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TECHNICAL MANUAL
OPERATIONS AND MAINTENANCE MANUAL

SATELLITE SIGNALS NAVIGATION SETS

AN/PSN-11
NSN 5825-01-374-6643
AND
AN/PSN-11(V)1
NSN 5825-01-395-3513

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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 498 CONSISTING OF THE FOLLOWING:

Page No.	*Change No.	Page No.	*Change No.
Title	0	10-1 - 10-10	0
A	0	11-1	0
i – xvii	0	11-2 Blank	0
xix - xxix	0	12-1	0
xxx Blank	0	12-2 Blank	0
xxxi - xli	0	13-1 - 13-64	0
xlii Blank	0	14-1 - 14-6	0
1-1 – 1-27	0	15-1 - 15-8	0
1-28 Blank	0	A-1 - A-18	0
2-1 - 2-32	0	Glossary 1 - Glossary 11	0
3-1 - 3-140	0	Glossary 12 Blank	0
4-1 - 4-66	0	Index 1 - Index 19	0
5-1	0	Index 20 Blank	0
5-2 Blank	0		
6-1 - 6-5	0		
6-6 Blank	0		
7-1	0		
7-2 Blank	0		
8-1 - 8-23	0		
8-24 Blank	0		
9-1 - 9-12	0		

***Zero in this column indicates an original page.**

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

FOREWORD

1. PURPOSE AND SCOPE.

This manual covers and supports all hardware and software part numbers of satellite signals navigation sets. Refer to the difference data sheet provided in Chapter 15 for a complete breakdown of unit differences. Throughout the manual the satellite signals navigation set is only referred to as the PLGR, unless otherwise noted. The Navigation Sets included in the manual are:

AN/PSN-11, NSN 5825-01-374-6643
AN/PSN-11(V)1, NSN 5825-01-395-3513

2. ARRANGEMENT.

This manual is arranged in the sequence that tasks are most logically performed:

Chapter 1, Introduction; Chapter 2, Keypad Operation; Chapter 3, Pre-Mission Operation; Chapter 4, Mission Operation; Chapter 5, Post-Mission Operation; Chapter 6, Emergency Procedures; Chapter 7, Limitations; Chapter 8, Maintenance; Chapter 9, Army/Maintenance Fielding; Chapter 10, Parts List; Chapter 11, Reprogramming; Chapter 12, Desktop Assistant; Chapter 13, Tutorial; Chapter 14, Installation Drawings; and Chapter 15, Difference Data; Appendix A, Crypto Logic Key Ordering Instructions.

3. LIST OF ABBREVIATIONS.

1PPS	1-Pulse-per-Second
2D	2-dimensional
2D-E	2-dimensional Error
2dRMS	Twice the RMS horizontal error
3D	3-dimensional
3D-E	3-dimensional Error
A-S	Antispoofing
ALC-1	Accounting Legend Code 1
ALM	Almanac
ALRT	Alert
AMARK	Automark
ANCD	Automated Net Control Device
ANCH	Anchor
AVG	Average
AZ	Azimuth
B-ALRT	Buffer Alert
batt	Battery
BIT	Built-in Test
BNG	British National Grid
BRT	Brightness
BZ	Buffer Zone
C	Celsius

C-ALRT	Corridor Alert
C/A or CA	Coarse/Acquisition code
CALC	Calculate
CDD	Complete Discharge Device
CCI	Controlled Crypto, Graphic Items
CD	Code
CDU	Control Display Unit
CEP	Circular Error Probable
CLR	Clear
CN	Carrier-to-Noise
COMSEC	Communications Security
CONT	Continuous
CORR	Corridor
CPIN	Computer Program Identification Number
CRS	Course
CSCI	Computer Software Configuration Item
CV	Cryptovariable
CVD	Crypto Variable Daily
CVW	Crypto Variable Weekly
D	Datum
DEG	Degree
desel	Deselect
DGPS	Differential Global Positioning System

DIR	Direction
DIST	Distance
dm	Degrees, Minutes
DMA	Defense Mapping Agency
dms	Degrees, Minutes, Seconds
DMWR	Depot Maintenance Work Requirement
DOD	Department of Defense
DOP	Dilution of Precision
DOT	Department of Transportation
DS	Direct Support
DTD	Data Transfer Device
DTM	Datum
Dur	Duration
DX	Direct Exchange
e	East
EHE	Estimated Horizontal Error
EL	Elevation
ELA	Elevation Angle
ELD	Elevation Difference
ELev	Elevation
ELH	Elevation Hold
ELhold	Elevation Hold
EPE	Estimated Position Error

err	Error
ERR	Error
ETE	Estimated Time Error
Ext	External
F	Fahrenheit
FOM	of Merit
FRM	From
FT	Feet
GPA	Glide Path Angle
GDOP	Geometric Dilution of Precision
GMT	Greenwich Mean Time
GND	Ground
GPdev	Glide Path Deviation
GPS	Global Positioning System
GS	Ground Speed
GUV	Group Unique Variable
HAZ	Hazard
HDOP	Horizontal Dilution of Precision
HQDA	Headquarters Department of the Army
ID	Identification
INIT	Initialize
I/O	Input/Output
ITMG	Irish Transverse Mercator Grid

JSSMO	Joint Services System Management Office
KEK	Key Encryption Key
KMD	Keyboard Menu Definition
KPH	Kilometers per Hour
KPK	Key Production Key
L/L	Latitude/Longitude
LCD	Liquid Crystal Display
$LiSO_2$	Lithium Sulphur Dioxide
LND	Land
LOC	Location
LRU	Line Replaceable Unit
M	Meter
MSL	Mean Sea Level
m/s	Meters/Second
MAC	Maintenance Allocation Chart
MAG	Magnetic
MAGVAR	Magnetic Variation
MGRS	Military Grid Reference System
mi	Miles
MIL	1/6400th of a circle
Mil-M	Gunner's mils displayed as g symbol
mis	Mission
MMD	Minimum Miss Distance

MOB	Man Overboard
MPH	Miles per Hour
MPS	Mission Planning Software
MRK	Mark
µs	Microseconds
ms	Milliseconds
msf	Minutes Since Fix
MSL	Mean Sea Level
MWO	Modification Work Order
n	North
N	Numeric Control
n/a	Not Applicable
NAV	Navigation
nm	Nautical Miles
NMEA	National Marine Electronics Association
ns	Nanoseconds
NSA	National Security Agency
NSN	National Stock Number
NUM	Numeric
OPS	Operations
P	Page
P-ALRT	Position Alert
PAR	Parity

PC	Personal Computer
PDOP	Position Dilution of Precision
PLGR	Precision Lightweight GPS Receiver
PM	Program Management
PMCS	Preventive Maintenance Checks and Services
PN	Part Number
POS	Position
PPS	Precise Positioning Service
PPS-SM	Precise Positioning Service - Security Module
PTTI	Precise Time and Time Interval
PVT	Position, Velocity, Time
Pwr	Power
RAM	Random Access Memory
RC	Remote Control
RF	Radio Frequency
RHRSL	Rehearsal
RMS	Root Mean Square
RNAV	Area Navigation
RNG	Range
ROM	Read-Only Memory
RPT	Repeat
RST	Reset
RTE	Route

RX	Repairable Exchange
SA/A-S	Selective Availability/Anti-Spoofing
SEL	Select
SEP	Spherical Error Probable
SPD	Speed
SPEC MSG	Special Message
SPS	Standard Positioning Service
SR	Slant Range
SRA	Specialized Repair Activity
Src	Source
ST	Scenario Timer
STBY	Standby
STD	Standard
STR	Steering
SV	Satellite Vehicle
TCTO	Time Compliance Technical Order
TEK	Traffic Encryption Key
TFOM	Time of Merit
TMDE	Test, Measurement, and Diagnostic Equipment
TNG	Training
TRK	Track
TTFF	Time To First Fix
TTG	Time to Go

TTSF	Time To Subsequent Fix
unt	Units
UPS	Universal Polar Stereographic
UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator
VEL	Velocity
VEP	Vertical Error Probable
VIS	Visible
VRT	Vertical
VTA	Vertical Angle
WARCO	Warranty Control Officer
WGS	World Geodetic System
wMM	World Magnetic Model
WP	Waypoint
WPT	Waypoint
XFER	Transfer
XFR	Transfer
XTE	Crosstrack Error
YD	Yards

4. RECOMMENDATIONS.

Recommendations concerning PLGR software updates, safety changes, or to receive a copy of the Pathfinder magazine, you may refer to the PM GPS web site, http://army-gps.robins.af.mil.

AIR FORCE

Recommendations concerning changes to this manual shall be submitted in accordance with TO 00-5-1 using AFTO Form 22 (Technical Order System Publication Improvement Report and Reply). Mail completed form through MAJCOM or equivalent to WR-ALC/LKCB, 460 Richard Ray Blvd, Suite 221, Robins AFB, Georgia 31098-1640.

ARMY

If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), direct to: WR-ALC/LKCB, 460 Richard Ray Blvd, Suite 221, Robins AFB, Georgia 31098-1640. A reply will be furnished to you. PM GPS Web Site; http://army-gps.robins.af.mil/

NAVY

SPAWAR

Recommendations concerning changes to this manual shall be submitted on SPAWAR 4160/1A (10-85) to Commanding Officer, Naval Electronics System Engineering Center Portsmouth, P.O. Box 55, Portsmouth, Virginia 23705-0055, Attention SPAWAR Technical Data Center.

NAVAIR

Recommendations concerning changes to this manual shall be submitted on OPNAV 4790/66, Technical Publications Deficiency Report, per OPNAV Instruction 4790.2.

SAFETY SUMMARY

1. DEFINITIONS.

The following definitions apply to WARNINGS and CAUTIONS found throughout this publication.

WARNING

Conditions, practices, or procedures which must be STRICTLY observed to prevent:

Personal injury
Death
Long-term health hazard

CAUTION

Conditions, practices, or procedures which must be STRICTLY observed to prevent:

Damage to equipment
Destruction to equipment
Failure to accomplish mission

WARNING

Safety steps for victim of electrical shock:

- Do not try to pull or grab the individual.
- If possible, turn off the electrical power
- If you cannot turn off the electrical power, pull, push, or lift the person to safety using a dry wooden pole or a dry rope or some other insulating material.
- Send for help as soon as possible.
- After the injured person is free of contact with the source of electrical shock, move the person a short distance away and immediately start artificial resuscitation.

2. GENERAL SAFETY PRECAUTIONS.

Personnel or equipment hazards cannot always be controlled strictly through the inclusion of a WARNING or a CAUTION. Personnel must think safety first at all times. The following guidance should be observed when using the Satellite Signals Navigation Set AN/PSN-11. For safety precautions for maintenance of electrical/electronic equipment see TB 385-4 (Army), TO 00-25-234 (Air Force), or NAVSEA 0967-LP-000-0199 (Navy). For information on the use, handling, transportation, and disposal of lithium-sulphur dioxide batteries, see 49 CFR, Prt 172-101, TB 43-0130, AFR 71-4/TM38-250/NAVSUP PUB 505/MP0 P4030.19E/DLAM 4145.3.

3. SPECIFIC PRECAUTIONS.

WARNING

- **THE BA-5800/U IS A LITHIUM BATTERY. THE LS6 IS A LITHIUM BATTERY. LITHIUM BATTERIES CAN EXPLODE.** NEVER USE any BA-5800 battery in the AN/PSN-11 when connected to external power. Remove the BA-5800 battery before connecting external power. **EXPLODING LITHIUM BATTERIES CAN KILL OR INJURE YOU.**

- A lithium battery used with your AN/PSN-11 contains pressurized sulfur dioxide gas. The gas is toxic, and the battery MUST NOT be abused in any way that might cause the battery to rupture. Failure to follow these instructions could result in an explosion or production of toxic gases that may kill or injure you.

- DO NOT heat, short circuit, crush, puncture, mutilate, or disassemble batteries.

- DO NOT USE external power such as vehicle power or the AC to DC power adapter while the BA-5800 power battery is installed. The battery may explode causing personal injury and equipment damage.

- DO NOT USE any battery which shows signs of damage. Damage can appear as bulging, disfigurement, a brow liquid in the plastic wrap, etc.

- DO NOT test lithium batteries for capacity.

- DO NOT dispose of lithium batteries with ordinary trash/refuse. Dispose of the old battery(s) in accordance with standard battery disposition procedures. For information on the use, handling, transportation, and disposal of lithium-sulphur dioxide batteries, see 49 CFR, Part 172.101, TB 43-0130, AFR 71-4/TM38-250/NAVSUPPUB 505/ MPO P 4030.19E/DLAM 41453.

- If any of the following conditions exist, IMMEDIATELY TURN OFF the equipment and leave the area. The battery compartment becomes hot to the touch, if you hear hissing or burping (i.e. battery venting), or smell irritating gas (sulfur dioxide). Allow the equipment to cool at least one hour. Remove and replace battery after the equipment has cooled to the touch. If there is a safety incident, or if you believe a safety hazard exists, tell your Safety Office/Officer. Also file a Product Quality Deficiency Report, SF Form 368, and tell the CECOM Safety Office, Ft. Monmouth, NJ at DSN 992-0084 X6447, (732) 532-0084 X 6447, or DSN 992-8824, (732) 532-8824. Failure to follow these instructions could result in an explosion or production of toxic gas, that may kill or injure you.

- DO NOT use a Halon Type fire extinguisher on a lithium battery fire, because rapid cooling of the battery is important. If a fire occurs near a lithium battery, rapid cooling of the battery is important. Flood the equipment with water, or use a carbon dioxide (CO2) extinguisher. Control of the fire and cooling, may prevent the battery from venting and exposing lithium metal. If lithium metal becomes involved in fire, the use of a graphite based Class D fire extinguisher, such as Lith-X or MET-L-X, is recommended Failure to follow these instructions could result in an explosion or production of toxic gas, that may kill or injure you.

- Exposure of the AN/PSN-11 to fire can result in toxic smoke/fumes.

- NAV assumes that the AN/PSN-11 is tracking three or more satellites to determine its position. If less than three satellites are being tracked, present position and nav information are degraded or inaccurate. The AN/PSN-11 shows, on present position and nav displays, the estimated accuracy of the displayed data (either of Merit (FOM), or Estimated Position Error (EPE), or Estimated Horizontal Error (EHE)).

- The zeroize function is used only in emergencies to protect mission sensitive data. The zeroize sequence destroys all data entered into or collected by the AN/PSN-11.

- The AN/PSN-11 is not to be used to navigate through minefields or mined waterways. The AN/PSN-11 is not to be used for the precise recording of mined areas. The AN/PSN-11 can be used for providing general locations of mined areas and for providing approximate boundaries of mined areas.

- The primary operation and employment of the AN/PSN-11 is with crypto keys installed. This provides the Precise Positioning Service (PPS) to the operator. An AN/PSN-11 without crypto keys installed acts like a Standard Positioning Service (SPS) receiver. It cannot compensate for Selective Availability (SA) and Anti-spoofing (A-S). No matter what the political conditions are, the National Command Authorities can raise the level of the SA errors at anytime. This can be done without prior notification.

- Clearing a waypoint will also clear any routes that contain that waypoint.

- Unless a DoD waiver is obtained, SPS receivers are not to be used for combat operations. These receivers are affected by the intentional SA errors. You have no protection from a spoofing threat. SPS receivers should not be used for target computation and personal position location in fire support operations. SPS receivers cannot be relied on for elevation/altitude information. You are subject to the errors of SA.

- Without Crypto Keys, you cannot compensate for selective availability errors. You cannot read the encrypted signals. You have no protection against spoofing. Your receiver still operates but cannot be used for combat operations.

- When connecting to vehicle power, the negative wire from the AN/PSN-11. External Power cable **MUST** be connected to the negative terminal of the vehicle battery which is **GROUNDED** or the memory battery in the AN/PSN-11 may explode causing bodily injury and equipment damage.

- DO NOT USE external power such as vehicle power or the AC to DC power adapter while the BA-5800 power battery is installed. The battery may explode causing personal injury and equipment damage.

- The AN/PSN-11 contains a lithium memory battery and may also contain lithium prime batteries. Incorrect handling may result in death or personal injury. Handle in accordance with the instructions in the warnings in this Safety Summary.

CAUTION

- *CRYPTO* is a menu option that is displayed only when the AN/PSN-11 is loaded with crypto keys. If *CRYPTO* is not displayed, the AN/PSN-11 functions as an SPS receiver. SPS receivers are not for combat operations. These receivers are affected by the intentional SA errors. You have no protection from a spoofing threat. Not having *CRYPTO* loaded could result in mission failure.

- The zeroize function is to be used in emergencies to protect mission sensitive data. The zeroize destroys all data that is entered into or collected by the AN/PSN-11. Failure to zeroize could compromise future missions.

- The AN/PSN-11 uses more power with the backlighting on. This affects battery life.

- Turning off or removing external power with a power battery installed, alerts the user that external power is lost. Failure to turn off the AN/PSN-11 could result in power battery discharge if unit is left unattended.

- The PPS-SM does NOT protect classified waypoints. When classified waypoints are stored in the AN/PSN-11, the AN/PSN-11 is classified at the same level as the waypoints.

- When using the waypoint *ENTER* or *EDIT* page, a *datum* may be selected that differs from the *datum* entered in the *MENU SETUP* page. To reduce the potential of significant positional errors, do not navigate between two waypoints with *different datums*. Do not measure range or azimuth between two waypoints with different datums.

- The AN/PSN-11 antenna requires a clear field of view (line-of-sight) to the sky, so that satellite acquisition and tracking can occur. If the antenna is *masked* (the inability of the AN/PSN-11 to receive the satellite signals) from the sky while in an operating mode (*CONT*, *FIX AVG*, or *TIME*), it may enter a '*Wide Window Search*' mode. This happens because the AN/PSN-11 does not receive the satellite signals it expects. In the mode, the AN/PSN-11 tries to find other satellites that are not yet visible.

- If the antenna masking is resolved, the AN/PSN-11 continues in the "*Wide Window Search*" mode, looking for the satellites that are not present. To return the AN/PSN-11 to normal operation, see sub-paragraph 4.4.9 for Low Signal (Dense Foliage) Use or sub-paragraph 6.1.2.4 for Under Cover (Antenna Masking). You can also Turn the AN/PSN-11 *Off*, the back *ON* to return to normal operation. Allow time for *TTFF* prior to mission use.

- Always check position, position error, datum, current crypto key, and current almanac before beginning a mission.

- **DO NOT** move the AN/PSN-11 while surveying; accuracy will be degraded.
- To reduce the potential of significant errors, **NEVER** measure range, slant range, azimuth, elevation angle, or elevation to target with a *datum* that differs from your *position datum*.
- To ensure proper AN/PSN-11 operation when installing or replacing both the power and memory batteries, ensure the power battery is installed or replaced prior to the memory battery.
- To prevent equipment damage, use only an LS 6 lithium thionyl chloride battery or approved equivalent.
- After the initial *Low primary battery* WARNING, continued operation of the AN/PSN-11 cannot be reliably predicted. Replace the power battery at the earliest possible opportunity.
- **DO NOT** store unused equipment with power batteries installed. Doing so could result in equipment damage.
- To prevent damage to equipment, **DO NOT** mix AA battery types. AA battery types of different chemistry are not compatible. **DO NOT** mix fresh batteries with partially used batteries. During battery replacement, all batteries in the holder must be replaced.

- Even though the memory battery appears to be the same as the AA power batteries, it is not. The voltage of the AA power batteries is not high enough for it to serve as a memory battery. Placing AA power batteries in the AN/PSN-11 for memory batteries could damage the unit or cause the unit to be inoperable.

- The AN/PSN-11 **MUST** have a live main power source (battery or external) connected while replacing the memory battery or all memory will be lost.

- Failure to observe correct polarity of the external power cable may result in damage to the AN/PSN-11.

- Continuous power on and power off of the AN/PSN-11 via vehicle power when using the external power cable (and NO power battery installed), may significantly reduce memory battery life.

- The AN/PSN-11 memory contents will be lost if the memory battery cap is removed when there are no prime batteries installed or it is not connected to external power.

CHAPTER 1

INTRODUCTION

1.1 GLOBAL POSITIONING SYSTEM (GPS) OVERVIEW.

The Global Positioning System (GPS) is a space-based navigation and timing system. GPS provides highly accurate, continuous, all weather, 3-dimensional (3D) position, velocity, and time (PVT) data. A constellation of satellites broadcasts precise signals for use by navigation (nav) sets. The nav sets receive the signals and compute 3D PVT data. To better understand operating the equipment, you must understand some basic GPS concepts.

1.1.1 Global Positioning System Structure. Refer to Figure 1-1. GPS consists of Satellites; Ground Control System; and nav sets installed in ships, vehicles, aircraft, and carried by personnel.

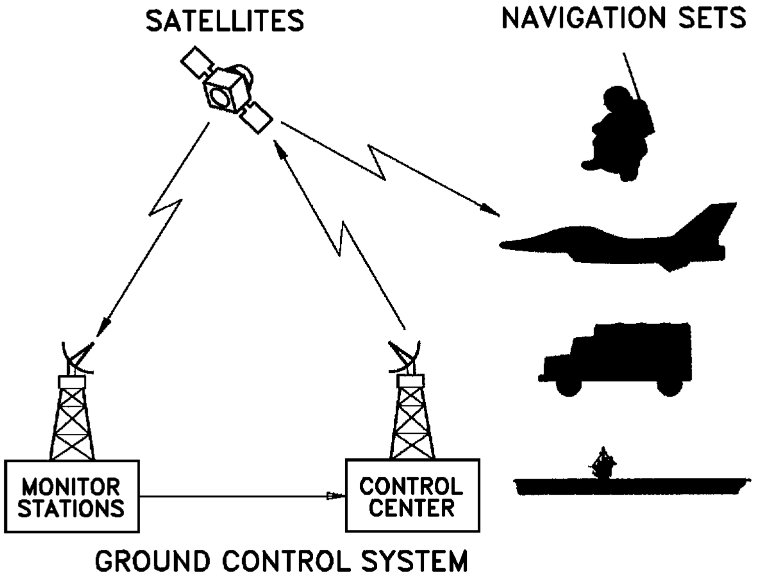


Figure 1-1 NAVSTAR Global Positioning System.

1.1.1.1 **Satellites.** The GPS satellites provide nav data to the nav set. The satellites are arranged in six rings that orbit the earth twice a day. This arrangement provides worldwide, continuous coverage. Each satellite broadcasts two spread-spectrum radio frequency (RF) signals. Each signal is modulated with a unique code sequence and a nav data message. The code sequence allows the nav set to identify each satellite. The nav data message provides the nav set information about the operation of the satellite.

1.1.1.2 **Ground Control System.** The ground control system tracks the satellites, checks and controls satellite orbits, and updates the satellite nav data message. The ground control system consists of monitor stations and a control center. Monitor stations are unmanned stations located throughout the world. They use special GPS receivers to track each satellite. The tracking information is sent to the control center. The control center uses the tracking information to calculate precise satellite position and satellite clock error for each satellite. This data is called ephemeris data. The control center calculates satellite position for all satellites, called almanac data. Once each 24 hours, the control center sends the ephemeris and almanac data to each satellite. This updates the nav data message.

1.1.1.3 Navigation Set. Nav set receives and decodes RF signals from satellites. The information is used to calculate a 3D position, 3D velocity, and exact time data. The nav set measures the time the signals take to travel from the satellite to the nav set. By multiplying travel time by the speed of light, the nav set determines the exact distance to each satellite. By calculating the distance to four satellites, an exact 3D position is calculated. The nav set calculates speed by measuring the rate of change of the RF signals.

1.1.2 GPS Basic Operating Concepts. This section will explain the actual signal structure that the GPS satellites use to determine a user's position, basic sources of error, and real world accuracies.

1.1.2.1 Satellite Signal Structure and Navigation Data Message.
Refer to Figure 1-2 for a diagram of the satellite signal structure. The GPS satellites transmit radio signals via spread-spectrum techniques on two frequencies known as Link 1 (L1) RF and Link 2 (L2) RF.

1.1.2.1.1 RF Signal. The L1 signal is centered at 1575.42 MHz. It is modulated by a precision code (P-code) modulated over 20.46MHz and a coarse/acquisition (C/A-code) modulated over 2.046 MHz. While more difficult to acquire, the P-code allows for greater accuracy. The L2 signal is centered at 1227.6 MHz. It is modulated by the P-code only.

1.1.2.1.2 NAV Message. The NAV message is transmitted from the GPS satellites superimposed on both the P-code and the C/A-code signals. The NAV message contains GPS system time of transmission, a hand-over-word (HOW) for the transition from C/A to P-code tracking, ephemeris (orbital position data), clock data, and almanac data. Almanac data is information about all the satellites in the GPS constellation.

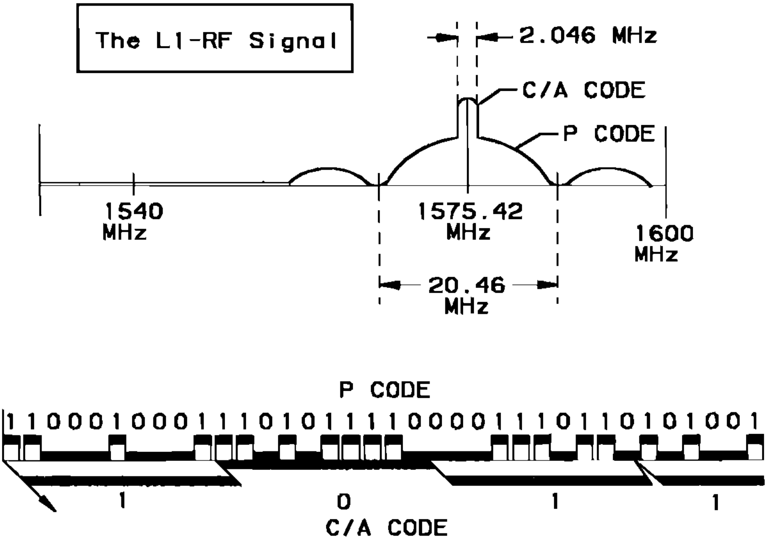


Figure 1-2 Satellite Signal Structure.

1.1.2.2 Satellite Signal Acquisition. During operation, the nav set collects and stores the satellite almanac data in a critical memory. The almanac data is normally available when the nav set is first turned on. This provides information about location of the satellites. Operators input information about the nav set position, time, and velocity to help the set find satellites. With this information, the nav set determines the satellites available and searches for the code sequence that identifies them. When the C/A code of the satellite is identified, the nav set switches to the more accurate P code, collects the nav data message, and updates the critical memory.

1.1.2.3 Satellite Ranging. GPS nav is based on the principle of satellite ranging. Satellite ranging involves measuring the time it takes the satellite signal to travel from the satellite to the nav set. By multiplying the travel time by the speed of light, the distance between a satellite and the nav set is known. By ranging to three satellites using altitude hold, a 3D position is determined. Without altitude hold, four satellites are required to determine 3D position. See Figure 1-3. The distance measurement to each satellite results in a sphere representing the distance of the nav set to the satellite. The point where the spheres intersect (X) is the position of the nav set. This explanation does not account for any errors. For satellite ranging to accurately provide position data, compensation is provided for the following three sources of error: satellite position and satellite clock error, atmospheric delay of satellite signals and nav set clock error.

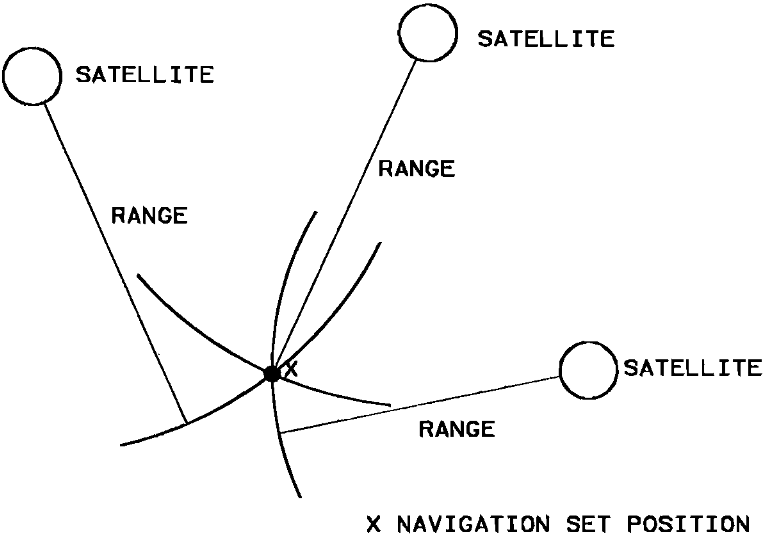


Figure 1-3 Satellite Ranging.

1.1.2.3.1 Satellite Position and Satellite Clock Error. Each satellite follows a known orbit around the earth. It also contains a precise clock that times the transmission of satellite signals. The monitor stations closely track the satellites to detect any errors in the orbits or clock. Corrections for errors are sent to the satellite every 24 hours as ephemeris and almanac data. The ephemeris data contains specific position and clock correction data for each satellite. The almanac data contains satellite position data for all satellites. The nav set receives the ephemeris and almanac data from the satellites and compensates for the position and clock errors when calculating the nav data.

1.1.2.3.2 Atmospheric Delay of Satellite Signals. Two types of atmospheric delays affect accuracy. The first is tropospheric delay. Tropospheric delay is predicted and the prediction included in the almanac data. After collecting the almanac data, the nav set removes the predicted delay from the satellite signal measurements. The second type of atmospheric delay is caused by the ionosphere. The error occurs because the ionosphere is thicker in some areas. Satellite signals received from nearer the horizon also pass through more of the ionosphere than those received from overhead. This delay is calculated by the nav set based on the position of the satellite relative to the horizon.

1.1.2.3.3 Navigation Set Clock Error. Refer to Figure 1-4 for a diagram of nav set clock error. The nav set determines distance to a satellite by measuring the time difference between signal transmission and signal reception. The time of signal transmission is derived from the satellite code sequence and satellite nav data. The time of satellite signal reception is derived from the nav set clock. When the nav set clock is not in sync with the satellite clock, the time measurement is not accurate. The error is compounded by the distance calculation so the position of the nav set is not accurately defined. The fourth satellite provides the additional measurement data needed for the nav set to calculate the clock error common to all distance measurements. The clock error is removed from the distance measurements, and the correct nav set position is found.

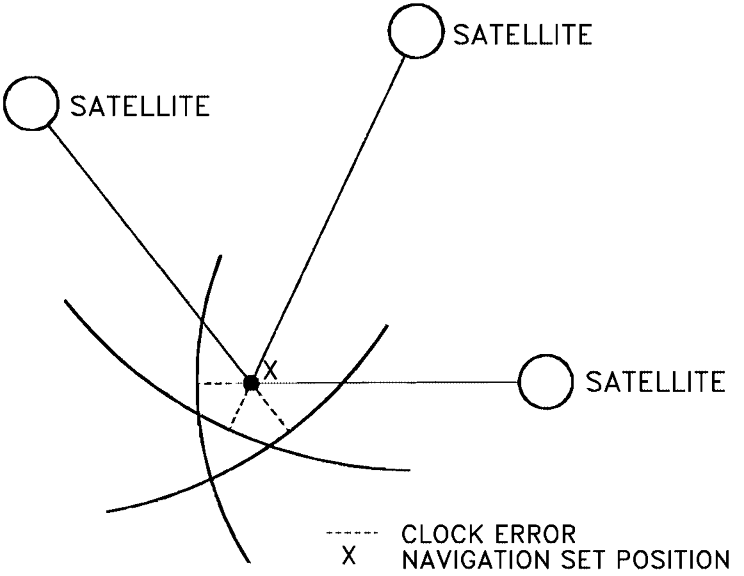


Figure 1-4 Navigation Set Clock Error.

1.1.3 Two Categories of GPS Service. There are two basic categories of GPS services: precise positioning service (PPS), and standard positioning service (SPS).

1.1.3.1 Precise Positioning Service (PPS). PPS was intended primarily for military purposes and the DoD determines authorization for its use. PPS access is controlled by two features using cryptographic techniques.

a. **Selective Availability (SA)** feature can be used to reduce the GPS accuracy by inserting controlled errors into the satellite signals. Currently the SA feature is deactivated.

b. **Anti-Spoofing (A-S)** techniques are used to protect authorized users from hostile attempts to imitate the GPS signals. A-S is an encrypted signal from the satellites that can only be read by PPS receivers. SPS receivers are not capable of using A-S. The PLGR, with valid crypto keys loaded and verified, reads this encrypted signal and operates in a spoofing environment.

1.1.3.1.1 Encryption Keys. Encryption keys and techniques are provided to authorized PPS users to remove the effects of SA and A-S, thereby allowing the maximum available accuracy of GPS. Only users who have crypto keys to decode this information get the PPS accuracies. U.S. Government agencies and some allies are authorized to have the crypto keys. A nav set with valid crypto keys loaded and verified is a PPS receiver.

1.1.3.2 Standard Positioning Service (SPS). SPS is intended primarily for civilian purposes. SPS receivers use GPS information broadcast in the clear and is available to anyone in the world. SPS receivers are for civil use. A PLGR without crypto keys acts like an SPS receiver.

1.2 PLGR DEFINITION.

The AN/PSN-11 Precision Lightweight GPS Receiver is a highly accurate Satellite Signals Navigation Set (hereafter referred to as PLGR). The PLGR computes accurate position coordinates, elevation, speed, and time information from signals transmitted by the GPS satellites. The PLGR selects satellites that are 10 degrees or more above the horizon (elevation angle) during initial acquisition. If less than four satellites are available at 10 degrees or more, and elevation angle of 0 degree is used for acquisition. The PLGR is operated stand-alone using prime battery power and integral antenna. It can also be used with an external power source and external antenna. Features of the PLGR include:

Continuous tracking of up to five satellites
Course/Acquisition (C/A), Precise (P), and Encrypted P (Y) code capability
One-handed operation
Backlit display and keyboard for night operation
Operates in all weather, day or night
Produces no signal that can reveal your position
Automatically tests itself during operation
Stores up to 999 waypoints
Stores up to 15 routes with up to 25 legs per route
Is sealed against dust and water to a depth of one meter
Compatible with night-vision goggles

WARNING

Exposure of the PLGR to fire can result in toxic smoke/ fumes.

1.3 PHYSICAL DESCRIPTION.

The PLGR is less that 9.5 inches long, 4.1 inches wide, and 2.6 inches deep. The PLGR weighs 2.75 pounds with all batteries in place. The durable plastic case is sealed for all weather use. The PLGR features make it easy to use. Refer to Figure 1-5 to identify physical features of the PLGR.

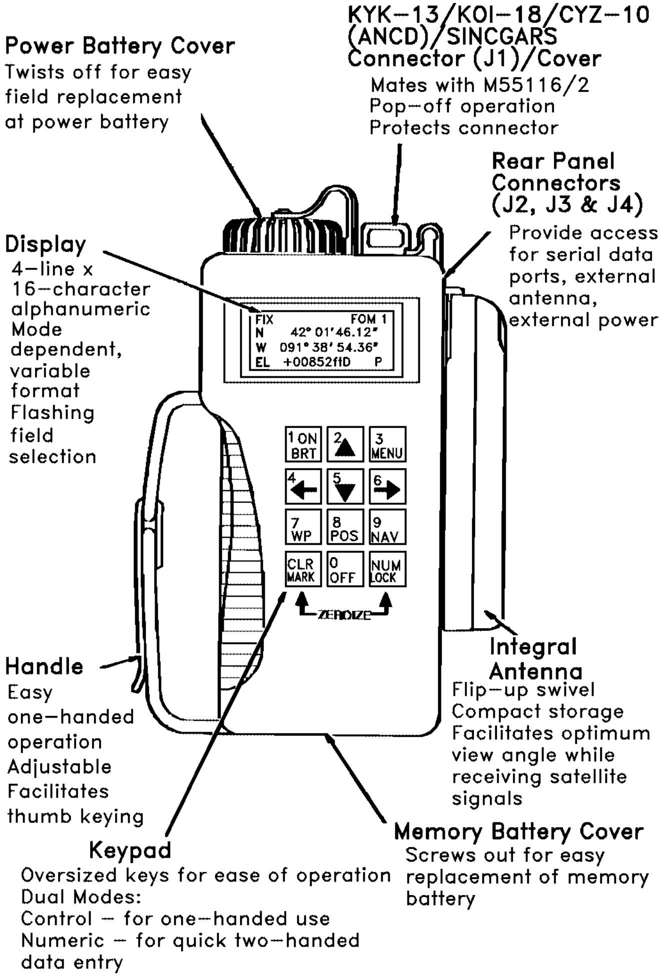


Figure 1-5 PLGR Physical Features.

1.3.1 Panel Connectors/Covers. Connector J1 with pop-off cover is located on the top right side of the PLGR. Connectors J2, J3, and J4 with pop-off covers are located on the rear panel of the PLGR. Figure 1-6 identifies external connectors J1 through J4.

J1 provides:
Connection for KYK-13/KOI-18/CYZ-10 Automated Net Control Device (ANCD)
SINCGARS Time Fill Data

J2 provides:
RS-232 compatible 2-way serial port
RS-422 compatible 2-way serial port
One-pulse-per-second (1PPS) input and output
Remote OFF signal
HAVE QUICK output (per ICD-GPS-060 and SS110990
NMEA 0183 interface (output only)
External reprogramming capability

J3 provides:
External helmet antenna (HA) input
External remote antenna (RA) input
External aircraft (A/C) antenna input

J4 provides:
External DC power input

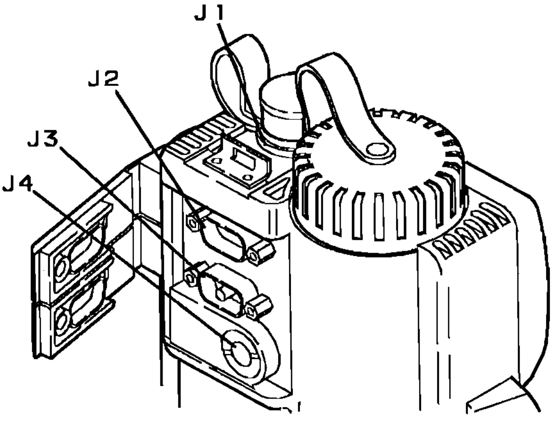


Figure 1-6 PLGR Connectors.

1.4 CHARACTERISTICS.

1.4.1 Elevation Limits. The PLGR operates at elevations from -1312 to +29,856 feet (ft) (-400 to +9100 meters (m)) Mean Sea Level (MSL). The PLGR is stored at elevations from -1312 to +49,213 ft (-400 to +15,000m) MSL. The maximum rate of elevation change for operation is 25 feet/second (7.62 meters/second) ascending or descending.

1.4.2 Temperature Limits. The PLGR operates at temperatures from -4 to +158 Fahrenheit (F) (-20 to +70 Celsius (C)). The PLGR is stored (without batteries) at temperatures from -76.2 to +158F (-57 to +70 C).

1.4.3 Humidity Limits. The PLGR operates in 0 to 100% relative humidity.

1.4.4 Accuracy. The PLGR (with crypto keys installed) provides position, velocity, and time accuracies better than the worst case levels described in Table 1-1.

1.4.5 Error Estimation. The PLGR shows the amount of error that can exist when satellites are being tracked. For position error this is called Figure of Merit (FOM). For time error this is called Time Figure of Merit (TFOM). FOM and TFOM are a representation of the PLGR status including PLGR state; nav mode; Position Dilution of Precision (PDOP) or Horizontal Dilution of Precision (HDOP); degradation due to Selective Availability (SA) exclusion (using user range accuracy index); and availability of Universal Time Coordinated (UTC) offset data (TFOM only).

1.4.6 Satellite Selection. The PLGR selects satellites that are 10 degrees or more above the horizon (elevation angle) during initial acquisition. If less than four satellites are available at 10 degrees or more, an elevation angle of 0 degree is used for acquisition. After acquisition (normal tracking), satellites with an elevation angle of 0.5 degree or more are selected (if less than four are available at 10 degrees or more).

NOTE

The electrical, environmental, and physical characteristics of the PLGR are listed in Table 1-1.

Table 1-1 PLGR Worst Case Accuracies .

Parameter	Stationary Mode	Constant Acceleration	Handheld	Surface Vehicle	Aircraft
Maximum velocity (kph)	0	36	36	90	999
3D (SEP) Position Error (m)	16	16	16	16	18
2D (2dRMS) Position Error (m)	21	21	21	21	25

Table 1-1 PLGR Worst Case Accuracies - Continued.

Parameter	Stationary Mode	Constant Acceleration	Handheld	Surface Vehicle	Aircraft
Horizontal (CEP) Position Error (m)	10	10	10	10	12
Vertical (VEP) Position Error (m)	10	10	10	10	12
3D (RMS) Velocity Error (kph)	n/a	0.72	1.8	7.2	72
Time Mark 1PPS Error (ns)	100	100	100	100	100
HAVE QUICK Time Error (µs)	10	10	10	10	10
SINCGARS (ms)	50	50	50	50	50

WARNING

When connected to vehicle power, the negative wire from the PLGR External Power Cable MUST be connected to the negative terminal of the vehicle battery which is grounded or the memory battery in the PLGR may explode and cause bodily harm and equipment damage.

CAUTION

Failure to observe correct polarity of the external power cable may result in damage to the PLGR. Continuous power on and power off of the PLGR via vehicle power when using the external power cable (and NO power battery installed), may significantly reduce memory battery life.

1.5 AUXILIARY EQUIPMENT.

Auxiliary equipment is available for vehicular mounting, external power input, battery charging, transport, and external antenna use.

1.5.1 External Power Adapter and External Power Cable. The external power adapter connects the PLGR to a 110/220 volt ac power source via an ac to dc power converter. The external power cable connects the PLGR to an external dc power source. The source end of the cable has lugs installed. An in-line fuse holder (2A fuse) is installed in the positive lead. The internal power adapter conditions the external power to supply charging power for NiCad battery (if installed). The external power adapter and external power cable are shown in Figure 1-7. The external power cable is also shown connected to a PLGR in Figure 1-10.

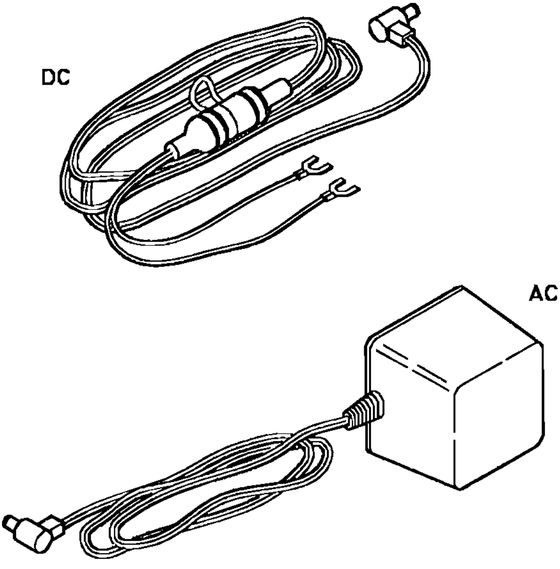


Figure 1-7 External Power Adapter and Cable.

1.5.1.1 External Power Cable Installation. The PLGR external power cable can reduce battery costs, but it must be installed properly to avoid damage to the PLGR or injury to the operator. The proper connection for the PLGR external power cable is shown in option A or B in Figure 1-8.

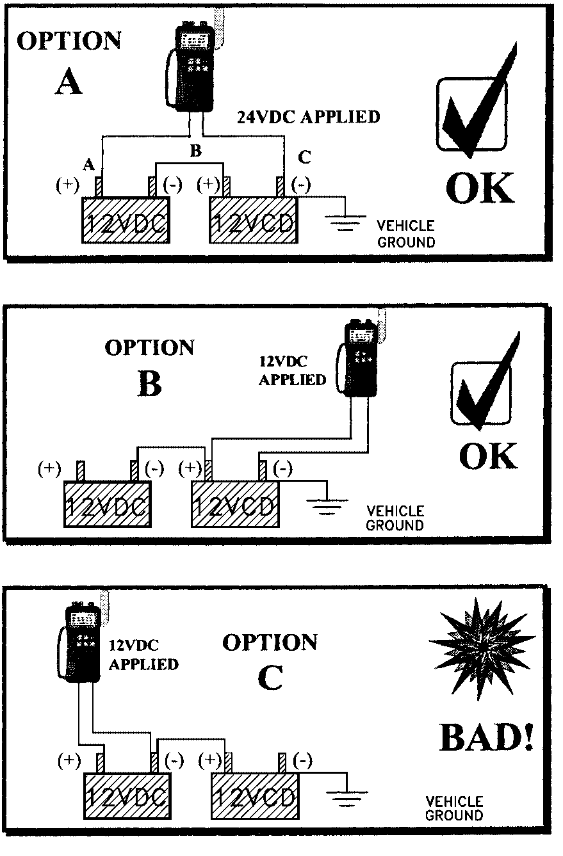


Figure 1-8 Proper Connection for External Power Cable.

NOTE

Take care not to reverse the polarity when wiring the cable to the vehicle power source.

1.5.1.2 The PLGR power cable can be installed to any host vehicle power source ranging from 9 to 32 volt dc (vdc) power. The wire with the in-line fuse is always the positive or “hot” wire. Reversing the wires may damage your PLGR and blow the in-line fuse.

1.5.1.3 The PLGR ground must be the same as the vehicle ground. Refer to the steps below before you install the PLGR external power cable.

WARNING

Not following these instructions can result in a hardware failure inside the PLGR that will cause the 3.6 vdc memory battery to receive a charge from the host vehicle battery and explode if the memory cap touches a grounded metal object while attached to vehicle power.

a. Remove the BA-5800 battery from the PLGR before applying external power.

b. Attach the grounding wire to the battery post and not to the vehicle body for grounding.

c. If you shorten the Vehicle Power Assembly (VPA) cable, be sure to retain the in-line fuse as it protects the PLGR electronics from damage from reverse polarity and power surges.

d. When you remove the PLGR from the vehicle mount, please secure the loose end of the external power cable so it does not swing loose.

1.5.2 PLGR To PLGR Cable. The 1-meter PLGR to PLGR cable provides the data transfer path between two units. Transfer data includes setups, waypoints, routes, time and satellite data. The cable is shown connecting two PLGR's in Figure 1-9.

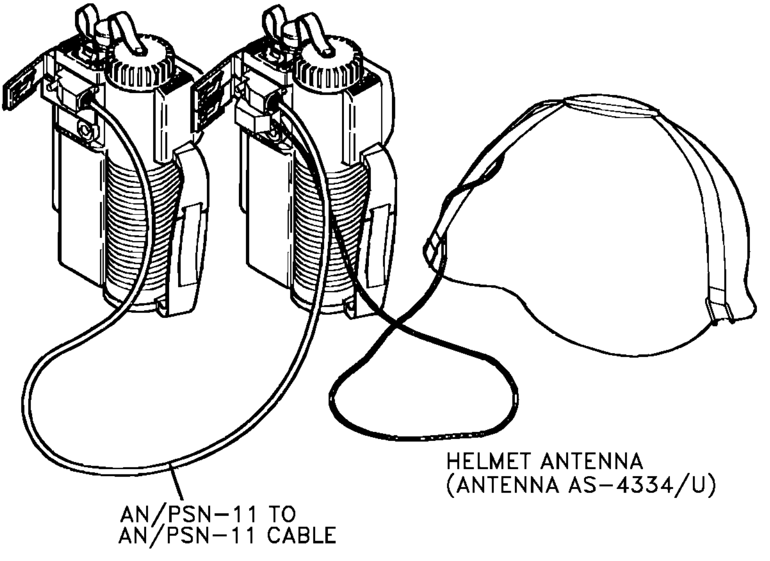


Figure 1-9 Helmet Antenna and PLGR to PLGR Cable.

1.5.3 External Antennas. Three external antennas are available for the PLGR: Remote Antenna (RA), Helmet Antenna (HA), and Aircraft Antenna (A/C). The RA is for vehicular use. It has a 5 meter cable, and is mounted by the built-in magnet. It can be secured with one bolt to its center. The HA is for helmet mounting. It has a 1.5 meter cable. The A/C antenna is for aircraft use. It can be mounted to an aircraft surface with four bolts. All three antennas mate with PLGR rear panel connector J3. The HA is shown connected to a PLGR in Figure 1-9 (remote antenna is the same, except cable length and cable to antenna connection). The RA and A/C antenna are shown in Figure 1-10.

1.5.4 PLGR To Personal Computer (PC) Cable. The PLGR to Personal Computer (PC) cable provides the data transfer path between a PLGR and PC. It is a 1.5 meter cable. Transfer data includes remote control, setups, waypoints, routes, initialization data, and satellite data. The cable is shown connected to a PLGR in Figure 1-10.

1.5.5 PLGR To HAVE QUICK Cable. The PLGR to HAVE QUICK cable provides for data output to HAVE QUICK compatible device. It is a 3 meter cable. The cable is shown connected to a PLGR in Figure 1-10. The HAVE QUICK end of the cable has stripped and tinned wires for these signals:

PLGR out to HAVE QUICK Out - Brown wire
PLGR Signal Ground to HAVE QUICK Signal Ground - Black wire
PLGR Shielded Ground to HAVE QUICK Chassis Ground

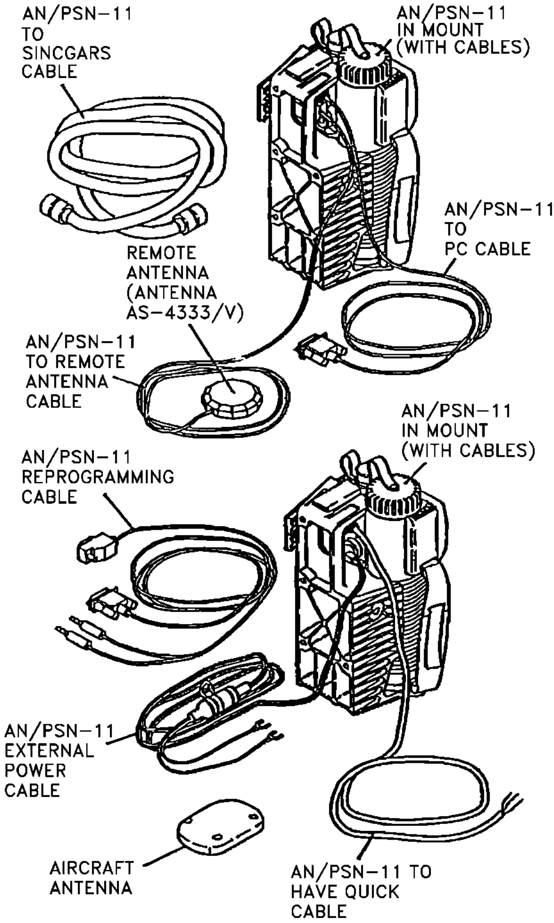


Figure 1-10 PLGR, Mount, Remote Antenna, Aircraft Antenna, and Cables.

NOTE

Two additional PLGR to SINCGARS cables are available (not shown). These cables are the 0.3 meter W4 cable and the 0.6 meter ANCD cable listed in Table 9-4, (Additional Authorization List). They are fielded with each SINCGARS radio.

1.5.6 <u>PLGR To SINCGARS Cable.</u> The PLGR to SINCGARS cable provides for SINCGARS Time Fill data input to a SINCGARS compatible device. It is a 3 meter cable. The cable is shown in Figure 1-10.

1.5.7 <u>PLGR Reprogramming Cable.</u> This cable is similar to a PLGR to Desktop Assistance Software (DAS) cable, except that it is 3 meters long. In addition, it has a pendant cable that connects; to a reprogramming 12±0.5 Vdc (stable) power source.

NOTE

One additional PLGR Reprogramming cable and a required power supply is available (not shown). The cable and power supply are listed in Table 9-4, (Additional Authorization List) and Chapter 10 (Parts List).

1.5.8 <u>Mount.</u> The mount for the PLGR is used in vehicle installations. The PLGR is installed by itself, with external power or RA, or both. The PLGR and attached accessories are secured in the mount. A PLGR is installed in a mount in Figure 1-10.

1.5.9 <u>Personnel Case.</u> The personnel case is used to protect and carry the PLGR and accessories. It has pockets for a spare battery, PLGR to PLGR cable, and Quick Reference Guide. It has two belt clips and a neck/shoulder strap. The personnel case is shown in Figure 1-11.

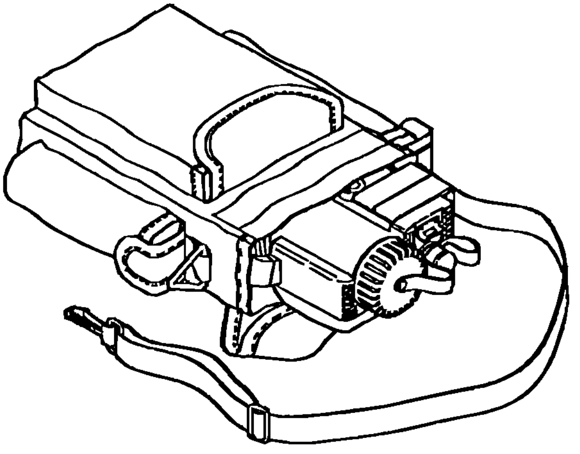


Figure 1-11 Personnel Case.

WARNING

DO NOT USE external power such as vehicle power or the AC to DC power adapter while the BA-5800 power battery is installed. The battery may explode causing personal injury and equipment damage.

CAUTION

To prevent damage to equipment, DO NOT mix AA battery types. AA battery types of different chemistry are not compatible. DO NOT mix fresh batteries with partially used batteries. During battery replacement, all batteries in the holder must be replaced.

1.6 BATTERIES.

The PLGR uses either an external input or its internal battery for primary power. Several battery types can be used as listed in Table 1-2. A battery holder is used with the AA type batteries. Power batteries are not included with the PLGR. The power batteries are shown in Figure 1-12.

WARNING

The BA-5800/U is the only authorized lithium power battery.

1.6.1 Memory Battery. A memory battery is used to maintain power to critical memory circuits when primary power has been removed. Data saved includes waypoint, crypto key, setup, and satellite information. The LS14500 lithium battery is used as the memory battery (memory battery is 3.6 V dc, AA size). The memory battery is replaced as a maintenance action annually.

1.6.2 Battery Life. Table 1-3 contains the minimum battery life estimates for the three power battery types. The estimates are for continuous satellite tracking at room temperature (71°F, 20°C) without backlighting. Time left may vary due to temperature sensing, current draw, and mode used by the PLGR. Because of this it is not unusual to get estimates less than shown in Table 1-3 for a new battery.

Table 1-2 PLGR Batteries .

Battery type	Nomenclature
Lithium (nonrechargeable)	BA-5800/U
Nickel Cadmium (rechargeable)	Rockwell 221-0134-020
AA-alkaline (8)* (nonrechargeable)	WB101
AA-lithium (8)* (nonrechargeable)	L91
Lithium (nonrechargeable) (memory battery)	LS14500 6135-01-301-8776
*Used with - Battery holder (Rockwell # 221-0135-020) for 8 AA.	

Table 1-3 PLGR Battery Life .

Minimum battery life (CONT mode, at 71°F) (0% Backlight)		
Battery type	CSCI number (Software loaded)	
	613-9854-XXX	613-9544-XXX
BA-5800/U	10 hours (15 hours typical)	20 hours (25 hours typical)
Rockwell NiCad (#221-0134-020)	2.5 hours	4.7 hours
EightWB101 (AA Alkaline)	4.2 hours	8.0 hours

Table 1-3 PLGR Battery Life - Continued.

Minimum battery life (CONT mode, at 71°F) (0% Backlight)		
Eight L-91 (AA Lithium)	7.0 hours	13.0 hours
LS14500 (#6135-01-301-8776)	1 year (change annually)	1 year (change annually)

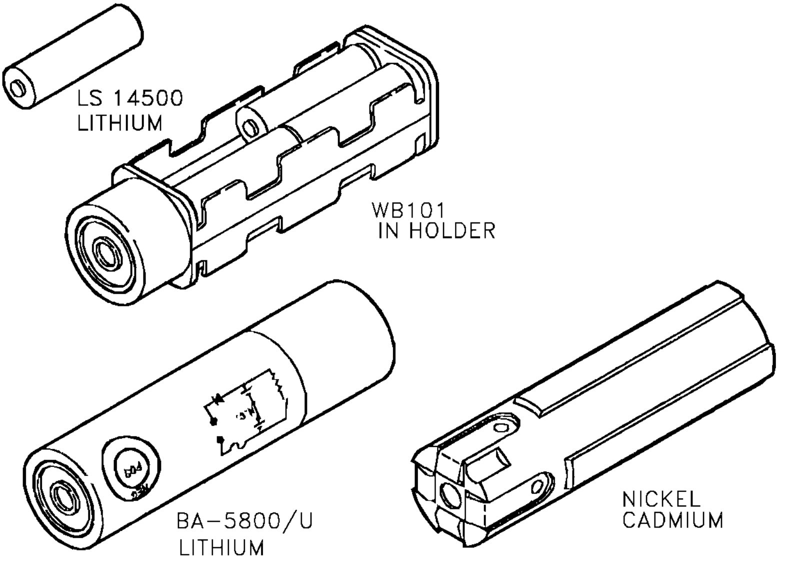


Figure 1-12 PLGR Power Batteries.

CHAPTER 2

KEYPAD OPERATION

2.1 KEYPAD OPERATION.

Understanding of the keypad operation and the basic principles of data entry is required to operate the PLGR. This chapter discusses the following topics: terms; the keypad operating modes; using the keypad; the PLGR display screen; data entry; and online help.

2.2 KEYPAD OPERATION TERMS.

Specific terms are used in the next several chapters when discussing keyboard operation and data entry. These terms are defined below:

FIELD	A **field** is an area of the display having a specific type of information or indication. Some fields are for display of information only, and cannot be **selected**. Other fields may be **selected**, then changed or acted on.
CURSOR	The **cursor** shows the current **selected** field. The cursor is viewed on the display screen as a blinking field, or the double-arrow symbol (for the paging field - see sub-paragraph 2.3.2.13).
SELECT	**Select a field** by using the *Left-arrow* (**🡐**) or *Right-arrow* (**🡒**) key to position the cursor on that field.
SCROLL	**Scroll a page or a field** by using the *Up-arrow* (**🡑**) or *Down-arrow* (**🡓**) key. When the **cursor** is on the paging **field** (see sub-paragraph 2.3.2.13) **scrolling** changes display pages. When another **field** is selected, **scrolling** changes the contents of the **field**.

FUNCTION FIELD A **function field** causes a specific action (function) to be performed when the **field** is **activated** by pressing the *Up-arrow* or *Down-arrow* key. Examples of function fields are: ACTIVATE, CLR, SAVE, QUIT.

ACTIVATE **Activate** is to **cause** a selected function field to perform that function by pressing the *Up-arrow* (🡅) or *Down-arrow* (🡇) key to **“activate”** the function.

2.3 OPERATION.

This section describes how to use the PLGR keypad. The keypad has twelve multifunction keys. The keys are used to enter data and control data displays. The keypad is shown in Figure 2-1.

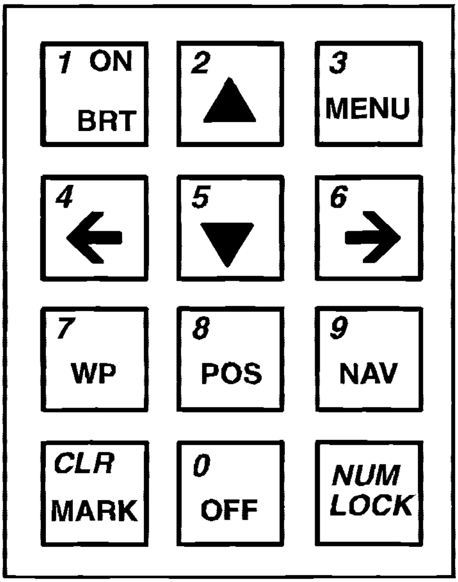


Figure 2-1 PLGR Keypad Layout.

NOTE

An underscore momentarily appears in the lower right-hand corner of the display each time a key is pressed. The underscore shows the user that the PLGR detected the pressed key.

2.3.1 Keypad Operational Modes. The PLGR keypad operates in either of two modes: control mode or numeric mode. The keypad goes to control mode when the PLGR is powered on. The *NUM LOCK* key is used to toggle between two modes. When the PLGR is in control mode, a P is usually displayed in the lower right-hand corner of the display. S (for scroll) will be displayed when entering or editing a route. When the PLGR is in the numeric mode, an N is usually displayed in the lower right-hand corner. The operation of the keypad in each mode is described in the following paragraphs. Figure 2-2 shows keypad operation in control mode and numeric mode.

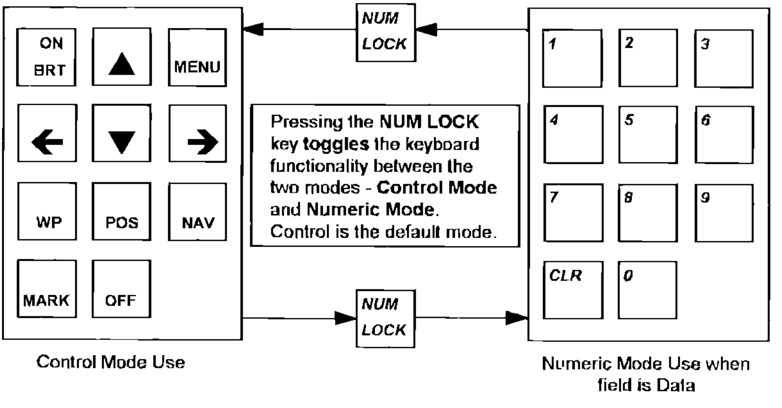


Figure 2-2 Keypad Operation - Control and Numeric Modes.

2.3.1.1 Control Mode. Control mode allows access to displays via the *MENU, WP, POS, NAV*, and *MARK* keys. Pressing one of these keys brings up the top-level display associated with that key. Data entry is a two-step process. First use the *Left-arrow* (🡐) and *Right-arrow* (🡒) keys to move the cursor to the entry locations (fields). Next use the *Up-arrow* (🡑) and *Down-arrow* (🡓) keys to scroll data values and options. Data entry is discussed in paragraph 2.4. Control is the default mode.

2.3.1.2 Numeric Mode. Numeric mode allows the direct entry of numeric data. Pressing a key in numeric mode enters the numeric value into the selected display field. Nonnumeric data is entered in the same manner as in control mode (scrolled). In numeric mode, when the (↕) symbol is displayed, the field may be scrolled. When the (↕) symbol is not displayed, direct numbers may be entered. Numeric mode allows access to displays via the *MENU, WP, NAV, POS*, and *MARK* keys only when a nonnumeric field is selected. Numeric mode is useful when several numeric entries are made, such as initializing position. Pressing the *NUM LOCK* key toggles the keyboard between control mode and numeric mode.

2.3.2 Keypad Operation in Control Mode. Operating each control mode key is described in the following paragraphs.

2.3.2.1 ON/BRT Key. The *ON/BRT* key turns the PLGR on. It also adjusts the brightness of the screen backlighting. The first press of the *ON/BRT* key turns the PLGR on. Pressing the *ON/BRT* key again allows the user to adjust the display backlighting.

a. **Turning On The PLGR.** Press the *ON/BRT* key to turn on your PLGR.

(1) Self-test begins as the unit powers on.

(2) The display blinks and shows a copyright notice.

(3) After self-test completes, the results are shown in a self-test and battery status display.

NO FAULTS FOUND
Battery status:
00h00m used
20h00m left

(4) Then a display of the last computed position comes up.

NOTE

If self-test fails, a failure is displayed.

(5) Press any key to continue. See sub-paragraph 8.1.1.

NOTE

Holding the *Up*- or *Down-arrow* key (while holding the *ON/BRT* key) causes the backlighting level to change faster.

b. **Adjusting Display Backlighting.** The display is backlit for night viewing. Be aware the PLGR draws more battery power with backlighting on.

(1) With the PLGR on, press the *ON/BRT* key. This toggles the display backlighting off and on.

(2) Hold the *ON/BRT* key and press the *Down-arrow* key. This reduces the display backlighting.

(3) Hold the *ON/BRT* key and press the *Up-arrow* key. This increases the display backlighting.

c. **Keypad Map.** The keypad map is used to find a key in the dark since the keypad is not backlit.

(1) Hold down the *ON/BRT* and *MENU* keys. This shows the keypad map on the display.

2.3.2.2 <u>Left/Right-Arrow Keys.</u> The *Left*- and *Right-arrow* keys are used to move the cursor from field to field in the display. They do not change the value of displayed data. The arrow keys have an auto repeat action when held. The cursor sequences through the available fields until the key is released. The cursor is shown on the display as a blinking field. As shown by the hint on the top *MENU* display line, the *Left-arrow* (🡐) and *Right-arrow* (🡒) keys move the cursor from field to field. Press the *Right-arrow* key and the cursor moves right across the display. It then moves down to the next line **as if the display were a single line.** As the last field on the bottom line is reached, the cursor wraps to the first selectable field on the top of the display. Pressing the *Left-arrow* key causes the cursor to move left, then up to the previous display line. The *Help* option is used as a reminder when you need help with operating the PLGR. See paragraph 2.5.

2.3.2.3 <u>Up/Down-Arrow Keys.</u> The *Up*- and *Down-arrow* keys are used to change display pages, change number/alpha field values, and activate functions. The operation performed depends on what field is selected when the keys are pressed. When the cursor is on an option field, pressing the *Up-Down-arrow* key scrolls through the options. When the cursor is on a changeable value field, pressing the *Up-arrow* key increases the field to the next higher available value. Pressing the *Down-arrow* key decreases the field to the next lower available value. The *Up*- and *Down-arrow* keys have a speed-scroll function. When held, i.e., pressing and holding, the key causes scrolling to speed up. The *Up*- and *Down-arrow* keys are also used to scroll to additional pages of display, when available (see sub-paragraph 2.3.2.13).

2.3.2.4 <u>MENU Key.</u> Pressing the *MENU* key displays the system menu. The menu consists of three display pages (see Figure 2-3). Pressing the *MENU* key again shows another menu display. The first line of the *MENU* display has two non selectable fields. The "*move*" label shows that the *Left*- and *Right-arrow* keys move the cursor between the fields. The "*select*" label shows that the *Up*- and *Down-arrow* keys are active. The keys are used to select the field at the cursor and bring up the associated display. The system *MENU* options and the function associated with each option are listed. The last used menu choice is selected when the menu display comes up. At turn on and first time *MENU* selected, cursor comes up on *STATUS*.

NOTE

- Shading shows the selected or selectable fields. The selected field is blinking on the display.

- The cursor appears at the last used option when the *MENU* or *WP* menus come up.

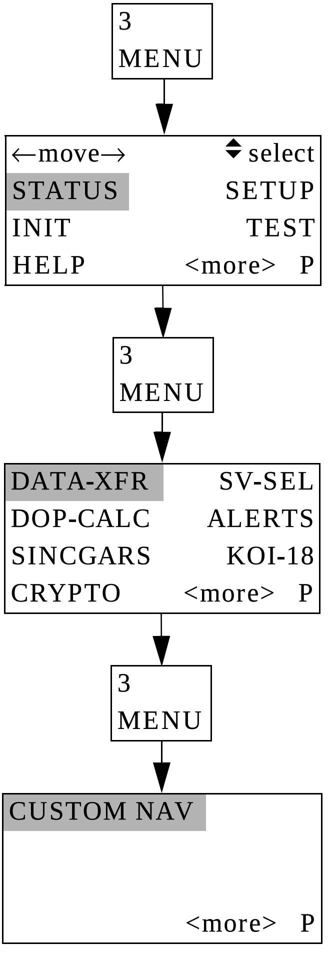


Figure 2-3 System Menu Display Pages.

MENU Page 1:

- STATUS - Provides system, battery, antenna, satellite, and other status information.
- SETUP - Allows user to select operating mode, coordinate system, units, and other operating and display parameters.
- INIT - Allows user to initialize position, time, date, user defined datum, crypto information.
- TEST - Allows the user to command PLGR self-test.
- HELP - Brings up the help displays.

MENU Page 2:

- DATA-XFR - Allows transfers of setups, time, waypoints, user defined datums, and satellite data to another PLGR.
- SV-SEL - Allows user to include or remove individual satellites for use by the PLGR.
- DOP-CALC - Used to command the PLGR to calculate the best satellite geometry for a given time period.
- ALERTS - Provides for set up and control of corridor, position error, buffer, anchor, hazard, and route leg advance alerts.
- SINCGARS - Allows user to load Time Fill data into a SINCGARS compatible radio.
- KOI-18 - Allows user to load crypto key data via a KOI-18 COMSEC device.

CAUTION

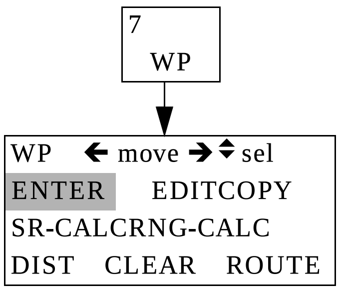
CRYPTO is a menu option that is displayed only when the PLGR is loaded with crypto keys. If *CYRPTO* is not displayed, the PLGR functions as an SPS receiver. SPS receivers are not for combat operations. These receivers are affected by the intentional SA errors. You have no protection from a spoofing threat. Not having *CRYPTO* loaded could result in mission failure.

CRYPTO - Provides access to crypto entry, status, and zeroize displays.

MENU Page 3:

CUSTOM NAV - Allows user to customize navigation displays.

2.3.2.5 **WP Key.** Pressing the WP key brings up the waypoint menu display. The waypoint menu options and functions are:



ENTER - Enter the position, identifier, datum, and magnetic variation of waypoints.

EDIT - Edit or review the position, identifier, datum, and magnetic variation of waypoints.

COPY - Copy position, datum, and magnetic variation data from one waypoint to another.

SR-CALC - Calculate the coordinates of a new waypoint using slant range, azimuth, and elevation angle or waypoint elevation from either present position or from another waypoint.

RNG-CALC - Calculate the coordinates of a new waypoint using range, azimuth, and elevation angle (ELA) or waypoint elevation from either present position or from another waypoint.

DIST - Determine range, azimuth, and elevation angle from one waypoint to another.

CLEAR - Clear from memory a single waypoint or a range of waypoints.

ROUTE - Link together the legs of a route using defined waypoints.

2.3.2.6 POS Key. Pressing the POS key brings up the position display. The position display is four pages (five when bullseye turned on) that display current position, time, speed, satellite tracking status, current datum, magnetic variation, operator identification (ID)), and bullseye position (when turned on). The last used position page comes up when the POS key is pressed from another display. While viewing a position display page, pressing the POS key brings up the next position page. The position display pages are scrolled using the procedure described in sub-paragraph 2.3.2.13. See Chapter 4 for a discussion of the position display. Pressing and holding the POS key for approximately two seconds causes the waypoint to change track mode as described in Table 2-1.

Table 2-1 Quick Fix .

Current tracking mode	New tracking mode
Standby	Last active track mode
Continuous*	Standby
Fix*	Standby
Averaging*	Standby
Time-only*	Standby
2D/3D Training	Standby
RHRSL (Rehearsal)	Standby
*Active Track Mode	

NOTE

There must be waypoints loaded in the PLGR when the *NAV* key is pressed. If there are not, the nav option does not work. A display comes up stating, "Not enough waypoints: Press POS, *MENU*, *WP*, or *MARK*."

2.3.2.7 **NAV Key.** Press the *NAV* key to bring up the nav displays. The first page selects the display mode, nav method, and destination waypoint. More pages are available to display the various waypoint nav information.

a. Select the first field to change display modes (either *SLOW*, *2D FAST*, *3D FAST*, or *CUSTOM*). The nav displays in each of the first three modes are similar. The nav displays for the *CUSTOM* mode are defined in the *MENU, CUSTOM NAV* setup option. See Chapter 4. The most useful information is provided and unnecessary information is left out for each nav method.

SLOW	DIRECT
WP001	MARK001
	P

b. Select the next field to change nav methods. This affects how the PLGR navigates to a destination.

SLOW	DIRECT
WP001	MARK001
	P

DIRECT - A course is computed from the PLGR position (at the time the destination is selected) to the destination.

CRS TO - A course (CRS) to the destination is entered.

CRS FROM - A course away from the destination is entered.

RTE - The legs of a route (RTE) are navigated either start-to-end or end-to-start.

APPROACH - A course and glide path is entered to the destination *(3D FAST or CUSTOM* only).

c. Select the destination field. The destination waypoint is entered numerically or with the cursor in the waypoint scrolling field. The scrolling field is the (↕) symbol located between the waypoint number and identifier. It is only displayed when the cursor is moved to that field. Only defined waypoint numbers are scrolled. They are scrolled in alphanumeric order by identifier.

SLOW		DIRECT
WP001	↕	MARK001
		P

d. Scroll through the nav pages in *SLOW*, *2D FAST*, *3D FAST*, and *CUSTOM* modes to become familiar with them.

e. Pressing and holding the *NAV* key for approximately two seconds provides easy access to the currently navigated waypoint number or route leg depending on the navigation method.

NOTE

There must be waypoints loaded in the PLGR when the *NAV* press-and-hold key is pressed. If there are none, the nav press-and-hold option does not work. A display comes up stating, "Not enough waypoints: press *POS, MENU, WP* or *MARK.*"

f. Press and hold the *NAV* key to bring up the *NAV* setup page containing the display mode, nav method, etc. The cursor is located on the waypoint number for nav methods of *DIRECT*, *CRS TO*, *CRS FROM,* or *APPROACH*. The cursor is located on the route leg number for the nav method of *ROUTE*. To return to the last nav page displayed prior to the *NAV* press-and-hold function, momentarily press the *NAV* key.

g. From the *NAV* press-and-hold setup page, any field may be selected as defined in sub-paragraph 2.3.2.7. However, if the navigation mode or type is changed, momentarily pressing the *NAV* key returns to the first page in the *NAV* page sequence. Selecting the page symbol results in cancelling the *NAV* press-and-hold function and the PLGR operates in normal *NAV* mode.

2.3.2.8 MARK Key. The *MARK* key is used to activate the *MARK* and Man Overboard *(MOB)* waypoint selection page. On this page the first unused waypoint is automatically selected for storage. The waypoint may be changed to any waypoint number. The waypoint number chosen can be used with either *MARK* or *MOB* selection.

a. To mark present position, press the *MARK* key again. This allows the current position to be stored as a waypoint. The *MARK*ed waypoint is stored with the label *MARK*nnn. Where nnn is the chosen waypoint number.

b. To store the present position as an *MOB* waypoint, and to activate the *MOB* navigation page, press the *NAV* key. The *MOB* waypoint is stored with the label *MOB*nnn. Where nnn is the chosen waypoint number.

c. The *MARK/MOB display* comes up with the waypoint number field selected. The first unused number in the waypoint database is displayed at right. Three choices can be made:

MARK		POS→WP001
MARK	:	saves
NAV	:	ManOverbrd
ON	:	cancels

(1) Press the *ON* key to cancel the *MARK* or *MOB* storage and return to the last display.

(2) Press the *MARK* key again to store the marked position in the chosen waypoint.

(3) Press the *NAV* key to store the current position in the chosen waypoint and activate the *MOB* navigation page.

2.3.2.9 NUM LOCK Key. Pressing the *NUM LOCK* key toggles the keyboard between control mode and numeric mode. An N is displayed at lower right of display in the numeric mode. However, the *NUM LOCK* key is only active where direct numeric entry is appropriate.

2.3.2.10 OFF Key. To turn the PLGR off, press the *OFF* key. Unit shows the power-off display is started. A 30 second power-off timer is started. The countdown prevents accidental turnoff.

a. While the timer is counting down, you have three choices:

(1) Press the *ON* key to cancel the power off and return to the last display.

(2) Press the *OFF* key to turn the unit off immediately.

(3) If no action is taken, the timer counts down and turns the PLGR off.

CAUTION

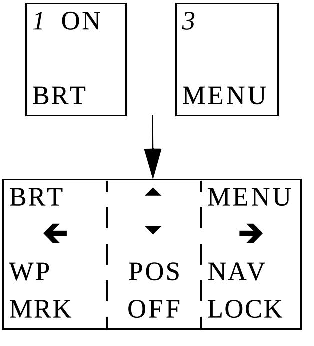
The zeroize function is to be used in emergencies to protect mission sensitive data. The zeroize destroys all data that is entered into or collected by the PLGR. Failure to zeroize could compromise future missions.

2.3.2.11 **Zeroize Keys.** Pressing the *CLR/MARK* and *NUM LOCK* keys at the same time brings up the zeroize display. Two choices can be made:

a. Press the *ON* to cancel the zeroize and return to the previous display.

b. Press the *OFF* key to destroy all data in the PLGR. The zeroize function stops all navigation functions.

2.3.2.12 **Keypad Map.** Pressing the *ON/BRT* and *MENU* keys at the same time brings up a map of the keypad. The keypad is not backlighted, so the keypad map may be useful in low-light situations to remind the user how the keys are arranged. The keypad map is displayed until any key is pressed.



2.3.2.13 **Paging Control.** Many of the PLGR functions have several display pages of information. When more than one page is available, the (↕) symbol (double-arrow symbol next to the P symbol) is displayed on the right side of line four. Additional pages of a display are accessed by first selecting the paging field (P symbol), then pressing the *Up-* or *Down-arrow* key to scroll through the pages. The (↕) symbol is displayed only when the cursor is on the paging field. Refer to Figure 2-4.

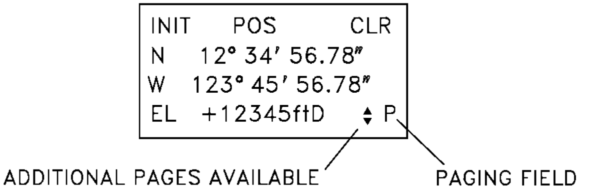


Figure 2-4 Page Change Indicator.

2.3.2.14 **Online Help.** Pressing the *Left-* and *Right-arrow* keys at the same time during any PLGR operation brings up the online help displays (see sub-paragraph 2.5). Thirteen pages of instruction on how to use the PLGR are available to the user. To exit the online help display, move cursor to the EXIT field and activate.

2.3.2.15 **Pause Feature - When in TNG (2dTNG or 3dTNG) or RHRSL Mode.** Pressing the *OFF* key then *ON/BRT* key within 30 seconds, activates a "pause" feature used in the Tutorials (see Chapter 13). Pause is toggled on and off by pressing the *OFF* key then *ON/BRT* key each time. Ignore the "Unit turning off display when using the pause feature."

NOTE

If an attempt is made to enter a number that is not valid for the selected field, the number is not accepted on the display.

2.3.3 <u>Keypad Operation in Numeric Mode.</u> Numeric mode is used only for entering numeric data. Keypad operation depends on the type of field that is selected. If a numeric field is selected while in numeric mode, pressing a key enters its numeric value into the selected field. If a nonnumeric field is selected, keypad operation is the same as described for control mode (see sub-paragraph 2.3.2).

2.3.3.1 <u>CLR Key.</u> The *CLR* key is used when the keypad is in numeric mode. The *CLR* key moves the cursor to the left. This allows wrong entries to be reentered.

2.3.4 <u>Conserve Power - Change Mode to Standby.</u> The PLGR uses the most power when trying to get and track satellites. Changing the mode to standby *(STBY)* saves battery power. There are two ways to change to the standby mode. One is the press and hold function of the *POS* key (see sub-paragraph 2.3.2.6). The other is by using the *MENU*, *SETUP* page.

a. Press the *MENU* key.

(1) Move the cursor and select the *SETUP* option.

```
← move →   ⇕ select
STATUS      SETUP
INIT        TEST
HELP        <more>  P
```

b. This brings up the first *SETUP* page, for operating mode and satellite type selection.

```
SETUP MODE:  CONT
Continuous POS
and VEL update
SV-TYPE:  mixed     P
```

c. Notice that when the display first comes up, the (↕) P shows that more pages are available. The *Up-* or *Down-arrow* key scrolls to these pages.

(1) Select the MODE control field on line 1 using the *Right-arrow* key. See that the (↕) symbol disappears and the selected field begins to blink.

(2) Press the *Up*- or *Down-arrow* keys to act upon the selected field. Since there are options that can be selected for this field, the choices scroll as the *Up*- or *Down-arrow* key is pressed. Scroll until standby *(STBY)* mode is displayed (selected).

d. Standby mode is used to save battery power and is commonly used for such tasks as setup, waypoint entry, and data transfer. Now that *STBY* is displayed, it needs to be processed by the PLGR. Entries on a page are not used by the PLGR until you change to another page.

(1) Press the *POS* key and see that *STBY* is shown on the position page.

SETUP MODE:	STBY
No tracking, low power	
SV-TYPE: mixed	P

2.4 DATA ENTRY.

Some display fields are only for displaying information. Other display fields are changed or selected to activate functions. The cursor is only moved to fields that can be changed or selected. When a field is selected, it blinks. Example displays shown in this manual show selected (blinking) fields as a shaded area. Entering data or activating a function using the PLGR keypad is a two-step process. First the cursor is moved to the desired field (it blinks). Then the contents are changed or function activated. There are three types of selectable fields: numeric fields, option (nonnumeric) fields, and function fields. These are described below:

Alphanumeric fields - Alphanumeric fields contain a letter, symbol (such as / or -), or number. The alphanumeric field value is changed by selecting the field (left/right arrows in control mode). Then either scroll (up/down arrows) through the valid alphanumeric values or enter numeric values by pressing the number keys (in numeric mode).

Option fields - Option fields contain alphabetic or symbol (such as + or -) data. The contents of option fields are changed by selecting the field (left/right arrows in control mode). Then scrolling (up/down arrows) through the available options. To leave the field, press the *Left- or Right-arrow* key. Data entry for option fields is the same in control and numeric modes.

Function fields - Function fields perform a specific process or lead to other function fields. A function field is activated by selecting the field (left/right arrows in control mode) and pressing the *Up-* or *Down-arrow* key. Examples include the following:

- Menu options - Three pages that lead to 12 processes (13 if crypto keys installed). (Refer to Figure 2-3.)
- Paging field - Used to move to the next or previous display page (the paging field does not blink when selected).
- CLR - *Clears* data entries on the current display page.
- ACTIVATE - Selected process is performed.
- SAVE - Data from the current display page is saved by the system.
- QUIT - Process associated with the current display page is not performed.
- CLEAR - Clears all data on the display page.
- STORE - Stores, in the set, all data on the display page.
- MARK - Marks and saves selected position or waypoint data.

SEND -	Sends data.
LOAD -	Loads crypto keys from the KOI-18.
START -	Starts DOP calculations.
RETRY -	Repeats process/procedure that was tried.
CANCEL -	Cancels process/procedure that is selected.
EXIT -	Leaves the option/display.

2.4.1 Entering Data in Control Mode. Figure 2-5 provides an example of control mode data entry for numeric, option, and function fields. The example uses the position initialization display (see sub-paragraph 3.7.3). Elevation is changed from *+00010* to *-00009*. Then the *CLR* field is selected to clear the entry and return it to the original value. All data entries are made in control mode by following two basic principles:

a. Use the *Left-* or *Right-arrow* keys to select the desired field.

b. Use the *Up-* or *Down-arrow* keys to change the contents of the selected field.

2.4.1.1 Change Data in Control Mode. Data on the display is changed:

a. If the selected field contains alpha or numeric data:

(1) Press the *Up-arrow* key to increment the value.

(2) Press the *Down-arrow* key to decrement the value.

(3) When the field contains the desired value, press the *Left-* or *Right-arrow* key to go to the next option field to be changed.

b. If the selected field contains option data:

(1) Press the *Up-* or *Down-arrow* keys to scroll through the options.

(2) When the desired option is displayed, press the *Left-* or *Right-arrow* key to go to the next option field to be changed.

c. If the selected field is a function field pressing the *Up-* or *Down-arrow* key performs the associated PLGR process.

2.4.1.2 <u>CLR Function.</u> There is a *CLR* function field in the upper right-hand corner of the first three initialization pages. This field activates a clear function that clears any entries that have been made on that page and restores each field to its original value. This field is useful when the user wants to abort or restart the process on a given initialization page.

a. To activate the clear function:

(1) Move the cursor to the *CLR* function field. This is done by using the arrow keys in control mode.

(2) Press the *Up-* or *Down-arrow* key to activate the clear function. The clear function clears all entries made on that page and restores each field to its original value.

(3) After the *CLR* is activated, the cursor moves to the paging field.

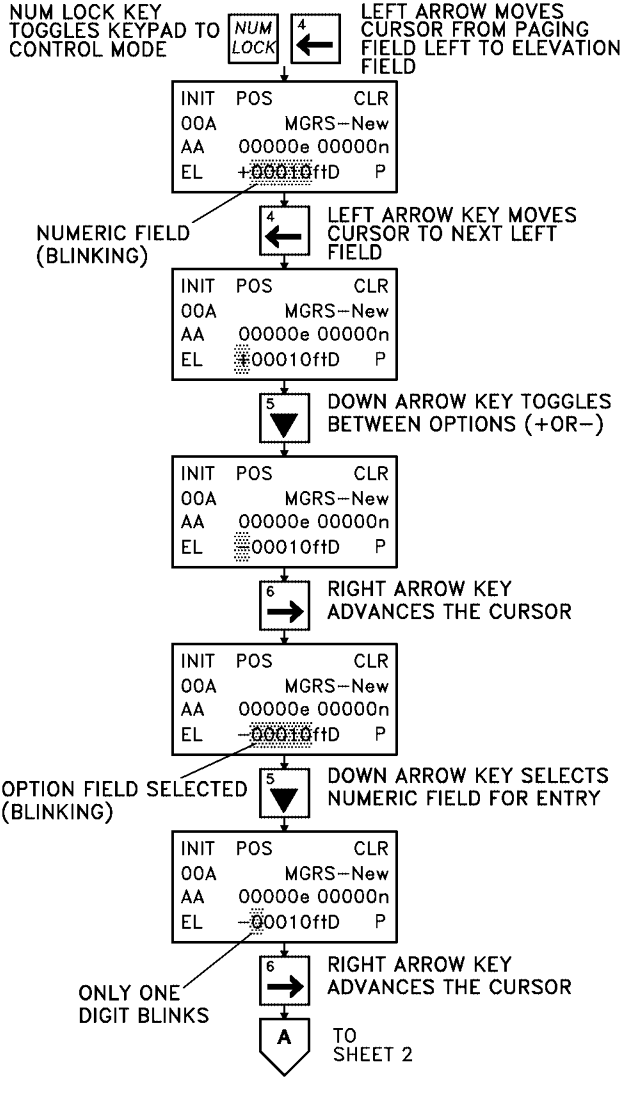


Figure 2-5 Entering Data-Control Mode. (Sheet 1 of 2)

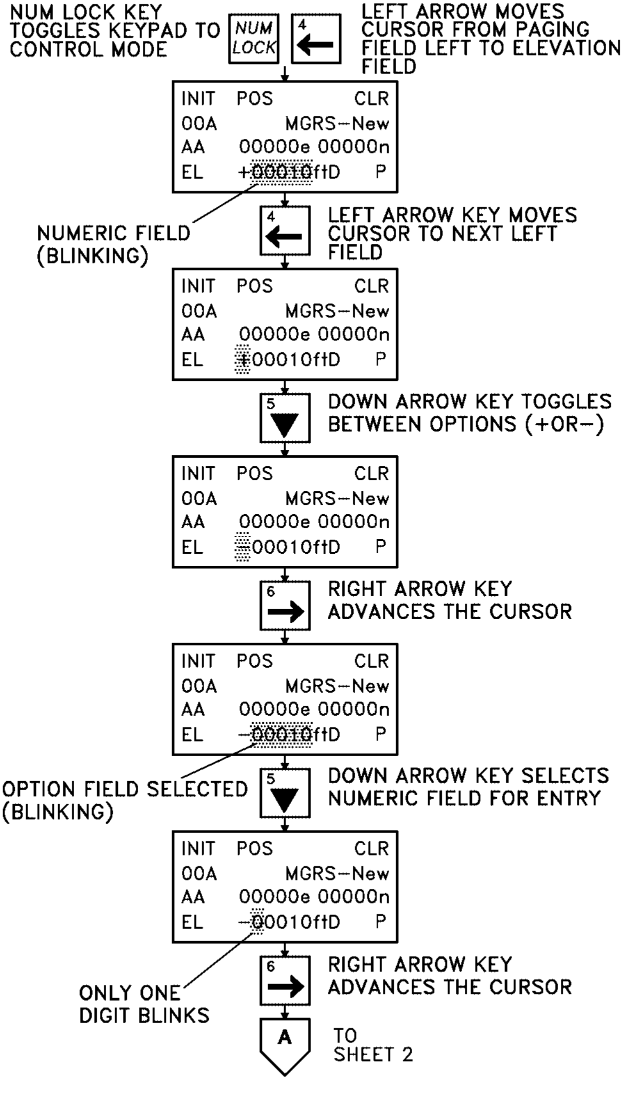


Figure 2-5 Entering Data-Control Mode. (Sheet 2)

2.4.2 <u>Entering Data in Numeric Mode.</u> Numeric mode allows numeric data to be entered on the display via the keypad number keys. Pressing the keys 0 through 9 causes that number to be displayed in the cursor position. The cursor then moves to the next selectable field. Numeric mode is entered by pressing the *NUM LOCK* key. When the keypad is in the numeric mode, an N is shown in the lower right-hand corner of the display. The N remains on the display until numeric mode is exited or the display page is exited.

NOTE

- When the display page is exited while in numeric mode, the keypad defaults to control mode for the next display.

- Once in numeric mode, the first cursor movement in a numeric field causes numeric changes to begin. If an invalid number is entered, the number is not accepted and the cursor does not move. Number fields that are not to be changed are reentered to move the cursor in numeric mode. The cursor is backed up by pressing the *CLR* key. Selecting control mode restores cursor and scroll function, without affecting numeric values.

a. Perform the following steps to enter numeric mode and make data entries:

(1) Select the field to be changed.

(2) Press the *NUM LOCK* key to enter numeric mode. The N in the lower right-hand corner of the display shows the keypad is in numeric mode. See Figure 2-6.

b. Figure 2-6 provides data entry example in numeric mode. The example uses the present position initialization display (see sub-paragraph 3.7.6). Elevation is changed from *+00010* to *-00009*, then the *CLR* field is activated (see sub-paragraph 3.7.5).

(1) If the selected field has a number, pressing a key (0 through 9) enters the number. The cursor then moves to the next selectable field. Only one character position is selected at a time, rather than the entire field, when in numeric mode.

(2) If the selected field is an option field, the double-arrow (↕) and N appear in the lower right-hand corner of the display (see Figure 2-7). When the (↕) N is displayed, the field may be scrolled using the *Up*- or *Down-arrow* key. Use the *Left*- or *Right-arrow* key to move to the next field.

(3) If the selected field is a function field, the double-arrow (↕) and N appear in the lower right-hand corner of the display. Pushing the *Up*- or *Down-arrow* key starts the function.

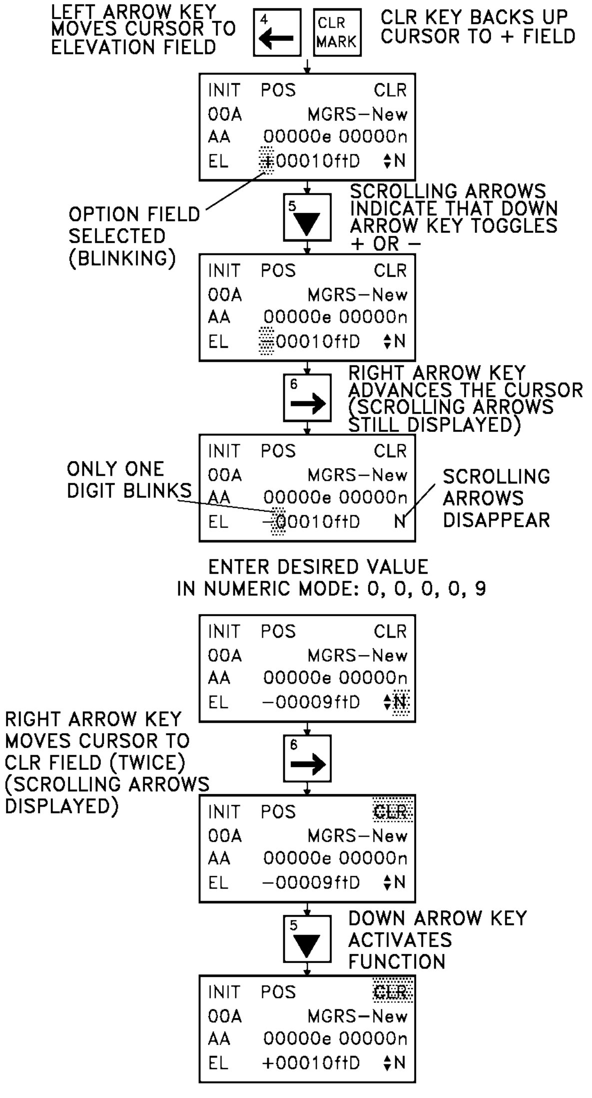


Figure 2-6 Entering Data-Numeric Mode.

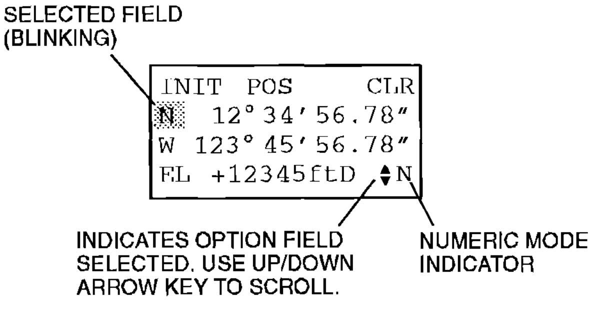


Figure 2-7 Numeric Mode Indicator.

2.4.2.1 <u>CLR Key.</u> The *CLR* key is functional only when the keypad is in numeric mode. The *CLR* key moves the cursor to the left. This allows wrong entries to be reentered.

2.5 <u>ON-LINE HELP DISPLAYS.</u>

Thirteen online help displays are available for the user.

2.5.1 <u>Accessing the Help Displays.</u> The help displays are accessed from the MENU display or by pressing the *Left*- and *Right-arrow* keys at the same time to display help, as shown in Figure 2-8. To exit the help displays, move cursor to EXIT and activate.

a. Perform the following steps to access the help displays:

(1) Press the *MENU* key to bring up the menu display.

(2) Position the cursor on the HELP field. The *MENU* key may have to be pressed twice to bring up the page with the HELP option.

(3) Press the *Up*- or *Down-arrow* key to bring up the first page of the help display.

(4) Use the *Up*- or *Down-arrow* key to scroll through the help display pages. The help display pages are shown in Figure 2-9.

(5) To exit the *HELP* option, use the *Left*- or *Right-arrow* key to position the cursor on the EXIT field and activate.

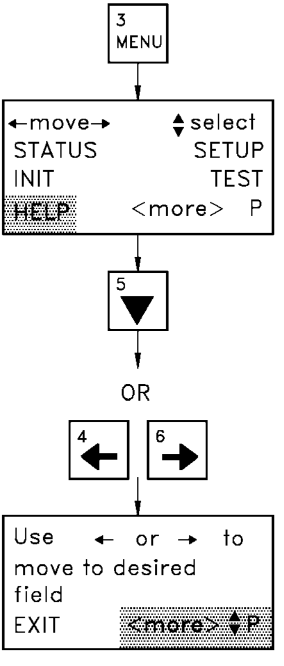


Figure 2-8 Accessing Help Displays.

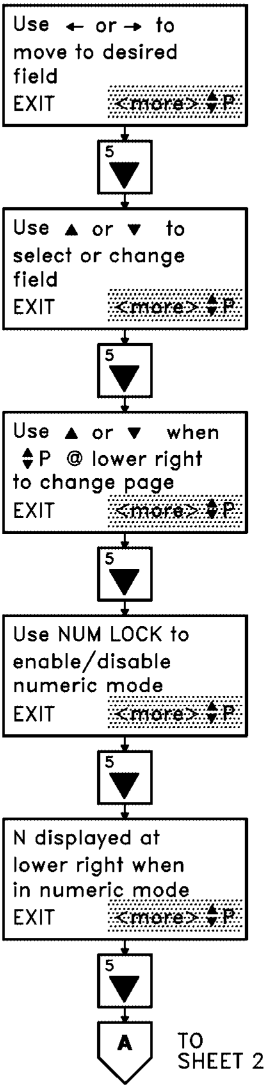


Figure 2-9 Help Display Pages. (Sheet 1 of 3)

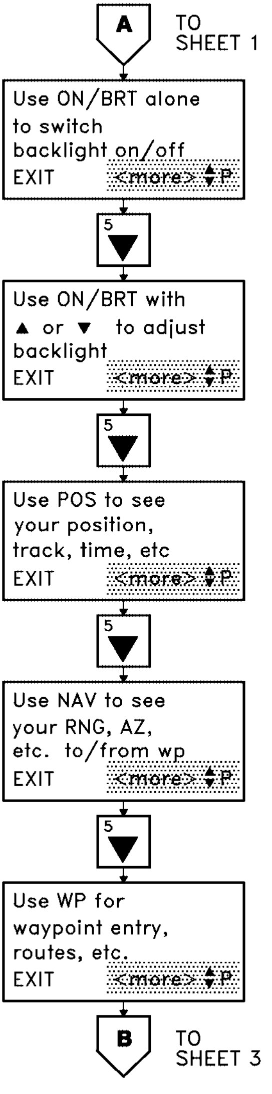


Figure 2-9 Help Display Pages. (Sheet 2)

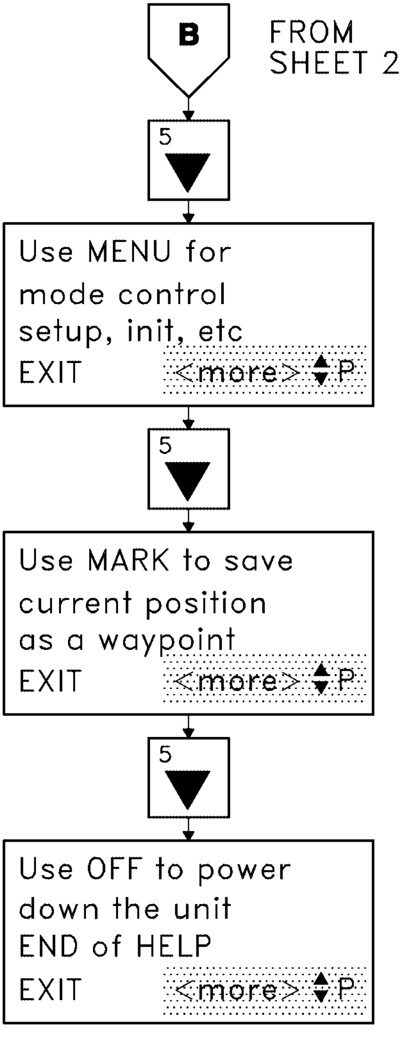


Figure 2-9 Help Display Pages. (Sheet 3)

CHAPTER 3

PRE-MISSION OPERATIONS

3.1 PRE-MISSION OPERATIONS.

This chapter discusses pre-mission operations that are performed while setting up for a mission. The following topics are discussed: turning the PLGR on and off; performing routine equipment checks; PLGR self-test; and setting up operating parameters. The operating parameters include: operating mode; the type of satellites to use; coordinate system; distance, elevation, and angle units; elevation reference and north reference; the source of the magnetic variation value; NAV display mode; elevation hold mode; format of the time and error displays; datum used; automatic-off timer; serial port configuration; HAVE QUICK, SINCGARS, and 1PPS mode; and the automark mode. Other topics discussed in this chapter are: crypto operations; initialization; status displays; waypoint operations; data transfer; best DOP calculation; selecting and deselecting satellites; warning displays; and mission planning.

3.2 TURNING ON/OFF.

This paragraph outlines the procedures for turning the PLGR on/off and adjusting the display backlighting. The PLGR is turned on/off via the keypad. The display is backlit for night viewing using the keypad, and is night-vision goggle (NVG) compatible. Be aware that the PLGR draws more power with the backlighting turned on.

NOTE

If the PLGR fails to turn on, see sub-paragraph 8.1.1.5 for troubleshooting, or sub-paragraph 8.1.3 for passivated batteries procedures.

3.2.1 <u>Turning the Unit ON.</u> The PLGR is turned on by pressing the *ON/BRT* key. When turned on, the sequence of displays comes up as shown in Figure 3-1.

a. First, a test pattern display showing all pixels (dots in each alpha/numeric segment of the display).

b. Second, a display showing a copyright notice, manufacturer name, and software part number.

NOTE

At this point, the power-on self-test is automatically started. This takes only a few seconds to complete.

c. Third, a self-test display showing self-test results and battery status.

NOTE

At this point, the keypad becomes active. If self-test fails, the display shown comes up instead of the battery status display. This display remains until any key is pressed. See paragraph 3.3 for routine checks.

FAILURES FOUND Press MENU and select STATUS for details.

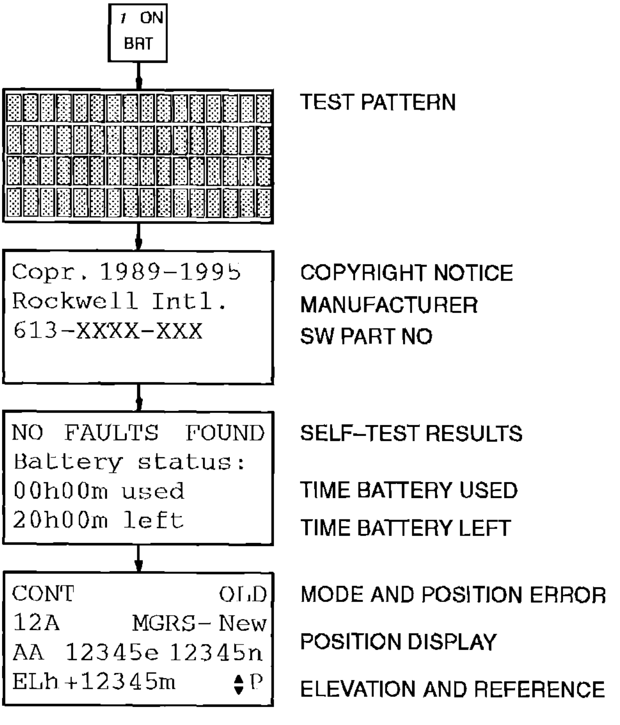


Figure 3-1 ON Display Sequence.

NOTE

- The Time To First Fix *(TTFF)* and Time To Subsequent Fix *(TTSF)* depend on the conditions when the fix is attempted. If the PLGR is moved a large distance while OFF, the *TTFF* takes longer if it is not reinitialized with the new position. How much longer is case-dependent. If almanac or crypto keys are not current, *TTFF* may increase.

- *TTFF* can be affected by the type of crypto key loaded into the PLGR.

- The indicated age of a recently collected almanac may be as much as 2 days old, depending on the delay between the time the Control Segment declared the almanac valid and the actual time of transmission to the particular satellite used by the PLGR to collect the almanac.

- When using *Group Unique Variable (GUV) Key* - the first time the PLGR is turned ON after 2400Z, it can take up to 15 minutes to download the daily *GUV* variables contained in the Satellite Navigation Message. Power-ON actions over the next 24 hour period will not experience this delay.

- When using *Crypto Variable Weekly (CVW) Key* - A CVW load does not require additional crypto variables from the Satellite Navigation Message, therefore normal TTFF is expected.

- Average *TTFF* is 3 minutes or less, maximum is 5 minutes. Average *TTSF* is 1 minute or less, if in *STBY* for 20 minutes or less. Average *TTSF* is 3 minutes or less, if in STBY for more than 20. Maximum *TTSF* is 5 minutes.

- There are several things to do to speed up *TTFF:* Initialize the position, time and date if needed. The operator also helps the PLGR acquisition logic by selecting/deselecting satellites or by changing positions. The PLGR does not know if a satellite is masked by mountains, buildings, etc.

3.2.1.1 A position display showing the last position recorded (if any) by the PLGR before being turned off. *OLD* on line 1 is displayed until a new position is computed.

CAUTION

The PLGR uses more power with the backlighting on. This affects battery life.

3.2.2 <u>Adjusting Display Backlighting.</u> Backlighting is off when the PLGR is turned on. Pressing the *ON/BRT* key when backlighting is off turns the backlighting on to the last used level. Pressing the *ON/BRT* key when the backlighting is on turns the backlighting off. The backlighting is adjusted by holding the *ON/BRT* key while pressing the *Up-* or *Down-arrow* keys to adjust the brightness level.

CAUTION

Turning off or removing external power with a power battery installed, alerts the user that external power is lost. Failure to turn off the PLGR could result in power battery discharge if unit left unattended.

3.2.3 Automatic Off and On. The PLGR turns off and on automatically by turning off and on the external power. This works if the *OFF* key has not been pressed and no power battery is installed.

3.2.4 Turning the Unit OFF. The PLGR is turned off by pressing the *OFF* key. A delayed power off starts. The power off is delayed thirty seconds to prevent accidentally turning off the PLGR. The *OFF* display has no selectable fields.

a. When the *OFF* display comes up:

(1) Pressing the *ON* key cancels the power off. The previous display returns without interruption of normal operation.

(2) Pressing the *OFF* key immediately turns off the PLGR.

(3) If neither the, *ON* or *OFF* key is pressed, the thirty-second timer counts down and the PLGR turns off.

```
0
    OFF
```

↓

```
Unit turning off
in 30 seconds
     ON: to cancel
    OFF: quick off
```

NOTE

Malfunction or failure of the PLGR does not prevent the start or completion of a mission. If this occurs, use standard navigation equipment, procedures, and techniques.

3.2.5 Remote OFF. The PLGR is remotely turned off using a command via the serial data port.

3.3 ROUTINE CHECKS.

If the PLGR is not operated correctly, a **CRITICAL MISSION COULD FAIL.** However, incorrect operation does not damage any unit.

3.3.1 Routine Checks Include:

Cleaning and dusting units.
Stowing units and parts that are not used.
Covering unused receptacles.
Checking for loose and missing hardware.

3.3.2 Daily Checks.

a. Daily checks should be done at the beginning of each day before operating the PLGR as well as before taking the PLGR on a mission.

b. Complete the daily checks, so the PLGR is always mission ready.

c. Use DA Form 2404 to report equipment damage to supervisors. See DA PAM 738-750 for instructions.

3.3.2.1 Daily Check List. Check for serviceability and repair as necessary.

Check that the unit is complete before missions. See paragraph 1.5 to see other equipment that is used with the PLGR.

Check each unit for dents, scratches, punctures or unreadable data plates.

Check each control key for cracks, breaks, missing or unreadable key markings. Be sure the display window is not cracked or cloudy with moisture.

Check each cable assembly for cuts, kinks, fraying or breaking insulation, and loose or damaged connectors.

Check for loose or damaged hardware.

Perform commanded self-test procedure as outlined in paragraph 3.4 (a power-on self-test is automatically performed).

Check power battery.

Check *MENU* page 2 for *CRYPTO* entry on display. If *CRYPTO* is not displayed, the PLGR is SPS only.

If *CRYPTO* is displayed, select *CRYPTO.* Verify crypto keys are current. If crypto keys are not current, the PLGR is SPS only.

CAUTION

The PLGR cannot perform any nav or provide any position coordinates while self-test is being performed.

3.3.3 Self-Test. A power-on self-test is automatically performed each time the PLGR is turned on. Commanded self-test should be performed on the PLGR any time you think it may have a fault or failure. Perform the procedures as outlined in paragraph 3.4.

3.3.4 Battery Checks. The PLGR monitors the batteries installed and provides an estimate of remaining power battery life. The power battery life *LEFT* (automatically calculated, and may not be accurate) depends on the battery type, mode of operation, backlighting use and level set, and accurate entry of time *USED*. The remaining power battery life is checked under the *MENU* choice of *STATUS* (see sub-paragraph 3.8.3). If the remaining time is shorter than the upcoming mission, the battery is replaced or a spare carried. See Chapter 8 for battery replacement procedures. Time *LEFT* may vary due to an internal temperature sensor in the PLGR, since battery power is affected by temperature.

NOTE

If a *rechargeable nickel-cadmium* power battery is used, the PLGR will automatically sense it and display *NiCad, rechargeable.* Time *USED* **MUST** still be entered.

3.3.4.1 The operator selects the battery type used by the PLGR, either '*BA5800*' lithium, AA-Lith lithium, or '*AA-Alk*' alkaline (each *non-rechargeable*), and enters the amount of time the battery has been used. For example, if a used battery is installed with 1.5 hours of use, enter *0130* (hours and minutes). If a new battery is installed, enter *0000* (or activate the *RST* (reset) field). This time is to be updated each time a different battery is installed.

CAUTION

After the initial *Low primary battery* WARNING, continued operation of the PLGR cannot be reliably predicted. Replace the power battery at the earliest possible opportunity.

NOTE

The battery life *LEFT* estimate, shown in the Battery Status Display, is not used to generate the *Low primary battery* WARNING.

BATTERY: AA-Alk
non-rechargeable
00h00m used RST
20h00m left ⬍ P

3.3.5 Battery Monitoring. The power battery is monitored while the PLGR is turned ON. A warning is displayed to alert you of low power battery voltage. This warning display overwrites the current display to warn that the power battery should be changed. Once the power battery *Low primary battery* WARNING occurs, it repeats every five minutes while the low power battery condition exists.

3.3.5.1 Low Primary Battery Warning.
Under certain conditions the PLGR will NOT give a *Low primary battery* WARNING before shutting off. Therefore, do not use the *Low primary battery* WARNING message as the sole means to determine when to change the power battery. When this warning occurs, pressing the *Up*- or *Down-arrow* key acknowledges the message.

WARNING
Low primary
battery
⬍ to acknowledge

3.3.5.2 Low Memory Battery Warning.

The memory battery is monitored while the PLGR is turned ON. A warning is displayed to alert you of low memory battery voltage. When this warning occurs, critical memory data may be lost if the PLGR is turned off and power battery or external power is not connected. Once the *low-memory battery* WARNING has occurred, it repeats every 15 minutes while the low-memory battery condition exists. When this warning occurs, pressing the *Up*- or *Down-arrow* key acknowledges the message.

WARNING
Low Memory
battery
⬍ to acknowledge

NOTE

The BA-5800 Lithium battery is not to be installed while on external power.

3.3.6 External Power Warning.

The PLGR checks for the connection of external power.

a. If the PLGR does not have a battery installed and external power is lost, it reports the loss of connection to external power as shown. Also, the PLGR automatically uses the memory battery to perform proper shutdown. If this is done often, the memory battery will be rapidly depleted.

WARNING
External power
lost
⬍ to acknowledge

b. If the PLGR has a power battery installed, this warning message occurs every time external power is lost. The PLGR automatically switches to power battery when external power is lost. It switches back to external power when reconnected.

c. When this warning occurs, pressing the *Up*- or *Down-arrow* key acknowledges the message.

3.3.7 <u>External Antenna Warnings.</u> The PLGR checks for the connection of external antenna.

a. If the PLGR has an external antenna installed, this warning message occurs every time external antenna is lost. The PLGR receiver automatically switches to the internal antenna when external antenna is lost. It switches back to external antenna when reconnected.

WARNING
External antenna
lost
$\updownarrow$ to acknowledge

b. When this warning occurs, pressing the *Up*- or *Down-arrow* key acknowledges the message.

WARNING
External antenna
Fault
$\updownarrow$ to acknowledge

3.3.8 <u>Internal Memory Warning.</u> The PLGR performs an internal memory integrity check. Memory corruption is reported as follows:

WARNING
The Receiver has
Cleared Memory!
$\updownarrow$ to acknowledge

a. This condition is checked upon power-up and periodically thereafter. Normally, the warning is displayed only following the removal of both prime and memory batteries.

b. When this message occurs, pressing the *Up*- or *Down-arrow* key acknowledges the message and clears the memory.

CAUTION

The PLGR cannot perform any nav functions or provide any position coordinates while self-test is being performed. Mission could be affected.

3.4 COMMANDED SELF-TEST.

Self-test can be commanded from the PLGR keypad or via the serial data port. The PLGR can perform a thorough self-test of the system to be sure it is working properly. Results of the test are reported to the user. When commanded self-test completes, the unit automatically changes to standby mode.

3.4.1 Accessing Commanded Self-Test. Commanded self-test is accessed from the *MENU* display, as shown in Figure 3-2.

3.4.2 Commanded Self-Test Initialization. Perform the following steps to command self-test:

a. Press the *MENU* key until the *MENU* display with TEST comes up.

b. Select the *TEST* field, then press the *Up*- or *Down-arrow* key to bring up the *TEST* display. The *TEST* display comes up with the cursor on the *QUIT* field.

c. Select the *ACTIVATE* field to start self-test. The commanded *TEST* displays are shown in Figure 3-3.

d. Activate the *QUIT* field to return to the *MENU* display.

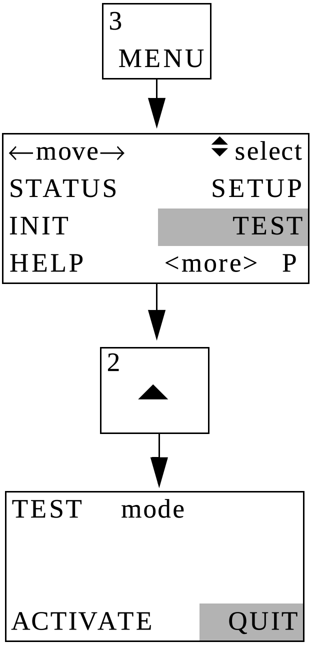


Figure 3-2 Accessing Commanded Self-Test.

3.4.2.1 When commanded self-test completes, the unit automatically changes to standby mode.

3.4.3 **Test Sequence.** As Self-test runs (shown in Figure 3-3), 'Self-test In Progress' is displayed. Line 4 is a brief description of the test being performed. The tests are:

RAM Testing
ROM Testing
PPS-SM
Timer-Interrupt
Track Subsystem
1PPS/HAVE QUICK
Low Pwr Time Src (A test title; not a battery low-warning indication.)

3.4.3.1 After a moment, the display/keypad portion of the test begins, when the display shows the display test is starting. Then a test pattern of all dots appears.

NOTE

The *OFF* key (also the '0') exits the keypad test, so the '0' key should be the last key tested.

a. The keypad test starts. Pressing each key causes the key indication (on the display) to be replaced by a dot pattern.

b. The display brightness test starts. The level automatically increases to maximum and decreases to minimum. This action repeats until the *OFF* key is pressed.

c. Self-test is complete.

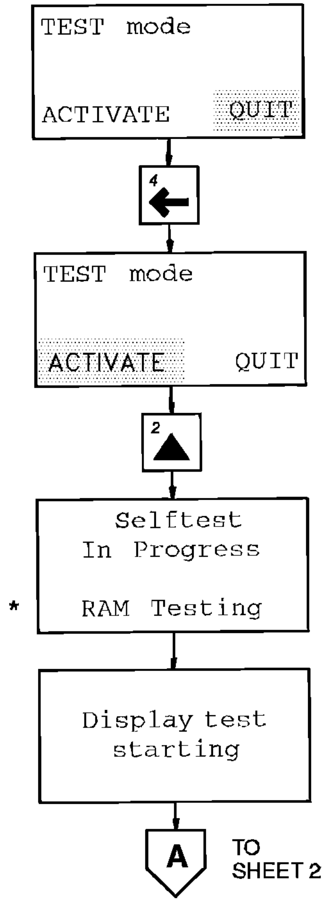
3.4.4 <u>Self-Test Failures.</u> The PLGR tests all portions of itself. In some cases, a mission may not be affected by a particular failure.

a. See sub-paragraph 3.8.8 for self-test failure display information.

b. See sub-paragraph 8.1.1 for maintenance and sub-paragraph 8.1.1.5 for troubleshooting information.

c. Any unit that shows failures should be turned in to maintenance as soon as possible.

d. See paragraph 8.2 for warranty return information.



* See sub-paragraph 3.4.3, Step 1

Figure 3-3 Commanded Self-Test Displays. (Sheet 1 of 2)

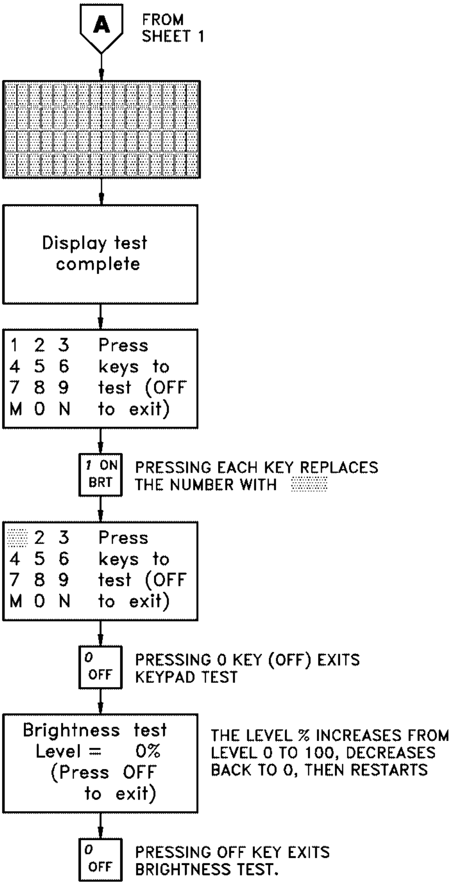


Figure 3-3 Commanded Self-Test Displays. (Sheet 2)

3.5 SETUP AND MODE CONTROL.

This paragraph describes the displays, procedures, and principles used in customizing the PLGR displays to suit the needs of the user. Customizing the displays is done using the *SETUP* display. This display consists of thirteen pages that allow the user to control the following parameters: operating mode; type of satellites to use; coordinate system; units; magnetic variation; display customization; elevation hold mode; time and error formats; datum; automatic-off timer; data port configuration; automark mode; bullseye mode; Operator ID setup; approach setup; and rehearsal setup.

3.5.1 Accessing The SETUP Display. The *SETUP* display is accessed from the *MENU* display. Perform the following steps:

a. Press the *MENU* key until the *MENU* display with *SETUP* comes up.

b. Select the *SETUP* field. (*MENU* display comes up with the cursor on the last selected field.)

c. Press the *Up*- or *Down-arrow* key to bring up the *SETUP* display. The first page of the *SETUP* display comes up with the cursor on the paging field.

d. Use the *Up*- or *Down-arrow* key to scroll through the pages of the *SETUP* display. The *SETUP* display pages are shown in Figure 3-4.

e. Selectable fields on the *SETUP* display pages are changed using the data entry procedures described in paragraph 2.4.

f. Use the *Up*- or *Down-arrow* key to scroll through the options available for the selected field until the desired option is displayed.

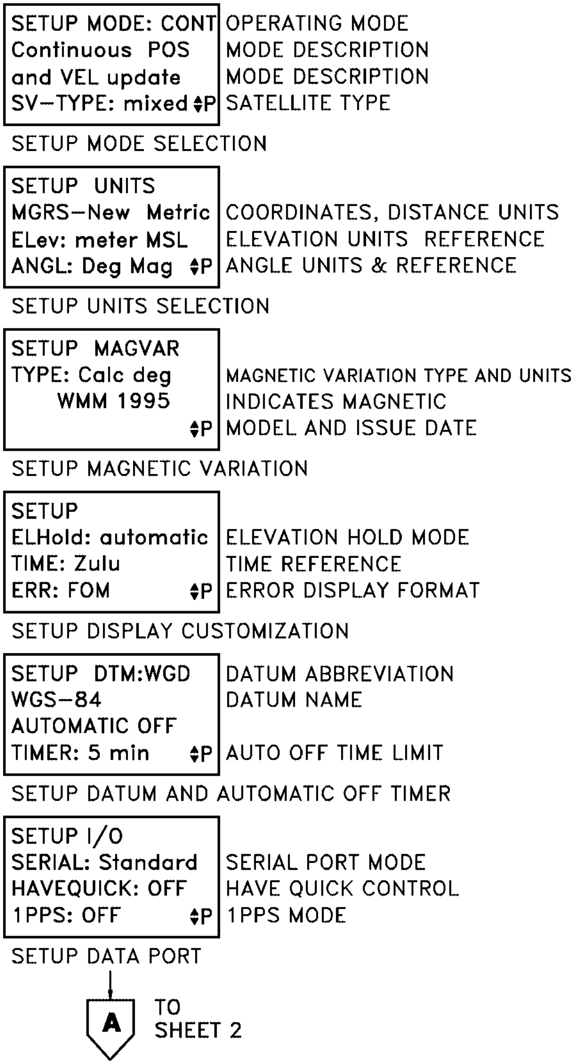


Figure 3-4 Setup Display Pages. (Sheet 1 of 2)

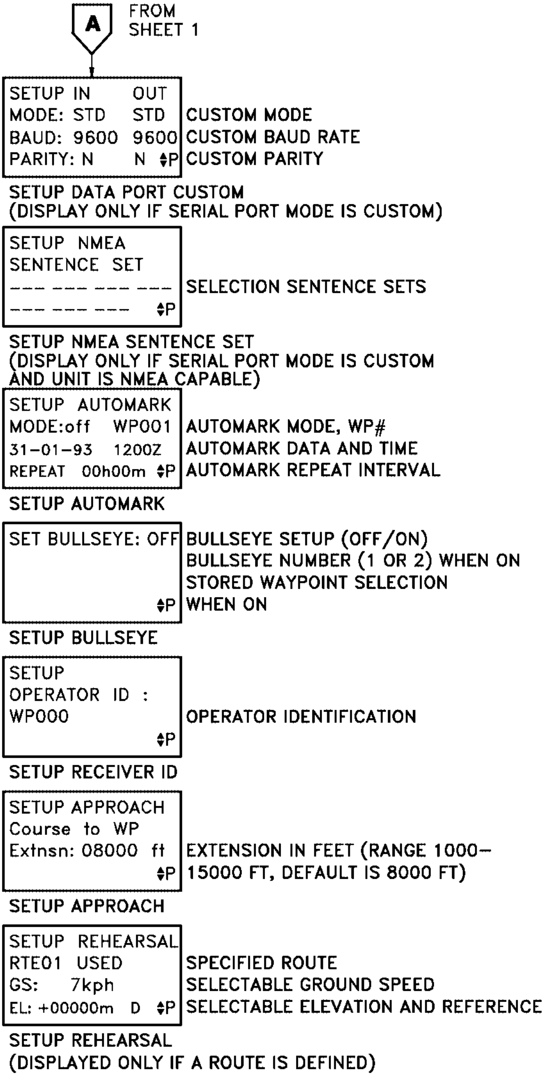


Figure 3-4 Setup Display Pages. (Sheet 2)

NOTE

Changes are not accepted until the current display page is exited.

3.5.2 **Default Setup Values.** On normal startup, the last setup values selected before the PLGR was turned OFF are displayed. However, should the memory be lost, the PLGR setup parameters default to the values shown in Table 3-1.

Table 3-1 Default Setup Values .

Parameter	Default
Operating Mode	Continuous (ext pwr) Quick-fix (batt pwr) Standby (after Zeroize)
SV - Type	Mixed All-Y (if crypto keys loaded)
Coordinate System	MGRS - New
Distance Units	Metric
Elevation Units	Meters
Elevation Reference	MSL
Angle Units	Deg
North Reference	Mag
MAGVAR Type	Calculated
Elevation Hold Mode Enable	Automatic
Time Format	Zulu (0000:00)
Error Format	FOM
Datum	WGD (WGS-84)
Automatic-Off Timer	5 Minutes
Serial Port Configuration	Standard
HAVE QUICK	Off
1PPS	Off
CUSTOM Mode	Standard-Standard

Table 3-1 Default Setup Values - Continued.

Parameter	**Default**
DGPS Baud Rate	9600
DGPS Parity	None (N)
Automark Mode	Off
Bullseye Mode	Off
Operator ID Setup	WP000
Approach Setup	8,000 (ft)
Rehearsal Setup	GS 7 kph; EL +00000m

3.5.3 <u>Selecting Operating Mode and Satellite Type.</u> The first page of the SETUP display is the mode selection and SV-TYPE display. The display page in Table 3-2 shows the current operating mode of the PLGR and allows it to be changed. Lines two and three of the display contain a brief description of the displayed operating mode. The options available for each field are shown in Table 3-2.

Table 3-2 Operating Mode/SV Type Options .

Parameter	Options
NOTE The selectable fields on this page are highlighted in the display shown.	SETUP MODE CONT Continuous POS and VEL update SV-TYPE: mixed ⬍P
Operating Mode	Continuous (CONT) Quick-fix (FIX) Averaging (AVG) Time-only (TIME) Standby (STBY) 2d Training (2dTNG) 3d Training (3dTNG) Rehearsal (RHRSL)
SV-TYPE	mixed all-Y (default when crypto/keys loaded)

3.5.3.1 Operating Modes. The following paragraphs briefly describe each of the user-selectable operating modes. The operating mode displays are shown in Figure 3-5.

3.5.3.2 Continuous (CONT) Mode. Continuous mode means the PLGR acquires and continues to track up to five satellites. Changes in the position and velocity are continuously reported. This mode allows full and accurate position, time, track, speed, and steering information.

3.5.3.2.1 Continuous mode is the power-up default when the unit is using external power. When using battery power, quick-fix mode is the power-up default, and continuous mode is accessed from the *SETUP MODE SELECTION* display.

NOTE

This mode uses the most power and may require more than one battery to complete a mission.

3.5.3.3 **Quick-fix (FIX) Mode.** Quick-fix mode means the PLGR acquires satellites and determines the present position, then automatically changes to standby (STBY) mode. The emphasis of this mode is on the speed of obtaining a position fix and on minimizing power usage. The PLGR uses much less power in standby mode than when tracking satellites.

3.5.3.3.1 Quick-fix mode is the power-up default when the unit is using battery power. When using external power, quick-fix mode is accessed from the setup mode selection display. The unit is full power until it obtains a position fix or times out (see sub-paragraph 3.5.7.2 for information on setting the timeout). It then goes to standby mode.

3.5.3.3.2 In standby mode, the PLGR no longer acquires or tracks satellites. Position and steering information is frozen, and current track and speed are zeroed. While in standby mode, data is reviewed, setup values changed, etc, with minimal battery drain.

3.5.3.4 **Averaging (AVG) Mode.** Averaging mode is for survey applications (see sub-paragraph 4.4.1). In this mode the unit must not move. Satellite signals are continuously received. The emphasis of this mode is on high accuracy and stability in the position solution. This mode is also used to improve performance in very low signal environments, such as under dense foliage (see sub-paragraph 4.4.9). To use this low signal search feature, select AVG mode from STBY mode. The search feature is not employed if AVG mode is selected from any tracking mode (i.e., CONT, *T-ONLY*, *FIX).*

3.5.3.5 **Time-only (TIME) Mode.** Time-only mode is for applications where the time output, *1PPS*, *SINCGARS*, or *HAVE QUICK*, is the only output used. In this mode the operator knows position, and only one satellite signal is necessary to provide full accurate time. The PLGR tracks up to five satellites. It solves time using only the operator-entered or confirmed position.

3.5.3.6 **Standby (STBY) Mode.** In standby mode, the PLGR accepts and displays keypad data, but does not acquire or track satellites.

3.5.3.6.1 The purpose of standby mode is to reduce power consumption while reviewing or entering waypoints, setup values, or other data. Standby mode is also available when using external power. The quick-fix mode goes to *STBY* after a fix is obtained and required data is collected. This allows the operator to observe position and nav data before turning the unit off.

3.5.3.6.2 When the receiver automatically transitions from *FIX* to *STBY* modes, the *FOM/error* indication on Present Position page and Nav pages will alternate with a time duration display which shows Minutes Since FIX (MSF). The FOM/error value shown is the last calculated FOM/error value. The Minutes Since Fix display has a range of 0 to 99 minutes, after which the Minutes Since Fix display will be replaced with "*OLD*".

NOTE

In *2dTNG* mode the elevation is held constant. In *3dTNG* mode the elevation is varied.

3.5.3.7 **Training (2dTNG and 3dTNG) Modes.** The PLGR does not track satellites in these modes. It generates simulated position and nav data for a moving scenario near Yuma, AZ. The PLGR acts like it is in continuous mode for training purposes.

3.5.3.8 Mission Rehearsal (RHRSL) Mode. The PLGR does not track satellites in this mode. It generates simulated position and navigation data for a moving scenario based on a route selected by the user. The elevation is held constant during the scenario, at the level entered by the user. The PLGR acts like it is in continuous mode for training purposes.

NOTE

The satellites shown on the satellite summary page (see sub-paragraph 4.2.4) while in rehearsal mode are not valid for the position shown on the position page (see sub-paragraph 4.2.2), and should not be used to plan satellite selection and/or deselection during an actual mission.

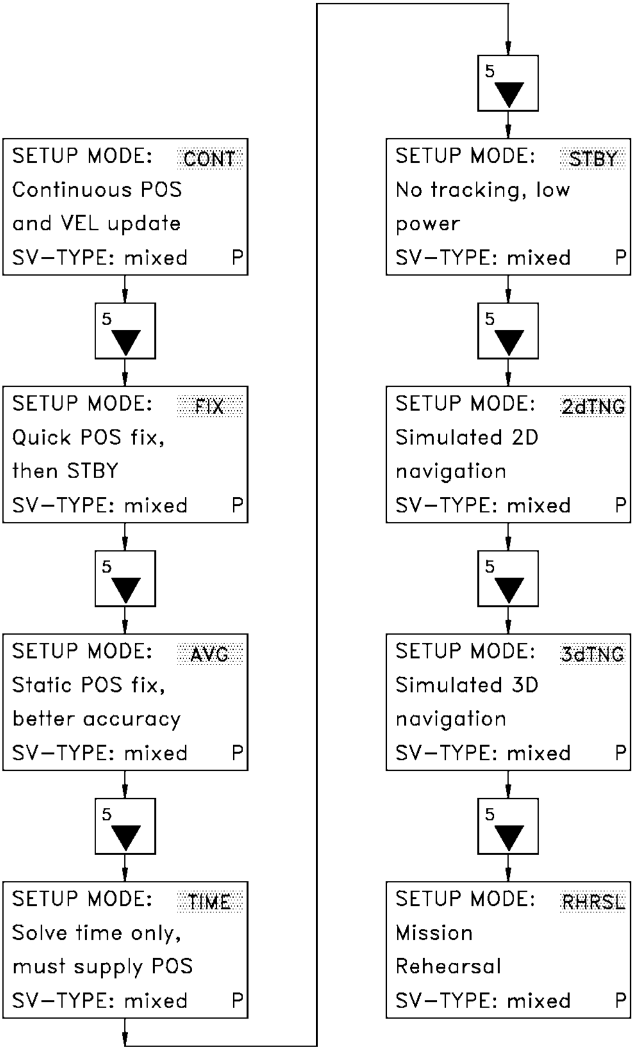


Figure 3-5 Operating Mode Displays.

3.5.3.9 <u>Satellite Type.</u> Two options are available to tell the PLGR what type of satellite codes to track: *mixed* and *all-Y*.

3.5.3.9.1 *Mixed* allows the PLGR to track any type of satellite signal (C/A code, P code, or Y code (if authorized)). *Mixed* mode is susceptible to spoofing (see sub-paragraph 6.1.2.3).

3.5.3.9.2 *All-Y* tells the PLGR to track only Y-code signals. When crypto keys are loaded, *all-Y* mode is not susceptible to spoofing. However, every so often (for various reasons) satellites stop broadcasting Y-code and broadcast only P-code signals instead, which causes a PLGR (once it gets its key for the day) that has SV-TYPE set to "*all-Y*" to stop tracking satellites and an 'Insufficient Y-Code SVS' warning is displayed. If this should occur, change the SV-TYPE to "*mixed*" to resume tracking satellites again.

3.5.4 <u>Selecting Coordinate System and Units.</u> The second page of the SETUP display is the coordinate system, and units selection page. The options available for each field are shown in Table 3-3.

Table 3-3 Coordinate System and Unit Option .

Parameter	**Options**
NOTE The selectable fields on this display page are highlighted in the display shown	SETUP UNITS MGRS-New Metric Elev: feet MSL ANGL: Deg True ⇕ P
Coordinate System	*MGRS - Old* (Military Grid Reference System, Old), position resolution to one meter *MGRS - New* (Military Grid Reference System, New), position resolution to one meter UTM/UPS (Universal Transverse Mercator/Universal Polar Sterographic), position resolution to one meter *L/L-dm* (Latitude/Longitude in degrees and minutes), position resolution to .001 minutes *L/L-dms* (Latitude/Longitude in degrees, minutes, and seconds), position resolution to .01 seconds *BNG* (British National Grid <Ord Surv GrBr 35>), position resolution to one meter *ITMG* (Irish Transverse Mercator Grid <Ireland 1965>), position resolution to one meter

Table 3-3 Coordinate System and Unit Option - Continued.

Parameter	**Options**
Distance and Velocity Units	*Metric* meters (m) - displayed as XXXX.X kilometers (km) - displayed as XXXX.XX kilometers per hour (kph) *English* feet (ft) - displayed as XXXX.X miles (mi) - displayed as XXXX.XX miles per hour (mph) *Nautical* yards (yd) - displayed as XXXX.X nautical miles (nm) - displayed as XXXX.XX knots (kts)
Elevation Units	*meter* *feet*
Elevation Reference	*MSL* (Mean Sea Level) *DTM* (Datum)
Angle Units	*Deg* (Degrees) *Mil*-µ (Mils) - **displayed as µ symbol**
North Reference	*Mag* (Magnetic) *Grid* *True*

NOTE

BNG and *ITMG* are unique coordinate systems. When selected, they override the previously selected datum with their own datum, *OGB-M* and *IRL*, respectively.

3.5.4.1 Coordinate System. The coordinate system selected affects the position and waypoint displays. Examples *MGRS (Old or New)*, *UTM/ UPS*, *L/L-dm.*, and *L/L-dms* formats are shown in Figure 3-6 through Figure 3-10.

3.5.4.1.1 *MGRS* maps are produced using two different systems. In the PLGR they are called *MGRS-Old* and *MGRS-New*. The following determines which one to use.

a. In certain geographical areas the second letter of the 100,000 meter square (see Figure 3-6) is shifted between the two MGRS systems as shown.

(1) Second letter: ABCDEFGHJKLMNPQRTSUV

(2) Shifted letter: LMNPQRSTUVABCDEFGHJK

NOTE

- If the second letter of the 100,000 meter square on the map being used is different from the one displayed, switch the PLGR to the other system *(MGRS-Old* to *MGRS-New* or vice-versa).

- If the second letter of the 100,000 meter square of the map being used is X, Y, or Z, set the PLGR to the *MGRS-Old* system.

b. A1so, since military maps include latitude and longitude coordinates you can load a waypoint in that coordinate format, then convert it to MGRS to determine which MGRS coordinate format to use *(OLD* or *NEW).*

NOTE

When using MGRS-(*Old/New*), there is no Zone number and the Grid Zone Designation is displayed as a single letter for Zones A, B, Y, and Z. When the grid zone Field is selected, a 00 is displayed, followed by *A*, *B*, *Y*, or *Z*.

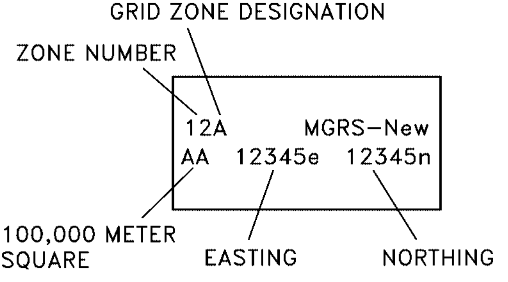


Figure 3-6 MGRS (Old/New) Position Format.

NOTE

When using *UTM*, a Zone number and Grid Zone Designation is displayed. When using *UPS*, there is no Zone Number. A *00* is displayed only when the grid zone field is selected, followed by *A*, *B*, *Y*, or *Z*.

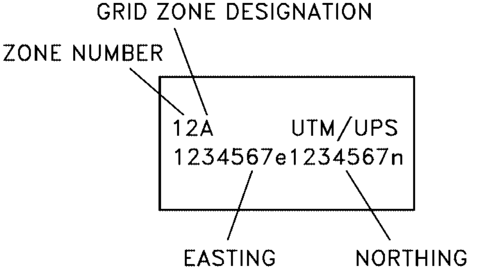


Figure 3-7 UTM/UPS Position Format.

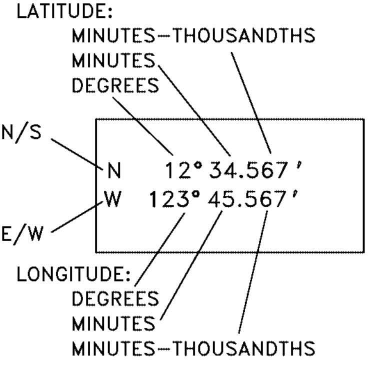


Figure 3-8 L/L-dm Position Format.

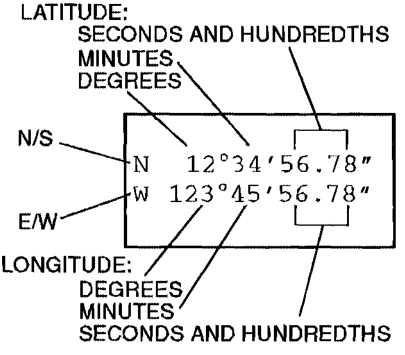


Figure 3-9 L/L-Dms Position Format.

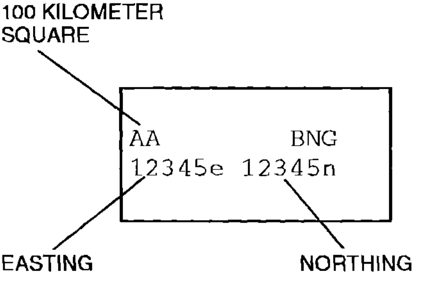


Figure 3-10 BNG/IMTG Position Format.

3.5.4.2 Selecting the Distance and Velocity Units. The distance units selected affects waypoint definition, speed and nav displays, Selecting Metric displays data in meters, kilometers, and kilometers per hour. Selecting English displays data in feet, miles, and miles per hour. Selecting Nautical displays data in yards, nautical miles, and knots. Distance units displayed switch to the larger unit at the following distances:

Feet to miles at 5280 ft
Meters to kilometers at 1000 m
Yards to nautical miles at 2025 yds

3.5.4.3 Selecting the Elevation Units. The elevation units selected affect position, waypoint, and nav displays. Select either feet or meters.

3.5.4.4 Selecting the Elevation Reference. The elevation reference selected affects position and waypoint displays. Select Mean Sea Level *(MSL)* for normal operations. Select Map Datum *(DTM)* for special topographic applications.

3.5.4.5 Selecting the Angular Units. The angle units selected affect angular displays, such as azimuth. The angle units may be in degrees or gunner's mils. When *"Deg"* angular units are selected, the entry MUST be in *degrees and tenths of degrees (nnn.n°).* Use the following conversion chart in Table 3-4.

NOTE

To convert from minutes to degrees, you simply divide by sixty.

Table 3-4 Angular Display Conversion Chart .

Minutes to Degrees		
1-6’	=	n.1°
7-12’	=	n.2°
13-18’	=	n.3°
19-24’	=	n.4°
25-30’	=	n.5°
31-36’	=	n.6°
37-42’	=	n.7°
43-48	=	n.8°
49-54’	=	n.9°
55-60’	=	n+1.0°

3.5.4.6 <u>Selecting the North Reference.</u> The north reference selected affects nav, track, and waypoint displays. The option chosen causes the displays to reference True, Magnetic, or Grid north.

3.5.5 <u>Selecting Magnetic Variation.</u> The third page of the *SETUP* display is used to choose the source of the magnetic variation (the *TYPE* field). It lets you enter the magnetic variation in a selectable angle format if the chosen source allows it. The selectable fields on this display page are highlighted in the displays shown. Note that magnetic variation may be entered only if the selected *TYPE is Entr* (see sub-paragraph 3.5.5.1). The available options for each selectable field are shown in Table 3-5.

NOTE

Choosing the entered or waypoint operations results in a constant *MAGVAR* used for all operations. This includes operations based on *Present Position* or *Waypoint Positions*.

3.5.5.1 Magnetic Variation Source. There are three possible choices for the source of the magnetic variation values shown in Table 3-5. These choices are:

Calculated - With this choice, the magnetic variation (MAGVAR) is calculated by the PLGR based on the MAGVAR of the last stored present position for all operations.

```
SETUP   MAGVAR
TYPE:  Calc    deg
       WMM    1995
                ⇕ P
```

Entered - With this choice, the magnetic variation direction and value are entered by the user. The entered MAGVAR is used by the PLGR for all operations.

```
SETUP   MAGVAR
TYPE:  Entr    deg
       E000.0°
                ⇕ P
```

Waypoint - With this choice, the magnetic variation is set to the magnetic variation stored for the current 'TO' nav waypoint. If no MAGVAR is stored for the waypoint, the value is calculated at that waypoint position. In either case, the resulting value is used by the PLGR for all operations.

```
SETUP  MAGVAR
TYPE:  Wp   deg

                ⇕ P
```

Table 3-5 Magnetic Variation Options .

Parameter	Options
Type	*Calc* (Calculated) *Entr* (Entered) *Wp* (Waypoint)
Unit	deg (degrees) dm (degrees/minutes) mil-µ (mils)
Magnetic Variation Direction	E W
Magnetic Variation Value*	000.0° to 180.0° or 0 to 3200 mils 000° 00' to 179° 59'
*Displayed only if *Type=Entr*	

3.5.5.2 <u>Magnetic Variation Value.</u> Magnetic variation is the east or west difference between True and Magnetic north. This value varies from location to location, and changes over time. The primary sources of magnetic variation are the Earth's core, crust, and atmospheric effects.

3.5.5.2.1 In "*Calc*" mode, the PLGR utilizes an internal program which automatically calculates magnetic variation (MAGVAR) according to the World Magnetic Model (WMM). It is important to realize that the model primarily characterizes the effect of the Earth's core on magnetic variation, and not local geographical crust or atmospheric effects. Declination anomalies of 2 to 3 degrees between the model and what is actually seen on a compass are relatively common, and in rare cases, differences of 10 degrees may occur.

3.5.5.2.2 The issue date of the current internal MAGVAR is displayed when the "*Calc*" option is selected. The MAGVAR is normally updated at 5-year intervals.

3.5.5.2.3 Aeronautical and marine charts contain a diagram that shows *MAGVAR;* grid maps contain a diagram that shows the *Grid Magnetic (G-M) Angle.* The following diagram in Figure 3-11 shows an example of the relationship between *True North, Grid North,* and *Magnetic North.*

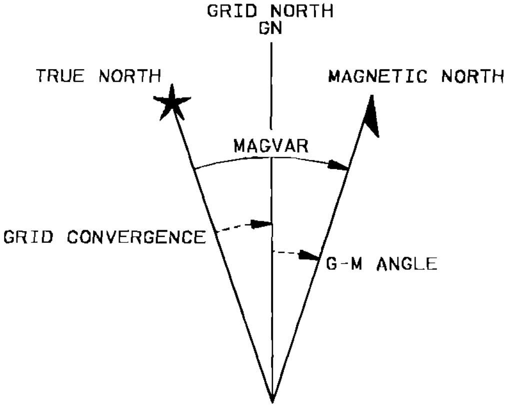


Figure 3-11 True/Grid/Magnetic Relationships.

3.5.6 Selecting Setup Options. The fourth page of the *SETUP* display is used to customize the displays. The available options for each field are shown in Table 3-6.

Table 3-6 Setup Display Options .

<table>
<tr><th>Parameter</th><th>Options</th></tr>
<tr><td>NOTE

The selectable fields on this page are highlighted in the display shown.</td><td>SETUP
Elhold: automatic
TIME Loc=Z-05:00
ERR: FOM ⬍ P</td></tr>
<tr><td>Elevation Hold Mode Enable</td><td>automatic
manual</td></tr>
<tr><td>Time Display Format</td><td>Zulu
Local (with offsets)</td></tr>
<tr><td>Error Display Format</td><td>FOM (Figure of Merit)* or Distance (see sub-paragraph 3.5.6.3)</td></tr>
<tr><td colspan="2">* Choosing FOM as the error display format specifies that position error is shown as a FOM and that time error is shown as a Time Figure of Merit (TFOM).</td></tr>
</table>

3.5.6.1 **Elevation Hold Mode Enable.** Elevation hold mode is used to increase the accuracy of the PLGR when it has poor vertical determination, such as:

a. When only three satellites are available due to poor satellite geometry, reduced satellite availability (health), or line-of-sight blockage of satellite signal due to terrain, vegetation, buildings, vehicles, or other obstructions.

b. When at least four satellites are available, but there is poor satellite geometry.

3.5.6.1.1 If *automatic* is chosen, the PLGR automatically enables and disables elevation hold mode when the conditions are right.

3.5.6.1.2 If *manual* is chosen, an *EL** shows up on line four of the position coordinates display (next to the elevation) when either of the conditions above occurs. The *EL** indicates that elevation hold mode is allowable, but not enabled. The user may or may not choose to enable elevation hold mode. See sub-paragraph 4.2.2.1 for more information on elevation hold mode.

3.5.6.2 <u>Selecting the Time Display Format.</u> Time is displayed in *ZULU* or local format. Local format is *ZULU* offset to the nearest half-hour time zone (Loc=Z+01:00, Loc=Z-01:00, etc.). The time display shows *L* for Local or Z for Zulu time format.

3.5.6.3 <u>Selecting the Error Display Format.</u> As shown in Table 3-6, position error is displayed either as a Figure of Merit *(FOM)* or as a distance.

3.5.6.3.1 When *FOM* is selected for the position error format, time error is displayed as Time Figure of Merit *(TFOM)*. Table 3-7 shows how the *TFOM* compares to time error.

3.5.6.3.2 <u>Figure of Merit and Time Figure of Merit.</u> The Figure of Merit *(FOM)* and Time Figure of Merit *(TFOM)* is a number from 1 to 9. The number reflects the total Estimated Position Error *(EPE)* and estimated Time Error *(ETE)* as shown in Table 3-7 and Table 3-8. Some conditions that affect *FOM* and *TFOM* are: inappropriate operating *MODE*, no current or loaded *crypto* keys, poor *satellite geometry*, not enough satellites due to *antenna masking* (the inability of the PLGR to receive the satellite signals), or the age of the Differential GPS (DGPS) corrections (only when using DGPS corrections).

Table 3-7 Figure of Merit (FOM) to Estimated Position Error .

FOM Value	Estimated position error
1	≤25 meters (82 ft/27 yd)
2	≤50 meters (164 ft/55 yd)
3	≤75 meters (246 ft/82 yd)
4	≤100 meters (328 ft/109 yd)
5	≤200 meters (656 ft/219 yd)
6	≤500 meters (1640 ft/547 yd)
7	≤1000 meters (3280 ft/1093 yd)
8	≤5000 meters (16,400 ft/5466 yd)
9	>5000 meters (16,400 ft/5466 yd)

3.5.6.3.3 Selecting the Distance Units. When position error is shown as a distance, the distance units displayed correspond with the distance units selected on the units selection page of the *SETUP* display (see subparagraph 3.5.4.2). Time error is shown as ± time when position error is shown as a distance.

a. If distance units=*Metric*, then position error is shown in meters or kilometers (±*m or km*).

b. If distance units=*English*, then position error is shown in feet or miles (±*ft or mi*).

c. If distance units=*Nautical*, then position error is shown in yards or nautical miles (±*yd or nm*).

Table 3-8 Time of Merit (TFOM) to Estimated Time Error .

FOM Value	Estimated position error
1	≤1 nanosecond
2	≤10 nanoseconds
3	≤100 nanoseconds
4	≤1 microsecond
5	≤10 microseconds
6	≤100 microseconds
7	≤1 millisecond
8	≤10 milliseconds
9	>10 milliseconds

3.5.7 Selecting the Datum/Controlling the Automatic-Off Timer.

The fifth page of the *SETUP* display is used to select the datum and to control the automatic-off timer. The available options for each field are shown in Table 3-9.

Table 3-9 Datum and Automatic-Off Timer Options .

Parameter	Options
NOTE The selectable fields on this display page are highlighted in the display shown.	SETUP DTM: WGD WGS-84 AUTOMATIC OFF TIMER 5-min ⬍ P
Datum (DTM)	See Table 3-10.
Automatic-Off Timer	*off* *5 minutes* *15 seconds* *20 minutes*

3.5.7.1 <u>Datum Selection.</u> The datum display has the datum identifier, that is scrollable, on line 1. It has a datum label field on line 2 (display only). The datum label corresponds to the datum label identifier.

3.5.7.1.1 Fifty map datum sets are available within the PLGR. Maps have two associated datums: *horizontal* and *vertical (altitude).* The selection of a map datum in Table 3-9 defines a horizontal datum and spheroid (ellipsoid). The PLGR allows two (2) user-defined datums. User defined datums are discussed in sub-paragraph 3.7.10.

NOTE

- Always check the name of the Horizontal Datum and Spheroid (Ellipsoid) printed on your map. For proper orientation with your map, select the map datum and spheroid (ellipsoid) from Table 3-10 that is the same as your map. If the horizontal datum or spheroid (ellipsoid) on your map is NOT the same as any datum/spheroid (ellipsoid) pair in Table 3-10, the positions displayed on the PLGR may not compare to your map. You should use a user defined datum (see sub-paragraph 3.7.10). The use of a user-defined datum **MUST** be coordinated with Unit or higher Operations representatives.

- When coordinate system *BNG* or *ITMG* is selected in *SETUP*, datum *OGB-M* or *IRL* is automatically set on the datum page.

- If after selecting *BNG* or *ITMG*, the *OGB-M* or *IRL* datum is changed on the datum page, the coordinate system reverts to L/L-dms.

- If after selecting *BNG* or *ITMG*, the coordinate system is changed from *BNG* or *ITMG*, the datums *OGB-M* or *IRL* remain.

Table 3-10 Map Datum and Regional Identifiers .

Identifier	Horizontal datum	Spheroid (Ellipsoid)
ARF-M	ARC 1950 - Mean Value	Clarke 1880
ARS	ARC 1960	Clarke 1880
AUA	Australian Geodetic 1966	Australian National
AUG	Australian Geodetic 1984	Australian National
BBOHM	Bessel-Bohm	Bessel 1841
BOO	Bogota Observatory	International 1924
CAI	Campo Inchauspe 1969	International 1924
CAP	Cape	Clarke 1880
CGE	Carthage	Clarke 1880
CHI	Chatham Island Astro 1971	International 1924
CHU	Chua Astro	International 1924
COA	Corrego Alegre	International 1924
EUR-A	European 1950-West Europe	International 1924
EUR-E	European 1950-Cyprus	International 1924
EUR-F	European 1950-Egypt	International 1924
EUR-H	European 1950-Iran	International 1924
EUR-J	European 1950-Sicily	International 1924
EUS	European 1979	Intemational 1924
FAH	Oman	Clarke 1880
GAA	Gan 1970	Intemational 1924
GEO	Geodetic Datum 1949	International 1924
HJO	Hjorsey 1955	International 1924
IND-I	Indian-India, and Nepal	Everest 1956
INF-A	Indian 1954 -Thailand	Everest 1830
IRL	Ireland 1965	Modified Airy
KEA	Kertau 1948	Everest 1948
LIB	Liberia 1964	Clarke 1880
LUZ-A	Luzon-Philippines	Clarke 1866

Table 3-10 Map Datum and Regional Identifiers - Continued.

Identifier	Horizontal datum	Spheroid (Ellipsoid)
MAS	Massawa	Bessel 1841
MER	Merchich	Clarke 1880
MIN-B	Minna-Nigeria	Clarke 1880
NAH-C	Nahrwan-Saudi Arabia	Clarke 1880
NAR	North American 1983	GRS 80
NAS-C	North American 1927-CONUS	Clarke 1866
NAS-D	North American 1927-Alaska	Clarke 1866
NAS-E	North American 1927-Canada Mean Value	Clarke 1866
NAS-N	North American 1927-Central America	Clarke 1866
OEG	Old Egyptian 1907	Helmert 1906
OGB-M	Ordnance Survey Great Britain 1936-Mean Value	Airy
OHA-M	Old Hawaiian - Mean Value	Clarke 1866
PIT	Pitcairn Astro 1967	International 1924
QAT	Qatar National	International 1924
QUO	Qornoq	International 1924
SAN-M	South America 1969 - Mean Value	South America 1969
SCK	Schwarzeck	Bessel 1841
TIL	Timbalai 1948	Everest
TOY-M	Tokyo - Mean Value	Bessel 1841
WGD	WGS 1984	WGS-84
WGS	WGS 1972	WGS-72
ZAN	Zanderij	International 1924
USER 1	User Local #1	as required
USER 2	User Local #2	as required

3.5.7.2 **Automatic-Off Timer.** The automatic-off timer is used to save battery power. It is enabled only when battery power is being used.

3.5.7.2.1 The automatic-off timer sets the amount of time the PLGR stays on after a position fix is obtained. At the end of the time limit, the PLGR OFF display (discussed in paragraph 3.2) comes up.

a. Starts immediately when standby mode is selected.

b. Starts when a good solution is obtained in FIX *mode* and after switchover to standby.

c. Starts when a good solution is obtained in continuous mode.

d. Starts without a good solution if it cannot be obtained after fifteen minutes in continuous or quick-fix mode.

e. Resets (starts over) every time a keystroke is entered or data is input via the serial data port.

3.5.8 **Data Interface Selection.** The sixth page of the SETUP display allows the user to select the serial port configuration. It also allows you to select or deselect HAVE QUICK, and to control the one-pulse-per-second (1PPS) mode. The available options for each field are shown in Table 3-11.

Table 3-11 Data Interface Options .

Parameter	**Options**
NOTE The selectable fields on this page are highlighted in the display shown.	SETUP I/O SERIAL: Standard HAVEQUICK: ON 1PPS: UTC ⬍ P
Serial Port	*Standard* *Instrum* (Instrumentation) *Custom*
HAVE QUICK	*Off* *On*
1PPS	*Off* *UTC* *T-Mark* (Time Mark)

3.5.8.1 <u>Serial Port Configuration.</u> As shown in Table 3-10, three serial port configurations are available: *Standard*, *Instrum*, and *Custom*. These configurations are discussed in the following paragraphs.

3.5.8.1.1 <u>Standard Configuration.</u> The standard (RS-232) serial port configuration transfers data (input and output) at 9600 bits per second. Data is transferred with 1 stop bit, no parity, and word count in number of 8-bit words. Choose the standard configuration to communicate with external equipment, such as another PLGR or a personal computer (PC).

3.5.8.1.2 <u>Instrumentation Configuration.</u> The instrumentation (RS-422) serial port configuration accepts input data at 19,200 bits per second. Output data is transferred at 76,800 bits per second. Data is transferred with 1 stop bit, odd parity, and word count in the number of 16-bit words. Choose the instrumentation configuration to communicate with external equipment for test.

3.5.8.1.3 Custom Configuration. The seventh and eighth page of the *SETUP* display are available to the user only if the sixth page (Serial Port Configuration) has *Custom* selected.

a. Choose the custom configuration to communicate with equipment using a Differential GPS *(DGPS)* or a National Marine Electronics Association *(NMEA)* interface.

b. Choosing the custom configuration causes two optional setup displays to be enabled. One is the custom setup page for the data port. The other is the custom setup page for NMEA, which is only available if the custom mode out is set to *NMEA*. The selectable fields on these display pages are highlighted in the displays shown. The available options for each field are shown at right.

SETUP	IN	OUT
MODE:	STD	STD
BAUD:	9600	9600
PARITY:	N	N ⇕ P

SETUP NMEA			
SENTENCE SET			
RMC	---	---	---
---	---	---	⇕ P

c. Choose the custom mode to communicate with equipment using a DGPS (Differential GPS) or *NMEA* (National Marine Electronics Association) interface. All NMEA positions are in WGS-84 datum.

3.5.8.1.4 Mode Configuration. As shown in Table 3-12, four mode configurations are available: DGPS NMEA, DGPS-Standard, Standard-NMEA and Standard-Standard. These configurations are discussed in the following paragraphs.

Table 3-12 Custom Interface Options .

Parameter	Options
Mode	*DGPS-NMEA* *DGPS-Standard* *Standard-NMEA* *Standard-Standard*
BAUD	*300* *600* *1200* *2400* *4800* *9600*
PARITY	*N* (None) *O* (Odd) *E* (Even)
NMEA Sentence Set	APA, APB, BWC, GGA, GLL, GSA, GSV, RMA, RMB, RMC, VTG, WCV, XTE, ZTG

a. **DGPS-NMEA Configuration.** The input data to the Serial Port is configured to the *DGPS* baud rate and *DGPS* parity. Only DGPS input messages are processed by the PLGR. The output data is transferred at 4,800 bits per second. Data is transferred with 1 stop bit and no parity.

b. **DGPS-Standard Configuration.** The input data to the Serial Port is configured to the DGPS baud rate and DGPS parity. The Serial Port output data continues to output data as described in sub-paragraph 3.5.8.1.1.

c. **Standard-NMEA Configuration.** The Serial Port output data continues to process input data as described in sub-paragraph 3.5.8.1.1. The output data is transferred at 4,800 bits per second. Data is transferred with 1 stop bit and no parity.

d. **Standard-Standard Configuration.** The Serial Port output data continues to process data as described in sub-paragraph 3.5.8.1.1.

e. **Baud Rate.** The baud rate of the DGPS input data. No other mode has selectable baud rates.

f. **Parity.** The parity of the DGPS input data. No other mode has a selectable parity.

3.5.8.2 HAVE QUICK Control. The PLGR provides exact time information in the HAVE QUICK format via the data port. The HAVE QUICK data port is enabled by setting HAVE QUICK to ON. When HAVE QUICK is enabled, the PLGR outputs HAVE QUICK data provided that the Time of Merit (TFOM) is less than or equal to 7, and the PLGR is operating in either CONT or FIX modes.

3.5.8.3 1PPS Configuration. This configuration selects a one pulse-per-second output via the data port connector J2. 1PPS output is used for synchronization of the PLGR with external equipment.

a. If *OFF* is chosen, the 1PPS output is disabled.

b. If *UTC* is chosen, the 1PPS signal output is synchronized with UTC one-second rollover (asynchronous with the PLGR 1-Hz tracking sequence).

c. If *T-Mark* is chosen, the 1PPS signal output is not synchronized with the UTC one-second rollover (synchronous with the PLGR 1-Hz tracking sequence).

3.5.9 <u>Automark Mode.</u> The seventh page of the SETUP display controls the automark mode. Automark mode is used to periodically 'wake up' the PLGR to do a position fix, that is stored as a waypoint. After the fix is obtained and stored, the PLGR returns to the mode it was in. The automark page has two formats: the display page when automark mode is set to off and the display page when automark is enabled.

CAUTION

Automark must be manually disabled if *rpt* is selected. The PLGR wakes up from any mode, even the *OFF* mode, and mark waypoints until automark is disabled. Failure to disable *rpt* may cause excess battery drain.

3.5.9.1 <u>Automark Set To Off.</u> When the automark mode is set to off, the display page allows automark mode to be enabled. The available options of each field are shown in Table 3-13. Perform the following steps.

a. On line 2, choose the mode option (once or rpt) and the starting waypoint number.

b. On line 3, enter the time to begin getting automatic marks.

c. On line 4, enter the desired time interval (hhmm) between automarks (if rpt was selected on line 2).

Table 3-13 Automark Display Options (If Automark Mode is Off) .

Parameter	**Options**
NOTE The selectable fields on this page are highlighted in the display shown.	SETUP AUTOMARK MODE: off WP 001 31-01-93 1200 L REPEAT 02 h 00 m ⬍ P
Mode	*off* *rpt* (repeat) *once*
Starting waypoint number	001 to 999
Date	Display only - current date
Start time	Must be ≤ 12 hours in the future
Repeat interval	Hours and minutes

3.5.9.2 <u>Automark Is Enabled.</u> When the automark display page is enabled, the page shows the automark status and allows the operator to disable automark mode. The fields on this display are described in Table 3-14.

Table 3-14 Automark Display Options (If Automark is Once or Rpt.) .

Parameter	**Description**
NOTE The OFF field is the only selectable field on this page.	SETUP AUTOMARK MODE: once WP 002 NEXT MARK: 0000 TOTAL 0 OFF ⬍ P
Current mode	Display only - once or rpt
Waypoint number	Display only - next waypoint that will be used.
Next mark	Display only - time of next automark
Total	Display only - total number of waypoints that are marked
Off	If selected, disables automark mode

NOTE

Bullseye is a **Common Reference Point.** There must be waypoints loaded in the PLGR when the SETUP *BULLSEYE* display is selected. If there are no waypoints, the display shows “Not enough waypoints defined.”

3.5.10 <u>Bullseye Selection.</u> The eighth page of the *SETUP* display allows the Bullseye function to be switched ON or OFF. This setup page has two formats. The first format is the display page that comes up if the Bullseye function is set to *OFF*. To switch from OFF to ON, place the cursor on the SET *BULLSEYE* field, and press the *Up*- or *Down-arrow* key.

a. The default state (after zeroize or all memory cleared) for the Bullseye function is OFF.

b. When the Bullseye function is ON, the second and third lines allow the user to select Bullseye 1 or 2, and to select one stored waypoint for Bullseye 1 and the same or another stored waypoint for Bullseye 2. This display page also allows the user to turn off the Bullseye function. The available options for each field are shown in Table 3-15.

Table 3-15 Setup Bullseye Options (If Bullseye Function is On) .

Parameter	**Options**
NOTE • The selectable field, highlighted on the top display, allows the Bullseye function to be turned on. • The selectable fields on this display page are highlighted in the bottom display.	SET BULLSEYE ⬍ OFF ⬍ P SET BULLSEYE :ON BULLSEYE: 1 WP 001⬍ MARK001 P
Bullseye function	On Off
Bullseye number	1 2
Waypoint number and waypoint name	Number and name of any existing waypoint

3.5.10.1 <u>Selecting the Bullseye Numbers.</u> Two distinct Bullseye reference waypoints (Bullseye 1 and Bullseye 2) can be specified. To change the Bullseye number, place the cursor on the *BULLSEYE* field and press the *Up*- or *Down-arrow* key to toggle between the numbers 1 and 2.

3.5.10.2 **Selecting the Bullseye Reference Waypoint.** Placing the cursor on the WP field allows the user to select one of the stored waypoints for the Bullseye reference waypoint. (This waypoint will become the Bullseye reference waypoint associated with the Bullseye number appearing on line 2 of the display.) If the *NUM LOCK* key has not been pressed, the existing waypoint numbers can be scrolled using the *Up*- or *Down-arrow* key. Pressing the *NUM LOCK* key while on this display page allows an existing waypoint number to be entered. (The display will not accept a waypoint number which has not been previously defined.) If the cursor is moved to the right from the WP field, the ⬍ symbol appears between the waypoint number and waypoint name fields. Pressing the *Up*- or *Down-arrow* key scrolls through the waypoint list in alphabetic sequence.

3.5.10.3 **Storing and Clearing Bullseye Reference Waypoints.** The Bullseye reference waypoint numbers are stored in memory; they are cleared when the Bullseye function is turned off, or the reference waypoint is cleared.

3.5.11 **Operator ID.** The ninth page of the SETUP display allows the entry of an Operator ID. The Operator ID is an alphanumeric identifier that has a default of WP000.

3.5.11.1 There are twelve character positions available for the Operator ID. Each position must be scrolled individually, though it is not required that all positions contain a character.

3.5.11.2 When the cursor is first moved to the Operator ID field, all twelve character positions flash. Pressing the *Up*- or *Down-arrow key* changes the blank character positions to underscores, and the first position flashes. Pressing the *Up*- or *Down-arrow key* again begins data entry for the first character position. The characters available to be entered for the Operator ID are.

a. Letter A-Z

b. Numbers 0-9

c. Dash(-), Slash(/), Period(.), and the underscore serves as a Blank( ).

3.5.11.3 Starting from an underscore, the *Up-arrow* key begins scrolling through letters A-Z then numbers 0-9, dash (-), slash (/), (.) period and blank ( ). Conversely, the *Down-arrow* key begins scrolling with blank ( ), period (.), slash (/), dash (-), numbers 9-0, and then letters Z-A.

```
SETUP
OPERATOR ID:
WP000 __________
                 P
```

3.5.12 **Approach.** The tenth page of the *SETUP* display allows the user to define an extension to the waypoint navigated to during approach, thus reducing XTE and AZ wandering. The extension allows the PLGR to cross a waypoint, without circling the waypoint.

3.5.12.1 The extension is entered in feet with a range of 1,000 to 15,000 feet (defaulted to 8,000 feet), and is used only when the nav method is *APPROACH*. The selectable field is highlighted in the display shown below.

SETUP APPROACH	
Course to WP	
EXTNSN: 08000 ft	EXTENSION IN FEET
⬍ P	(RANGE 1 000-15 000 FT)

NOTE

Once the rehearsal mode scenario has started, changes made to the defined route or ground speed will not take effect until the scenario is stopped and restarted.

3.5.13 Rehearsal (Tutorial Function). The eleventh page of the SETUP display allows the user to modify the Tutorial (see Chapter 13) function to use a predefined route, instead of the predefined Yuma, Arizona tutorial. The fields on this display are described in Table 3-16.

Table 3-16 Setup Rehearsal Options .

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td colspan="2">NOTE

• Route number, ground speed (GS) and elevation (EL) are user-defined. These selectable fields are highlighted in the top display shown at right.

SETUP REHEARSAL
RTE 01 USED
GS: 7 kph
EL: + 00000 m D ⬍ P

• Rehearsal uses a specified route as the mission definition. If Rehearsal mode is selected and the selected route is undefined, the second display shown comes up and the PLGR automatically goes to STBY mode.

SETUP REHEARSAL
Not Enough
Routes Defined
⬍ P</td></tr>
<tr><td>Route Number</td><td>01-15; defined routes only</td></tr>
<tr><td>Ground Speed</td><td>4-999 mph (English)
4-999 kts (Nautical)
7-999 kph (Metric); units selectable on setup display (see paragraph 3.5.4)</td></tr>
<tr><td>Elevation</td><td>-99999 to +99999; units selectable on setup display (see paragraph 3.5.4)</td></tr>
</table>

WARNING

Without crypto keys, you cannot compensate for the selective availability errors. You cannot read the encrypted signals. You have no protection against spoofing. Your receiver still operates but cannot be used for combat operations.

CAUTION

After turn on, you can quickly decide if crypto keys are installed. Select *MENU*, second page. If you do not see “CRYPTO” displayed on line 4, crypto keys are not installed or are not valid, and you have an SPS receiver.

NOTE

Crypto keys are discussed in Appendix A. You will be provided with the proper type of key for your mission.

3.6 CRYPTO VARIABLE OPERATIONS.

The GPS Control Segment, at certain times, causes the satellites to transmit false data to the users (i.e., PLGR). This is called Selective Availability (SA). To compensate for this, the PLGR uses crypto *keys* to correct the false data and provide full accurate performance.

3.6.1 Encrypted Signals. Some signals transmitted by the satellites are encrypted to deny certain users the reception of those signals. This is called anti-spoofing (A-S). Entering crypto keys allows the PLGR to receive those signals, when available.

CAUTION

The PPS-SM does NOT protect classified waypoints. When classified waypoints; are stored in the PLGR, the PLGR is classified at the same level as the waypoints.

NOTE

- The PLGR has a National Security Agency (NSA) module that stores the crypto keys. Since the crypto keys are stored in this tamper-proof module (called a Precise Positioning Service-Security Module, or PPS-SM), the PLGR is NOT classified when crypto keys are installed.

- Displays described in this paragraph are available *only if* the unit contains crypto keys. To enter crypto keys into a receiver that has no crypto keys (the CRYPTO option is not available), see sub-paragraph 3.6.3, sub-paragraph 3.6.4, or use the INIT page. (See sub-paragraph 3.7.11.)

- The PLGR should not be zeroized before the new Group Unique Variable (GUV) key is loaded. The new GUV key can be loaded into the PLGR along with the old one. The PLGR will switch keys automatically when necessary. Check with your COMSEC custodian 3-6 weeks prior to expiration to assure you will receive a replacement when required.

3.6.2 Accessing the Crypto Variable Display. The crypto, variable displays are, accessed by pressing the *MENU* key until the *MENU* display with CRYPTO comes up. The crypto variable displays are shown in Table 3-17.

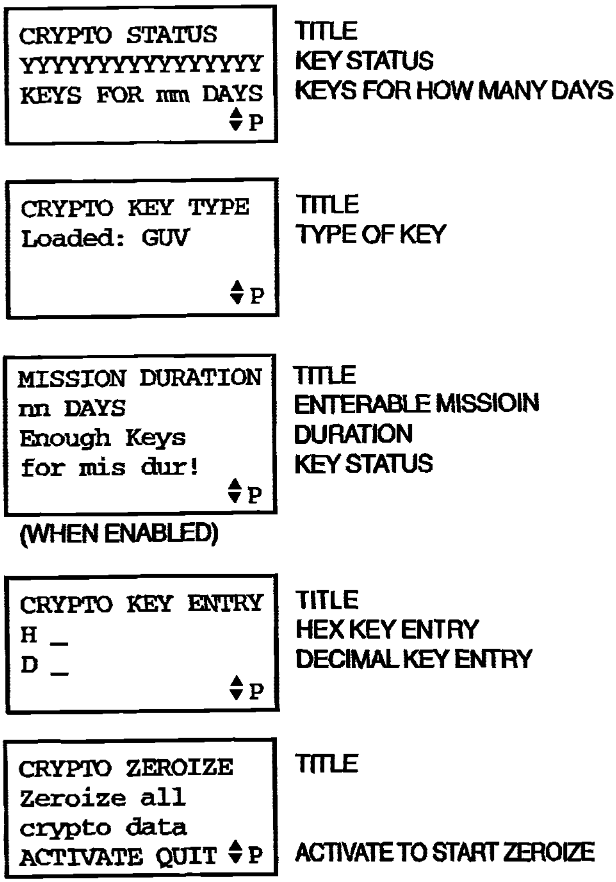


Figure 3-12 Crypto Variable Display Pages.

3.6.3 Entering Crypto Key. Crypto keys can be electronically entered into the PLGR using either a KYK-13, KOI-18 and the CYZ-10. The PLGR must be turned on and not in self-test to load crypto keys. Entering crypto keys protects the user from intentionally degraded accuracy. If the unit does not contain crypto keys, no indication is given to the operator that SA/A-S operation is possible. Refer to Table 3-17 through Table 3-20.

Table 3-17 Crypto Status Display .

NOTE This display is only available if the PLGR contains crypto keys. To enter crypto keys with the keyboard into a PLGR that has no keys, refer to INIT subparagraph 3.7.8.	CRYPTO STATUS YYYYYYYYYYYYYYYY KEYS FOR mm DAYS ⬍ P
Line 1.	Title.
Line 2.	SA/A-S information message. 16 character message *(Have today's key*, *Wait for SV data*, *No key for today*, *Incorrect Key*, *or ***Key* Loaded***).
Line 3.	Displays number of days for which the PLGR contains valid daily crypto keys. When CVW is loaded, number of days is 00 to 41. When GUV is loaded, number of days is 00 to 02.

Table 3-18 Crypto Key Type Display .

CRYPTO KEY TYPE LOADED: GUV P	OR CVW
Line 1.	Title.
Line 2.	Display type of key selected by the user. Toggles between GUV or CVW. This selection is based on the type of key loaded by the COMSEC custodian. If user indicates GUV, the *Mission Duration Page* (below) is hidden, since mission duration does not apply when GUV keys are used.

Table 3-19 Mission Duration Page (When Enabled).

MISSION DURATION nn DAYS Enough Keys for mis dur! P	OR TOO MANY KEYS
Line 1.	Title.
Line 2.	Enterable mission duration of 00 to 41 days.
Line 3, 4.	Display status of keys.

Table 3-20 Crypto Key Entry Via Keypad .

CRYPTO KEY ENTRY H _ D _ ⬍ P	
Line 1.	Title.
Line 2.	Hexadecimal crypto key, initialized to all blanks.
Line 3.	Decimal crypto key, initialized to all blanks.
Line 4.	Empty or entry line counter, and paging field.

3.6.3.1 How To Enter A Crypto Key.

a. The crypto key fields are initialized to blanks.

b. A crypto key consists of four line entries of 8 hexadecimal characters or 10 decimal digits per line.

c. If no entry is made on a line (all blanks), the cursor moves to the next field on the page. Any previous entries on the line are discarded. If a nonblank entry is made on a line, the cursor goes back to the beginning of line for the next entry. It then increments the entry line counter on line 4.

d. After the fourth nonblank entry the crypto key is sent to the PPS-SM.

e. The cursor moves to the paging field after all four lines of the crypto key are entered.

f. Bring up the CRYPTO pages from the system *MENU*. Verify the crypto key status.

g. Enter the key type loaded on the Crypto Key Type Display. See Table 3-18.

3.6.3.2 Crypto Key Entry Via KYK-13.

a. Connect the KYK-13 to the J1 port on the PLGR. The PLGR is turned on and not doing self-test.

b. Set the KYK-13 selector switch to the position that contains the crypto key.

c. Set the KYK-13 mode switch to ON. The light on the KYK-13 flashes, showing a successful crypto key load.

d. Set the KYK-13 mode switch to OFF. Disconnect the KYK-13 from the PLGR.

e. Bring up the CRYPTO pages from the system MENU. Verify the crypto key status.

3.6.3.3 Crypto Key Entry Via KOI-18 (Special Screen).

a. Connect the KOI-18 to the J1 port on the PLGR. The PLGR is turned on and not doing self-test.

b. Press the *MENU* key until the *MENU* display with KOI-18 comes up.

c. Select and activate the KOI-18. See the display shown.

KOI-18 load:
Select LOAD then
pull tape
LOAD QUIT

d. Select and activate LOAD. (Press the down arrow key.) Then immediately pull the paper tape through the K0I-18.

e. After loading, select and activate QUIT.

f. Bring up the CRYPTO pages from the system *MENU*. Verify the crypto key status.

g. Disconnect the KOI- 18 from the PLGR.

3.6.3.4 <u>Crypto Key Entry Via AN/CYZ-10 (Special ANCD).</u>

a. Turn on the ANCD, read *"Radio/SOI/SUPERVISOR"*.

b. Enter *RADIO,* read *"SEND/RECEIVE/DATABASE/SETUP/* COMSEC/TIME".

c. Enter *COMSEC*, read *"VG/LD/RV/AK/MK/VU"*.

d. Enter *LD*, read *"Select TEK/KEK"*.

e. Enter *TEK*.

f. Select the desired GPS key, then press ENTER.

g. Enter *QUIT*, read *"Connect ANCD to RT ↓"* - (DO NOT comply).

h. Press ↓, read *"Press LOAD on RT"* - (DO NOT comply).

i. Turn the PLGR on, wait for self-test to complete.

j. Connect ANCD to the J1 port on the PLGR. GPS key transfers automatically.

k. The ANCD reports: “1 Keys Transferred”. The PLGR reports: “Key Loaded”.

l. Bring up the CRYPTO pages from the system MENU. Verify the Crypto Key Status.

m. Disconnect ANCD from the J1 port on the PLGR.

3.6.4 **Crypto Key Load Failure.** If crypto key load fails, a warning appears. These warnings are a result of crypto key availability, mission duration, and other warnings.

3.6.4.1 **Crypto Key Availability Warnings.** After a crypto key load is attempted, warnings that may occur are shown.

NOTE

If a CVW is loaded and was previously valid, this warning indicates that it has expired, and a valid CVW should be loaded.

3.6.4.1.1 This warning is shown when the crypto key load fails the parity check. Try the load again.

WARNING
Invalid key
entered
⬍ to acknowledge

3.6.4.1.2

This warning is the result of a failed crypto key verification. Check that the proper crypto key was loaded.

WARNING
Bad key
detected
⬍ to acknowledge

3.6.4.1.3 This warning occurs if no crypto key for the next day is stored in the PLGR. Crypto keys expire at 2400Z. This warning is displayed at 2200Z.

WARNING
No key for
tomorrow
⬍ to acknowledge

NOTE

Mission duration does not apply when the user selects the *GUV* entry on the Crypto Key Type Display. See Table 3-18. A second *GUV key* may be loaded prior to expiration of the current *GUV key.*

3.6.4.2 **Mission Duration Warnings.** The user may want to enter a mission duration to limit the number of crypto keys stored in the PPS-SM. Mission duration only applies when *Crypto Variable Weekly* (CVW) *keys* are used. The maximum duration for those keys is 42 *days* (six weeks or current day + 41). Up to six (6) CVW keys may be loaded in any order After the mission duration is entered, the PLGR may display one of the warnings shown.

3.6.4.2.1 This warning shows that the mission duration entered exceeds the number of CTYPTO keys stored.

MISSION DURATION
nn DAYS
Not enough Keys
for mis dur! ⬍ P

3.6.4.2.2 This warning is the opposite, crypto keys exceed the desired mission duration.

MISSION DURATION
nn DAYS
Too many Keys
for mis dur! ⬍ P

3.6.4.3 Other Crypto Warnings. Additional warnings that may occur are shown.

3.6.4.3.1 This warning shows that the data gathered from the satellites and the *GUV* entered do not match. This warning indicates the *GUV* has expired, and that a valid *GUV* should be loaded. Contact your Unit or Operations representative.

WARNING
Check GUV issue
number
⬍ to acknowledge

3.6.4.3.2 This warning is only displayed if the PLGR is set to *all-Y*, and not enough *Y-code* satellites are available for tracking. Report loss of *Y-code* to your Unit or Operations representative.

WARNING
Insufficient
Y-code SVS
⬍ to acknowledge

3.6.4.3.3 This warning tells of possible *spoofer*. Report *spoofing* to your Unit or Operations representative.

WARNING
Possible
spoofers
⬍ to acknowledge

CAUTION

This procedure zeroizes the crypto key only. To zeroize mission sensitive data, the Zeroize (see Chapter 6) must be performed.

3.6.5 Crypto Key Zeroize.

Table 3-21 Crypto Key Zeroize .

CRYPTO ZEROIZE Zeroize all crypto data ACTIVATE QUIT P	
Line 1.	Title
Line 2.	Description of zeroize function.
Line 3.	Same.
Line 4.	*ACTIVATE* to start SA/A-S zeroize or *QUIT* to not zeroize and return *MENU* display.

3.6.5.1 If zeroize fails, the display shown comes up. Press the *Up*- or *Down-arrow* key to acknowledge the message. The unit then changes to standby mode. Repeat crypto key zeroize once. If failure repeats, send the faulty unit to depot maintenance for repair. See paragraph 8.2 for warranty return.

WARNING
Zeroize failed
⬍ to acknowledge

3.6.5.2 When the zeroize completes successfully, the display shown comes up. Press the *Up*- or *Down-arrow* key to acknowledge the message. The unit then changes to standby mode.

WARNING
All keys
zeroized
⬍ to acknowledge

3.7 INITIALIZATION.

This paragraph describes the displays used for starting the PLGR system data. The initialization display consists of six pages that allow the user to start the following parameters: position; time and date; track and ground speed; user-defined datums; and crypto keys.

NOTE

Average time for "search-the-sky" (cold start) acquisition is 6 minutes or less; maximum is 15 minutes. To reduce cold start time, follow procedures in sub-paragraph 3.7.4 through sub-paragraph 3.7.8.1.

3.7.1 PLGR Cold Start. The PLGR has the ability to determine position, time, date, track, ground speed, and magnetic variation without any operator input. A non-initialized PLGR has the ability to determine that information, either by using internally stored data or by performing a "search-the-sky" (cold start) acquisition.

3.7.2 Initialization Data Entry. Operator entry of Initialization data may speed up acquisition time. If you cannot initialize the PLGR, check the position, date, and time group data. Correct any errors (e.g., wrong position data entered), then reinitialize the PLGR.

3.7.3 **Data Entry Via Keypad or Data Port.** Data may be initialized via the keypad or via the data port. When using the data port, to initialize the PLGR, the source of the data may be another PLGR or the Desktop Assistant Software (DAS). Crypto data cannot be initialized via the data port. PLGR to PLGR and PC to PLGR data transfer is discussed in paragraph 3.10, sub-paragraph 3.10.1, and sub-paragraph 3.10.2.

3.7.4 **Accessing the Initialization Displays.** The initialization displays are accessed from the *MENU* display. Perform the following steps to access the initialization display.

a. Press the *MENU* key until the *MENU* display with *INIT* comes up.

b. Select the *INIT* field.

c. Press the *Up*- or *Down-arrow* key to bring up the *INIT* display. The first page of the *INIT* display comes up with the cursor on the paging field.

d. Use the *Up*- or *Down-arrow* key to scroll through the initialization display pages. The initialization pages are shown on the following page. The initialize position page is shown with position in *MGRS*-New coordinates format. The position format is selected using the *SETUP* display described in sub-paragraph 3.5.4.

e. Selectable fields on the initialization display pages are changed using the data entry procedures described in paragraph 2.4.

NOTE

Entries are not accepted until the current display page is exited.

Display	
INIT POS CLR	TITLE, CLEAR ENTRY FIELD
12A MGRS-New	
AA 12345e 12345n	POSITION
EL +12345m ⬍P	ELEVATION AND REFERENCE

INITIALIZE POSITION

Display	
INIT TIME CLR	TITLE, CLEAR ENTRY FIELD
30-02-93	DATE IN DAY–MONTH–YEAR
0000:00Z	TIME IN HRS, MINS, SECS
⬍P	

INITIALIZE TIME AND DATE

Display	
INIT TRK/GS CLR	TITLE, CLEAR ENTRY FIELD
TRK 000.0°M	CURRENT DIRECTION
GS 000kph	GROUND SPEED
⬍P	

INITIALIZE TRACK AND GROUND SPEED

Display	
INIT DTM USER1	TITLE, DATUM NUMBER
dA:+0000.000	DELTA A PARAMETER DIFFERENCE
dF*E4:-.00000001	DELTA F PARAMETER DIFFERENCE
MGRS adv:00 ⬍P	MGRS LETTER ADVANCE

INITIALIZE USER–DEFINED DATUM (PAGE 1)

Display	
INIT DTM USER1	TITLE, DATUM NUMBER
dX:+0000.0	DELTA X TRANSFORM PARAMETER
dY:+0000.0	DELTA Y TRANSFORM PARAMETER
dZ:+0000.0 ⬍P	DELTA Z TRANSFORM PARAMETER

INITIALIZE USER–DEFINED DATUM (PAGE 2)

Display	
INIT CRYPTO KEY	TITLE, CLEAR ENTRY FIELD
H _	HEX KEY
D _	DECIMAL KEY
⬍P	

INITIALIZE CRYPTO KEY

Figure 3-13 Initialization Display Pages.

3.7.5 **Clear Function.** There is a *CLR* field in the upper right-hand corner of the first three initialization pages. This field activates a clear function that clears out any entries that were made on that page, and restores each field to its original value. This field is useful when the user wants to abort or restart the initialization process on a given initialization page.

NOTE

> The selectable fields on these display pages are highlighted in the displays shown.

3.7.6 **Position Initialization.** Position is initialized using the first page of the initialization display. Position is initialized in any of the following available coordinate formats:

MGRS (Old or New)

INIT	POS		CLR
12A		MGRS-New	
AA 12345 e		12345 n	
EL	+12345 ft	⬍ P	

UTM/UPS

INIT	POS		CLR
12A		UTM/UPS	
1234567 e		1234567 n	
EL	+12345	ftD	⬍ P

L/L-dm.

INIT	POS		CLR
N	12°34.567’		
W	123°45.567’		
EL	+12345	ftD	⬍ P

L/L-dms

INIT	POS		CLR
N	12°34’56.78”		
W	123°45’56.78”		
EL	+12345	ftD	⬍ P

BNG/ITMG

INIT		POS	CLR
12A			BNG
12345	e	12345	n
EL	+12345	ftD	⬍ P

3.7.6.1 The coordinate format is selectable from the SETUP display discussed in sub-paragraph 3.5.4. These displays show the initialize position page in each of the available formats. Each field on the display is described in Table 3-22.

Table 3-22 Initialize Position Page .

Line #	Field	Description
1	POS	Initializes position.
	PRECISE	Initialize precise position.
	CLR	Any data entries that were made on that page are cleared. All data returns to original values.
2 3	Coordinate display	See sub-paragraph 3.5.4 for coordinate formats.
4	Elevation	-99999 to +99999; units selectable on setup display (see paragraph 3.5).
4	Elevation reference	Display only: D (DTM)/or blank (MSL) - selectable on setup display. See paragraph 3.5.

a. Enter your position (in *Latitude/Longitude-dm.)* and elevation by:

(1) Moving the cursor to the latitude field, scroll between N and S with ↑ or ↓.

(2) Move the cursor to the numeric field with →. Only the first degrees digit blinks.

(3) Enter the latitude.

(4) As the last latitude digit is entered, the cursor moves to the longitude field. Scroll between E and W with ↑ or ↓.

(5) Move the cursor to the numeric field with →. Only the first degrees digit blink.

(6) Enter the longitude.

(7) As the last latitude digit is entered, the cursor moves to the elevation sign field. Scroll between + and - with ↑ and ↓.

(8) Move the cursor to the elevation field with →.

(9) Enter the elevation.

(10)As the last elevation digit is entered, the cursor moves to the paging field.

b. Press the *Down-arrow* key to go to the next page. Numeric mode is deselected as the page is changed.

c. If the initialize position display is accessed after a good position fix is obtained, the display shown comes up. This display contains no selectable fields.

```
        POS
Known, init is
not required
                  ↕ P
```

NOTE

The entered position must be accurate to 100 meters for a P or Y-code acquisition to be successful.

3.7.7 Precise Position Initialization.

Precise position is entered by changing the *POS* label on line 1 to *PRECISE*. *By* entering position this way, and having a time accuracy that is good enough (such as after a PLGR to PLGR time transfer), satellites are acquired directly on P or Y-code.

```
INIT      POS      CLR
12A          MGRS-New
AA      12345e 12345n
EL   +12345ftD    ↕ P
```

```
INIT  PRECISE  CLR
12A          MGRS-New
AA      12345e 12345n
EL  +12345ftD     ↕ P
```

NOTE

The *TIME* known display may come up before the *POS* or *TRK/GS* known display. This is because the PLGR only needs to acquire 1 satellite to know time, while 3 or 4 satellites are needed to navigate.

3.7.8 Time and Date Initialization. The time and date are initialized using the second page of the initialization display. Each field on the display is described in Table 3-23.

Table 3-23 Time and Date Page .

Line #	**Field**	**Description**
NOTE The selectable fields on this display page are highlighted in the display shown.		INIT TIME CLR 31-01-93 1234:56 L P
1	CLR	If selected, any data entries that have been made are cleared; all data returns to original values.
2	Date	Day-month-year.
3	Time	Hours: minutes: seconds; Local/Zulu selectable on setup display (see paragraph 3.5.6.2).

3.7.8.1 If the initialize time and date display is accessed after a time and date are determined, the display shown comes up rather than the initialize time display discussed in the previous paragraph. This display contains no selectable fields.

```
        TIME
Known, init is
not required
                 P
```

3.7.9 **Track and Ground Speed Initialization.** Track and ground speed are initialized using the third page of the initialization display. Each field on the page is described in Table 3-24.

Table 3-24 Track and Ground Speed Page .

Line #	**Field**	**Description**
NOTE The selectable fields on the display page are highlighted in the display shown at right.		INIT TRK/GS CLR TRK 123.0 °T GS 123 kph ⇕ P
1	CLR	If selected, any data entries that were made are cleared. All data returns to original values.
2	Track	000.0 to 360.0 degrees, or 0000.0 to 6400.0 mils; units selectable on setup display (see paragraph 3.5).
2	North reference	Display only: T (True)/M (Magnetic)/G (Grid) - selectable on setup display (see paragraph 3.5).
3	Speed	000 to 999; units selectable on setup display (see paragraph 3.5).

3.7.9.1 If the initialize track and ground speed display is accessed after track and ground speed are obtained, the display shown comes up rather than the display discussed in the previous paragraph. This display contains no selectable fields.

TRK/GS
Known, init is
not required
⇕ P

CAUTION

- Prior to entering the values for *dA*, *dF*, *dX*, *dY*, and *dZ*, verify that these values are in *meters*. Entering user-defined datum values requires the PLGR *SETUP UNITS* be in *meters*.

- Prior to entering the *dF* value, verify that the number *4* has decimal places. This parameter is to be entered as a 10^4 value; abbreviated as *E4* on the display.

3.7.10 <u>User-Defined Datum Initialization.</u> Two datums, *USER1* and *USER2*, are reserved for user-defined datums. Pages four and five of the initialization display allow the entry of parameters necessary to define a datum. The proper information to be entered in the fields is found in the manual published by the Defense Mapping Agency or supplied by your Intelligence Officer. Each field on the pages is described in Table 3-25.

Table 3-25 User-Defined Datum Pages .

Line #	Field	Description
NOTE The selectable fields on the user-defined datum display pages are highlighted in the displays shown.		
INIT DTM PAGE 1		
1	Datum #	USER1/USER2
2	dA	-9999.999 to +9999.999
3	dF*E4	-0.99999999 to +.99999999
4	Coordinate format	Display only - selectable on setup display (see paragraph 3.5).
4	adv	00 to 26; The amount to shift (advance) the row letter in a MGRS position (usually from 00 to 10)
INIT DTM PAGE 2		
1	Datum #	USER1/USER2
2	dX	-9999.9 to +9999.9
3	dY	-9999.9 to +9999.9
4	dZ	-9999.9 to +9999.9

INIT	DTM	USER1
dA:	+0000.000	
dF*E4:	-.00000001	
MGRS	adv: 00	⬍ P

INIT	DTM	USER2
dX:	+0000.0	
dY:	+0000.0	
dZ:	+0000.0	⬍ P

CAUTION

The PPS-SM does NOT protect classified waypoints. When classified waypoints are stored in the PLGR, the PLGR is classified at the same level as the waypoints.

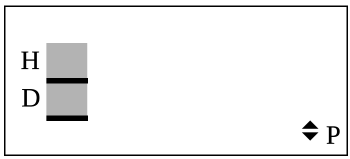
3.7.11 Crypto Key Initialization. Crypto keys are entered in the PLGR via the *INIT CRYPTO KEY* page. The crypto keys are used by the PLGR to correct false satellite data. This provides full accuracy and protection against intentional satellite interference. The crypto keys are stored in a tamper-proof module (called a Precise Positioning Service-Security Module, or PPS-SM), so the PLGR is NOT classified when crypto KEYS are installed. There are two versions of the *INIT CRYPTO KEY* page shown in Table 3-26 where each field on the display page is described.

Table 3-26 Initialize Crypto Key Page .

<table>
<tr><th>Line #</th><th>Field</th><th>Description</th></tr>
<tr><td colspan="3">

NOTE

The selectable fields on each version of this display page are highlighted. If the PLGR is not authorized (no crypto keys loaded), the upper display page comes up. If the PLGR is authorized, the lower display page comes up.



(IF NOT AUTHORIZED)

(IF AUTHORIZED)

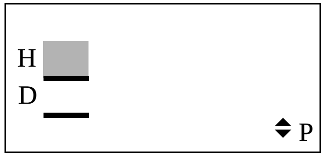
</td></tr>
<tr><td>2</td><td>H</td><td>Hexadecimal crypto key</td></tr>
<tr><td>3</td><td>D</td><td>Decimal crypto key</td></tr>
</table>

NOTE

Decimal entry is selected by moving the cursor to the Decimal entry field.

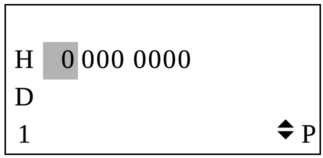
3.7.11.1 The H indicates that Hexadecimal crypto keys are entered (by scrolling only) on line 2. The D indicates that Decimal crypto keys are entered (by scrolling or numeric entry) on line 3. Enter a crypto key by:

a. Use *Left*- or *Right-arrow* key to move the cursor to the Hexadecimal entry field. The underline (cursor) starts blinking next to the H.



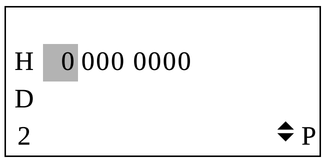
b. Press the *Up*- or *Down-arrow* key to select the entry method.

c. After the method has been selected, a “1” appears on line 4, showing that the first 4 lines of data are about to be entered (a line counter).



d. Enter the first group of data, one digit at a time. For Hexadecimal entry, eight digits are entered on each four lines of data, one line at a time. For Decimal entry, ten digits are entered per line.

e. Entering the last digit on a line causes the cursor to move to the start of the next line of data (still on display line 2) and increment the line counter.



f. After the last digit of the fourth line is entered, a message is displayed on line 4 showing the status of the crypto key entry.

```
INIT CRYPTO KEY
H  ___
D  ___
key loaded       ⬍P
```

3.8 STATUS DISPLAYS.

This paragraph describes the PLGR status displays. The status display consists of eight pages. These displays provide the following information: nav ability; self-test summary; type of antenna used (internal or external); power source (battery or vehicle); computed battery life; satellite tracking summary; relative satellite location; and interface activity.

3.8.1 Accessing the Status Displays. The status display is accessible via the *MENU* key, as shown in Figure 3-14.

a. Press the *MENU* key until the *MENU* display with *STATUS* comes up.

b. Select the *STATUS* field.

c. Press the *Up*- or *Down-arrow* key to bring up the first page of the *STATUS* display.

d. Use the *Up*- or *Down-arrow* key to scroll through the *STATUS* display pages. The status display pages are shown in Figure 3-15.

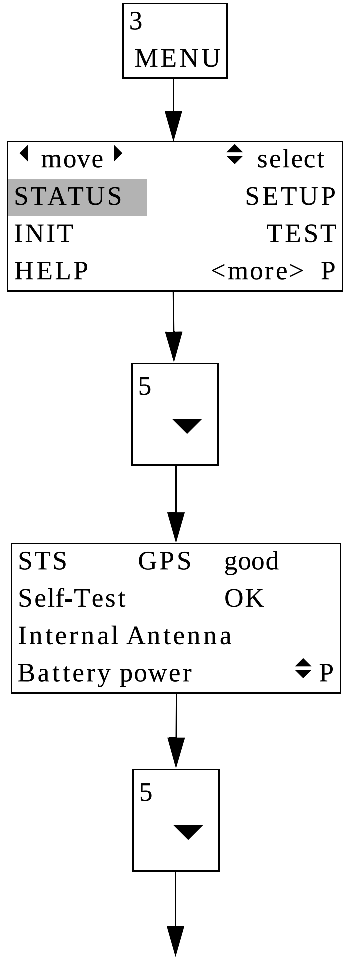


Figure 3-14 Accessing the Status Displays.

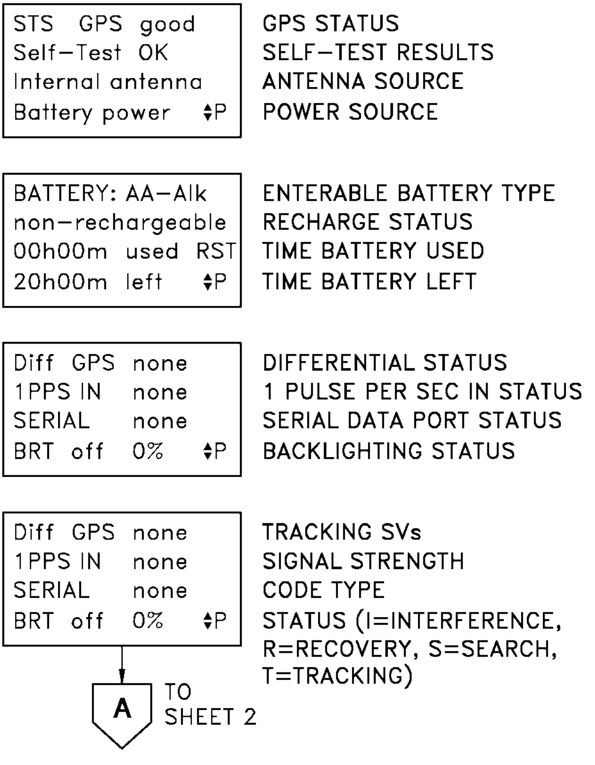


Figure 3-15 Status Display Pages. (Sheet 1 of 2)

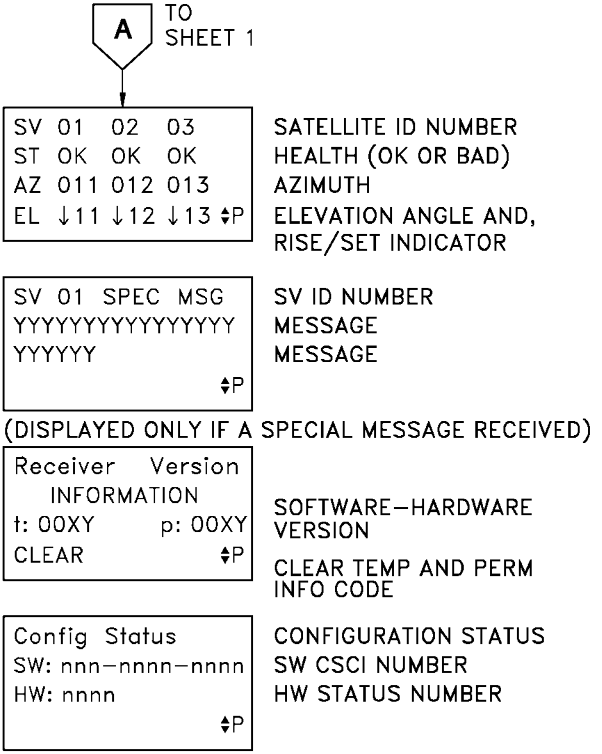


Figure 3-15 Status Display Pages. (Sheet 2)

3.8.2 Status Page 1.

The first page of the status display contains the following system information:	STS GPS good Self-Test OK Internal antenna Battery power ⬍ P
Line 1.	GPS status - This field displays "*good*" or "*<3 SV*".
Line 2.	Self-test results - This is the result of power-on or commanded self-test. Displays "*Self-Test OK*" or "*Self-Test Fail*". For a Self-Test Fail condition, see Chapter 8, Maintenance.
Line 3.	Antenna source - This is the source of the antenna. Displays "*Internal antenna*" or "*External antenna*".
Line 4.	Power source - This is the source of the power to the unit. Displays "*Battery power*" or "*Vehicle power*".

3.8.3 Battery Status Page. The estimated power battery life *LEFT* depends on the battery type, mode of operation, backlighting use and level set, and accurate entry of time *USED*.

NOTE

The estimated power battery life *LEFT* is to be checked prior to starting a mission, with the PLGR set to a tracking mode.

<table>
<tr><td colspan="2">The second page of the status display contains the following battery status information

BATTERY:AA-Alk
non-rechargeable
00h00m used RST
20h00m left ⬍ P</td></tr>
<tr><td>Line 1.</td><td>If a rechargeable nickel-cadmium battery is installed the PLGR automatically senses it and displays: NiCad. If either a BA-5800 or AA-alkaline batteries are used, the user selects the appropriate type: BA-580 or AA-Alk.</td></tr>
<tr><td>Line 2.</td><td>Dependent on the battery type displayed on line 1. If NiCad, rechargeable is displayed. If BA-5800 or AA-Alk, non-rechargeable is displayed.</td></tr>
<tr><td>Line 3.</td><td>Time USED: an enterable value (hours and minutes) the PLGR uses to calculate the amount of battery life remaining. RST is used to reset time USED to 00h00m.</td></tr>
<tr><td colspan="2">NOTE

This time may vary due to an internal temperature sensor in the PLGR, since battery power is affected by temperature.</td></tr>
<tr><td>Line 4.</td><td>Time LEFT: the calculated amount of battery life remaining.</td></tr>
</table>

3.8.4 I/O Status Page.

<table>
<tr><td colspan="2">The third page of the status display contains the following input/output status information:

Diff GPS none
1PPS IN none
SERIAL none
BRT off 0% ⬍ P</td></tr>
<tr><td>Line 1.</td><td>Differential GPS status: none, active, or using.

a. None means the input is not being received.

b. Active means that it is being received.

c. Using (differential GPS only) means it is being received and is being used.</td></tr>
<tr><td>Line 2.</td><td>1-pulse-per- second input status: none or active.</td></tr>
<tr><td>Line 3.</td><td>Serial data port status: none or active.</td></tr>
<tr><td>Line 4.</td><td>Backlighting status, on or off, and percent of maximum brightness.</td></tr>
</table>

3.8.5 Satellite Tracking Status Page.

The fourth page of the status display shows the signal status of each satellite being tracked or searched. The display comes up showing satellites for four channels. The fifth channel information is displayed by pressing *Left*- or *Right-arrow* key, that toggles the first column row labels to show the fifth channel status information. The satellite signal status page contains the following information:	SV 01 02 03 04 CN 00 00 00 00 CD CA P Y CA ST S S S S ⬍ P
Line 1.	The numbers of the satellites that are being tracked or searched (tracking SV).
Line 2.	The strength (25 to 50 dB, 34 dB nominal) of the signal being transmitted from the satellite (carrier-to-noise (CN) values for each channel).
Line 3.	Code Type - The type of code being transmitted by the satellite: *CA=CA code, P=P code,* and *Y=Y code.*
Line 4.	Satellite status - *I=interference, R=recovery, S=search,* and *T=track*.

3.8.6 Visible Satellite Status Page.

The fifth page of the status display shows satellite status information. There are enough satellite status pages to include information for all visible satellites, with a maximum of eight pages. The satellite status pages contain the following information:

SV	01	02	03	
ST	OK	OK	OK	
AZ	011	012	013	
EL	↓11	↓12	↑13	⬍ P

Line 1.	The numbers of the visible satellites (SV id numbers).
Line 2.	The health of each satellite, *OK* or *BAD* (SV health).
Line 3.	The azimuth of each satellite (in degrees, relative to True north).
Line 4.	The elevation angle of each satellite, and whether the satellite is ascending or descending (elevation, rise/set indicator).

3.8.7 Special Message Page.

The sixth page of the status display contains special satellite messages (Y's can be letters, numbers, or symbols such as - or ") and is displayed only if there are messages. There may be more messages to be displayed. The SV number on line 1 is selectable, and can be scrolled to display special messages for the other satellites. The special message page contains the following information:

```
SV  01   SPEC   MSG
YYYYYYYYYYYYYYYYYY
YYYYYY
                  ⬍ P
```

Line 1.	The SV number that special messages are available for.
Line 2.	The special message from the satellite indicated in line 1.
Line 3.	Same.
Line 4.	Blank

3.8.8 Self-Test Message Pages.

The seventh page of the status display contains the results of self-test. There may be more messages to be displayed. The data display on line 1 is selectable and is scrolled to display other messages.

Display	Description
XXXXXXXXXXXXXXXXX	**SELF-TEST FAIL DEVICE**
FAILURE	
t:dddd p:dddd	**TEMP AND PERM FAULT CODE (DEPOT USE ONLY)**
CLEAR ⇕ P	**CLEAR TEMP AND PERM FAULT CODE**

Display	Description
XXXXXXXXXXXXXXXXX	**SELF-TEST INFO DEVICE**
INFORMATION	
t:dddd p:dddd	**TEMP AND PERM INFO CODE**
CLEAR ⇕ P	**CLEAR TEMP AND PERM FAULT LOG INFO**

Line 1.	Data display	
	FAILURE	INFORMATION
	Track Subsys 1	Real Time Exec 1
	Track Subsys 2	Real Time Exec 2
	Track Subsys 3	Real Time Exec 3
	Track Subsys 4	Receiver Manager
	Timer-Interrupt	Keyboard Display
	Low Pwr Time Src	Serial Port Rcv
	1PPS/HAVE QUICK	Serial Port Xmit
	PPS-SM	PPS-SM Manager
	RAM Zeroize	Nonvolatile Mem
	RAM Testing	Time Manager
	ROM Checksums	Int/Ext Antenna
		Int/Ext Power
		SINCGARS
		Receiver Version

Line 2.	Indication of data type on line 1 *(FAILURE* or *INFORMATION).*
Line 3.	The *(t)emporary* and *(p)ermanent* codes for the data displayed.
NOTE By using *CLEAR*, you may reset or clear the failure and the PLGR may operate.	
Line 4.	The *CLEAR* field, used to clear the temporary and permanent codes on line 3.

3.8.9 Configuration Status Page.

The eighth page contains the software CSCI number and hardware status number. Verify these numbers to identify the configuration status of the PLGR. The configuration status page contains the following information:

Config Status	CONFIGURATION STATUS
SW:nnn-nnnn-nnnn	SOFTWARE CSCI NUMBER
HW:nnnn	HARDWARE STATUS NUMBER
⬍ P	

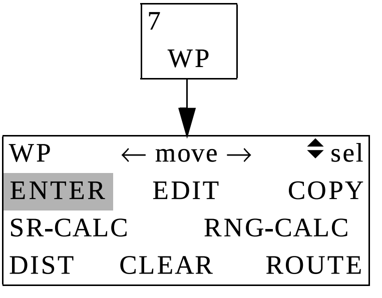
Line 1.	Title.
Line 2.	Software CSCI number (the software part number loaded).
Line 3.	Hardware status number (for engineering use only).

3.9 WAYPOINT OPERATIONS.

A waypoint is the location of a point on the desired course. A normal mission consists of a series of waypoints. Nine hundred and ninety-nine way points (numbered 001 through 999) are available on the PLGR. Waypoint 000 is defined as present position. All waypoints are defined by position (latitude/longitude, or *MGRS (Old or New)* or *UTM/UPS* coordinates), altitude, and map datum. Waypoints can also be defined by range, azimuth, and elevation angle from present position or a previously defined waypoint.

3.9.1 Waypoint Displays. This paragraph describes the PLGR waypoint displays and waypoint operations. The waypoint display pages are used to perform the following operations: enter, edit, or review waypoints; copy waypoints; calculate a new waypoint; determine the distance between waypoints; clear waypoints; and define mission routes.

3.9.2 Accessing the Waypoint Displays. Pressing the *WP* key in control mode brings up the waypoint menu display for selecting waypoint operations, shown at right. The waypoint display pages are shown in Figure 3-16. Perform the following steps to access the waypoint operation displays:



a. Press the WP key to bring up the waypoint menu page. The waypoint menu page comes up with the cursor on the *ENTER* field.

b. Select the desired waypoint menu option.

c. Press the *Up*- or *Down-arrow* key to select the desired operation and bring up its associated display page.

Display	Description
WP001 WPT001	WAYPOINT NUMBER & LABEL
12A MGRS-New AA 12345e 12345n	POSITION
+00000m CLR⇕ P	ELEVATION AND REFERENCE, *RESET

ENTER/EDIT/VIEW WAYPOINT

Display	Description
COPY WP001 to 002	ORIGIN AND DESTINATION OF COPY DATA
ACTIVATE QUIT	ACTIVATE COPY, QUIT TO WP MENU

COPY WAYPOINT

Display	Description
CALC from WP000	ORIGIN WAYPOINT
SR 0000.0m	SLANT RANGE TO TARGET
AZ 000.0°M	AZIMUTH TO TARGET
ELA +000.0° ⇕ P	ELEVATION ANGLE TO TARGET OR TARGET (EL)

SR CALCULATE WAYPOINT

Display	Description
CALC from WP000	ORIGIN WAYPOINT
RNG 0000m	RANGE TO TARGET
AZ 000.0°M	AZIMUTH TO TARGET
EL +00000m ⇕ P	TARGET ELEVATION OR ELEVATION ANGLE TO TARGET (ELA)

RNG CALCULATE WAYPOINT

Display	Description
DIST WP001→→002	FROM WAYPOINT, TO WAYPOINT
RNG 0.0m	RANGE BETWEEN WAYPOINT
AZ 000.0°M	AZIMUTH BETWEEN WAYPOINT
ELA+000.0°	ELEVATION ANGLE BETWEEN WP

DETERMINE DISTANCE BETWEEN WAYPOINTS

Display	Description
CLEAR frm WP:001	STARTING WAYPOINT
to WP:999	ENDING WAYPOINT
ACTIVATE QUIT P	ACTIVATE TO CLEAR WP, QUIT TO RETURN TO WP MENU

CLEAR WAYPOINTS

Display	Description
RTE ←move→ ⇕ sel ENTER EDIT COPY CLEAR	PROVIDES ACCESS TO ROUTE DEFINITION PAGES

DEFINE ROUTE

* **ENTER** AND **EDIT** PAGES HAVE AN ASSOCIATED DATUM PAGE.

Figure 3-16 Waypoint Display Pages.

CAUTION

When using the waypoint *ENTER* or *EDIT* page, a *datum* may be selected that differs from the *datum* entered in the *MENU SETUP* page. To reduce the potential of significant positional errors, do not navigate between two waypoints with *different datums. Do* not measure range or azimuth between two waypoints with different datums.

NOTE

ENTER and *EDIT* functions operate the same, except that in *ENTER* the next available *WP* is selected. In *EDIT,* the *WP* is selected from those already existing. If all 999 *WP* are filled, you must select *EDIT* function to change a *WP* or *CLEAR* to make *WP* available.

3.9.3 **Enter and Edit Pages.** Waypoints are entered, edited, or reviewed using the enter and edit pages of the waypoint display. Waypoints are entered in any one of seven available position formats: *MGRS (Old or New), UTM/UPS, L/L-dm., L/L-dms, BNG,* and *ITMG*. Data is entered using the data entry procedures described in paragraph 2.4. The default coordinate system is that entered in the *MENU SETUP* page. However, the coordinate system can be changed on the second page.

a. In *ENTER,* changing the datum will not change the horizontal coordinates or elevation. In *EDIT,* with elevation reference selected as *MSL* in *SETUP,* changing the datum will change the horizontal coordinates. With elevation reference selected as *DTM* in *SETUP,* changing the datum will change the horizontal coordinates and elevation.

b. In *ENTER*, you may select a datum for a waypoint that differs from that selected in *SETUP*. In *EDIT*, changing the datum for a waypoint will only change the datum for that waypoint. When you exit, enter, or edit, the newly entered datum will remain even though it differs from the datum selected in *SETUP*.

c. In *ENTER*, you may select a coordinate system for the waypoint that differs from that selected in *SETUP*. In *EDIT*, changing the coordinate system for one waypoint will change the coordinate system for all waypoints that are currently stored. When you exit *ENTER* or *EDIT*, the coordinate system for all waypoints will return to the coordinate system selected in *SETUP*.

d. The enter and edit waypoint display has two pages: 1, the waypoint position page, and 2, the waypoint datum/magnetic variation page.

3.9.3.1 Waypoint Position Page. The waypoint position page allows waypoints to be entered, edited, or reviewed. Each field on the page is described in Table 3-27.

Table 3-27 Waypoint Position Page .

Line#1	Field	Description
NOTE The selectable fields on this display page are highlighted in the display shown.		WP 001 ⬍ WPT001 N 42 ° 37 ´ 56 . 00 “ W 091 ° 46 ´ 12 . 00 “ +12345 m D CLR ⬍ P
1	Waypoint number	001 to 999 - Can scroll (when in *control mode (P)*) in numerical order or enter directly (when in *numeric mode (N)*). Scroll includes defined waypoints in *EDIT* and undefined waypoints in *ENTER*.
1	Scrolling field	Visible only when selected - see sub-paragraph 3.9.3.4. Only the defined waypoints (in *EDIT*) or undefined waypoints (in *ENTER*) come up when this field is scrolled. Scroll alphanumeric (by label) in *EDIT* or numeric (by *WP* number) in *ENTER*.
1	Waypoint label	10-character alphanumeric waypoint identifier - see sub-paragraph 3.9.3.5.
2 & 3	Coordi-nate display	*MGRS* (*Old or New*), *UTM/UPS*, *L/L-dm.*, *L/L-dms*, *BNG*, *ITMG* - default is selected on setup display (see Chapter 4); *WP* display format can be changed on *WP Datum/MAGVAR* page.
4	Elevation	-99999 to +99999 (elevation units are selectable on the setup display, paragraph 3.5)
4	Elevation reference	*D* (datum) or *MSL* Display only selected on setup display (see paragraph 3.5)
4	CLR	If selected, any data entries that have been made are cleared; all data returns to original values. The user is prompted to *CONFIRM* or *CANCEL* this function.

3.9.3.2 Waypoint Datum/Magnetic Variation Page. The second page is the datum/magnetic variation page. This page allows the entry of the datum and magnetic variation associated with the waypoint. It also allows the selection of the waypoint position page for the selection of the position coordinate system format. Each field on this page is described in Table 3-28.

Table 3-28 Waypoint Datum/Magnetic Variation Page .

Line #	Field	Description
NOTE The selectable fields on this display page are highlighted in the display shown.		WP001 DTM: WGD WGS-84 MAGVAR: E 000.0° MGRS-New CLR ⇕ P
1	Waypoint number	Display only - selected on WP position page
1	Datum ID	Scrollable; see Datum Table 3-10 for available datums
2	Datum name	Display only
3	Magnetic variation	*MAGVAR* (E or W) Value (0000.0 to 3200.0 mils, 000.0 to 180.00)
4	Coordinate format	*MGRS (Old or New), UTM/UPS, L/L-dm., L/L-dms, BNG, ITMG;* affects only the waypoint position display.
4	CLR	If selected, any data entries that have been made are cleared; all data returns to original values. The user is prompted to *CONFIRM* or *CANCEL* this function (see paragraph 3.5).

3.9.3.3 <u>Editing the Navigation Waypoint (Current Destination).</u> If the waypoint being edited has been changed, and is currently used for navigation, the display below comes up. This screen appears if the edited waypoint has been previously stored as a route waypoint, or a waypoint used in the alerts mode. The user is given a choice of changing (with *STORE)* or not changing (with *QUIT*) the waypoint.

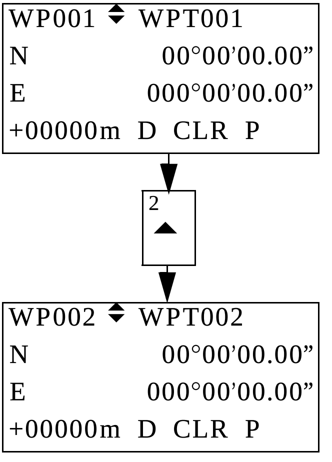
```
WP001 used for:
NAV                    OR ALERT OR ROUTE OR BULLSEYE
Confirm WP chng
STORE             QUIT
```

3.9.3.4 <u>Reviewing Waypoints.</u> Waypoints are reviewed on the waypoint edit page. Waypoints are brought up for display using the following methods:

a. Entering the waypoint number (when in *numeric mode (N))* of the waypoint to be reviewed in the waypoint number field brings up its current definition.

b. Scrolling the waypoint number field (when *in control mode (P))* scrolls through each waypoint number and associated definition, in numeric order.

c. The waypoint scrolling field is the (↕) symbol located between the waypoint number and waypoint label fields. It is used to scroll through the list of all defined waypoints, in alphanumeric order of the identifier (i.e., *MARK002* comes up before *WP001*). The waypoint scrolling field (↕) is visible only when the cursor is on the field. See display shown.



3.9.3.5 **Entering the Waypoint Label.** There are ten character positions available for the waypoint label. Each position must be scrolled individually, though it is not required that all positions contain a character.

3.9.3.5.1 When the cursor is first moved to the waypoint label field, all ten character positions flash. Pressing the *Up*- or *Down-arrow* key changes the blank character positions to underscores, and the first position flashes. Pressing the *Up*- or *Down-arrow* key again begins data entry for the first character position. The characters available to be entered for the waypoint label are:

a. Letters A-Z

b. Numbers 0-9

c. Dash (-), Slash (/), Period (.), and Blank( )

3.9.3.5.2 Starting from an underscore, the *Up-arrow* key begins scrolling through letters A-Z, then numbers 0-9, dash (-), slash (/), period (.) and blank ( ). Conversely, the *Down-arrow* key begins scrolling with blank ( ), period, (.), slash (/), dash (-), numbers 9-0, and then letters Z-A.

3.9.4 **Copying Waypoints.** The copy page of the waypoint display copies data from one waypoint to another. The waypoint numbers are used to show the source and target waypoints. The position, elevation, label, datum, and magnetic variation associated with the source waypoint are copied to the target waypoint. The first available waypoint is automatically selected as the *TO* waypoint. Each field on the page is described in Table 3-29.

Table 3-29 Copy Waypoint Page .

<table>
<tr><th>Line #</th><th>Field</th><th>Description</th></tr>
<tr><td colspan="3">NOTE
The selectable fields on this display page are highlighted in the display shown.

COPY
WP001 TO 002

ACTIVATE QUIT</td></tr>
<tr><td>1</td><td>From WP</td><td>001 to 999</td></tr>
<tr><td>1</td><td>To WP</td><td>001 to 999</td></tr>
<tr><td>3</td><td>Message</td><td>Contains a message under the following conditions: ’WPxxx overwrite’ if the TO WP is already defined - the copy overwrites the defined WP. ’WPxxx not defined’ if the FROM WP is not defined - copy cannot be performed.</td></tr>
<tr><td>4</td><td>ACTIVATE</td><td>If selected, the copy is performed. Display returns to waypoint menu.</td></tr>
<tr><td>4</td><td>QUIT</td><td>If selected, the copy is not performed. Display returns to waypoint menu.</td></tr>
</table>

3.9.5 Calculating a New Waypoint. A new waypoint is calculated using the calculate waypoint page of the waypoint display. The new waypoint can be calculated in two ways:

a. By entering the range, and azimuth to the target waypoint, and either the elevation of the target or elevation angle to the target.

b. By entering the slant range, and azimuth to the target waypoint, and either elevation angle to the target or elevation of the target.

3.9.5.1 Using Range, Azimuth, and Elevation Difference (RNG-CALC). Waypoints are defined from a reference waypoint using the *WP* menu *RNG-CALC* option. The range, azimuth, and either elevation of the target or elevation angle from the reference waypoint are required. Three pages are used to define the waypoints. They are waypoint reference, position, and store pages.

3.9.5.1.1 RNG-CALC Reference Page. The waypoint reference page is used to enter information from the reference waypoint to the target. Information required is range, azimuth, and either elevation of the target or elevation angle from the reference waypoint. Each field on the page is described in Table 3-30 below.

Table 3-30 RNG-CALC Reference Page .

<table>
<tr><th>Line #</th><th>Field</th><th>Description</th></tr>
<tr><td colspan="3">

NOTE

- This display shows the Elevation to target. The selectable fields on this display page are highlighted in the display shown at the top right.
- This display shows the Elevation Angle to the target. When you change between EL (elevation of the target) and ELA (elevation angle to the target), the data field on line 4 changes to the correct format as shown in the middle and bottom displays at right.

CALC from WP 000
RNG 1234.56 nm
AZ 1234.5 µG
EL +12345 ft ⬍ P

CALC from WP000
RNG 1234.56nm
AZ 1234.5µG
EL +1234.5ftD ⬍ P

CALC from WP000
RNG 1234.56nm
AZ 1234.5µG
ELA +1234.5µ ⬍ P

</td></tr>
<tr><td>1</td><td>Reference waypoint</td><td>Waypoint # 000 to 999 (WP 000 is current position)</td></tr>
<tr><td>2</td><td>Range to target</td><td>0 to 9999.9 or 9999.99; distance units system selected on setup display (see paragraph 3.5)</td></tr>
<tr><td>2</td><td>Range units</td><td>Change between large and small units for the distance system in use (ex: nm or yd)</td></tr>
<tr><td>3</td><td>Azimuth to target</td><td>0 to 360.0 degrees or 0 to 6400.0 mils; units selected on setup display</td></tr>
<tr><td>4</td><td>EL
OR
ELA</td><td>EL (elevation of target) is the default. You can toggle between EL and ELA (elevation angle to the target)</td></tr>
</table>

Table 3-30 RNG-CALC Reference Page - Continued.

4	Elevation of target **OR** Elevation angle to the target	EL: + or -, 0 to 99999; units selected for elevation on setup display ELA: + or -; 0 to 90.0 degrees or 0 to 1600 mils; units selectable on setup display
4	Elevation reference	Display only when EL is selected - D (DTM) or blank. If blank, it is MSL. Selectable on setup display (see paragraph 3.5)

3.9.5.1.2 <u>RNG-CALC Position Page.</u> The position page displays the position coordinates that were calculated using the information from the reference page. The format of the waypoint may be changed to be different from the one selected during setup (see paragraph 3.5). Each field on the page is described in Table 3-31.

Table 3-31 RNG-CALC Position Page .

Line #	Field	Description
NOTE The selectable field (shown highlighted) on this page is the coordinates format field.		CALC MGRS-New 12A AA 00000e 00000n EL +12345ftD ⬍ P
1	Position format	Scrollable - *MGRS (Old or New), UTM/UPS, L/L-dm., L/L-dms, BNG, ITMG*
2 & 3	Position display	Display only - see sub-paragraph 3.5.4.1 for a description of the coordinate displays
4	Elevation display	-99999 to +99999; units selectable on setup display (see paragraph 3.5).
4	Elevation reference	Display only - D (DTM) or blank. If blank, it is MSL. Selectable on setup display (see paragraph 3.5).

3.9.5.1.3 RNG-CALC Store Page. The store waypoint page allows the user to store the calculated waypoint. Each field on the page is described in Table 3-32.

Table 3-32 RNG-CALC Store Page .

Line #	Field	Description
NOTE The first available waypoint is automatically selected, but may be changed (shown highlighted).		CALC Store as WP 004 CALC004 STORE P
2	Target waypoint number	Waypoint # 001 to 999 - is entered directly or scrolled. Defaults to next unused waypoint.
2	Waypoint identifier	Display only
3	Waypoint overwrite	This line is blank unless the waypoint entered on line 2 is already defined, then “WPxxx overwrite”.
4	STORE	If selected, stores the calculated waypoint definition on the waypoint entered on line 2.
NOTE • Datum stored with the waypoint is the datum of the reference WP. • Elevation validity of the calculated WP is the same as the reference WP. • Source of magnetic variation for the calculated WP is set to calculated.		

3.9.5.2 Using Slant Range, Azimuth, and Elevation Angle (SR-CALC).

Waypoints are defined by slant range from a reference waypoint using the WP menu *SR-CALC* option. The slant range, azimuth, and either elevation angle to the target or elevation of the target are required. Three pages are used to define the waypoints. They are the waypoint reference page, the position coordinates page, and the store waypoint page.

3.9.5.2.1 SR-CALC Reference Page. The reference page is used to enter the slant range, azimuth, and either elevation of the target or elevation angle from the reference waypoint. Each field on the page is described in Table 3-33.

Table 3-33 SR-CALC Reference Page .

Line #	Field	Description

NOTE

- The selectable fields on these display pages are highlighted in the top display shown.
- The middle display shows the Elevation Angle to the target. The bottom display shows the Elevation to the target. When you change between ELA (elevation angle to the target) and EL (elevation of the target), the data field on line 4 changes to the correct format as shown in the middle and bottom displays at right.

```
CALC  from      WP 000
SR    0000.00 mi
AZ    64000.0 µG
ELA   +0000.0 µ        ⬍ P
```

```
CALC   from  WP 000
RNG    1234.56mi
AZ     1234.5µG
ELA    +1234.5µ        ⬍ P
```

```
CALC   from  WP 000
RNG    1234.56mi
AZ     1234.5µG
EL     +1234.5ft       ⬍ P
```

Table 3-33 SR-CALC Reference Page - Continued.

1	Reference waypoint	Waypoint # 000 to 999 (WP 000 is current position)
2	Slant range to target	0 to 9999.9 or 9999.99; distance units selected on setup display (see paragraph 3.5).
2	Slant range units	Change between large and small units for the distance system in use (ex: mi or ft)
3	Azimuth to target	0 to 360.0 degrees or 0 to 6400 mils; units selected on setup display
4	ELA OR EL	ELA (elevation angle to the target) is the default. You can toggle between ELA and EL (elevation of target)
4	Elevation angle to the target **OR** Elevation of target	ELA: + or -; 0 to 90.0 degrees or 0 to 1600 mils; unit selectable on setup display. EL: + or -, 0 to 99999; units selected for elevation on setup display
4	Elevation reference	Display only when EL is selected - D (DTM) or blank. If blank, it is MSL. Selectable on setup display

3.9.5.2.2 SR-CALC Position Page. The position page displays the position coordinates calculated using the information from the reference page. The format of the waypoint may be changed to be different from the one selected during setup. Refer to Table 3-34.

Table 3-34 SR-CALC Position Page .

<table>
<tr><th>Line #</th><th>Field</th><th>Description</th></tr>
<tr><td colspan="2">NOTE

The selectable field (shown highlighted) on this page is the coordinates format field.</td><td>CALC MGRS-New
12A
AA 00000e 00000n
EL +12345ftD ⇕ P</td></tr>
<tr><td>1</td><td>Position format</td><td>Scrollable - MGRS (Old or New), UTM/UPS, L/L-dm.,L/L-dms, BNG, ITMG</td></tr>
<tr><td>2 & 3</td><td>Position display</td><td>Display only - see sub-paragraph 3.5.4.1 for a description of the coordinate displays</td></tr>
<tr><td>4</td><td>Elevation display</td><td>-99999 to +99999; units selectable on setup display (see paragraph 3.5).</td></tr>
<tr><td>4</td><td>Elevation reference</td><td>Display only - D (DTM) or blank. If blank, it is MSL. Selectable on setup display (see paragraph 3.5).</td></tr>
</table>

3.9.5.2.3 SR-CALC Store Page. The store waypoint page allows the user to store the calculated waypoint. Each field on the page is described in Table 3-35.

Table 3-35 SR-CALC Store Page .

<table>
<tr><th>Line #</th><th>Field</th><th>Description</th></tr>
<tr><td colspan="3">NOTE
The selectable fields on this display page are highlighted in the display shown.

CALC Store as
WP 005 CALC005

STORE ⇕ P</td></tr>
<tr><td>2</td><td>Target waypoint</td><td>Waypoint # 001 to 999 - is entered directly or scrolled</td></tr>
<tr><td>2</td><td>Waypoint identifier</td><td>Display only</td></tr>
<tr><td>3</td><td>Waypoint overwrite</td><td>This line is blank unless the waypoint entered on line 2 is defined, then “WPxxx overwrite”.</td></tr>
<tr><td>4</td><td>STORE</td><td>If selected, stores the calculated waypoint definition on the waypoint entered on line 2.</td></tr>
<tr><td colspan="3">NOTE
• Datum stored with the waypoint is the datum of the reference WP.
• Elevation validity of the calculated WP is the same as the reference WP.
• Source of magnetic variation for the calculated WP is set to calculated.</td></tr>
</table>

3.9.6 Determining Distance Between Two Waypoints (DIST). When determining waypoint distance and azimuth while using a WP *ROUTE*, the range and azimuth data provided on the display represent the distance and azimuth calculated from your present position to a given waypoint. If you want the calculated distance and azimuth between any two waypoints (whether in your route or not), you must use the *WP* menu *DIST* option. The fields on this page are described in Table 3-36.

Table 3-36 Waypoint Distance Page .

Line #	Field	Description
NOTE The waypoint fields are selectable (shown highlighted) on the display page shown.		DIST WP 001 ▸ ▸ 002 RNG 1234.12nm AZ 1234.1µG ELA+ 1234.5µ ⬍ P
1	*From* waypoint	WP # 000 to 999
1	*To* waypoint	WP # 001 to 999
2	Range between waypoints	0 to 9999.9 or 9999.99; distance units selectable on setup display (see paragraph 3.5).
3	Azimuth between waypoints	0 to 360.0 degrees or 0 to 6400 mil; units selectable on setup display
3	North reference	Display only, selectable on setup display
4	Elevation angle between waypoints	+ or -, 0 to 90° or 0 to 1600 mils; units selectable on setup display

WARNING

Clearing a waypoint will also clear any Routes that contain this waypoint.

3.9.7 Clearing Waypoints (CLEAR). One or more waypoints are cleared using the *CLEAR* option on the *WP* menu. The following display page sequence shown represents the waypoint clear process. The selectable fields on these displays are highlighted in the displays shown. Each field on the *WP* Clear page is described in Table 3-37.

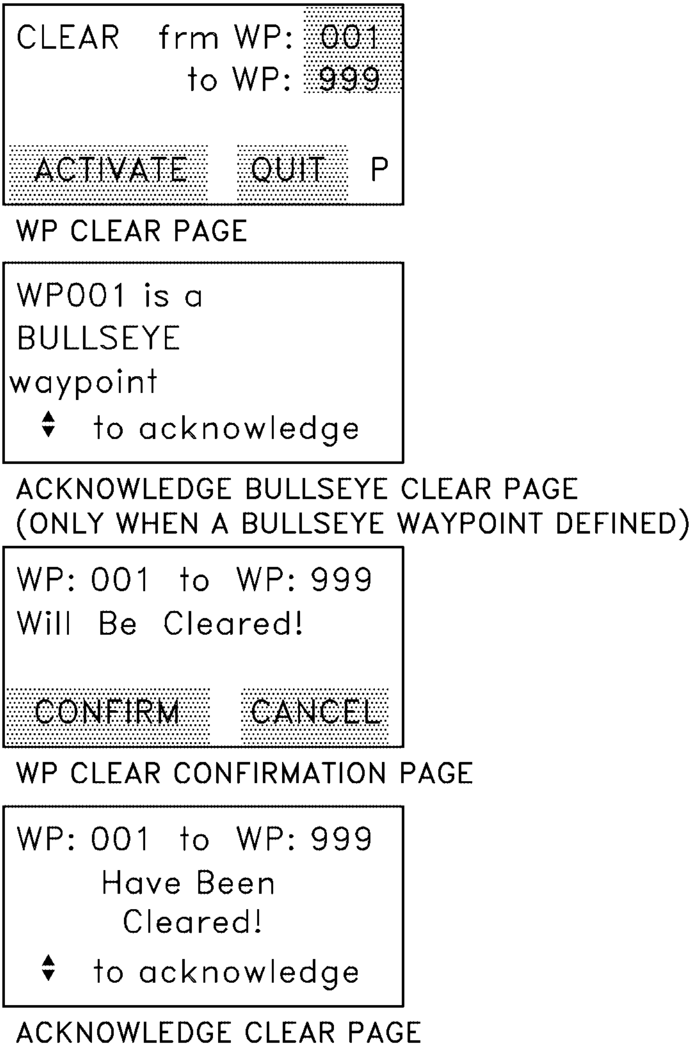


Figure 3-17 Clear Waypoints.

Table 3-37 Clear Waypoint Page .

Line #	Field	Description
1	*From* waypoint	First *WP* to be cleared; waypoint # 001 to 999
2	*To* waypoint	Last *WP* to be cleared; waypoint # 001 to 999
4	*ACTIVATE*	If selected, brings up the WP Clear Confirmation page (unless a Bullseye Waypoint is defined).
4	*QUIT*	If selected, the clear will not be performed; the display will return to the WP menu.

3.9.7.1 Waypoints to be cleared (user selectable) are displayed. A single waypoint or a range of waypoints can be cleared. To clear a single waypoint, the “*frm*” (from) and “*to*” waypoints must be the same number. To clear a range of waypoints, the “*frm*” waypoint must be a smaller waypoint number than the “*to*” waypoint number.

3.9.7.2 Select the *ACTIVATE* or *QUIT* option on the WP Clear page (If a *BULLSEYE* waypoint is defined, the Bullseye Clear page is displayed and must be acknowledged). The user must then select the *CONFIRM* or *CANCEL op*tion on the WP Clear Confirmation page. Selecting the *CONFIRM* option brings up the Acknowledge Clear page, which must be acknowledged. Selecting the *CANCEL* option returns the user to the WP menu.

3.9.8 Defining a Mission Route.

A mission route is defined by linking together waypoints using the *WP ROUTE* function. To create a route, press the WP key to display the waypoint page. Select *ROUTE* and activate by pressing the *Up*- or *Down-arrow* key. The Route page is displayed.

RTE	← move →	⬍ sel
ENTER	EDIT	COPY
CLEAR		

3.9.8.1 <u>Defining a Route (Route Definition Page).</u> To create a new Route, or Edit an existing Route, select the *ENTER* or *EDIT* option and activate by pressing the *Up*- or *Down-arrow* key. The Route Enter or Edit Page is displayed. If the *ENTER* option is selected, only undefined Routes are available for editing. If the *EDIT* option is selected, only defined Routes are available for editing.

```
RTE 01          RTE-NAME
→009→010→011→012
→013→014→015→016
                     ⬍ S
```

3.9.8.1.1 The Route number displayed is selected by moving the cursor to the *RTE* field and scrolling using the *Up*- or *Down-arrow* key or by using the numeric (N) mode. The Route name is entered by selecting the *RTE-NAME* field, and activating that function by pressing the *Up*- or *Down-arrow* key. The method for entering the Route name is identical to that used for entering a Waypoint Label, see sub-paragraph 3.9.3.5. If the cursor is placed on the page Scroll symbol, line 4 identifies the leg currently displayed.

NOTE

The bottom line of the display indicates that you can **Insert** or **Delete** a waypoint. Pressing the *Down-arrow* key causes the waypoint following the cursor to be deleted. Press the *Up-arrow* to insert a new waypoint.

```
RTE 01          RTE-NAME
→ 005→006→006→007
→ 008→009→010→011
↑INS↓DEL  LEGXX S
```

3.9.8.1.2 Lines 2 and 3 of the Route Enter or Edit page list the waypoints in the Route in the sequence in which they are linked. To insert a defined waypoint, position the cursor on the arrow (which represents a leg) in front of where you want the waypoint inserted.

```
RTE 01          RTE-NAME
→ 005→006→007→008
→ 009→010→011→012
↑INS↓DEL  LEG20 S
```

3.9.8.1.3 A new waypoint is inserted (same as the next waypoint) that you can now edit to the desired new waypoint. The waypoint is edited in the same manner as new waypoints are entered, i.e., by scrolling the waypoint using the *Up*- or *Down-arrow* key, or by using the numeric (N) mode. After a Route has been created or edited, it must be saved. There are two ways to save a Route.

a. By scrolling through the end of the Route list of waypoints. Following the last waypoint, a *SAVE* option is provided. Select this function and activate by pressing the *Up*- or *Down-arrow* key.

b. By exiting the program and pressing any of the major function keys (*MENU*, *WP*, *POS*, or *NAV*).

(1) If you attempted to exit without saving the Route, the following is displayed.

```
RTE    01  was
modified   without
saving
SAVE       QUIT
```

(2) Select *SAVE* and activate by pressing the *Up*- or *Down-arrow* key.

```
RTE   has been
saved
```

(3) If the Route being created or edited is incomplete, the following is momentarily displayed.

```
Incomplete RTE
RTE 01 will NOT
be saved
```

(4) If you attempt to enter (insert) a waypoint into a Route that is already full, the following warning is displayed.

```
RTE 01 IS FULL!
WP999 in Leg 25
will be lost
ACTIVATE      QUIT
```

3.9.8.1.4 By selecting *ACTIVATE*, the specified waypoint in leg 25 is dropped off the end of the route, and you are allowed to enter a new waypoint at the position of your cursor. If the *QUIT* option is selected, the PLGR ignores the insert command, and resumes operation where you left off.

3.9.8.2 Copy Route. The *COPY* function allows you to easily create a new Route that is similar to, but not exactly the same as, an existing Route. This is accomplished by copying the similar Route to a new Route number and then editing that new Route. To copy a Route, select *COPY* on the Route page. Activate the copy function by pressing the *Up*- or *Down-arrow* key.

```
COPY
RTE 01 to RTE 02

ACTIVATE      QUIT
```

3.9.8.2.1 This page allows you to select which Route you want to copy and where you want to copy it to. If the Route you are copying to already contains a valid Route the following message is displayed.

```
COPY
RTE 01 to RTE 02
RTE 02  Overwrite
ACTIVATE      QUIT
```

3.9.8.2.2 To activate the copy function select *ACTIVATE* and press the *Up*- or *Down-arrow* key.

Route 01 has
been copied to
Route 02

3.9.8.2.3 If the route you are copying from has not yet been defined, the following message is displayed. Your only option is to *QUIT* or reenter the number of a route that has been defined.

COPY		
RTE	01	to RTE 02
RTE 01 undefined		
		QUIT

3.9.8.3 Clear Route. One or more routes are cleared using the *ROUTE*, *CLEAR* options on the *WP* menu. The following display page sequence shown represents the route clear process. The selectable fields on these displays are highlighted in the displays shown.

ROUTE CLEAR PAGE	CLEAR : from : RTE 01 to : RTE 15 ACTIVATE QUIT
ROUTE CLEAR CONFIRMATION PAGE	RTE: 01 TO RTE: 15 Will Be Cleared! CONFIRM CANCEL
ACKNOWLEDGE CLEAR PAGE	RTE: 01 TO RTE: 15 Have Been Cleared! ⬍ to acknowledge

3.9.8.3.1 Routes to be cleared (user selectable) are displayed. A single route or a range of routes can be cleared. To clear a single route, the "*from*" and "*to*" routes must be the same number. To clear a range of routes, the "*from*" route must be a smaller route number than the "*to*" route number.

3.9.8.3.2 Select the *ACTIVATE* or *QUIT* option on the ROUTE Clear page. The user must then select the *CONFIRM* or *CANCEL* option on the ROUTE Clear Confirmation page. Selecting the *CONFIRM* option brings up the Acknowledge Clear page, which must be acknowledged. Selecting the CAN*CEL* option returns the user to the *WP*, *ROUTE* menu.

3.9.9 **Marking Waypoints.** This paragraph describes the function of the *MARK* key. Pressing the *MARK* key presents the MARK/Man Overboard *(MOB)* selection display. This display provides three options:

a. Mark the current position as a waypoint.

b. Mark the current position as a Man Overboard *(MOB)* waypoint and activate the MOB navigation page.

c. Cancel the MARK/MOB selection display.

3.9.9.1 **Marking Waypoint Capabilities.** Marking a waypoint stores current position coordinates, elevation, magnetic variation *(MAGVAR)*, and datum *(DTM)* into the waypoint database at the selected waypoint number. This capability is used to rapidly store position coordinates of specific events.

NOTE

The first MARK freezes the current position. The second MARK or MOB stores the frozen position, no matter how far you have moved since the first MARK.

a. Pressing the *MARK* key brings up the *MARK/MOB* display, as shown.

CLR
MARK

↓

MARK POS → WP001
MARK: saves
NAV: ManOverbrd
ON: cancels

b. The *MARK/MOB* display comes up with the cursor on the waypoint number field. This field is the only selectable field on the page.

c. The waypoint that the current position is stored in can be changed to any valid waypoint number (001 to 999) using normal data entry procedures. When the waypoint number is changed, the associated waypoint label changes to correspond with the new waypoint number. Also the label will correspond to the selected option (e.g., if WP=003 then label = MARK003 or MOB003, if WP= 170, then label=MARK 170 or MOB 170, etc).

d. If the waypoint number is changed to a waypoint that is already defined, the display changes to show that the waypoint is overwritten with the current position. The overwrite condition also applies to the MOB option as shown in the display at right.

OVERWRITE WP: 001
MARK: overwrites
NAV: ManOverbrd
ON: cancels

e. If all nine hundred ninety-nine waypoints are already defined when the *MARK* key is pressed, the waypoint defaults to 001. The user can choose to overwrite the default waypoint 001, select a different waypoint to be overwritten, or cancel the mark.

3.9.9.1.1 The following display comes up if the waypoint you choose to mark the waypoint you are currently navigating to, is already used in an alert or nav route.

WPXXX	used	for:
ALERT		
Confirm	WP	Chng
STORE		QUIT

3.9.9.2 Mark Waypoints. Perform the following steps to mark a waypoint with the current position coordinates and altitude.

a. Press the *MARK* key to bring up the *MARK/MOB* display and freeze the current position.

b. The waypoint that the current position coordinates and altitude will be stored in, defaults to the first undefined waypoint, or define a waypoint for the data to be stored to.

c. Press the *MARK* key a second time to store the current position into the displayed waypoint and return to the previous display OR press ON to cancel the mark and return to the previous display.

d. After the *MARK* key is pressed a second time, a message confirming the waypoint being marked is displayed. The confirmation message is shown at right.

WAYPOINT MARKED

NOTE

The MOB navigation page is not configurable.

3.9.9.3 Man Overboard Waypoints and Navigation. Perform the following steps to store a waypoint as a *MOB* waypoint and activate the *MOB* navigation page.

a. Press the *MARK* key to bring up the *MARK/MOB* display and freeze the current position.

b. The waypoint that the current position coordinates and altitude will be stored in defaults to the first undefined waypoint, or define a waypoint for the *MOB* data to be stored to.

c. Press the *NAV* key to store the waypoint data and to activate the navigation page. The *MOB* navigation page pops up automatically when the *NAV* key is pressed. Navigation data to the *MOB* waypoint will be continually displayed until the page is exited. This display illustrates the *MOB* navigation page.

```
WP001            MOB001
RNG:          0.0m
  AZ:    000.0°M
⬍  to  return
```

d. To exit the *MOB* navigation page press the *Up*- or *Down-arrow* key. This will present a confirmation page on which *YES* must be selected prior to exiting. There are two active fields on the exit display. The default active field is the *NO* field. While the *NO* field is active, pressing the *Up*- or *Down-arrow* keys returns the user to the *MOB* navigation page. If the *YES* field is active, pressing the *Up*- or *Down-arrow* key exits the *MOB* navigation page and returns to the last active page prior to pressing the *MARK* key. This display illustrates the *MOB* navigation exit page.

```
Exit Man-
Overboard Mode?

YES      NO
```

3.10 DATA TRANSFER.

In addition to entering data through the keypad, data is transferred to and from a PLGR through the serial data port. This is very useful when several PLGR are initialized with the same data. See Chapter 15, Difference Data, II for which data can or cannot be transferred.

```
DATA-XFR
TYPE:  all

SEND      QUIT
```

NOTE

- To ensure transferred data is not corrupted, the receiving PLGR should have the *POS* page displayed prior to a PLGR to PLGR data transfer.
- Route leg advance setup is supported for PLGR to PLGR data transfers, but is NOT supported for PLGR to DAS data transfers.

3.10.1 PLGR To PLGR Data Transfer. Selected data is transferred from one PLGR to another. This feature saves setup time during keypad data entry. Access *DATA-XFR* from the system *MENU*. Any combination of the following data items is transferred:

Time
Custom nav pages
User-defined datum data
Setup information (coordinates, units, modes, etc)
Satellite data
Waypoints (includes routes)
All the above

a. Ensure that the receiving PLGR has the serial data port configured as *standard* (see sub-paragraph 3.5.8.1).

b. Connect the PLGR to PLGR Cable to the J2 data port on each PLGR.

c. Select the type of data to transfer (in the example, *time* is selected).

NOTE

To transfer time, the sending PLGR must be tracking satellites and have a good *TFOM* (7 or less).

d. Use *SEND* to start transfer. Use *QUIT* to return to menu.

```
DATA-XFR
TYPE:  time

SEND      QUIT
```

e. When data transfer begins, the display shown comes up.

```
DATA-XFR IN PROG
```

f. Successful data transfer confirmation is displayed upon completion.

```
DATA-XFR
SUCCESSFUL

                ⇕ P
```

g. If data transfer fails, a failure message is displayed.

```
DATA-XFR FAILED
Check cable or
serial mode of
other unit      ⇕ P
```

```
DATA-XFR FAILED
invalid data
detected
                ⇕ P
```

3.10.2 PLGR Transfer Via Desktop Assistant Software. Various data is moved from a PLGR to Desktop Assistant Software (DAS), or vice-versa. This feature saves setup time during keypad data entry. All control of data transfer is done by the DAS (the PLGR does not “send” data, the DAS requests it). Any of the following data items are transferred:

Waypoints (includes routes)
Satellite data
Setup information (coordinates, units, modes, etc)
User-defined datum data
Time
All the above

NOTE

Be sure PLGR has the serial data port configured as *standard* (see sub-paragraph 3.5.8.1).

3.10.2.1 Connect the PLGR to RC/PC Cable to the PLGR J2 data port and the DAS RS-232 data port. Desktop Assistant Software can be obtained by following the procedures in Chapter 12.

3.11 BEST SATELLITE GEOMETRY CALCULATION.

The PLGR has the ability to calculate the best satellite geometry (Dilution of Precision) (DOP) for a position fix, and the time that ideal geometry occurs. Either Position DOP (PDOP) or Horizontal DOP (HDOP) are calculated. The lower the value of PDOP or HDOP, the better the satellite geometry. PDOP is associated with 3-D operations, and HDOP is associated with 2-D operations.

NOTE

While calculating, no satellite tracking is performed. Almanac data must be stored to perform DOP calculations.

3.11.1 <u>Accessing DOP-CALC.</u> The display page for commanding the best Dilution of Precision (DOP) calculation is under the *MENU* choice of *DOP-CALC*.

Selecting this causes the setup display shown to come up. The selectable fields are highlighted on the display shown.

DOP-CALC:	PDOP	
31-01-93		1234Z
Interval		+ 01h00m
START	QUIT	P

Line 1.	*DOP-CALC* option for calculation: PDOP or HDOP (scrollable).
Line 2.	Start date, time for the calculation (defaults to current time/date).
Line 3.	Interval time for the calculation (defaults to one hour). This time is no greater than 12 hours from the start data/time entered on line 2.
Line 4.	Use *START* to start calculation. Use *QUIT* to return to *MENU*.

After selecting the *START* function to begin the calculation, the display shown comes up.		Best PDOP: XX.XX Calculating mm% complete CANCEL
Line 1.	Best PDOP or HDOP.	
Line 2.	"Calculating" message.	
Line 3.	Percent complete.	
Line 4.	*CANCEL* to cancel calculation and return to *DOP-CALC* setup display.	

When the calculation is completed, the display shown comes up, showing the best time/date and value for a position solution.		Best PDOP: 12.34 31-01-93 1234Z 100% complete ⇕ P
Line 1.	Best DOP value.	
Line 2.	Best DOP date, time.	
Line 3.	Percent complete.	
Line 4.	Paging field.	

3.11.2 Calculation Without Almanac.

The PLGR cannot calculate the best DOP if no almanac is stored. The display is shown.

```
Best PDOP: YY.YY
Data unavailable
     100% complete
                  ⇕ P
```

3.12 SELECTING AND DESELECTING SATELLITES.

The PLGR has the capability of selecting or deselecting satellites. The selected satellites, if visible, are used for nav while they are visible. Deselected satellites are not used for nav. SV-SEL/DESEL entries are erased when the PLGR is turned off.

3.12.1 Accessing SV-SEL. The display page for selecting and deselecting the satellites is under the *MENU* choice of *SV-SEL*.

Selecting this causes the display shown to come up. The selectable fields are highlighted on the display shown.	SV-SEL/DESEL SEL: 00 00 00 00 DESEL: 00 00 00 CLR EXIT P
Line 1.	Title
Line 2.	*SEL - You* can enter up to 4 valid satellite numbers (01-32) to use.
Line 3.	*DESEL - You* can enter up to 3 valid satellite numbers (01-32) to not use.
Line 4.	*CLR* - Used to reset all satellite numbers to 00. *EXIT - Used* to return to *MENU*.

3.13 WARNING DISPLAYS.

Warning displays replace the current display when the indicated event occurs. They remain displayed until acknowledged. This alerts the user of conditions that may affect the mission.

CAUTION

After the initial Low primary battery WARNING, continued operation of the PLGR cannot be reliably predicted. Replace the power battery at the earliest possible opportunity.

3.13.1 **Battery Warnings.** The PLGR monitors the batteries installed and reports a low battery condition as shown. After being acknowledged, these warnings recur while the low battery condition exists.

WARNING
Low memory
battery
⬍ to acknowledge

WARNING
Low primary
battery
⬍ to acknowledge

3.13.2 **External Power Warning.** The PLGR checks for the connection of external power. It reports the loss of connection as shown. If the PLGR power battery is installed, this warning occurs every time external power is removed. The PLGR automatically switches to power battery when external power is lost. It switches back to external power when reconnected.

WARNING
External power
lost
⬍ to acknowledge

3.13.3 **External Antenna Warnings.** The PLGR checks for the connection of an external antenna. It reports the loss of connection or fault, as shown.

a. This warning indicates the external antenna has been disconnected.

WARNING
External antenna
lost
⇕ to acknowledge

b. This warning indicates a fault of the external antenna. Replace it.

WARNING
External antenna
fault
⇕ to acknowledge

3.13.4 Zeroize Warnings. As the result of a Zeroize, a warning comes up to show the status of the zeroize. One of two displays is shown.

a. This warning shows that the zeroize was successful.

WARNING
Emergency
zeroize passed
⇕ to acknowledge

b. This warning shows a failure of the zeroize. Repeat zeroize procedure again.

WARNING
Emergency
zeroize failed
⇕ to acknowledge

3.13.5 Crypto Warnings. Several crypto key warnings may occur such as crypto key availability, mission duration and zeroize as well as other warnings.

3.13.5.1 Crypto Key Availability Warnings. After a crypto key load is attempted, warnings that may occur are shown.

a. This warning is shown when the crypto key load fails the parity check. Try the load again.

WARNING
Invalid key
entered
⇕ to acknowledge

b. This warning is the result of a failed crypto key verification. Check that the proper crypto key was loaded.

WARNING
Bad key
detected
⇕ to acknowledge

c. This warning occurs if no crypto key for the next day is stored in the PLGR. If a CVW is loaded and was previously valid, this warning indicates that it has expired, and a valid CVW should be loaded.

WARNING
No key for
tomorrow
⇕ to acknowledge

NOTE

Mission duration does not apply when the user selects the *GUV* entry on the Crypto Key Type Display. See Table 3-18. A second *GUV* key may be loaded prior to expiration of the current *GUV* key.

3.13.5.2 **Mission Duration Warnings.** The user may want to enter a mission duration to limit the number of crypto keys stored in the PPS-SM Mission duration only applies when *Crypto Variably Weekly (CVM)* keys are used. The maximum duration for these keys is *42 days* (six weeks or current day + 41). Up to six (6) CVW keys may be loaded, in any order. After the mission duration is entered, the PLGR may display one of the warnings shown.

a. This warning shows that the mission duration entered exceeds the number of crypto keys stored.

```
MISSION DURATION
nn DAYS
Not enough Keys
for mis dur!        ⬍ P
```

b. This warning is the opposite, crypto keys exceed the desired mission duration.

```
MISSION DURATION
nn DAYS
Too many Keys
for mis dur!        ⬍ P
```

3.13.5.3 **Crypto Key Zeroize Warnings.** As the result of a commanded crypto key zeroize, a warning comes up to show the status of the zeroize. These two displays are shown.

a. This warning shows that the zeroize was successful.

```
     WARNING
ALL keys
zeroized
⬍ to acknowledge
```

b. This warning shows a failure of the zeroize.

```
     WARNING
Zeroize failed

⬍ to acknowledge
```

3.13.5.4 <u>Other Crypto Warnings.</u> Additional warnings that occur are shown.

a. This warning shows that the data gathered from the satellites and the *GUV* entered do not match. If a *CVW* is loaded and was previously valid, this warning indicates that it has expired, and a valid *CVW* should be loaded.

WARNING
Check GUV issue
number
⬍ to acknowledge

b. This warning is only displayed if the PLGR has all-Y satellites commanded, and not enough Y-code satellites are available for tracking.

WARNING
Insufficient
Y-code SVS
⬍ to acknowledge

c. This warning tells of possible spoofer.

WARNING
Possible
spoofers
⬍ to acknowledge

3.13.6 Datum Mismatch Warning. During actions involving modification or definition of waypoints, the user is notified of potential navigation errors due to datum mismatches between waypoint datums or the current receiver datum. The warning message only occurs in the event of a datum mismatch. The datum mismatch warning displays under the following conditions:

a. Redefinition of the NAV TO waypoint on NAV page #1.

b. Redefinition of the NAV TO waypoint on the Waypoint Edit Page. In this case, the warning occurs only when editing the NAV TO waypoint.

c. Redefinition of the NAV TO waypoint by Auto or Manual Leg advance during route navigation.

d. During route definition. In this case, the first waypoint datum of the route shall be compared to the system datum. All subsequent waypoint datum shall be compared to the first waypoint datum of the route.

e. During definition of Buffer and Corridor alerts. In this case, the FROM waypoint datum is compared to the system datum, and the TO waypoint datum is compared to the FROM waypoint datum. When the alert is turned on, the FROM and TO waypoints; are compared to the system datum

f. After definition of the Bullseye waypoint, the bullseye waypoint datum is compared to the system datum.

g. During definition of Anchor alert waypoint, the anchor waypoint is compared to the system datum.

h. The following display illustrates the Datum Mismatch Warning display presented when a datum mismatch event occurs.

> WARNING
> Datum Mismatch
> WP000 and WP001
> ⬍ to acknowledge

3.13.7 Internal Memory Warning.

The PLGR performs an internal memory integrity check upon power-up and periodically thereafter. Normally, the warning is displayed only following the removal of both prime and memory batteries. When this message occurs, pressing the *Up*- or *Down-arrow* key acknowledges the message and clears the memory. Memory corruption is reported in display shown at right.

> WARNING
> The Receiver has
> Cleared Memory!
> ⬍ to acknowledge

3.14 MISSION PLANNING.

Mission planning is performed using the Desktop Assistant Software (DAS). Use and operation of the DAS is explained in Chapter 12. This data can be transferred to one or more PLGR.

3.15 OBTAINING A FIRST POSITION FIX.

As a final check before beginning a mission, ensure the PLGR is fully functional. This final check should always include obtaining a position fix. Use Table 3-38 to assist you in ensuring the PLGR is ready to go. If you cannot obtain a position fix, see paragraph 4.5 for Mission Operations Checks or sub-paragraph 8.1.1.5 for Troubleshooting.

Table 3-38 Obtaining a First Position Fix .

Action	Comments	Reference
Turn the PLGR ON	Ensure the Power-On self-test completes with no faults.	3.2 Turning ON/OFF
Load crypto key if not already loaded	Check MENU (Second page). If CRYPTO is not displayed, load crypto key.	3.6 Crypto Variable Operations 3.7.11 Crypto Key Initialization
Check all SETUP pages	SETUP pages should conform with operational mission.	3.5 Setup and Mode Control
Initialize position, date, and time	The PLGR will acquire automatically; however, initializing will speed up the Time to First Fix.	3.7 Initialization
Allow the PLGR to track satellite signals	Allow the PLGR to collect current almanac (Check Satellite Summary Page, POS key) and current key (Select CRYPTO on second page of MENU, then check Crypto Status Page), if they are not present.	4.2.4 Satellite Summary Page 3.6.2 Status Display
Check FOM or Position Error	A FOM of 1 is most desirable. You may have to select CONT mode to obtain a FOM of 1. FIX mode will also provide a valid position fix, but may not allow the FOM to decrease to 1 before switching to STBY. Always ensure the antenna has a clear view of the sky.	Table 3-6 of Quick Reference Guide

CHAPTER 4

MISSION OPERATIONS

WARNING

Nav assumes that the PLGR is tracking three or more satellites to determine its position. If less than three satellites are being tracked, present position and nav information are degraded or inaccurate. The PLGR shows on present position and nav displays, the estimated accuracy of the displayed data (either Figure of Merit (*FOM*), or Estimated Position Error (*EPE*), or Estimated Horizontal Error *(EHE))*.

CAUTION

- The PLGR antenna requires a clear field of view (line-of-sight) to the sky, so that satellite acquisition and tracking can occur. If the antenna is masked (the inability of the PLGR to receive the satellite signals) from the sky while in an operating mode (*CONT*, *FIX*, *AVG*, or *TIME),* it may enter a *"Wide Window Search"* mode. This happens because the PLGR does not receive the satellite signals it expects. In this mode, the PLGR tries to find other satellites that are not yet visible.

- If the *antenna masking* is resolved, the PLGR continues in the "*Wide Window Search*" mode, looking for the satellites that are not present. To return the PLGR to normal operation, see sub-paragraph 4.4.9 for Low Signal (Dense Foliage) Use or sub-paragraph 6.1.2.4 for Under Cover (Antenna Masking). You can also turn the PLGR *OFF*, then back *ON* to return to normal operation. Allow time for *TTFF* prior to mission use.

4.1 MISSION OPERATIONS.

Mission operations include using the PLGR to check the present position and navigate to one or more destinations (waypoints). You can also calculate the relative positions of waypoints (azimuth, range, etc), survey, or provide exact timing data (via the HAVE QUICK, SINCGARS, or 1 Pulse-Per-Second (1PPS) data ports). Position displays, Navigation, and Applications are the topics discussed in this chapter.

CAUTION

Always check position, position error, datum, current crypto key, and current almanac before beginning a mission.

NOTE

The displayed position is always associated with the *datum* selected in the *MENU SETUP* page.

4.2 POSITION DISPLAYS.

This paragraph describes the PLGR position display. The position display consists of five pages. The following information is displayed: Current position; Time, date, track and ground speed; Satellite usage summary; Current datum, magnetic variation, and Operator ID; and Bullseye data.

4.2.1 Accessing the Position Displays. The position displays are accessed by pressing the *POS* key in control mode. Perform the following steps to access the position display.

a. Press the *POS* key to bring up the position display.

b. Use the *POS* key to scroll through the position display pages. The *Up*- or *Down-arrow* keys are used, if the cursor is on the paging field.

4.2.1.1 The position display pages are shown in Figure 4-1. A position page example is shown for the available coordinate system formats. Select the coordinate system and datum used from the *SETUP* display (described in sub-paragraph 3.5.4 and sub-paragraph 3.5.7).

4.2.2 <u>Position Page.</u> The following coordinate formats are available for the position display: *MGRS (Old or New), UTM/UPS, L/L-dm., L/L-dms, BNG (not shown), and ITMG (not shown).* Table 4-1, Table 4-2, and Table 4-3 describe the fields and information contained on the position page.

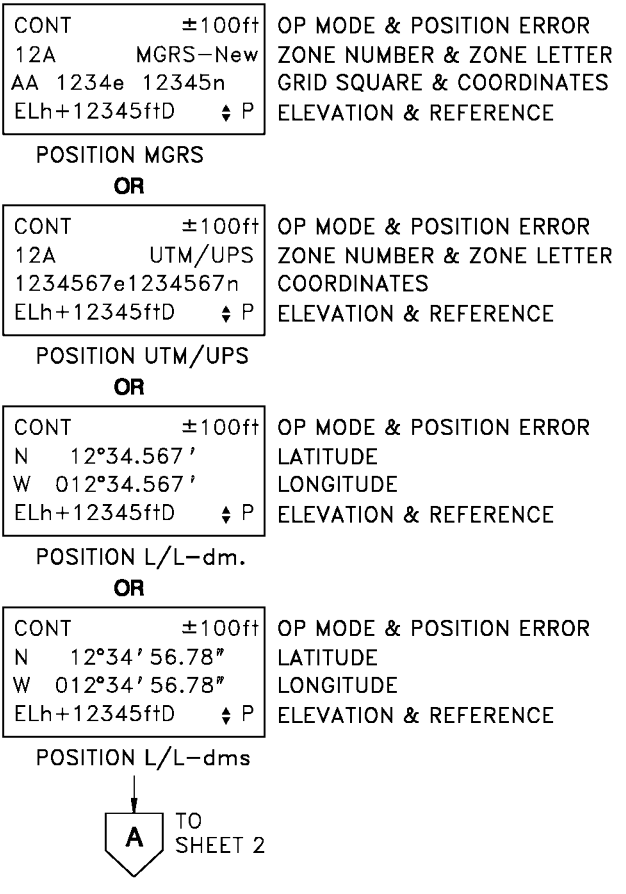


Figure 4-1 Position Display Pages. (Sheet 1 of 2)

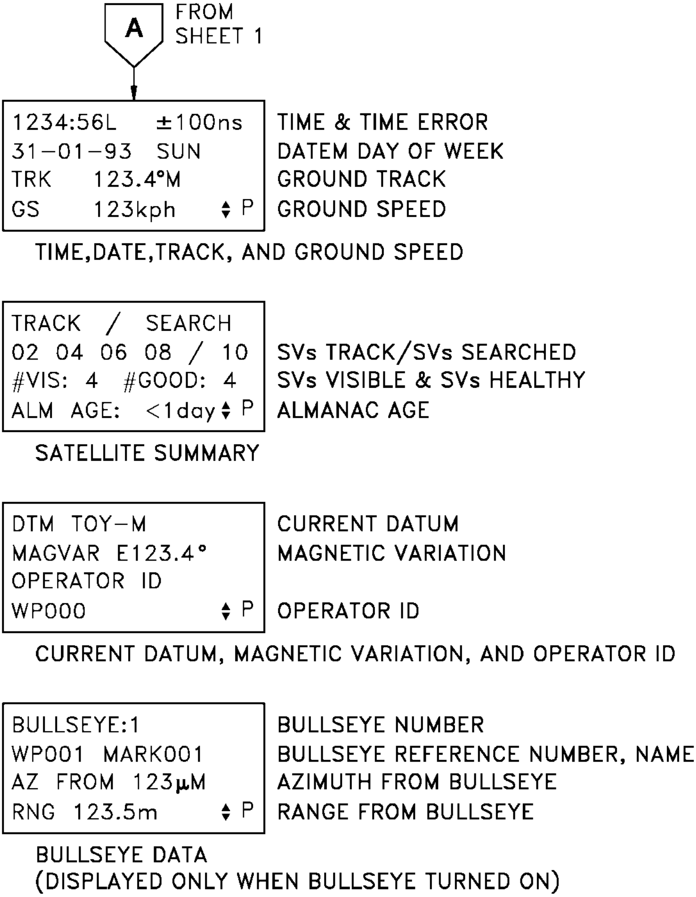


Figure 4-1 Position Display Pages. (Sheet 2)

Table 4-1 Position Display Page .

Line	Field	Description
1	Operating mode	Display only, selectable on set up display (see paragraph 3.5). See Table 4-2.
1	Position error	Display only, except as indicated in Table 4-3. Format is changed on setup display (see paragraph 3.5)
2 & 3	Position coordinate display	Display only. See paragraph 3.5 for coordinate format description and selection.
4	Elevation	EL - display only EL* - elevation may be user entered (0 to 99999) Elh - elevation may be user entered (0 to 99999) unit is in automatic elevation hold mode.
4	Elevation reference	Display only: D (DTM)/blank (MSL) - selectable from setup display (see paragraph 3.5).

NOTE

- Line one of the display page shows the operating mode and estimated position error. If the receiver is not actively tracking satellites, the time since the receiver last tracked (in minutes) is alternated with the estimated error.

- The position coordinates are shown on lines two and three. Elevation, units, and elevation reference are shown on line four.

Table 4-2 Operating Mode Field .

Operating mode display	Condition
CONT	Indicates continuous track mode.
FIX	Indicates quick-fix mode.

Table 4-2 Operating Mode Field - Continued.

AVG xxxxx	Indicates averaging mode. xxxxx is the number of samples in the measurement.
STBY	Indicates standby mode.
T-ONLY	Indicates time-only mode.
2dTNG or 3dTNG	Indicates training mode (simulated navigation).
RHRSL	Indicates rehearsal mode (simulated navigation)

Table 4-3 Position Error Field .

Position error display	Condition
B-ALRT	Position error is small and buffer alert.
C-ALRT	Position error is small and corridor alert.
FOM x	Position error displayed as a Figure of Merit (FOM). See Table 3-6.
±000 ft	Position error displayed as a distance. Units selected on setup display (see paragraph 3.5).
OLD	No current position solution.
P-ALRT	Position error alert.
STATIC	Unit is in time-only mode.
ST XXX	Scenario time.
A-ALRT	Position error is small and anchor alert.
H-ALRT	Position error is small and hazard alert.
PAUSED	Training scenario paused.

4.2.2.1 **Elevation Hold Mode.** Elevation hold mode is used to increase the accuracy of the PLGR when vertical data is poor.

4.2.2.1.1 When only three satellites are available due to poor satellite geometry, reduced satellite availability (health), or line-of-sight blockage of satellite signal due to terrain, vegetation, buildings, vehicles, or other obstructions.

4.2.2.1.2 When at least four satellites are available, but poor geometry exists.

NOTE

If *automatic* is chosen, the PLGR automatically enables and disables elevation hold mode when the conditions are right.

4.2.2.1.3 <u>Automatic Elevation Hold Mode.</u> In automatic mode, the PLGR goes into elevation hold mode when only three satellites are received. Elevation hold mode is shown by ELh on line four of the position page displayed. When the unit goes into elevation hold mode, the last computed elevation value is displayed. Elevation hold mode is disabled when the conditions listed in sub-paragraph 4.2.2.1 are no longer present.

CONT ±100ft
12A MGRS-New
AA 00000e 00000n
Elh+00000ftD P

ELh INDICATES UNIT IS IN ELEVATION HOLD

NOTE

If *manual* is chosen, an *EL** shows up on line four of the position coordinates display (next to the elevation) when either of the conditions above occurs. The *EL** shows that elevation hold mode is allowable, but not enabled. The user may or may not choose to enable elevation hold mode.

4.2.2.1.4 Manual Elevation Hold Mode.

In manual elevation hold mode, the PLGR displays *EL** on line four of the position page display at right. The *EL** indicates poor vertical geometry exists (conditions listed in paragraph 4.2.2.1.1). Elevation hold mode is enabled by entering an elevation on line four of the position page. Once an elevation is entered, the *EL** on line four is replaced with ELh. The elevation is updated by the user anytime the EL* is displayed. Elevation hold mode is disabled in two ways:

CONT	±100ft
00A	MGRS-New
AA	00000e 00000n
EL * + 00000	ftD P

EL* INDICATES ELEVATION HOLD MODE MAY BE ENABLED BY ENTERING ELEVATION OR BY CHANGING THE '*' TO 'h'.

a. Automatically when the conditions listed in paragraph 4.2.2.1.1 are no longer present.

b. When the user sets elevation hold mode to manual. The h of the ELh indicator changes to *. Changing the ELh to *EL** disables elevation hold mode.

4.2.3 Time, Date, and Ground Speed Page.

The second page of the position display is the time, time error, date, track, and ground speed page. Each data field on this display page is described in Table 4-4. This page contains no selectable fields.

0000:00Z	±100ns
31-01-93	SUN
TRK	000.0°T
GS	***kts ⬍ P

Table 4-4 Time, Date, Track, and Ground Speed Page .

Line	Field	Description
1	Time	Local/Zulu selectable on setup display (see paragraph 3.5). Time is initialized on the initialization display (see paragraph 3.7).
1	Time error	See Table 4-5.
2	Date and day	Date is initialized on the initialization display (see paragraph 3.7). The day is calculated.
3	Track	See Table 4-6. Track is initialized on the initialization display. Units are selectable on setup display.
3	North reference	T/M/G - selectable on setup display.
4	Ground speed	See Table 4-6. Ground speed is initialized on the initialization display. Units are selectable on setup display.

Table 4-5 Time Error Format .

Time error	Condition
blank	If in standby mode.
TFOMnn	If TFOM selected on *SETUP* page. See Table 3-7.
±mmm ns	If time units selected on *SETUP* page.

Table 4-6 Track and Ground Speed .

Condition	Display
If speed >0.5 m/s	Display track and ground speed
If speed <0.5 m/s	Line 3: Speed too slow Line 4: GS <1.5 kph
If in averaging mode	Line 3: Averaging mode Line 4: DO NOT MOVE
If in time-only mode	Line 3: Time-only mode Line 4: DO NOT MOVE
If in standby mode	Line 3: Standby mode Line 4: (blank)

4.2.4 <u>Satellite Summary Page.</u> The satellite identifiers are for each satellite being tracked or searched. The IDs to the left of the slash “/” are satellites being tracked. The IDs to the right of the slash are satellites being searched. The third page of the position display is the tracking summary page. Each data field on this display page is described in Table 4-7. This page has no selectable data fields.

```
TRACK / SEARCH
02  04  06 08  /  10
#VIS: 4  #GOOD: 4
ALM AGE: <1day⬍ P
```

Table 4-7 Satellite Summary Page .

Line #	Field	Description
2	TRACK/ SEARCH	The satellite identifier for each satellite tracked or searched for. The IDs to the left of the slash “/” are satellites tracked. The IDs to the right of the slash are satellites searched for.
3	#VIS	The number of visible satellites.
3	#GOOD	The number of visible satellites that are in good health.
4	ALM AGE	The age of the almanac data: mmday - age of almanac in days >99 day - almanac data is more than 99 days old 1 day - almanac data is at least one day (0-24 hours) old No Almanac - almanac data is not available or incomplete

4.2.5 Current Datum, Magnetic Variation, and Operator ID. The fourth page of the position display is the current datum, magnetic variation, and Operator ID. Each data field is described in Table 4-8. This page has no selectable data fields.

Table 4-8 Current Datum, Magnetic Variation, and Operator ID .

Line	Field	Description
	DTM TOY-M MAGVAR E123.4° OPERATOR ID WP000 ________ ⇕ P	CURRENT DATUM MAGNETIC VARIATION OPERATOR ID
1	DTM	Display setup datum identifier (see sub-paragraph 3.5.7.1)
2	MAGVAR	Display magnetic variation (see sub-paragraph 3.5.5.1 and sub-paragraph 3.5.5.2). Note: Only integer values of magnetic variation will be displayed when in mils.
3	OPERATOR ID	Display Operator ID (see sub-paragraph 3.5.10)

4.2.6 **Bullseye Page.** The fifth page of the position display presents range and azimuth from a common reference point (the Bullseye reference point) to the present position. Each data field on this page is described in Table 4-9. The one selectable data field is the Bullseye number.

```
BULLSEYE     :1
WP001  MARK001
AZ FROM 1234µM
RNG  1234.5m ⇕ P
```

4.2.6.1 Bullseye Page Display. In order for the Bullseye page to be displayed, the Bullseye function (selected on the Bullseye Setup page) must be on. Up to two Bullseyes, together with the corresponding waypoint number and name for each Bullseye, may be identified on the Bullseye Setup page (see sub-paragraph 3.5.10). Line 1 of the Bullseye page allows selection of Bullseye 1 or Bullseye 2 as the Bullseye reference point. The waypoint number and name displayed on line 2 are for the Bullseye number shown on line 1. Line 3 of this page azimuth shows and range (Great Circle distance) from the selected Bullseye to the present position. Units for azimuth and range, together with the angular reference for the Bullseye reference waypoint, are from Setup Display page 2. Data on the Bullseye display page is updated once per second. If a position fix has not been acquired, the waypoint number and name fields are blank, and the AZ and RNG parameters are displayed as “n/a”. The last viewed Bullseye page is stored and displayed again when the Bullseye page is exited, and then selected.

Table 4-9 Bullseye Page .

Line	Field	Description
1	BULLSEYE NUMBER	Bullseye number 1 of 2
2	WAYPOINT NUMBER	Bullseye reference waypoint number
2	WAYPOINT NAME	Bullseye reference waypoint name
3	AZ	Azimuth from Bullseye
4	RNG	Range from Bullseye

WARNING

PLGR is not to be used to navigate through mine fields or mined waterways. The PLGR is not to be used for the precise recording of mined areas. The PLGR can be used for providing general locations of mined areas and for providing approximate boundaries of mined areas.

CAUTION

When using the waypoint *ENTER* or *EDIT* page, a datum may be selected that differs from the datum entered in the *MENU SETUP* page. To reduce the potential of significant positional errors, do not navigate between two waypoints with *different datums*. Do not measure range or azimuth between two waypoints with different datums.

4.3 NAVIGATION.

Navigation (nav) is using the PLGR to find your present position, relative to other points. The PLGR provides azimuth, range, and steering information in a variety of formats.

4.3.1 NAV Display Modes. There are four nav display modes that may be accessed and selected (see display at right). The nav display mode selected determines the type of information shown on the nav displays. Changing the nav display mode changes the format of the nav displays. The nav information displayed for each nav display mode selected (except *CUSTOM*) is shown in Table 4-10, Table 4-11, and Table 4-12. This gives the user the most useful information for a certain mission profile: *SLOW*, *2D FAST*, *3D FAST*, or *CUSTOM* (see sub-paragraph 4.3.5.4).

SLOW	DIRECT
WP001 TARGET	
	P

Table 4-10 SLOW Navigation Display Mode .

SLOW Mode		
Navigation Method	Nav Display Page	Information Displayed
Direct	2	*WP number, WP label* *RNG* *AZ*, north ref
	3	*ELD* *SR* *AZ*, north ref *ELA*
Course To	2	*WP number, WP label* *RNG* *AZ*, north ref *XTE*

Table 4-10 SLOW Navigation Display Mode - Continued.

SLOW Mode		
Navigation Method	Nav Display Page	Information Displayed
	3	*ELD* *SR* *AZ*, north ref *ELA*
Course From	2	*WP number, WP label* *RNG* *AZ*, north ref *XTE*
	3	*ELD* *SR* *AZ*, north ref *ELA*
Route	2	*WP number, WP label* *RNG* *AZ*, north ref *XTE*
	3	*ELD* *SR* *AZ*, north ref *ELA*

Table 4-11 2D FAST Navigation Display Mode .

2D FAST Mode		
Navigation Method	Nav Display Page	Information Displayed
Direct	2	*WP number, WP label* *TRK, GS* *AZ*, north ref *STR*
	3	*RNG* *TTG2* *ELD* *MMD2*
	4	*WP number, WP label* *SR* *AZ*, north ref *ELA*
Course To	2	WP *number, WP label* *TRK, GS* *AZ*, north ref *XTE*
	3	*RNG* *TTG2* *ELD* *MMD2*
	4	*WP number, WP label* *SR* *AZ*, north ref *ELA*
Course From	2	WP *number, WP label* *TRK, GS* *AZ*, north ref *XTE*
	3	*RNG* *ELD*

Table 4-11 2D FAST Navigation Display Mode - Continued.

2D FAST Mode		
Navigation Method	Nav Display Page	Information Displayed
	4	*WP number*, *WP label* *SR* *AZ*, north ref *ELA*
Route	2	*WP number*, *WP label* *TRK*, *GS* *AZ*, north ref *XTE*
	3	*RNG* *TTG2* *ELD* *MMD2*
	4	*WP number*, *WP label* *SR* *AZ*, north ref *ELA*

Table 4-12 3D FAST Navigation Mode .

3D-FAST Mode		
Navigation Method	Nav Display Page	Information Displayed
Direct	2	*WP number*, *WP label* *TRK*, *GS* *AZ*, north ref *STR* (*L*/*R* and *U*/*D*)
	3	*RNG* *TTG3* *ELD* *MMD3*

Table 4-12 3D FAST Navigation Mode - Continued.

3D-FAST Mode		
Navigation Method	Nav Display Page	Information Displayed
	4	*WP number, WP label* *SR* *AZ*, north ref *ELA*
Course To	2	*WP number, WP label* *TRK, GS* *AZ*, north ref *XTE*
	3	*RNG* *TTG3* *ELD* *MMD3*
	4	*WP number, WP label* *SR* *AZ*, north ref *ELA*
Course From	2	*WP number, WP label* *TRK, GS* *AZ*, north ref *XTE*
	3	*RNG* *ELD*
	4	*WP number, WP label* *SR* *AZ*, north ref *ELA*
Route	2	*WP number, WP label* *TRK, GS* *AZ*, north ref *XTE*

Table 4-12 3D FAST Navigation Mode - Continued.

3D-FAST Mode		
Navigation Method	Nav Display Page	Information Displayed
	3	*RNG* *TTG3* *ELD* *MMD3*
	4	*WP number*, *WP label* *SR* *AZ*, north ref *ELA*
Approach	2	*WP number*, *WP label* *TRK*, *GS* *AZ*, north ref *XTE*
	3	*RNG* *GPdev* (Lo or Hi) *ELD* *XTE*
	4	*WP number*, *WP label* *SR* *AZ*, north ref *ELA*

NOTE

Examples of users are those traveling on foot on rough or difficult terrain, drifting in a boat, or a helicopter in and out of hover.

4.3.1.1 SLOW NAV Mode. In *SLOW* nav mode, the PLGR performs *two-dimensional (2D)* nav. *SLOW* nav mode is used for *land* or *sea* nav, when the user can not maintain the minimum speed necessary (approximately 1.5 kph) for GPS to compute navigation parameters that depend on velocity, such as:

Steering (left/right)	STR (← →)
Time to go	TTG2
Minimum miss distance	MMD2
Steering (up/down)	STR (↑↓)
Glide path deviation	GPdev (Lo or Hi)

NOTE

Examples of users are those traveling on foot on open terrain, in ground vehicles, or in ships.

4.3.1.2 2D FAST NAV Mode. In *2D FAST* nav mode, the PLGR performs *two-dimensional (*2D*)* nav. *2D FAST* nav mode is used for *land* or *sea* nav, when the user can maintain the minimum speed necessary for GPS to compute navigation parameters based on velocity. Since these users travel horizontally, TTG2 and MMD2 are based on horizontal range.

NOTE

Examples of users are those traveling in a helicopter, airplane, or parachute.

4.3.1.3 <u>3D FAST NAV Mode.</u> In *3D FAST* nav mode, the PLGR performs three-dimensional (3D) nav. *3D FAST* nav mode has an *APPROACH* sub-mode. *3D FAST* nav mode is used for *air* nav, when the user can travel in three dimensions and can maintain the minimum speed necessary for GPS to compute navigation parameters based on velocity. Therefore, TTG3 and MMD3 are based on slant range.

NOTE

- If no nav pages are defined for the *CUSTOM* setup mode, then only one other nav page is displayed with *WP/FOM* only.

- The nav display pages are scrolled up or down using the *Up*- or *Down* arrow key. Repeatedly pressing the *NAV* key also scrolls the display pages down.

4.3.2 <u>Accessing the Navigation Displays.</u> The nav displays are accessed by pressing the *NAV* key. The first page is used to customize the display mode (either *SLOW*, *2D FAST*, *3D FAST*, or *CUSTOM*. The displays are pre-customized for display modes *SLOW*, *2D FAST*, or *3D FAST*, and provide the most useful information with a minimum of keystrokes. The displays are user customized for display mode *CUSTOM*, (see sub-paragraph 4.3.5.4).

4.3.3 <u>Selecting Navigation Display Modes.</u> The nav display mode is selected on the first *NAV* page by selecting the mode field and scrolling to the desired option. *SLOW* nav display mode is the default, but any mode selected is maintained until changed by the user.

4.3.4 Methods of Navigation. Select the nav method field on the first *NAV* page, and scroll to the desired option. See display at right. The options are *DIRECT*, *CRS TO*, *CRS FROM*, *ROUTE* (if a route is defined), and in *3D FAST* and *CUSTOM* (see sub-paragraph 4.3.5.4) modes only, *APPROACH*, as shown.

```
SLOW         CRS  TO
WP001  TARGET
CRS  360.0°T
                    P
```

OR DIRECT, CRS FROM, ROUTE

OR APPROACH (3D FAST AND CUSTOM ONLY)

4.3.4.1 Direct. *DIRECT* is used to navigate from the present position directly to the destination waypoint.

4.3.4.2 Course To. *CRS TO* is used to navigate along a desired course into a destination way point. The user enters the desired course. Steering information steers to the destination. Crosstrack error shows the perpendicular Great Circle distance that you are to left or right of the desired course line.

4.3.4.3 Course From. *CRS FROM* is used to navigate along a desired course away from a destination waypoint. The user enters the desired course. Steering information steers away from the destination. Crosstrack error shows the perpendicular Great Circle distance that you are to left or right of the desired course line.

4.3.4.4 **Route.** ROUTE nav is like linking together several waypoints that are navigated using the ROUTE method. In this mode the PLGR does all of the course computing for you. *ROUTE* nav is used to navigate from one way point to the next along a pre-defined route. The waypoints are previously linked together (using the procedure under the *WP* menu choice of *ROUTE).* The *ROUTE* method of nav has an additional option to select either start to end or end to start (forwards or backwards). The selectable fields are highlighted on the display shown. The *ROUTE* field is available only when a route has been defined.

SLOW ROUTE 01
LEG 04 start→end
WP009 AIR3
→→005 END ⬍ P

4.3.4.5 Steering displays steer to the destination. Crosstrack error shows the perpendicular Great Circle distance that you are to the left or to the right of the desired course line mapped from one waypoint to the next.

4.3.4.6 **Approach.** APPROACH is used to navigate along an entered glide path to the destination waypoint.

4.3.5 **Selecting a Destination.** Waypoints are selected as the destination on line two of the first *NAV* page (i.e., press the *NAV* key from another display). If no waypoints or *MARKS* are stored, the display shows that no waypoints are defined.

Not enough
waypoints:
Press POS, Menu,
WP or MARK

a. Select the waypoint number field on line two. The destination waypoint number is entered by scrolling or by entry in *NUM LOCK* mode. The way points are scrolled from 001 to 999.

```
SLOW          DIRECT
WP 001 TARGET

                   P
```

b. The available waypoints are also scrolled by moving the cursor to the way point scrolling field (↕ between the waypoint number and identifier). This scrolls the waypoints alphabetically. The waypoint identifier changes as the waypoint number is scrolled or entered.

```
SLOW          DIRECT
WP001 ↕ TARGET

                   P
```

4.3.5.1 <u>Slow Display Mode.</u> Since there are four methods of nav for *SLOW* display mode, each is explained individually.

4.3.5.1.1 <u>Slow - Direct.</u> After *SLOW* display mode and *DIRECT* nav method are selected on *NAV* page one, two pages of nav information are available:

a. The second page shows: destination, computed range, and azimuth and north reference.

```
WP001:TARGET
RNG        1234.56mi
AZ         1234.5µG
                 ↕ P
```

b. The third page includes: elevation difference, slant range, azimuth and north reference, and elevation angle to the destination. Units are also displayed.

```
ELD      +12345ft
SR       1234.56mi
AZ       1234.5µG
ELA      +1234.5µ   ↕ P
```

4.3.5.1.2 **Slow - Course To.** After *SLOW* display mode and *CRS TO* nav method are selected on *NAV* page one, the desired course to the destination is entered on line three. Two more pages of nav information are available:

```
SLOW        CRS  TO
WP001  TARGET
CRS  360.0   °T
                  P
```

a. The second page shows: destination, range, azimuth and north reference, and crosstrack error (distance left or right of the desired course). Units are also displayed.

```
WP001:TARGET
RNG   1234.56mi
AZ    1234.5µG
XTE   R1234.56mi ⬍ P
```

b. The third page includes: elevation difference, slant range, azimuth and north reference, and elevation angle. Units are also displayed.

```
ELD  -12345ft
SR    123.4ft
AZ    1234.5µG
ELA  -1234.5µ     ⬍ P
```

4.3.5.1.3 **Slow - Course From.** After *SLOW* display mode and the *CRS FROM* nav method are selected on *NAV* page one, the desired course from the destination is entered on line three. Two more pages of nav information are available.

```
SLOW      CRS FROM
WP001  TARGET
CRS  360.0   °T
                  P
```

a. The second page shows: destination, range, azimuth and north reference, and crosstrack error (distance left or right of the desired course). Units are also displayed.

```
WP001:TARGET
RNG   1234.56mi
AZ    1234.5µG
XTE   R1234.56mi ⬍ P
```

b. The third page includes: elevation difference, slant range, azimuth and north reference, and elevation angle. Units are also displayed.

```
ELD -12345ft
SR    123.4ft
AZ   1234.5µG
ELA -1234.5µ        ⬍ P
```

4.3.5.1.4 __**Slow - Route.**__ Route nav is performed in either direction on the route: start to end or end to start. After reaching the destination waypoint of a route leg, the next leg is selected to change the destination. After *SLOW* display mode, *ROUTE* nav method and route number are selected on *NAV* page one, the Leg number to be navigated along is entered on line two. The waypoints that mark the ends of the Leg change when the Leg number is changed. On line two, either “start to end” or “end to start” is chosen for the direction of nav. Two more pages of nav information are available.

```
SLOW       ROUTE 01
LEG    01  start→end
WP001  HOME
→→002  CORNER  ⬍ P
```

a. The second page shows: destination, range, azimuth and north reference, and crosstrack error (distance left or right of the desired course). Units are also displayed.

```
WP002:CORNER
RNG  1234.56mi
AZ   1234.5µG
XTE  R1234.56mi ⬍ P
```

b. The third page includes: elevation difference, slant range, azimuth and north reference, and elevation angle. Units are also displayed.

```
ELD -12345ft
SR    123.4ft
AZ   1234.5µG
ELA -1234.5µ        ⬍ P
```

4.3.5.2 2D Fast Display Mode. Since there are four methods of nav for *2D FAST* display mode, each is explained separately.

4.3.5.2.1 2D Fast - Direct. After *2D FAST* display mode and *DIRECT* nav method are selected on *NAV* page one, three pages of nav information are available.

a. The second page shows: destination, track, ground speed, azimuth and north reference, and steering. Units are also displayed. Note that no data is available (*n/a*) for track, ground speed, and steering if the speed is too slow.

WP001:TARGET		
TRK	123.4°T	45
AZ	123.4°T	mph
STR	←123°	⬍ P

b. The third page includes: range, time to go, elevation difference, and minimum miss distance. Units are also displayed. Note that no data is available (*n/a*) for time to go and minimum miss distance if the speed is too slow.

RNG	1234.56mi
TTG2	1234:56
ELD	+12345ft
MMD2	1234.5ft ⬍ P

c. The fourth page includes: destination, slant range, azimuth and north reference, and elevation angle to the destination. Units are also displayed.

WP001:TARGET		
SR	1234.56nm	
AZ	123.4°T	
ELA	+123.4°	⬍ P

4.3.5.2.2 2D Fast - Course To. After *2D FAST* display mode and *CRS TO* nav method are selected on *NAV* page one, the desired course to the destination is entered on line three. Three more pages of nav information are available.

2D FAST		CRS TO
WP001 TARGET		
CRS	360.0	°T
		P

a. The second page shows: destination, track, ground speed, azimuth and north reference, and crosstrack error (distance left or fight of the desired course). Units are also displayed. Note that no data is available (*n/a*) for track and ground speed if the speed is too slow.

```
WP001:TARGET
TRK        123.4°T     45
AZ         123.4°T    mph
XTE   L1234.56nm ⬍ P
```

b. The third page includes: range, time to go, elevation difference, and minimum miss distance. Units are also displayed. Note that no data is available (*n/a*) for time to go and minimum miss distance if the speed is too slow.

```
RNG    1234.56mi
TTG2   1234:56
ELD    +12345ft
MMD2   1234.5ft ⬍ P
```

c. The fourth page shows: destination, slant range, azimuth and north reference, and elevation angle to the destination. Units are also displayed.

```
WP001:TARGET
SR     1234.56nm
AZ        123.4°T
ELA    +123.4°      ⬍ P
```

4.3.5.2.3 2D Fast - Course From.

After *2D FAST* display mode and *CRS FROM* nav method are selected on *NAV* page one, the desired course from the destination is entered on line three. Three more pages of nav information are available.

```
2D FAST CRS FROM
WP001 TARGET
CRS   360.0 °T
                    P
```

a. The second page shows: destination, track, ground speed, azimuth and north reference, and crosstrack error (distance left or right of the desired course). Units are also displayed. Note that no data is available (*n/a*) for track and ground speed if the speed is too slow.

```
WP001:TARGET
TRK      360.0°T     39
AZ       123.4°T    kts
XTE   L1234.56nm ⬍ P
```

b. The third page includes: range and elevation difference.

```
RNG  123.45mi

ELD  +12345ft
                 ⬍ P
```

c. The fourth page includes: destination, slant range, azimuth and north reference, and elevation angle to the destination. Units are also displayed.

```
WP001:TARGET
SR   1234.56mi
AZ   1234.5µG
ELA  +1234.5µ ⬍ P
```

4.3.5.2.4 <u>2D Fast - Route.</u> Route nav is performed in either direction on the route: start to end or end to start, After reaching the destination waypoint of a route leg, the next leg is selected to change the destination. After *2D FAST* display mode, *ROUTE* nav method and route number are selected on *NAV* page one, the Leg number to be navigated along is entered on line two. The way-points that mark the ends of Leg change when the leg number is changed. On line two, either “start to end” or “end to start” is chosen for the direction of nav. Three more pages of nav information are available.

```
2D FAST ROUTE   01
LEG    01  start→end
WP001  HOME
→→002  CORNER ⬍ P
```

a. The second page shows: destination, track, ground speed, azimuth and north reference, and crosstrack error (distance left or right of the computed course between the ends of the leg). Units are also displayed. Note that no data is available *(n/a)* for track and ground speed if speed is too slow.

```
WP002:CORNER
TRK      123.4°T    39
AZ       123.4°T   kts
XTE  L1234.56nm ⬍ P
```

b. The third page includes: range, time to go, elevation difference, and minimum miss distance. Units are also displayed. Note that no data is available *(n/a)* for time to go and minimum miss distance if the speed is too slow.

```
RNG    1234.56mi
TTG2   1234:56
ELD    +12345ft
MMD2   1234.5ft ⬍ P
```

c. The fourth page includes: destination, slant range, azimuth and north reference, and elevation angle. Units are also displayed. Note that no data is available *(n/a)* for elevation angle if elevation is not stored with the destination waypoint.

```
WP002:CORNER
SR     1234.56nm
AZ        123.4°T
ELA   +123.4°      ⬍ P
```

4.3.5.3 <u>3D Fast Display Mode.</u> Air display mode is ideal for parachute applications. Since there are five methods of nav for *3D FAST* display mode, each is explained individually.

4.3.5.3.1 <u>3D Fast - Direct.</u> After *3D FAST* display mode and *DIRECT* nav method are selected on *NAV* page one, three pages of nav information are available.

a. The second page shows: destination, track, ground speed, azimuth and north reference, and steering (left or right and up or down). Units are also displayed. Note that no data is available *(n/a)* for track, ground speed, and steering if the speed is too slow.

```
WP001:TARGET
TRK        123.4°T    39
AZ         123.4°T   kts
STR  ←123°↓123°⬍ P
```

b. The third page includes: range, time to go, elevation difference, minimum miss distance. Units are also displayed. Note that no data is available *(n/a)* for time to go and minimum miss distance if the speed is too slow.

```
RNG    1234.56mi
TTG3   1234:56
ELD    +12345ft
MMD3   1234.5ft    ⬍ P
```

c. The fourth page includes: destination, slant range, azimuth and north reference, and elevation angle to the destination. Units are also displayed.

```
WP001:TARGET
SR      1234.56nm
AZ         123.4°T
ELA+   123.4°      ⬍ P
```

4.3.5.3.2 __3D Fast - Course To.__ After *3D FAST* display mode and *CRS TO* nav method are selected on *NAV* page one, the desired course to the destination is entered on line three. Three more pages of nav information are available.

```
3D FAST CRS TO
WP001 TARGET
CRS  360.0   °T
                     P
```

a. The second page shows: destination, track, ground speed, azimuth and north reference, and crosstrack error (distance left or right of the desire course). Units are also displayed. Note that no data is available (*n/a*) for track and ground speed if the speed is too slow.

```
WP001:TARGET
TRK      123.4°T      39
AZ       123.4°T     kts
XTE   L123.56nm ⬍ P
```

b. The third page includes: range, time to go, elevation difference, and minimum miss distance. Units are also displayed. Note that no data is available (*n/a*) for time to go and minimum miss distance if the speed is too slow.

```
RNG     1234.56mi
TTG3    1234:56
ELD     +12345ft
MMD3    1234.5ft ⬍ P
```

c. The fourth page includes: destination, slant range, azimuth and north reference, and elevation angle. Units are also displayed.

```
WP001:TARGET
SR     1234.56km
AZ        123.4°T
ELA   -090.0°       ⬍ P
```

4.3.5.3.3 <u>3D Fast - Course From.</u> After *3D FAST* display mode and *CRS FROM* nav method are selected on *NAV* page one, the desired course from the destination is entered on line three. Three more pages of nav information are available.

```
3D FAST CRS FROM
WP001 TARGET
CRS  360.0  °T
                    P
```

a. The second page shows: destination, track, ground speed, azimuth and north reference, and crosstrack error (distance left or right of the desired course). Units are also displayed. Note that no data is available (*n/a*) for track and ground speed if the speed is too slow.

```
WP001:TARGET
TRK     360.0°T     39
AZ      123.4°T    kts
XTE  L1234.56nm ⬍ P
```

b. The third page includes: range and elevation difference.

```
RNG    123.45mi

ELD    +12345ft
                  ⬍ P
```

c. The fourth page includes: destination, slant range, azimuth and north reference, and elevation angle to the destination. Units are also displayed.

```
WP001:TARGET
SR     1234.56mi
AZ     1234.5µG
ELA   +1234.5µ ⬍ P
```

4.3.5.3.4 3D Fast - Route. Route nav is performed in either direction on the route: “start to end” or “end to start”. After reaching the destination waypoint of a route leg, the next leg is selected to change the destination. After *3D FAST* display mode, *ROUTE* nav method and route number are selected on *NAV* page one, the Leg number to be navigated along is entered on line two. The waypoints that mark the ends of Leg change when the leg number is changed. On line two, either “start to end” or “end to start” is chosen for the direction of nav. Three more pages of nav information are available.

3D FAST ROUTE		01
LEG	01 start → end	
WP001	HOME	
→→002	CORNER	⬍ P

a. The second page shows: destination, track, ground speed, azimuth and north reference, and crosstrack error (distance left or right of the computed course between the ends of the leg). Units are also displayed. Note that no data is available (*n/a*) for track and ground speed if the speed is too slow.

WP002:CORNER		
TRK	123.4°T	39
AZ	123.4°T	kts
XTE	L1234.56nm	⬍ P

b. The third page includes: range, time to go, elevation difference, and minimum miss distance. Units are also displayed. Note that no data is available (*n/a*) for time to go and minimum miss distance if the speed is too slow.

RNG	1234.56mi
TTG3	1234:56
ELD	+12345ft
MMD3	1234.5ft ⬍ P

c. The fourth page includes: destination, slant range, azimuth and north reference, and elevation angle to the destination. Units are also displayed. Note that no data is available (*n/a*) for elevation angle if elevation is not stored with the destination waypoint.

```
WP002:CORNER
SR      1234.56km
AZ        123.4°T
ELA     +012.3° ⬍ P
```

4.3.5.3.5 <u>3D Fast - Approach.</u> After *3D FAST* display mode and *APPROACH* nav method are selected on *NAV* page one, the desired course to the destination is entered on line three. Glide Path Angle (*GPA*) to the destination also is entered, on line four. Three more pages of nav information are available.

```
3D FAST APPROACH
WP001 TARGET
CRS  360.0  °T
GPA  +012.3  °        P
```

a. The second page shows: destination, track, ground speed, azimuth and north reference, and crosstrack error (distance left or right of the desired course). Units are also displayed. Note that no data is available (*n/a*) for track and ground speed if the speed is too slow.

```
WP001:TARGET
TRK     360.0°T      39
AZ      123.4°T     kts
XTE  L1234.56nm ⬍ P
```

b. The third page includes: range, glide path deviation (*GPdev* - Lo or Hi) angle, elevation difference, and crosstrack error. Units are also displayed.

```
RNG    1234.56mi
GPdev  Lo 12.3°
ELD    +12345ft
XTE    L1234.56mi ⬍ P
```

c. The fourth page includes: destination, slant range, azimuth and north reference, and elevation angle to the destination. Units are also displayed.

```
WP001:TARGET
SR      1234.56km
AZ          123.4°T
ELA   +012.3° ⇕ P
```

4.3.5.4 <u>Custom NAV Page Setup.</u> User-defined navigation display pages can be set up to support the individual user's performances or mission requirements. The following paragraphs explain this information.

NOTE

The last line will not allow selection of *TRK/GS*, *WP* or *WP/FOM* nav items.

4.3.5.4.1 <u>Accessing the CUSTOM NAV Setup Pages.</u> The *CUSTOM NAV* setup pages are accessed from the *MENU*, *CUSTOM NAV* display page. Perform the following steps:

a. Press the *MENU* key until the *MENU* display with *SETUP* comes up.

b. Select the *CUSTOM NAV* field. *(MENU* display comes up with the cursor on the paging field).

c. Press the *Up*- or *Down-arrow* key to bring up the *NAV displays* pages (sample page shown).

```
WP/FOM      PAGE 01
AZ
RNG
ELD               ⇕ P
```

NOTE

The first nav line cannot be edited.

d. Use the *Up*- or *Down-arrow* key while on the paging symbol to access the different nav pages.

e. Use the *Left*- or *Right-arrow* key to access the nav item lines. Use the *Up*- or *Down-arrow* key to select the various nav item options. The following parameter options are available:

blank	Blanks the parameter (If all four lines are blank, the page is not accessible via the NAV key)
AZ	Azimuth
EHE	Estimated Horizontal Error
ELA	Elevation Angle
ELD	Elevation Difference
EPE	Estimated Position Error
FOM	Figure of Merit
GPdev	Glide Path Deviation
GS	Ground Speed
MMD2d	Minimum Miss Distance 2 Dimensional
MMD3d	Minimum Miss Distance 3 Dimensional
RNG	Range
SR	Slant Range
STR2d	Steering 2 Dimensional
STR3d	Steering 3 Dimensional
TRK	Track
TRK/GS	Track and Ground Speed (on one line)
TTG2d	Time To Go 2 Dimensional
TTG3d	Time To Go 3 Dimensional
WP	Waypoint (not available on the bottom line)
WP/FOM	Waypoint Name and Figure of Merit (on one line)
XTE	Crosstrack Error

4.3.5.4.2 Default Setup Values. On normal startup, the customized navigation pages retain the configuration defined before the PLGR was turned *OFF*. However, should the memory be lost, the PLGR defaults all customizable navigation pages to *WP/FOM* on line 1, and lines two through four are “blank”.

4.3.5.4.3 Custom Display Mode. The following custom display modes are available. The nav information displayed for each nav display mode selected is shown in Table 4-13.

Table 4-13 Custom Navigation Display Mode .

CUSTOM Mode		
Navigation Method	Nav Display Page	Information Displayed
Direct	1-10	As defined in *SETUP*
Course To	1-10	As defined in *SETUP*
Course From	1-10	As defined in *SETUP*
Route	1-10	As defined in *SETUP*
Approach	1-10	As defined in *SETUP*

4.3.5.4.4 Custom - Direct. After *CUSTOM* display mode and *DIRECT* nav method are selected on *NAV* page one, up to ten more pages of nav information (defined in *SETUP)* are available.

4.3.5.4.5 Custom - Course To. After *CUSTOM* display mode and *CRS TO* nav method are selected on *NAV* page one, the desired course to the destination is entered on line three. Up to ten more pages of nav information (defined in *SETUP)* are available.

4.3.5.4.6 Custom - Course From. After *CUSTOM* display mode and *CRS FROM* nav method are selected on *NAV* page one, the desired course from the source is entered on line three. Up to ten more pages of nav information (defined in *SETUP)* are available.

NOTE

> If the “to” waypoint name displayed on line four is eight or more characters in length, an ellipses (...) character is displayed after the seventh character.

4.3.5.4.7 <u>Custom - Route.</u> Route nav is performed on any one of up to fifteen defined routes, in either direction on the route: “start to end” or “end to start”. After reaching the destination waypoint of a route leg, the next leg is selected to change the destination. After *CUSTOM* display mode, *ROUTE* nav method and route number to be navigated are selected on *NAV* page one, the Leg number to be navigated is entered on line two. The waypoints that mark the ends of a Leg changes when the Leg number is changed. On line two, either “start to end” or “end to start” is chosen for the direction of nav. Up to ten more pages of nav information (defined in *SETUP)* are available.

NOTE

> No data is available (*n/a*) for *XTE* if the nav method is *DIRECT* or for *GPdev* if the nav method is not *APPROACH*.

4.3.5.4.8 <u>Custom - Approach.</u> After *CUSTOM* display mode and *APPROACH* nav method are selected on *NAV* page one, the desired course to the destination is entered on line three. Glide Path Angle (*GPA*) to the destination is also entered, on line four. Up to ten more pages of nav information (defined in *SETUP*) are available.

4.3.6 Navigation Alerts. Seven nav alerts are available to alert the user of degraded nav accuracy, or departure from, or approach to, known positions or areas. Up to twenty alerts can be entered in each of the following alert types, except for Route Leg Advance Alert.

2D Position Alert
3D Position Alert
Corridor Alert
Buffer Alert
Anchor Alert
Hazard Alert
Route Leg Advance Alert

NOTE

> The Leg Advance alert is independent of the first four alert options. Data is manually entered, edited, or cleared from the *RTE LEG ADVANCE* page.

4.3.6.1 Accessing Alerts. To access the *ALERTS* display page, press the *MENU* key until the *MENU* display with *ALERTS* comes up. Select the *ALERTS* option and activate it to access the alerts menu page shown.

```
ALRT  ←move→  ↕ sel
EDIT
ALL-OFF  ALL-ON
CLEAR  LEG-ADV
```

a. The *ALERTS* menu page includes the following options:

EDIT	-	Allows editing (definition and/or selection) of an alert type
ALL ON	-	Turns all defined alerts on, except LEG ADV
ALL OFF	-	Turns all defined alerts off, except LEG ADV

CLEAR - Clears out all defined alerts (resets all alerts to default, except LEG ADV)

LEG ADV - Allows a route leg advance alert to be defined (must be manually cleared by scrolling distance to all 0's, and mode to “*off*”)

b. To **exit** the *ALERTS* display page, press the *MENU* or *NAV* key. Any alert setups defined are automatically **saved** when the alerts page is exited.

NOTE

When 2D-E is selected, the alert triggers based on estimated horizontal error (EHE) using range only. When 3D E is selected, the alert triggers based on estimated position error (EPE) using 3D slant range.

4.3.6.2 **Position Error Alerts.** The position error alert function alerts you that the PLGR position error estimate is greater than the threshold entered. The alert type is controlled on line one; and the value is entered on line four.

LINE	DESCRIPTION
	ALRT:01 2D-E OFF OR 3D-E OFF/ON when 2D position err >1234.5ft OR mi
Line 1.	Alert type, alert mode.
Line 2.	Blank.
Line 3.	Description.

LINE	DESCRIPTION
Line 4.	Alert value (scrollable). Minimum and maximum values that can be entered are shown below.

UNITS	MIN	MAX
Meters	0005.0	9999.9
Feet	0016.4	9999.9
Yards	0004.6	9999.9
Km	0000.1	9999.99
Miles	0000.1	9999.99
Nm	0000.1	9999.99

4.3.6.3 Enter a value for estimate of position error on line four. The units of feet/meters/yards are the same as those selected during *SETUP (ft* scrollable to *mi*, *m* to *km*, *yd* to *nm)*. Enable alert mode by scrolling (line one), “mode”: to *ON*.

4.3.6.4 If the PLGR estimate of error exceeds the entered value for the alert, an alert display replaces the current display. After the user acknowledges the alert, *'P-ALRT”* alternates with the *FOM* until the error estimate drops below the entered value.

```
     ALERT 01
2D POSITION ERR
err >1234.5ft
⬍ to acknowledge
```

4.3.6.5 **Corridor Alert.** The corridor alert function alerts the user that the present position is out side of a corridor, of user entered width, through two waypoints.

<table>
<tr><th>LINE</th><th>DESCRIPTION</th></tr>
<tr><td colspan="2">ALRT:02 CORR OFF | OFF/ON
NAME: CORR-NAME
Frm WP001 to 002
Dist > 1234.5yds | OR nm</td></tr>
<tr><td>Line 1.</td><td>Alert type, alert mode.</td></tr>
<tr><td>Line 2.</td><td>Alert Name or name of first waypoint.</td></tr>
<tr><td>Line 3.</td><td>Alert waypoints.</td></tr>
<tr><td>Line 4.</td><td>Alert value (scrollable). Minimum and maximum values that can be entered are shown below.</td></tr>
</table>

UNITS	MIN	MAX
Meters	0005.0	9999.9
Feet	0016.4	9999.9
Yards	0004.6	9999.9
Km	0000.1	9999.99
Miles	0000.1	9999.99
Nm	0000.1	9999.99

4.3.6.6 Figure 4-2 shows a representation of a corridor. After entering a distance to define the borders of the corridor and enabling the corridor alert, the PLGR alerts the user of departure from the corridor (shown in gray).

4.3.6.7 When the PLGR calculated distance from the center of the corridor exceeds the entered value for the alert, an alert display replaces the current display. After the user acknowledges the alert, *"C-ALRT"* alternates with the *FOM* until the calculated distance from the center of the corridor is less than the entered value.

ALRT 02
OUTSIDE CORRIDOR
CORR-NAME
⬍ to acknowledge

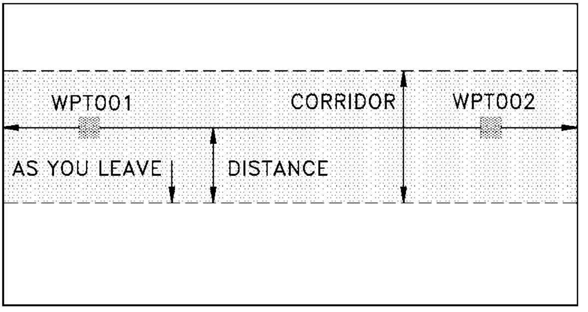


Figure 4-2 Corridor Description.

4.3.6.8 Buffer Alert. The buffer alert function alerts the user that the present position is inside a buffer zone, of user entered width, through two waypoints

LINE	DESCRIPTION
	ALRT 03 BZ OFF — OFF/ON NAME:BUFF-NAME Frm WP001 to 002 Dist < 1234.5m — OR km
Line 1.	Alert type, alert mode.
Line 2.	Alert Name or name of first waypoint.
Line 3.	Alert waypoints.

LINE	DESCRIPTION
Line 4.	Alert value (scrollable). Minimum and maximum values that can be entered are shown.

UNITS	MIN	MAX
Meters	0005.0	9999.9
Feet	0016.4	9999.9
Yards	0004.6	9999.9
Km	0000.1	9999.99
Miles	0000.1	9999.99
Nm	0000.1	9999.99

4.3.6.9 Figure 4-3 shows a representation of a buffer zone. After entering a distance to define the borders of the buffer zone and enabling the buffer alert, the PLGR alerts the user of entry into the buffer zone (shown in white).

4.3.6.10 When the PLGR calculated distance from the center of the buffer zone is less than the entered value for the alert, an alert display replaces the current display. After the user acknowledges the alert, "*B-ALRT*" alternates with the *FOM* until the calculated distance from the center of the buffer is greater than the entered value.

ALRT 03
INSIDE BUFFER
BUFF-NAME
▲▼ to acknowledge

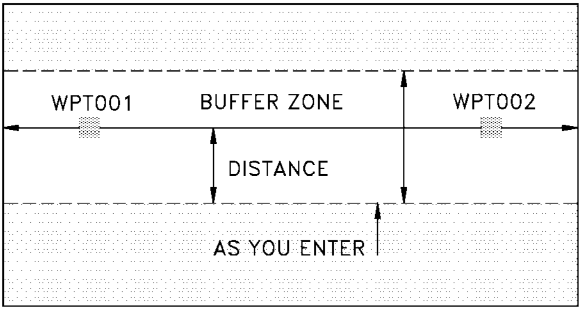


Figure 4-3 Buffer Zone Description.

4.3.6.11 **<u>Anchor Alert.</u>** The anchor alert function alerts the user that the present position is outside of a user entered distance from a way-point.

LINE	DESCRIPTION
	ALRT:04 ANCH OFF OFF/ON NAME:ANCH-NAME Origin:WP001 Dist>1234.5m OR km
Line 1.	Alert type and mode.
Line 2.	Alert Name or name of first waypoint.
Line 3.	Alert waypoint.
Line 4.	Alert value (scrollable). Minimum and maximum values that can be entered are shown.

UNITS	MIN	MAX
Meters	0005.0	9999.9
Feet	0016.4	9999.9
Yards	0004.6	9999.9
Km	0000.1	9999.99
Miles	0000.1	9999.99
Nm,	0000.1	9999.99

4.3.6.12 Figure 4-4 shows a representation of an anchor. After entering a distance to define the radius of the anchor and enabling the anchor alert, the PLGR alerts the user of departure from the anchor (shown in gray).

4.3.6.13 When the PLGR calculated distance from the center of the anchor exceeds the entered value for the alert, an alert display replaces the current display. After the user acknowledges the alert, “A-ALRT” alternates with the FOM until the calculated distance from the center of the anchor is less than the entered value.

```
      ALRT 04
  TOO FAR FROM
    ANCH-NAME
⬍ to acknowledge
```

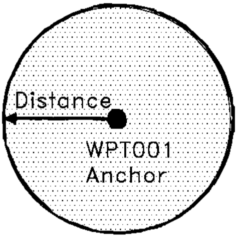


Figure 4-4 Anchor Description.

4.3.6.14 <u>Hazard Alert.</u> The hazard alert function alerts the user that the present position is inside of a user entered distance from a waypoint.

LINE	DESCRIPTION
	ALRT:05 HAZ OFF — OFF/ON NAME:HAZ-NAME Origin:WP001 Dist>1234.5m — OR km
Line 1.	Alert type and mode.
Line 2.	Alert Name or name of first waypoint.
Line 3.	Alert waypoint.
Line 4.	Alert value (scrollable). Minimum and maximum values that can be entered are shown.

LINE	DESCRIPTION		
	UNITS	MIN	MAX
	Meters	0005.0	9999.9
	Feet	0016.4	9999.9
	Yards	0004.6	9999.9
	Km	0000.1	9999.99
	Miles	0000.1	9999.99
	Nm	0000.1	9999.99

4.3.6.15 Figure 4-5 shows a representation of a hazard. After entering a distance to define the radius of the hazard and enabling the hazard alert, the PLGR alerts the user of entrance into the hazard (shown in white).

4.3.6.16 When the PLGR calculated distance from the center of the hazard is less than the entered value for the alert, an alert display replaces the current display. After the user acknowledges the alert, "H-ALRT" alternates with the FOM until the calculated distance from the center of the hazard is less than the entered value.

```
      ALRT:05
   TOO CLOSE TO
     HAZ-NAME
⬍ to acknowledge
```

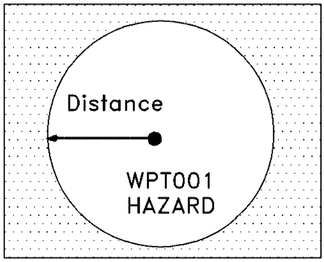


Figure 4-5 Hazard Description

4.3.6.17 Route Leg Advance Alerts. The route leg advance alert function alerts the user that the end of a route leg is being approached. See display at right. The auto leg advance is for *Route NAV* modes. Three modes are provided; 1) *prompt,* 2) *auto,* and 3) *off.*

LINE	DESCRIPTION
	RTE LEG ADVANCE: OR mi at 0000.0ft from end of leg mode: prompt OR auto OR off
Line 1.	Title
Line 2.	User can enter the distance from the end of the leg at which the alert will be given. Value can be entered by scrolling or by using the numeric entry mode. Unit can be selected in m or km, ft or mi or yd or nm, depending on *units* selected in *SETUP*.
Line 3.	Text describing the value entered in line two.
Line 4.	Prompt/auto/off (scrollable).

a. If “prompt” is selected, the display at right is shown when the end of the leg is approached.

```
RTE LEG ADVANCE
At WP001
G0 to WP002
YES          NO
```

b. If “auto” is selected, the display shown at right is displayed for approximately three seconds and the next leg is switched automatically.

```
RTE LEG ADVANCE
At WP001
Switching to
WP002
```

c. If “prompt” or “auto” is selected and the end of the last leg is being approached, the display shown at right is displayed for approximately three seconds. “Off” turns the route leg advance alerts off.

```
RTE LEG ADVANCE
At WP001
RTE 01
ROUTE     NAME
```

4.3.6.18 Leg advances occur when the leg advance threshold is crossed. The threshold is crossed when present position is within user-defined radius from the route or NAV-TO waypoint **OR** when present position crosses a line perpendicular to the course into the NAV TO waypoint.

a. In *prompt* mode, the user is prompted to allow or not allow the leg advance when the threshold is crossed. If NO is selected, the NAV-TO waypoint is not changed and auto advance notification is suspended. Once suspended, auto advance notification can be reinitiated by any of the following:

Selecting a new route.
Reversing the current route.
Performing a manual leg advance.

b. In *auto* mode, the route is automatically advanced when the threshold is crossed. Reaching the end of a Route (crossing the threshold of the final waypoint in a route) suspends auto advance notification.

c. In *off* mode, the route leg advance alert is simply turned off.

4.4 APPLICATIONS.

The PLGR may be used for applications other than normal waypoint to waypoint nav. This includes: surveying; targeting; automark; HAVE QUICK; SINCGARS; time output; time-only; differential-GPS; and low signal (dense foliage) use.

CAUTION

DO NOT move the PLGR while surveying; accuracy will be degraded.

NOTE

- Best accuracy is obtained when the best satellite geometry (Dilution of Precision) exists. See paragraph 3.11.

- When the PLGR is in AVG mode accuracy improves with time. Optimum position and elevation accuracy can be obtained, if the PLGR is kept in the AVG mode for at least 900 times (approximately 15 minutes).

- This time provides a horizontal accuracy of less than 5 meters, and a vertical accuracy of less than 7 meters. These accuracies assume *Y-code* reception, good DOP, and NO *antenna masking.*

4.4.1 Surveying. The PLGR provides better accuracy for surveying by using Averaging mode (*AVG*). This is one of the operating modes that is selected during SETUP. The position page shows the number of times the position is averaged. The averaging rate is at once per second. The value is reset by selecting the *counter* field and pressing the *Up*- or *Down-arrow* key. The averaging counter will begin to increment only after:

AVG	12345±100ft
12A	MGRS-New
AA	00000e 00000n
EL	+00000ftD ⬍ P

a. The *AVG* mode has been selected in *SETUP*.

b. The PLGR has obtained a valid position fix.

4.4.1.1 To achieve the best results in the shortest time, allow the PLGR to obtain a *FOM* of 1 before selecting *AVG* mode. This will prevent less accurate position solutions from being included in the averaging solution calculation. The track and ground speed page show that you are in averaging mode. It also reminds you not to move!

0000:00Z	+00ns
31-01-93	SUN
Averaging mode	
DO NOT MOVE!	⬍ P

CAUTION

To reduce the potential of significant errors, **NEVER** measure range, slant range, azimuth, elevation angle, or elevation to target with a *datum* that differs from your *position datum*.

4.4.2 Targeting. Targeting is done by using the *WP* menu option of either *RNG-CALC* or *SR-CALC*. The coordinates of a remote point are calculated using range *(RNG-CALC)* or slant range *(SR-CALC)*. Present position or a waypoint is used as the reference. See sub-paragraph 3.9.4 and sub-paragraph 4.2.

4.4.3 Automark. The automark feature is a convenient way to mark a waypoint once or at regular intervals. Enter the time to start marking waypoints and the interval between marks into the PLGR (see sub-paragraph 3.5.9). The time to start must be within 12 hours of the present time. This causes the PLGR to "wake up" from *OFF* mode, do a *FIX*, store the waypoint, and turn off.

4.4.4 HAVE QUICK. HAVE QUICK data is output by the PLGR. The Time Figure of Merit (TFOM) must be seven or less and HAVE QUICK data selected (see sub-paragraph 3.5.8.2).

4.4.4.1 Connect the HAVE QUICK cable to the data port on the PLGR. The user end of the cable has bare, tinned wires:

HAVE QUICK Out - Brown wire
HAVE QUICK Return - Brown/White striped wire

4.4.5 SINCGARS. SINCGARS Time Fill data is loaded into a SINCGARS radio from the PLGR. This data is loaded from connector J1. The TFOM must be seven or less and have SINCGARS radio connected.

a. Connect the SINCGARS cable to the data port (J1) on the PLGR.

b. Connect the other end of this cable to the SINCGARS radio data port.

4.4.5.1 The SINCGARS function is accessed by pressing the *MENU* key until the *MENU* display with *SINCGARS* comes up. The associated SINCGARS displays are shown in Figure 4-6.

4.4.6 **1PPS Time Mark Pulse Output.** The PLGR supplies a 1-Pulse-Per-Second (1PPS) output. Time data is available by using the 1PPS output with the serial data port. The user chooses either UTC or *T-Mark* output format (see SETUP sub-paragraph 3.5.8.3).

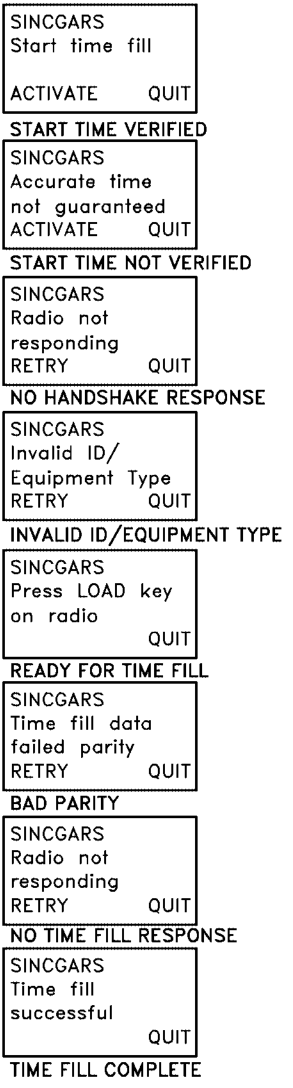


Figure 4-6 SINCGARS Display Pages.

4.4.6.1 When *UTC* is selected, the pulse is output at the *UTC 1* second rollover. Use the *Standard* serial data port configuration for data.

4.4.6.2 When *T-Mark* is selected, the pulse is output at the PLGR 1-Hertz satellite tracking sequence. Use the *Instrum* serial data port configuration for data.

CAUTION

Do not move when *TIME* (time-only) is selected. Accuracy may be affected.

4.4.7 Time-Only. The PLGR is used to supply very accurate time information with only one satellite. This is done by entering accurate position coordinates (or doing a FIX), and entering *TIME* as the operating mode (selected during *SETUP*). The PLGR tracks one or more satellites, but does not navigate. The time data is available via the HAVE QUICK cable or by using the 1PPS output with the serial data port.

a. The position page shows *T-ONLY* selected as the mode, and *STATIC* to show you are not moving.

```
T-ONLY      STATIC
12A       MGRS-NEW
AA   00000e 00000n
EL   +00000ftD  ⇕ P
```

b. The track and ground speed page shows that you are in *Time-Only* mode. It also reminds you not to move!

```
0000:00Z      ±00ns
31-01-93        SUN
Time-only mode
DO NOT MOVE!    ⇕ P
```

4.4.8 Differential-GPS. The PLGR accepts differential GPS input via the serial data port. The PLGR will not use the differential GPS input if the PLGR has crypto/keys installed.

4.4.8.1 <u>Differential Mode.</u> The *differential mode is* selected using the *Custom* mode of the SETUP DATA PORT SERIAL selection (see subparagraph 3.5.8.1). Connect the PLGR data port to the DGPS equipment using the appropriate cable. Select *DGPS-NMEA* or *DGPS-Standard* mode and configure the *baud* and *parity* to match the baud and parity of the DGPS interface (monitoring the Diff GPS item on the MENU STATUS IO page informs you if the PLGR is receiving DGPS messages).

NOTE

The search feature is **NOT** used if *AVG* mode is selected directly from any tracking mode (i.e., *CONT*, *T-ONLY*, *FIX).*

4.4.9 <u>Low Signal (Dense Foliage) Use.</u> In very low signal environments, such as under dense foliage, use the Averaging (*AVG*) mode to acquire satellites. This increases the PLGR ability to acquire and track satellites. To use this low signal search feature:

a. Press *MENU* key until the *MENU* display with *SETUP* comes up.

b. Select *SETUP* and activate it.

c. Change *SETUP MODE* to *STBY*.

d. Press *MENU* key.

e. Activate *(SETUP).*

f. Change *SETUP MODE* to *AVG*.

g. Press *POS* key (low signal search feature is now in use).

4.4.9.1 Once the Low Signal (Dense Foliage) feature is selected, the position page will display the averaging counter. The counter will begin to increment only after the PLGR has actually obtained a valid position fix. When using the Low Signal (Dense Foliage) feature, **DO NOT** move the PLGR.

4.5 MISSION OPERATIONS CHECK.

During mission operations, if you experience “abnormal” indications, the PLGR may not be malfunctioning. Use Table 4-14 to assist you in isolating the cause. For hardware troubleshooting, see sub-paragraph 8.1.1.4 for Troubleshooting.

Table 4-14 Mission Operations Checks .

Indication	Action	Reference
High FOM/Position Error	Ensure you are tracking 4 satellites. Check Satellite Summary Page (POS key) or Satellite Tracking Status Page (MENU).	4.2.4 Satellite Summary Page 3.8.5 Satellite Tracking Status Page
	Ensure the antenna is not masked. Move to position where antenna has clear view of the sky. If you cannot move and the antenna is masked by foliage, select the Dense Foliage function.	4.4.9 Low Signal (Dense Foliage) Use
	Ensure you are keyed and you have current key. Select CRYPTO on second page of MENU, then check Crypto Status Page.	3.6.2 Crypto Status Display

Table 4-14 Mission Operations Checks - Continued.

Indication	Action	Reference
Unexpected power off	Check Automatic-Off Timer (MENU SETUP) Check for dead battery. If PLGR will not power on at all, the battery is dead. Replace it.	3.5.7 and 3.5.7.2 Automatic-Off Timer 8.1.1.1 Power Battery Replacement
ON display sequence does not complete. PLGR shuts off when new battery is installed.	Press ON key repeatedly until PLGR stays on. If PLGR still does not turn ON, replace battery.	8.1.1.1 Power Battery Replacement
Obtaining a position fix takes too long.	Initialize position, date, and time. Ensure the antenna is not masked. Move to position where antenna has clear view of the sky.	3.7 Initialization

Table 4-14 Mission Operations Checks - Continued.

Indication	Action	Reference
PLGR not tracking satellites	Ensure you are not in STBY, 2dTNG, 3dTNG, or RHRSL (MENU SETUP). Ensure the antenna is not masked. Move to position where antenna has clear view of the sky. If the PLGR has been in the CONT mode while masked, recycle power or select STBY and then FIX or CONT.	3.5.3 Selecting Operating Mode and Satellite Type
Position does not agree with map or other navigation sources.	Check for proper datum and spheroid (ellipsoid).	Table 3-9 or Quick Reference Guide
Navigation information does not agree with map or other navigation sources.	Ensure waypoint datum matches SETUP datum. Check coordinates system if using MGRS and second letter of 100,000 meter square designation is different. Check for proper distance and velocity units (metric, English, or nautical) in SETUP	3.5.7 and 3.5.7.1 Datum Selection 3.5.4.1 Coordinate System 3.5.6.3.3 Selecting the Distance Units

Table 4-14 Mission Operations Checks - Continued.

Indication	Action	Reference
Azimuth does not agree with other navigation sources.	Ensure MAGVAR type, direction, and value in SETUP matches your map or other navigation source. Check for proper north reference (magnetic, grid, or true)	3.5.5.1 Magnetic Variation Source 3.5.4.6 Selecting the North Reference
Elevation does not agree with map or other navigation sources	Check for proper elevation reference. MSL is normally used. Check to see if you are in elevation hold on POS display. Ensure you are tracking at least four satellites, so that elevation can be calculated accurately. Select AUTOMATIC elevation hold in SETUP.	3.5.4.4 Selecting the Elevation Reference 3.5.6.1 Elevation Hold Mode Enable

Table 4-14 Mission Operations Checks - Continued.

Indication	Action	Reference
PLGR will not compute ground speed, tracking, steering, time to go, minimum miss distance, or glide path deviation.	You may not be moving fast enough. You must move at least 0.5 m/s (approximately 1.8 K/hr or 1 mph). Ensure you are not in STBY. In STBY, the PLGR does not track satellites or compute navigation information.	4.3 Navigation 3.5.3 Selecting Operating Mode and Satellite Type
Averaging counter will not increment.	Ensure that the PLGR has a good position fix. The counter will not begin incrementing until 13 seconds after a position fix is obtained.	4.4.1 Surveying
Multiple symptoms	Clear temporary receiver information faults (receiver version, serial port xmit, antenna and power will not clear).	3.8.8 Self-test Message Pages

CHAPTER 5

POST-MISSION OPERATIONS

5.1 POST-MISSION OPERATIONS.

You can clear one or more waypoints, crypto key data, or zeroize all data entered and collected by the PLGR. Post-mission operations may include the following activities.

5.1.1 Downloading Mission Data. To transfer data to another PLGR or DAS, see sub-paragraph 3.10.1 through sub-paragraph 3.10.2.

5.1.2 Clearing Waypoints. One or more waypoints are cleared using the *CLEAR* option on the *WP* menu. Perform the procedures in sub-paragraph 3.9.7.

5.1.3 Clearing Crypto Keys. The crypto keys are zeroized using the *CRYPTO* option on the system *MENU*. Perform the procedure in sub-paragraph 3.6.5.

WARNING

The zeroize function is used only in emergencies to protect mission sensitive data. The zeroize sequence destroys all data entered into or collected by the PLGR.

5.2 ZEROIZE (ALL DATA).

Pressing the *CLR/MARK* and *NUM LOCK* keys at the same time brings up the Zeroize display. This allows you to zeroize all data or quit. Perform the procedure in sub-paragraph 6.1.1.

CHAPTER 6

EMERGENCY PROCEDURES

6.1 EMERGENCY PROCEDURES.

This chapter discusses emergency procedures that can be performed on the PLGR. The topics discussed are zeroize, signal interference, and lithium batteries.

CAUTION

> The zeroize function is used only in emergencies to protect mission sensitive data. The zeroize sequence destroys all data entered into or collected by the PLGR.

6.1.1 Zeroize. The PLGR may contain mission sensitive data (including crypto/keys) that could be compromised through capture. This threat is countered by use of the Zeroize function.

6.1.1.1 A zeroize can be performed any time power is applied to the unit. The zeroize is done in two steps to prevent accidental loss of data.

6.1.1.2 Performing the Zeroize. The Zeroize function is initiated by pressing the *CLR/MARK* and *NUM LOCK* keys at the same time. This brings up a display that allows you to zeroize all data. See Figure 6-1.

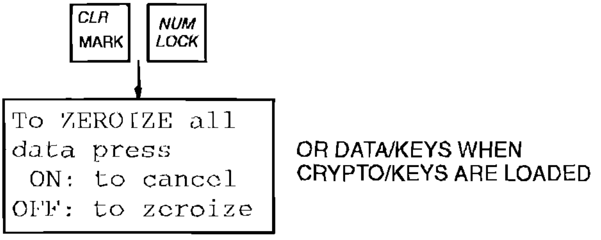


Figure 6-1 Zeroize Display.

6.1.1.3 When the zeroize display comes up: Press *ON* to cancel the zeroize and bring up the previous display.

a. Press *OFF* to activate the zeroize, destroying all data in the PLGR.

b. The PLGR acts like it was just turned on. It shows a test pattern of all dots, the copyright notice, battery status, and a status display indicating a pass or fail of the zeroize. See Figure 6-2.

c. When the zeroize is performed, the unit goes into STBY mode.

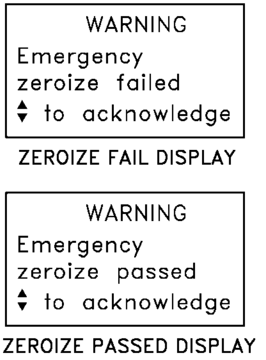


Figure 6-2 Zeroize Status.

6.1.2 **Signal Interference.** Difficulty in obtaining a good position solution could be caused by signal interference.

NOTE

> Low levels of jamming may not cause any obvious indications. The carrier-to-noise ratios may change (see sub-paragraph 3.8.5).

6.1.2.1 **Jamming Operation.** You cannot stop the jamming, but you can help the PLGR. This is done by moving to a position where there is no jamming signal (CN increases), trying to get something between the antenna and the jammer, or selecting the Averaging (*AVG*) operating mode (selected on the *MENU*, *SETUP* display):

a. Change the mode to *AVG*.

b. Press the *POS* key. *AVG* is displayed with position information indicating the PLGR is in Averaging mode.

NOTE

Do not move while in the Averaging mode.

c. To return to normal operation, press the *MENU* key.

d. Select *SETUP*.

e. Select the desired mode.

6.1.2.2 When the CN levels of the satellites are once again above 34 dB, jamming has probably stopped. Normal operation is resumed.

6.1.2.3 Spoofing. The PLGR may be vulnerable to intentional spoofing errors. Spoofing is the generation of satellite signals to cause errors in nav and position information. Optimum protection against this threat is provided by the use of crypto keys. These generate the anti-spoofing "*Y-Code*". Commanded use of this code (and this code only) is via the "*All-Y*" selection under *MENU*, *SETUP*. See paragraph 3.5.

6.1.2.4 Under Cover (Antenna Masking). If while tracking satellites you are forced to run to cover (e.g., under rock or into a building) for fifteen minutes or longer, you will have to reacquire satellites after leaving cover. To accomplish this quickly, set the PLGR *SETUP* mode to *STBY*, then back to the previous tracking mode to reacquire satellite tracking.

6.1.2.4.1 This is easily accomplished by pressing and holding the *POS* key for about one second (this changes the tracking mode to *STBY*), then pressing and holding the *POS* key again to return to the previous tracking mode (see paragraph 2.3.2.6).

WARNING

- If any of the following conditions exist, IMMEDIATELY TURN OFF the equipment and leave the area:
- The battery compartment becomes hot to the touch.
  If you hear hissing or burping (i.e., battery venting).
  If you smell irritating gas (sulfur dioxide).
- If any of these conditions do exist and the equipment is turned off, allow the equipment to cool at least one hour so that it is cool to the touch, then remove and replace the battery.
- THE BA-5800/U IS A LITHIUM BATTERY. THE LS14500 IS A LITHIUM BATTERY.

*****LITHIUM BATTERIES CAN EXPLODE*****

BE CAREFUL - DO NOT:

Apply external power while a BA-5800 battery is installed.
Short circuit lithium batteries.
Try to recharge lithium batteries.
Store lithium batteries at temperatures above 130°F (545°C).
Keep lithium batteries near open flame or heat.
Throw lithium batteries into fires.
Open, crush, puncture, or break lithium batteries.

******EXPLODING LITHIUM BATTERIES CAN KILL OR INJURE YOU******

6.1.3 **Lithium Batteries.** Contains pressurized sulfur dioxide gas. The gas is toxic and the battery **MUST NOT** be abused in any way that might cause the battery to rupture.

CHAPTER 7

LIMITATIONS

7.1 LIMITATIONS.

7.1.1 Operating Limits. The PLGR is capable of operating:

In all weather, day or night.
From 0 to 100% relative humidity.
At elevations from -1312 to +29,856 feet (-400 to +9100 meters) Mean Sea Level.
At temperatures from -4 to +158° F (-20 to +70° C).

NOTE

The maximum rate of elevation change is 25 feet/second (7.62 meters/second) up or down.

7.1.2 Non-Operating Limits. The PLGR stored (non-operating) limits are:

At elevations from -1312 to +49,213 ft (-400 to +15,000 m).
At temperatures from -76.2 to +158° F (-57 to 70° C) (without batteries).

7.1.3 Cold Weather Operation. To shorten warm-up time in cold weather temperatures, wrap the PLGR in a parka or blanket during warm-up. The parka/blanket acts as thermal insulation. Keeping equipment heat from escaping to the ambient air results in a shortened warm-up period.

CHAPTER 8

MAINTENANCE

NOTE

- DO NOT send any PLGR receivers to a defense reutilization and marketing office (DRMO).

- The PLGR is NOT to be opened in the field, except to change batteries. Opening the receiver will void the warranty.

8.1 MAINTENANCE.

This chapter contains information about the maintenance performed on the PLGR. Army only, refer to the Maintenance Allocation Chart (MAC) in Chapter 9. The external power cable is the only auxiliary equipment that can be maintained. Replacement of the memory battery cap, J2/J3 connector cover, J4 connector cover, and the prime battery cap is possible as an option alternative to returning the PLGR to the contractor for warranty repair of these listed parts only. The following topics are discussed:

Organizational maintenance
Power battery replacement
Power battery recharging
Memory battery replacement
External power cable fuse replacement
Troubleshooting
Preventive maintenance checks and services (PMCS)
Passivated batteries
Warranty return
Memory battery cap replacement
J2/J3 Connector Cover replacement
J4 Connector cover replacement
Prime battery cap replacement

CAUTION

DO NOT store unused equipment with power batteries installed. Doing so could result in equipment damage.

8.1.1 <u>Organizational Maintenance.</u> Organizational maintenance on the PLGR is limited to replacing the internal power battery(s), memory battery (annually), memory battery cap, J2/J3 connector cover, J4 connector cover, prime battery cap, and troubleshooting using Built-In Test (BIT). Organizational maintenance on the external power cable is limited to replacement of the fuse.

WARNING

Be Careful - Do Not:

- Short circuit lithium batteries
- Try to recharge lithium batteries, store lithium batteries at temperatures above 130°F (54.5°C).
- Store lithium batteries with other hazardous materials.
- Keep lithium batteries near open flame or heat.
- Throw lithium batteries into fires, open crush, puncture, or break lithium batteries.
- Apply external power while a BA-5800 battery is installed.

CAUTION

To ensure proper PLGR operation when installing or replacing both the power and memory batteries, ensure the power battery is installed or replaced prior to the memory battery.

8.1.1.1 Power Battery Replacement. The following procedure is used to replace all types of batteries (refer to Table 8-1) the PLGR uses.

Table 8-1 PLGR Power Batteries .

Battery type	Nomenclature
Lithium (nonrechargeable)	BA-5800/U
Nickel Cadmium (rechargeable)	Rockwell # 221-0134-020
AA-alkaline (8)* (nonrechargeable)	WB101
AA-lithium (8)* (nonrechargeable)	L-91
*Used with - Battery holder for 8 AA batteries (Rockwell # 221-0135-020)	

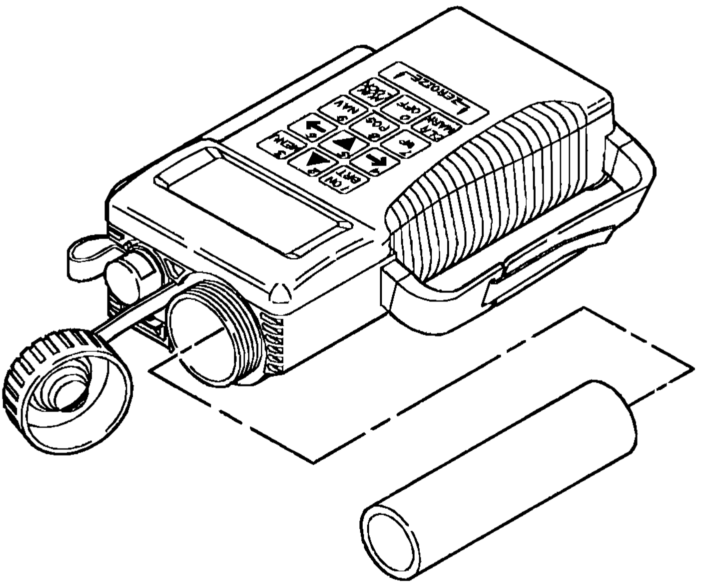


Figure 8-1 Replace Power Battery.

a. To remove the power battery, turn OFF the PLGR. Remove the power battery cover (top of the unit) by twisting counterclockwise (ccw). Tilt the unit upside down and the battery slides out into your hand. Refer to Figure 8-1.

b. Dispose of the old battery(s) in accordance with standard battery disposition procedures. For information on the use, handling, transportation, and disposal of lithium-sulphur dioxide batteries, refer to 49 CFR, Part 172.101, TB 43-0130, AFR 71-4/ -IM38-250/NAVSUP PUB 505/MPO P4030.19E/DLAM 4145.3. The BA-5800 Lithium Sulphur Dioxide (LiSO2) battery is the primary power source for the PLGR and contains a feature called the Complete Discharge Device (CDD). The CDD is a small switch located under a removable seal at the top of the BA-5800. Its purpose is to consume remaining lithium in the battery after use and before disposal. Press the CDD button and place the BA-5800 in a ventilated non-occupied area for 5 days. This is sufficient time to ensure that the CDD feature has drained the lithium. The BA-5800 can then be disposed of as a non-hazardous waste in most areas. Always coordinate with local environmental officer to ensure conformance with federal, state and local environmental regulations. For more information refer to TB 43-0134, Battery Disposition and Disposal.

c. Inspect the gasket inside of the battery cover for damage and dirt. Clean if necessary.

CAUTION

To prevent damage to equipment, DO NOT mix AA battery types. AA battery types of different chemistry are not compatible. DO NOT mix fresh batteries with partially used batteries. During battery replacement, all batteries in the holder must be replaced.

NOTE

- If a nickel cadmium (rechargeable) battery is installed, check to BE SURE it is fully charged and align the battery keying with the battery compartment.
- If AA-alkaline batteries are installed, BE SURE they are correctly installed in the holder. Plus (+) and minus (-) markings on the holder show correct polarity.

d. Gently insert the battery (contact ends first, refer to Figure 8-2) into the compartment. Screw the power battery cover on snugly.

e. Turn the PLGR ON and reset the battery usage timer per sub-paragraph 3.8.3.

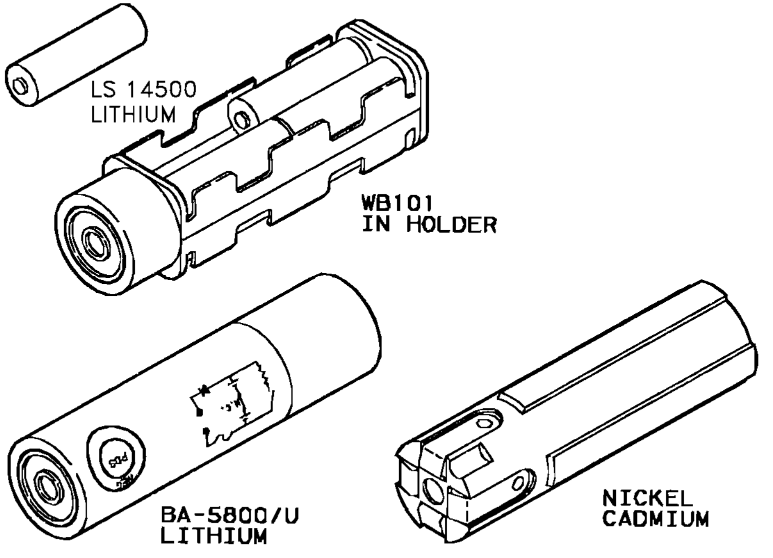


Figure 8-2 PLGR Power Batteries.

8.1.1.1.1 Perform the following procedures to connect a BA-5800 powered PLGR to external power:

a. Turn off PLGR before connecting to external power.

b. Remove the BA-5800 battery.

c. Protect the battery and ensure battery is stored so that the terminals can be shorted or use electrical tape across the terminals.

d. Connect the external power cable or AC power adapter to the PLGR.

e. Install the PLGR in the mount.

f. Turn on the PLGR.

8.1.1.1.2 Perform the following procedures when disconnecting the PLGR from external power for operations with the BA-5800 battery:

a. Turn off the PLGR:

b. Remove the PLGR from the mount.

c. Disconnect the external power cable or AC power adapter.

d. Remove any electrical tape, dirt, debris from the BA-5800 battery and install in the PLGR

e. Turn the PLGR on.

f. Replace the BA-5800 battery with a fresh battery in the event of low power indication.

8.1.1.1.3 The following steps MUST be taken to safely dispose of BA-5800 batteries:

a. DO NOT push the Complete Discharge Devise (CDD) immediately after use. Return battery to designated battery disposal personnel (to be designated by unit commander) for disposal processing.

b. Designated personnel must carefully slit or remove the protective label covering the CDD. NEVER pierce the CCD label with any object to activate the CDD.

c. Gently depress the CDD with a small screwdriver. Push the screwdriver in a straight down motion until you hear a single click. DO NOT use a knife or any sharp object which may cause damage during CDD activation. NEVER twist any object in the CDD slot.

d. After depressing the CDD, place the batteries in a secure well ventilated area isolated from personnel and separated from other hazardous material.

e. Separate all discharging batteries by at least two inches on all sides.

f. Allow the batteries to sit a minimum of five days for complete discharge.

g. After five days (six days in temperatures below 32 degrees Fahrenheit) the battery voltage MUST BE measured. If the voltage reading is less than two volts the battery may be disposed of as non-regulated waste in accordance with local regulations. If two volts or greater, depress the CDD a second time and wait an additional five or six days or DISPOSE OF AS HAZARDOUS WASTE. After the waiting period, recheck the battery voltage. Dispose of as non-regulated waste if less than two volts or as HAZARDOUS WASTE if two volts or greater.

NOTE

Refer to Army TM 11-6140-231-14-5 for charging nickel cadmium batteries outside the PLGR.

8.1.1.2 **<u>Power Battery Recharging.</u>** The PLGR recharges a nickel cadmium battery when connected to an external power source. It recharges the battery within 36 hours. A dead nickel cadmium battery cannot be recharged. The input power to the PLGR must be between 12 and 32 V dc to charge batteries.

CAUTION

- Even though the memory battery appears to be the same as the AA power batteries, it is not. The voltage of the AA power batteries is not high enough for it to serve as a memory battery. Placing AA power batteries in the PLGR for memory batteries could damage the unit or cause the unit to be inoperable.
- The PLGR **MUST** have a live main power source (battery or external) connected while replacing the memory battery, or all memory will be lost.
- To prevent equipment damage, use only an LS14500 lithium thionyl chloride battery or approved equivalent.

8.1.1.3 Memory Battery Replacement. This procedure is used to replace the LS14500 lithium thionyl chloride (nonrechargeable) memory battery.

a. Remove the memory battery cover (bottom of the unit) by turning it out with a flat-tip screwdriver. Tilt the unit upside down and the memory battery easily slides out into your hand (refer to Figure 8-3).

b. Dispose of the old battery per standard battery disposition procedures.

c. Inspect the gasket on the battery cover for damage and dirt; clean if necessary.

d. Install the battery positive (+) end first. Screw the Memory Battery Cover in snugly, using a flat-tip screwdriver.

e. Check the display. Clear the WARNING message (*Low memory battery*) by pressing either the *Up*- or *Down-arrow* key.

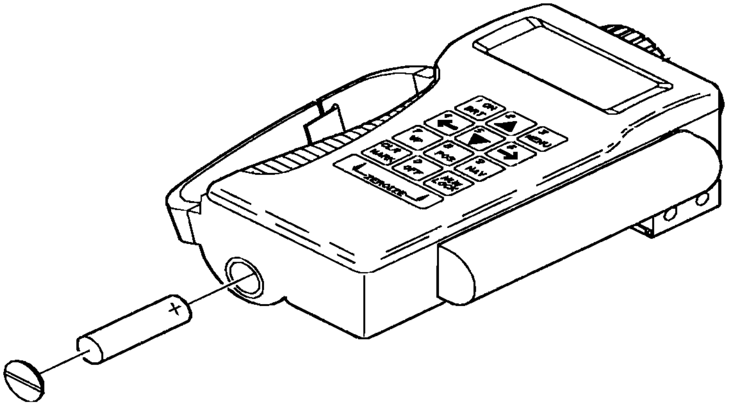


Figure 8-3 Replace Memory Battery.

CAUTION

Failure to observe correct polarity of the external power cable may result in damage to the PLGR.

8.1.1.4 <u>External Power Cable Fuse Replacement.</u> This procedure is used to replace the 2A/250V fuse in the in-line fuse holder installed in the positive lead of the external power cable. Refer to Figure 8-4.

a. Locate and disconnect the external power cable from the external power source.

b. Twist open the fuse holder to access the fuse.

c. Remove and inspect the fuse for serviceability, and replace with a new fuse (2A/250V fuse only), as required.

d. Reconnect and securely close the fuse holder.

e. Reconnect external power cable to the external dc power source.

f. Turn the PLGR ON and perform the Commanded Self-Test (refer to paragraph 3.4).

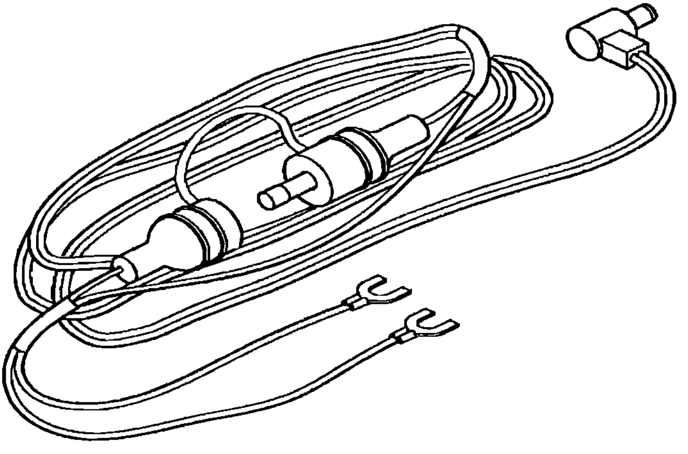


Figure 8-4 Replace External Power Cable Fuse.

8.1.1.5 **Troubleshooting.** This covers troubleshooting and maintenance procedures at the Organizational/Direct Support level using BIT. This troubleshooting test is applicable to all configurations of the PLGR, mount, and antennas. Have the set assembled for operation. Perform the following steps to test the PLGR:

a. Inspect the PLGR, Mount Remote Antenna, and/or Helmet Antenna for damage and missing parts.

b. Perform the procedures located in sub-paragraph 3.2.1; Turning the Unit ON.

c. If the PLGR briefly stays on, displays a "*Low primary battery*" WARNING, and/or the display remains blank, replace the power battery. Perform the procedures located in sub-paragraph 8.1.1.1; Power Battery Replacement. If a passivated battery is suspected, perform the procedures located in sub-paragraph 8.1.3; Passivated Batteries.

d. If the PLGR is powered via the External Power Cable, has no internal power battery and remains blank after attempting to turn it ON, locate and check the cable in-line fuse. Perform the procedures located in sub-paragraph 8.1.1.4; External Power Cable Fuse Replacement.

e. If the PLGR is inoperable and/or the display pixel pattern is dark (indicating the unit is locked-up), replace the PLGR.

f. Observe the power-on self-test results as described in sub-paragraph 3.2.1; Turning the Unit ON. Refer to Figure 3-1; ON Display Sequence.

g. If the PLGR displays a "*Low memory battery*" WARNING, perform the procedures located in sub-paragraph 8.1.1.3; Memory Battery Replacement.

h. After PLGR unit successfully completes power-on self-test, press the *MENU* key.

i. Select the *STATUS* option, page 1.

j. If a *Self-test Fail* message is displayed, press the *Up-arrow* key to refer to the Self-test Failure Page (refer to sub-paragraph 3.8.8; Self-test Messages). If *Self-test OK* is displayed, proceed to step l.

k. Record the failure mode displayed. Perform the procedure located in sub-paragraph 3.2.4; Turning the Unit OFF. Replace the PLGR.

l. Perform the self-test procedures located in sub-paragraph 3.4.2; Commanded Self-Test Initialization.

m. After the unit successfully completes commanded self-test, press the *MENU* key.

n. Select the *STATUS* option, page 1.

o. If a *Self-test Fail* message is displayed, press the *Up-Arrow* key to refer to the Self-test Failure Page (refer to sub-paragraph 3.8.8; Self-test Messages). If *Self-test OK* is displayed, proceed to step q.

p. Record the failure mode displayed. Perform the procedure located in sub-paragraph 3.2.4; Turning the Unit OFF. Replace the PLGR.

q. Initialize the PLGR by following the procedures in paragraph 3.1; Pre-mission Operations. Allow the unit to acquire satellites and have a good position fix. Refer to paragraph 4.2; Position Displays.

NOTE

The area should be open to the sky (direct line-of-sight) for best satellite visibility. For best reception, the integral antenna should be in the vertical position in relation to the earth's surface.

r. Unit troubleshooting and checkout is complete.

8.1.2 Preventive Maintenance Checks and Services (PMCS). PMCS consist of replacing the memory battery. This is required annually.

8.1.2.1 PMCS Schedule (Army). The DD Form 314 or equivalent service form for the PLGR shows when to replace the memory battery. If the memory battery is replaced during unscheduled maintenance, update the DD Form 314.

8.1.3 Passivated Batteries. The lithium power batteries and the lithium memory battery are subject to the phenomenon of passivation. The passivation phenomenon is not a noticeable factor for the memory battery. However, for the primary power battery the PLGR will appear to not turn ON.

8.1.3.1 Passivation Description. Passivation is the growth of an oxide layer (a protective electrochemical polarization film) created internally on the battery's lithium anode by the contact of the lithium (solvent), electrolyte, and impurities present. This film provides electrical stability by isolating the transistor surface from electrical and chemical conditions in the environment, and helps to provide a long battery shelf life up to 10 years.

8.1.3.2 Passivation Disadvantages. The disadvantage of the passivation layer is the delay in reaching full voltage upon initial current draw from the battery. This delay varies with the length and temperature of battery storage, as well as the rate and temperature of discharge. The time required to work through the passivation film is increased at lower temperatures and lower loads. It may not be unreasonable to have to work a battery for 5 minutes. If a passivated battery is suspected, perform the following procedure:

a. Ensure that a lithium power battery is correctly installed.

b. Press the *ON/BRT key and* wait 30 to 40 seconds. NOTE: After each press of the *ON/BRT* key, the PLGR automatically runs a series of power-on cycles.

c. If the PLGR does not turn ON, press the *ON/BRT* key again and wait 30 to 40 seconds.

d. If the PLGR still does not turn ON, repeatedly press *ON/BRT* and *OFF* keys until PLGR turns ON. NOTE: It may not be unreasonable to have to work this procedure for 5 minutes.

e. If the PLGR still does not turn ON, install a new power battery and repeat this procedure.

f. If the PLGR turns ON, the passivation has been eliminated and this procedure is complete.

8.1.4 Special Repair Instructions. The purpose of these repair instructions are to provide procedures for replacing the memory battery cap, J2/J3 connector cover (mud flap), J4 connector cover (mud flap), and prime battery cap on the PLGR.

WARNING

The PLGR contains a lithium memory battery and may also contain lithium prime batteries. Incorrect handling may result in death or personal injury.

CAUTION

The PLGR memory contents will be lost if the memory battery cap is removed when there are no prime batteries installed or it is not connected to external power.

8.1.4.1 Memory Battery Cap Assembly Replacement. Install new battery cap assembly as follows:

a. Remove the memory battery cap by turning it counter clockwise. Be careful not to allow the memory battery to fall out.

b. Be sure the gasket of the replacement cap is flat against the lip of the cap.

c. Install new cap on the PLGR by turning clockwise until fully seated.

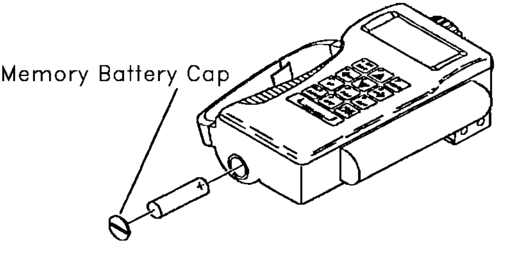


Figure 8-5 Memory Battery Cap Assembly.

8.1.4.2 <u>J2/J3 Connector (Mud Flap) Replacement.</u> Install new J2/J3 connector (mud flap) as follows:

a. Remove the two screws, using the appropriate screwdriver, and the flat washers securing the J2/J3 cover to the PLGR and remove the cover.

b. Determine if screws removed are machine screws (MSS 195 - 72) with inserts or thread forming screws (330-0295-010).

c. Position new cover over the mounting posts. Install two new screws and flat washers, as appropriate, securing the cover to the PLGR.

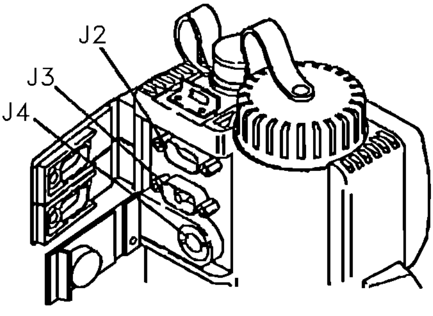


Figure 8-6 J2/J3/J4 Connector Covers.

8.1.4.3 <u>J4 Connector Cover (Mud Flap) Replacement.</u> Replace the J4 connector cover (mud flap) as follows:

a. Locate J4 connector cover (refer to Figure 8-6) and use a knife to cut away adhesive securing the mud flap to the PLGR. Remove mud flap from the PLGR.

b. Use cotton swabs and isopropyl alcohol to clean remaining adhesive from the surface of the PLGR where the mud flap was attached.

c. Apply a thin film of Loctite 414 adhesive (P/N 41450, CAGE 05972) to the PLGR and mud flap mating surfaces.

d. Carefully position new mud flap on the PLGR. Be sure mud flap tab is positioned over screw access hole. Apply pressure to mating surfaces for 2-3 minutes to ensure a complete bond.

8.1.4.4 <u>Prime Battery Cap Replacement.</u> Replace the prime battery cap as follows:

a. Remove the prime battery cap by turning counter clockwise.

b. Using a knife, cut prime battery cap tether at the edge of the tether metal insert (refer to Figure 8-7). This tether holds the prime battery cap to the PLGR.

c. Install the new battery cap onto the PLGR by turning it clockwise until fully seated. Be aware that the new battery cap **<u>is not</u>** tethered to the PLGR.

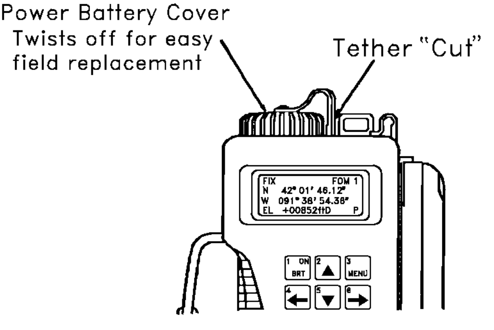


Figure 8-7 Prime Battery Cap Assembly and Tether "Cut" Location.

8.1.5 Operational Checkout. Turn the PLGR on and observe the display window during the Power-on Test. If no faults are found, the unit is serviceable. Reinitialize as applicable. Refer to PLGR Technical Manual Initialization, paragraph 3.7, for procedures.

NOTE

- The PLGR is **NOT** to be opened in the field, except to change batteries. Opening the receiver will void the warranty. Prior to shipping refer to paragraph 8.3 and subparagraphs.

- DO NOT send any PLGR receivers to a Defense Reutiliazation and Marketing Office (DRMO).

8.2 WARRANTY RETURN.

Prior to shipping, zeroize the PLGR and remove the power battery. Leave memory battery installed so that fault codes are retained. The PLGR with only a memory battery installed is exempt from DOT hazardous material transportation restrictions. Such exemption may be found in CFR 49, paragraph 173.185(i). The remote antenna and helmet antenna are also covered by warranty. The PLGR is to be returned without accessories. Only the PLGR with the memory battery installed is to be returned to the contractor for warranty repair. Operable accessories are to be retained by the owning unit. A reusable container should be utilized for shipping an PLGR whenever possible. A quantity of these containers should be maintained for future return shipments. **Ensure DD form 1149 contains shipping activity DODAAC. DD form 1149 should clearly list the organization, point of contact, and commercial telephone number to whom the repaired PLGR is to be returned. Failure to provide DODAAC and other required return address information could delay or prevent the return of a set to its proper owner.**

ARMY:

Refer to paragraph 9.7.

Army, Air Force, Marine Corps, & Other Users:

Return unserviceable Warranted items directly to the contractor. Replacement items will be supplied by the contractor.

Return Rockwell/Collins Unserviceable Warranted items to the Address below. For equipment from other manufacturers, check the manufacturers code (CAGE) on the item and page 10-2 to determine where the item is to be sent.

DODAAC EZ 7415
ROCKWELL COLLINS INC
ATTN ROCKWELL COLLINS SERVICE CNTR
855 35th ST NE
Attn: Service Center MS 139-141
CEDAR RAPIDS, IA 52402-3613
mark for: PLGR Warranty

NAVY:

Return unserviceable Warranted items to the Supply system. Requisition replacement items through the Supply system.

8.3 PLGR RETEST OK (RTOK) PROCEDURES.

There are some conditions that can make the PLGR appear to be malfunctioning when in fact it is operating properly. The PLGR should be reviewed for the following common problems before returning the unit for repair.

8.3.1 Low Memory Battery. To inspect for the wrong memory battery, first install a main power battery or apply external power to the PLGR. (NOTE: Before applying external power remove any BA-5800 Lithium Batteries installed and DO NOT install BA-5800 batteries while using external power). This will preserve the fault logs if the failure is valid. Remove the memory battery and look for the value printed on the battery. If it is not a 3.6 volt battery replace it with a 3.6 volt lithium memory battery. If the battery is a 3.6 volt battery, replace it with a new 3.6 battery. If the unit is on, turn it off by pressing the OFF button twice. Turn the PLGR back on and watch the screens as the PLGR powers up. If the PLGR displays a message about the memory battery being low, it is a valid failure and needs to be returned. If the LOW MEM BATT screen does not appear then no failure exists with the battery.

8.3.2 The PLGR Will Not Shut Off. This problem is characterized by the PLGR turning itself on after having been shut off. This is almost never a true error. There is an AUTOMARK feature in the PLGR menu that can inadvertently get turned on. This will cause the PLGR to power up after a period of time. Go into the SETUP menu and page through until the AUTOMARK is reached. Set the AUTOMARK mode to off, then press menu to be sure the change is properly registered by the PLGR.

8.3.3 No Almanac or Will Not Hold Data. PLGRs that have all power removed including the memory battery will lose almanac data. If the PLGR is not holding almanac data, check to see that the memory battery is installed.

8.3.4 PLGR Will Not Track Satellites. There are many things that can make a PLGR slow in acquiring or tracking satellites. If it seems to be taking excessive time to get a fix, go to the menu and scroll through the status pages until the satellite tracking page is reached. This will allow the user to watch the progress of the receiver in acquiring satellites and the signal levels of those satellites. Remember that in general it will require 4 satellites to get a fix. If the intent is to update the almanac it can take 12-13 minutes before a new almanac is received.

8.3.5 Failure Reporting. To facilitate repair of the PLGR, provide the following data on the appropriate service maintenance form:

a. What mode was the receiver in when failure occurred?

b. What function was being attempted?

c. Describe the failure scenario in as much detail as possible. (For Example):

(1) What fault code was reported?

(2) What was the power source utilized?

(3) Was the receiver tracking satellites when failure occurred?

(4) How old was the almanac?

(5) Was the receiver providing the correct position and time when failure occurred?

CHAPTER 9

ARMY MAINTENANCE/FIELDING

9.1 GENERAL.

This chapter applies to Army users only. It provides a general explanation of all maintenance, repair, and warranty return functions authorized at various maintenance categories.

9.1.1 Maintenance Authority. The Maintenance Allocation Chart (MAC) in Table 9-1 designates overall authority and responsibility for the performing maintenance functions on the PLGR and its components. The application of the maintenance functions to the unit or components will be consistent with the capacities and capabilities of the designated maintenance categories.

9.1.2 Tools and Test Equipment. Table 9-2 lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from Table 9-1.

9.1.3 Supplemental Instructions. Table 9-3 contains supplemental instructions and explanatory notes for a particular maintenance function.

NOTE

> Other services have designated the PLGR as a set component under different accessory authorization procedures which do not apply to Army users. At the unit commander's discretion, Army units may select any or all of the accessory items listed in the Additional Authorization List, Table 9-4 for the support of PLGR operations.

9.1.4 The PLGR nomenclature and NSN refer to the self-contained handheld receiver only. The standard line item number (LIN) is N95862. HQDA designated the PLGR as a CLASS VII end item. The PLGR nomenclature and NSN does not define a set of components.

9.2 MAINTENANCE FUNCTIONS.

9.2.1 **Inspect.** To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

9.2.2 **Test.** To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

9.2.3 **Service.** Operations required periodically to keep and item in proper operating condition, i.e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

9.2.4 **Adjust.** To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

9.2.5 **Align.** To adjust specified variable elements of an item to bring about optimum or desired performance.

9.2.6 **Calibrate.** To determine and cause corrections or adjustments to be made on instruments, test, measuring, and diagnostic equipment used in precision measurement. Consists of comparisons of two (TMDE) instruments, one of which is a certified standard of known accuracy. To detect and adjust any discrepancy in the accuracy of the instrument being compared.

9.2.7 Remove/install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

9.2.8 Replace. To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and is shown as the third position of the SMR code.

9.2.9 Repair. The application of maintenance services, including fault location/troubleshooting, removal/installation, and disassembly/assembly procedures, and maintenance actions to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

9.2.10 Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

9.2.11 Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

9.3 EXPLANATION OF COLUMNS IN THE MAC, TABLE 9-1.

9.3.1 Column 1. Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. The PLGR is group number "00."

9.3.2 Column 2. Component/Assembly. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

9.3.3 Column 3. Maintenance Function. Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions see paragraph 9.2.)

9.3.4 Column 4. Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance., If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate work time figures will be shown for each category. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance categories are as follows:

C............................ Operator or Crew
O............................ Organizational Maintenance
F............................ Direct Support Maintenance
H............................ General Support Maintenance
L............................ Specialized Repair Activity (SRA)
D............................ Depot Maintenance

9.3.5 Column 5. Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual hand tools) and special tools, TMDE, and support equipment required to perform the designated functions.

9.3.6 Column 6. Remarks. This column contains a letter code, in alphabetic order, which is keyed to the remarks contained in Table 9-3.

Table 9-1 Maintenance Allocation Chart for PLGR .

(1)	(2)	(3)	(4)					(5)	(6)
			MAINTENANCE LEVEL						
GROUP NO.	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	UNIT		INTER-MEDIATE		DEPOT	TOOLS AND EQUIP	REMARKS
			C	O	F	H	D		
00	Satellite Signals, Navigation Set PLGR	Inspect	0.1						
		Test	0.1						A
		Repair	0.1						B
		Inspect		0.1					
		Test		0.1					C
		Repair		0.1				2	D
		Remove/Replace		0.1					E
		Inspect			0.1				F
		Test			0.1				
		Inspect					*		
		Test					*		
		Repair					*		G

9.4 EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, TABLE 9-2.

9.4.1 Column 1. Reference Code. The tool and test equipment reference code correlates with a code used in the MAC, Table 9-1, Column 5.

9.4.2 Column 2. Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.

9.4.3 Column 3. Nomenclature. Name or identification of the tool or test equipment.

9.4.4 Column 4. National Stock Number. The National Stock Number of the tool or test equipment.

9.4.5 Column 5. Tool Number. The manufacturer's part number.

Table 9-2 Tools and Test Equipment Requirements For PLGR.

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/ NATO	TOOL NUMBER
1	0	**TOOL KIT, ELECTRONIC EQUIPMENT	5180-064-5178	TK-101/G
2	O/F	#8 TORQUE BIT/ SCREWDRIVER	70808, CAGE CODE: 75347	TORX-8

9.5 EXPLANATION OF COLUMNS IN REMARKS, TABLE 9-3.

9.5.1 Column 1. Reference Code. The code recorded in Column 6, Table 9-1.

9.5.2 **Column 2. Remarks.** This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Table 9-1.

Table 9-3 Remarks for PLGR .

REFERENCE CODE	REMARKS
A	Operational Test.
B	Repair is limited to the replacement of the main power battery.
C	Fault detection/verification, using Built-In Test. (BIT)
D	Repair is limited to the replacement of memory battery and items coded throwaways at Org level (i.e., connecting cables, other accessories, etc.). The remote and helmet antennas shall be returned to the contractor for replacement, if failure falls within the warranty coverage, otherwise they should be treated as throwaways, at the Org level.
E	Faulty LRU is evacuated to Direct Support (DS) level for Direct Exchange (DX).
F	DS function is limited to maintaining Repairable Exchange (RX), through fault confirmation using BIT, and evacuation of the faulty LRU to the contractor for repair or disposition.
G	Depot level maintenance will be provided by the prime contractor (Rockwell International) for the life of the equipment as follows: 1. During the first six years, the equipment will be covered under contractor's warranty. In addition, the contract, under a separate clause, provides for coverage of failures not covered by the warranty.

Table 9-3 Remarks for PLGR - Continued.

REFERENCE CODE	REMARKS
	2. Upon the expiration of the warranty, a contractor support contract will be in place to provide Depot level support for the life of the equipment.
*	Time interval will be determined by the activity.
**	The only tool required is a flathead screwdriver to remove and replace the memory battery.

9.6 EXPLANATION OF LISTINGS IN ADDITIONAL AUTHORIZATION LIST, TABLE 9-4.

National Stock Numbers, Description, and Quantities are provided to help identify and request the additional items which may be used to support this equipment. The items are listed in alphabetical sequence by item name.

Table 9-4 Additional Authorization and National Stock Number to Part List .

(1) National Stock No NSN	(2) Description CAGE and Part Number	(3) U/M	(4) Qty Auth
6130-01-376-2168	AC Power Adapter (13499) 218-0325-020	ea	1
5985-01-391-2947	Aircraft Antenna (0UVG2) AT-575-9	ea	1
5985-01-446-1427	Aircraft Antenna (0UVG2) AT575-9MGR	ea	1
6150-01-375-8661	AN/PSN11-1 External Power Cable (98752) 9728558-10	ea	1
6150-01-469-6066	AN/PSN11-1 External Power Cable (13499) 426-0144-010	ea	1

Table 9-4 Additional Authorization and National Stock Number to Part List - Continued.

(1) National Stock No NSN	(2) Description CAGE and Part Number	(3) U/M	(4) Qty Auth
6130-01-396-4211	Regulated Power Supply (02980) 87F2900 TYPEWM144.S	ea	1
6150-01-382-1551	AN/PSN11-1 Reprogramming Cable (98752) 9434308-10	ea	1
6150-01-375-8663	AN/PSN11-1 to AN/PSN11-1 Cable (13499) 426-0141-020	ea	1
6150-01-375-8665	AN/PSN11-1 to HAVE QUICK Cable (13499) 426-0141-040	ea	1
6150-01-375-8664	AN/PSN11-1 to PC Cable (13499)426-0141-010	ea	1
6150-01-375-8662	AN/PSN11-1 to Remote Antenna Cable (13499) 426-0141-050	ea	1
5340-01-449-1045	Connector Cover (J2/J3) (13499) 988-6726-001	ea	1
6140-01-380-9981	Large Ni-Cad Rechargeable	ea	1
6140-01-400-2902	Female Pin Adapter SK6674, 9-15	ea	1
5340-01-449-1036	Connector Cover Power (J4) (14399) 986-0651-001	ea	1
6150-01-375-8666	AN/PSN11-1 to SINCGARS Cable (13499) 426-0141-070	ea	1
5995-01-379-9689*	AN/PSN11-1 to SINCGARS ANCD Cable (80063) CX-13467/U	ea	1
5995-01-310-0335*	AN/PSN11-1 to SINCGARS W4 Cable (80063) A3013735-1	ea	1
6160-01-385-4358	Battery Holder (13499) 221-0135-020	ea	1

Table 9-4 Additional Authorization and National Stock Number to Part List - Continued.

(1) National Stock No NSN	(2) Description CAGE and Part Number	(3) U/M	(4) Qty Auth
5985-01-374-7757	Helmet Antenna, AS-4334/U (13499) 013-1925-010	ea	1
5975-01-375-1301	Helmet Antenna Mount (13499) 013-1928-010	ea	1
5340-01-449-1033	Memory Battery Cap Assy. (13499) 988-6725-001	ea	1
5975-01-375-1302	Mount (13499) 986-0645-001	ea	1
5895-01-375-7528	Personnel Case (13499) 021-0706-010	ea	1
5340-01-449-1029	Prime Battery Cap Assy. (13499) 988-6724-001	ea	1
5985-01-375-4660	Remote Antenna, AS-4333/V (13499) 013-1925-030	ea	1
	Remote Antenna (79329) 3395-8015-004	ea	1

* These cables are fielded with each SINCGARS radio.
** This cable has the locking newell nut atached.

9.7 WARRANTY RETURN.

Army Direct Support (DS) maintenance units have been provided with a pool of spare PLGR receivers/antenna for the purpose of providing forward direct support. Under normal circumstances, Army users should directly exchange faulty items at the servicing DS unit. The DS unit will then coordinate with the Warranty Control Officer (WARCO) to obtain replacement items from the manufacturer under warranty terms. When Army users do not have DS unit support, direct return of faulty items to the manufacturer is authorized. Follow procedures contained in paragraph 8.2, Warranty Returns.

NOTE

DO NOT send any PLGR receivers to a Defense Reutilization and Marketing Office (DRMO).

9.7.1 Warranty Deficiency Reports. Submit, when appropriate, a Product Quality Deficiency Report (PQDR) SF 368. Completed PQDRs, to include the serial number of the PLGR, should be submitted to CDR, CECOM, ATTN: AMSEL-LC-ED-CFO, Fort Monmouth, NJ 07703. PQDR exhibits should be shipped to the manufacturer and should be Marked For: PLGR Exhibit: ”TO BE OPENED IN THE PRESENCE OF A GOVERNMENT REP.” For further warranty information, refer to Army Warranty Technical Bulletin TB 11-5852-291-30. For additional troubleshooting information, refer to Army PLGR Technical Bulletin TB 11-5825-291-13-1.

9.8 OTHER CONSUMABLE MATERIALS LIST.

The other consumable materials list, Table 9-5, identifies the consumables available for use with the PLGR. Memory batteries should remain in the unit when it is turned in for maintenance; power batteries should be removed.

9.8.1 Explanation of Listings for Table 9-5. National Stock Numbers, Description, and Quantities are provided to help identify and request additional consumables required to support this equipment.

Table 9-5 Other Consumable Materials List .

(1) National Stock No. NSN	(2) Description CAGE and Part Number	(3) U/M	(4) Qty
5920-00-280-4960	Fuse Cartridge (13499) 264-0723-000	ea	1
6135-00-985-7845	Alkaline Storage Battery, BA3058/U	ea	8
6135-01-301-8776	Lithium Storage Battery, LS14500 (31586)	ea	1
6135-01-333-6101	Lithium Storage Battery, L-91	ea	8
6140-01-400-2902	Ni-Cad Storage Battery 221-0134-020 (13499)	ea	1
6135-01-440-7774	Lithium Storage Battery, BA-5800/U	ea	1
8040-01-197-2993	Loctite 414 Adhesive 41450 (05972)	ea	1

CHAPTER 10

PARTS LIST

10.1 INTRODUCTION.

10.1.1 General. The purpose of this parts list is for identification and requisition of parts. Army users shall use the Additional Authorization List in Chapter 9. Parts listed meet critical equipment design specification requirements. Use only part numbers specified in this parts list for replacement of parts.

10.2 GROUP ASSEMBLY PARTS LIST.

10.2.1 FIG-ITEM Column. Digits preceding the first dash are chapter numbers. Digits preceding the second dash refer to numbers. Digits following the second dash are item numbers assigned in sequence to correspond with item numbers on the illustrations.

10.2.2 PART NO Column. Listed are MIL standard and vendor part numbers.

10.2.3 INDENT Column. Items are coded 1, 2, 3, etc, to indicate the relationship to the next higher assembly.

10.2.4 DESCRIPTION Column. Listed are the noun name, modifier, descriptive information, federal manufacturers code.

10.2.5 UNITS PER ASSY Column. Quantities specified are per item number.

10.2.6 USABLE ON CODE Column. Part variations within a group of equipment are indicated by a letter code (A, B, C, etc). Absence of a code indicates part applies to all models.

10.2.7 SOURCE, MAINTENANCE, AND RECOVERABILITY (SMR) CODE Column. This manual contains Joint Military Service Uniform SMR Codes only. Definitions of these are available in TO 00-25-195.

10.3 MANUFACTURER'S CODE, NAME, AND ADDRESS.

MFR CODE	MANUFACTURERS NAME AND ADDRESS
0UVG2	AERO ANTENNA TECHNOLOGY INC 9410 DESOTO AVE UNIT J CHATSWORTH CA 91311
02980	ELPAC ELECTRONICS INC COMPONENT DIV 1562 REYNOLDS AVE IRVINE CA 92714-5612
13499	ROCKWELL INTERNATIONAL CORPORATION COLLINS AVIONICS & COMMUNICATIONS DIVISION 350 COLLINS ROAD NE CEDAR RAPIDS IA 52498
31586	SAFT AMERICA INC ADVANCED BATTERY SYSTEMS DIVISION 107 BEAVER COURT COCKEYSVILLE MD 21030-2106
79329	SPECTRA SYSTEMS INC 777 YAMATO ROAD, SUITE 105 BOCA RATON FL 33431-4406
98752	WARNER ROBINS AIR LOGISTICS CENTER ROBINS AIR FORCE BASE GA 31098

10.4 CONFIGURATION IDENTIFIERS.

The following CI/REV LTR were used in compiling data for this manual.

CI/ REV LTR	UNIT PART NUMBER	FIG-RMM
L	822-0077-002	F-1-1
D	8224-0077-103	F-1-1
B	012-0706-010	F-1-2
H	221-0500-020	F-1-3
F	013-1925-010	F-1-4
-	013-1928-010	F-1-5
C	986-0645-001	F-1-6
C	426-0144-010	F-1-7
F	013-1925-030	F-1-8
H	426-0141-050	F-1-9
H	426-0141-020	F-1-10
H	426-0141-010	F-1-11
H	426-0141-040	F-1-12
A	218-0325-020	F-1-13
H	426-0141-070	F-1-14
H	426-0141-060	F-1-15
C	221-0135-020	F-1-16
-	9434310-10	F-1-18
B	9434308-10	F-1-20

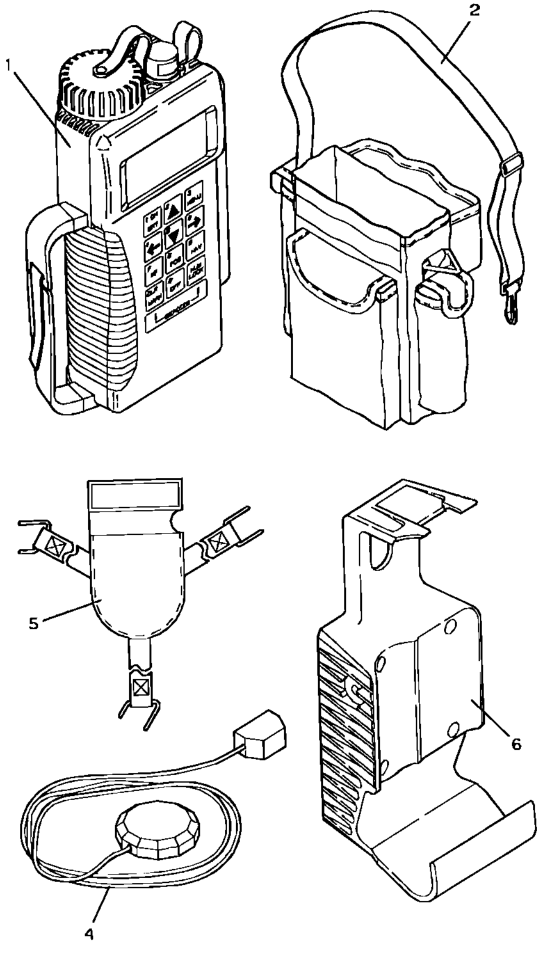


Figure 10-1 Satellite Signals Navigation Set AN/PSN-11 Parts Location Diagram. (Sheet 1 of 3)

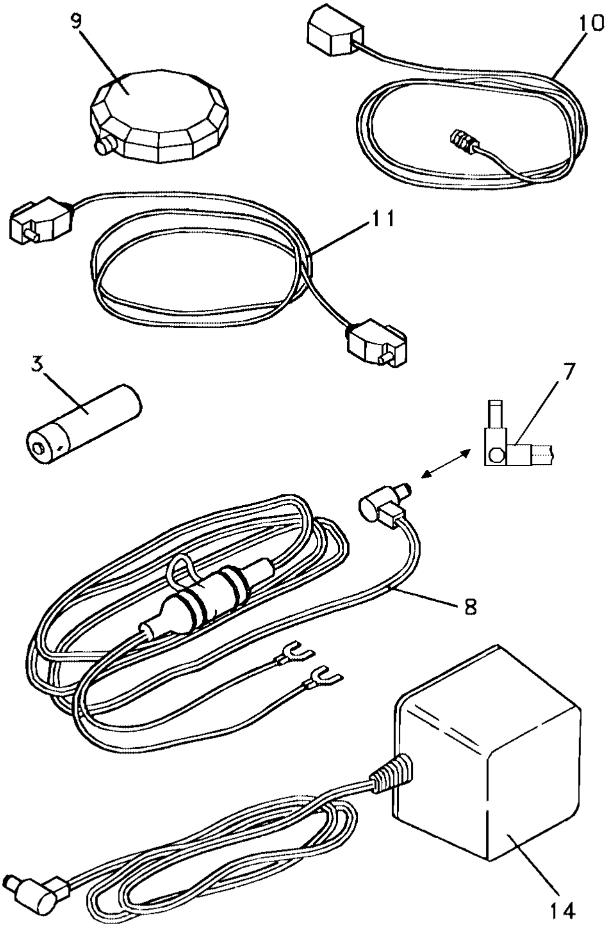


Figure 10-1 Satellite Signals Navigation Set AN/PSN-11 Parts Location Diagram. (Sheet 2)

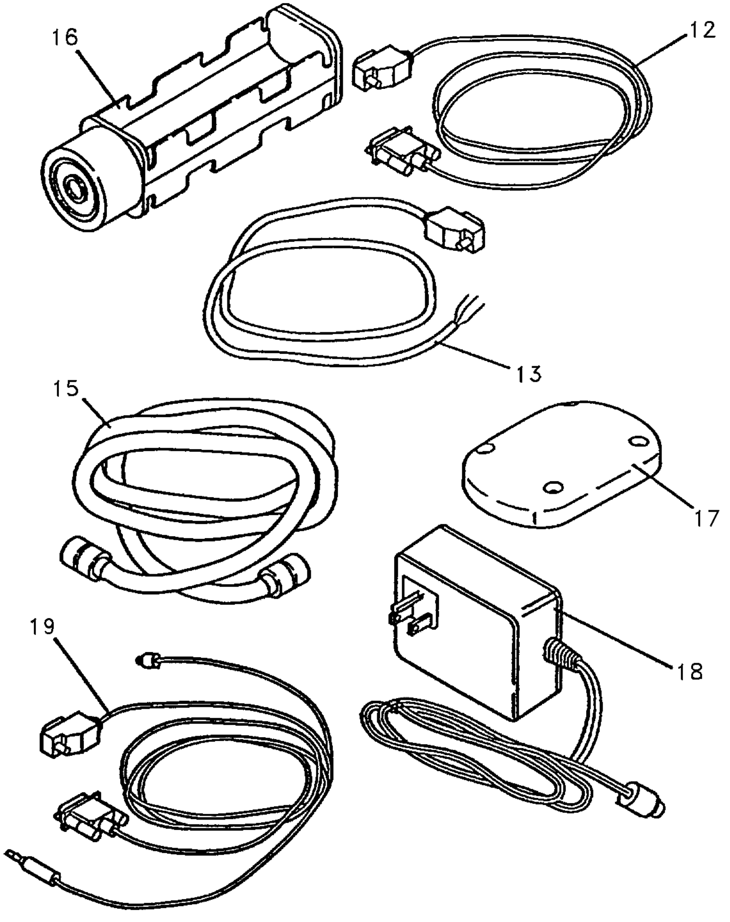


Figure 10-1 Satellite Signals Navigation Set AN/PSN-11 Parts Location Diagram. (Sheet 3)

Table 10-1 Group Assembly Parts List .

FIG-ITEM	PART NUMBER	IND	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE	SMR CODE
10-1-1	822-0077-022	1	NAVIGATION SET, SATTELLITE SIGNALS AN/PSN-11 (13499)	1		PAODD
	822-0077-103	1	NAVIGATION SET, SATELLITE SIGNALS	1		PAODD
2	021-0706-010	1	CASE, NYLON (PER-SONNEL) (13499)	1		PAOZZ
3	LS14500	1	BATTERY, STORAGE (MEMORY) (31586) 221-0500-020	1		PAOZZ
4	013-1925-010	1	ANTENNA, HELMET AS-4334/U (13499	1		PAOZZ
5	013-1928-010	1	MOUNT, ANTENNA (HELMET) (13499)	1		PAOZZ
6	986-0645-001	1	MOUNT (13499)	1		PAOZZ
7	426-0144-010*	1	CABLE ASSEMBLY, POWER (13499) (AN/PSN-11 EXTER-NAL POWER CABLE)	1		PAOZZ
	264-0723-000	2	FUSE, CARTRIDGE, 2A 250V (13499)	1		
8	9728558-10	1	CABLE ASSEMBLY, POWER (98752)	1		PAOZZ
9	013-1925-030	1	ANTENNA, REMOTE AS-4333/V (13499)	1		PAOZZ
10	426-0141-050	1	CABLE ASSEMBLY, SPECIAL (13499) (AN/PSN-11 TO REMOTE ANTENNA CABLE)	1		PAOZZ

* This cable has the locking newell nut attached.

Table 10-1 Group Assembly Parts List - Continued.

FIG-ITEM	PART NUMBER	IND	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE	SMR CODE
11	426-0141-020	1	CABLE ASSEMBLY, SPECIAL (13499) (AN/PSN-11 TO AN/PSN-11 CABLE)	1		PAOZZ
12	426-0141-010	1	CABLE ASSEMBLY, SPECIAL (13499) (AN/PSN-11 TO PC CABLE	1		PAOZZ
13	426-0141-040	1	CABLE ASSEMBLY, SPECIAL (13499) (AN/PSN-11 TO HAVE QUICK CABLE)	1		PAOZZ
14	COM218-0325-020	1	POWER ADAPTER, 110/220V, 50/60 HZ, AC TO DC (13499)	1		PAOZZ
15	426-0141-070	1	CABLE ASSEMBLY, SPECIAL (13499) (AN/PSN-11 TO SINC-GARS CABLE)	1		PAOZZ
16	221-0135-020	1	HOLDER, BATTERY (13499)	1		
17	AT-575-9	1	ANTENNA, AIRCRAFT (0UVG2)	1		
18	87F2900 TYPE WM14.4.S	2	POWER SUPPLY, 110V, REGULATED (02980)	2		PAOZZ
19	9434308-10	2	CABLE ASSEMBLY, PLGR REPROGRAM-MING (98752)	1		PAOZZ

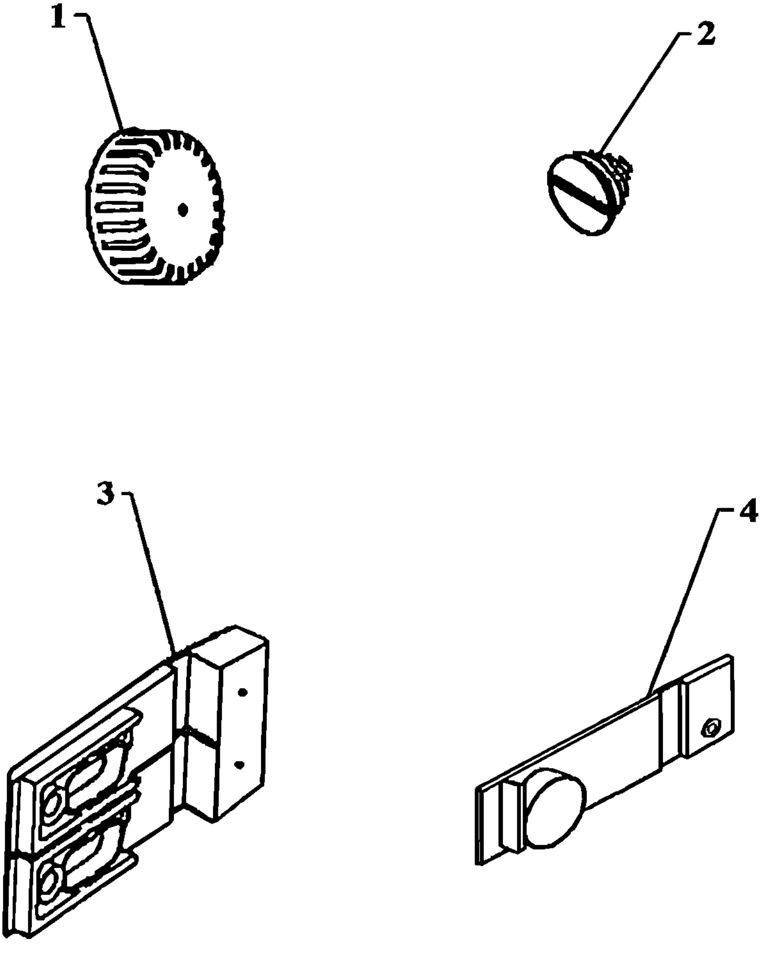


Figure 10-2 AN/PSN-11 Replacement Parts.

Table 10-2 Replacement Parts List .

FIG-ITEM	PART NUMBER	IND	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE	SMR CODE
1	988-6724-001	1	BATTERY CAP, PRIME ASSEMBLY	1		PAOZZ
2	988-6725-001	1	BATTERY CAP, ASSEMBLY MEMORY	1		PAOZZ
3	988-6726-001	1	COVER, CONNECTOR (J2/J3)	1		PAOZZ
4	986-0651-001	1	COVER CONNECTOR, POWER (J4)	1		PAOZZ

CHAPTER 11

REPROGRAMMING

CAUTION

Equipment problems during the reprogramming process could leave the PLGR non-operational. If this occurs the reprogramming process must be restarted and completed successfully.

11.1 REPROGRAMMING.

The PLGR is reprogrammable without requiring the unit to be returned to the factory. When reprogramming of the PLGR is in order, the required authorization and instructions, as well as software and hardware necessary for the task, will be disseminated through appropriate channels. Reprogramming instructions will be provided by Time Compliance Technical Order (TCTO) and/or Modification Work Order (MWO).

CHAPTER 12

DESKTOP ASSISTANT SOFTWARE

12.1 DESKTOP ASSISTANT SOFTWARE.

Desktop Assistant Software (DAS) for Windows has been designed to make the task of setting up the PLGR easier. DAS allows you to use a Persona Computer (PC) to interface with the PLGR and control the PLGR functions. You can build waypoint databases and save them to your PC hard drive, upload them to the PLGR, or save waypoints stored in your PLGR to your PC. You also need a PLGR-PC cable (part No. 426-0141-010) to connect the PLGR to your PC.

12.1.1 Ordering Software. The software can be ordered from PM GPS (JSSMO) by CPIN 894-PSN11-S002-00A. A complete copy of the DAS User's Instruction is included on the software diskette. A request for DAS can be ordered by mail: WR-ALC, ATTN: LKNA, 460 Richard Ray Blvd., Bldg. 301, Robins AFB, GA 31098-1640, or FAX at DSN: 468-9091, Commercial: (478) 926-9091.

CHAPTER 13

TUTORIAL

13.1 TUTORIAL - GETTING STARTED.

NOTE

It is helpful if the user is familiar with the keypad operation prior to using this tutorial. See Chapter 2.

This tutorial is a limited series of exercises using the PLGR. It is designed to help you learn how to turn on, initialize, enter data, pause, navigate, and turn off the PLGR for the following navigation scenario. It is not designed to teach you all the functions and capabilities of the PLGR. There are three lessons in this tutorial:

Lesson 1 - Turning On/Off:
Learn to turn the PLGR on and off, adjust for display backlighting, and recognize the display screens.

Lesson 2 - Initialization:
Learn to initialize the PLGR (after turn on) by setting up the displays for use, and entering waypoints and other data.

Lesson 3 - Navigation:
Learn to navigate with the PLGR, using the training *(2dTNG* or *3dTNG)* navigation mode, in the following navigation scenario.

13.1.1 Lesson 1 - Turning On/Off.

The PLGR is turned on/off using the keypad. The display is backlit for night viewing using the keypad, and is night-vision goggle (NVG) compatible. Be aware that the PLGR draws more power with the backlighting turned on.

13.1.1.1 Turning On the PLGR. The PLGR is turned on by pressing the *ON/BRT* key. When turned on, the following sequence of displays comes up (see Figure 13-1):

NOTE

If the PLGR fails to turn on, see sub-paragraph 8.1.1.5 for troubleshooting, or sub-paragraph 8.1.3 for passivated batteries procedures.

a. A test pattern display showing all pixels (dots in each alpha/numeric segment of the display).

b. A display showing a copyright notice, manufacturer name, and software part number.

NOTE

At this point the power-on self-test is automatically started. This takes only a few seconds to complete.

c. A self-test display showing self-test results and battery status.

NOTE

- At this point the keypad becomes active.

- If self-test fails, a display showing this comes up instead of the battery status display. This display remains until any key is pressed.

FAILURES FOUND Press MENU and select STATUS for details.

d. A position display showing the last position recorded (if any) by the PLGR before being turned off. OLD on line 1 is displayed until a new position is computed.

CAUTION

The PLGR draws more power with the backlighting turned on. This may affect battery life and mission capability.

13.1.1.2 Adjusting Display Backlighting. The display is backlit for night viewing. The backlighting is off when the PLGR is first turned on. However, when the backlighting is turned on, the last selected level (0 to 100%) automatically comes up. This is also true if the PLGR is turned off with the backlighting selected to on.

a. With the PLGR turned on, press the *ON/BRT* key. This turns the backlighting on. The backlighting is toggled on and off each time the *ON/BRT* key is pressed.

NOTE

Holding the *Up*- or *Down-arrow* key while holding the *ON/BRT* key, causes the backlighting level to change faster.

b. Hold the *ON/BRT* key and press the *Up*- or *Down-arrow* key to increase/decrease the backlighting level.

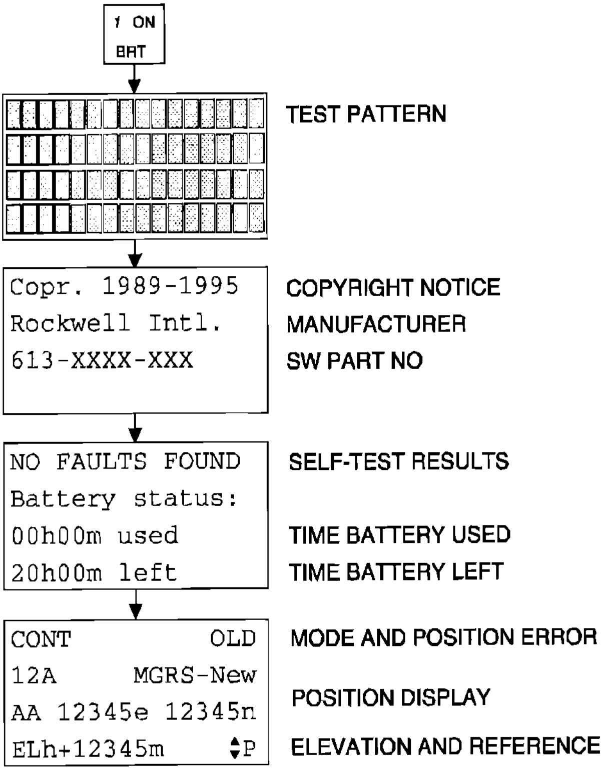
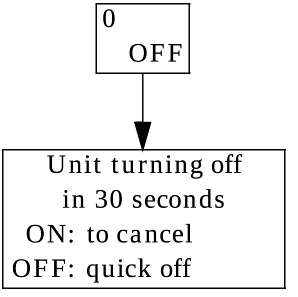


Figure 13-1 ON Display Sequence.

13.1.1.3 Turning Off the PLGR. The PLGR is turned off by pressing the *OFF* key, once or twice. If the *OFF* key is pressed only once the display at the right comes up. A thirty-second delay timer is started to prevent accidental turn off. At this point you have the option to press the *ON* key to cancel, or the *OFF* key for quick off. If the *OFF* key is pressed twice the PLGR turns off immediately. However, you may momentarily see the off display come up.



13.1.2 Lesson 2 - Initialization. The PLGR is initialized (after turn on) by setting up the displays for use, and entering waypoints and other data.

NOTE

- Be aware that display pages can be selected to either *control mode* (*'P'* at lower right of display), *scroll mode* (*'S'* at lower right of display when entering or editing a route) or *numeric mode* (*'N'* at lower right of display). Press the *NUM LOCK* key to select the desired *mode*.

- Be aware that even in *numeric mode* all *nonnumeric fields* can only be scrolled. See paragraph 2.4.

13.1.2.1 SETUP of the PLGR. Press the *MENU* key. Select the *SETUP* option. This brings up the first of eleven *SETUP* display pages (see Figure 13-2). *SETUP is* used to prepare the AN/PSN-11 for mission needs (in this case, the navigation scenario). **Not all features are used.**

13.1.2.1.1 SETUP Mode Selection. *SETUP* display page 1 is for SETUP mode selection. Scroll through the options and setup as follows:

a. Select STBY mode on line 1.

b. Select *mixed* on line 4.

c. Scroll down to the next page.

13.1.2.1.2 SETUP Coordinates and Units Selection. *SETUP* display page 2 is for SETUP coordinates and units selection.

a. Scroll through the options and setup as follows:

(1) *L/L-dm*. coordinates on line 2

(2) *English* distance units on line 2

(3) *meter* elevation units on line 3

(4) *DTM* elevation reference od line 3

(5) *Mil*-µ angular unit's on line 4

(6) *Grid* North reference on line 4

b. Scroll down to the next page.

13.1.2.1.3 <u>SETUP Magnetic Variation.</u> *SETUP* display page 3 is for SETUP magnetic variation source selection.

a. Scroll through the options and setup as follows:

(1) *Calc* - the magnetic variation is automatically calculated

(2) *deg* - the magnetic variation unit of measure selected

b. Scroll down to the next page.

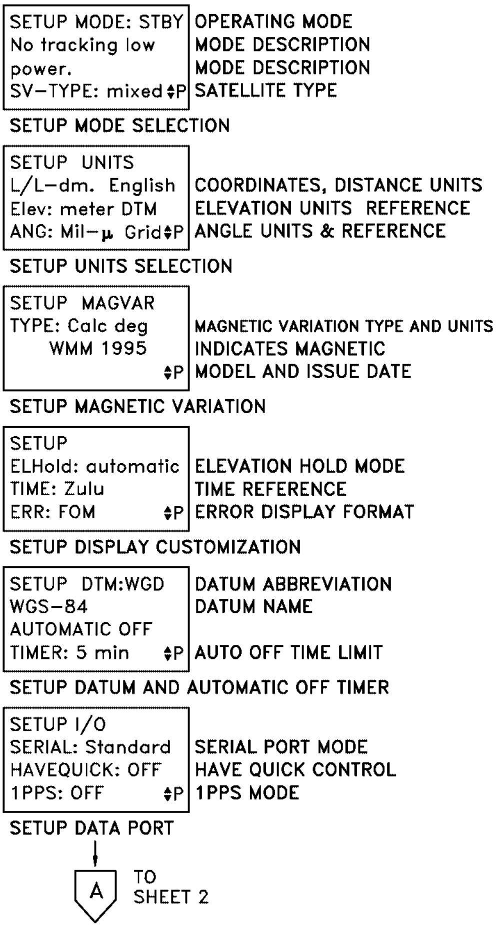


Figure 13-2 Setup Display Pages. (Sheet 1 of 2)

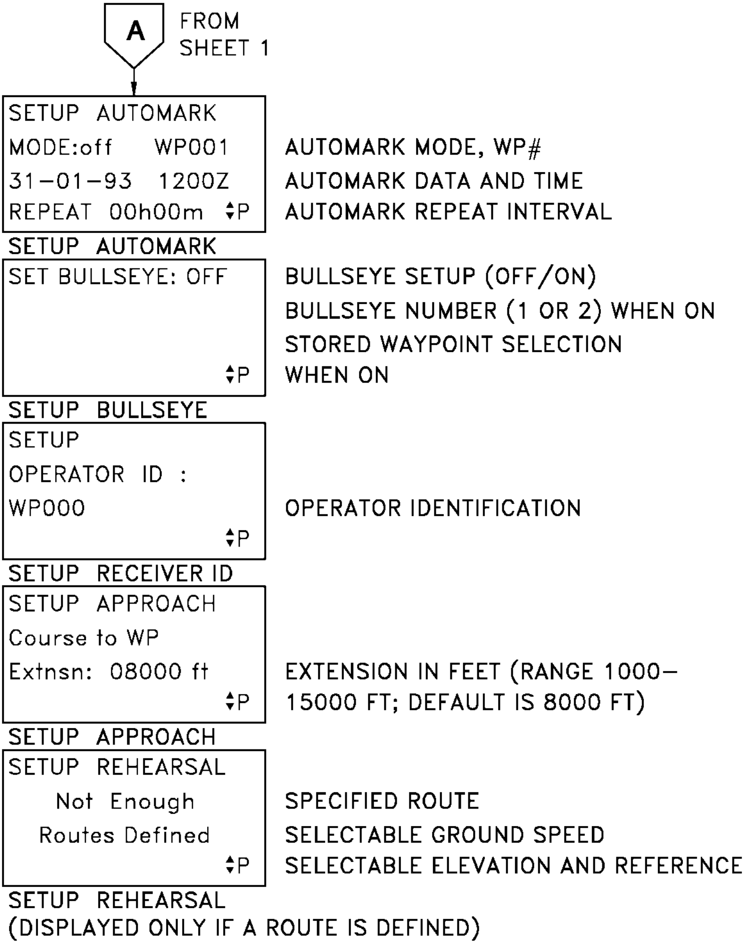


Figure 13-2 Setup Display Pages. (Sheet 2)

13.1.2.1.4 SETUP Display Customization. *SETUP* display page 4 is for *SETUP* display modes and formats selection.

a. Scroll through the options and setup as follows:

(1) *automatic* Elevation Hold Mode on line 2

(2) *Zulu* time offset on line 3

(3) *FOM* error estimate on line 4

b. Scroll down to the next page.

13.1.2.1.5 SETUP Datum and Automatic-Off Timer. *SETUP* display page 5 is for *SETUP* map datum and automatic off timer selection.

a. Scroll through the options and setup as follows:

(1) WGD for WGS-84 map datum on line 1

(2) 5 minute automatic off timer on line 4

b. Scroll down to the next page.

13.1.2.1.6 SETUP Data Port. *SETUP* display page six is for *SETUP* data port configuration selection.

a. Scroll through the options and setup as follows:

(1) *Standard* serial port configuration on line 2

(2) *Off* for HAVE QUICK control on line 3

(3) *Off* for 1PPS control on line 4

b. Scroll down to the next page.

13.1.2.1.7 SETUP Automark Mode. SETUP display page seven is for *SETUP* automark mode selection.

CAUTION

When the Automark mode is setup for *"rpt"* or *"once"*, the AN/PSN-11 cannot be fully turned off. This means that unless the Automark mode is reset for "off", the PLGR initiates a power-on *("wake up")* condition based on the Automark mode setup.

a. **Scroll through the options for training** as follows:

(1) *off* automark mode on line 2

(2) *WP* - do not select for this option; should come up as first unused waypoint

(3) *time* - scroll through this option for training. Do not attempt to enter time *00h00m* repeat time on line 4. If you enter *00h30m*, this causes a fix to be stored every 30 minutes from the starting time and this page display would change

b. Turn *automark mode* on later, if desired. Scroll down to the next page. This is the first setup display page. Ensure that *SETUP MODE is* set to STBY.

13.1.2.1.8 SETUP Bullseye Function. *SETUP* display page eight allows the user to set the Bullseye function *ON* or *OFF*.

a. **Scroll through the options for training** as follows:

(1) *OFF - turns* the Bullseye function off

(2) *ON - turns* the Bullseye function on and allows the user to enter one or more Bullseye waypoints

b. Set the Bullseye function *OFF* for this tutorial.

13.1.2.1.9 SETUP Operator ID. *SETUP* display page nine allows the user to setup the Operator ID. The Operator ID is an alphanumeric identifier (e.g., *WP000*).

a. **Scroll through the options for training** as follows:

(1) *OPERATOR ID:* - enter up to twelve alphanumeric characters as your identification, or leave *WP000* displayed.

13.1.2.1.10 SETUP Approach. *SETUP* display page ten allows the user to setup an approach. This allows the user to define an extension to the waypoint navigated to during an approach.

a. **Scroll through the options for training** as follows:

(1) *Extnsn:* - enter a range in feet between 1,000 and 15,000 feet (default value is 8,000 ft), or leave 8,000 ft displayed.

13.1.2.1.11 SETUP Rehearsal. SETUP display page eleven allows the user to modify the tutorial to use a predefined scenario instead of the predefined scenario presented. **Scroll past this display page at this time,** the tutorial does not use this mode.

13.1.2.2 <u>Initialization of the AN/PSN-11.</u> Press the *MENU* key. Select the *INIT* (initialize) option. This brings up the first of six *INIT* display pages (see Figure 13-3). *INIT* is used to prepare the PLGR for mission needs (in this case, the navigation scenario). Not all features are used. Initialize the following parameters:

Position
Time and date
Track and ground speed
User-defined datums
Crypto keys

INIT POS CLR	TITLE, CLEAR ENTRY FIELD
N 33°01.011′	LATITUDE
W 114°23.855′	LONGITUDE
EL +00114m D ⇕P	ELEVATION AND REFERENCE

INITALIZE POSTION

INIT TIME CLR	TITLE, CLEAR ENTRY FIELD
30–02–93	DATE IN DAY–MONTH–YEAR
0000:00Z	TIME IN HRS, MINS, SECS
⇕P	

INITALIZE TIME AND DATE

INIT TRK/GS CLR	TITLE, CLEAR ENTRY FIELD
TRK 0000.0°µG	CURRENT DIRECTION
GS 000mph	GROUND SPEED
⇕P	

INITALIZE TRACK AND GROUND SPEED

INIT DTM USER1	TITLE, DATUM NUMBER
dA:+0000.000	DELTA A PARAMETER DIFFERENCE
dF*E4:.000000010	DELTA F PARAMETER DIFFERENCE
MGRS adv:00 ⇕P	MGRS LETTER ADVANCE

INITALIZE USER-DEFINED DATUM (PAGE 1)

INIT DTM USER1	TITLE, DATUM NUMBER
dX:+0000.0	DELTA X PARAMETER PARAMETER
dY:+0000.0	DELTA Y PARAMETER PARAMETER
dZ:+0000.0 ⇕P	DELTA Z TRANSFORM PARAMETER

INITALIZE USER-DEFINED DATUM (PAGE 2)

INIT CRYPTO KEY	TITLE, CLEAR ENTRY FIELD
H _	HEX KEY
D _	DECIMAL KEY
⇕P	

INITALIZE CRYPTO KEY

Figure 13-3 Initialization Display Pages.

13.1.2.2.1 Initialize Position. INIT display page 1 is for initializing position. This display is in the coordinates type selected in *SETUP*. This data does not need to be exact for the PLGR to accurately determine (Fix) on its position.

a. Scroll through the options and setup as follows:

(1) *POS* on line 1

(2) *N* 33°0 1.0 11' latitude on line 2

(3) *W* 114°23.855' longitude on line 3

(4) +*00114* elevation on line 4

b. Scroll down to the next page.

13.1.2.2.2 Initialize Time and Date. INIT display page 2 is for initializing time and date. This display is in the *Zulu time offset* selected in SETUP.

a. Scroll through the options and setup as follows:

(1) *date* (day, month, year) on line 2

(2) *time* (24-hour time; Zulu or Local) on line 3

b. Scroll down to the next page.

13.1.2.2.3 Initialize Track and Ground Speed. INIT display page 3 is for initializing track and ground speed. This display is in the *units* selected in *SETUP*. Track and ground speed do not need to be entered here but are used in the navigation scenario.

a. **Scroll through the options for training** as follows:

(1) *CLR - clears* out an entry you made; returns to the old data

(2) *TRK* - the track of travel on line 2

(3) *GS* - the ground speed of travel on line 3

b. Scroll down to the next page.

13.1.2.2.4 Initialize User-Defined Datum. INIT display pages 4 and 5 (datum pages 1 and 2) are for initializing *USER* 1 or *USER* 2 map datums. User-defined datum does not need to be entered here. It is used in the navigation scenario. **Scroll through the options for training** as follows:

a. For datum page 1:

(1) *INIT DTM - either USER 1* or *USER 2* for datum entry on line 1

(2) *dA* - the delta A offset (-9999.999 to +9999.999) on line 2

(3) *dF - the* delta F offset (-.99999999 to +.99999999) on line 3

(4) *MGRS adv* - the *MGRS* second letter advance (00 to 26) on line 4

b. Scroll down to the next page.

c. For datum page 2:

(1) *INITDTM - either USER 1* or *USER 2* for datum entry on line 1

(2) *dX* - the delta X offset (-9999.9 to +9999.9) on line 2

(3) *dY* - the delta Y offset (-9999.9 to +9999.9) on line 3

(4) *dZ* - the delta Z offset (-9999.9 to +9999.9) on line 4

d. Scroll down to the next page.

13.1.2.2.5 **Initialize Crypto Keys.** INIT display page six is for initializing crypto keys (if authorized). If the PLGR does not contain crypto keys (not authorized), line 1 is blank. If crypto keys are desired, follow the procedures provided in *Appendix A*.

a. **Scroll through the options for training** as follows:

(1) *H* - indicates that *Hexadecimal keys* may be entered on line 2

(2) *D - indicates* that *Decimal keys* may be entered on line 3

13.1.2.3 **Waypoint Data.** A waypoint is the location of a point on a desired course. A normal mission consists of a series of waypoints. Nine hundred and ninety-nine waypoints (numbered 001 through 999,000 is defined as present position) can be entered into the PLGR.

13.1.2.3.1 Waypoint Overview. In this exercise you clear, enter, copy, edit, and link together some waypoints into a route for the navigation scenario in Lesson 3. Not all features are used. The waypoint display pages (see Figure 13-4) are used to perform the following:

Enter, edit, or review waypoints
Copy waypoints
Calculate a new waypoint *(SR-CALC* or *RNG-CALC)*
Determine distance between waypoints
Clear waypoints
Define a mission route

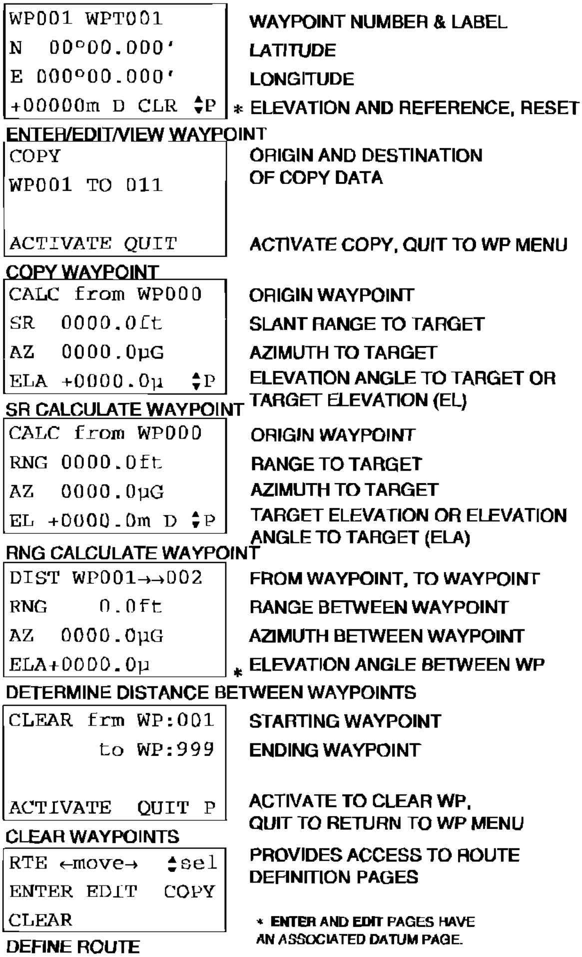


Figure 13-4 Waypoint Display Pages.

13.1.2.3.2 **Clearing Waypoints.** First, make sure there are no waypoints already stored. One or more waypoints can be cleared at the same time. Press the WP key and select the *CLEAR* option.

a. Scroll through the options and select the following:

```
WP  ←move→   ⬍ sel
ENTER   EDIT   COPY
SR-CALC  RNG-CALC
DIST  CLEAR  ROUTE
```

(1) *from WP* - enter 001 on line 1

(2) *to WP* - enter 999 on line 2

(3) *ACTIVATE* - select this option and activate on line 4 (a waypoint clear confirmation page is displayed)

(4) *CONFIRM* - select this option and activate on line 4 (a waypoint clear acknowledge page comes up, which must be acknowledged)

13.1.2.3.3 **Entering Waypoints.** Enter waypoints 001 through 006 in different coordinate types, to help you become familiar with them. Enter all waypoints in the same format, if desired. Table 13-1 contains a list of the waypoints to use, in four coordinate formats. The suggested entry is in italics.

NOTE

Displayed position data may be slightly different (least significant digit only) than the entered value. This should rarely occur and is not a cause for concern.

a. Press the WP key. Select the ENTER option. Activate it.

```
WP  ←move→   ⬍ sel
ENTER   EDIT   COPY
SR-CALC  RNG-CALC
DIST  CLEAR  ROUTE
```

NOTE

- The first available waypoint is automatically selected as the to waypoint. The current default mode is *control mode (P)*.
- To select a waypoint number, move the cursor to the waypoint number field. Scroll up or down to the desired waypoint number.
- To enter waypoints numerically, select *numeric mode (N).* Cursor to the waypoint number field. Enter waypoint number.

b. This brings up a display page for entering and checking waypoint data. The first page contains:

```
WP001  UNUSED001
N        90°  00.000'
E       000°  00.000'
No    EL      CLR    P
```

Waypoint number - 001 to 999
Waypoint label - a 10 character alphanumeric identifier
Position coordinates - defaults to the format selected during SETUP (see the second page to change)
Elevation - defaults to No *EL* until selected
CLR - used to clear out an entire entry and return the old position data (a waypoint clear confirmation page is displayed)

Table 13-1 Waypoints For Lesson 3 .

WP#	ID	MGRS	UTM/UPS	L/L-dm	L/L-dms
001	START	11S QS 43117e 56209n +00000m D	11S 0743117e3656209n +00000m D	N 33°01.035’ W 114°23.840’ +00000m D	N 33°01’02.09” W 114-23-50.41” +00000m D
002	TURN1	11S QS 43071e 58028n +00020m D	11S 074307le3658028n +00020m D	N 33°02.019’ W 114°23.841’ +00020m D	N 33°02’0 1.14" W 114°23’50.44 +00020m D
003	TURN2	11S QS 43913e 58912n +00000m D	11S 0743913e3659912n +00000m D	N 33°02.486’ W 114°23.286’ +00000m D	N 33°02’29.16” W 114°23’17.16” +00000m D
004	TURN3	11S QS 45133e 58943n +00000m D	11S 0745133e3658943n +00000m D	N 33°02.486’ W 114°22.502’ +00000m D	N 33°02’29.16” W 114°22’30.12 +00000m D
005	END	11S QS 46388e 60262n +00000m D	11S 0746388e3660262n +00000m D	N 33°03.182’ W 114°21.676’ +00000m D	N 33°03’10.92” W 114°21’40.54” +00000m D
006	MISS	11S QS 45749e 60246n +00000m D	11S 0745749e3660246n +00000m D	N 33°03.182’ W 114°22.086’ +00000m D	N 33°03’10.92” W 114°22’05.16” +00000m D
007	AIR1	11S QS 43070e 58028n +00364m D	11S 0743070e3658028n +00364m D	N 33°02.019’ W 114°23.841’ +00364m D	N 33°02’01.14” W 114°23’50.46” +00364m D
008	AIR2	11S QS 43913e 58912n +00364m D	11S 0743913e3658912n +00364m D	N 33°02.486’ W 114°23.286’ +00364m D	N 33°02’29.16” W 114°23’17.16” +00364m D
009	AIR3	11S QS 45133e 58943n +00364m D	11S 0745133e3658943n +00364m D	N 33°02.486’ W 114°22.502’ +00364m D	N33°02’29.16” W 114°22’30.12” +00364m D
010	AIR-MISS	11S QS 43913e 58912n +00664m D	11S 0743913e3658912n +00664m D	N33°02.486’ W 114°23.286’ +00664m D	N 33°02’29.15” W 114°23’17.16” +00664m D

13.1.2.3.4 Entering Waypoint 001 (MGRS-Old or MGRS-New Format).

Enter waypoint number 001 in Military Grid Reference System *(MGRS)* format, change the coordinates type on page 2. Enter the waypoint number, identifier, and coordinates on page 1. Proceed as follows:

a. With cursor on the paging field, scroll to page 2.

b. Page 2 can be used to change setup options that apply to only the particular waypoint shown on line 1. The selectable fields on this page are highlighted in the display shown.

```
WP001   DTM:WGD
WGS-84
MAGVAR:No magvar
MGRS-New  CLR ⬍ P
```

DTM - select a datum that is different than the setup datum
MAGVAR - defaults to No *magvar* until selected. Magnetic variation is calculated unless entered
L/L-dm - the position coordinates type for the waypoint. Defaults to the format selected during SETUP

c. Change the coordinates type to *MGRS (Old or New).* Move the cursor back to the paging field. Scroll to page 1.

d. The waypoint number field displays the first unused waypoint number. In this case 001.

```
WP001  UNUSED001
00B        MGRS-New
AN   00000e  00000n
No    EL   CLR      P
```

e. Move the cursor to the identifier. Select it (press the *Up-* or *Down-arrow* key). The identifier can be up to ten alphanumeric characters.

(1) The characters available for entry of the waypoint label are:

Letters A-Z
Numbers 0-9
Dash (-), Slash (/), Period (.), and Blank

(2) Starting from an underscore, the *Up-arrow* key begins scrolling through letters A-Z, then numbers 0-9, dash (-),

slash (/), period (.) and blank. Conversely, the *Down-arrow* key begins scrolling with blank period slash 0, dash (-), numbers 9-0, and then letters Z-A.

(3) Enter the identifier START.

f. Move the cursor to line 2. Enter 11S (zone number and letter). Move the cursor to line 3. Enter QS (grid square) and *43117e 56209n* (easting and northing).

```
WP001  START
11S        MGRS-New
QS   43117e 56209n
No    EL   CLR     P
```

g. Entry of elevation is not required, but enter one for this waypoint. Scroll from No *EL* to +00000m. Enter an elevation of +00000m.

```
WP001  START
11S        MGRS-New
QS     43117e 56209n
+00000m D CLR     P
```

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message momentarily displays.

h. Move the cursor to the paging field. Scroll between page 1 and page 2. See that the displayed data match the desired entries. Select the different position display formats on page 2. See Table 13-1. The PLGR automatically selects the first waypoint entered (WP001) as the destination.

13.1.2.3.5 <u>Entering Waypoint 002 (UTM/UPS Format).</u> Enter waypoint number 002 in Universal Transverse Mercator/Universal Polar Sterographic (UTM/UPS) format. Change the coordinates type on page 2. Enter the waypoint number, identifier, and coordinates on page 1. Proceed as follows:

a. Change the coordinates type from *MGRS (Old or New)* to UTM/UPS. Move the cursor back to the paging field. Scroll to page 1.

```
WP001   DTM:WGD
WGS-84
MAGVAR:No magvar
UTM/UPS    CLR ⬍ P
```

b. Select the waypoint number field. Change it to 002 (either by scrolling or numeric entry). Notice the identifier changes as the waypoint number changes. Change the identifier to *TURN1*.

```
WP002  UNUSED002
00B        UTM/UPS
2000000e 2000000n
No    EL   CLR       P
```

c. Move the cursor to line 2. Enter 11S (zone number and letter). Move the cursor to line 3. Enter *0743071e* and *3658028n* (easting and northing).

```
WP002  TURN1
11S        UTM/UPS
0743071e3658028n
NO    EL   CLR       P
```

d. Enter the elevation for this waypoint. Scroll from *No EL* to *+00000m*. Enter an elevation of *+00020m*.

```
WP002  TURN1
11S        UTM/UPS
0743071e3658028n
+00020m   CLR      P
```

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message momentarily displays.

e. Move the cursor to the paging field. Scroll between page 1 and page 2. Select the different position display formats on page 2. See the displayed data match the desired entries. See Table 13-1.

13.1.2.3.6 Entering Waypoint 003 (L/L-dm. Format). Enter waypoint number 003 in Latitude/Longitude, - degrees and minutes (L/L-dm.) format (default format). Change the coordinates type on page 2. Enter the waypoint number, identifier, and coordinates on page 1. Proceed as follows:

a. Change the coordinates type from *UTM/UPS* to *L/L-dm*. Move the cursor back to the paging field. Scroll to page 1.

```
WP002   DTM:WGD
WGS-84
MAGVAR:No magvar
L/L-dm.      CLR  P
```

b. Select the waypoint number field. Change it to 003. Notice the identifier changes as the waypoint number changes. Change the identifier to TURN2.

```
WP003  UNUSED003
N       00°00.000'
E      000°00.000'
No   EL      CLR     P
```

c. Move the cursor to line 2. Enter *N* (scroll between *N* and *S*). Move the cursor to the latitude field. Enter *33°02.486'*. Move cursor to line 3. Enter *W*, then *114°23.286'* (longitude).

```
WP003  TURN2
N       00°00.000'
E      000°00.000'
No   EL      CLR     P
```

d. Enter the elevation. Scroll from *No EL* to *+00000m*. Enter an elevation of *+00000m*.

```
WP003  TURN2
N          33°02.486'
E        114°23.286'
+00000m  D  CLR    P
```

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message momentarily displays.

e. Move the cursor to the paging field. Scroll between page 1 and page 2. Select the different position display formats on page 2. See the displayed data match the desired entries. See Table 13-1.

13.1.2.3.7 Entering Waypoint 004 (L/L-dms Format). Enter waypoint number 004 in Latitude/Longitude - degrees, minutes, and seconds (L/L-dms) format. Change the coordinate type on page 2. Enter the waypoint number, identifier, and coordinates on page 1. Proceed as follows:

a. Change the coordinates type from *L/L-dm*. to *L/L-dms*. Move the cursor back to the paging field. Scroll to page 1.

```
WP003    DTM:WGD
WGS-84
MAGVAR:No magvar
L/L-dms       CLR  P
```

b. Select the waypoint number. Change it to 004. Notice the identifier changes if the waypoint number changes. Change the identifier to TURN3.

```
WP004  UNUSED004
N      00°00.000”
E     000°00.000”
No   EL      CLR     P
```

c. Move the cursor to line 2. Enter *N* (scroll between *N* and *S*). Move the cursor to the latitude field. Enter *33°02 29.16’*. Move the cursor to line 3. Enter *W*, then *114°22'30.12’* (longitude).

```
WP004  TURN3
N      33°02.29.16”
E     114°22.30.12”
No    EL       CLR   P
```

d. Enter the elevation. Scroll from *No EL* to *+00000m*. Enter an elevation of *+00000m*.

```
WP004  TURN3
N       33°02.29.16”
E     114°22.30.12”
+00000m  D  CLR    P
```

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message will momentarily display.

e. Move the cursor to the paging field. Scroll between page 1 and page 2. Select the different position display formats on page 2. See the displayed data match the desired entries. See Table 13-1.

13.1.2.3.8 Entering Waypoint 005 (MGRS-Old or MGRS-New Format). Enter waypoint number 005 in *MGRS* format. Change the coordinate type on page 2. Enter the waypoint number, identifier, and coordinates on page 1. Proceed as follows:

a. Change the coordinates type from *L/L-dms* to *MGRS (Old or New)*. Move the cursor back to the paging field. Scroll to page 1.

```
WP:04    DTM:WGD
WGS-84
MAGVAR:No magvar
MGRS-New   CLR  P
```

b. Select the waypoint number field. Change it to *005*. Notice the identifier changes as the waypoint number changes. Change the identifier to *END*.

```
WP005  UNUSED005
00B         MGRS-New
AN      00000e  00000n
No    EL      CLR      P
```

c. Move the cursor to line 2. Enter *11S*. Move the cursor to line 3. Enter *QS*, *46388e* and *60262n*.

WP005	END		
11S		MGRS-New	
QS	46388e	60262n	
No	EL	CLR	P

d. Enter the elevation. Scroll from *No EL* to *+00000m*. Enter an elevation of *+00000m*.

WP005	END		
11S		MGRS-New	
QS	46388e	60262n	
+00000m	D	CLR	P

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message momentarily displays.

e. Move the cursor to the paging field. Scroll between page 1 and page 2. Select the different position display formats on page 2. See that the displayed data match the desired entries. See Table 13-1.

13.1.2.3.9 <u>Entering Waypoint 006 (MGRS-Old or MGRS-New Format).</u> Enter waypoint number 006 in *MGRS* format. Change the coordinate type (if needed), on page 2. Enter the waypoint number, identifier, and coordinates on page 1. Proceed as follows:

a. Change the coordinates type (if needed). Move the cursor back to the paging field. Scroll to page 1.

b. Select the waypoint number field. Change it to *006*. Notice the identifier changes as the waypoint number changes. Change the identifier to *MISS*.

WP006	UNUSED006		
00A		MGRS-New	
AA	00000e	00000n	
No	EL	CLR	P

c. Move the cursor to line 2. Enter *11S*. Move the cursor to line 3. Enter *QS*, *45749e* and *60246n*.

```
WP006  MISS
11S          MGRS-New
QS      45749e  60246n
No    EL      CLR     P
```

d. Enter the elevation. Scroll from *No EL* to +*00000m*. Enter an elevation of +*00000m*.

```
WP006  MISS
11S          MGRS-New
QS      45749e  60246n
+00000m  D  CLR     P
```

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A WAYPOINT *STORED* message momentarily displays.

e. Move the cursor to the paging field. Scroll between page 1 and page 2. Select the different position display formats on page 2. See that the displayed data match the desired entries. See Table 13-1.

13.1.2.3.10 **<u>Copying Waypoints.</u>** Copy some waypoints needed for the navigation scenario in Lesson 3. Waypoints 007 through 010 are copied from the entered waypoints. Press the WP key to bring up the waypoint menu display. Select the COPY option. Activate it.

```
WP  ←move→     ⬍ sel
ENTER   EDIT   COPY
 SR-CALC  RNG-CALC
DIST  CLEAR  ROUTE
```

NOTE

- The first available waypoint is automatically selected as the *to* waypoint. The current default mode is *control mode (P)*. To select a waypoint number, move the cursor to the waypoint number field. Scroll up or down to the desired waypoint number.

- To enter waypoints numerically, select *numeric mode (N)*. Cursor to the waypoint number field. Enter waypoint number. This brings up a display page for copying data from one waypoint to another. The waypoint numbers are used to indicate the source and target waypoints. The position, elevation, label, datum, and magnetic variation associated with the source waypoint are copied to the target waypoint.

```
COPY
WP006 to 007

ACTIVATE  QUIT
```

13.1.2.3.11 **Copying Waypoint 002 to Waypoint 007.** Copy the first waypoint needed (WP002 to WPO07) as follows:

a. Move the cursor to the from waypoint number field. Change it to 002.

```
COPY
WP002 to 007

ACTIVATE  QUIT
```

b. Since the to waypoint is correct (automatically selected), we can skip over it here.

```
COPY
WP002 to 007

ACTIVATE  QUIT
```

NOTE

When the ACTIVATE option is activated, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message displays to acknowledge the storing of the waypoint data.

c. Move the cursor to the ACTIVATE option. Activate the copy (press the *Up*- or *Down-arrow* key). The WP menu comes up, allowing you to select other waypoint options.

```
COPY
WP002 to 007

ACTIVATE  QUIT
```

13.1.2.3.12 **Copying More Waypoints.** Copy the rest of the waypoints needed for Lesson 3. Perform steps 1 through 3 from the previous section using the following:

from WP	*to* WP
003	008
004	009
008	010

13.1.2.3.13 **Editing an Existing Waypoint.**

Select the EDIT option. Activate it. Editing a waypoint is like entering a new waypoint. Edit the waypoints you just copied.

```
WP  ←move→   ⬍sel
ENTER   EDIT   COPY
SR-CALC    RNG-CALC
DIST  CLEAR  ROUTE
```

13.1.2.3.14 Editing Waypoint 007.

a. Select the waypoint number field. Change it to *007*. Notice the identifier is COPY007 and the coordinate format is *L/L-dm*. The format is *L/L-dm*. because that is the format selected in SETUP. Change the identifier to AIR1.

```
WP007  COPY007
N            33°02.019’
E           114°23.841’
+00020m  D  CLR        P
```

b. Change the elevation to *+00364m*.

```
WP007  AIR1
N            33°02.019’
E           114°23.841’
+00364m  D  CLR        P
```

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message momentarily displays.

c. Move the cursor to the paging field. Scroll between page 1 and page 2. Select position display formats on page 2. See the displayed data match the desired entries. See Table 13-1.

13.1.2.3.15 Editing Waypoint 008.

a. Scroll to page 1.

b. Select the waypoint number field. Change it to *008*. Notice the identifier *COPY008*. Change it to *AIR2*.

WP008 COPY008	
N	33°02.486'
E	114°23.286'
+00000m D CLR	P

c. Select the elevation field. Change it to *+00364m*.

WP008 AIR2	
N	33°02.486'
E	114°23.286'
+00364m D CLR	P

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message will momentarily display.

d. Move the cursor to the paging field. Scroll between page 1 and page 2. Select different position display formats on page 2. See that the displayed data match the desired entries. See Table 13-1.

13.1.2.3.16 Editing Waypoint 009.

a. Scroll to page 1.

b. Select the waypoint number field. Change it to *009*. Notice the identifier *COPY009*. Change it to *AIR3*.

```
WP009  COPY009
N         33°02.486’
E        114°22.502’
+00000m  D  CLR    P
```

c. Select the elevation field. Change it to *+00364m*.

```
WP009  AIR3
N         33°02.486’
E        114°22.502’
+00364m  D  CLR    P
```

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message momentarily displays.

d. Move the cursor to the paging field. Scroll between page 1 and page 2. Select different position display formats on page 2. See the displayed data match the desired entries. See Table 13-1.

13.1.2.3.17 Editing Waypoint 010.

a. Scroll to page 1.

b. Select the waypoint number field. Change it to *010*. Notice the identifier *COPY010*. Change it to *AIR-MISS*.

```
WP010  COPY010
N         33°02.486'
E        114°23.286'
+00000m  D  CLR    P
```

c. Select the elevation field. Change to *+00664m*.

```
WP010  AIR-MISS
N         33°02.486'
E        114°23.286'
+00664m  D  CLR    P
```

NOTE

As the page is scrolled, the data is checked for validity and entered into memory. A *WAYPOINT STORED* message momentarily displays.

d. Move the cursor to the paging field. Scroll between page 1 and page 2. Select different position display formats on page 2. See the displayed data match the desired entries. See Table 13-1.

13.1.2.3.18 Defining a Route. This section defines the route that will be used in the navigation scenario in Lesson 3:

a. The mission route is defined by linking together waypoints using the *WP ROUTE* function. To create a route, press the *WP* key to display the waypoint page. Select the *ROUTE* option and activate it by pressing the *Up*- or *Down-arrow* key. The Route Definition Page is displayed.

```
RTE  ←move→    ⬍ sel
ENTER   EDIT   COPY
CLEAR
```

b. To create the new Route, select the ENTER option and activate it by pressing the *Up-* or *Down-arrow* key. The Route-Enter or Edit Page is displayed.

```
RTE01   RTE-NAME
→000→000→000→000
→000→000→000→000
                S
```

c. Enter waypoints in the following order: 001, 007, 008, 009, 005.

```
RTE01     RTE-NAME
→001→007→008→009
→005→000→000→000
↑Ins↓Del  LEGXX  S
```

NOTE

The data is checked for validity and entered into memory. *A "RTE has been saved"* message momentarily displays. (An *"Incomplete RTE RTEXX will NOT be saved"* message momentarily displays if the route definition is incomplete.

d. Save the defined Route by pressing the *WP* key (or any major function key), then select and activate the *SAVE* option on the Route-Save Page that is displayed.

13.1.3 <u>Lesson 3 - Navigation.</u> Use the PLGR to navigate in the three navigation modes (*SLOW*, *2D FAST*, and *3D FAST).* The *CUSTOM* mode is not used in this lesson. Select several destinations. Change between the different display modes.

a. The PLGR operating modes called *training (2dTNG* and *3dTNG) simulate* tracking satellites and movement along a course near Yuma, Arizona. The waypoints entered in Lesson 2 are at or near this course (see Figure 13-5).

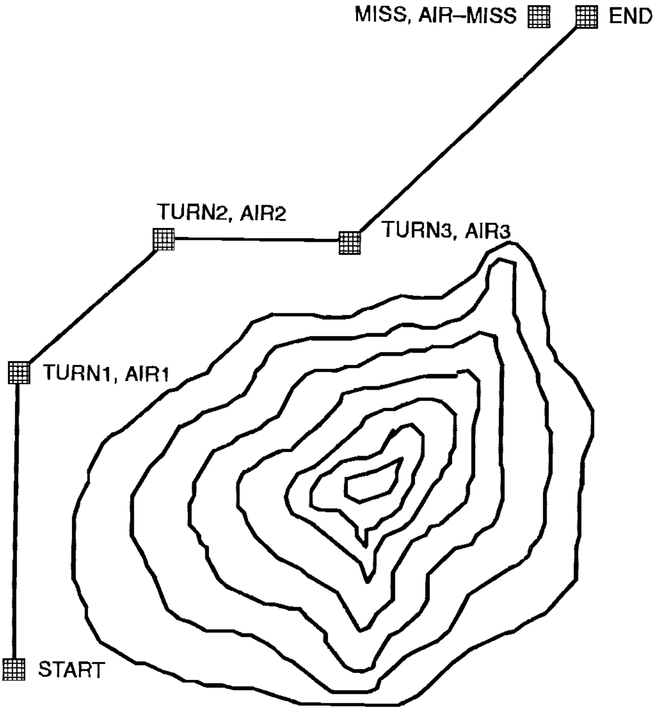


Figure 13-5 Training Mode Course.

b. For less experienced users a *"pause"* feature is available when in the *2dTNG* or *3dTNG mode of* operation. It stops *(at that moment)* the training mode course, anytime the user requires more time to understand the lesson.

c. Pressing the *OFF* key, then *ON/BRT* key activates the "*pause*" feature used in this lesson, when in the *2dTNG* or *3dTNG mode of* operation. *Pause* is toggled on and off by pressing the *OFF* key, then *ON/BRT* key each time. Ignore the "Unit turning off" display when using the pause feature.

TRAINING MODE DESCRIPTION:

15 seconds stationary at *START*
90 seconds travel time from *START* to *TURN1*
60 seconds travel time from *TURN1* to *TURN2*
60 seconds travel time from *TURN2* to *TURN3*
90 seconds travel time from *TURN3* to *END*
15 seconds stationary at *END*
Reverse course until leaving *2dTNG* or *3dTNG mode*

NOTE

When the *2dTNG* or *3dTNG mode* is selected, the *Training Mode Course* immediately starts to run (navigate). This simulation moves quickly.

NOTE

When the "*pause*" feature is used, the term "*PAUSED*" alternates with "*ST*" on certain *POS* (position) and *NAV* (navigation) display pages.

d. It is OK to stop *("pause")* the simulation to select destinations, change navigation method, or if you feel too rushed. This may also be done by deselecting *2dTNG* or *3dTNG mode* and selecting STBY *mode.* However, for this lesson you may want to use the "*pause*" feature for convenience. Remember, the *Training Mode Course is* simulating movement and navigation. It's time to learn to navigate.

13.1.3.1 <u>SLOW, DIRECT - Navigation.</u>

Press the *NAV* key to bring up the navigation displays. Scroll to the page for mode and destination selection. Select the following:

```
SLOW          DIRECT
WP002  TURN1
```

a. Select the display mode field. Change it to *SLOW*.

b. Select the navigation method field. Change it to *DIRECT*.

c. Select the waypoint number field. Scroll up until the destination is *TURN1* (*WP002*).

13.1.3.1.1 <u>Selecting 2dTNG Mode.</u> Press the *MENU* key twice to access the *ALERTS* page. Verify that all alert modes are set to mode: *off*.

a. Press the *MENU* key twice. Select the SETUP option. Activate it.

b. Scroll down to change the following: SETUP: Elevation units from *meter* to *feet*.

```
←move→          ⬍ sel
STATUS          SETUP
INIT             TEST
HELP         <more> P
```

NOTE

You have 15 seconds of stationary time before the simulation starts moving once *2dTNG mode is* selected.

c. Scroll up and change the operating mode to *2dTNG*. This starts the simulation.

```
SETUP MODE: 2dTNG
Simulated 2D
navigation
SV-TYPE:mixed        P
```

13.1.3.1.2 Observe Present Position Data.

a. Press the POS key. See present position, mode, and ST (scenario timer) count.

```
2dTNG      ST        1
N       33°01.035'
E      114°23.840'
EL      +00000ftD  ↕ P
```

b. Scroll down to the page to see time, time accuracy, date, track, and ground speed. Note that before the simulation begins moving, track and ground speed cannot be computed.

```
1234:56Z      TFOM 3
31-01-93        SUN
Speed too slow
GS       <   lmph  ↕ P
```

c. Scroll down again to see what appears to be five satellites being tracked, five SV visible, and almanac less than 1 day old.

```
TRACK  /   SEARCH
02  04  06  08  10  /
#VIS: 5    #GOOD: 5
ALM AGE:   1day ↕ P
```

13.1.3.1.3 Navigate Using RNG and AZ to TURN1. Press the NAV key.

a. Scroll down to the page with range and azimuth. Note the ST count increasing on line 1.

```
TURN1        ST    2
RNG          1.10mi
AZ        0024.3µg
                 ⬍ P
```

b. Observe the *RNG* (range) decrease as *TURN1* is approached. When the value gets small enough, the range units change from *mi* to *ft*.

c. When *TURN1* is reached, the *RNG* begins to increase and AZ (azimuth) changes to about 4023.5µG. This indicates the waypoint is behind you.

13.1.3.1.4 Navigate Using ELD, SR, AZ, and ELA to TURN2. Scroll up to the page for mode and destination selection.

a. Select the waypoint number field. Scroll up until the destination is *TURN2 (WP003).*

```
SLOW      DIRECT
WP003  TURN2


                   P
```

b. Scroll up to the page with elevation difference, slant range, azimuth and north reference, and elevation angle.

```
ELD   +00000ft
SR    3600.0ft
AZ    0825.0µG
ELA   -0001.5µ    ⬍ P
```

c. Observe the SR (slant range) decrease as *TURN2* is approached. When *TURN2* is reached, the *SR* begins to increase and AZ and *ELA* changes, indicating you have passed the waypoint.

13.1.3.2 <u>2D FAST, DIRECT - Navigation.</u> Scroll down to the page for mode and destination selection. Select the following:

2D FAST	DIRECT
WP004	TURN3
	P

a. Select the display mode field. Change it to 2D FAST.

b. Select the waypoint number field. Scroll up until the destination is *TURN3* (*WP004*).

13.1.3.2.1 <u>Navigate Using TRK, AZ, and STR to TURN3.</u> Scroll down to the page with track and speed, azimuth and north reference, and steering.

TURN3	ST	168
TRK	1574.7µG	45
AZ	1574.8µG	mph
STR	♦♦♦♦♦	⬍ P

a. *TRK* (track) and speed show your direction and speed of travel.

b. AZ (azimuth) changes as you approach the waypoint and as you pass it.

c. *STR* (steering) data is all diamonds, indicating you are on course.

d. When TURN3 is reached, *TRK* changes to about 0774.5µG, AZ changes to about 3966.5µG, and STR indicates → 180°. This indicates a change in track and passing the waypoint.

13.1.3.2.2 <u>Navigate Using RNG, TTG2, ELD, and MMD2 Past MISS.</u> Scroll up to the page for mode and destination selection.

a. Select the waypoint number field. Scroll up until the destination is *MISS (WP006).*

2D FAST DIRECT	
WP006 MISS	
	P

b. Scroll down to the page with range, time to go, elevation difference, and minimum miss distance.

RNG	4229.1ft	
TTG2	0001:04	
ELD	+00001ft	
MMD2	1481.3ft	⬍ P

c. Observe the *RNG* (range) and *TTG2* (time to go) decrease and *ELD* (elevation difference) of +00001 feet and *MMD2* (minimum miss distance) of about 1481.3 feet, until *MISS* is passed. At that time, *RNG* and *TTG2* begin increasing. This indicates you passed the waypoint, When the end of the simulation course is reached, motion is stationary for about 15 seconds before the course is reversed.

RNG	2096.8ft	
TTG2	n/a	
ELD	+00001ft	
MMD2	n/a	⬍ P

d. *TTG2* and *MMD2* cannot be computed when the PLGR is not moving.

13.1.3.3 <u>3D FAST, DIRECT - Navigation.</u> Scroll down to the page for mode and destination selection. Select the following:

a. Select the display mode field. Change it to *3D FAST*.

b. Select the waypoint number field. Scroll up until the destination is *AIR1* (*WP007*).

3D FAST	DIRECT	
WP007	AIR1	
		P

13.1.3.3.1 PLGR SETUP. Press the *MENU* key. Select the *SETUP* option. Activate it.

←move→ ⬍ sel
STATUS SETUP
INIT TEST
HELP <more> P

a. Select the *SETUP MODE* field. Change the operating mode to STBY. This stops the simulation. Now change some of the display setups.

SETUP MODE:STBY
No tracking, low
power
SV-TYPE:mixed P

b. Select the paging field. Scroll down to change the following *SETUPs:*

Distance units from *English* to *Metric*
Elevation units from *feet* to *meter*
Elevation reference from *DTM* to *MSL*
Angular units from *Mil* to *Deg*
North reference from Grid to *True*

13.1.3.3.2 Navigate Using SR, AZ, and ELA to AIR1. Press the *MENU* key. Select the *SETUP* option. Activate it.

←move→ ⬍ sel
STATUS SETUP
INIT TEST
HELP <more> P

a. Select the *SETUP MODE* field. Change the operating mode to *3dTNG*. This starts the simulation (remember, only 15 seconds of stationary time before the simulation starts moving).

SETUP MODE: 3dTNG
Simulated 3D
navigation
SV-TYPE:mixed P

b. Press the NAV key. Scroll to the page for mode and destination selection. Verify *3D FAST* for display mode, *DIRECT* as navigation method, and *AIR1 (WP007)* as destination.

```
3D FAST DIRECT
WP007 AIR1

                          P
```

c. Scroll up to the page with slant range, azimuth and north reference, and elevation angle.

```
AIR1       ST      1
SR       1.86km
AZ       359.9°T
ELA      +011.1°      ↕ P
```

d. Observe the SR (slant range) decreases and the *AZ* (azimuth) and *ELA* (elevation angle) change as *AIR1* is approached.

e. When *AIR1* is reached, SR begins to increase, *AZ* changes to about 225.0°T, and *ELA* changes to about +000.1°. This indicates a change in track and passing the waypoint.

13.1.3.3.3 **<u>Navigate Using RNG, TTG3, ELD, and MMD3 to END.</u>** Scroll down to the page for mode and destination selection.

a. Select the waypoint number field. Scroll down until the destination is *END (WP005).*

```
3D FAST DIRECT
WP005   END

                          P
```

b. Scroll up to the page with range, time to go, elevation difference, and minimum miss distance.

```
RNG          4.00km
TTG3      0003:16
ELD      -00364m
MMD3     3.50km   ↕ P
```

c. Observe the *RNG* (range) and *TTG3* (time to go) decrease and *ELD* (elevation difference) of -00364 meters and *MMD3* (minimum miss distance) of about 3.50 kilometers, until *END* is reached.

d. When the waypoint is reached, *RNG* and *ELD* will decrease to approximately zero.

e. When the end of the simulation course is reached, motion is stationary for about 15 seconds before the course is reversed.

```
RNG          2.1m
TTG3        n/a
ELD     +00000m
MMD3        n/a      ⬍ P
```

f. *TTG3* and *MMD3* cannot be computed when the PLGR is not moving.

13.1.3.3.4 <u>Navigate Using TRK, AZ, and STR to AIR3.</u> Scroll down to the page for mode and destination selection.

a. Select the waypoint number field. Scroll up until the destination is *AIR3 (WP009).*

```
3D FAST DIRECT
WP009  AIR3


                       P
```

b. Scroll down to the page with track and speed, azimuth and north reference, and steering.

```
AIR3             ST    336
TRK  225.0°T            72
AZ     225.0°T         kph
STR ♦♦♦♦♦ ♦♦♦♦ ⬍ P
```

TRK (track) and speed show your direction and speed of travel.

AZ (azimuth) changes as you approach the waypoint and as you pass it.

STR (steering) data (both left/right and up/down) is all diamonds, indicating you are on course.

c. When *AIR3* is reached, *TRK* changes to about 270.0°T, *AZ* changes to about 90.0°T, and *STR* indicates →180°. This indicates a change in track and passing the waypoint.

13.1.3.3.5 <u>Navigate Using TRK, AZ, and STR to AIR-MISS.</u> Scroll up to the page for mode and destination selection.

a. Select the waypoint number field. Scroll up until the destination is *AIR-MISS (WP010).*

```
3D FAST DIRECT
WP010  AIR-MISS

                    P
```

b. Scroll down to the page with track and speed, azimuth and north reference, and steering.

```
AIR-MISS  ST  428
TRK  270.0°T 72
AZ   270.0°T kph
STR  ♦♦♦♦♦ ↑14°  ⬍
```

TRK (track) and speed show your direction and speed of travel.

AZ (azimuth) changes as you approach the waypoint and as you pass it.

STR (left/right) data is all diamonds, indicating you are on course.

STR (up/down) data increases to ↑ 90° (degrees), then decreases as you pass directly under *AIR-MISS*.

STR (left/right) data changes to → 180° when *AIR-MISS* is passed.

13.1.3.4 <u>SLOW, COURSE TO - Navigation.</u> Scroll up to the page for mode and destination selection. Select the following:

a. Select the display mode field. Change it to *SLOW*.

b. Select the navigation method field. Change it to *CRS TO*.

```
SLOW        CRS TO
WP003 TURN2
CRS  045.0 °T
                 P
```

c. Select the waypoint number field. Scroll up until the destination is *TURN2* (*WP003*).

d. Select the course (*CRS*) field. Enter a course to *TURN2* of 045.0°T.

13.1.3.4.1 PLGR SETUP and Alerts. Press the *MENU* key.

a. Select the *SETUP* option. Activate it.

```
←move→       ⬍ select
STATUS         SETUP
INIT            TEST
HELP       <more>  P
```

b. Select the *SETUP MODE* field. Change the operating mode to STBY. This stops the simulation. Now change some of the display setups.

```
SETUP MODE: STBY
No tracking, low
power.
SV-TYPE:mixed      P
```

c. Select the paging field. Scroll down to change the following *SETUPs:*

distance units from *Metric* to *Naut* (nautical)
error from *FOM* to ±yd

d. Press the *MENU* key twice. Select the *ALERTS* option. Activate it. Scroll alert type up to the buffer alert (BZ). Set mode to *ON*. Skip alert name.

```
DATA-XFR     SV-SEL
DOP-CALC     ALERTS
SINCGARS     KOI-18
           <move>  P
```

e. The buffer alert is set up to alert you that the present position is within a buffer between two waypoints. Enter *WP006 (MISS)* as the "*from*" waypoint, and enter *WP005 (END)* as the "to" waypoint. Enter 0200.0 yds as the buffer distance (400 yards wide).

```
ALRT:01  BZ        ON
NAME:  MISS
Frm   WP006  TO   005
Dist> 0200.0  yds  ⬍ P
```

f. Scroll up to alert number *02*. Scroll alert type to corridor *(CORR)* alert. Set mode to *ON*. The corridor is set up to alert you that the present position is outside of a corridor between two waypoints. Enter *WP002 (TURN1)* as the "*from*" waypoint, and enter *WP003 (TURN2)* as the "*to*" waypoint. Enter 0300.0 yds as the buffer distance (600 yards wide).

```
ALRT: 02  CORR   ON
NAME:  TURN1
Frm    WP002 TO 003
Dist>  0300.0  yds   P
```

g. You may see the following display as soon as you exit the alert setup page. The corridor alert comes up. This is because you are outside of the corridor between waypoints *TURN1* and *TURN2* (see simulation map, Figure 13-5). Acknowledge the corridor alert display. Notice *C-ALRT* alternating with ST, until you enter the corridor.

```
      ALRT:02
OUTSIDE CORRIDOR
   TURN1
⇕ to acknowledge
```

13.1.3.4.2 <u>Navigate Using RNG, AZ, and XTE to TURN2.</u> Press the *MENU* key three times. Select the *SETUP* option. Activate it.

```
←move→          ⇕ select
STATUS            SETUP
INIT               TEST
HELP         <more>  P
```

a. Select the *SETUP MODE* field. Change the operating mode to *2dTNG*. This starts the simulation (remember, only 15 seconds of stationary time before the simulation starts moving).

```
SETUP MODE: 2dTNG
Simulated 2D
navigation
SV-TYPE:mixed        P
```

b. Press the *NAV* key. Scroll to the page for mode and destination selection. Verify *SLOW* for display mode, *CRS TO* as navigation method, *TURN2* (WP003) as destination, and *CRS* of 045.0°T.

```
SLOW          CRS TO
WP003  TURN2
CRS    045.0°T
                   ⇕ P
```

c. Scroll down to the page with range, azimuth and north reference, and crosstrack error.

```
TURN2          C-ALRT
RNG         1.50nm
AZ         018.1°T
XTE  R1377.1yds ⬍ P
```

d. Notice that *C-ALRT* alternates with *ST*, until you enter the corridor.

e. When *XTE* (crosstrack error) is less than the corridor alert distance (300 yds), you are inside the corridor. The *C-ALRT* stops alternating with ST.

f. *XTE* shows that you are right of the course and the distance to the course.

g. When *TURN1* is reached, *XTE* is decreased to zero, then changes to all diamonds (on course). *AZ* changes to about 045.0°T to indicate a change in track.

h. Observe the *RNG* (range) and *XTE* (cross track error) decrease and *AZ* (azimuth) changes as *TURN2* and the course to *TURN2* are approached.

i. When *TURN2 is* reached, *RNG* begins to increase and *AZ* changes to about 269.0°T. XTE shows that you are off course R (right) (because *2dTNG mode* changes track).

13.1.3.4.3 **<u>Navigate Using RNG, AZ, and XTE to MISS.</u>** Scroll up to the page for mode and destination selection.

a. Select the waypoint number field. Scroll up until the destination is *MISS (WP006)*. Select the course select field. Enter 045.0°T if not already entered.

```
SLOW  CRS TO
WP006  MISS
CRS  045.0  °T
                P
```

b. Scroll down to the page with range, azimuth and north reference, and crosstrack error.

```
MISS          C-ALRT
RNG        1.20nm
AZ        054.6°T
XTE    L 403.4yds  ⬍ P
```

c. Observe and acknowledge the corridor alert. Notice that *C-ALRT* alternates with ST.

d. *XTE* (crosstrack error) shows that you are left of the course and the distance to the course. You will pass through the course. This is indicated as the *XTE* decreases to zero, changes from L (left) to *R* (right), then increases.

e. When *TURN3* is reached, *XTE* stops changing and *AZ* (azimuth) changes to about 26.7°T, indicating that you are traveling parallel to the course into “MISS”.

f. Observe *RNG* (range) and *XTE* as *MISS* is approached. When *RNG* is equal to *XTE*, you are passing the waypoint. A buffer alert occurs as you enter the buffer between *MISS (WP006)* and *END (WP005)*.

g. Observe and acknowledge the buffer alert. Notice that *C-ALRT* and *B-ALRT* alternate with ST.

13.1.3.5 <u>3D FAST, COURSE FROM and APPROACH - Navigation.</u>

Scroll up to the page for mode and destination selection. Select the following:

a. Select the display mode field. Change it to *3D FAST*.

b. Select the navigation method field. Change it to *CRS FROM*.

```
3D FAST CRS FROM
WP001   START
CRS   360.0  °T
                P
```

c. Select the waypoint number field. Scroll down until the destination is *START (WP001)*.

d. Select the course *(CRS)* field. Change it to 360.0°T.

13.1.3.5.1 <u>PLGR SETUP.</u> Press the *MENU* key.

a. Select the *SETUP* option. Activate it.

```
←move→      ▲▼ select
STATUS         SETUP
INIT            TEST
HELP      <more>   P
```

b. Select the SETUP *MODE* field. Change the operating mode to STBY. This stops the simulation. Now change some of the display setups.

```
SETUP MODE: STBY
No tracking, low
power.
SV-TYPE:mixed      P
```

c. Select the paging field. Scroll down to change the following *SETUP:*

distance units from *Naut* (nautical) to *Metric*
error from ±*yd* to *FOM*

d. Press the *MENU* key twice. Select the *ALERTS* option. Activate it. Move the cursor to the alert number field. Scroll up through alert numbers 01 and 02. Set each alert mode to "*OFF*" Move the cursor to the paging field. Scroll to the *RTE LEG ADVANCE* alert setup page and set the mode to "*off*".

```
DATA-XFR     SV-SEL
DOP-CALC    ALERTS
SINCGARS    KOI-18
           <more> P
```

13.1.3.5.2 Navigate Using TRK, AZ, and XTE from START. Press the *MENU* key three times.

a. Select the *SETUP* option. Activate it.

```
←move→         ⬍ select
STATUS          SETUP
INIT             TEST
HELP          <more> P
```

b. Select the *SETUP MODE* field. Change the operating mode to *3dTNG*. This starts the simulation (remember, only 15 seconds of stationary time before the simulation starts moving).

```
SETUP MODE:  3dTNG
Simulated 3D
navigation
SV-TYPE:mixed      P
```

c. Press the NAV key. Scroll to the page for mode and destination selection. Verify *3D FAST* for display mode, CRS *FROM* as navigation method, *START (WP001)* as destination, and *CRS* of 360.0°T.

```
3D FAST    CRS FROM
WP001   START
CRS 360.0°T
                   P
```

d. Scroll down to the page with track and speed, azimuth and north reference, and crosstrack error.

START	ST	16
TRK	360.0°T	72
AZ	181.2°T	kph
XTE	♦♦♦♦	⬍ P

e. Observe AZ (azimuth) stay fairly constant as the course is traveled.

f. When *AIR1* is reached, *TRK* (track) changes to 45.0°T and *XTE* (crosstrack error) changes to about R 14.9m, to indicate a change in track. *AZ* and *XTE* begins increasing, indicating a change in track.

13.1.3.5.3 <u>Navigate Using RNG, GPdev, and ELD to END.</u> Scroll up to the page for mode and destination selection.

a. Select the following:

(1) Select the navigation method field. Change it to *APPROACH*.

(2) Select the waypoint number field. Scroll up until the destination is *END (WP005)*.

(3) Select the course (CRS) field. Change it to 045.0°T.

(4) Select the GPA (glide path angle field). Enter +011.4°.

3D FAST	APPROACH	
WP005	END	
CRS	045.0° T	
GPA	+011.4°	P

b. Scroll down to the page with range, glide path deviation, elevation difference, and crosstrack error.

RNG	3.45km	
GPdev	LO 4.8	
ELD	+00394m	
XTE	L 864.9m	P

c. Observe *RNG* (range) and *ELD* (elevation difference) change as the course is traveled.

d. *GPdev* (glide path deviation) decreases as *AIR3* is approached. When *AIR3* is reached, *GPdev* changes to all diamonds. This indicates you are on the glide path to waypoint *END (WP005).*

e. When *END is* reached, *RNG* and *ELD* decrease to approximately zero and motion is stationary for about 15 seconds before the course is reversed.

13.1.3.6 <u>3D FAST, ROUTE - Navigation.</u> Scroll up to the page for mode and destination selection.

a. Select the following:

(1) Select the navigation method field. Change it to *ROUTE*.

(2) Select the *ROUTE* number field. The route number can only be changed if more than one route has been defined. In this case only one route is defined, so only 01 will display.

```
3D FAST     ROUTE 01
LEG  01 start→end
WP001  START
→→007    AIR1      ⬍ P
```

(3) Select the *LEG* number field. The leg number can only be changed if more than one leg of a route has been defined. In this case more than one leg is defined. Scroll to 01 (if needed).

(4) Select the route direction field. Select *start→end* (if needed).

(5) The *from* waypoint is *START (WP001)*. The *to* waypoint is *AIR1* (→→007).

b. Press the *MENU* key. Select the *SETUP* option. Activate it.

```
←move→          ⬍ select
STATUS            SETUP
INIT               TEST
HELP          <more>  P
```

c. Select the *SETUP MODE* field. Change the operating mode to STBY. This stops the simulation. Now restart for route navigation, beginning at *START (WP001)*.

```
SETUP MODE:   STBY
No tracking, low
power.
SV-TYPE:mixed     P
```

13.1.3.6.1 Navigate Using TRK, AZ, and XTE from START to AIR1.

Press the *MENU* key.

a. Select the SETUP option. Activate it.

```
←move→        ⬍ select
STATUS        SETUP
INIT           TEST
HELP       <more>  P
```

b. Select the *SETUP MODE* field. Change the operating mode to *3dTNG*. This starts the simulation (remember, only 15 seconds of stationary time before the simulation starts moving).

```
SETUP MODE:  3dTNG
Simulated 3D
navigation
SV-TYPE:mixed      P
```

c. Press the NAV key. Scroll to the page for mode and destination selection. Verify *3D FAST* for display mode, *ROUTE 01*, *LEG 01* as navigation method and route/leg numbers, *start→end as* route direction, and AIR1 (→→007) as destination.

```
3D FAST ROUTE 01
LEG 01 start→end
WP001 START
→→007     AIR1    ⬍ P
```

d. Scroll down to the page with track and speed, azimuth and north reference, and crosstrack error.

```
AIR1          ST     16
TRK   360.0°T        72
AZ    359.9°T       kph
XTE   ♦♦♦♦          ⬍ P
```

e. Observe *AZ* (azimuth) stays fairly constant and *XTE* (crosstrack error) indicates you are on course (all diamonds or R 1.5m (small error)) as the course is traveled.

f. When *AIR1* is reached, *TRK* (track) changes to 45.0°T and *XTE* (crosstrack error) changes to about R 16.0m, to indicate a change in track. *AZ* and XTE begins increasing, indicating a change in track.

13.1.3.6.2 <u>Navigate Using TRK, AZ, and XTE from AIR2 to AIR3.</u>

Scroll up to the page for mode and destination selection.

a. Select the *LEG#* field. Scroll up to 03.

3D FAST ROUTE 01		
LEG 03	start→end	
WP008 AIR2		
→→009 AIR3		⬍ P

b. Scroll down to the page with track and speed, azimuth and north reference, and crosstrack error.

AIR3	ST	107
TRK	045.0°T	72
AZ	067.7°T	kph
XTE	R 849.2m	⬍ P

c. Observe *AZ* (azimuth) and *XTE* (crosstrack error) indicate you are not on course. *AZ* increases and XTE increases, then decreases as you approach AIR2.

d. When *AIR2* is reached, *TRK* (track) changes to 90.0°T and *XTE* changes to all diamonds. This indicates a change in track and that you are now on course.

AIR3	ST	168
TRK	090.0°T	
AZ	090.0°T	kph
XTE	♦♦♦♦	⬍ P

e. When *AIR3* is reached, *TRK* changes to 45.0°T and *XTE* changes to about L 13.3m. This indicates a change in track and that the waypoint is passed. *AZ* changes to about 223.1°T, indicating a change in track.

AIR3	ST	229
TRK	045.0°T	72
AZ	223.1°T	kph
XTE	14.5m	P

13.1.3.6.3 Navigate Using TRK, AZ, and XTE from AIR3 to END. Scroll up to the page for mode and destination selection.

a. Select the *LEG#* field. Scroll up to 04.

3D FAST ROUTE 01
LEG 04 start→end
WP009 AIR3
→→005 END ⬍ P

b. Scroll down to the page with track and speed, azimuth and north reference, and crosstrack error.

END	ST	229
TRK	045.0°T	72
AZ	045.0°T	kph
XTE	♦♦♦♦	⬍ P

c. Observe *TRK* (track), *AZ* (azimuth), and *XTE* (crosstrack error) indicate you are moving towards the waypoint and are on course. *XTE* is all diamonds or R 1.1m (small error) as the course is traveled.

d. When END is reached, AZ changes to 234.5°T and XTE changes to all diamonds or R 1.1m (small error). This indicates reaching the end of the route.

END	ST	320
TRK	n/a n/a	
AZ	234.5°T	
XTE	♦♦♦♦	⬍ P

e. Motion is stationary for about 15 seconds before the course is reversed. *TRK* cannot be computed when the PLGR is not moving.

13.1.3.6.4 Navigate Using TRK, AZ, and XTE from END to AIR3.

Scroll up to the page for mode and destination selection. Verify *LEG#* is 04.

a. Select the route direction field. Select *end→start* as route direction. The from waypoint is END (WPO05). The *to* waypoint is AIR3 (→→009).

```
3D FAST ROUTE 01
LEG  04 end→start
WP005 END
→→009     AIR3  ⬍ P
```

b. Scroll down to the page with track and speed, azimuth and north reference, and crosstrack error.

```
AIR3            ST   336
TRK        225.0°T    72
AZ         225.0°T   kph
XTE   ♦♦♦♦            ⬍ P
```

c. Observe *TRK* (track), AZ (azimuth), and XTE (crosstrack error) indicate you are moving towards the waypoint and are on course. *XTE* is all diamonds or R 1.1m (small error) as the course is traveled.

d. *TRK*, AZ, and *XTE* change after the destination has passed.

CONGRATULATIONS!

You have just successfully completed this *navigation scenario* training exercise.

13.1.3.7 Post-Mission. After a mission, you want to protect sensitive data collected during the mission. This may include the waypoints and routes used. It is not necessary to clear the crypto keys, they are stored in a secure (tamper-proof) module.

WARNING

Clearing a waypoint will also clear any Routes that contain that waypoint.

13.1.3.7.1 Clearing Waypoints and Routes. Clear the mission sensitive waypoints and routes.

a. Press the WP key to bring up the waypoint menu display page. Select the *CLEAR* option. Activate it.

```
WP      ←move→      ⬍ sel
ENTER EDIT        COPY
SR-CALC     RNG-CALC
DIST    CLEAR ROUTE
```

b. This brings up a display page for clearing one or more waypoints. To *clear* waypoints 001 to 010, enter 001 as the "*frm*" waypoint, and 010 as the "*to*" waypoint.

```
CLEAR        Frm  WP:001
             to   WP:010

ACTIVATE  QUIT       P
```

c. Select the activate option. Activate it. This brings up a waypoint clear confirmation page. Select the *CONFIRM* option and activate it to perform the *clear* function. A waypoint clear acknowledge page is displayed, which must be acknowledged. Waypoints 001 through 010, and the defined route are cleared.

13.1.3.8 <u>End of Tutorial.</u> This ends this tutorial. You may not use all of the features of the PLGR for every mission. This tutorial simply showed you most applications typically used. You may want to repeat some or all of this tutorial to increase your familiarity and confidence.

CHAPTER 14

INSTALLATION DRAWINGS

14.1 INTRODUCTION.

14.1.1 Scope. The purpose of this chapter is to provide installation information for the PLGR.

14.1.2 General. Figure 14-1 through Figure 14-5 provide the installation drawings unique to the PLGR equipment. Specific dimensions, centers of gravity, and notes are provided where applicable.

NOTES:
1. DIMENSIONS ARE IN MILLIMETRES [INCHES].
2. WEIGHT, 1.3 kg [2.75 lb] MAX.
3. DENOTES CENTER OF GRAVITY.
4. POWER DISSIPATED, 4 WATTS MAXIMUM.
5. CONNECTOR DATA, SEE TABLE I.
6. TOP LEVEL ASSEMBLY PART NUMBER 822–0077–XXX
7. UNLESS OTHERWISE SPECIFIED, TOLERANCE ON METRIC DIMENSIONS (MILLIMETERS), .X= ±.5, .XX= ±.20

TABLE I

REF DES	INTERFACE	MATING CONNECTOR
J1	KYK–13	M55116/2
J2	DATA	M24308/2–11
J3	ANTENNA	POSITRONIC INDUSTRIES CONNECTOR, CBD5W1F2000X COAX CONTACT: FS4202D
J4	POWER	SWITCHCRAFT RA–765

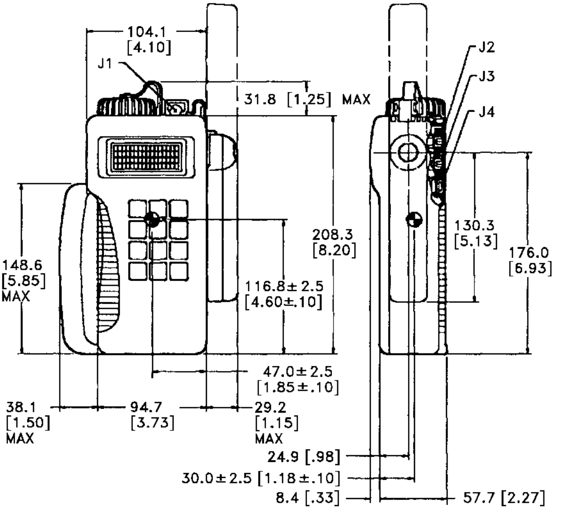


Figure 14-1 AN/PSN-11.

NOTES:
1. DIMENSIONS ARE IN MILLIMETRES [INCHES].
2. WEIGHT: .4 kg [80 lb] MAX.
3. DENOTES CENTER OF GRAVITY.
4. POWER DISSIPATED, 4 WATTS MAXIMUM.
5. TOP LEVEL ASSEMBLY PART NUMBER 986-0645-001.
6. UNLESS OTHERWISE SPECIFIED, TOLERANCE ON METRIC DIMENSIONS (MILLIMETERS), .X=±.5, .XX=±.20

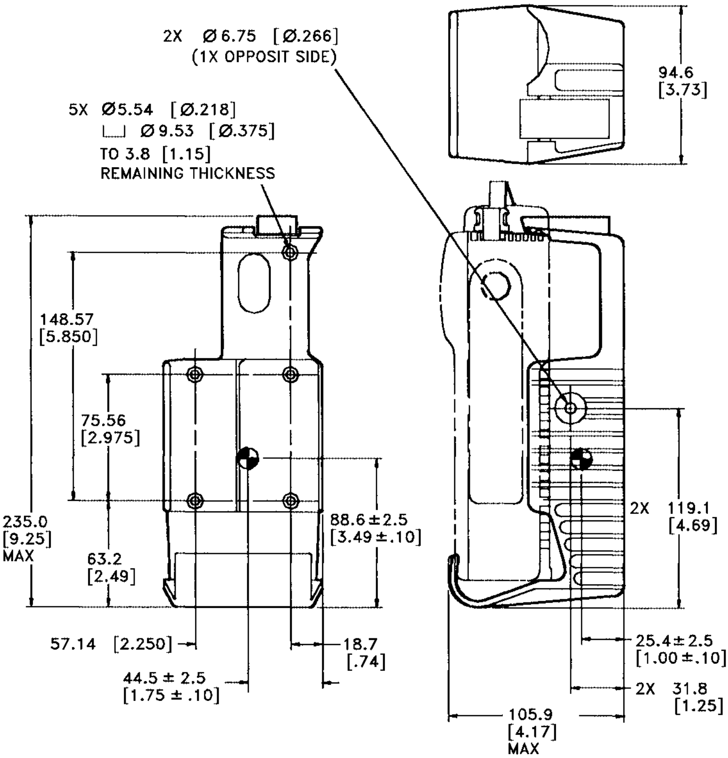


Figure 14-2 Mount.

NOTES:

1. THE HELMET ANTENNA MOUNT CONSISTS OF THE FOLLOWING:
   A) A CLOTH POUCH WITH HOOK AND PYLE FASTENERS.
   B) THREE ELASTIC STRAPS (ATTACHED TO THE POUCH).
   C) THREE CLIPS.

2. THE HELMET ANTENNA CONSISTS OF THE FOLLOWING:
   A) ANTENNA.
   B) PENDANT COAX CABLE.
   C) RECEIVER INTERFACE CONNECTOR.

3. INSTALLATION INSTRUCTIONS:
   A) SLIP ANTENNA INTO OPENING IN THE CLOTH POUCH AND SECURE THE HOOK AND PYLE FASTENERS AROUND THE CABLE. THIS WILL RETAIN THE ANTENNA AND ALLOW THE CABLE TO PASS THROUGH.

   B) PLACE THE ANTENNA/ANTENNA MOUNT ASSEMBLY ON TOP OF THE HELMET. STRETCH THE THREE ELASTIC STRAPS DOWN THE SIDE OF THE HELMET AND SECURE THE CLIPS TO THE RIM OF THE HELMET AT THE LOCATIONS SHOWN.

4. THIS INSTALLATION CAN BE DONE EITHER OVER THE TOP OF, OR UNDERNEATH THE HELMET.

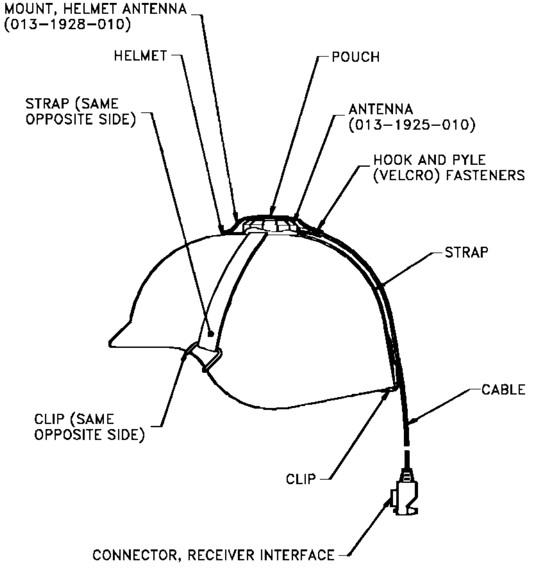


Figure 14-3 Helmet Antenna.

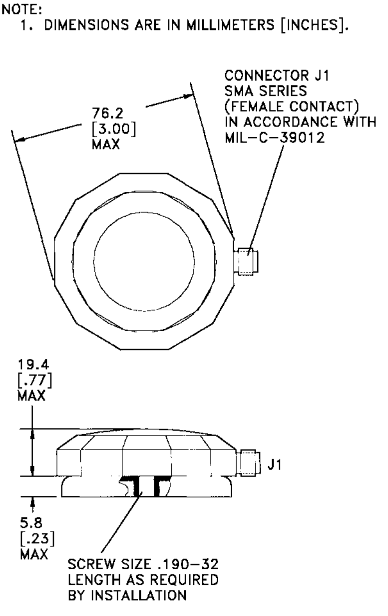


Figure 14-4 Remote Antenna.

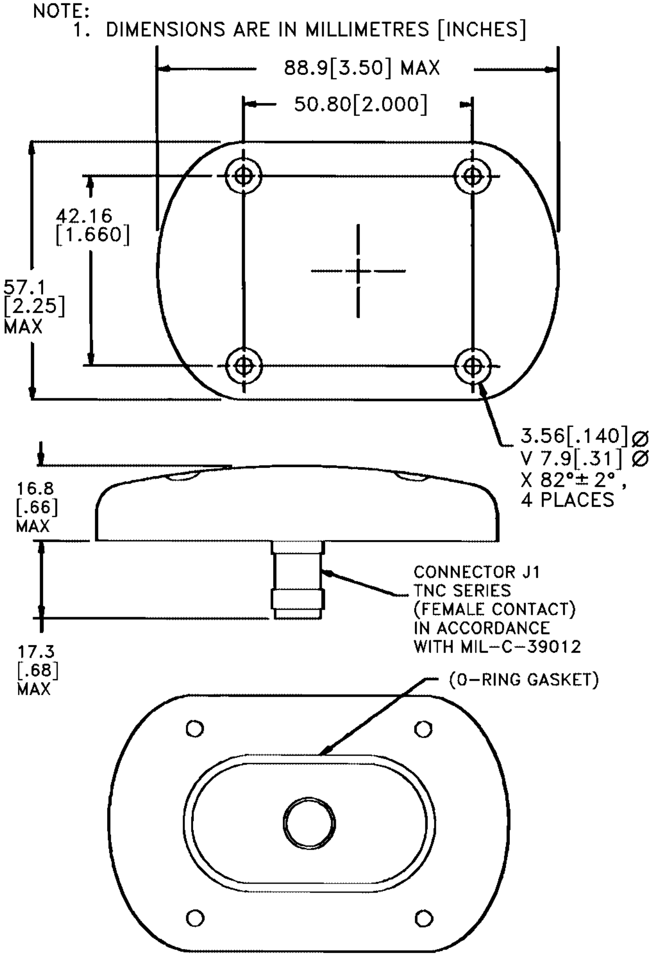


Figure 14-5 Aircraft Antenna.

CHAPTER 15

DIFFERENCE DATA

DIFFERENCE DATA I	UNIT TYPE & CSCI NO.			
	Basic BL II AN/PSN-11 V04b.2	**Basic BL III AN/PSN-11 V04c.3**	**Enhanced BL II AN/PSN-11 613-9854-XXX**	**Enhanced BL III AN/PSN-11 613-9544-XXX**
Unit Description				
5-Channel L 1 P/Y Digital GPS Receiver	X	X	X	X
Meets SS-M/ V-500C Performance Requirements	X			
Meets SS-M/ V-500D Performance Requirements		X	X	X
Meets SS M/ V-500D/1 Requirements			Note 1	X
Display	Character LCD	Dot-matrix LCD	Character LCD	Dot-matrix LCD
NVG Compati- ble	X	X	X	X
Battery Life (BA-5800)	>10 Hours	>20 Hours	>10 Hours	>20 Hours

DIFFERENCE DATA I	UNIT TYPE & CSCI NO.			
	Basic BL II AN/PSN-11 V04b.2	**Basic BL III AN/PSN-11 V04c.3**	**Enhanced BL II AN/PSN-11 613-9854-XXX**	**Enhanced BL III AN/PSN-11 613-9544-XXX**
Coordinate Systems				
Lat Lon - dm.m, Lat Lon dms, MGRS, UTM/UPS, BNG, ITMG	X	X	X	X
Standard datums, including WGS-84 and 2 user-definable	51	51	52	52
Navigation Features				
Waypoints	99	99	999	999
Routes/Waypoints per route	1/10	1/10	15/25	15/25
Automatic Leg Advance			X	X
Magnetic Variation Data	WMM 1990	WMM 1995	WMM 1995	WMM 1995
Angular Measurements				
NATO mils, Degrees	X	X	X	X
Interfaces				

DIFFERENCE DATA I	UNIT TYPE & CSCI NO.			
	Basic BL II AN/PSN-11 V04b.2	**Basic BL III AN/PSN-11 V04c.3**	**Enhanced BL II AN/PSN-11 613-9854-XXX**	**Enhanced BL III AN/PSN-11 613-9544-XXX**
RS-232/ RS-422, KYK-13/KOI-18, CYZ- 10, HAVE QUICK, SINCGARS, Precise Time, External Power, External Antenna, Remote-On, Inter-unit Data Exchange	X	X	X	X
Direct RTCM-104 Input, Enhanced			9600 baud	X
NMEA 0183				X
User Interface Features				
AN/PSN-11 Nav Modes/ Menus	X	X	X	X
Automatic NUMLOCK	X	X		
Updated Datums		X	X	X

DIFFERENCE DATA I	UNIT TYPE & CSCI NO.			
	Basic BL II AN/PSN-11 V04b.2	Basic BL III AN/PSN-11 V04c.3	Enhanced BL II AN/PSN-11 613-9854-XXX	Enhanced BL III AN/PSN-11 613-9544-XXX
Improved Datum/Ellipsoid Identification		X	X	X
Bullseye Function			X	X
"Man Overboard" Function (Auto Nav to a Marked WP)			X	X
Mission Rehearsal			X	X
Buffer Zones			X	X
Anchor Alert			X	X
Hazard Alert			X	X
Enhanced SV selection for reduced reacquisition time			X	X
Datum Mismatch Warning			X	X
Extended Entry Limits and Display Resolution			X	X

DIFFERENCE DATA I	UNIT TYPE & CSCI NO.			
	Basic BL II AN/PSN-11 V04b.2	Basic BL III AN/PSN-11 V04c.3	Enhanced BL II AN/PSN-11 613-9854-XXX	Enhanced BL III AN/PSN-11 613-9544-XXX
Approach Nav Function			X	X
Magvar Entry/ Display Improvements			X	X
Enhanced Battery Life Display			X	X
Alternate between OLD and FOM after transition to STBY			X	X
Waypoint Clear Confirmation			X	X
Hot Key to FIX from STBY			X	X
Clarify NUM-LOCK, vs Pointer Mode			X	X
Auto Zeroize Warning			X	X
Default Mode is All-Y (when crypto/keys loaded)			X	X

DIFFERENCE DATA I	UNIT TYPE & CSCI NO.			
	Basic BL II AN/PSN-11 V04b.2	Basic BL III AN/PSN-11 V04c.3	Enhanced BL II AN/PSN-11 613-9854-XXX	Enhanced BL III AN/PSN-11 613-9544-XXX
Hot Key to return to 1st NAV page			X	X
Present Position Naming			X	X

Note 1: This configuration meets SS-M/V-500D/1 requirements with the following exceptions:
-Unit has a ten (10) hour battery life.
-The NMEA is not included.
-The DGPS Interface baud rate is fixed at 9600.

DIFFERENCE DATA II	UNIT TRANSFER TYPE	
Data Type	**Basic to Enhanced Transfer**	**Enhanced to Basic Transfer**
Waypoints (includes Routes and Alerts)	All 99 waypoints can be transferred to Enhanced waypoints 1-99. Route is transferred to Enhanced PLGR Route # 1. Alerts are not transferable. (Messages 5110, 5111)	Only 1st 99 Waypoints can be transferred. Routes are not transferable. Alerts are not transferable. (Messages 5110, 5139, plus new message for Alerts)
Satellite Data (includes Almanac, Ephemeris, Special Msgs, UTC/lono, HAC, Subframe 4, Health)	All Satellite data transfers without exception. (Messages 5120 through 5126)	All Satellite data transfers without exception. (Messages 5120 through 5126)
Setup	Message 5130 is transferable to Enhanced PLGR (includes SV Type, References, Units, Magvar Type, Entered Magvar, Nav type, El Hold type, Timer Reference, Error Units, Datum, Auto-off timer, HAVE QUICK, 1PPS)	Message 5130 is transferable to Basic PLGR. Enhanced feature setup data is not transferable (contained in new message 5131)
User-defined datum	User-defined datums will transfer to an Enhanced PLGR without exception. (Message 5138)	Transfer to a Basic PLGR may fail if user-defined datum values exceed Basic PLGR datum limits. (Message 5138)
Time	All time data will transfer to an Enhanced PLGR without exception. (Message 5101)	All time data will transfer to a Basic PLGR without exception. (Message 5101)
SV selection via “all” option on	SV selection and deselection data are transferable. Position.	SV selection and deselection data are transferable. Position.
DATA-XFR page	Alert is data not transferable.	Alert is data not transferable.

DIFFERENCE DATA II	UNIT TRANSFER TYPE	
Data Type	**Basic to Enhanced Transfer**	**Enhanced to Basic Transfer**
PVT Init (via “all” option on DATA-XFR page)	PVT Init is transferable to Enhanced PLGR without exception. (Message 5128).	PVT Init is transferable to Basic PLGR without exception. (Message 5128).
Note: This identifies the data that are transferable between the various PLGR types. Datum transfers will be rejected for Enhanced to Basic transfers if a datum used in the Enhanced type is not included in the Basic type.		

APPENDIX A

CRYPTO LOGIC KEY ORDERING INSTRUCTIONS

A.1 INTRODUCTION. The NAVSTAR Global Positioning System is a US satellite based radio-navigation system that provides accurate position, velocity, and time information to users on a continuous, all weather, worldwide basis. GPS provides two levels of service; the Standard Positioning Service (SPS) and the Precise Positioning Service (PPS).

A.1.1 Standard Positioning Service (SPS). The SPS is a positioning and timing service that is available to all GPS users. The SPS accuracy is set al levels consistent with US national security interests. The SPS is intended primarily for civil use. Access to the SPS is openly available and does not require the use of cryptography.

A.1.2 Precise Positioning Service (PPS). The PPS is a highly accurate positioning, velocity, and timing service that is available only to users authorized by the US DoD. The PPS provides the greatest degree of GPS accuracy. The PPS is intended primarily for US military use. However, through special agreements with the US DoD, military and civil agencies of the national governments of US-allied and friendly countries are authorized access to the PPS. Access to the PPS is controlled through the use of cryptography.

A.1.3 Objective. The objective of this appendix is to promulgate procedures for ordering GPS cryptographic keying material. It is intended to inform, all parties of these procedures and thereby facilitate the process of ordering keying material.

A.1.4 Authority. The Assistant Secretary of Defense for Command, Control, Communications and Intelligence (OASDIC31) designated HQ US Space Command as the Controlling Authority for GPS FPS cryptographic keying material.

A.1.5 References:

DoD Global Positioning System (GPS) Security Policy (S).

US Space Command NAVSTAR Global Positioning System (GPS) Joint Operations Concept (JOC) (S).

NTISSI No. 4006, Controlling Authorities for COMSEC Keying Material (FOUO).

NTISSI No. 3006, Operational Security Doctrine for the NAVSTAR Global Positioning System (GPS) User Segment (FOUO).

NTISSI No. 4003, Reporting COMSEC Insecurities (FOUO).

National Communications Security (COMSEC) Glossary NCSC-9 (FOUO).

A.1.6 Explanation of Terms. In addition to the definitions in NCSC-9, the following definitions apply to this appendix:

Black CRYPTO Key material	Encrypted CRYPTO Keys. Black GPS keys must first be decrypted before they can be used by the GPS receiver. For GPS, black keys can only be decrypted within a SAASM-based GPS receiver.
Controlling Authority	The organization responsible for directing the establishment and operation of the cryptonet and managing the operational use of material assigned to the cryptonet.
Cryptonet	Stations that hold a specific key for use. For GPS, the cryptonet is the set of all PPS capable receivers.
Cryptoperiod	The time span a specific key is authorized for use or its designated effectivity period.
Daily Cryptovariable (CVd)	The daily Cryptovariable is the Traffic Encryption Key (TEK) for the GPS and is required by the GPS user to access the Precise Positioning Service (PPS). The CVd is obtained as a result of a KEK or KPK operation and is not distributed directly to the GPS user. The CVd has a cryptoperiod of one day.
Group Unique Variables (GUV)	The GUV is a KEK, which is used to decrypt a portion of the GPS navigation message that contains an encrypted version of the CVd. The GUV keys have a cryptoperiod of approximately one year. Zeroing of the PLGR during the process of loading a new GUV key is not necessary, since the PLGR automatically deletes the old GUV keys as they expire.

Key Encryption Key (KEK)	A key that encrypts or decrypts other keys for transmission (rekeying) or storage.
Monthly Cryptovariable (CVm)	The CVm is a KPK, which is used in the self-contained generation of CVd keys (TEKs) within the GPS user equipment. The GPS CVm is available to specified SAASM-based users in black form only (BCVm). BCVm keys have been organized in unique and distinct black cryptonets. The BCVm has a cryptoperiod of approximately one month.
Red CRYPTO Key material	Unencrypted CRYPTO keys. Red GPS keys can be used by the GPS receiver with no pre-processing required.
Selective Availability Anti-Spoofing Module (SAASM)	SAASM is a security module that is embedded in newer generations of GPS user equipment.
Short Title	A combination of letters and numbers assigned to communications security (COMSEC) material (keys) for identification purposes.
Traffic Encryption Key (TEK)	A key that encrypts or decrypts plain text or previously encrypted information (cipher text).

Validating Authority	The organization responsible for validating user keying material requirements
Weekly Cryptovariable (CVw)	The CVw is a KPK, which is used in the self-contained generation of CVd keys (TEKs) within the GPS user equipment. The GPS CVw is available to specified users in red form only (RCVw). It has a cryptoperiod of one week and can be used to generate 7 CVd keys. The CVw is referred to in some NSA publications as a a Cryptokey Weekly (CKW).

A.2 GPS KEY MATERIAL DESCRIPTION.

A.2.1 Operational Key Material. The operational cryptographic keys, the GUV and the CVW keys, are available to authorized users. Either key can be used to obtain the daily key, which is the traffic encryption key. The daily encryption key is used to protect the Selective Availability and Anti-Spoofing techniques. The difference between the CVW and GUV keys is the amount of time required to acquire and begin processing the PPS signal when the User Equipment is first turned on. A user with a CVW key requires less time to begin processing navigational data because the CVW produces its own daily key. The GUV key takes longer to begin processing the navigational data since it must first acquire and decrypt the daily key being broadcast by any GPS satellite. As a result of its special capability, the CVW key will have limited distribution to those users who demonstrate a valid need to initially acquire GPS satellite signals in a minimal amount of time. Operational keys are classified CONFIDENTIAL and marked CRYPTO.

A.2.2 Maintenance Key Material. A maintenance key is available to users for troubleshooting the GPS user equipment. The maintenance key does not allow a user to gain access to the daily encryption key. Maintenance keys are unclassified and may be reused until physically unusable.

A.2.3 Simulator Key Material. A simulator key is also available to users for testing systems. Both the simulator and user equipment must be keyed with the simulator key. The simulator key can also be used as an ON-THE-AIR test key. This key does not allow a user to gain access to the daily encryption key. Just like the maintenance key, the simulator keys are unclassified and may be reused until physically unusable. The use of operational keys in simulators is prohibited.

A.2.4 ON-THE-AIR Test Key Material. There are no on-the-air test keys available.

A.2.5 Key Format Description. GPS keying material is provided in three different formats to accommodate various methods of key loading. The eight-level punched tape format is used in common COMSEC fill devices such as the KOI-18 General Purpose Tape Reader or the KYK-13 Electronic Transfer Device (capable of loading multiple keys) used in conjunction with the KOI-18 and the AN/CYZ-10 Data Transfer Device (DTD) used in conjunction with the KOI-18. The hexadecimal printed format is used in conjunction with the GPS data loader or an equivalent NSA approved key loader device. The decimal printed format is used with the GPS control display unit. Both the decimal and hexadecimal key formats are commonly referred to as key lists.

A.2.6 Short-Title Explanation. A short title is an identifying combination of letters and numbers assigned to COMSEC material for brevity. It consists of a group of alphabetical designators followed by an alphanumeric suffix. The combination of letters and numbers known as the GPS short titles are unique and are assigned only to GPS cryptographic keying material (see Table A-1). The GPS keying material short titles are used exclusively for ordering and managing GPS cryptographic material.

Table A-1 GPS User Keying Material .

Operational maintenance	**AKAT-XXXXX KMT-XXXXX**	**AKAK-XXXXX KMK-XXXXX**	**AKAK-XXXXX KMK-XXXXX**
CVW	A1001	A1001	F1001
GUV-1	A1101	A1101	F1101
GUV-2	A1102	A1102	F1102
GUV-3	A1103	A1103	F1103
GUV-4	A1104	A1104	F1104
GUV-5	A1105	A1105	F1105
FORMAT	8-LEVEL PUNCHED	HEXADECIMAL PRINTED	DECIMAL PRINTED

SIMULATOR	AKZT-XXXXX	AKZK-XXXXX	AKZK-XXXXX
CVW	A1011	A1011	F1011
GUV-1	A1111	A1111	F1111
GUV-2	A1112	A1112	F1112
GUV-3	A1113	A1113	F1113
GUV-4	A1114	A1114	F1114
GUV-5	A1115	A1115	F1115

A.2.7 Cryptoperiods. The cryptoperiod for the GUV key is 54 weeks while the cryptoperiod for the CVW key is 1 week.

a. GUV Key Canister - Provided in each GUV key canister is one primary yearly key, copied 11 additional times, for a total of 12 identical yearly key segments per canister.

b. CVW Key Canister - Within each CVW canister are six primary 1-week segments. Each primary segment, labeled from 1 through 6, is only good for its preassigned week; for example: primary segment 1 is only good for week 1; primary segment 2 is only good for week 2; etcetera. In addition, each of the primary segments 1 through 6 are each copied two times. Therefore, for each six 1-week primary segments, there are two additional copies per each primary segment, totaling 18 segments per canister.

A.3 GPS KEY MANAGEMENT STRUCTURE.

A.3.1 Overview. Every effort has been made to use standard COMSEC procedures when requesting, shipping, and destroying GPS cryptographic keying material. However, because GPS has worldwide applications and the number of users will exceed those of other crypto systems by several orders of magnitude, special procedures are necessary for the application, approval and distribution of the GPS cryptographic keying material.

A.3.2 Controlling Authority. The Controlling Authority for GPS keying material is shared between HQ USSPACECOM/J33 and HQ USSPACECOM/J60. The day-to-day processing of keying material is performed by J60 (see sub-paragraph A.5.1).

A.3.3 Validating Authority. The Validating Authority for GPS keying material for US Military users is performed by the following organizations (see sub-paragraph A.5.2):

US Army	USARSPACE/MOSC-00 for Army Contractors, CSLA/SELCL-KPD-KEY for Army units
US Air Force	HQ AFSPACECOM/DOGS
US Navy	COMNAVSPACECOM/N312
US Marine Corps	COMDT MARINE CORPS/CSBT
US Coast Guard	COGARD-TISCOWOPS4
NASA	NASA HQ Code 01

A.3.4 GPS Key Request Process (see Figure A-1).

A.3.4.1 US Military Users. All DOD PPS users operating crypto capable GPS receivers are authorized users of GPS crypto keys, provided they possess a confidential clearance. Requests for GPS PPS keying material must follow the Services standard COMSEC procedures. In general, the user contacts the organization's COMSEC custodian who submits the necessary unit and mission information along with the desired GPS keying material short titles to the appropriate Service Validating Authority with an information copy to the GPS COMSEC Manager.

A.3.4.1.1 The validating authority consolidates, validates, and forwards all requests to the GPS Controlling Authority. The Controlling Authority reviews each key request for compliance with DOD policy regarding type of keys authorized and GUV assignment. Validating authorities are notified by the Controlling Authority if a request for keys appears to violate DOD policy. Unresolved conflicts will be processed by the Joint Chiefs of Staff (JCS) and forwarded to OASD/C3I, as appropriate.

A.3.4.1.2 Upon review, the GPS Controlling Authority sends authorizations to the appropriate Cryptological Distribution Center to distribute keying material. Information copies of the authorization are also sent to the component command and to the user COMSEC custodian.

A.3.4.1.3 DOD contractors must request keying material through their sponsoring Service Contracting Officer. Requests are then forwarded to the appropriate Service Validating Authority and Controlling Authority.

A.3.4.2 Other Government Agency Users. For a Government agency to be an authorized user of GPS crypto keying material, a Memorandum of Agreement (MOA) must first be established between DOD and that agency. MOAs should be submitted to OASD/C3I for processing. A validating authority for that agency should also be established in the MOA OASD/C3I forwards all validated requests to the Controlling Authority for action.

A.3.4.3 Foreign Users (Military and Civil). Prior to receipt of crypto-capable user equipment, crypto keys and associated fill devices, a foreign government must negotiate appropriate security memoranda of understanding (MOU) with the US DOD. They must have received the specific approval of OASD/C3I. Once the MOU is established, users must submit their requests through their Minister of Defense to OASD/C3I for approval. OASD/C3I will forward requests to Controlling Authority for processing.

A.3.4.4 US Civil Users. All Civil Users without a DOD sponsor must submit GPS crypto access requirements to OASD/C3I for approval. Upon approval Civil user must submit request for keying material to Controlling Authority in accordance with Industrial Security standards. Upon completion of review, Controlling Authority will instruct NSA to distribute keying material to the user.

A.3.4.5 Fill Devices. When a user has a requirement for GPS keying material it is important to know the type of fill device that will be used to load the crypto key into the user equipment. The fill device on hand determines the type of key to order. For example, if a KYK-13 or KOI-18 is used, then an 8-level punched tape type AKAT-AXXXX should be requested.

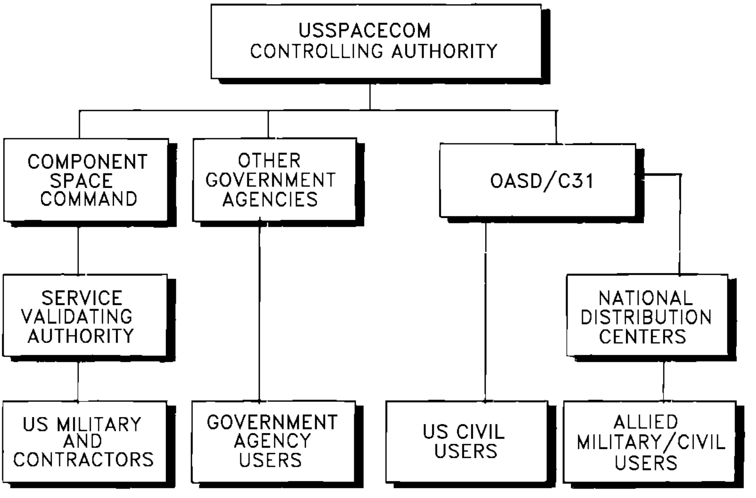


Figure A-1 Key Request Process.

Table A-2 Fill Devices.

Fill device	Short title	Type
KOI-18 KYK-13/KOI-18 or AN/CYZ-10/KOI-18	AKAT-AXXXX	8-Level Punched Tape
GPS Data Loader 1553 Bus	AKAK-AXXXX	Printed Hexadecimal Key List
Control Display Unit (CDU)	AKAK-FXXXX	Printed Decimal Key List

NOTE

When a PLGR is used, printed key lists (both hexadecimal and decimal) can also be entered via the key board. However, there is less probability for error when the key is loaded electronically (punched tape/fill device).

A.3.5 GPS Key Distribution Process. Upon receipt of Controlling Authority notification, distribution centers issue keying material to appropriate designated crypto user accounts either by direct shipment, through a distribution center, or through a national distribution authority for foreign governmental users (see Figure A-2).

A.3.5.1 Service Distribution Centers. US military users receive their GPS keying material from three distribution centers. These organizations are: The Communications Security Logistics Agency (CSLA) for the Army; the Directorate of COMSEC Material System (DCMS) for the Navy, Marine Corps and Coast Guard; and the Air Force Cryptologic Support Center (AFCSC) for the Air Force.

A.3.5.2 **National Security Agency.** Other US Government Agencies, US Civil and Non-NATO users receive requested keying material from NSA.

A.3.5.3 **National Distribution Authorities (NDA).** NATO military and civil users receive GPS keying material through their national distribution authorities.

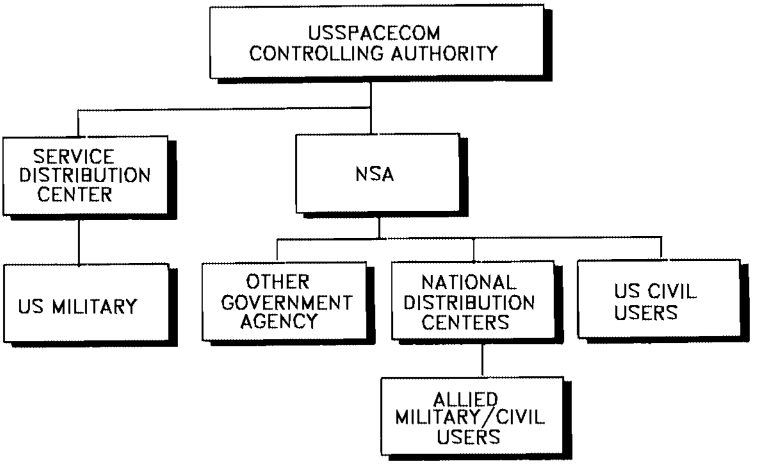


Figure A-2 Key Distribution Process.

A.4 GPS KEY MATERIAL SECURITY.

A.4.1 **Reporting Insecurities.** All PPS users will report incidents of suspected compromise of keying material to the GPS Controlling Authority and inform their chain of command, validating authority and NSA/X71. Specific guidance for reportable insecurities can be found in NTISSI No. 4003 and appropriate Service or NATO regulations.

A.4.2 Adjudicating Security Incidents. HQ USSPACECOM, as the GPS Controlling Authority, is responsible for evaluating all security incidents. In coordination with Joint Staff and NSA, Controlling Authority will take appropriate action and notify users to resolve any security incident involving GPS keying material.

A.5 MESSAGE AND MAILING ADDRESSES.

A.5.1 GPS Controlling Authority.

HQ US Space Command (USSPACECOM)

POC:	Mr. Martin Ferrante
	DSN 692-5022 or COM 719-554-5022
	Msgt. Mary Grier
	DSN 692-9613
	COM 719-554-69134
FAX:	Unclass - DSN 692-6314
	Secure - DSN 692-6847
PLA:	GPS COMSEC MANAGER PETERSON AFB CO//
MAIL:	GPS COMSEC MANAGER
	250 S Peterson Blvd STE 116
	Peterson AFB CO 80914-3050

A.5.2 Validating Authorities.

US Department of Defense.

US Air Force (USAF)

POC: LtCol Jerry Oney
DSN 692-3582
COM 719-554-3582
FAX: Uunclass - DSN 692-2422
Secure - DSN 692-5246
PLA: HQ AFSPACECOM PETERSON AFB CO//DOGS//
MAIL: HQ AFSPACECOM/DOGS
150 Vandenberg St STE 1105
Peterson AFB CO 80914-4200

US Army (USA)

POC: Mr. Raul Limon
DSN 879-7560
COM 520-538-7560
FAX: Unclass - DSN 879-7048
Secure - DSN 879-7043
PLA: DIRUSACCSLA FT HUACHUCA AZ//SELCL-KP-KEY//
MAIL: DIR USACCSLA
Attn: SELCL-KP-KEY
Ft Huachuca AZ 85613-7090

US Navy (USN)

POC: Lt Bobby Pullin
DSN 249-6520
COM 703-663-6520
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A.6 POC On This Appendix.

Questions, comments or suggestions regarding this appendix should be directed to the GPS COMSEC Manager, Mr Martin Ferrante, at DSN 692-5022 or COM 719-554-5022.

GLOSSARY

A

Almanac Data	General position and time data applicable to all satellites.
Alphanumeric	A character set that contains both letters and digits, but usually some other characters such as punctuation.
Angle	The geometric figure, or algebraic signed quantity determined by two planes emanating from a common point or line.
Antenna Masking	The inability of the PLGR to receive satellite signals, due to interference with line-of-sight visibility to the sky.
Anti-spoofing	A security technique used to protect against hostile attempts to imitate GPS satellite signals.
Azimuth	An angle measured clockwise in the horizontal plane between a reference direction and any other line. The reference is North (true, magnetic, or grid).

B

British National Grid (BNG)	A grid coordinate system that uses a metric scale grid square specific to the area around Great Britain. A position is described by a series of numbers and letters to describe a 100,00 meter square and a distance to the east followed by a distance to the north, both measured from the southern most point of the square.
Buffer Zone	An area of distance (parameter) set to define borders between or around waypoints.
Bullseye	A common reference point.

C

C/A Code	A code used by navigation sets to acquire satellites and perform rough navigation calculations.
Clock Data	Provides Greenwich Mean Time data (GMT) to navigation sets; used to refine (make more accurate) the time kept by the navigation set internal clock, when four satellites are being tracked.
Cold Start	The collecting of information from a satellite to find out how many satellites are available.
Course	The intended path of movement in the horizontal plane expressed in degrees from North (true, magnetic, or grid).

Crosstrack Error	The perpendicular Great Circle distance that the vehicle is on the left or right of the course.
Crypto/Key	Cryptographic (encoded) data provided to the receiver to enable full capabilities of the SA/A-S function.

D

Datum	The reference frame for a selected map coordinate system.
Differential GPS	GPS correction transmitted from the reference station to mathematically correct for position errors.
Distance To Go	Great Circle distance from the present position to a selected waypoint.

E

Easting	Eastward (that is left to right) reading of grid values on a map.
Elevation	The distance above (positive) or below (negative) mean sea level or datum surface.
Elevation Angle	The angle in a vertical plane between the local horizontal and ascending line, as from an observer to an object.
Elevation Difference	The difference between user position elevation (altitude) and a selected way-point elevation (altitude).

Ephemeris Data	Specific position and clock data peculiar to a particular satellite.

F

Figure of Merit	The amount of position error that can exist when satellites are being tracked.

G

Glide Path Angle	Elevation angle special case where the reference point is the glide path intercept point on a runway or landing zone.
Glide Path Deviation	The difference between the flight path of an aircraft in a glide (as seen from the side), from the desired value corresponding to the set point.
Great Circle	The spherical path defined by a fixed radius from the center of the earth in a specified direction from a given reference point.
Grid North	The northerly or zero direction, indicated by the grid datum of directional reference.
Ground Speed	The horizontal component of the speed of a vehicle relative to the earth's surface.
Gunner's Mils	A scale graduated in mils used to measure the amount of deflection (angle). Gunner's mils is selected in setup as MIL-µ and is displayed as the µ symbol.

H

HAVE QUICK	A frequency-hopping scheme used to maintain communications security in the high-frequency range.
Heading	The direction in which the longitudinal axis of an aircraft or ship is pointed, expressed in degrees clockwise from North (true, magnetic, compass, or grid).
Helmet Antenna	An antenna that is mounted to a helmet.
Hexadecimal	A numbering system using the base 16.
Horizontal Dilution of Precision	Horizontal position error that degrades position accuracy when satellites are being tracked.

I

Integral Antenna	An antenna that is an integral (built-in) part of a unit.
Irish Transverse Mercator Grid (ITMG)	A grid coordinate system that uses a metric-scale grid square specific to the area around Ireland. A position is described by a series of numbers and letters to describe a 100,000 meter square and a distance to the east followed by a distance to the north, both measured from the southern most point of the square.

K

Keys	Data provided to the receiver to enable full capabilities of the SA/A-S function.

L

Latitude	Angular distance from a primary great circle or plane, as on the celestial sphere or the earth.
Longitude	Angular distance along the Equator, between the meridian passing through a position and, usually, the meridian of Greenwich.

M

Magnetic Heading	Direction of the vehicle measured from magnetic north.
Magnetic Variation	The horizontal angle at a place between the true north and magnetic north measured in degrees and minutes east or west according to whether magnetic north lies east or west of true north.
Map Datum	The elevation reference used for special topographical (map) applications, from which calculation or measurement may be taken.
Mean Sea Level	The elevation reference used for normal applications, from which calculation or measurement may be taken.

Military Grid Reference System (MGRS)	A system that uses standard-scale grid square, based on a point of origin on a map projection of the earth's surface in an accurate and consistent manner to permit either position referencing or the computation of direction and distance between grid positions. A position is described by a series of numbers and letters to describe a grid zone, a 100,000 meter square, and a distance to the east followed by a distance to the north both measured from the coordinate origin of the square.
Minimum Miss Distance	The smallest range (SLOW, 2d-FAST, CUSTOM modes) or slant range (3D-FAST, CUSTOM mode) to a waypoint that can be obtained with the current track.

N

Nautical Mile	A unit of distance; the length of 1 minute of any great circle of earth, the meridian being the great circle most commonly used.
Northing	Northerly (that is bottom to top) reading of grid values on a map.

P

P Code	A code used by navigation sets to perform precise navigation calculations.

Passivation	Growth of an oxide layer (a protective electrochemical polarization film created due to the solvent, electrolyte, and impurities present) on the surface of a semiconductor. This film provides electrical stability by isolating the transistor surface from electrical and chemical conditions in the environment. This process reduces the reverse-current leakage, increases breakdown voltage, and raises the power dissipation rating.
Position Dilution of Precision	Position error that degrades position accuracy when satellites are being tracked.
Precise Positioning Service	Encoded GPS information broadcast that contains corrections to remove intentional Selective Availability (SA) errors.

R

Range	The horizontal distance between any given point and an object or target. Horizontal Range is the same as Great Circle Distance.
Remote Antenna	An antenna that is mounted in a location other than where a unit is operated.
Reprogramming Cable	A cable that is connected to provide reprogramming capability.

S

Search-the-Sky	A cold-start application to determine position, time, date, track, ground speed, and magnetic variation without operator input.

Selective Availability	A security technique that limits the accuracy of a receiver by broadcasting GPS information that contains built-in errors.
SINCGARS	Single Channel Ground and Airborne Radio System; used to establish a time reference factor and frequency-hopping scheme to maintain communications security in the low-frequency range.
Slant Range	The line-of-sight distance between two points not at the same level relative to a specified datum.
Spoofing	Generation of satellite signals to cause errors in navigation and position information.
Standard Positioning Service	GPS information broadcast in the clear, and is available to anyone in the world.
Steering (left, right, up, or down)	Specifies the direction to steer to navigate to the waypoint. Direction is referenced to the current course heading of the user.
Steering Angle	Specifies the angle to steer to the right or left (and up/down in 3-D homing) to navigate to the waypoint. Angle is referenced to the current course heading of the user.
Streck	An angular unit of measure.

T

Time Figure of Merit	The amount of time error that can exist when satellites are being tracked.

Time to First Fix	Time required to obtain a first or initial position fix (location).
Time to Go	Estimated time to reach a selected waypoint from the current position given the current speed.
Time to Subsequent Fix	Time required to obtain a subsequent position fix (location), after a first or initial position fix.
Track	The projection on the surface of the earth of the present path of a vehicle, the direction of which path at any point is expressed in degrees from North (true, magnetic, or grid).
Track Speed	The actual line of movement and speed of an aircraft over the surface of the earth; it is the projection of the history of the flight path on the surface.
True Heading	Direction of the vehicle measured from true north.
True North	Direction of the north geographical pole.

U

Underdetermined	Navigating with less than four satellites.
Universal Polar Sterographic Grid (UPS)	A military grid prescribed for joint use in operations in limited areas and used for operations requiring precise position reporting. It covers areas between N 84 - N 90 and S 80- S 90 parallels and the poles.

Universal Time Coordinated	The coordinated time kept by a uniformly running clock.
Universal Transverse Mercator Grid (UTM)	A grid coordinate system based on the transverse mercator projection, applied to maps of the earth's surface extending to 84 degrees North to 80 degrees South latitudes. A position is defined by a series of numbers and a letter to describe a Grid Zone and a distance to the east followed by a distance to the north where each distance is preceded by the coordinates of a larger grid than was used in MGRS.
User-Defined Datum	A datum stored in the GPS receiver which is defined by the user.

V

Velocity	Ground speed.

W

Waypoint	A point along the desired path of travel (i.e.) position coordinates and height of a point you are going to or are passing through).

Y

Y Code	An encrypted P code when crypto/keys are loaded (installed); used by navigation sets to perform precise navigation calculations.

INDEX

Subject *Paragraph, Figure, Number*

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Z

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THE METRIC SYSTEM AND EQUIVALENTS

NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

EIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

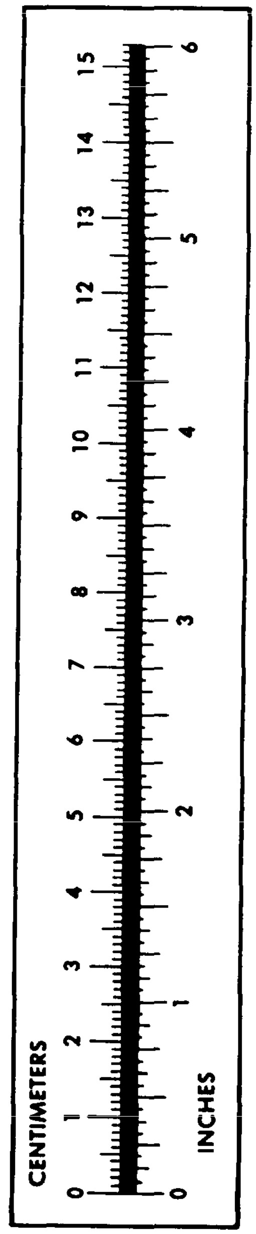
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ts	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
ers	Gallons	0.264
ms	Ounces	0.035
ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
lometers per Liter	Miles per Gallon	2.354
meters per Hour	Miles per Hour	0.621



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