	TBD
D28/2	BCU PARAMETERS	TBD
D28/1	VEHICLE CANT/ROLL	TBD
D28/0	AZIMUTH	TBD
D29/7	POINTING DEVICE BORESIGHT ANGLES	TBD
D29/6	VEHICLE BORESIGHT ANGLES	TBD
D29/5	SHOT DETECT	TBD
D29/4	TRAVEL LOCK COMMANDS	TBD
D29/3	TRAVEL LOCK DISCRETE	TBD
D29/2	TRACKED/WHEELED VEHICLE	TBD
D29/1	SPARE	TBD
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	TBD

CONFIGURATION CODE: 7	CONFIGURATION DISCRETE 1 2 3 4 = 0 1 1 1
PRIME SYSTEM: ETAS	
DRU COORDINATE FRAME CODE:	
Orientation 1:	TBD
Orientation 2:	TBD
VEHICLE BORESIGHT ANGLES:	
α:	TBD mils
β:	TBD mils
γ:	TBD mils
POINTING DEVICE BORESIGHT ANGLES:	
Orientation 1:	
A:	TBD mils
B:	TBD mils
r:	TBD mils
Orientation 2:	
A:	TBD mils
B:	TBD mils
r:	TBD mils
ZRP OFFSET DISTANCES:	
Orientation 1 (vehicle):	
ΔX:	TBD meters
ΔY:	TBD meters
ΔZ:	TBD meters
Orientation 2 (Pointing Device):	
ΔX:	0.0 meters
ΔY:	0.0 meters
ΔZ:	0.0 meters
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:	TBD minutes
ODOMETER MODE:	TBD minutes
NORMAL ALIGN TIME:	TBD minutes
SHOT DETECT INTERVAL:	0.0 seconds
VMS SCALE FACTOR:	TBD
FUEL CONSUMPTION FACTOR:	TBD microradians/km
1-2 THRESHOLD ANGLE	TBD mils
2-1 THRESHOLD ANGLE	TBD mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	TBD
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	TBD
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	TBD
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	TBD
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	TBD
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	TBD
D28/3	EXTENDED ALERT DATA	TBD
D28/2	BCU PARAMETERS	TBD
D28/1	VEHICLE CANT/ROLL	TBD
D28/0	AZIMUTH	TBD
D29/7	POINTING DEVICE BORESIGHT ANGLES	TBD
D29/6	VEHICLE BORESIGHT ANGLES	TBD
D29/5	SHOT DETECT	TBD
D29/4	TRAVEL LOCK COMMANDS	TBD
D29/3	TRAVEL LOCK DISCRETE	TBD
D29/2	TRACKED/WHEELED VEHICLE	TBD
D29/1	SPARE	TBD
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	TBD

CONFIGURATION CODE: 8	CONFIGURATION DISCRETE 1=1 2=0 3=0 4=0		
PRIME SYSTEM: M-998 HMMWV (FAT VEHICLE)			
DRU COORDINATE FRAME CODE:			
Orientation 1:	00		
Orientation 2:	00		
VEHICLE BORESIGHT ANGLES:			
α:	0.0	mils	
β:	0.0	mils	
γ:	0.0	mils	
POINTING DEVICE BORESIGHT ANGLES:			
Orientation 1:			
A:	0.0	mils	
B:	0.0	mils	
Γ:	0.0	mils	
Orientation 2:			
A:	0.0	mils	
B:	0.0	mils	
Γ:	0.0	mils	
ZRP OFFSET DISTANCES:			
Orientation 1 (Vehicle):			
ΔX:	2.36	meters	
ΔY:	-1.26	meters	
ΔZ:	-1.10	meters	
Orientation 2 (Pointing Device):			
ΔX:	0.0	meters	
ΔY:	0.0	meters	
ΔZ:	0.0	meters	
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:	4.0	minutes	
ODOMETER MODE:	60.0	minutes	
NORMAL ALIGN TIME:	15.0	minutes	
SHOT DETECT INTERVAL:	0.0	seconds	
VMS SCALE FACTOR:	0.0		
FUEL CONSUMPTION FACTOR:	0.0	microradians/km	
1-2 THRESHOLD ANGLE	0.0	mils	
2-1 THRESHOLD ANGLE	0.0	mils	

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	0
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	0
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	0
D29/2	TRACKED/WHEELED VEHICLE	0
D29/1	SPARE	0
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	0

CONFIGURATION CODE: 9	CONFIGURATION DISCRETE 1 2 3 4 = 1 0 0 1
PRIME SYSTEM: M-1009 CUCV (FAT VEHICLE)	
DRU COORDINATE FRAME CODE:	
Orientation 1:	00
Orientation 2:	00
VEHICLE BORESIGHT ANGLES:	
α:	0.0 mils
β:	0.0 mils
γ:	0.0 mils
POINTING DEVICE BORESIGHT ANGLES:	
Orientation 1:	
A:	0.0 mils
B:	0.0 mils
Γ:	0.0 mils
Orientation 2:	
A:	0.0 mils
B:	0.0 mils
Γ:	0.0 mils
ZRP OFFSET DISTANCES:	
Orientation 1 (Vehicle):	
ΔX:	2.15 meters
ΔY:	-0.47 meters
ΔZ:	-0.97 meters
Orientation 2 (Pointing Device):	
ΔX:	0.0 meters
ΔY:	0.0 meters
ΔZ:	0.0 meters
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:	4.0 minutes
ODOMETER MODE:	60.0 minutes
NORMAL ALIGN TIME:	15.0 minutes
SHOT DETECT INTERVAL:	0.0 seconds
VMS SCALE FACTOR:	0.0
FUEL CONSUMPTION FACTOR:	0.0 microradians/km
1-2 THRESHOLD ANGLE	0.0 mils
2-1 THRESHOLD ANGLE	0.0 mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	0
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	0
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	0
D29/2	TRACKED/WHEELED VEHICLE	0
D29/1	SPARE	0
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	0

CONFIGURATION CODE: 10	CONFIGURATION DISCRETE 1/1 2/0 3/1 4/0
PRIME SYSTEM: M-1009 CUCV (FAT VEHICLE)	
DRU COORDINATE FRAME CODE:	
Orientation 1:	00
Orientation 2:	00
VEHICLE BORESIGHT ANGLES:	
α:	0.0 mils
β:	0.0 mils
γ:	0.0 mils
POINTING DEVICE BORESIGHT ANGLES:	
Orientation 1:	
A:	0.0 mils
B:	0.0 mils
Γ:	0.0 mils
Orientation 2:	
A:	0.0 mils
B:	0.0 mils
Γ:	0.0 mils
ZRP OFFSET DISTANCES:	
Orientation 1 (Vehicle):	
ΔX:	2.15 meters
ΔY:	-0.47 meters
ΔZ:	-0.97 meters
Orientation 2 (Pointing Device):	
ΔX:	0.0 meters
ΔY:	0.0 meters
ΔZ:	0.0 meters
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:	10.0 minutes
ODOMETER MODE:	60.0 minutes
NORMAL ALIGN TIME:	15.0 minutes
SHOT DETECT INTERVAL:	0.0 seconds
VMS SCALE FACTOR:	0.0
FUEL CONSUMPTION FACTOR:	0.0 microradians/km

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	0
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROU	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D2612-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D2717	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESEWED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGET ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	0
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	0
D29/2	TRACK/WHEELED VEHICLE	0
D29/1	SPARE	0
D29/0	ODOMETER EXCLUSIVE ZUPT MODE	0

CONFIGURATION CODE: 11	CONFIGURATION DISCRETE 1/1 2/0 3/1 4/1		
PRIME SYSTEM: M-109 SELF-PROPELLED HOWITZER (FAT VEHICLE)			
DRU COORDINATE FRAME CODE:			
	Orientation 1:	00	
	Orientation 2:	00	
VEHICLE BORESIGHT ANGLES:	α:	0.0	mils
	β:	0.0	mils
	γ:	0.0	mils
POINTING DEVICE BORESIGHT ANGLES:			
	Orientation 1:		
	A:	0.0	mils
	B:	88.9	mils
	Γ:	0.0	mils
	Orientation 2:		
	A:	0.0	mils
	B:	88.9	mils
	Γ:	0.0	mils
ZRP OFFSET DISTANCES:			
Orientation 1 (Vehicle):			
	ΔX:	3.1	meters
	ΔY:	-2.1	meters
	ΔZ:	-2.2	meters
Orientation 2 (Pointing Device):			
	ΔX:	0.0	meters
	ΔY:	0.0	meters
	ΔZ:	0.0	meters
ZUPT INTERVALS:	EXCLUSIVE ZUPT MODE:	10.0	minutes
	ODOMETER MODE:	60.0	minutes
	NORMAL ALIGN TIME:	15.0	minutes
	SHOT DETECT INTERVAL:	3.0	seconds
VMS SCALE FACTOR:		1.0	
FUEL CONSUMPTION FACTOR:		-9.3	microradians/km
1-2 THRESHOLD ANGLE		0.0	mils
2-1 THRESHOLD ANGLE		0.0	mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	1
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	1
D29/4	TRAVEL LOCK COMMANDS	1
D29/3	TRAVEL LOCK DISCRETE	0
D29/2	TRACKED/WHEELED VEHICLE	1
D29/1	SPARE	0
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	1

CONFIGURATION CODE: 12	CONFIGURATION DISCRETE 1/1 2/1 3/0 4/0
PRIME SYSTEM: M-1009 CUCV (FAT VEHICLE)	
DRU COORDINATE FRAME CODE:	
Orientation 1:	00
Orientation 2:	00
VEHICLE BORESIGHT ANGLES:	
α:	0.0 mils
β:	0.0 mils
γ:	0.0 mils
POINTING DEVICE BORESIGHT ANGLES:	
Orientation 1:	
A:	0.0 mils
B:	0.0 mils
Γ:	0.0 mils
Orientation 2:	
A:	0.0 mils
B:	0.0 mils
Γ:	0.0 mils
ZRP OFFSET DISTANCES:	
Orientation 1 (Vehicle):	
ΔX:	0.0 meters
ΔY:	0.0 meters
ΔZ:	0.0 meters
Orientation 2 (Pointing Device):	
ΔX:	0.0 meters
ΔY:	0.0 meters
ΔZ:	0.0 meters
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:	4.0 minutes
ODOMETER MODE:	60.0 minutes
NORMAL ALIGN TIME:	15.0 minutes
SHOT DETECT INTERVAL:	0.0 seconds
VMS SCALE FACTOR:	0.0
FUEL CONSUMPTION FACTOR:	0.0 microradians/km
1-2 THRESHOLD ANGLE	0.0 mils
2-1 THRESHOLD ANGLE	0.0 mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	0
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	0
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	0
D28/2	BCU PARAMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	0
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	0
D29/2	TRACKED/WHEELED VEHICLE	0
D29/1	SPARE	0
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	0

CONFIGURATION CODE: 13	CONFIGURATION DISCRETE 1/1 2/1 3/0 4/1		
PRIME SYSTEM: AS-90 SELF-PROPELLED HOWITZER			
DRU COORDINATE FRAME CODE:			
Orientation 1:		TBD	
Orientation 2:		TBD	
VEHICLE BORESIGHT ANGLES:	α:	TBD	mils
	β:	TBD	mils
	γ:	TBD	mils
POINTING DEVICE BORESIGHT ANGLES:			
Orientation 1:			
	A:	TBD	mils
	B:	TBD	mils
	Γ:	TBD	mils
Orientation 2:			
	A:	TBD	mils
	B:	TBD	mils
	Γ:	TBD	mils
ZRP OFFSET DISTANCES:			
Orientation 1 (Vehicle):			
	ΔX:	TBD	meters
	ΔY:	TBD	meters
	ΔZ:	TBD	meters
Orientation 2 (Pointing Device):			
	ΔX:	0.0	meters
	ΔY:	0.0	meters
	ΔZ:	0.0	meters
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:		TBD	minutes
ODOMETER MODE:		TBD	minutes
NORMAL ALIGN TIME:		TBD	minutes
SHOT DETECT INTERVAL:		TBD	seconds
VMS SCALE FACTOR:		TBD	
FUEL CONSUMPTION FACTOR:		TBD	microradians/km
1-2 THRESHOLD ANGLE		TBD	mils
2-1 THRESHOLD ANGLE		TBD	mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	TBD
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	TBD
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	TBD
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	TBD
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	TBD
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	
D2B/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	TBD
D28/3	EXTENDED ALERT DATA	TBD
D28/2	BCU PARAMETERS	TBD
D28/1	VEHICLE CANT/ROLL	TBD
D28/0	AZIMUTH	TBD
D29/7	POINTING DEVICE BORESIGHT ANGLES	TBD
D29/6	VEHICLE BORESIGHT ANGLES	TBD
D29/5	SHOT DETECT	TBD
D29/4	TRAVEL LOCK COMMANDS	TBD
D29/3	TRAVEL LOCK DISCRETE	TBD
D29/2	TRACKED/WHEELED VEHICLE	TBD
D29/1	SPARE	TBD
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	TBD

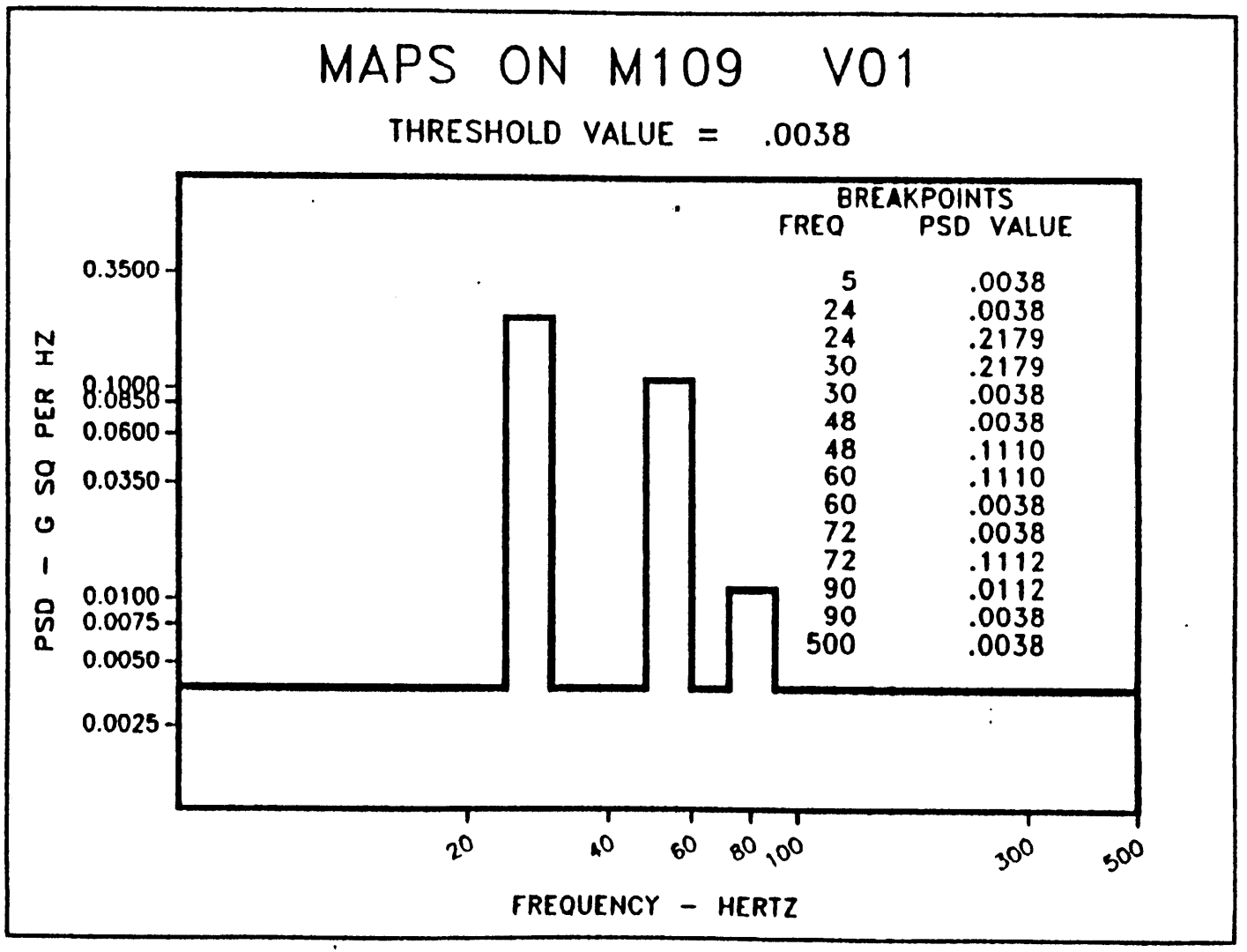
CONFIGURATION CODE: 14	CONFIGURATION DISCRETE 1 1 / 2 1 / 3 1 / 4 0	
PRIME SYSTEM: WARRIOR OBSERVATION POST VEHICLE		
DRU COORDINATE FRAME CODE:		
	Orientation 1:	00
	Orientation 2:	00
VEHICLE BORESIGHT ANGLES:	α:	0.0 mils
	β:	0.0 mils
	γ:	0.0 mils
POINTING DEVICE BORESIGHT ANGLES:		
Orientation 1:		
	A:	0.0 mils
	B:	0.0 mils
	r:	0.0 mils
Orientation 2:		
	A:	0.0 mils
	B:	0.0 mils
	r:	0.0 mils
ZRP OFFSET DISTANCES:		
Orientation 1 (Vehicle):		
	ΔX:	0.0 meters
	ΔY:	0.0 meters
	ΔZ:	0.0 meters
Orientation 2 (Pointing Device):		
	ΔX:	0.0 meters
	ΔY:	0.0 meters
	ΔZ:	0.0 meters
ZUPT INTERVALS: EXCLUSIVE ZUPT MODE:		6.0 minutes
ODOMETER MODE:		60.0 minutes
NORMAL ALIGN TIME:		13.0 minutes
SHOT DETECT INTERVAL:		0.0. seconds
VMS SCALE FACTOR:		1.0
FUEL CONSUMPTION FACTOR:		0.0 microradians/km
1-2 THRESHOLD ANGLE		0.0 mils
2-1 THRESHOLD ANGLE		0.0 mils

CONFIGURATION DEFINITION FLAGS:		
D26/7	ORIENTATION 2 BASED ON TRAVEL LOCK	0
D26/6	ORIENTATION 1 - 2 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/5	ORIENTATION 2 - 1 BASED ON POINTING DEVICE PITCH/ROLL	0
D26/4-3	ORIENTATION 1 - 2 DIRECTION OF TRAVERSE	00
D26/2-1	ORIENTATION 2 - 1 DIRECTION OF TRAVERSE	00
D26/0	ORIENTATION 2 BASED ON POINTING DEVICE ATTITUDE	0
D27/7	SPARE	0
D27/6	SPARE	0
D27/5	SPARE	0
D27/4	SPARE	0
D27/3	SPARE	0
D27/2	SPARE	0
D27/1	SPARE	0
D27/0	SPARE	
D28/7	SUPPLIER RESERVED	0
D28/6	SUPPLIER RESERVED	0
D28/5	SUPPLIER RESERVED	0
D28/4	POINTING DEVICE CANT/ROLL	0
D28/3	EXTENDED ALERT DATA	1
D28/2	BCU PARAMETERS	0
D28/1	VEHICLE CANT/ROLL	0
D28/0	AZIMUTH	0
D29/7	POINTING DEVICE BORESIGHT ANGLES	0
D29/6	VEHICLE BORESIGHT ANGLES	0
D29/5	SHOT DETECT	0
D29/4	TRAVEL LOCK COMMANDS	0
D29/3	TRAVEL LOCK DISCRETE	1
D29/2	TRACKED/WHEELED VEHICLE	0
D29/1	SPARE	1
D29/0	ODOMETER/EXCLUSIVE ZUPT MODE	

	CONFIGURATION DISCRETE			
	1	2	3	4
CONFIGURATION CODE: 15	1	1	1	1

DESIGNATES CONFIGURATION DATA TO BE SUPPLIED USING AN ACCEPT CONFIGURATION DATA COMMAND.

APPENDIX G



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 V01

TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL, G: 1.80

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
24.0	30.0	3.0	.21790	17.6
48.0	60.0	6.0	.11100	14.7
72.0	90.0	9.0	.01120	4.7

FLOOR VALUES

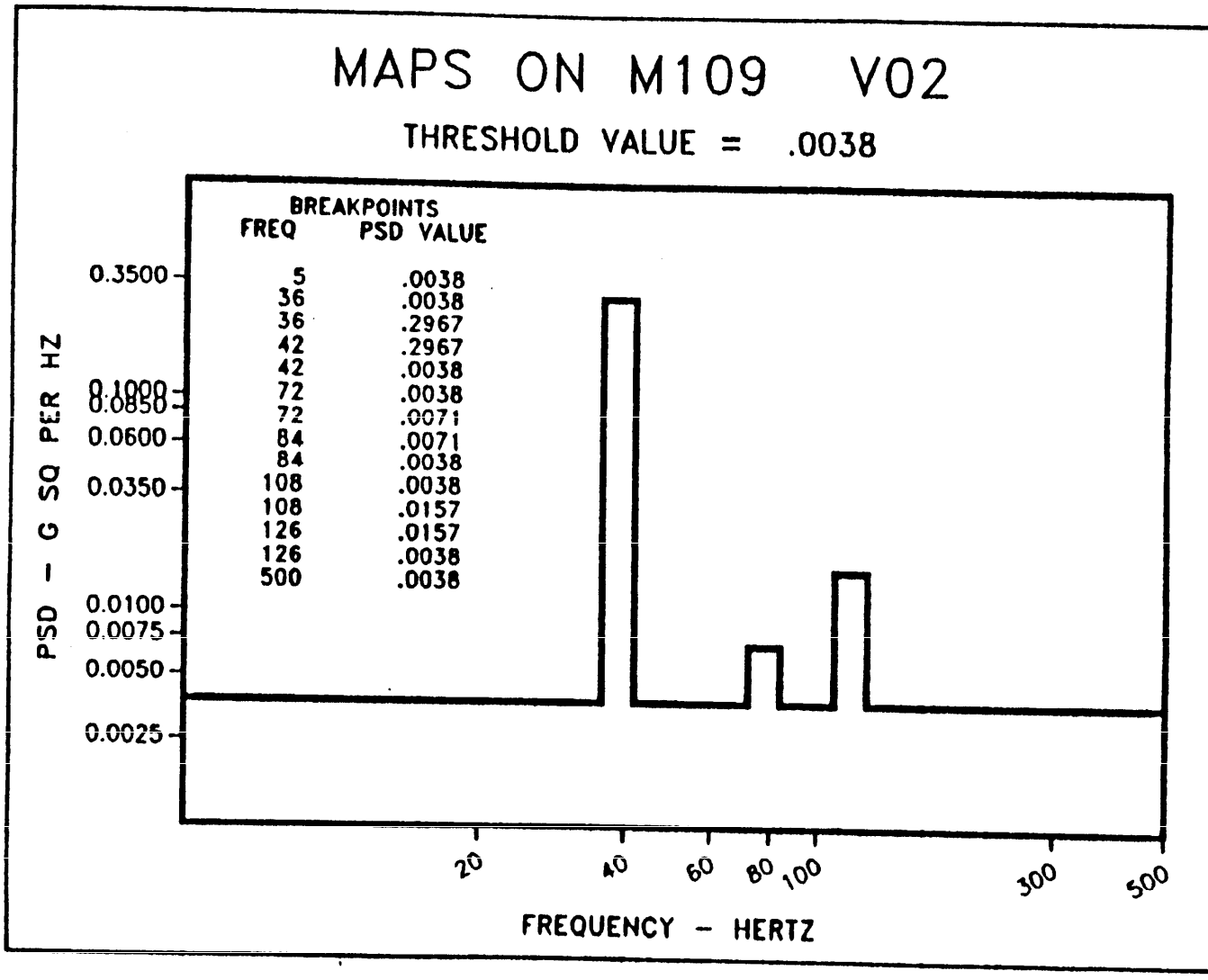
5.0	500.0	495.0	.00380

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
10	9
9	11
8	12
7	15
6	18
5	20
4	20
3	20
2	20
1	20

*** USE 9 WEEPS AND 11 AVEraGES PER LOOp ****

*** SET CONTROL WINDOW TO 20 DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 V02

TEST TIME, MINUTES: 54.0 DELTA F, HZ 1.0 OVERALL RMS, G: 1.70

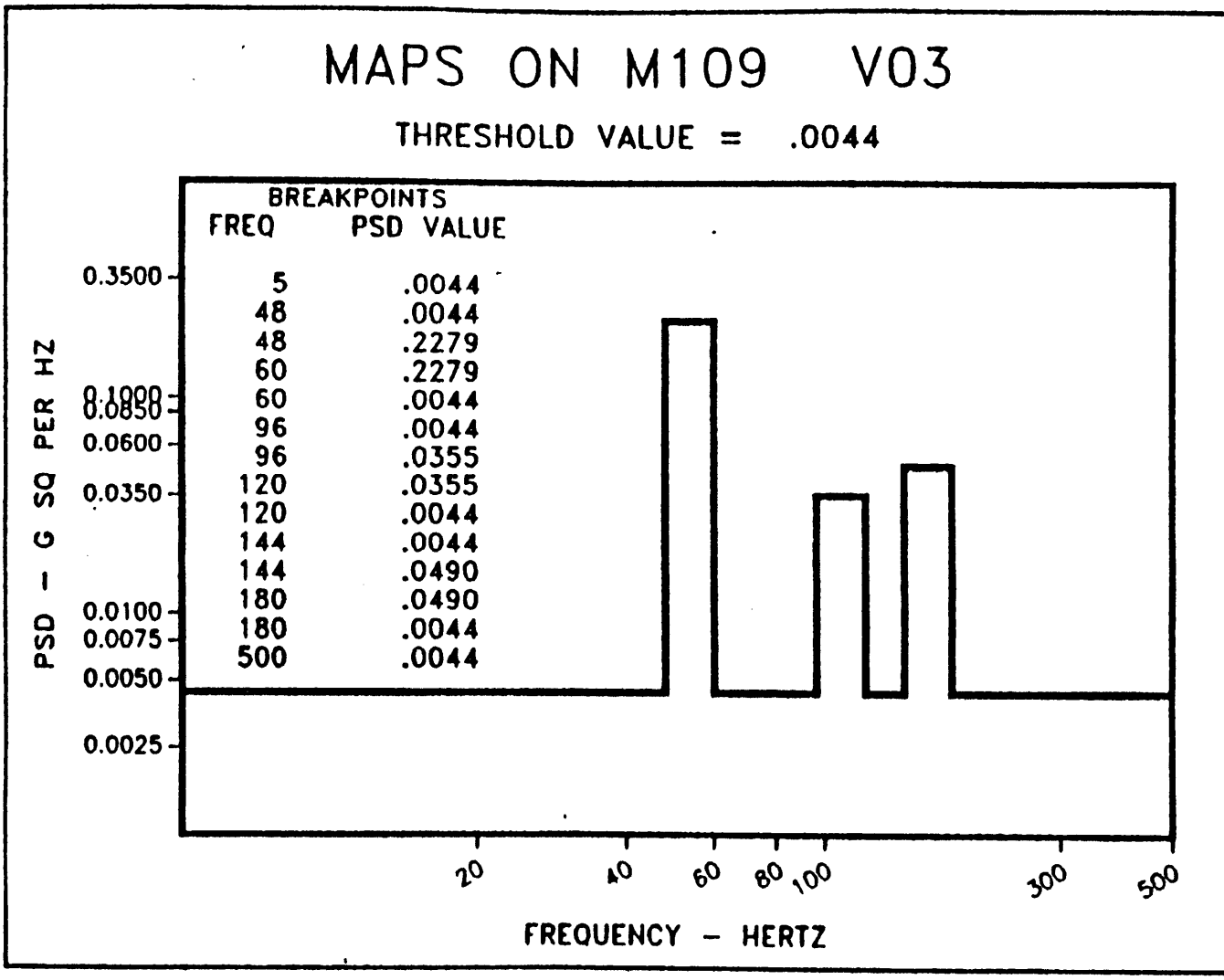
START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
36.0	42.0	3.0	.29670	18.9
72.0	84.0	6.0	.00710	2.7
108.0	126.0	9.0	.01570	6.2
		FLOOR VALUES		
5.0	500.0	495.0	.00380	

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
10	9
9	11
8	12
7	15
6	18
5	20
4	20
3	20
2	20
3	20

*** USE 9 WEEPS AND 11 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 20 DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 V03

TEST TIME, MINUTES; 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 2.17

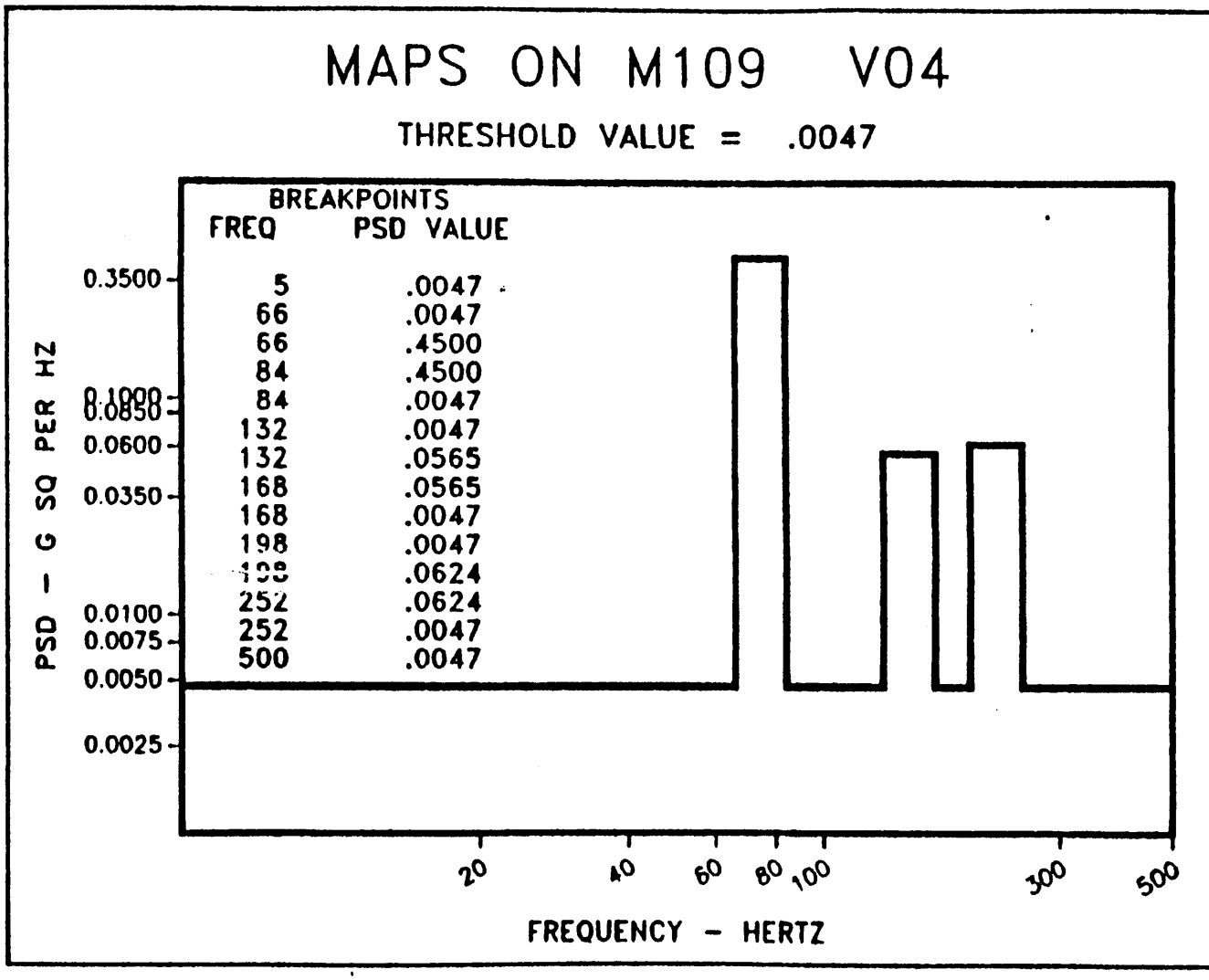
START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
48.0	60.0	6.0	.22790	17.1
96.0	120.0	12.0	.03550	9.1
144.0	180.0	18.0	.04900	10.5
		FLOOR VALUES		
5.0	500.0	495.0	.00440	

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
10	2
9	3
8	4
7	5
6	7
5	9
4	12
3	18
2	20
1	

*** USE 4 SWEEPS AND 12 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 20 DB ***



NARROW BAND RANDOM ON RANDOM RATE PROGRAM

MAPS ON M109 V04

TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 2.97

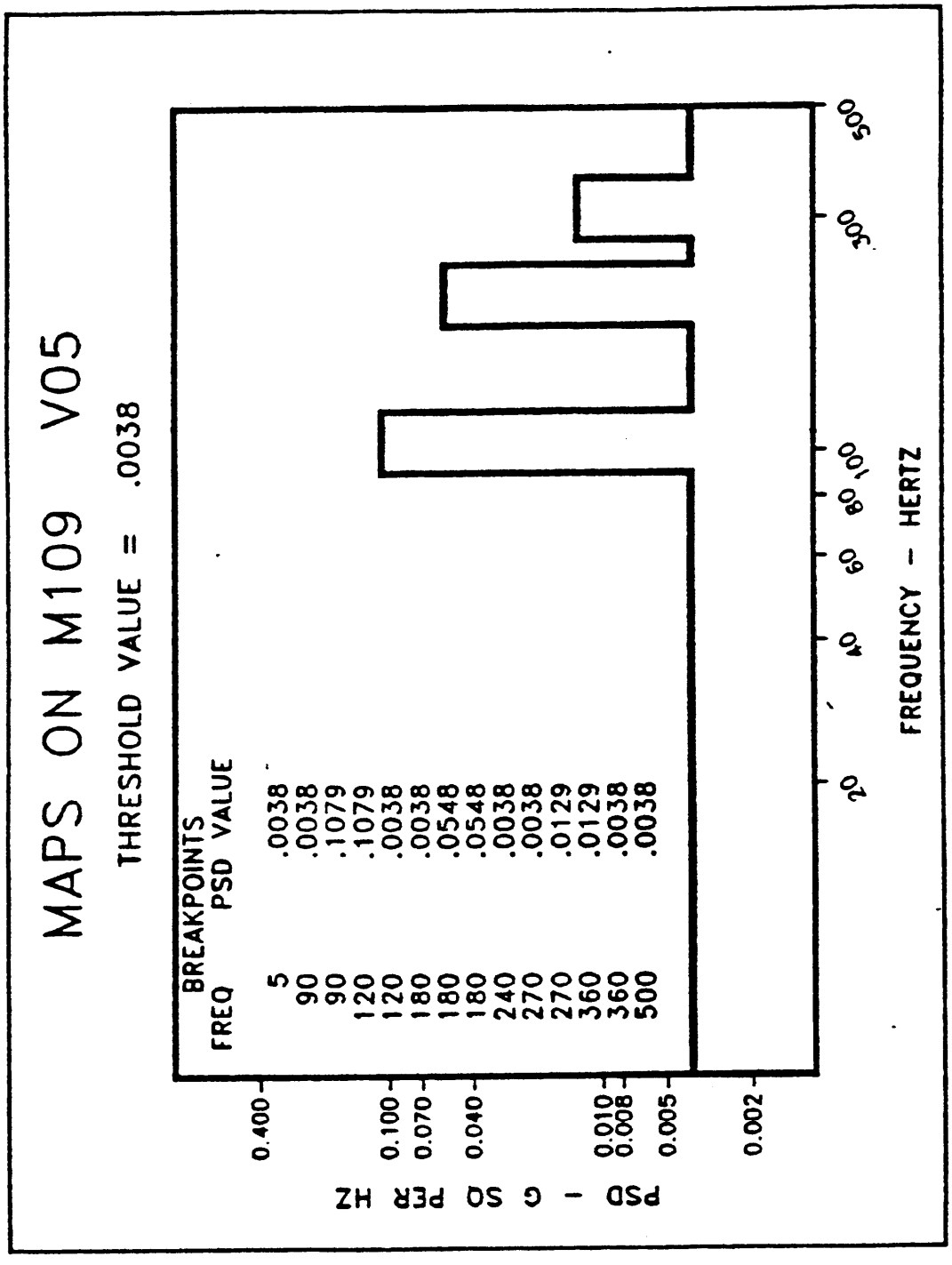
START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
66.0	84.0	9.0	.45000	19.8
132.0	168.0	18.0	.05650	10.8
198.0	252.0	27.0	.06240	11.2
		FLOOR VALUES		
5.0	500.0	495.0	.00470	

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
8	1
7	2
6	3
5	4
4	7
3	11
2	18
1	20

*** USE 3 SWEEPS AND 11 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 25 DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 V05

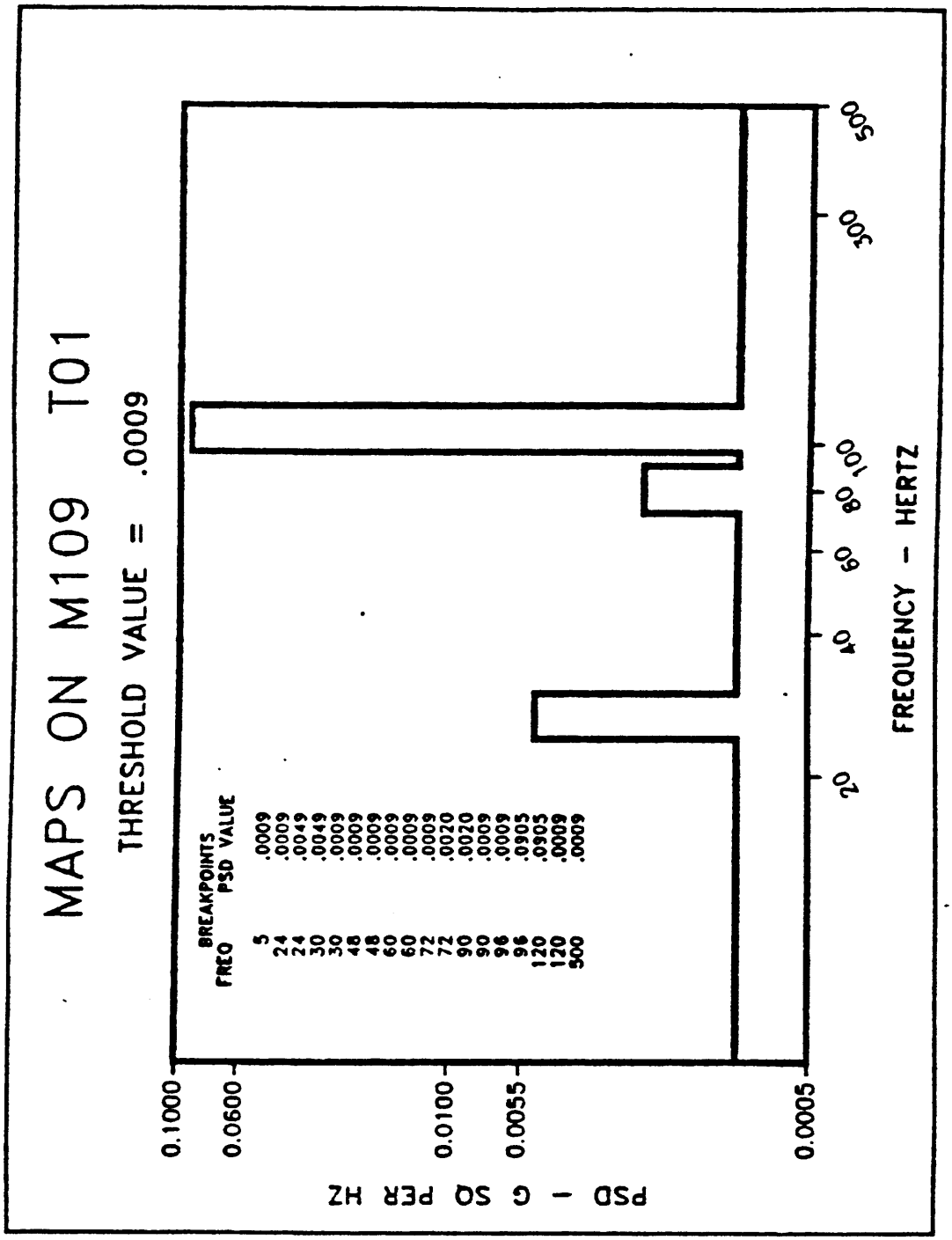
TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RHS, G: 2.32

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
90.0	120.0	15.0	.10790	14.5
180.0	240.0	30.0	.05480	11.6
270.0	360.0	45.0	.01290	5.3
		FLOOR VALUES		
5.0	500.0	495.0	.00380	

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
4	2
3	4
2	9
1	20

*** USE 2 SWEEPS AND 9 AVERAGES PER LOOP ****
*** SET CONTROL WINDOW TO 20 DB ***



nARRov BAND RANDOM ON RANDOM SWEEPRATE PROGRAM

MAPS ON M109 T01

TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 1.24

START FIWl	EUD FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
24.0	30.0	3.0	,00490	7.4
48.0	60.0	6.0	.00091	0
72.0	90.0	9.0	.00200	3.5
96.0	120.0	12.0	.09050	20.0

FLOOR VALUES

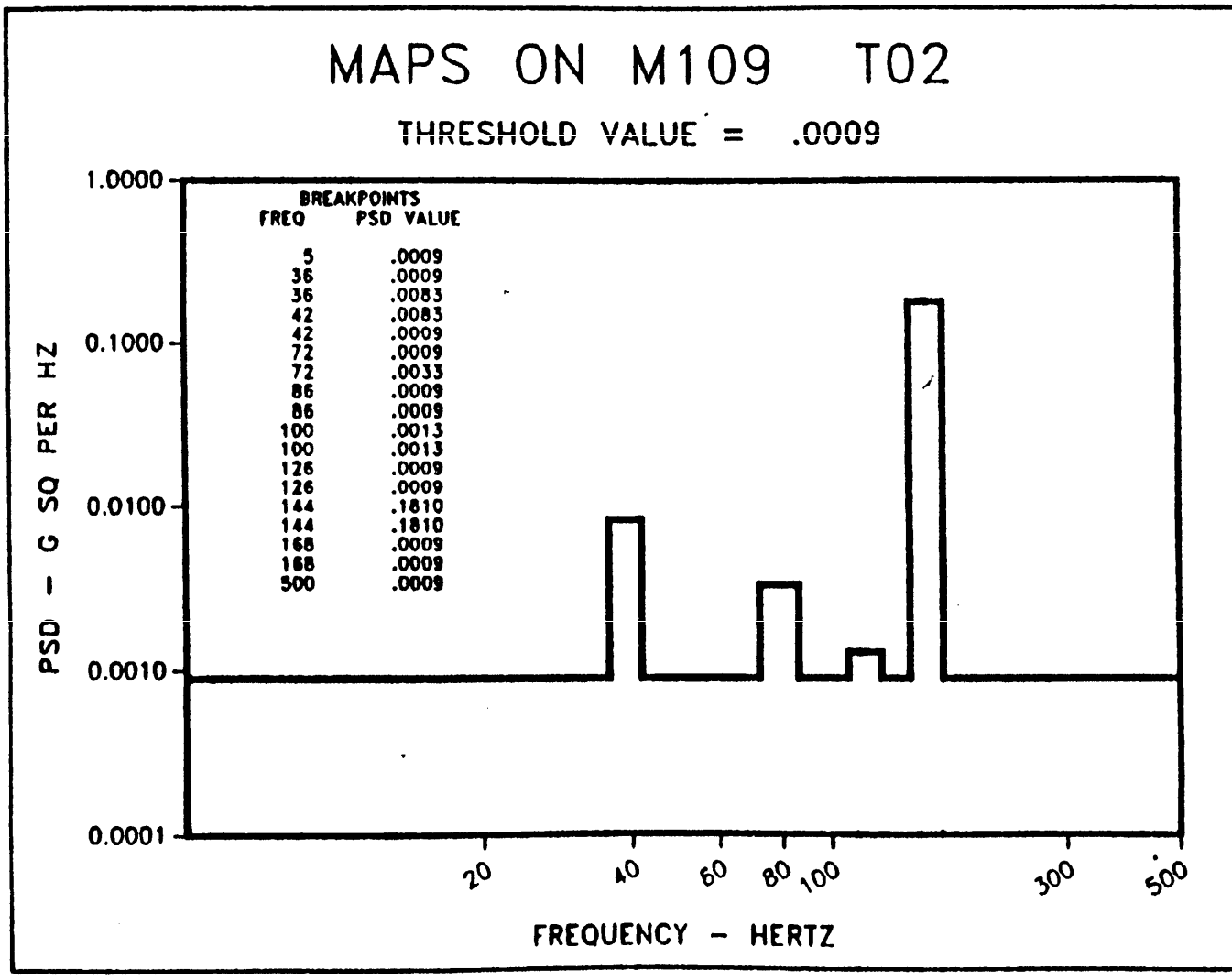
5.0	500.0	495.0	.00090

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
10	5
9	7
8	8
7	10
6	12
5	16
4	20
3	20
2	20
1	20

*** USE 7 SWEEPS AND 10 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 25 DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 T02.

TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 1.63

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
36.0	42.0	3.0	.00830	9.6
72.0	84.0	6.0	.00330	5.6
108.0	126.0	9.0	.00130	1.6
144.0	168.0	12.0	.18100	23.0

FLOOR VALUES

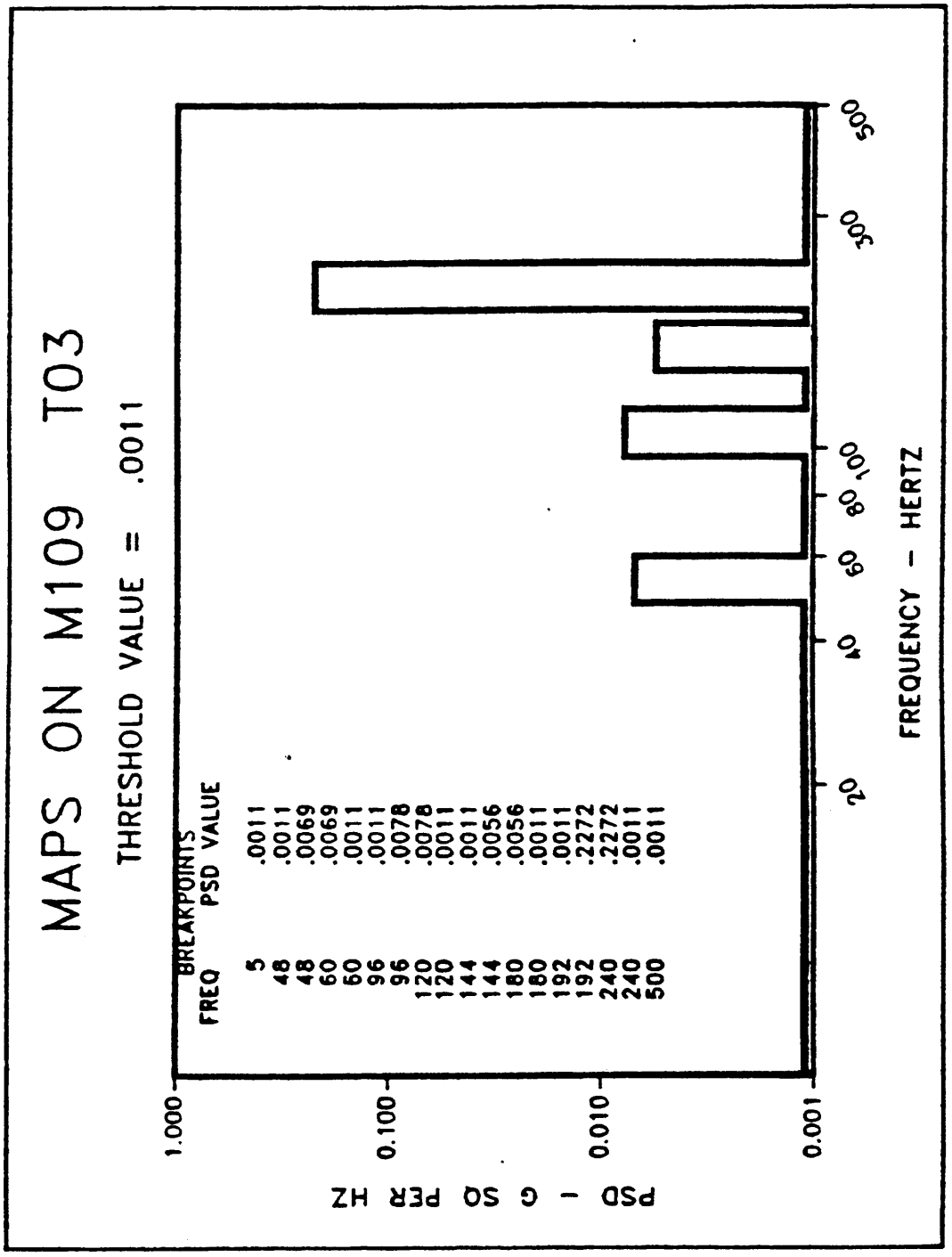
5.0	500.0	495.0	.00090

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
10	5
9	7
8	10
7	12
6	16
5	20
4	20
3	20
2	20
1	20

*** USE 7 SWEEPS AND 10 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO *25* DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 T03

TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 2.48

START FREQ	END FREQ	BAND WIDTH	PSD VALVE	DB RE FLOOR
48*O	60.0	6.0	.00690	8.0
96.0	120.0	12.0	.00780	8.5
144.0	180.0	18.0	.00S60	7.1
192.0	240.00	24.0	.22720	23.2

FLOOR VALUES

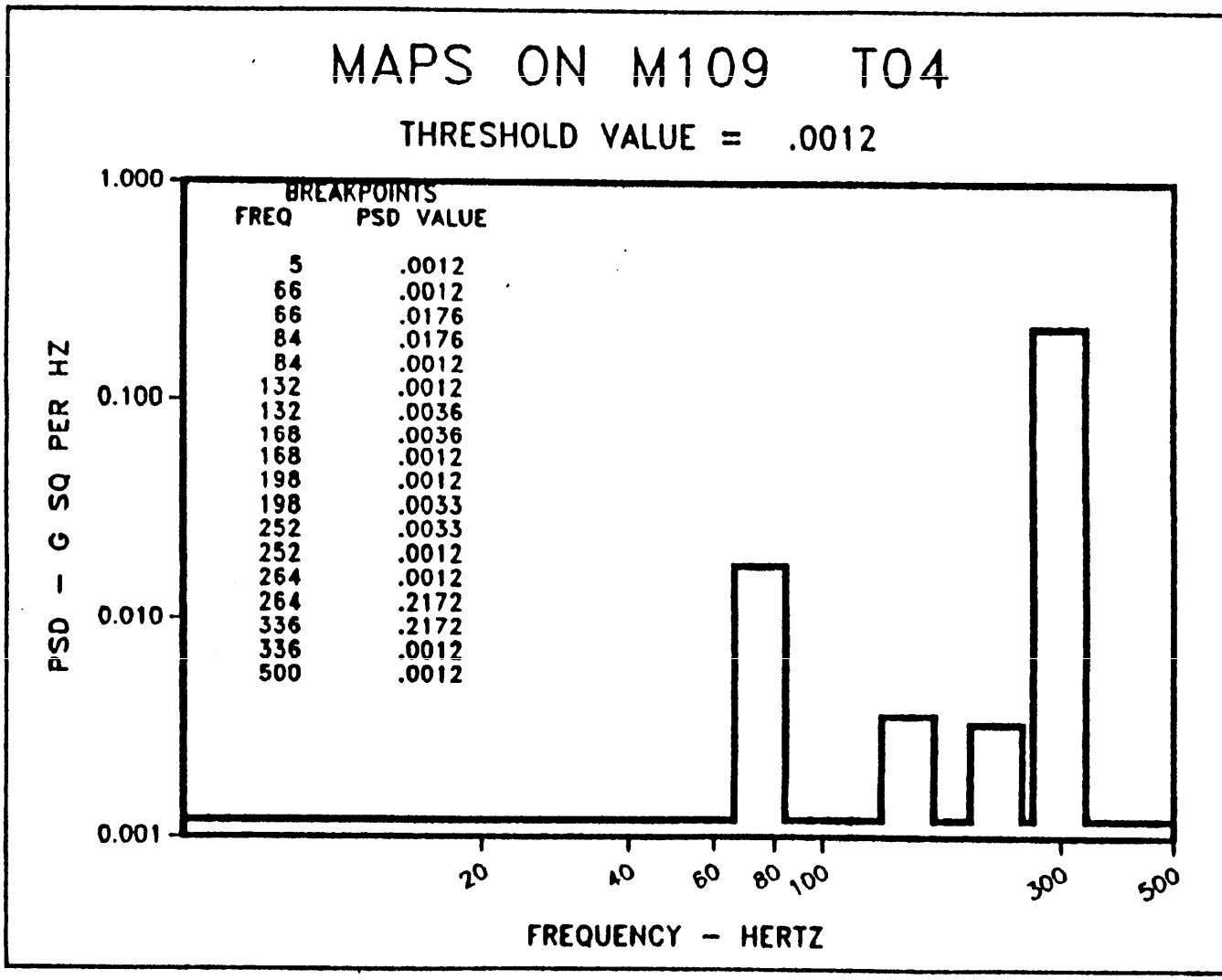
5.0	500.0	495.0	.00110

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

WEEPS	AVERAGES
9	1
8	1
7	2
6	4
5	5
4	8
3	12
2	20
.1	20

*** USE 3 SWEEPS AND 12 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 25 DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAX

MAPS ON M109 T04

TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 2.94

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
66.0	84.0	9.0	.01760	11.7
132.0	168.0	18.0	.00360	4.8
198.0	252.0	27.0	.00330	4.4
264.0	336.0	36.0	.21720	22.6

FLOOR VALUES

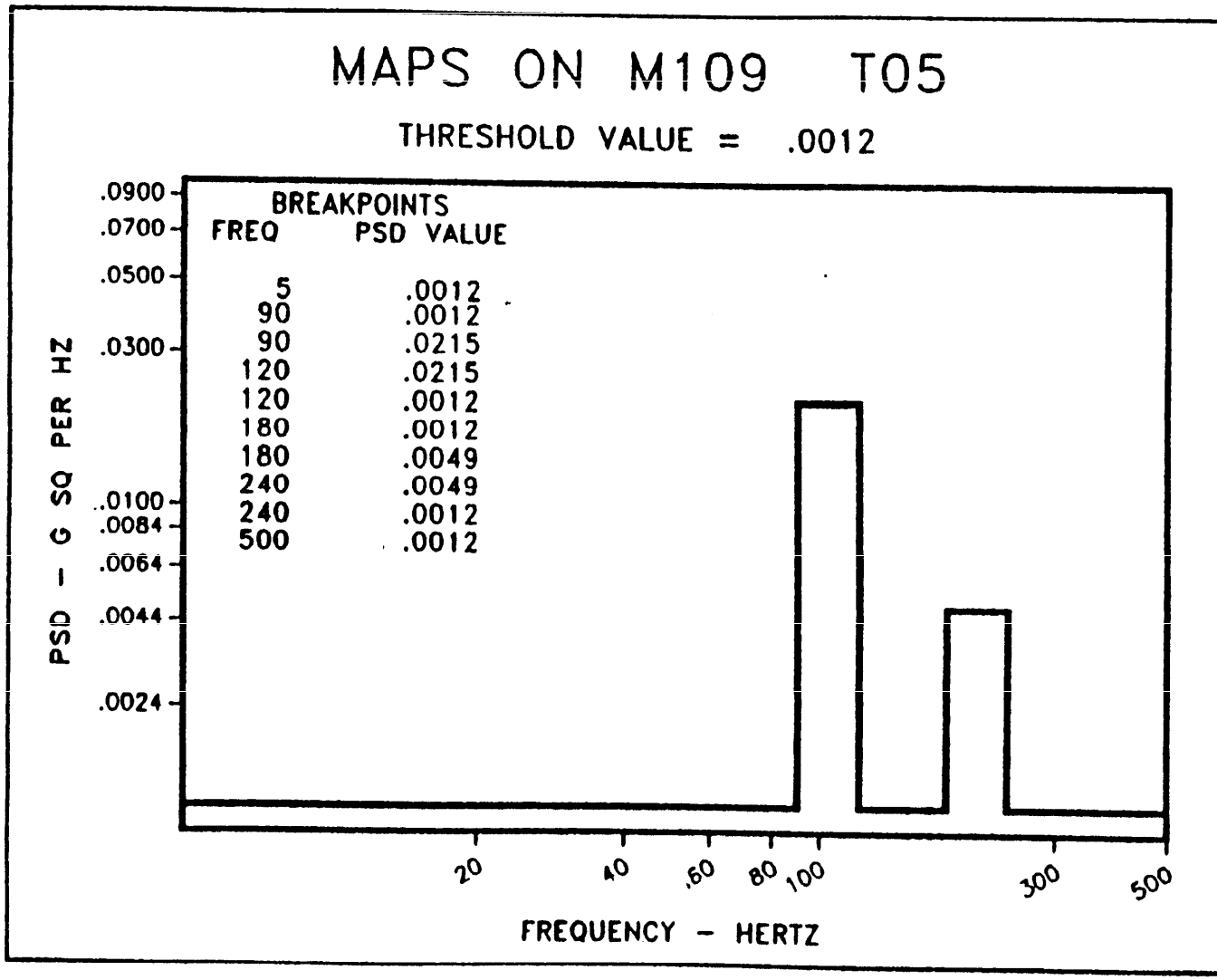
5.0	500.0	495.0	.00120

ACCEPTABLE NUMBER OF WEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
6	1
5	2
Text	4
;	7
2	12
1	20

*** USE 2 SWEEPS AND 12 AVERAGES PER LOOP *****

*** SET CONTROL WINDOW TO 25 DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 T05

TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 1.00

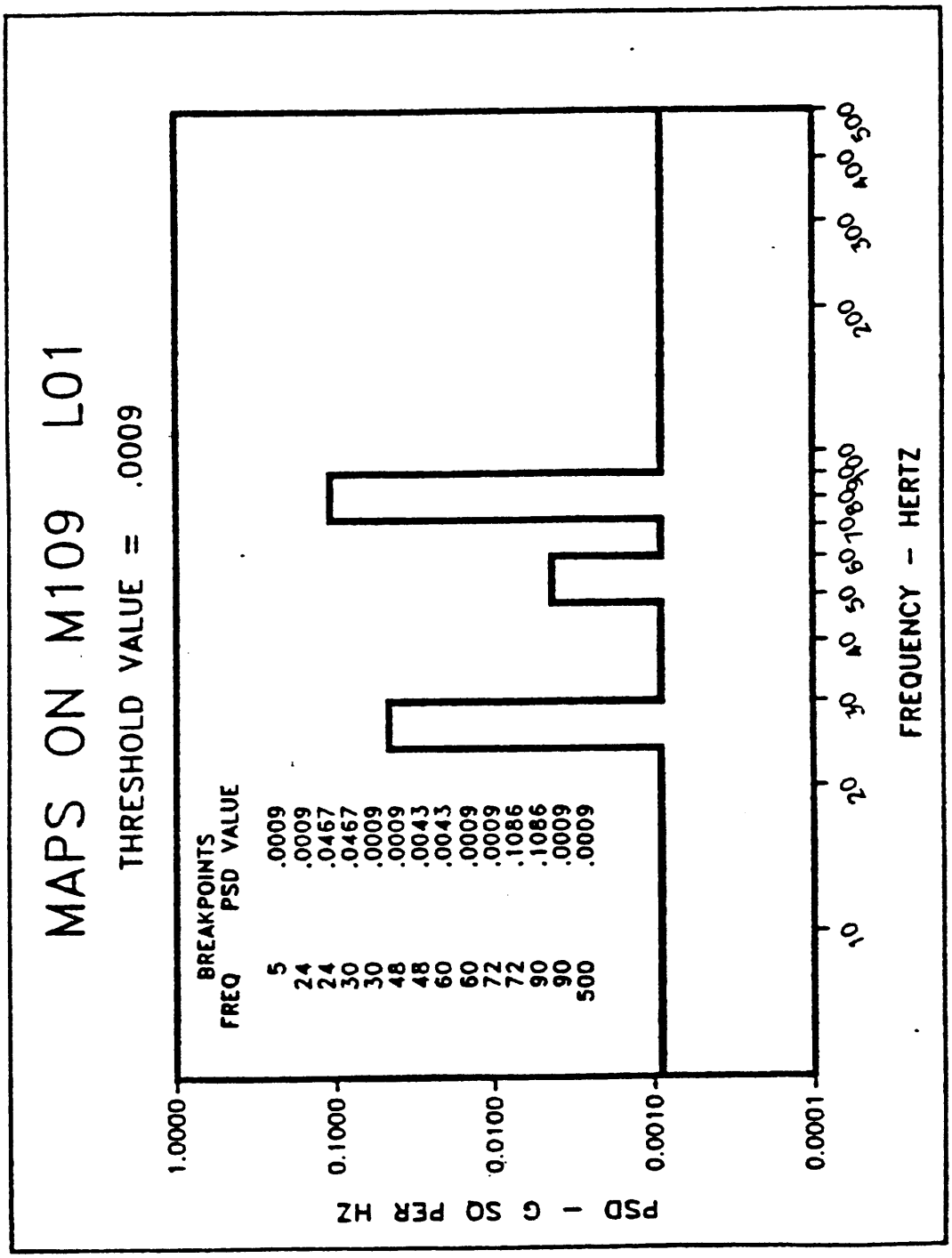
START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
90.0	120.0	15.0	.02150	
180.0	240.0	30.0	.00490	
		FLOOR VALUES		
5.0	500.0	495.0	.00120	

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
7	1
6	2
5	3
4	5
3	9
2	16
1	20

*** USE 2 SWEEPS AND 16 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 20 DB ***



NARROW BAND RANDOM ON RANDOM RATE PROGRAM

MAPS ON M109 L01

TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 1.25

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
24.0	30.0	3.0	.04670	17.2
48.0	60.0	6.0	.00430	6.8
72.0	90.0	9.0	.10860	20.8

FLOOR VALUES

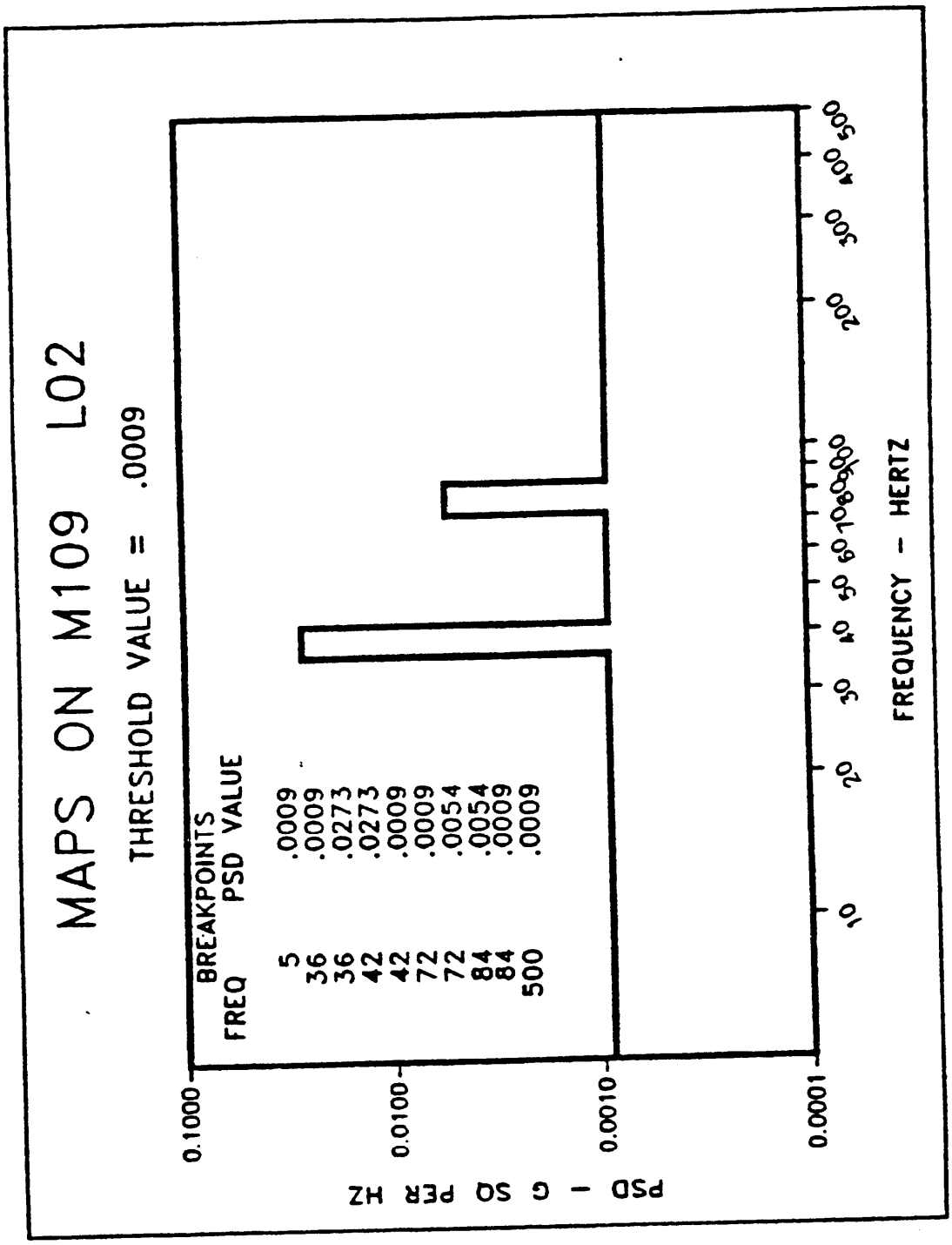
5.0	500.0	495.0	.00090

ACCEPTBALE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
10	9
9	11
8	12
7	15
6	18
5	20
4	20
3	20
2	"20
1	20

*** USE 9 SWEEPS AND 11 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 25 DB ***



NARROw BAND RANDOM ON RANDOM SWEEP RATE PROGRAM_

MAPS ON M109 L02.

TEST TIRE, TIME 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: .74

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
36.0	42.0	3.0	.02730	24.8
72.0	84.0	6.0	.00540	7.8

FLOOR VALUES

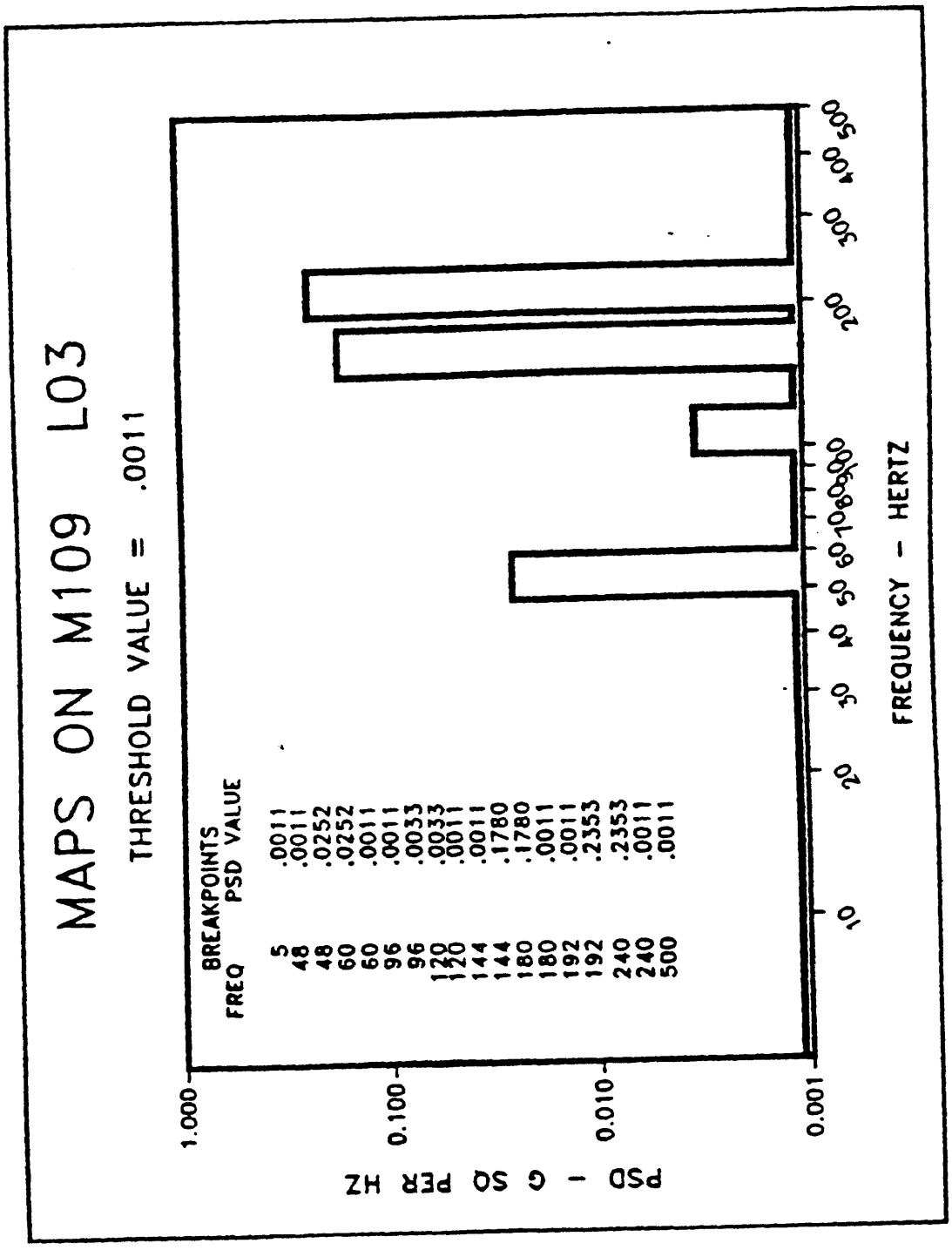
5.0	500.0	495.0	.00090

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
10	16
9	18
8	20
7	20
6	20
5	20
4	20
3	20
2	20
1	20

*** USE 10 SWEEPS AND 16 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 20 DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 L03.

TEST TIME. MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 3.09

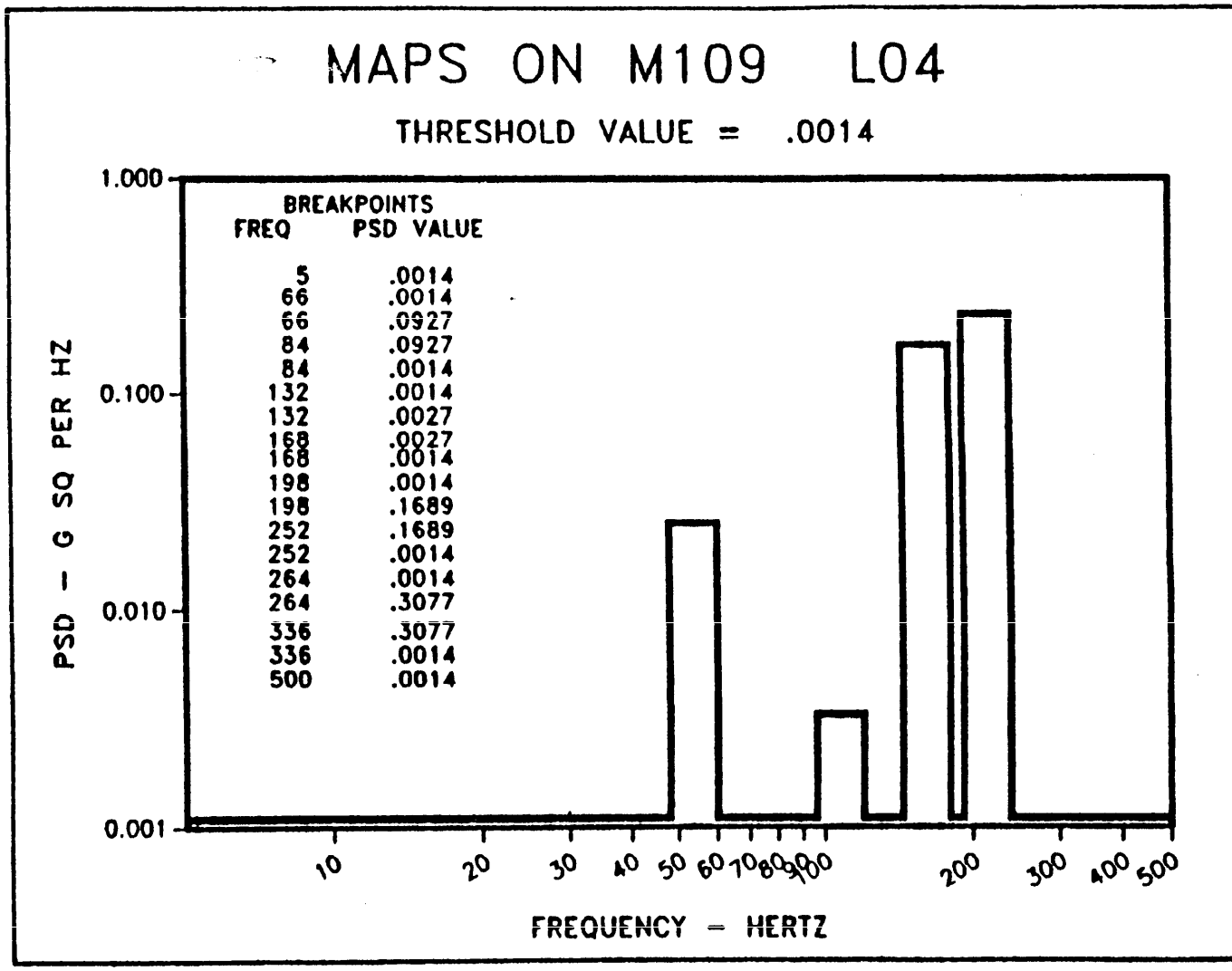
START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
48.0	60.0	6.0	.02520	13.6
96.0	120.0	12.0	.00330	4.8
144.0	180.0	18.0	.17800	22.1
192.0	240.0	24.0	.23530	23.3
		FLOOR VALUES		
5.0	500.0	495.0	.00120	

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
9	1
8	1
7	2
6	4
5	5
4	8
3	12
2	20
1	20

*** USE 3 SWEEPS AND 12 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 25 DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 M4

TEST TIME, MINUTES: 54.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 4.13

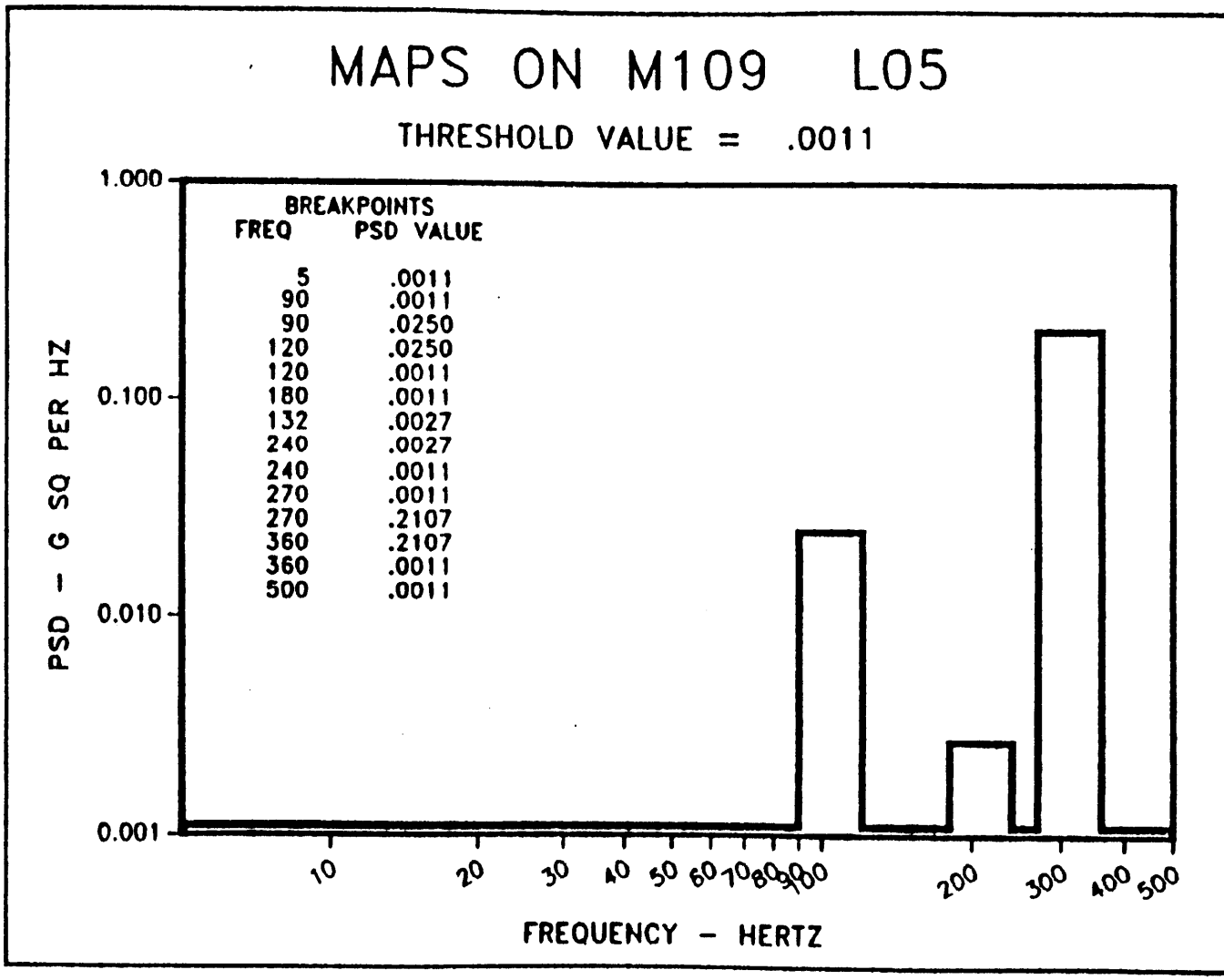
START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
66.0	84.0	9.0	.09270	18.2
132.0	168.0	18.0	.00270	2.9
198.0	252.0	27.0	.16890	20.8
264.0	336.0	36.0	.30770	23.4
		FLOOR VALUES		
5.0	500.0	495.0	.00140	

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
6	1
5	2
4	4
3	7
2	12
1	20

*** USE 2 SWEEPS AND 12 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 25 DB ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 L05

TEST TIME, MINUTES 54.0 DELTA F, HZ: 1.0 OVERALL MS, G: 3.22

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
90.0	120.0	15.0	.02500	13.6
180.0	240.0	30.0	.00270	3.9
270.0	360.0	45.0	.21070	22.9

FLOOR VALUES

5.0	500.0	495.0	.00110

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

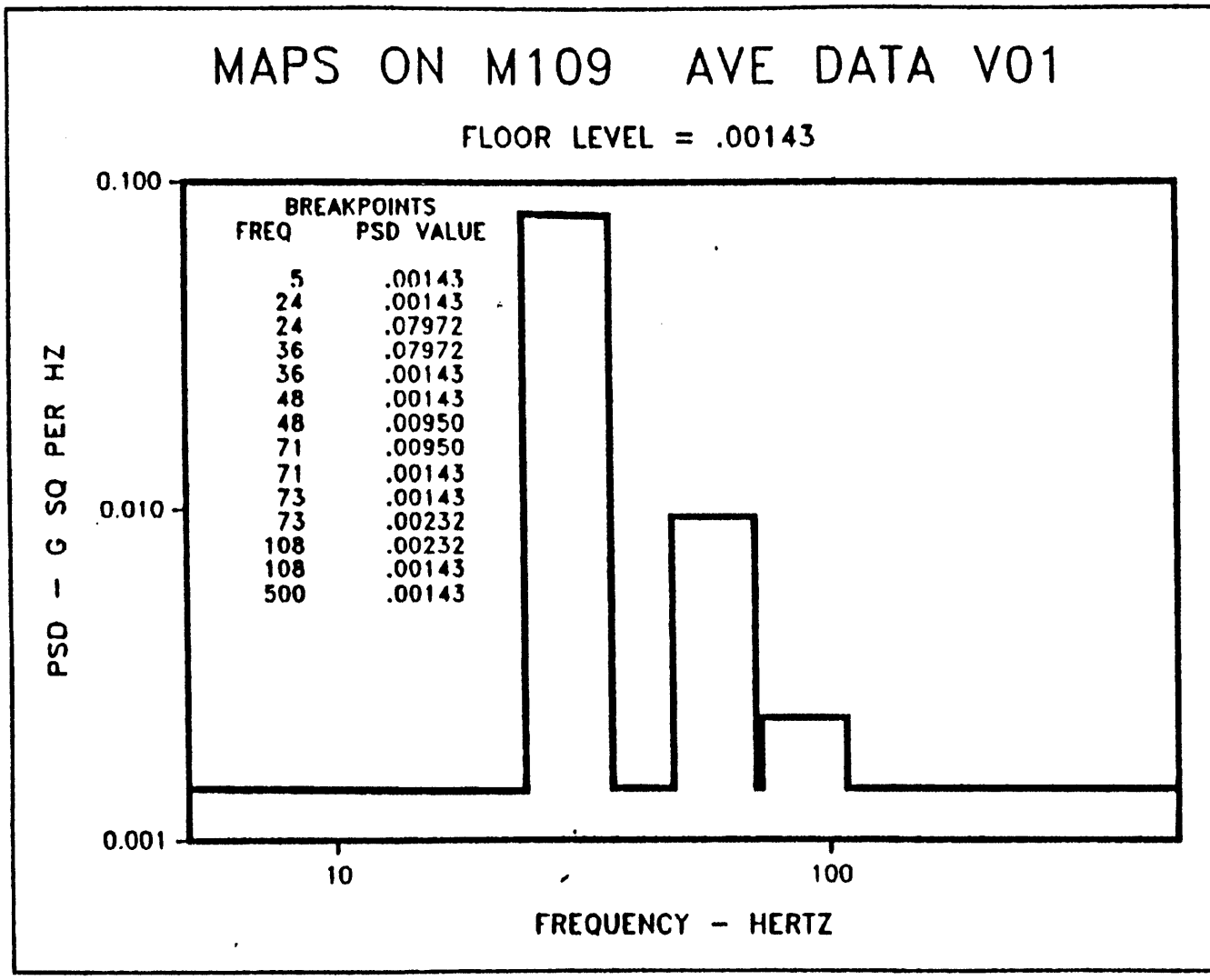
SWEEPS	AVERAGES
4	2
3	4
2	9
1	20

*** USE 2 SWEEPS AND 9 AVERAGES PER LOOP ****

*** SET CONTROL WINDOW TO 25 DB ***

APPENDIX H

RELIABILITY VIBRATION TEST SCHEDULES



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 AVE DATA PHASE V01

TEST TIME, MINUTES: 12.0. DELTA F, HZ: 1.0 OVERALL RHS, G: 1.14

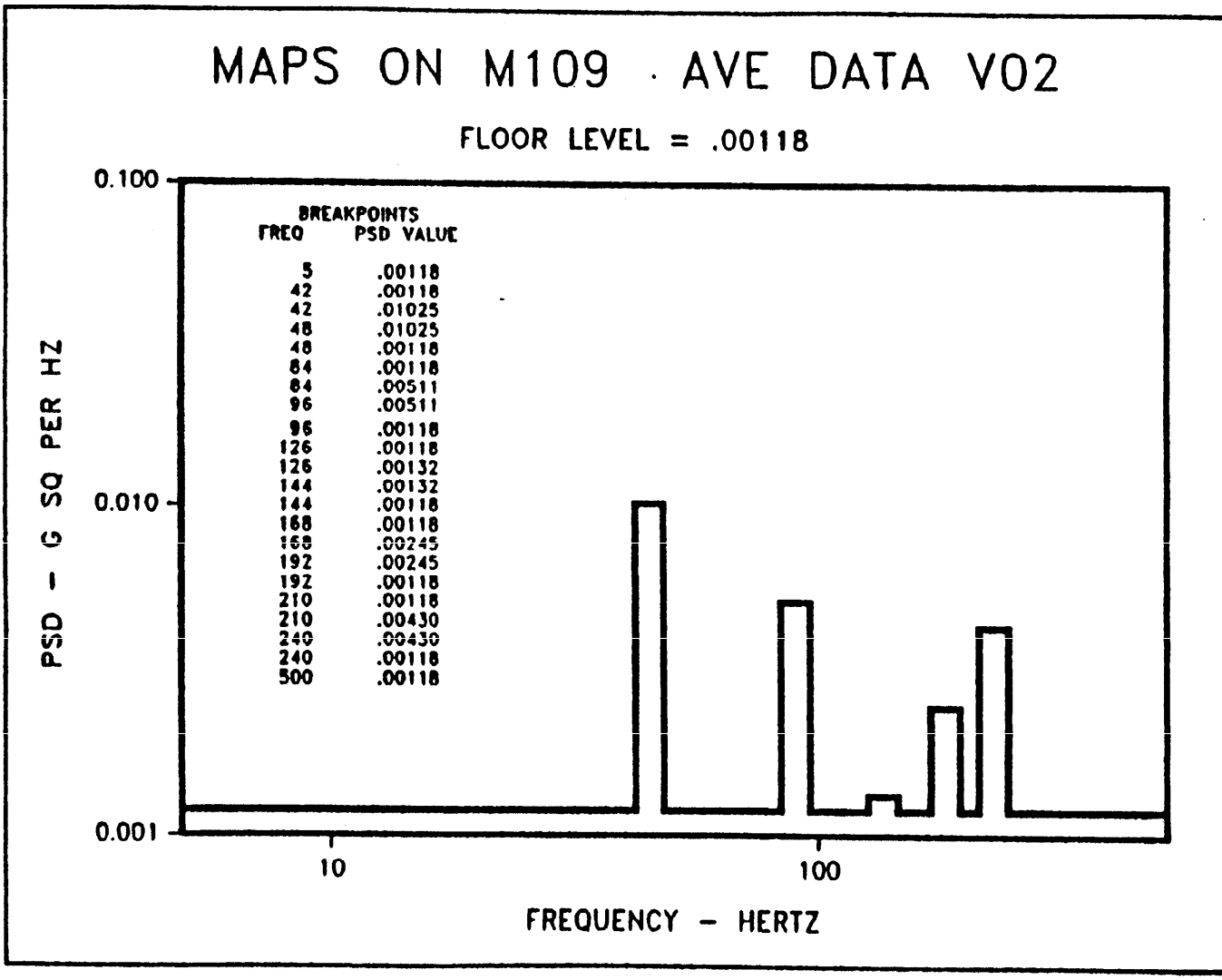
START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
24.0	36.0	6.0	.07972	17.5
48.0	72.0	12.0	.00950	6.2
72.0	108.0	18.0	.00232	2.1

FLOOR VALUES

5.0	500.0	495.0	.00143

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
2	3
1	11



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

HAPS ON M109 AVE PHASE V02

TEST TIME, MINUTES: 12.0 DELTA F, HZ: 1.0 OVERALL RMS, G: .84

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
42.0	48.0	3.0	.01025	9.4
84.0	96.0	6.0	.00s12	6.4
126.0	144.0	9.0	.00132	.5
168.0	240.0	12.0	.00245	3.2
210.0	240.0	15.0	l 00430	5.6

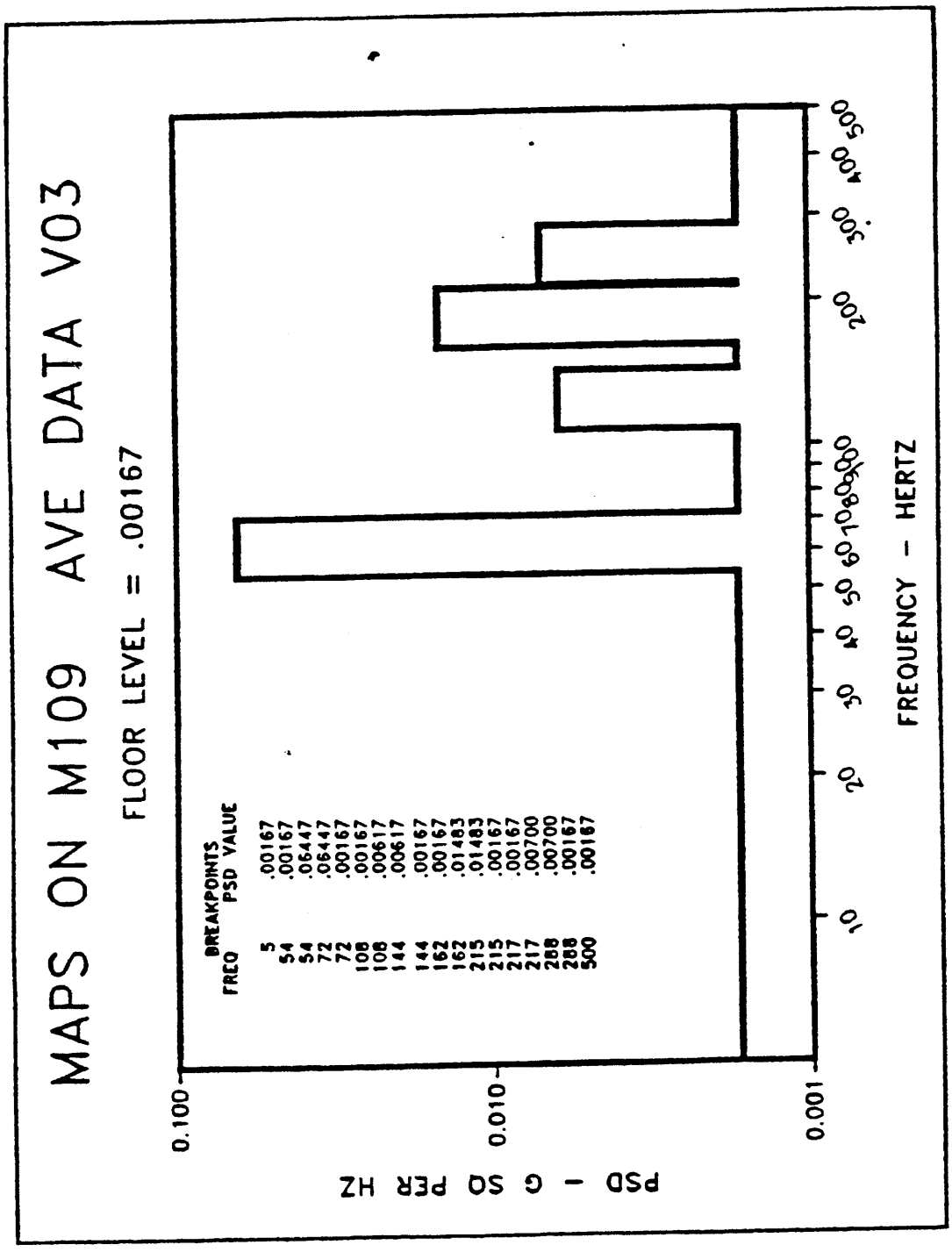
FLOOR VALUZS

5.0	500.0	495.0	.00118

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
3	1
2	4
1	14

4 SET CALIBRATION TO 500 MV/G ***



NARROW BAND RANDOM ON RANDOM RATE PROGRAM

MAPS ON M109 AVE PHASE V03

TEST TIME, MINUTES: 12.0 DEKTA F, HZ: 1.0 OVERALL RMS,. G: 1.42

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
54.0	72.0	9.0	.06447	15.9
108.0	144.0	18.0	.00617	5.7
162.0	216.0	27.0	.01483	9.5
216.0	288.0	36.0	.00700	6.2

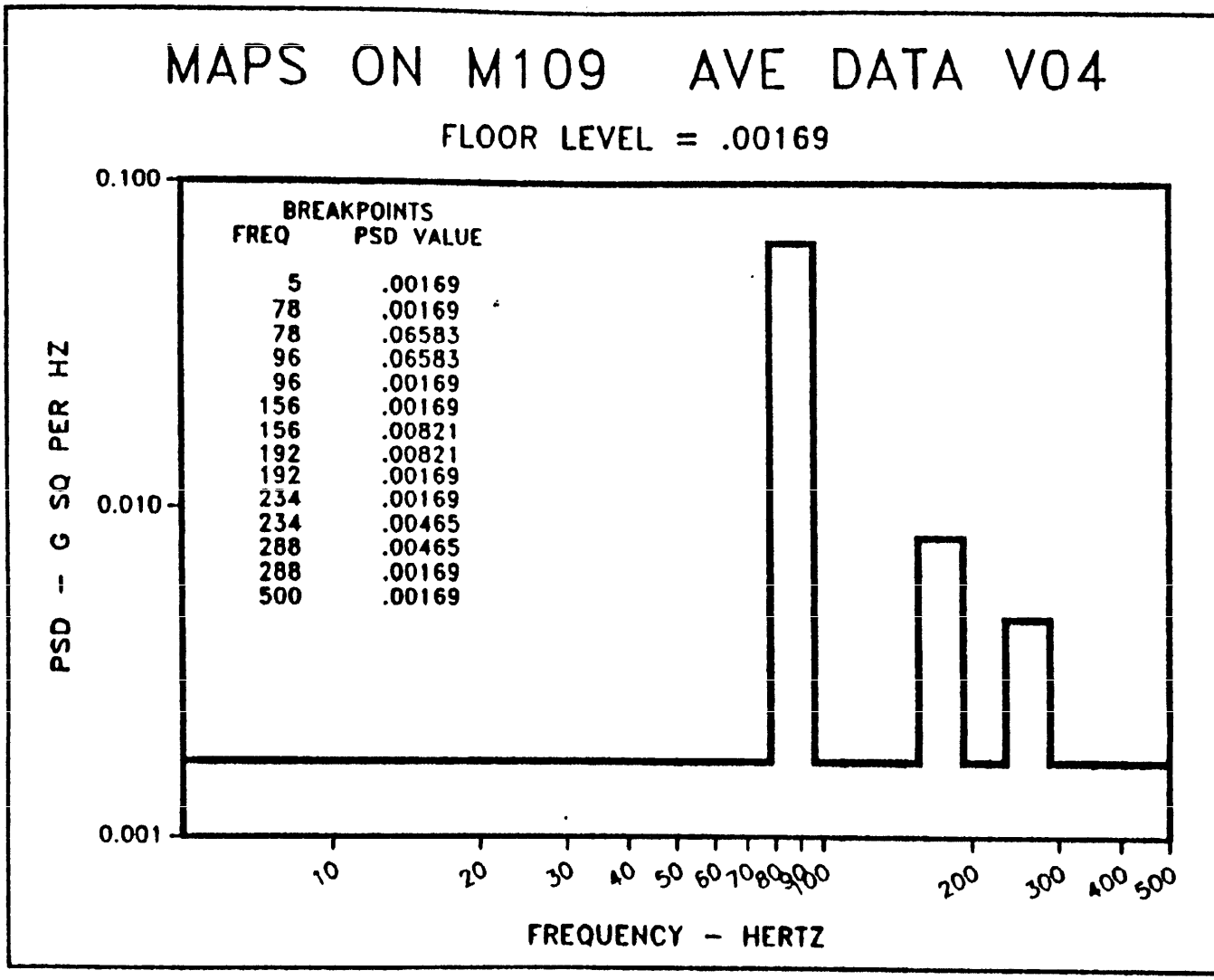
FLOOR VALUES

5.0	500.0	495.0	.00167

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
1	3

*** SET CONTROL WINDOW TO 20 DB ***
*** PEAK G VALUE EXPECTED: 6 SET CALIBRATION TO 500 MV/ ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 AVE PHASE V04

TEST TIME, MINUTES: 12.0 DELTA F, HZ: 1.0 OVERALL RMS, G: 1.27

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
78.0	96.0	9.0	.06583	15.9
156.0	192.0	18.0	.00821	6.9
234.0	288.0	27.0	.00465	4.4

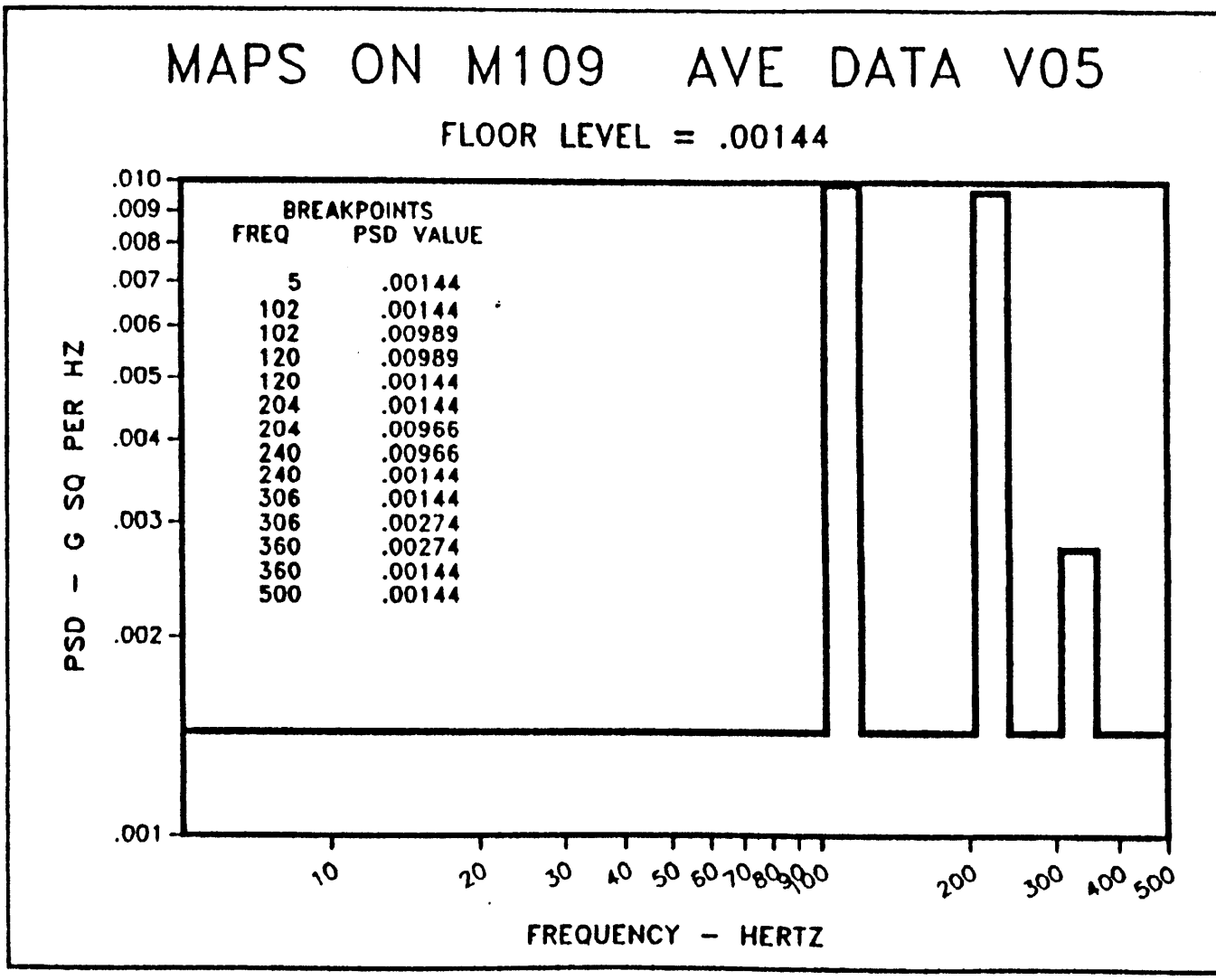
FLOOR VALUES

5.0	500.0	495.0	.00169

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
1	5

6 SET CALIBRATION TO 500 HV/G ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON K109 AVE PHASE V05

TEST TIME, MINUTES: 12.0 DELTA F, HZ 1.0 OVERALL RHS, G: .99

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
102.0	120.0	9.0	.00989	8.4
204.0	240.0	18.0	.00966	8.3
306.0	360.0	27.0	.00274	2.B

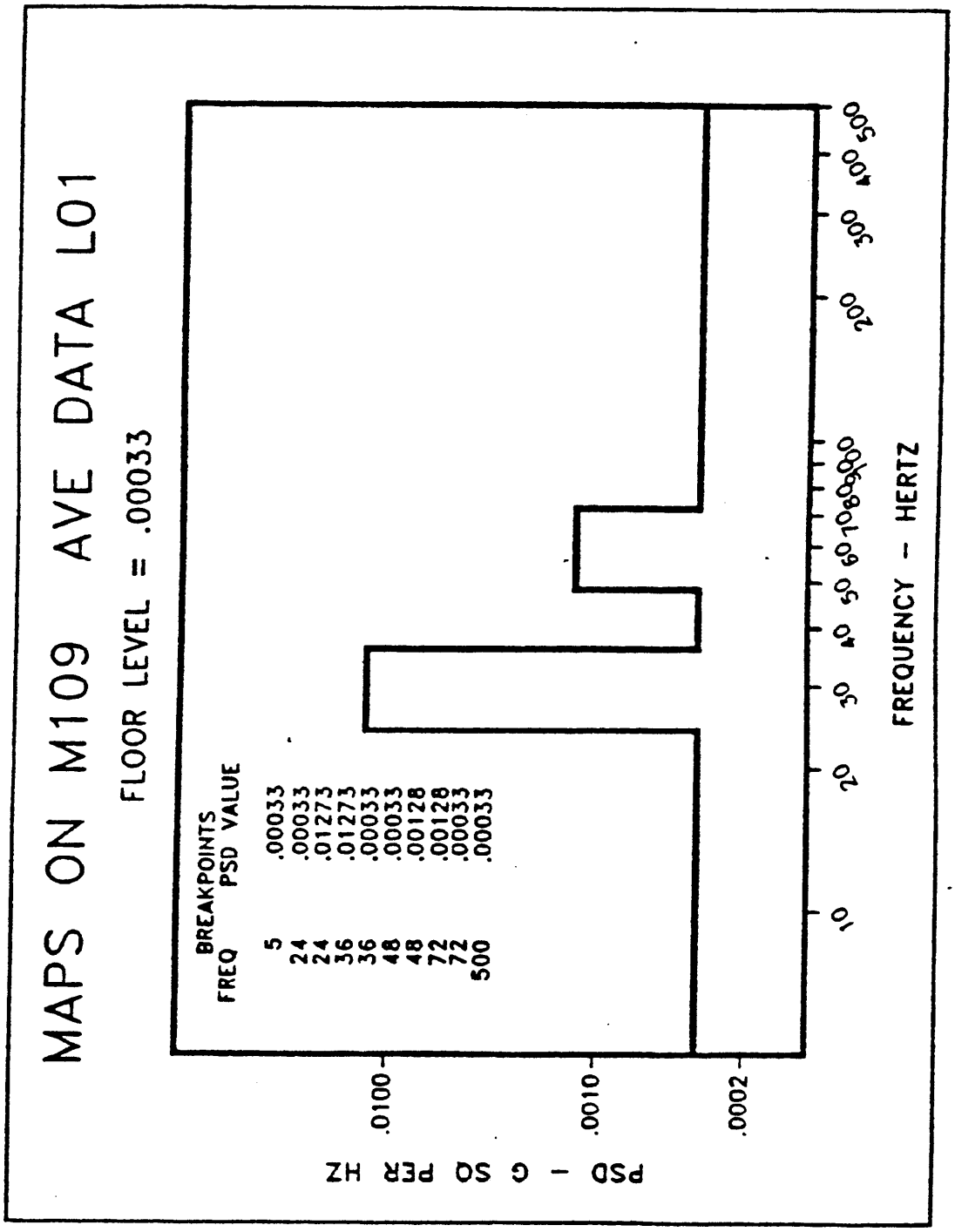
FLOOR VALUES

5.0	500.0	495.0	.00144

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
1	5

*** SET CONTROL WINDOW TO 20 DB ***
*** PEAK G VALUE EXPECTED: 5 SET CALIBRATION TO 500 MV/G ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 AVE PHASE L01

TEST TIME, MINUTES: 12.0 DELTA F, HZ: 1.0 OVERALL RMS, C: .50

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
24.0	36.0	6.0	.01273	15.9
48.0	72.0	12.0	.00128	5.9
		FLOOR VALUES		
5.0	500.0	495.0	.00033	

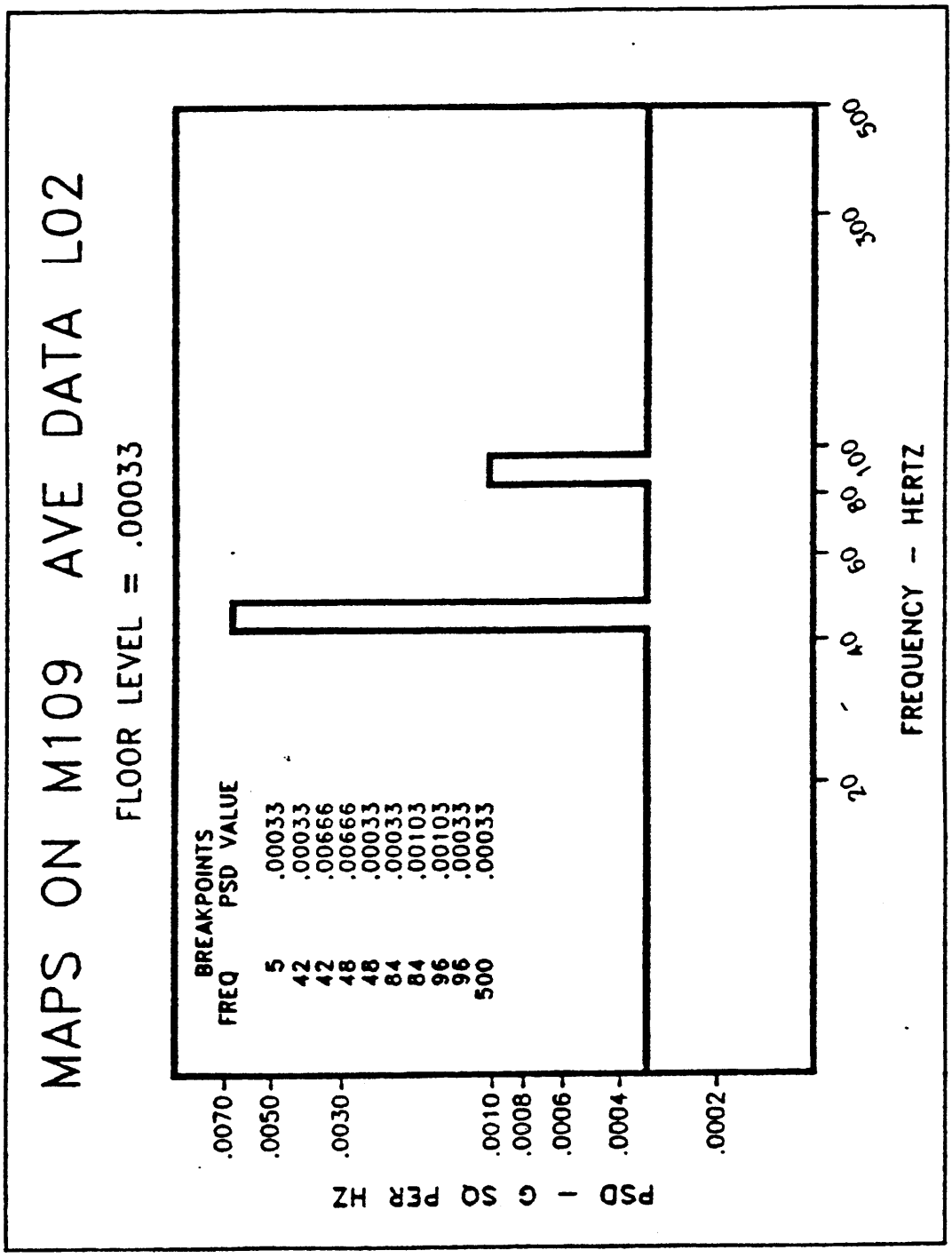
ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
4	1
3	3
2	7
1	18

*** USE 2 SWEEPS AND 7 AVERAGES PER LOOP ***

*** SET CONTROL WINDOW TO 20 DB ***

*** PEAK G VALUE EXPECTED: 3 SET CALIBRATION TO 500 MV/G ***



NARROW BAND RANDOM OR RANDOM SWEEP RATE PROGRAM

MAPS ON M109 AVE PHASE L02

TEST TIME, MINUTES: 12.0 DELTA F: HZ: 1.0 OVERALL RMS, G: .43

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
42.0	48.0	3.0	.00666	13.0
84.0	96.0	6.0	.00103	4.9

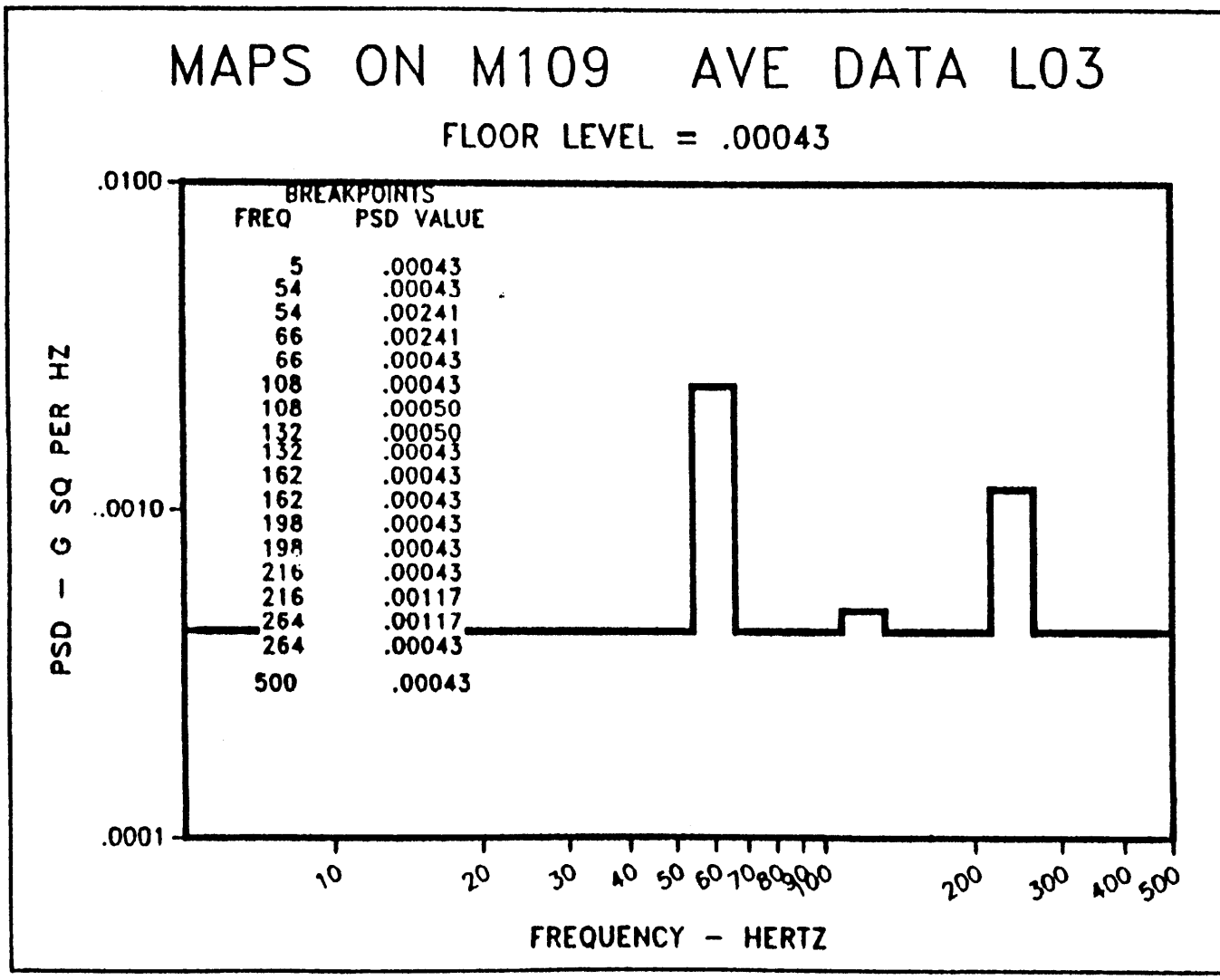
FLOOR VALUES

5.0	500.0	495.0	.00033

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
8	1
7	2
6	3
5	4
4	7
3	11
2	18
1	20

*** USE 3 SWEEPS ANS 11 AVERAGES PER LOOP ***
*** SET CONTROL WINDOW TO 20 DB ***
*** PEAK G VALUE EXPECTED: 2 SET CALIBRATION TO 500 MV/G ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 AVE PHASE L03

TEST TIME, MINUTES: 12.0 DELTA F, HZ: 1.0 OVERALL RMS, G: .49

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
54.0	66.0	6.0	.00241	7.5
108.0	132.0	12.0	.00050	.7
162.0	198.0	18.0	.00043	0.0
216.0	264.0	24.0	.00117	4.3

FLOOR VALUES

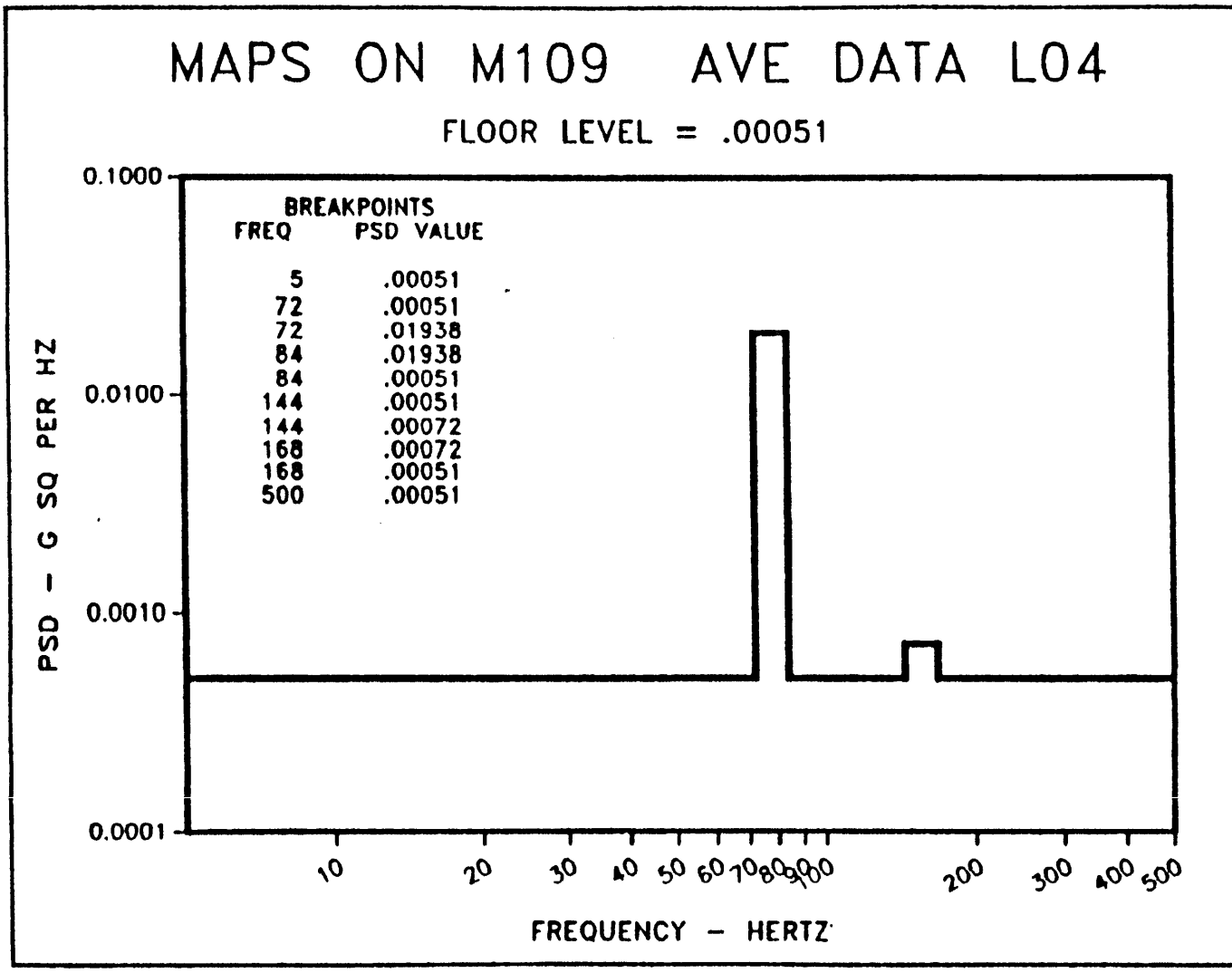
5.0	500.0	495.0	.00043

ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
2	1
1	7

*** SET CONTROL WINDOW TO 20 DB ***

*** PEAK G VALUE EXPECTED: 3 SET CALIBRATION TO 500 MV/G ***



NARROW BAND RANDOM ON RANDOM SWEEP PROGRAM

HAPS ON M109 AVE PHASE L04

TEST TIME, MINUTES: 12.0 DELTA F, HZ: 1.0 OVERALL RMS, G: .61

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
72.0	84.0	6.0	.01938	15.8
144.0	168.0	12.0	.00072	1.5

FLOOR VALUES

5.0	500.0	495.0	.00051

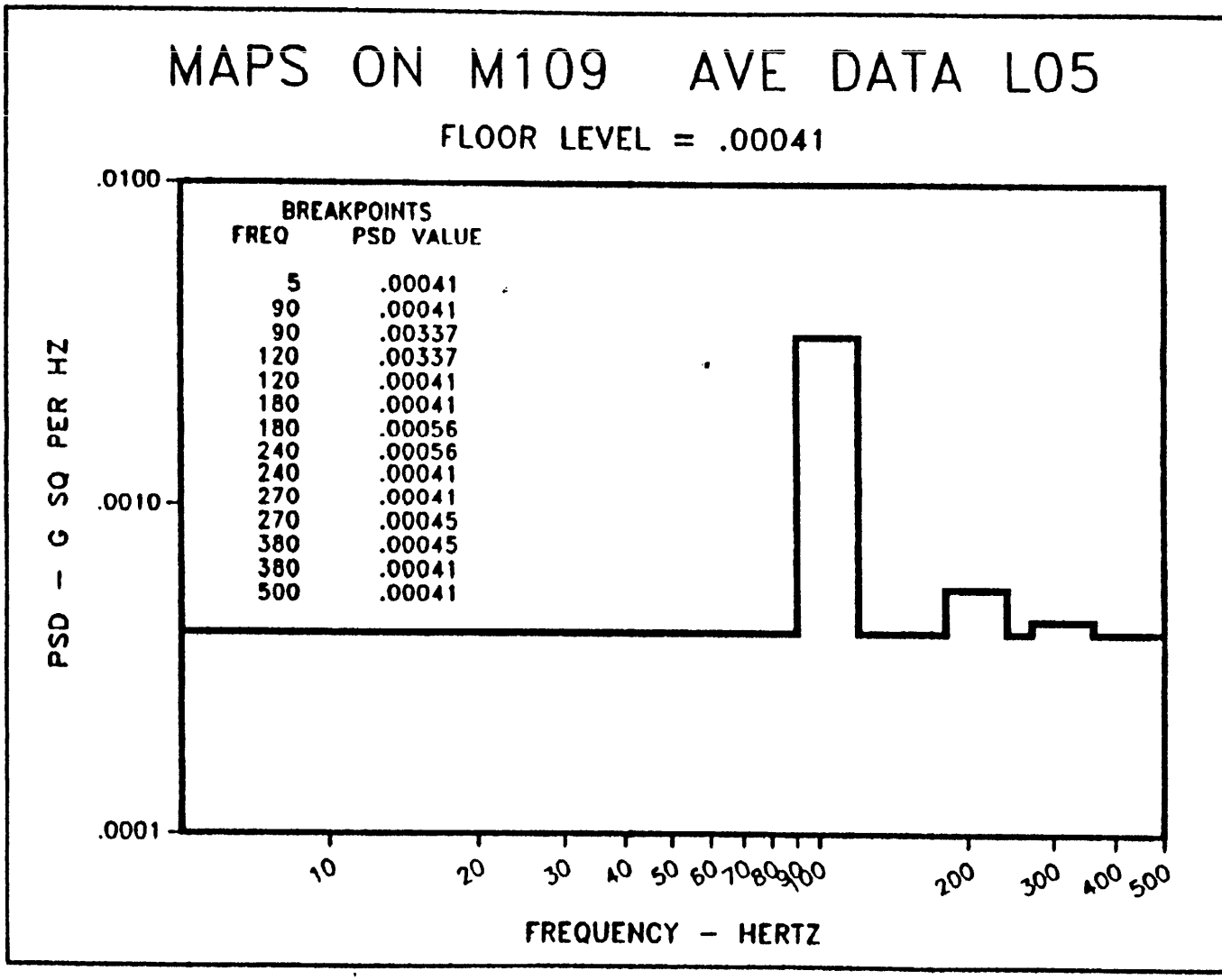
ACCEPTABLE NUMBER OF SWEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
4	1
3	3
2	7
1	18

*** USE 2 SWEEPS AND 7 AVERAGES PER LOOP ***

*** SET CONTROL WINDOW TO 20 DB***

*** PEAK G VALUE EXPECTED: 3 SET CALIBRATION TO 500 MV/G ***



NARROW BAND RANDOM ON RANDOM SWEEP RATE PROGRAM

MAPS ON M109 AVE PHASE L05

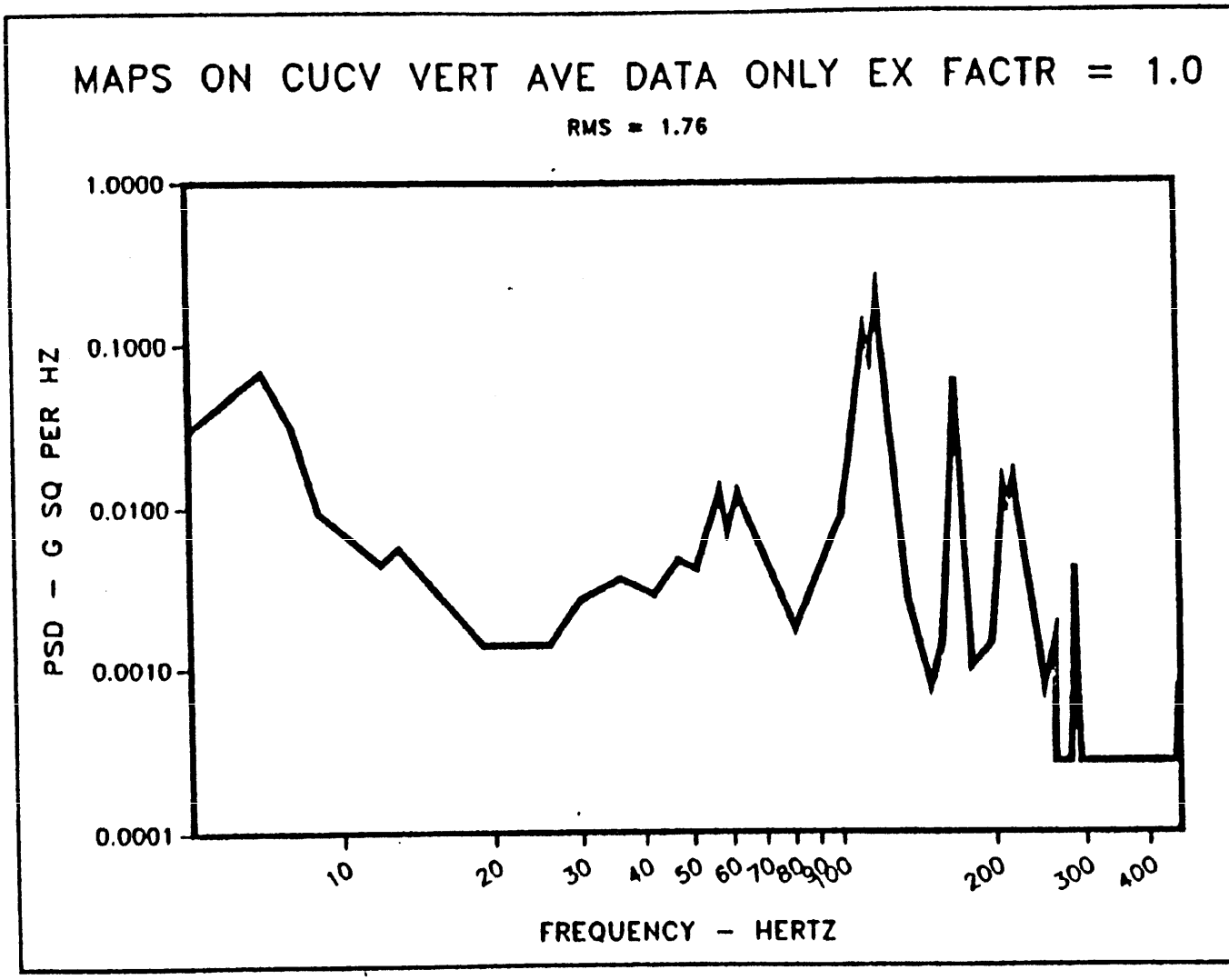
TEST TEST TIME, MINUTES: 12.0 DELTA F, HZ: 1.0 OVERALL RMS, G: .50

START FREQ	END FREQ	BAND WIDTH	PSD VALUE	DB RE FLOOR
90.0	120.0	15.0	.00337	9.1
180.0	240.0	30.0	.00056	1.4
270.0	360.0	45.0	.00045	.4
		FLOOR VALUES		
5.0	500.0	495.0	.00041	

ACCEPTABLE NUMBER OF SWVEEPS AND NUMBER OF AVERAGES PER LOOP

SWEEPS	AVERAGES
1	1

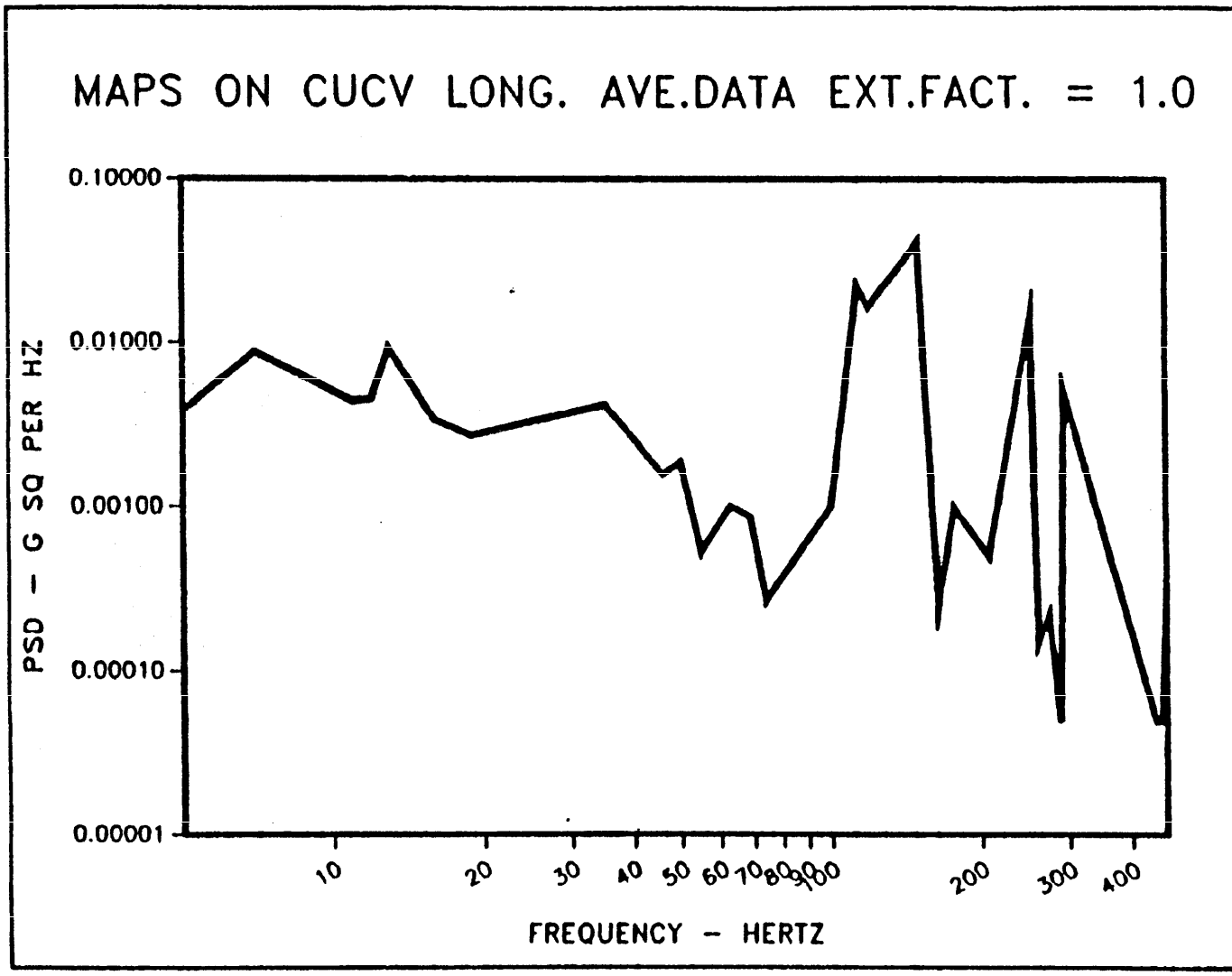
*** SET CONTROL WINDOW TO 20 DB ***
*** PEAK G VALUE EXPECTED: 3 SET CALIBRATION TO 500 MV/G ***



APPENDIX H

MAPS ON CUCV VERT. AVE. DATA EX. FACT.-1.0

0001	39 NUMBER OF BREAK POINTS		
0002	5.00	.02950	FREQUENCY AND AMPLITUDE
0003	7.00	.06699	FREQUENCY AND AMPLITUDE
0004	8.00	.03101	FREQUENCY AND AMPLITUDE
0005	9.00	.00941	FREQUENCY AND AMPLITUDE
0006	12.00	.00446	FREQUENCY AND AMPLITUDE
0007	13.00	.00558	FREQUENCY AND AMPLITUDE
0008	19.00	.00139	FREQUENCY AND AMPLITUDE
0009	26.00	.00139	FREQUENCY AND AMPLITUDE
0010	30.00	.00265	FREQUENCY AND AMPLITUDE
0011	36.00	.00357	FREQUENCY AND AMPLITUDE
0012	42.00	.00285	FREQUENCY AND AMPLITUDE
0013	47.00	.00469	FREQUENCY AND AMPLITUDE
0014	51.00	.00414	FREQUENCY AND AMPLITUDE
0015	57.00	.01236	FREQUENCY AND AMPLITUDE
0016	59.00	.00716	FREQUENCY AND AMPLITUDE
0017	62.00	.01206	FREQUENCY AND AMPLITUDE
0018	80.00	.00174	FREQUENCY AND AMPLITUDE
0019	100.00	.00873	FREQUENCY AND AMPLITUDE
0020	112.00	.11863	FREQUENCY AND AMPLITUDE
0021	115.00	.08378	FREQUENCY AND AMPLITUDE
0022	119.00	.19021	FREQUENCY AND AMPLITUDE
0023	135.00	.00265	FREQUENCY AND AMPLITUDE
0024	149.00	.00078	FREQUENCY AND AMPLITUDE
0025	157.00	.00135	FREQUENCY AND AMPLITUDE
0026	168.00	.06065	FREQUENCY AND AMPLITUDE
0027	180.00	.00103	FREQUENCY AND AMPLITUDE
0028	197.00	.00139	FREQUENCY AND AMPLITUDE
0029	209.00	.01332	FREQUENCY AND AMPLITUDE
0030	213.00	.01065	FREQUENCY AND AMPLITUDE
0031	219.00	.01471	FREQUENCY AND AMPLITUDE
0032	250.00	.00078	FREQUENCY AND AMPLITUDE
0033	262.00	.00142	FREQUENCY AND AMPLITUDE
0034	262.00	.00027	FREQUENCY AND AMPLITUDE
0035	281.00	.00027	FREQUENCY AND AMPLITUDE
0036	287.00	.00425	FREQUENCY AND AMPLITUDE
0037	293.00	.00027	FREQUENCY AND AMPLITUDE
0038	453.00	.00027	FREQUENCY AND AMPLITUDE
0039	457.00	.00078	FREQUENCY AND AMPLITUDE
0040	462.00	.00027	FREQUENCY AND AMPLITUDE
0041	RMS VALUE=1.76		



APPENDIX H

MAPS ON CUCV LONG. AVE. DATA EX.FACT = 1.0

0001	30 NUMBER OF BREAK POINTS		
0002	5.00	.00387	FREQUENCY AND AMPLITUDE
0003	7.00	.00878	FREQUENCY AND AMPLITUDE
0004	11.00	.00449	FREQUENCY AND AMPLITUDE
0005	12.00	.00460	FREQUENCY AND AMPLITUDE
0006	13.00	.00923	FREQUENCY AND AMPLITUDE
0007	16.00	.00342	FREQUENCY AND AMPLITUDE
0008	19.00	.00273	FREQUENCY AND AMPLITUDE
0009	35.00	.00427	FREQUENCY AND AMPLITUDE
0010	46.00	.00158	FREQUENCY AND AMPLITUDE
0011	50.00	.00188	FREQUENCY AND AMPLITUDE
0012	55.00	.00053	FREQUENCY AND AMPLITUDE
0013	63.00	.00101	FREQUENCY AND AMPLITUDE
0014	69.00	.00087	FREQUENCY AND AMPLITUDE
0015	74.00	.00027	FREQUENCY AND AMPLITUDE
0016	100.00	.00099	FREQUENCY AND AMPLITUDE
0017	113.00	.02202	FREQUENCY AND AMPLITUDE
0018	115.00	.01634	FREQUENCY AND AMPLITUDE
0019	119.00	.04099	FREQUENCY AND AMPLITUDE
0020	149.00	.00025	FREQUENCY AND AMPLITUDE
0021	163.00	.00099	FREQUENCY AND AMPLITUDE
0022	176.00	.00050	FREQUENCY AND AMPLITUDE
0023	207.00	.01443	FREQUENCY AND AMPLITUDE
0024	252.00	.00015	FREQUENCY AND AMPLITUDE
0025	260.00	.00022	FREQUENCY AND AMPLITUDE
0026	273.00	.00005	FREQUENCY AND AMPLITUDE
0027	287.00	.00508	FREQUENCY AND AMPLITUDE
0028	293.00	.00005	FREQUENCY AND AMPLITUDE
0029	444.00	.00005	FREQUENCY AND AMPLITUDE
0030	457.00	.00037	FREQUENCY AND AMPLITUDE
0031	466.00	.00005	FREQUENCY AND AMPLITUDE
0032	RMS VALUE = .94		

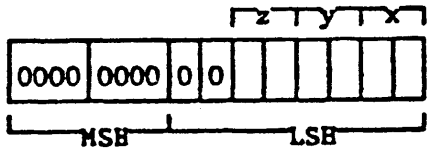
APPENDIX I

DRU CASE COORDINATE FRAME CODES

30.9 DRU Case Coordinate Frame Codes

DRU CASE COORDINATE FRAME CODES

BIT CODE	HEX	CONNECTORS	BOTTOM COVER	MOUNTING SURFACE
0000*	00	Forward	Down	Left
0100	10	Right	Down	Forward
0200	20	Aft	Down	Right
0300	30	Left	Down	Aft
0002	02	Forward	Up	Right
0102	12	Right	Up	Aft
0202	22	Aft	Up	Left
0302	32	Left	Up	Forward
0003	03	Forward	Right	Down
0103	13	Right	Aft	Down
0203	23	Aft	Left	Down
0303	33	Left	Forward	Down
0001	01	Forward	Left	Up
0101	11	Right	Forward	Up
0201	21	Aft	Right	Up
0301	31	Left	Aft	Up
0010	04	Up	Forward	Left
0013	07	Up	Right	Forward
0012	06	Up	Aft	Right
0011	05	Up	Left	Aft
0032	0E	Down	Forward	Right
0033	0F	Down	Right	Aft
0030	0C	Down	Aft	Left
0031	0D	Down	Left	Forward



16-bit code,
LSH used only

- 2 bits are allocated for each axis.

APPENDIX J

DESCRIPTION OF

CONFIGURATION DEFINITIONS

30.10 Configuration Definition Flags

The presence of a "1" in any of the bit positions indicates that the mode or function listed below has been selected/defined for the current installation.

D26 Character	
BIT POSITION	MODE OR CONDITION
7	Orientation 2 Based on Travel lock.
6	Orientation 1 - 2 Based on Pointing Device Pitch/Roll.
5	orientation 2 - 1 Based on Pointing Device Pitch/Roll.
6/3	Orientation 1 - 2 Direction of Traverse.
2/1	Orientation 2 - 1 Direction of Traverse.
0	Orientation 2 Based on Pointing Device Attitude.

D27 Character	
BIT POSITION	MODE OR CONDITION
7	Spare.
6	Spare.
5	spare.
4	spate .
3	Spare.
2	Spare.
1	Spare.
0	Spare.

D28 Character	
BIT POSITION	MODE OR CONDITION
7	Supplier Reserved.
6	Supplier Reserved.
5	Supplier Reserved.
4	Pointing Device Cant/Roll.
3	Extended ALERT DATA.
2	BCU Parameters.
1	Vehicle Cant/Roll.
0	Azimuth.

D29 Character	
BIT POSITION	MODE OR CONDITION
7	Pointing Device Boresight Angles.
6	Vehicle Boresight Angles.
5	Shot Detect.
4	Travel Lock Commands.
3	Travel Lock Discrete.
2	Tracked/Wheeled Vehicle.
1	Spare.
0	Odometer/Exclusive ZUPT mode.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revisio letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

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RECOMMENDED CHANGES	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-D-70789A	92/06/15

3. DOCUMENT TITLE: DYNAMIC REFERENCE UNIT (DRU)

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets if needed.)

5. REASON FOR RECOMMENDATION

[redacted]

6. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code)
U.S ARMY ARDEC STANDARDIZATION OFFICE	(1) Commercial: 201-724-6625 (2) AUTOVON: DSN-880-6625
c. ADDRESS (Include Zip Code) ATTN: SMACA-BAC-S PICATINNY ARSENAL, NJ 07806-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340