Continuous Geodetic Reference Station (CGRS)™

Operations & Technical Manual

Ashtech
1170 Kifer Road
Sunnyvale, CA USA 94086

Phone and Fax Numbers

- Main
  - Voice: 408-524-1400
  - Fax: 408-524-1500
- Sales
  - US: 800-922-2401
  - International: 408-524-1670
  - Fax: 408-524-1500
- Europe
  - Voice: 1-44-993-883-533
  - Fax: 1-44-993-883-977
- Support
  - US: 800-229-2400
  - International: 408-524-1680
  - Fax: 408-524-1500
- BBS
  - Direct: 408-524-1527

Internet

- support@ashtech.com
- http://www.ashtech.com

Printed in the United States of America.
Part Number: 630182, Revision B
May, 1998

SOFTWARE LICENSE AGREEMENT

IMPORTANT: BY OPENING THE SEALED DISK PACKAGE CONTAINING THE SOFTWARE MEDIA, YOU ARE AGREEING TO BE BOUND BY THE TERMS AND CONDITIONS OF THE LICENSE AGREEMENT ("AGREEMENT"). THIS AGREEMENT CONSTITUTES THE COMPLETE AGREEMENT BETWEEN YOU ("LICENSEE") AND MAGELLAN CORPORATION. ("LICENSOR"). CAREFULLY READ THE AGREEMENT AND IF YOU DO NOT AGREE WITH THE TERMS, RETURN THIS UNOPENED DISK PACKAGE AND THE ACCOMPANYING ITEMS TO THE PLACE WHERE YOU OBTAINED THEM FOR A FULL REFUND.

LICENSE. LICENSOR grants to you a limited, non-exclusive, non-transferable, personal license ("License") to (i) install and operate the copy of the computer program contained in this package ("Program") in machine acceptable form only on a single computer (one central processing unit and associated monitor and keyboard) and (ii) make one archival copy of the Program for use with the same computer. LICENSOR and its third-party suppliers retain all rights to the Program not expressly granted in this Agreement.

OWNERSHIP OF PROGRAMS AND COPIES. This License is not a sale of the original Program or any copies. LICENSOR and its third-party suppliers retain the ownership of the Program and all copyrights and other proprietary rights therein, and all subsequent copies of the Program made by you, regardless of the form in which the copies may exist. The Program and the accompanying manuals ("Documentation") are copyrighted works of authorship and contain valuable trade secret and confidential information proprietary to LICENSOR and its third-party suppliers. You agree to exercise reasonable efforts to protect the proprietary interests of LICENSOR and its third-party suppliers in the Program and Documentation and maintain them in strict confidence.

USER RESTRICTIONS. The Program is provided for use in your internal commercial business operations and must remain at all times upon a single computer owned or leased by you. You may physically transfer the Program from one computer to another provided that the Program is operated only on one computer at a time. You may not operate the Program in a time-sharing or service bureau operation or rent, lease, sublease, sell, assign, pledge, transfer, transmit electronically or otherwise dispose of the Program or Documentation, on a temporary or permanent basis, without the prior written consent of LICENSOR. You agree not to translate, modify, adapt, disassemble, decompile, or reverse engineer the Program, or create derivative works of the Program or Documentation or any portion thereof.

TERMINATION. The License is effective until terminated. The License will terminate without notice from LICENSOR if you fail to comply with any provisions of this Agreement. Upon termination, you must cease all use of the Program and Documentation and return tem, and any copies thereof, to LICENSOR.

GENERAL. This Agreement shall be governed by and construed in accordance with the Laws of the State of California and the United States without regard to conflict of laws provisions thereof and without regard to the United Nations Convention on Contracts for the International Sale of Goods.

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY

LICENSOR AND ITS THIRD-PARTY SUPPLIERS MAKE NO WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING THE PROGRAM, MEDIA, DOCUMENTATION, RESULTS OR ACCURACY OF DATA AND HEREBY EXPRESSLY DISCLAIM ANY WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND NONFRINGEMENT. LICENSOR AND ITS THIRD-PARTY SUPPLIERS DO NOT WARRANT THE PROGRAM WILL MEET YOUR REQUIREMENTS OR THAT ITS OPERATION WILL BE UNINTERRUPTED OR ERROR-FREE.

LICENSOR, its third-party suppliers, or anyone involved in the creation or deliver of the Program or Documentation to you shall have no liability to you or any third-party for special, incidental, indirect or consequential damages (including, but not limited to, loss of profits or savings, downtime, damage to or replacement of equipment or property, or recover or replacement of programs or data) arising from claims based in warranty, contract, tort (including negligence), strict liability, or otherwise even if LICENSOR or its third-party suppliers have been advised of the possibility of such claim or damages. The liability of LICENSOR and its third-party suppliers for direct damages shall not exceed the actual amount paid for this Program License.

Some states do not allow the exclusion of limitation of implied warranties or liability for incidental or consequential damages, so the above limitations or exclusions may not apply to you.

U.S. GOVERNMENT RESTRICTED RIGHTS

The Program and Documentation are provided with RESTRICTIVE RIGHTS. Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subdivision (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013 or subdivision 9(C)(1) and (2) of the Commercial Computer Software - Restricted Rights 48 CFR 52.227.19, as applicable.

Should you have any questions concerning the License Agreement or the Limited Warranties and Limitation of Liability, please contact in writing: Ashtech, 1170 Kifer Road, Sunnyvale, CA 94086

FCC Notice

The equipment described in this manual has been tested pursuant to Part 15 of the FCC Rules and found to comply with the limits for a Class A digital device for use in commercial business, and industrial environments. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. The equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio and television reception. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, you can try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the receiver relative to the equipment which it interferes.
- Power the equipment from a different AC receptacle so that this equipment and the interfered equipment are on different branch circuits. If necessary, contact the Ashtech customer service department or an authorized representative for additional advice.

Table of Contents

Chapter 1. Overview 23

Applications 23
CGRS Innovations 23
Componentry 24
Remote Control Software 24
External Sensors 24
Meteorological Station 24
Standard Features 24
Waterproof Receiver 24
12 Channel All-In-View Operation 24
Z-Tracking 25
Dual Bit Processing 25
2Hz Data Position Computation and Data Recording Rate 25
Choke-Ring Dual Band Antenna 25
10 MB Memory (18 - 20 - MB Compression Utility) 25
Real-time Data Output (NMEA / Raw Data) 25
High Speed Remote Download Software / RINEX Converter 25
Fully Automated Modem Control 25
Strong Motion Sampling / Ring Buffer 26
Clock Steering 26
Four Separate and Independent RS-232 Serial Communication Ports. 26
1 PPS Output 26
Dual Power Input 26
External Frequency Input 26
Programmable Meteorological Input 26
External Sensor Input 26
External AC/DC Power Supply and Cable (Auto Sensing) 27
Softcase Battery 27
Battery Charger 115-240 27
Car battery Adapter Cable 27
Radio Modem Cable 27
30 Meter Antenna Cable 27
Y Cable for Multiple Power Inputs / Solar Power Inputs 27
Dual RS-232 Cable 27
Single RS-232 Cable 27

Chapter 2. General Information 29

Introduction 29
List of Equipment Supplied 31

Chapter 3. General Operations 33

Reference Station Setup 33
System Configuration 33
Powering the Receiver 36
Self-Test Messages 36
Resetting Memory 36
Front Panel 37
GPS Antenna Platform 38
Collecting Data 38
Conventional Memory versus Seismic Ring Buffer Memory 39
Conventional Memory 39
File Basics 39
Entering a Site Name 40
More File Basics 40
Session Programming 42
Downloading Data 42
Direct Downloads 42
Remote Download 43
Remotely Downloading Conventional Memory 43
Remotely Downloading Seismic Ring Buffer Memory 44
Real-Time Code and Carrier Phase Differential Operations 45
Setting up using receiver screens and keypad 47
Setting up using receiver commands 51

Chapter 4. Screen Operation 53

Screen 0 - Satellite Tracking Information 53
Screen 1 - Satellite Orbit and Health Information 55
Screen 2 - Position and Navigation Information 57
Screen 2/Page 1 57
Screen 2/Page 2 59
Screen 3 - Data Collection Information 60
Screen 4 - Receiver Control 61
Main Screen Fields 61
Reference Position (LAT, LON and ALT) 62
Screen 4 - Position Submenu 63
Screen 4 - Differential Submenu 65

RTCM Options - RTCM Format Submenu 67
Type 15 - RTCM Type 15 Submenu 70
Type 16 - RTCM Type 16 Message Submenu 71
Screen 4 - Session Submenu 71
Screen 4 - RCVR CTRL Submenu 74
Screen 4 - Port A/B/C/D Submenu 76
Screen 4 - EXT FREQ Submenu 80
Screen 4 - PULSE GEN Submenu 81
Screen 4 - DATUM Submenu 82
Screen 4 - MODEM Submenu 83
Screen 4 - SUBCMDS Submenu 84
Screen 5 - Differential Information and Range Residuals/Position Error 86
RTCM Information 86
Range Residuals 88
Screen 6 - Waypoint Control 89
LOG Present POS 90
SET DISPLAY 90
EDIT WAYPOINT 91
EDIT ROUTE 94
RESTART ROUTE 95
WAYPOINT SWITCH 96
RANGE/BEARING 97
UNIT SELECTION 97
MAGVAR MODE 98
Screen 7 - Satellite Selection Control 100
Screen 8 - File Information/Seismic Ring Buffer™ 101
SEISMIC RING BUFFER MENU 103
Screen 9 - Site and Session Control 104
Screen 10 - All-in-View Information 107
Screen 11 - Visibility Information 109
Screen 12 - Bar Code Control 110

Chapter 5. Serial Port Operation 113

Real-Time Data Output 113
Setting Up the Receiver 114
Commands 116
Setting Commands 116
Query Commands 122
Setting-up Serial Port Real-Time Data Output 123
To start NMEA message output: 124
To stop NMEA message output: 124
NMEA Output 124
Setting Up the Receiver 125

NMEA Message Types 126
Latitude/Longitude for Position 127
Present Position Fix with Time of Fix 127
Global Positioning System Position 128
COG/SOG 129
SNR of GPS Satellites Being Tracked 129
Autopilot Format 130
Almanac Message 130
RTCM Message 131
Message Type 1 or 9 Format: RTCM Corrections 132
Message Type 2 Format: Delta RTCM Corrections 133
Message Type 3 Format: Reference Station Coordinates 133
Message Type 15 Format: Ionospheric Corrections 134
Message Type 16 Format: GPS Special Message 134
Cross-Track Error 134
Bearing and Distance 135
Almanac 135
DOP and Active Satellites 137
Satellites in View 137
Trigger Time Tag Serial Output Message 138
Satellite Range Residuals and Position Errors 138
GPS Satellite Range Residuals 139
Position Using UTM Coordinates 140

Chapter 6. Data Formats 141

Stored Formats 141
B-files 141
E-files 143
S-files 144
D-File 144
Real-Time Data Files in ASCII 146
MBEN Files in ASCII 146
PBEN Files in ASCII 148
Real-Time Data Files in Binary 148
MBEN Files in Binary 148
PBEN Files in Binary 150
TBEN File in Binary 151
SNAV Files in Binary 154
Raw Broadcast Ephemeris Message 155
DBEN Files in Binary 157
General 157
DBEN Message Structure 157
Message Header Part 158

Message Data Part. 158
Message Tail 159
DBEN Message Types 159
With Doppler 160
Message Compression 161
Pseudo Range Smoothing 161

Chapter 7. Maintenance 163

Antenna Cables 163
Power Cables 164
RS-232 Pinout 164
Radio Interference 165
Power Consumption 166
Internal Batteries 166
Sleep Mode 166
Upgrading Firmware 166
General 166
Program Execution 167
Warning Messages 168
Error Messages and Abnormal Termination 169
Boot Loading 170

Appendix A. Datums A-1

Appendix B. Supporting Software B-1

CGRS Remote B-1
System Setup B-1
Direct Communication Link B-1
Modem Communication Link B-2
Program Operation B-3
Status Line B-4
Remote Setting Commands B-4
Help: Remote Command Menu Screen B-5
Setup/Communication Parameter B-6
Receiver Parameter Setup B-7
Setup/Transfer Parameter B-8
Setup/Modem Parameter B-10
Setup/Modem Parameter B-12
Communication with Receiver/Phone Dialup B-14
Adding a Dialing Entry B-16
Deleting an Entry B-16
Saving the Phone Numbers B-16
Exiting the Dialing Screen B-16

Setup/Transfer Parameters B-16
Ashtech Receiver-Related Screens B-17
Communication with Receiver/View Receiver Status B-17
Tracking Mode B-20
Setup/Receiver Parameters B-21
Communication with Receiver/File Processing B-23
Converting Receiver Files B-25
Seismic Ring Buffer Screen B-27
RTCM Status Display B-28
Operational Notes B-32
Communication with Receiver/Initialize Modem B-33
Communication with Receiver/Hang Modem B-33
Setup/Capture Log Filename B-34
Input Files Used by CGRS REMOTE B-34
REMOTE.CNF B-34
PHONENUM.LST B-35
Output Files Generated by CGRS REMOTE B-35
Command Line Options B-36
Command Summary B-38
Troubleshooting B-39
Upgrading Firmware at a Remote Station B-39
Troubleshooting B-40
CGRS HOSE B-41
Input Data Files B-41
Output Data Files B-41
Program Execution B-41
Main Menu and Display B-42
Option Selection Section B-44
Option A: Display Receiver Directory B-44
Option B: Download Receiver Files. B-46
Option C: Change Communications Parameters. B-48
Option D: Change Destination Path B-50
Option F: Read Photogrammetry Data B-51
Option G: Read Almanac Data B-51
Option H: Edit Waypoints B-52
Quit/Execute Section B-55
Troubleshooting B-55
Advanced Program Options B-56
Command Line Parameters B-56
Hose Cable B-57
ASHTORIN B-58
Input Data Files B-58

Output Data Files B-58
Program Execution B-58
Ashtech Source Files B-59
Source Disk Drive: and Source Directory B-59
RINEX Target Files B-59
Option A: File Input/Output Menu B-61
Option B: Create RINEX Observation File B-62
Agency Information (Top Section) B-63
Equipment and Data Information (Second Section) B-63
Antenna Offsets (Third Section) B-64
Processing the Conversion B-65
Option C: Create RINEX Navigation File B-66
Agency Information (Top Section) B-66
Option D: Create RINEX Meteorological File. B-66
Option E: Exit B-68
Warning Messages B-68
Error Messages B-68
RINTOASH B-69
Input Data files B-69
Output Data Files B-69
Program Execution B-69
DATALOGR B-71
Input Data Files B-71
Output Data Files B-71
Program Execution B-71
Command Line Options B-73

Appendix C. Additional System Information C-1

Unhealthy Codes C-1
Receiver User Parameters C-3

Appendix D. Additional Information D-1

Position Determination with GPS D-1
Conducting a Static Survey D-1
System Set Up D-2
Measuring Antenna Height D-2
Operating the Receiver D-3
Entering Site Name D-5
Ionosphere Information D-6
Reference Documents D-6
Ashtech recommends the following reference books on GPS theory: D-6
Sources of GPS Information D-7

Common GPS Acronyms D-8

List of Figures

Figure 2.1: Front View 29
Figure 2.2: Back Display Panel 30
Figure 2.3: 100% IGS Compatible Choke Ring Antenna Front & Side Display 30
Figure 3.1: Examples of Powering the Z-12 Receiver 33
Figure 3.2: Example Configurations 34
Figure 3.3. Additional Example Configurations 35
Figure 3.4: Front Panel 37
Figure 3.5: Screen 4. 47
Figure 3.6: Differential Mode Selection Screen 48
Figure 3.7: RTCM Options Menu 49
Figure 4.1: Screen 0. 53
Figure 4.2: Screen 1. 55
Figure 4.3: Screen 2, Page 1 57
Figure 4.4: Screen 2, Page 2 59
Figure 4.5: Screen 3. 60
Figure 4.6: Screen 4. 61
Figure 4.7: Screen 4, Position Fix Parameters 63
Figure 4.8: Screen 4, Differential Menu Selection 65
Figure 4.9: RTCM Options Screen 67
Figure 4.10: RTCM Type 15 Screen Message 70
Figure 4.11: RTCM Type 16 “Send Message” Screen 71
Figure 4.12: Screen 4, Session Programming 72
Figure 4.13: Screen 4, Receiver Control 74
Figure 4.14: Screen 4, Port A Parameter Selection 76
Figure 4.15: Screen 4, External Frequency Setup 80
Figure 4.16: Screen 4, Pulse Generation Parameters 81
Figure 4.17: Screen 4, Datum Select 82
Figure 4.18: Screen 4, Modem Setup Menu 83
Figure 4.19: Subcommands Menu. 84
Figure 4.20: Screen 5, Page 1 86
Figure 4.21: Screen 5, Page 2 88
Figure 4.22: Screen 6. 89
Figure 4.23: Screen 6, Menu 90
Figure 4.24: Screen 6, Set Display 91
Figure 4.25: Screen 6, Edit Waypoint 92
Figure 4.26: Screen 6, Edit Route 94
Figure 4.27: Screen 6, Restart Route. 95

Figure 4.28: Screen 6, Waypoint Switch 96
Figure 4.29: Screen 6, Range/Bearing 97
Figure 4.30: Screen 6, Unit Selection. 98
Figure 4.31: Screen 6, MAGVAR Mode 98
Figure 4.32: Screen 7 100
Figure 4.33: Screen 8 101
Figure 4.34: Screen 9 104
Figure 4.35: Screen 10 107
Figure 4.36: Screen 11 109
Figure 4.37: Screen 12 110
Figure 5.1: Screen 4, Setting up receiver 114
Figure 5.2: Screen 4, Port A Parameter Selection 115
Figure 5.3: Port A NMEA Options Menu 125
Figure 5.4: NMEA Sentence Example 126
Figure 7.1: Antenna Cable 163
Figure 7.2: Power Cable 164
Figure 7.3: 16-pin Circular Connector 164
Figure B.1: Receiver Response Screen B-3
Figure B.2: Remote Command Menu Screen B-5
Figure B.3: Communication Parameters Pop-up Menu B-6
Figure B.4: Receiver Parameters Pop-Up Menu. B-7
Figure B.5: Translation Parameters Pop-Up Menu. B-8
Figure B.6: Modem Parameters Screen. B-10
Figure B.7: Modem Response Menu Screen. B-12
Figure B.8: Dialing Screen B-14
Figure B.9: Dialing Pop-Up Screen B-15
Figure B.10: Pop-Up Editing Screen (When Dialing) B-15
Figure B.11: Factory Default Parameters B-16
Figure B.12: Remote Screen B-18
Figure B.13: Display Template B-19
Figure B.14: Remote Established Communication B-21
Figure B.15: Remote Established Communication B-22
Figure B.16: Receiver Files Commands B-24
Figure B.17: Remote Display Status B-25
Figure B.18: File Options B-26
Figure B.19: Download Receiver Files B-26
Figure B.20: RTCM Status B-29
Figure B.21: Established Communication (Remote) B-30
Figure B.22: Capture Mode Screen. B-34
Figure B.23: Summary File Example B-36
Figure B.24: Menu Screen B-42
Figure B.25: HOSE Main Menu B-43

Figure B.26: Main Option Menu B-45
Figure B.27: Selection Screen B-46
Figure B.28: Main Options menu B-47
Figure B.29: Download Summary menu B-48
Figure B.30: Option C, Change Communication Parameters B-49
Figure B.31: Option D, Change Destination B-50
Figure B.32: Option E, Reset for New Receiver B-51
Figure B.33: Option H, Edit Waypoint B-52
Figure B.34: Option H, Waypoint File to Download. B-52
Figure B.35: Waypoint File Name. B-53
Figure B.36: Editing Waypoint B-54
Figure B.37: Clearing Waypoints B-54
Figure B.38: Serial Port Pin Diagram B-57
Figure B.39: Ashtech Source File Screen B-59
Figure B.40: Menu 2.1 Screen B-60
Figure B.41: Menu 2.0, Program Options B-61
Figure B.42: Menu 2.2 . . . . . B-62
Figure B.43: RINEX Navigation, Option C. B-66
Figure B.44: RINEX Meteorological File, Option D. B-67
Figure B.45: DATALOGR Screen. B-71
Figure B.46: DATALOGR Status B-72
Figure B.47: DATALOGR, Option i B-73
Figure D.1: Screen 4. . . . . D-4
Figure D.2: Screen 1. . . . . D-4
Figure D.3: Screen 9. . . . . D-5

List of Tables

Table 2.1: CGRS Receiver System 31
Table 3.1: Front Panel Descriptions. 37
Table 3.2: File Subcommands 40
Table 3.3: PASH Commands. 41
Table 3.4: Data Storage Modes 41
Table 3.5: Differential Operating Modes. 46
Table 3.6: RTCM Message Types 46
Table 3.7: Basic Differential Functions. 49
Table 3.8: Antenna Offset Parameters. 50
Table 4.1: Screen 0 Field Descriptions 54
Table 4.2: Screen 1 Field Descriptions 56
Table 4.3: Screen 2, Page 1 Field Descriptions. 57
Table 4.4: Screen 2, Page 2 Field Descriptions. 59
Table 4.5: Screen 4 Field Descriptions 62
Table 4.6: Screen 4, Menu Fields and Descriptions 64
Table 4.7: Screen 4, Diffferential Menu Field Descriptions 66
Table 4.8: Differential Mode Selection Screen Descriptions 67
Table 4.9: RTCM Type 15. 70
Table 4.10: Screen 4, Session Menu Field Descriptions 72
Table 4.11: Screen 4, Receiver Control Menu. 75
Table 4.12: Screen 4, Port A Parameter Selection Field Descriptions 77
Table 4.13: Screen 4, External Frequency Setup Field Descriptions. 80
Table 4.14: Screen 4, Pulse Generation Parameters Field Descriptions 82
Table 4.15: Screen 4, Modem Setup Menu Field Descriptions. 84
Table 4.16: Screen 4, SUBCMDS Descriptions 85
Table 4.17: Differential Information and Range Residuals Field Descriptions 87
Table 4.18: Screen 5, Page 2 Field Descriptions. 88
Table 4.19: Screen 8 Field Descriptions 102
Table 4.20: Seismic Ring Buffer Menu Field Descriptions. 103
Table 4.21: Screen 9, Site & Session Control Field Descriptions. 104
Table 4.22: All-In-View Screen Field Descriptions 107
Table 4.23: Screen 11 Field Descriptions 109
Table 5.1: Serial Port Message Type and Formats 113
Table 5.2: Baud Rate Codes. 117
Table 5.3: Z Codes 118
Table 5.4: “w” Codes 118
Table 5.5: “d” Code Output Rate 120
Table 5.6: Latitude/Longitude Field Descriptions. 127

Table 5.7: Present Position Field Descriptions 127
Table 5.8: GPS Field Descriptions 128
Table 5.9: COG/SOG Field Descriptions 129
Table 5.10: SNR of GPS Field Descriptions. 129
Table 5.11: Autopilot Format Field Descriptions 130
Table 5.12: Almanac Messages Field Descriptions 130
Table 5.13: RTCM Messages Field Descriptions (1-7) 131
Table 5.14: RTCM Messages Field Descriptions (8-17) 132
Table 5.15: Message Type 2 Format Field Descriptions 133
Table 5.16: Message Type 3 Format Field Descriptions 133
Table 5.17: Message Type 15 Field Descriptions. 134
Table 5.18: Message Type 16 Field Descriptions. 134
Table 5.19: Cross Track Error Field Description 134
Table 5.20: Bearing and Distance Field Descriptions. 135
Table 5.21: Almanac Field Descriptions. 136
Table 5.22: DOP and Active Satellites Field Descriptions. 137
Table 5.23: Satellites in View Field Descriptions. 137
Table 5.24: Trigger Time Tag Field Descriptions. 138
Table 5.25: Satellite Range Residuals Field Descriptions 139
Table 5.26: GPS Satellite Range Field Descriptions. 139
Table 5.27: Position Using UTM Field Descriptions 140
Table 6.1: D-File Field Information 144
Table 6.2: D-File Tilt Meter Data Field Descriptions. 145
Table 6.3: MBEN Format in ASCII 146
Table 6.4: Total Number of Bytes Sent. 148
Table 6.5: MBEN File in Binary. 149
Table 6.6: PBEN File in Binary 150
Table 6.7: SNAV Files 154
Table 6.8: Raw Broadcast Ephemeris Data. 155
Table 6.9: Message Header. 158
Table 6.10: Message Data. 158
Table 6.11: Message Tail 159
Table 6.12: DBEN Message Definition 160
Table 6.13: DBEN Message Size (bits) 160
Table 6.14: Doppler Message Size (bits) 160
Table 7.1: Antenna Cable Electrical Specifications 163
Table 7.1: Pin Assignments. 165
Table A.1: Datums A-1
Table B.1: CGRS REMOTE Screen Descriptions. B-4
Table B.2: Parameter Range and Description B-9
Table B.3: Fields B-25
Table B.4: Directory Information B-45

Table B.5: Waypoint Functions B-53
Table B.6: CGRS HOSE Command Line Parameters B-56
Table B.7: B-File Parameters B-64
Table B.8: Command Line Options B-73
Table B.9: Command Parameters B-74
Table C.1: NAV Data Health (Bits 0 through 2) C-1
Table C.2: NAV Data Health (Bits 3 through 7) C-2
Table C.3: Receiver User Parameters C-3

Overview

Applications

Ashtech's Continuous Geodetic Reference Station (CGRS™) systems are used worldwide for scientific research such as crustal deformation, earthquake and seismic monitoring, volcanic eruption studies, and other applications requiring a high level of precision. Development of the CGRS system included extensive input from scientists, surveyors and engineers throughout the world. The result is a rugged system that provides the reference station community with the most powerful and advanced GPS technology available today. The CGRS provides millimeter-level measurements that are being used on a global basis by scientists and investigators to gain a better understanding of our planet.

The CGRS system was designed for permanent installation and continuous-use operation. It is built upon Ashtech's field-tested and patented Z-Tracking™ technology, which provides a 13dB signal-to-noise ratio advantage over cross-correlation receivers while mitigating the effects of Anti-Spoofing (AS). For the user, this translates into uninterrupted operation during AS and periods of large ionospheric and atmospheric activity, as well as consistently-accurate data.

CGRS Innovations

Numerous research institutions and private companies around the world use the Ashtech CGRS system as a reference point for their precision work, having chosen the CGRS system for its robust and reliable performance in a continuously-operating environment. These systems currently form the backbone of over 35 continuous monitoring GPS arrays around the globe, and include the Southern California Integrated GPS Network (SCIGN), the Southern California Earthquake Center (SCEC), the Geographical Survey Institute (GSI) of Japan, the U.S. Geological Survey (USGS), the National Geodetic Survey (NGS) and more. In fact, well over 60% of the NGS CORS sites are Ashtech CGRS systems. The Reference Station Department maintains a close relationship with the scientists and technical staff of each of these networks. The CGRS system is continually fine-tuned to provide users with the most reliable and efficient reference station available.

Componentry

The Ashtech CGRS package consists of all hardware including a Z-12 CGRS receiver, plus all software and cables for quick and easy installation. It also incorporates several key advantages that are highlighted below.

Remote Control Software

A remote control software package is shipped with all CGRS systems and provides the user with complete control over remote sites. This software can remotely download data and set any of the receiver's parameters. Simply connect a modem or a radio to the remote receiver and start the remote software on a PC with a corresponding modem or radio. Once the modems or radios are in place, CGRS users can enjoy full control of any given site located anywhere in the world. Many CGRS users maintain networks that are thousands of miles from the control facility.

External Sensors

The CGRS receiver has been designed for easy integration with a wide variety of sensors such as tiltmeters and atmospheric monitoring devices. With resolution better than 1 micron per meter, tiltmeters provide the earliest indication of monument deformation. Two tiltmeters connected to the CGRS receiver provide a guarantee that the first signs of any deformation will be detected. An array of tiltmeters or other sensors can be also used to monitor areas inaccessible to GPS. These arrays are being used to monitor large engineered structures such as bridges, dams and reservoirs, as well as natural hazards.

Meteorological Station

A meteorological station can be connected to any of the 4 independent serial ports on the CGRS receiver. The met station provides real-time information on temperature, barometric pressure and humidity. Both the tiltmeters and the meteorological station can be powered by the CGRS receiver. Tilt and met data can be output in real-time, or written to external memory.

Standard Features

Waterproof Receiver

The CGRS is housed in a machined aluminum case and waterproof to 5 PSI and is impervious to wind driven rain and dust.

12 Channel All-In-View Operation

The Reference Station tracks coarse acquisition (C/A) carrier phase and pseudo range, and P1 and P2 carrier phase and pseudo range. All of the above are tracked with full - *not half* - carrier wavelengths.

Z-Tracking

The CGRS system is built upon Ashtech's field-tested and patented Z technology. This technology provides a 13 dB signal-to-noise ratio advantage over cross-correlation receivers. What this means to the user is consistently great data and uninterrupted operation during AS and large ionospheric activity.

Dual Bit Processing

Ashtech's dual line processing capabilities substantially improves jam immunity. The receiver does not lose lock near strong transmitters or high voltage power lines.

2Hz Data Position Computation and Data Recording Rate

The Reference Station can be programmed to record or output data at rates as fast as 2Hz. The recording range is from 0.5 sec to 999.5 seconds (rate can be set in half-second increments).

Choke-Ring Dual Band Antenna

The Ashtech choke ring is a 100% IGS compatible dual frequency antenna. The Antenna contains a Dorne - Margollin™ C-146-10 vertical dipole element.

10 MB Memory (18 - 20 - MB Compression Utility)

The Reference Station comes standard with 10 MB of memory (6 MB configurations are also available). A data compression utility has been added that increase the memory to 18 - 20 MB. The compression process is transparent to the user.

Real-time Data Output (NMEA / Raw Data)

The Reference Station supports output of 22 NMEA messages and 6 Ashtech messages.

High Speed Remote Download Software / RINEX Converter

Remote download software provides the Reference Station user with complete control over a remote receiver. This includes the ability to remotely change any of the receiver's settings, and to download data at rates up to 115200 baud. The remote software can be easily programmed (batched) to automatically download all receivers in the network. The Remote software allows the user to remotely upload firmware without data loss.

Fully Automated Modem Control

The CGRS has full modem capabilities. Each of the four RS-232 ports supports a modem. The CGRS will re-connect and re-initialize the modem following a power

fail. Information regarding the power fail will be written to memory for further analysis.

Strong Motion Sampling / Ring Buffer

The Ring Buffer provides high-speed data capture without compromising conventional data recording.

Clock Steering

The Reference Station allows the user to turn clock steering on or off. Clock steering minimizes clock and frequency error to less than 1 microsecond and removes millisecond clock jumps.

Four Separate and Independent RS-232 Serial Communication Ports.

These four ports can be programmed independently and support data transfer at rates up to 115200 baud. All four of these ports can provide power to external sensor arrays.

1 PPS Output

The Reference Station has a 1 PPS output feature. The 1 PPS accuracy is +/- 1 microsecond. The PPS signal is programmable to rising or falling edge.

Dual Power Input

The CGRS has two separate power inputs. These inputs are diode protected. Two cables are provided which split these two power inputs into four separate power inputs.

External Frequency Input

The Reference Station contains a fully programmable external frequency feature. Frequencies from 1 to 21 Mhz can be entered including offsets.

Programmable Meteorological Input

The Reference Station can accept temperature readings, barometric pressure readings, and humidity reading from an external met station. This data can be written to file and output in real-time.

External Sensor Input

The Reference Station can manage an array of sensors such as tiltmeters. With resolution better than one micron per meter, tiltmeters provide the earliest indication of monument deformation. The CGRS system has been designed to be easily

integrated with numerous tiltmeters and other sensors. The CGRS can output the tiltmeter data in real-time, or write the tiltmeter data to internal memory.

External AC/DC Power Supply and Cable (Auto Sensing)

115-240 50/60 Mhz. CSA, CE, GS, TUV ratings.

Softcase Battery

The sealed lead-acid softcase battery can power the CGRS unit for 4 hours.

Battery Charger 115-240

Fuse protected, 5 amp battery charger.

Car battery Adapter Cable

Adaptable to car batteries or solar panels. Military specifications.

Radio Modem Cable

25 pin serial cable designed for wireless modems.

30 Meter Antenna Cable

RG-214 with N type connectors.

Y Cable for Multiple Power Inputs / Solar Power Inputs

The Y cable is provided for directing two power sources into one power port.

Dual RS-232 Cable

The dual nine-pin cable splits 1 CGRS serial port into two serial ports.

Single RS-232 Cable

Standard nine-pin communication and data download cable.

General Information

Introduction

The Ashtech CGRS GPS system makes full use of the NAVSTAR Global Positioning System, which provides state-of-the-art precision surveying and navigation to users worldwide. The CGRS system incorporates the Ashtech Z-12 receiver, which is one of the most sophisticated GPS receivers available to-date, and the first receiver to offer true all-in-view automatic tracking. With 12 independent channels, the Z-12 tracks all satellites in view automatically, and records L1 C/A, L1 P, and L2 P-code and carrier measurements even in the presence of Anti-Spoofing (AS) due to Ashtech's patented Z-Tracking technology. The Z-12's primary function is to serve as a reference station for the CGRS system.

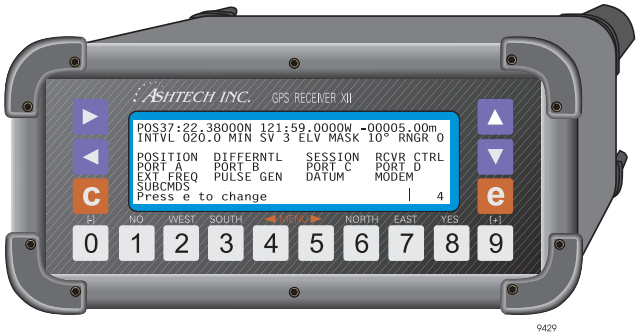


Figure 2.1: Front View

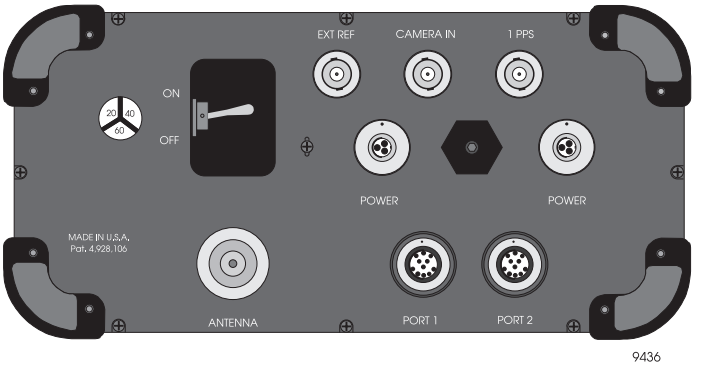


Figure 2.2: Back Display Panel

As shown in Figure 2.2, 2 DC power inputs are available as well as 4 independent RS-232 serial ports (Port 1 (A/C) and Port 2 (B/D) each support 2 serial ports). In addition, external frequency input and 1 pulse-per-second (1PPS) output are also supported. The system includes the Ashtech choke-ring antenna with a Dorne & Margolin™ dipole antenna element mounted on a precision platform for accurate positioning above the survey mark, as shown in Figure 2.3. (Phase center values are published by NGS, 1997).

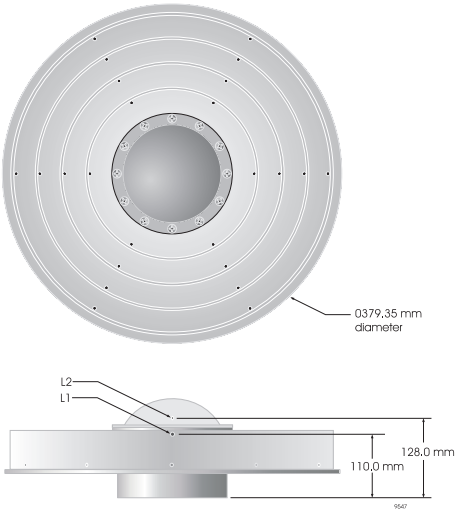


Figure 2.3: 100% IGS Compatible Choke Ring Antenna
Front & Side Display

List of Equipment Supplied

The following table specifies the part numbers that comprise the CGRS (990173-##) receiver system:

Table 2.1: CGRS Receiver System

Part Number	Description	Quantity
100914	30m GPS Antenna Cable	1
101918	Battery Charger Kit	1
102747	Warranty Registration Form	1
103754	12v Battery w/ Pouch	1
600485	CGRS Utility Software	1
630182	CGRS Operating Manual	1
700423	DC Power Cable to Battery w/pouch	1
700492	DC Power Cable to Car Battery	1
700493	Power Y Cable	1
700617	Single channel data cable	1
700619	Dual channel data cable	1
700744	RS232 Data Cable - Modem - trailblazer	1
700845 - # #	Z-12 CGRS Receiver	1
700936	Choke Ring Antenna w/ Radome	1
730085	Cable Assembly	1
800069	External Power Supply 24 vdc	1

General Operations

Reference Station Setup

System Configuration

Connect one end of the receiver power cable (700423 or 800069) to an external power source and the other end to either of the power connectors on the back of the receiver. Different scenarios of powering the Z12 receiver are shown in Figure 3.1.

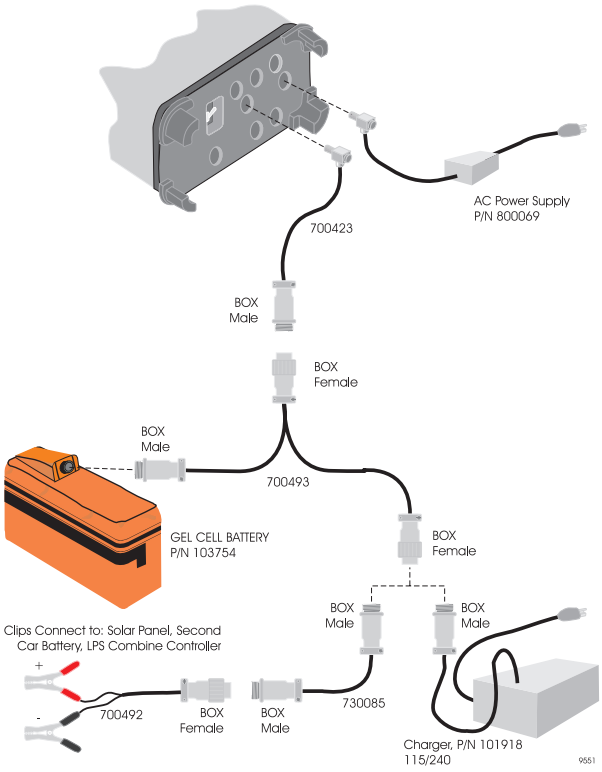


Figure 3.1: Examples of Powering the Z-12 Receiver

Connect one end of the antenna cable to the antenna and the other end to the ANTENNA connector on the back of the receiver. For additional configuration options for the CGRS Z12 receiver, refer to Figure 3.2 and Figure 3.3.

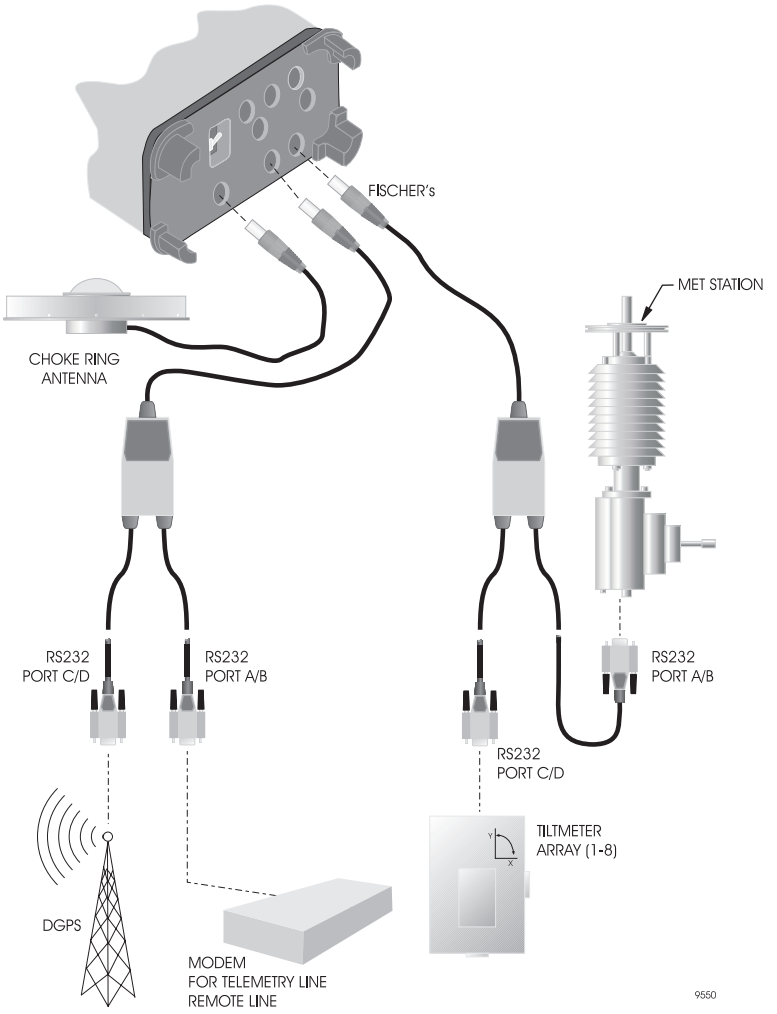


Figure 3.2: Example Configurations

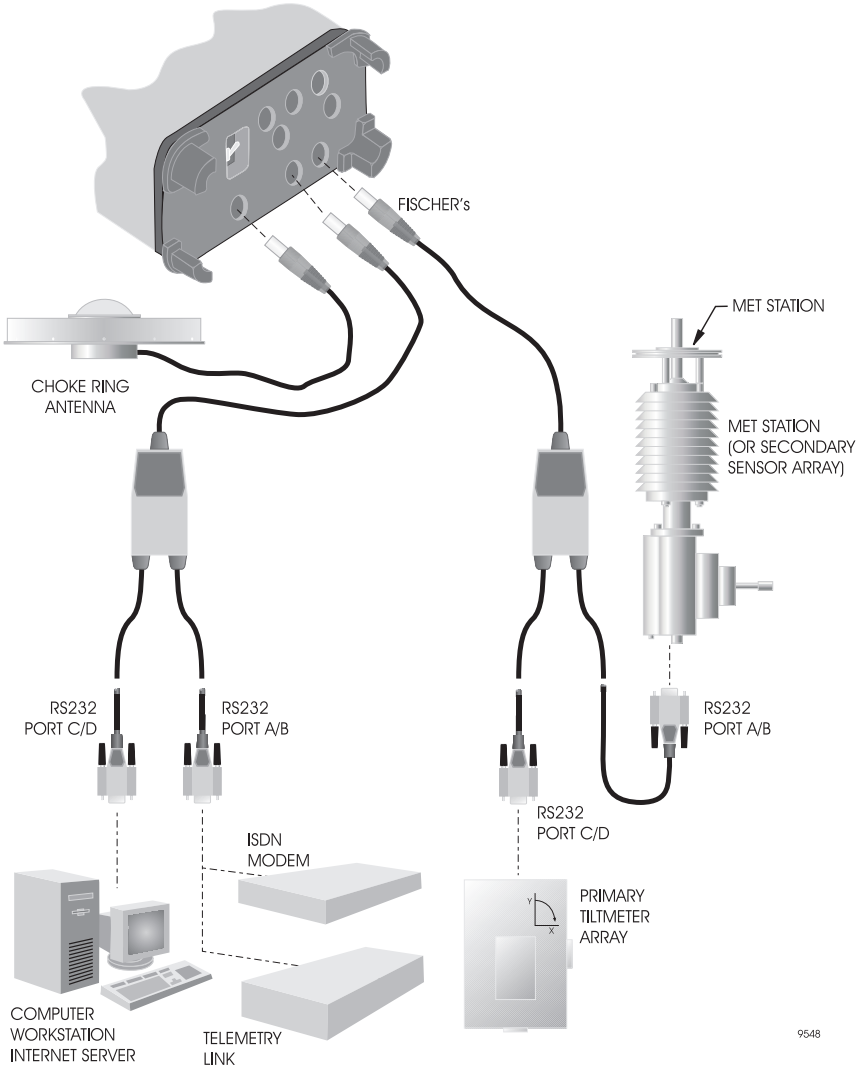


Figure 3.3. Additional Example Configurations

Powering the Receiver

In order to turn the power ON, ensure that the power cable is connected and flip the power switch in the back of the receiver.

Self-Test Messages

At power-up, the receiver performs internal tests to check various components and circuits. As the self-test is completed, the respective self-test messages are displayed:

- EPROM checksum test pass
- XRAM installed
- Mag var checksum OK
- Downloading Channel

If all tests pass, the screen will display the message "downloading channel" and proceed to Screen 0. If any test fails, the program halts with the corresponding self-test message.

Resetting Memory

After powering the receiver for the first time after receiving it from the factory, it is recommended to reset internal and external memory. A reset of the internal memory of the receiver clears the receiver to the factory defaults, including almanac data. To complete the resetting procedure, proceed as follows:

1. Turn the receiver OFF.
2. While pressing the ▲ key, turn the receiver ON.
3. Keep holding the ▲ key down until the message "Test of internal RAM. Will clear all data. Press YES within 10 seconds to continue" is displayed.
4. Press [8] (YES) and a message appears: "Push any key to continue." Press any key to continue with the receiver normal operation.

A reset of the external memory of the receiver erases all data files displayed on Screen 8 which are stored in the memory RAM board. To complete this reset, proceed as follows:

1. Turn the receiver OFF.
2. While pressing the ▶ key, turn the receiver on.
3. Keep holding the ▶ key down until the message "Test of external RAM. Will clear all data. Press YES within 10 seconds to continue" is displayed.

Press [8] (YES) and the message "Push any key to continue" appears. Press any key. The receiver is now ready for use.

Front Panel

The receiver's front panel includes an 8-line x 40-character backlit LCD display, plus various keys for controlling the receiver and entering data, making the Z-12 CGRS receiver very easy to operate. Operating controls are located on the front; power, input, and output connections can be found on the back.

The functionality is available through several easy-to-use screens. Information in the title of a screen means "display-only." Control in the title indicates a screen with which users can interact, such as Screens 4 and 9. All screens are described in detail in Chapter 4. Subscreens are described in Chapter 4 under their respective top-level screens.

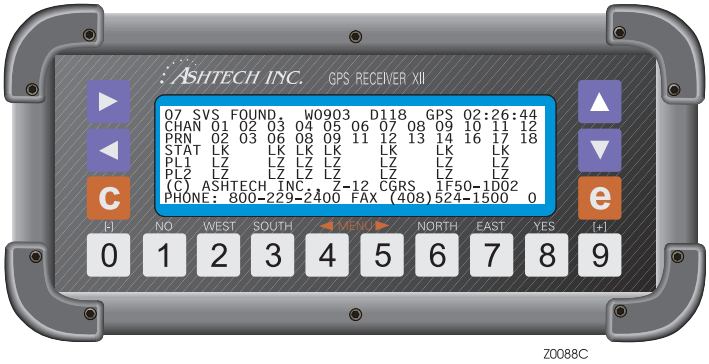


Figure 3.4: Front Panel

The keys that activate the receiver's functions are shown in the following table.

Table 3.1: Front Panel Descriptions

Field	Description
0 - 9	Pressing a number key calls up a specific screen directly. The lower right corner of the screen displays the screen number. Whenever the manual explains a screen, it identifies the screen by number (for example, Screen 1, Orbit Information). • The number keys are used to enter alphanumeric data such as latitude, antenna height, site name. Depending on the particular screen, number keys may have other functions; for example, the [8] key for 'yes'.
[ ]	In this manual, square brackets indicate all receiver keys except the directional arrows.
[c]	Use the Cancel [c] key to cancel the current entry.

Table 3.1: Front Panel Descriptions (continued)

Field	Description
[e]	Press the Enter [e] key to enter data-entry mode, to save entered values, and to go back to higher level displays; the Enter [e] key functions like the <Enter> key on a computer.
▶ ◀	In display mode, use the ▶ key or the ◀ key to change to the next higher or lower numbered screen or subscreen.
▲ ▼	Scrolls through the different pages of a screen, or to raise and lower the contrast when only one page is available and the receiver is in display mode. After two minutes of keyboard inactivity, the backlighting automatically turns off to extend the life of the battery. To restore it, push any key. Ashtech recommends Cancel [C] because it does not change the display.
▲ ▼ ▶ ◀	In data-entry mode, use the arrow keys to move the cursor: to highlight a field or to flash in a character position where the next entry goes. The ▶ key and the ◀ key move the cursor horizontally and the ▲ key and the ▼ key move it vertically.
highlight	To highlight a parameter, use an arrow key (▲, ▼, ▶ or ◀) to move the cursor until that field is displayed in inverse video and a character position in that field is flashing.
toggle	To toggle a field, highlight it and press the [+] or [-] key until it displays the desired setting. For example, below Screen 4, on the Port A/B/C/D Parameter Selection screens, you can toggle through various baud rates. Use the ▶ key to high-light the BAUD RATE indicator and press the [+] key or [-] key to scan through 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 to the desired baud rate.

GPS Antenna Platform

A choke-ring antenna is seated on a precision platform. A low-noise preamplifier housed at the base of the antenna provides sufficient gain for a cable up to 30 meters long.

For antenna height measurement, it is recommended to mount the antenna on a fixed surface and survey in the position of the actual antenna.

For more information about how to measure a known position, refer to Appendix D.

Collecting Data

The CGRS receiver provides users with a tremendous amount of flexibility in data collection. Two separate memory sections are standard with each CGRS unit: conventional memory and seismic ring buffer memory.

Conventional Memory versus Seismic Ring Buffer Memory

Conventional memory stores GPS data in discrete files similar to the DOS File System. Up to 100 individual files can be opened, closed and deleted by users. Once conventional memory fills up, existing files must be deleted in order for any further data collection to occur.

The seismic ring buffer uses an innovative technique that allows continuous high-speed data capture without the requirement to delete files. This is accomplished by employing a circular memory architecture. Once the partition is full, the ring buffer returns to the start of the file and overwrites the oldest record. This method of data storage provides users with a high-speed data record of the last several hours of data.

Users can decide which portion of the receiver's memory to allocate to the 2 separate memory types. For example, a 10Mb receiver can be programmed to have a 6Mb conventional memory capacity and a 4Mb seismic ring buffer capacity by setting the seismic ring buffer to 4Mb. Different recording intervals can then be assigned to each partition. An example would be collecting data every 30 seconds for conventional memory, and collecting data twice per second (2Hz) in the seismic ring buffer. It should be noted the emphemeris file stored within the seismic ring buffer is valid for two hours only. Users should choose the seismic ring buffer size and data recording interval for a two hour period unless some other means of obtaining an emphemeris file is possible.

The advantage of this configuration is that users accumulate data files in the conventional memory section at a specified recording rate, and also obtain a high-speed data record for the last several hours. This high-speed data is extremely useful for earthquake studies, building response studies and other applications requiring speedy data capture.

The CGRS receiver can be programmed just for conventional memory operation, simply by setting the seismic ring buffer partition to 0Mb.

Conventional Memory

File Basics

GPS data is usually stored in the conventional memory section. Collecting dual frequency data is as simple as turning the receiver ON for a specific time period, and then turning it OFF. A new file is opened each time the CGRS receiver is powered ON (assuming the memory is not full and that the receiver has not been placed in SLEEP mode by session programming).

The recording interval for a new file is either the default value (30 seconds) or the recording value that was last input. Different recording intervals can be entered through the Screen 4 main screen (see Chapter 4). The currently-opened file will be automatically closed when the receiver's power is cycled OFF.

Entering a Site Name

To type in text (done from several screens such as Screen 9):

1. Press Enter [e] to switch to data-entry mode.
2. Type in the site name, one number at a time, where each number corresponds to the letter you want.
3. To view another bank of alphanumeric characters, press the ▲ key to cycle through the 5 displays.
4. If the cursor is in the wrong character position, use the ◀ ▶ keys to line it up again.

After the fourth character of the name, the cursor jumps to the field where you can enter a session identifier.

To change an entry, move the cursor to the desired field and re-enter the information. When the entries are acceptable, press Enter [e] to save the changes in memory and return to display mode. To cancel the changes before saving them, press Cancel [c].

More File Basics

Files can be opened, closed and deleted using subcommands or Ashtech's CGRS Remote software, as per the table below. Subcommands are entered directly through the keyboard.

Table 3.2: File Subcommands

Code	Description
456	Delete a file
123	Close a file

Ashtech's CGRS Remote software extends complete remote control of the conventional memory to the CGRS operator. Files can be opened, closed and deleted on a receiver located thousands of miles from users. (See Appendix B for additional information about CGRS Remote software.) Ashtech-proprietary PASH commands can also be used for file manipulation. These commands can be entered through

terminal programs connected to the receiver. The table below lists the PASH commands used for file control.

Table 3.3: PASH Commands

Command	Description
$PASHS,FIL,C	Closes last file in receiver and opens a new file
$PASHS,FIL,D,X	Index of the file to be deleted.

The CGRS receiver can be pre-programmed for fieldwork by setting the appropriate recording interval, site name, elevation mask and other parameters. These parameters are then saved automatically. Consequently, the receiver can be sent out for fieldwork and will automatically open a file when turned ON. The opened file will have the correct site name, recording interval, elevation mask and other pre-configured parameters. This file will automatically be saved when power is removed from the receiver.

Four data storage modes are available to the CGRS user. Different modes are selected through the RCVR CTRL menu item in Screen 4. The 4 storage modes are:.

Table 3.4: Data Storage Modes

Mode	Description
Data mode 0	Mode 0 stores the Ashtech B-file. This data includes full code and carrier phase information. The data can be post-processed by Ashtech software or converted to the RINEX format for third party processing
Data mode 1	Mode 1 stores code phase data only. This data can be post-processed by Ashtech software or converted to the RINEX format for third party processing.
Data mode 2	Mode 2 stores position data. No code or carrier phase information is stored in mode 2 (positions only). A mode 2 file cannot be post-processed. If the receiver is a differential remote unit, differentially-corrected positions will be stored if mode 2 is selected. The file produced by selecting mode 2 is termed a C-file.
Data mode 3	Mode 3 stores a compressed version of mode 0. Mode 3 approximately doubles the available receiver memory. The compression process is transparent to the user since the download software decompresses the file. Mode 3 data can be used for post-processing. Select mode 3 for normal CGRS operation.

Data mode 3 is default setting.

Session Programming

Always set data recording mask & position mask to same value.

Session programming is used to program the receiver to automatically open and close files at pre-determined times. This eliminates the requirement for an operator to open and close files manually. For virtually any application, as many as 24 sessions may be programmed into the CGRS receiver using session programming, allowing users optimal versatility and flexibility.

Session programming is particularly useful in combination with the remote monitor software. Data files can automatically be opened and closed 24 hours a day, 365 days a year using session programming. CGRS receivers can be placed in remote locations around the globe and will automatically store dual-frequency GPS data according to the pre-programmed parameters. The remote monitoring software can then be batched to automatically download the existing files, and then delete them after the success of the download has been verified.

Downloading Data

Data can be downloaded from the CGRS receiver through a direct connection or through a remote connection. Direct downloads can be accomplished using the CGRS Hose software package and an Ashtech download cable. Remote downloads can be accomplished using the software package CGRS Remote and a modem or a radio. Many different types of radios and modems are available for use with the CGRS receiver. The CGRS receiver comes standard with 4 separate and independent serial ports. Each of these ports can be used to download data at baud rates up to 115,200.

CGRS Remote will not stop data recording during downloading; CGRS Hose will stop data recording during download. Either program can be used to download ring buffer or conventional memory. Refer to Appendix Bw for more Information on downloading with CGRS HOSE and CGRS REMOTE.

Direct Downloads

Data can be quickly and easily downloaded using the download cable supplied by Ashtech and the CGRS Hose software program. Ashtech manufactures a standard download cable and a Y download cable. Both of these cables are null modem cables. The standard cable has a 16-pin fisher connector which plugs into the Z-12 CGRS and a 9-pin RS-232 connector which plugs into a PC. The Y cable also has a 16-pin

Fisher connector but is split into two 9-pin RS-232 connectors. The Y cable is used to expand serial port 1 and 2 on the Z-12 CGRS into serial ports A, B, C, and D. For example, if a Y cable is connected to port 1 of the Z-12 CGRS, the RS-232 connector labeled A/B will be port A, and the RS-232 connector labeled C/D will be port C.

To download data, connect either a standard download cable or a Y cable to port 1 or port 2 on the back of the receiver. Connect the 9-pin RS-232 to a PC with CGRS Hose loaded onto it. CGRS Hose will determine the baud rate of the port after is has been executed. Select option B (Download Receiver Files) after the baud rate has been successfully detected. A new screen will appear presenting information on all files currently stored in the conventional memory section. Ensure that a Y proceeds each file you wish to download and press [F10] to begin downloading.

A summary of all files downloaded will be displayed when the transfer is complete. CGRS Hose will create a B, E and S file for each file downloaded from the receiver. Please refer to the CGRS Hose section in Appendix B for more information.

Remote Download

CGRS Remote must be used when downloading data from a receiver located at a remote location. CGRS Remote can also be used to download data when directly connected to the receiver.

Before attempting to download data with CGRS Remote, verify that the communication link between the software and the receiver has been established. This can be done by starting CGRS Remote and pressing the [F3] key. This will send a command to the receiver requesting identification information. A response message such as the message shown below should immediately appear on the screen:

$PASHR,RID,

If no message appears, the communication link between the CGRS Remote and the receiver has not been established. Check that the proper COM port and baud rate have been selected in CGRS Remote. This can be verified by checking the parameters set in the software's Communications Parameters screen. Press [ALT]+[C] to access this screen.

Remotely Downloading Conventional Memory

Once the communication link between CGRS Remote and the GPS receiver has been verified, access the Receiver Files screen by pressing [ALT]+[F]. The Receiver Files screen will display complete information on all files currently stored in Conventional memory. The ↑ and ↓ keys can be used to scroll through all files stored in the receiver.

Use the ↑ ↓ and → ← arrow keys to position the cursor beneath the Tag field of the files you wish to download. The Enter [e] key is used to select which files will be downloaded. Repeatedly pressing the Enter [e] key will toggle the field between a

check mark and no check mark. Once the proper files have been selected for download, press [F10] to begin the download. A status message will appear that displays the progress of the file transfer.

The image that CGRS Remote downloads is a RAM image file, or R file for short. The R file is a condensed version of the B, E and S files that CGRS Hose downloads. An important distinction between CGRS Hose and CGRS Remote is that CGRS Hose automatically converts the receiver R file into Ashtech B, E and S files, whereas CGRS Remote does not. Therefore, it is necessary to take the R file from the CGRS Remote download and convert it to Ashtech B, E and S files using CGRS Hose. To do this, simply place the R files in the same directory as CGRS Hose and type:

CGHOSE -r filename

where filename is the name of the R file you wish to convert. CGRS Hose will then split the R file into its component B, E and S files.

Remotely Downloading Seismic Ring Buffer Memory

The Seismic Ring Buffer (SRB) memory can be directly downloaded or remotely downloaded using CGRS Remote. CGRS Remote allows users to download all data currently in the ring buffer, or selected data from a start and stop time specified by users.

Once the communication link between CGRS Remote and the GPS receiver has been verified, access the Receiver Files screen by pressing [ALT]+[F]. Press [F8] to access the Receiver Fast Buffer Info Display screen. Enter a 4 letter site name in the File Name field. To download all data currently in the ring buffer, press [F10]. A status screen will appear displaying the progress of the download. A single R file is the result of downloading the entire ring buffer memory. The format of the R file name is as follows:

R____A97.006

where R is RAM file, ____ is a 4-character identifier entered by users and A is the session identifier, and 97 indicates the last 2 digits of the current year, and .006 is the current Julian day.

Repeat the procedure outlined in Remotely Downloading Conventional Memory to transform the ring buffer R file into Ashtech B, E and S files.

Downloading a user-defined section of the ring buffer's current contents simply involves entering a start and stop time. Enter a start time in the Partial Start Time (GMT) field, and a stop time in the Partial Ending Time (GMT) field. Ensure that all entered start and stop times are valid by comparing them with the reported start and end times of the ring buffer memory. After the partial start and stop times have been entered, press [F10] to partially download the ring buffer. When the download is complete, the summary message will indicate that the ring buffer R file has been successfully downloaded. Repeat the procedure outlined in Remotely Downloading

Conventional Memory to transform the ring buffer R file into Ashtech B, E and S files.

CAUTION
Do not name ring buffer file the same name as the conventional file.

Real-Time Code and Carrier Phase Differential Operations

The CGRS receiver can operate as a base station to support rover receivers functioning in both code and carrier phase differential modes. Both modes assume that both the base and rover can observe the same sattelites at the same time.

When the base operates in the code differential mode, it transmits satellite range corrections to the rover receiver. Since the rover observes the same satellites, it can apply the corrections to its own measured ranges, and thus remove much of the position error. This mode will usually result in a rover horizontal position precision of about 1 metre.

In the carrier phase differential mode (more commonly known as RTK), the base carrier phase measurements are transmitted to the rover. The rover solves for the baseline vector components in much the same way as your post-processing software, by differencing and solving for the integer ambiguity. RTK mode will usually result in a rover horizontal precision of a few centermetres depending on baseline length.

A communication link must exist between the base and remote receivers. This link can be a radio, telephone line, cellular phone, communications satellite, or any other medium that can transfer digital data. The link allows the base receiver to send messages to the rover receivers. The messages contain corrections, phase measurements, and text, as well as other information that the rover can use. The RTCM Standard specifies the format and transmission characteristics of these messages (refer to appedix D for information on how to obtain the RTCM document).

The remainder of this section of the manual will show you how to set up the CGRS receiver as a base station operating in one of the following three differential modes:

Table 3.5: Differential Operating Modes

Differential Mode	RTCM Standard
Code	Type 1 -- each message contains corrections for all satellites in view.
Code	Type 9 -- each message contains corrections for up to 3 satellites. This type preffered for slower data links or links with periods of noise.
Carrier (RTK)	Type 03 -- transmits base station coordinates to the rover. Type 18 -- uncorrected carrier phases. Type 19 -- uncorrected psuedoranges. Type 22 -- (optional) antenna parameters to be sent to rover.

The Z12 CGRS receiver can output RTCM message types 1,2,3,6,9,15,16,18,19, and 22. A summary of the messages is presented in Table 3.6.

Table 3.6: RTCM Message Types

RTCM Message Designation	Function
1	Differential GPS Corrections
2	Delta Differential GPS Corrections
3	Base Station Parameters
6	Null Frame
9	Differential GPS Corrections in groups of 3
15	Ionospheric Delay Message
16	Special Message
18	RTK Uncorrected Carrier Phase
19	RTK Uncorrected Code Phase
22	Extended Base Station Parameters

Setting up using receiver screens and keypad

This section will instruct the user on the basic procedure using the necessary Z12 CGRS screens to setup a base station which broadcasts RTCM messages. For additional information regarding screen functionality, refer to Chapter 4, Screen Operation.

1. Reset the internal memory as follows:
   a. Turn the receiver OFF.
   b. While pressing the ▲ key, turn the receiver ON.
   c. Keep holding the ▲ key down until the message "Test of internal RAM. Will clear all data. Press YES within 10 seconds to continue" is displayed.
   d. Press [8] (YES) and a message appears: "Push any key to continue." Press any key to continue with the receiver normal operation.
2. Press [4] to go to screen 4 and On Screen 4, press Enter [e] to shift to data-entry mode.

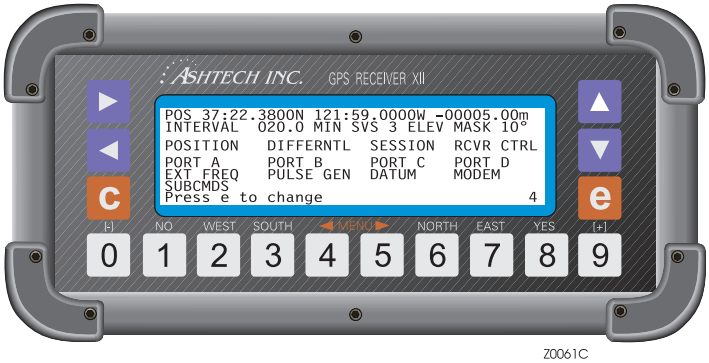


Figure 3.5: Screen 4

3. Enter the WGS 84 coordinates for the base station in the POS line (line 1 on screen 4). This position should be the position of the antenna, not the *ground truth* or *monument* position. If an antenna offset is associated with the base station setup, then add the antenna offset to the ellipsoidal height value and enter this new height along with the WGS84 Latitude and Longitude.

4. Highlight DIFFERNTL and press Enter [e] to go to the Differential Mode Selection Screen:

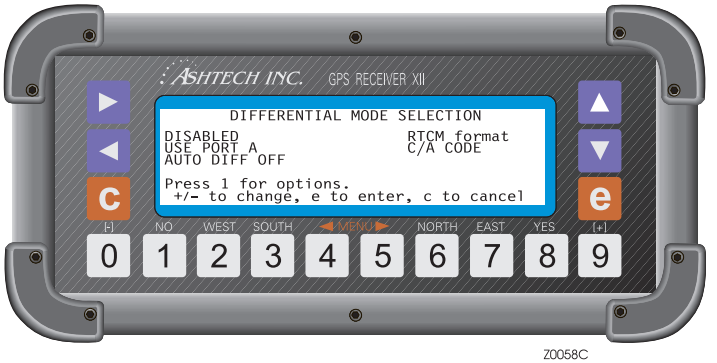


Figure 3.6: Differential Mode Selection Screen

5. Highlight “DISABLED” (the mode indicator) and press the [+] or [-] key to toggle to the “BASE” selection. You may also select this capability within the “RTCM format” subscreen.
6. Highlight the output port indicator and toggle it through “USE PORT A”, “USE PORT B”, “USE PORT C”, and “USE PORT D” until it corresponds with the serial port you wish to broadcast RTCM messages through.

WARNING
Broadcasting RTCM messages through a serial port causes it to become dedicated to that single task. Once RTCM messages are selected to output through a port, that port will no longer be available for any other type of communication.

7. Highlight “RTCM format” and press [1] to access the RTCM OPTIONS menu.

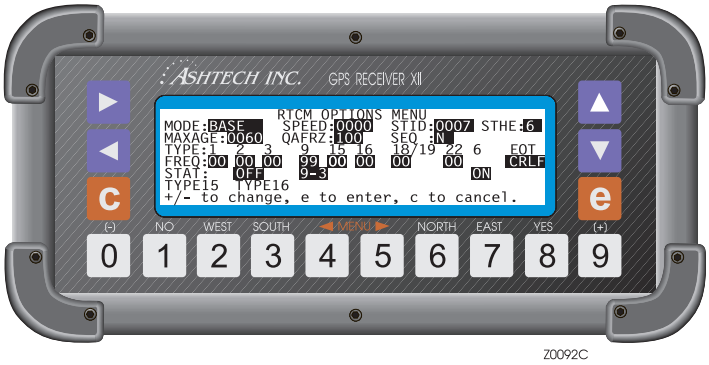


Figure 3.7: RTCM Options Menu

8. Set RTCM parameters referring to Table 3.7 if necessary. Press[e] to return to the previous screen when done. Refer to Chapter 4, Screen 4 - Differential Submenu for more information.

Table 3.7: Basic Differential Functions

Component	Function
MODE	Sets the receiver to operate RTCM differential in BASE, REMOTE or OFF. For a base station, set it to BASE. The REMOTE option is not supported in this firmware. The mode can be set here or on the Differential Mode Selection screen.
SPEED	The RTCM byte has 6 significant bits. The speed field allows users to set the bits per second (bps) rate for the serial port when the receiver is being used for differential base operation only. Available speeds are: 00, 25, 50, 100, 110, 150, 200, 250, 300 and 1500 (default setting is 50). If this field is set to 00, then the speed will be set to the baud rate that the serial port is set to. A “00” setting is recommended if message types 18 and 19 are selected.
STID	Is the reference station identification supplied by the user. It can be set to any number from 0 to 1023.

Table 3.7: Basic Differential Functions (continued)

Component	Function
TYPE	The Type field displays all RTCM message types that the CGRS is capable of generation. This field is display-only. When PL1 code is selected, Type 10 will be displayed instead of Type 1.
FREQ	The output rate for each RTCM message can be set using the frequency field. A frequency field is located beneath each of the message types. Each field can accept a value from 0 to 99. A setting of 0 means that no message will be generated. for the exception to this, refer to TYPE 2 in this table. The default setting for message Type 9 is 99, and is the recommended setting for high-speed differential operation. A setting of 99 provides for continuous Type 9 message output. Settings between 1-98 will output Type 9 messages relative to the value of that particular setting. For example, if Type 9 frequency is set at 30, a Type 9 message will be output every 30 seconds. All other messages have a default frequency setting of 0. Settings between 1-99 for message types 2, 3, 15, 16, 18, 19, and 22 will output a message relative to the value of that particular setting where message type 2, 18, and 19 will output in seconds and message types 3,15, 16, and 22 outuput in minutes. For example, if the frequency for message Type 3 is set to 5, then Type 3 messages will be output every 5 minutes.

9. If the position entered from step 3 has an antenna offset associated with it, and you wish to broadcast RTCM messages 18, 19, and 22 for RTK broadcasts, you must also highlight “ANTENNA PARAMS”. and press [1] to access the screen where the antenna offsets can be sent. Enter the values of your antenna offset, refer to Table 3.8.

Table 3.8: Antenna Offset Parameters

Parameter	Description
SLANT	Slant distance from the monument to antenna.
RADIUS	Radius of the antenna.
V-DIST	Vertical offset to physical center of antenna.

10. Press [e] twice to return to screen 4 and save the changes that have been made.

    RTCM messages should now be being output through the selected port of your CGRS receiver.

Setting up using receiver commands

This section will instruct the user on the basic serial commands necessary to setup a base station which broadcasts RTCM messages. For additional information regarding serial port commands, refer to Chapter 5, Serial Port Operation.

1. Establish communications with the receiver through the desired serial port using some communication program such as Ashtech's CGRS REMOTE or other terminal program. Ensure that the communications program is set to the same baud rate and parameters as the Ashtech CGRS Receiver.

   To verify the communication link, issue the followin command to the receiver:

   $PASHQ,RID

   The receiver should respond with a string beginning with $PASHR,RID. The receiver must respond before you can begin sending other commands.

2. Reset all user parameters to factory defaults:

   $PASHS,INI,b1,b2,b3,b4,1,0

   Where b1 through b4 are the baud rate indices of serial ports A through D. Refer to table 5.2 for baud rate indices.

3. Enter the base station WGS 84 coordinates:

   $PASHS,POS,ddmm.mmmm,d,dddmm.mmmm,d,saaaaa.aa

   This position should be the position of the antenna, not the *ground truth* or *monument* position. If an antenna offset is associated with the base station setup, then add the antenna offset to the ellipsoidal height value and enter this new height along with the WGS84 Latitude and Longitude.

   Enter the antenna offset with command:

   $PASHS,ANT,slant,radius,vertical

   Refer to chapter 5 for command descriptions.

4. Put receiver in RTCM base mode:

   $PASHS,RTC,BAS,x

   This will turn on RTCM correction output through port x, where x can be either A, B, C, or D.

WARNING
Do not broadcast RTCM messages out through a serial port you want to communicate through. Once RTCM messages are selected to output through a port, this port is no longer available for any other tasks.

5. Enable RTCM messages:

a. For code differential mode:

$PASHS,RTC,TYP,1,1

or

$PASHS,RTC,TYP,9,1

This enables RTCM type 1 or 9 messages to be broadcast at an interval of 1 second.

b. For RTK only mode:

$PASHS,RTC,TYP,1,0

$PASHS,RTC,TYP,3,1

$PASHS,RTC,TYP,6,OFF

$PASHS,RTC,TYP,9,0

$PASHS,RTC,TYP,18,1

$PASHS,RTC,TYP,19,1

$PASHS,RTC,TYP,22,1

This enables RTCM type 3,18,19, and 22 messages to be broadcast. Types 18 and 19 will be broadcast every second while type 3 and 22 will be broadcast once per minute. Type 1, 6, and 9 will be disabled.

c. For code and RTK modes:

$PASHS,RTC,TYP,3,1

$PASHS,RTC,TYP,9,1 or $PASHS,RTC,TYP,1,1

$PASHS,RTC,TYP,18,1

$PASHS,RTC,TYP,19,1

$PASHS,RTC,TYP,22,1

This enables RTCM type 3, 1 or 9, 18,19, and 22 messages to be broadcast. Type 1 or 9, 18, and 19 will be broadcast every second while type 3 and 22 will be broadcast once per minute.

6. Set the RTCM bit rate:

$PASHS,RTC,SPD,9

This will set the broadcast bit rate to the fastest speed, called *burst mode,* and is necessary when RTCM messages 18 and 19 are being broadcast.

RTCM messages should now be output through the selected port of your CGRS receiver.

Screen Operation

Screen 0 - Satellite Tracking Information

Screen 0 displays satellite tracking information for each of the receiver's 12 parallel channels. The screen is composed of a series of columns and rows which provide complete information on the channel activity. This includes the number of GPS satellites being tracked, the channel assignment (which channel is tracking which satellite), the ongoing search pattern, and the status of code phase and carrier phase tracking.

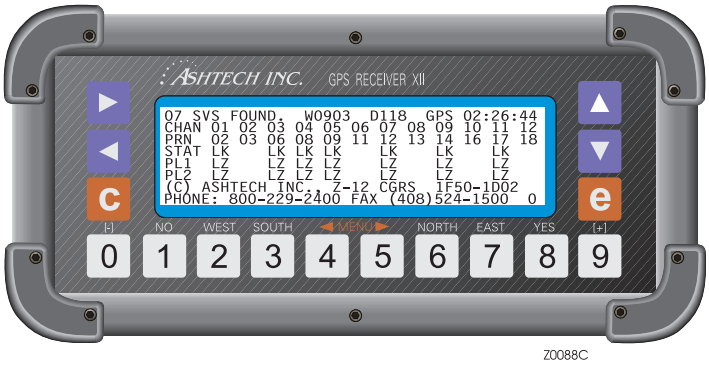


Figure 4.1: Screen 0

In addition to satellite tracking information, Screen 0 also displays the firmware version and the toll-free telephone numbers for Ashtech customer support and fax.

Screen 0 is a display-only screen; you cannot enter data in it. To view other screens in sequential order, press ▶ or ◀. To jump to another screen, press the number of a particular screen.

Table 4.1: Screen 0 Field Descriptions

Field	Description
SVS FOUND	The SVS FOUND field indicates the number of satellites found during the ongoing search pattern.
GMT 05:22:44	Time information is reported in the upper right of Screen 0. Prior to locking onto a satellite, this field displays time elapsed since the receiver was turned on. After the receiver locates the first satellite, this field switches to a GPS time display. Once the receiver is tracking a satellite, this field switches to a GMT time display.
CHAN	The CHAN column lists the 12 parallel channels of the CGRS receiver.
PRN	The PRN column displays the pseudorandom number (PRN) for each satellite in the ongoing search pattern. If the satellite is not locked on to after two minutes, a new satellite PRN number will be cycled into the search pattern. Once the receiver locks onto a satellite, that channel will be dedicated to tracking that satellite. The remaining free channels will continue to cycle PRN numbers in the ongoing search pattern. A PRN number shown in inverse video (blue numbers in a white box) indicates that the satellite is being tracked in Z-mode (AS on).
STAT	The STAT column displays the current status (SN or LK) of Coarse-Acquisition (C/A) tracking. SN The receiver identifies a possible C/A signal. LK The signal proves to be a GPS satellite. Once the satellite is locked, the receiver reads its ephemeris and almanac files.
PL1	The PL1 field displays the current status of the P1 code tracking. The PL1 column also reports SN for possible signal, and LK for lock. If Z-mode is engaged, LK will switch to LZ.
PL2	The PL2 field displays the current status of the P2 code tracking. The PL2 column also reports SN for possible signal, and LK for lock. If Z-mode is engaged, LK will switch to LZ.
CGRS	This column displays the receiver type and the firmware version being used. Have this information handy when calling Ashtech for technical support.
PHONE	The PHONE column displays the telephone number for Ashtech technical support.

Screen 1 - Satellite Orbit and Health Information

Screen 1 displays GPS satellite orbit and health information for each satellite currently being tracked. The upper column contains the PRN numbers of all satellites being tracked and searched for. Satellites that the receiver has locked onto will have a row of orbit and health information directly beneath the PRN number.

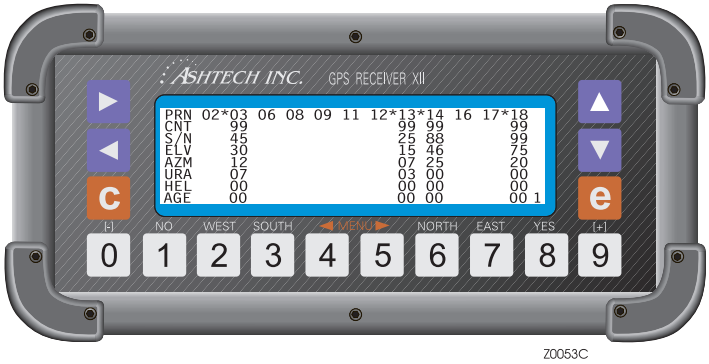


Figure 4.2: Screen 1

Three pages are available within Screen 1. Each page can be accessed by using the ▲ and ▼ arrow keys located on the right side of the keyboard display. The current screen and page information are displayed in the lower right portion of the screen. Page 1 contains satellite orbit and health information for the C/A code tracking. Page P1 and P2 contain satellite orbit and health information for P1 and P2 tracking respectively.

Table 4.2: Screen 1 Field Descriptions

Field	Description
PRN	The PRN column displays the pseudorandom number (PRN) for each satellite in the ongoing search pattern. An asterisk (*) preceding the PRN number indicates that the satellite is locked. If the PRN number is shown in inverse video (blue numbers in a white field), that satellite is being tracked in Z-mode (AS on).
CNT	The Continuous Field (CNT) keeps a record of the number of epochs of continuous GPS data that the receiver has recorded. This field provides an indicator of how well the receiver is tracking each satellite. During normal operation, the continuous field will climb to 99 and remain there. A 99 in the continuous field indicates that the receiver has established a good lock on the satellite. This field is updated every second. A drop from 99 to 0 indicates a cycle slip. Cycle slips are extremely rare during normal operations, occurring when an object overhead or nearby interrupts the GPS signal. If a cycle slip (loss of lock) occurs, the receiver must re-establish lock with that satellite.
S/N	The signal-to-noise (S/N) ratio field provides a measure of the satellite's signal strength. A signal below 20 is considered weak. A signal greater than 50 is considered strong. Satellites at a low angle above the horizon will have weaker signals than satellites at a high angle above the horizon.
ELV	The elevation (ELV) field displays the angle between the satellite and the local horizon. This value will be between 0° and 90°.
AZM	The azimuth (AZM) field displays the geodetic azimuth of the satellite relative to the receiver's current position. Geodetic azimuth is computed with respect to the WGS-84 reference frame. The azimuth scale begins at 0° (geodetic north) and increases clockwise in increments of 10°. When the azimuth value reads 12°, for example, this should be interpreted as 120°. It is important to note that the receiver cannot calculate elevation or azimuth until it begins to compute a position. An estimate of position can be entered into Screen 4, Mode Control to expedite the calculation.
URA	The URA field displays the range accuracy for each satellite currently being tracked. A URA value of 0 indicates that the range accuracy is high. A URA value greater than 8 indicates that the range accuracy is low.
HEL	The HEL field displays a hexadecimal health indicator. A health code of 00 indicates a healthy satellite with no apparent problems. See Appendix C for complete instructions on health code interpretation.
AGE	The AGE field shows the number of minutes that have transpired since lock was lost on a particular satellite. For example, if the elevation (ELV) field displays 35 and the age field displays 12, then the satellite was 35° above the horizon 12 minutes ago when a loss of lock occurred. The AGE field will reset to 0 when lock is re-acquired.

Screen 2 - Position and Navigation Information

Screen 2 displays position and navigation information based upon data the receiver collects from the GPS satellite constellation. For normal CGRS usage, there are two pages to Screen 2.

Page 1 of Screen 2 contains the autonomous position computation, the receiver's speed and heading, as well as the status of the current satellite geometry. Page 2 of Screen 2 displays waypoint navigation information. Waypoint navigation is covered in detail in Chapter 4 (Screen 6).

Screen 2/Page 1

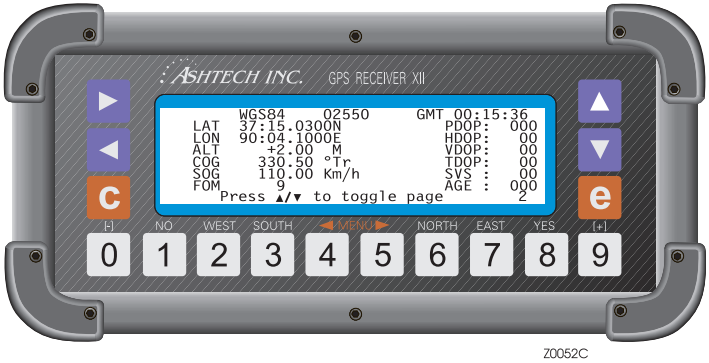


Figure 4.3: Screen 2, Page 1

Table 4.3: Screen 2, Page 1 Field Descriptions

Field	Description
WGS-84	The upper left field in column 1 displays the current datum. WGS-84 is the default datum. A wide range of other datums can be selected in Screen 4 in the Datum menu.
02550	The middle field in column 1 displays a position computation counter that increments every half-second (2Hz). This field will stop counting and display OLD when a position has not been computed in the last ten seconds. Once position computation resumes, the counter will resume from the last count. If a reference position is entered in Screen 4, the counter will reset to 0 and begin counting.
GMT	The last field column 1 displays the GMT time. In the example of Screen 2, page 1, the GMT time displayed is 00:15:36.

Table 4.3: Screen 2, Page 1 Field Descriptions (continued)

Field	Description
LAT	The LAT field displays the current latitude computed by the receiver. Latitude is reported in degrees and minutes to 4 decimal places. An N (north) or S (south) at the end of the latitude field indicates in which hemisphere the receiver is.
LON	The LON field displays the current longitude computed by the receiver. Longitude is reported in degrees and minutes to 4 decimal places. An E (east) or W (west) at the end of the longitude field indicates whether the receiver is east or west of the Greenwich prime meridian.
ALT	The ALT field displays the ellipsoidal height of the antenna. The altitude is always reported in meters.
COG	The course over ground (COG) field displays the receiver's current heading in degrees. Tr° equals true north.
SOG	The speed-over-ground (SOG) field displays the receiver's current velocity. Several different velocity units can be selected for this field through Screen 6; Option 8. These include kilometers per hour (KM/H), miles per hour (MP/H) and knots (KN).
FOM	The figure-of-merit (FOM) field provides an estimate of the accuracy of the stand-alone position computation. This estimate is based upon satellite range residuals and satellite geometry (PDOP). A value of 1 represents the greatest accuracy. A value of 9 indicates that a position is not being computed.
PDOP	Satellite geometry is represented by a value termed the Position Dilution of Precision (PDOP). Satellite geometry is defined by the number of satellites being tracked and their geometrical relationship to the receiver. The PDOP value increases or decreases as the satellite geometry changes. In general, as the number of satellites being tracked increases, the PDOP decreases. Similarly, as the satellites become more evenly distributed throughout the sky, the PDOP decreases. A PDOP greater than 6 indicates bad satellite geometry.
HDOP	The two-dimensional horizontal component of PDOP is defined as the Horizontal Dilution of Precision (HDOP).
VDOP	The height component of PDOP is defined as the Vertical Dilution of Precision (VDOP)
TDOP	The Time Dilution of Position (TDOP) is an error estimation of clock offset.
SVS	The satellite vehicles (SVS) field reports the number of satellites currently being used for position computation.
AGE	The AGE field reports the number of minutes elapsed since a position was last computed.

Screen 2/Page 2

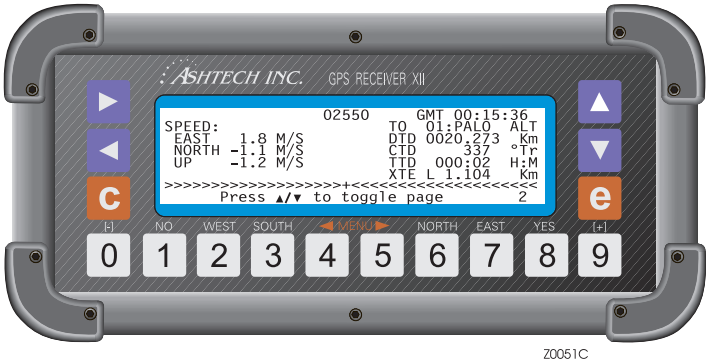


Figure 4.4: Screen 2, Page 2

Table 4.4: Screen 2, Page 2 Field Descriptions

Field	Description
SPEED	The east, north and up components of the receiver's current speed are displayed in the SPEED files. Velocities are reported in meters per second (M/S).
TO	The TO field displays the current waypoint name and number. Waypoints are entered through Screen 6.
DTD	The distance-to-destination (DTD) field displays the distance from the receiver's current location to the defined waypoint (the TO waypoint). Several different distance units can be selected for this field through Screen 6; Option 8. These include kilometers (Km), miles (Mi) and nautical miles (Nm).
CTD	The course-to-destination field displays the necessary course heading to follow to arrive at the current waypoint location. Course heading is displayed in true degrees (Tr°) or magnetic degrees (Mg°). Use Option 9 (Magvar mode) in Screen 6 to toggle between magnetic and true.
TTD	The time-to-destination field displays an estimate of time to arrival at the current waypoint. This estimate is based upon the receiver's current speed-over-ground (SOG).
XTE	Cross-track error provides the user with an indication of the current course deviation. Any deviation from the straight line between the FROM point (last waypoint) and the TO point (destination waypoint) will be reported as a cross-track error. Several different distance units can be selected for this field through Screen 6; Option 8. These include kilometers (Km), miles (Mi) and nautical miles (Nm). The cross-track error indicator [>>>>>>>+<<<<<<<] provides a visual representation of the current course error. This indicator is extremely helpful when trying to resume the correct course.

Screen 3 - Data Collection Information

Data collection information for each satellite currently being tracked is displayed in Screen 3. A series of dots and asterisks are used to indicate the amount of data collected from each satellite. A column of all dots to the right of a satellite indicates that no data has been collected for that particular satellite. Each asterisk in the column represents 5 minutes of collected data. For ease of reading, the data is separated into light and dark bands of 30-minute blocks. Screen 3 displays up to 180 minutes (3 hours) of data.

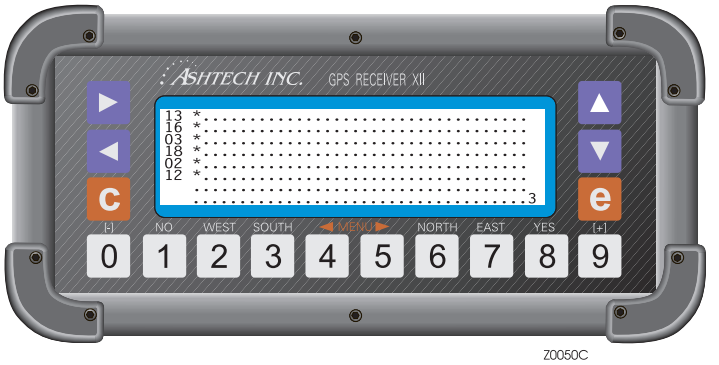


Figure 4.5: Screen 3

This screen does not refresh automatically. In addition, Screen 3 is display-only; no data can be entered in it.

Screen 4 - Receiver Control

Screen 4 contains numerous subscreens that allow the user to define many aspects of receiver operation. The layout of Screen 4 consists of a single page with 14 menu selections and 6 fields. A subscreen will open for each menu selection. Each of the 6 fields and all of the menus permit the user to enter information.

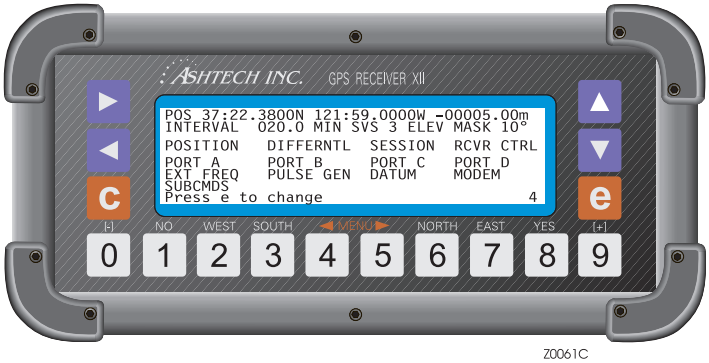


Figure 4.6: Screen 4

To enter information, simply press the Enter [e] key and use the arrow keys to toggle to the appropriate field or menu. For menu selections, press the Enter [e] key to activate the cursor. Once the cursor is activated, highlight the desired menu and press the Enter [e] key a second time. This will open the menu subscreen. Use the arrow keys and the alpha-numeric keypad to enter information in the CGRS receiver.

The Cancel [c] key can be used at anytime to clear any altered values. The receiver will ignore all changes made since the last entry (pushing the Enter [e] key a second time constitutes an entry).

The following section will cover the 6 fields located in the Screen 4 main display. A detailed explanation for each of the 14 menus will follow. The first portion of the field section will include a brief example demonstrating data entry.

Main Screen Fields

The two upper columns in Screen 4 (main screen) contain 6 separate fields which the user can edit. A reference position can be entered into the three fields which compose the upper column (lat, lon and alt). The next column down contains a field for the data recording interval, a field for the minimum number of satellites and a field for the elevation mask.

Reference Position (LAT, LON and ALT)

Entering a reference position is an important component of CGRS operation. High precision work demands a careful survey of the antenna location. The quality of data will depend heavily on the accuracy of the location of the CGRS antenna.

To enter the antennas reference coordinates:

1. Go to Screen 4 by pressing the [4] key.
2. Press the Enter [e] key to activate the cursor. The cursor will be positioned on the POSITION menu.
3. Depress the ▲ key twice to position the cursor at the beginning of the latitude field. Use the alpha-numeric keypad to enter the latitude (degrees and minutes). Ensure that either [N] or [S] is entered for the correct hemisphere (keys [6] and [3]).
4. The cursor will jump to the beginning of the longitude field after the latitude is entered. Enter the longitude. Ensure that either [E] or [W] is entered for the correct direction away from the prime meridian (keys [7] and [2]).
5. The cursor will jump to the beginning of the altitude field after entering the longitude. Enter the altitude in meters. Ensure that a [+] or [-] precedes the altitude entry. Press the Enter [e] key to save entered position information.

Table 4.5: Screen 4 Field Descriptions

Field	Descriptions
Interval	The interval field allows users to specify how frequently to record GPS data into memory. A default recording interval of 30 sec has been programmed into the CGRS receiver. Changing the data recording interval is as simple as positioning the cursor into this field and entering the new value. The CGRS receiver supports recording intervals from 0.5 sec to 999 sec. Data can be recorded at any half second interval (for example, 0.5, 1.5, 2.5, etc.). Any other fractional value will not be accepted. It is important to ensure that the proper recording interval is entered prior to the start of continuous operation (or survey session). The data recording interval should not be changed once data collection begins).
MIN SV	The minimum satellite vehicle field provides users with the ability to specify a minimum number of satellites that the receiver must track before data recording can begin. These satellites must have valid ephemeris data. The CGRS defaults to a minimum of 3 satellites.

Table 4.5: Screen 4 Field Descriptions

Field	Descriptions
ELEV MASK	The elevation mask allows users to set the cutoff angle below which satellite data will not be recorded. All satellites below this angle will continue to be tracked, but their data will not be recorded. Satellites below the elevation mask will, however, continue to be used for position computation. Position masking is controlled through the Screen 4 POSITION menu.
SUBCMDS	System-level commands are entered through the subcommands screen. These commands consist of three numbers and provide users with additional control over the CGRS unit. For example, the command used to reset the receiver to its original default values is 550. To enter system-level commands, highlight the SUBCMDS field and press Enter [e]. Enter the system level command and press Enter [e] again. The command will immediately take effect.

Screen 4 - Position Submenu

The POSITION menu contains 13 fields which allow users to set various position fix parameters. For example, elevation and DOP masking are controlled in the POSITION menu. Several aspects of position computation (recorded and displayed) are also controlled in this menu.

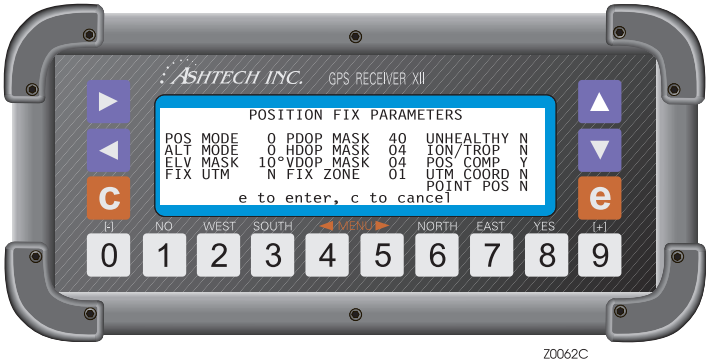


Figure 4.7: Screen 4, Position Fix Parameters

Table 4.6: Screen 4, Menu Fields and Descriptions

Field	Description
POS MODE	The position mode field allows users to specify whether to compute altitude or hold it fixed. This field can contain a value ranging from 0 to 3. Satellites used for position computation must be higher than the elevation mask specified in this subscreen. 0. At least 4 satellites must be tracked for position computation. Altitude will never be held fixed (default setting). The following settings for POS MODE require a minimum of three tracked satellites to compute position. 1. Altitude will be held fixed (not computed) if the number of tracked satellites equals three. Altitude will be computed when the receiver tracks 4 or more satellites. 2. Altitude is always held fixed regardless of the number of satellites tracked. 3. Altitude will be held fixed when the number of tracked satellites equals three. When more than three satellites are being tracked, the altitude computation depends on the HDOP. If the HDOP is less than the specified HDOP mask, the receiver will compute altitude. If, however, the HDOP is equal to or greater than the HDOP mask, the receiver will hold the altitude fixed. It is important to note that the altitude is always set to 0 immediately after the receiver is turned on. An altitude value should always be entered in the altitude field (Screen 4/main screen) if the position mode is set to 1,2 or 3.
ALT MODE	The altitude mode provides users with additional control in altitude computation. This field can contain either a 0 or 1 value. 0. In mode 0, the receiver will use the last entered altitude if the VDOP is greater than the specified VDOP mask. If the VDOP is less than the specified VDOP mask, the receiver will use the last computed value. 1. In mode 1, the receiver will only use the altitude entered in Screen 4 (main screen).
ELV MASK	The elevation mask is used to set the minimum elevation angle below which satellites will not be used for position computation. However, satellites that fall below this cutoff angle will still be used for data recording.
PDOP MASK	The PDOP mask allows users to define a PDOP threshold above which a position will not be computed. A position will not be computed when the actual PDOP value exceeds the entered value. (The default setting is 40).
HDOP MASK	The HDOP mask is used to set the HDOP threshold for position computation. A position will not be computed when the actual HDOP value exceeds the entered value. The position mode field must be set to 3 to activate HDOP masking.
VDOP MASK	The VDOP mask defines the vertical dilution-precision parameter. It is effective only when ALTD FIX MODE is set to 0. (The default is 4.)
UNHEALTHY	The UNHEALTHY field is used to specify whether or not unhealthy satellites should be used in the position computation. Unhealthy satellites will be used for position computation when this field is toggled to Y. When the field is toggled to N, unhealthy satellites will not be used for position computation.

Table 4.6: Screen 4, Menu Fields and Descriptions

Field	Description
ION/TROP	Ionospheric and tropospheric models have been incorporated into the CGRS receiver. Options: N - do not apply either model M - apply ionspheric model R - apply both ionospheric and tropospheric model
POS COMP	The position computation field allows users to toggle position computation ON and OFF.
UTM COORD	Universal Transverse Mercator (UTM) coordinates can be displayed by activating the UTM coordinates field. To do this, simply enter a Y in this field. The proper UTM zone should be entered into the FIX zone field simultaneous to activating the UTM display. Engaging the UTM display will not affect data collection.

Screen 4 - Differential Submenu

Differential capability is standard with the CGRS system. Most parameters affecting differential GPS operation are set in the differential menu. This menu is composed of 2 subscreens. The first subscreen is accessed through the RTCM format field. Use this subscreen to define the RTCM configuration. The second subscreen is accessed through the Antenna Params. Use this subscreen to define the antenna parameters for RTCM Message 22.

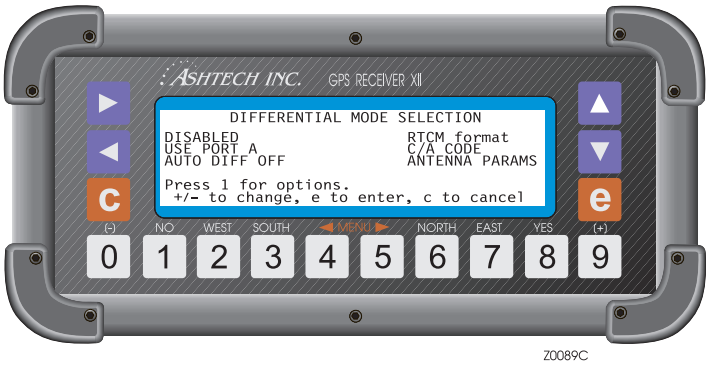


Figure 4.8: Screen 4, Differential Menu Selection

Table 4.7: Screen 4, Diffferential Menu Field Descriptions

Field	Descriptions
DISABLED (BASE/REMOTE)	The upper left field of the differential menu is used to activate differential operation. There are three differential modes: disabled, base and remote. To select one of these modes, position the cursor on the mode field and use the [+] and [-] keys to toggle to the desired mode. (The remote mode is not supported in this firmware. Selecting BASE will enable RTCM base station operation and commence generation of differential corrections through the selected port. Selecting REMOTE will enable RTCM remote station operation and prepare the receiver for input of RTCM differential corrections. Selecting DISABLED will deactivate RTCM differential operation.
USE PORT A	For RTCM base differential operation, an output port must be selected. The CGRS provides users with 4 distinct ports with which to work, and each port can be used for transmitting RTCM differential corrections. Use the [+] and [-] keys to toggle through the different ports (A, B, C and D). (The CGRS defaults to port A).
C/A CODE	Switch to enable the standard C/A code RTCM differential or the L1 P-code RTCM differential. Press [+] or [-] to toggle it through C/A code or PL1 code. When PL1 code is selected, a Type 10 message will be generated for P-Code differential corrections, instead of the Type 1 for C/A code differential correction. Both messages have the exact format.
AUTO DIFF OFF	The receiver can be programmed to automatically switch position computation from differential mode to autonomous (non-differential) mode in the event that a differential solution is not available. This provides a smooth transition from a high-accuracy differential solution to a lower accuracy autonomous solution. To activate this feature, set the AUTO DIFF OFF field to ON. Only used in Remote mode.
RTCM FORMAT	RTCM configuration is controlled through the RTCM FORMAT subscreen. Position the cursor on RTCM FORMAT and press 1 to access the subscreen. Each field is highlighted in white. The text in the currently-selected field will flash in inverse video to indicate that the cursor is positioned on that field. Use the arrow keys and the alpha-numeric keypad to highlight fields and to enter information.
ANTENNA PARAMS	Calls sumbmenu which allows user to set up antenna parameters used by RTCM message type 22. The fields are: • Slant - Slant distance from monument to outside edge of antenna. • Radius - Radius of antenna. • V-dist - Vertical offset to physical center of antenna.

RTCM Options - RTCM Format Submenu

Highlighting RTCM format on the Differential Mode Selection screen, press [1] to access the RTCM Options menu.

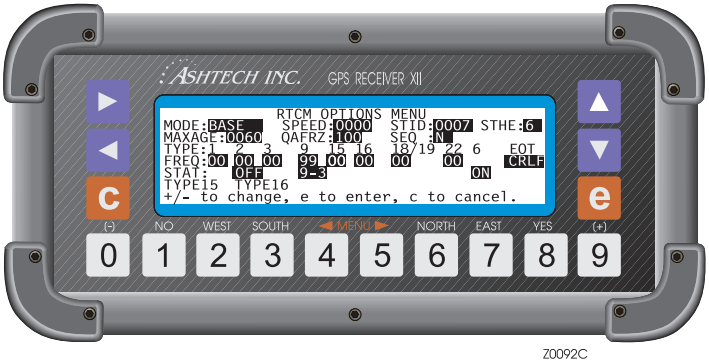


Figure 4.9: RTCM Options Screen

Table 4.8: Differential Mode Selection Screen Descriptions

Field	Description
MODE	Sets the receiver to operate RTCM differential in BASE, REMOTE or OFF. For a base station, set it to BASE. The REMOTE option is not supported in this firmware. The mode can be set here or on the Differential Mode Selection screen.
SPEED	The RTCM byte has 6 significant bits. The speed field allows users to set the bits per second (bps) rate for the serial port when the receiver is being used for differential base operation only. Available speeds are: 00, 25, 50, 100, 110, 150, 200, 250, 300 and 1500 (default setting is 50). If this field is set to 00, then the speed will be set to the baud rate that the serial port is set to. A “00” setting is recommended if message types 18 and 19 are selected.
STID	The station identification field can be set to any number from 0 to 1023.

Table 4.8: Differential Mode Selection Screen Descriptions

Field	Description
STHE	Is the reference station health. It can be set to a value from 0 to 7, based on conditions as follows: **Value** **Code** **Health Indication** 7 111 Reference Station not working 6 110 Reference Station transmission not received 5 101 UDRE scale factor = 0.10 4 100 UDRE scale factor = 0.20 3 011 UDRE scale factor = 0.30 2 010 UDRE scale factor = 0.50 1 001 UDRE scale factor = 0.75 0 000 UDRE scale factor = 1.00 The UDRE scale factor indicated the range of UDRE values for the set of corrections currently being transmitted or received.
MAXAGE	This feature is a useful data monitoring tool that allows users to set a message age threshold at the remote RTCM differential unit only. Values between 0-1199 seconds may be entered into the MAXAGE field. The default is 120. Note that any RTCM differential message that is older than the MAXAGE value will be rejected. For example, if the MAXAGE is set to 30, then any message older than 30 seconds cannot be used by the remote unit.
QAFREQ	The quality assurance frequency field provides remote differential users with a valuable tool for evaluating the communication between the base and remote units. This field determines the number of consecutive differential messages that must pass a parity check at the remote differential unit. Once each message has passed the parity check, a QA of 100% is displayed in Screen 5 of the remote unit (please refer to the Screen 5 section). If a value of 200 is entered, for example, then 200 consecutive differential messages must pass a parity check at the remote differential unit before the Screen 5 QA display reads 100%.The Screen 5 display will display a QA of 50% after 100 messages have passed the parity check. The default QAFREQ setting is 100. Note that the quality assurance frequency tool is only relevant for remote RTCM differential operation
SEQ	Sequential message checking is used to monitor data quality and can only be used by the remote differential station. Messages that are out of sequence will not be accepted when this feature is engaged. Use the [+] or [-] key to toggle this field between ON and OFF.

Table 4.8: Differential Mode Selection Screen Descriptions

Field	Description
FREQ	The output rate for each RTCM message can be set using the frequency field. A frequency field is located beneath each of the message types. Each field can accept a value from 0 to 99. A setting of 0 means that no message will be generated. for the exception to this, refer to TYPE 2 in this table. The default setting for message Type 9 is 99, and is the recommended setting for high-speed differential operation. A setting of 99 provides for continuous Type 9 message output. Settings between 1-98 will output Type 9 messages relative to the value of that particular setting. For example, if Type 9 frequency is set at 30, a Type 9 message will be output every 30 seconds. All other messages have a default frequency setting of 0. Settings between 1-99 for message types 2, 3, 15, 16, 18, 19, and 22 will output a message relative to the value of that particular setting where message type 2, 18, and 19 will output in seconds and message types 3,15, 16, and 22 outuput in minutes. For example, if the frequency for message Type 3 is set to 5, then Type 3 messages will be output every 5 minutes.
TYPE	The Type field displays all RTCM message types that the CGRS is capable of generation. This field is display-only. When PL1 code is selected, Type 10 will be displayed instead of Type 1.
TYPE 2	Output of RTCM Type 2 messages is controlled by the FREQ and Type 2 field. If Type 2 is turned off, then Type 1 or Type 9 messages will output corrections using old IODE values for 90 seconds after a IODE change has been detected. If Type 2 is turned on, but the FREQ value is set to 00, the Type 2 messages are broadcast for 90 seconds after the change has been detected.
TYPE 9	Allows user to choose between 9-1 and 9-3 RTCM formats. Type 9-3 is default.
TYPE 6	Output of RTCM Type 6 messages is controlled by the Type 6 field. Use the + or - keys to toggle this field from ON to OFF. The default is message Type 6. Message Type 6 is on by default.
TYPE 15/16	Calls submenu which allows user to set up information to be broadcast out RTCM message types 15 and 16.

Type 15 - RTCM Type 15 Submenu

When selecting TYPE 15 from the RTCM OPTIONS MENU. The RTCM TYPE 15 MESSAGE submenu appears, as shown below:

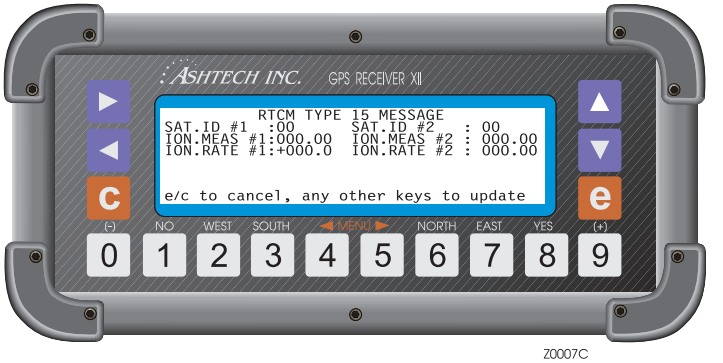


Figure 4.10: RTCM Type 15 Screen Message

This submenu is display only, no data can be entered.

Table 4.9: RTCM Type 15

Component	Function
SAT.ID #1/2	Satellite ID (PRN 1-32).
ION.MEAS #1/2	Ionospheric measurement un meters.
ION.RATE #1/2	Ionospheric rate measurement in centimeters per minute.

Type 16 - RTCM Type 16 Message Submenu

When selecting TYPE 16 from the RTCM OPTIONS MENU when the receiver is set to base mode, the RTCM TYPE 16 MESSAGE submenu appears, as shown below:

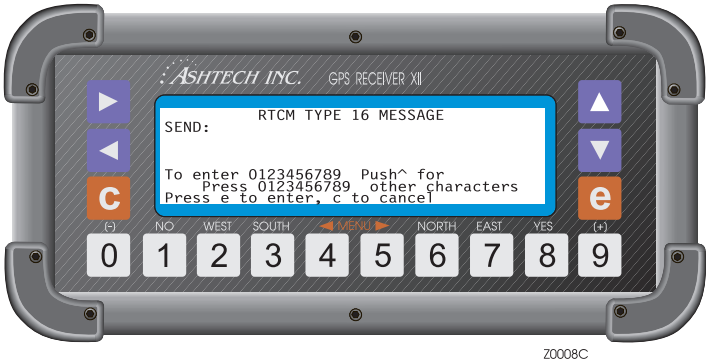


Figure 4.11: RTCM Type 16 “Send Message” Screen

To enter an ASCII message, type it using the keys on the receiver panel. To enter other characters than numbers, use the ▲ key to call them up on the screen and press one of the keys [0] through [9] that represents the desired character. The characters are displayed in blocks of ten. Five sets of characters are available.

Screen 4 - Session Submenu

Session programming is a highly versatile and useful feature of the CGRS receiver that allows users to program the receiver to automatically start and stop recording data during prespecified times. As many as 96 individual recording sessions can be predefined.

Session programming can be used in tandem with remote software to control a CGRS station from anywhere on earth. Many CGRS users place their systems in remote areas and use session programming and remote software to manage the system. All aspects of managing a CGRS system can be done through a modem, including downloading data files generated by session programming as well as entering new session programming parameters.

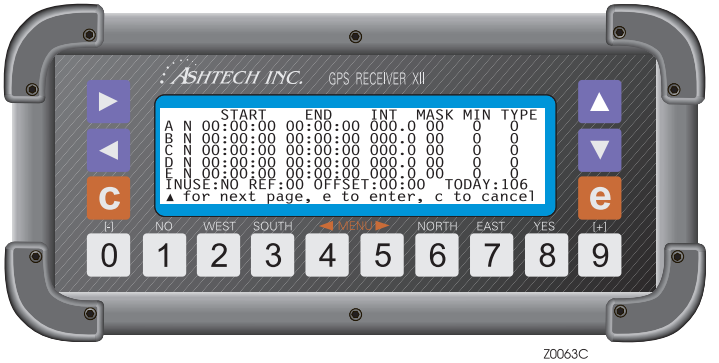


Figure 4.12: Screen 4, Session Programming

The pages of the session programming menu are composed of a series of columns and rows. The first 5 columns of any page contain the parameters for 5 data recording sessions. Each session begins with a numeric identifier (1-96) and is followed by 7 fields that users can edit. The ▲ key is used to scroll through the session programming pages.

The second-to-last column of each page contains 4 editable fields that include global parameters that affect all sessions. Note that the INUSE field must be set to YES before session programming is enabled. If the INUSE field is set to NO, no sessions will be activated. Below is a complete description of all fields that comprise the session programming menu.

Table 4.10: Screen 4, Session Menu Field Descriptions

Field	Description
N/Y	The first field allows users to activate or deactivate that particular session. Use the YES or NO keys ([1] or [8]) to switch this field ON or OFF. Note that the first field cannot have a value of 0.
START	Use the start field to define a start time (GMT) for the session. Enter hours, minutes and seconds. The field will reset to 0 or to the last legal value if an illegal value is entered.
END	Enter the session end time (GMT) in the END field. If the end time is earlier than the start time, the session will record to the end time in the following day.
INT	The interval field controls the data collection rate. This field may be set to a value ranging from 0.5 to 999.5 (half second increments are acceptable).
MASK	Use the mask field to set the elevation mask. Satellites below the entered value will not be used for data recording.

Table 4.10: Screen 4, Session Menu Field Descriptions (continued)

Field	Description
MIN	A minimum number of satellites may be specified for each session. The receiver will not record data if the number of satellites locked is below the threshold set in the MIN field.
TYPE	The data collection format can be selected in the Type field. Four data types are available. Once session programming is activated, the values programmed into the INT, MASK and MIN fields will override the equivalent values set in the Screen 4 main screen.
INUSE	A global session programming switch is incorporated into the lower left portion of the session menu screen. This field must be set to YES for any session programming to occur, regardless of any individual session setting. Setting the INUSE field to Y will activate any sessions where the individual session switch is set to Y. Please note that when the INUSE field is toggled to YES, the current file will be closed and a new one will be opened. The SESSION field in the main screen of Screen 4 will begin to flash once session programming has been activated. A flashing arrow will appear after the SESSION field in the menu screen of Screen 4 whenever session data is being recorded. The arrow will disappear during times when no session data is being recorded.
REF	A Julian reference day must be entered for session programming. If the REF field is set to 000, then session programming will not occur. Future reference days may be specified in the REF field. The receiver will not begin recording session data until the reference Julian day matches the current Julian day. If the reference field is set to a day of the year previous to the present, then session programming will start in the current day. For this case, a time offset will be applied to the session recording. This concept will be fully explained in the OFFSET section.
OFFSET	The OFFSET field provides users with an efficient tool for continuous session recording. By employing time offsets, users gain complete control over the future start and stop times of the original session parameters. Note that the value entered into the offset field only has relevance when the current day is greater than the reference day. No offset will be employed if the reference day equals the current day. For a day subsequent to the reference day, each session start and end time will be decremented by the time specified in the OFFSET field, multiplied by the day difference (where the day difference is the current day minus the reference day). Consider the following examples where the offset equals 4:00 and the reference day is set to 001. • On day 001, no time offset will be used. • On day 002, a 4 minute offset will be applied to each session's start and end times. • On day 003, an 8 minute offset will be applied to each session's start and end times. • On day 004, a 12 minute offset will be applied to each session's start and end times, and so on.

Screen 4 - RCVR CTRL Submenu

Several high-level receiver parameters are set through the receiver control menu. The receiver control menu contains one subscreen containing 4 fields. These fields influence the receiver's current tracking, data collection, block size, and whether GPS time interpolation is ON or OFF.

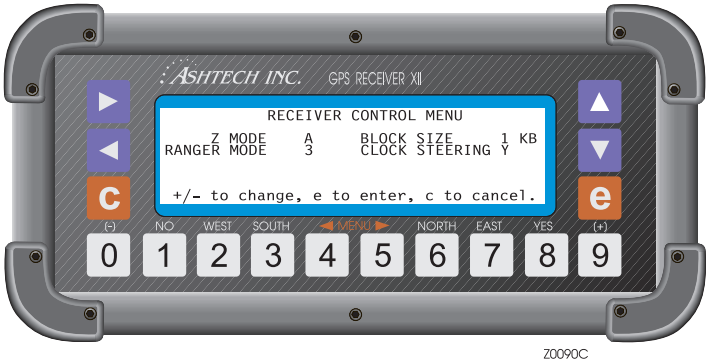


Figure 4.13: Screen 4, Receiver Control

Table 4.11: Screen 4, Receiver Control Menu

Field	Description
Z-MODE	Three possible Z-Tracking modes can be selected through the Z-mode field. Z-mode defaults to automatic [A], in which the receiver automatically switches between P-mode and Z-mode when Anti-Spoofing (AS) is activated and deactivated. The receiver automatically and seamlessly employs Z-Tracking to defeat AS. Ashtech recommends that this field be set to automatic [A] for most applications. When the receiver is set to Y, Z-Tracking is used for all satellites at all times. When the receiver is set to N, P-Tracking is used for all satellites at all times.
DATA MODE	The format and Type of data collected by the CGRS receiver is set through the data mode field. Four data modes (0, 1, 2, and 3) are supported by the receiver. Mode 0 Stores the Ashtech B file. This data includes full code and carrier phase information and can be post-processed by Ashtech software or converted to the RINEX format for third party processing. Mode 1 Stores code phase data only. This data can be post-processed by Ashtech software or converted to the RINEX format for third party processing. Mode 2 Stores position data. No code or carrier phase information is stored in Mode 2 (positions only). A Mode 2 file cannot be post-processed. If the receiver is a differential remote unit, then deferentially-corrected positions will be stored if Mode 2 is selected. The file produced by selecting Mode 2 is referred to as a C-file. Mode 3 Stores a compressed version of Mode 0. Mode 3 approximately doubles the available receiver memory. The compression process is transparent to users since the download software decompresses the file. Mode 3 data can be used for post-processing and for normal CGRS operation. **Note: If you will be using the ring buffer, you must select Mode 3. The ring buffer will only record Mode 3 data.**
Clock Steering	GPS clock steering can be switched ON or OFF in the CGRS receiver. When steering is active, the receiver will correlate its internal time with the GPS time of the satellite constellation. Default is ON.

Screen 4 - Port A/B/C/D Submenu

Standard with the CGRS receiver are four independent ports, each of which has its own menu in Screen 4. Ports can be programmed independently of the other ports to perform a wide variety of input/output (I/O) tasks. The CGRS receiver can also receive input from external sensors such as tiltmeters and meteorological stations through any of these 4 ports.

Each port can be used for outputting differential corrections. Real-time GPS data and real-time NMEA messages can also be output through any of the four ports. See Chapter 5, Serial Port Operation, for additional details.

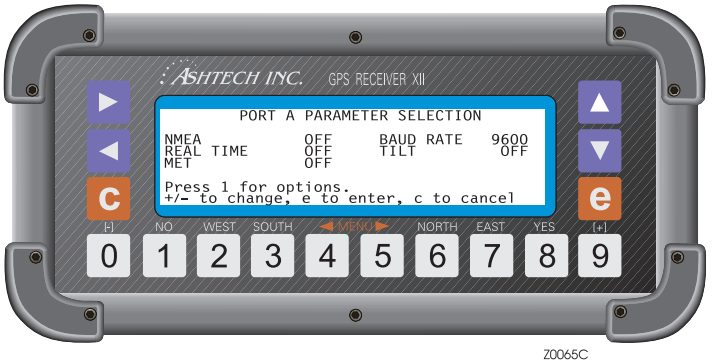


Figure 4.14: Screen 4, Port A Parameter Selection

To access the port menu subscreens, highlight the menu title and press Enter [e]. Each port menu is composed of 5 subscreens.

Table 4.12: Screen 4, Port A Parameter Selection Field Descriptions

Field	Description
NMEA	National Marine Electronics Association (NMEA) messages can be output in real-time through any of the 4 ports. The NMEA field allows users to both activate NMEA output as well as select which NMEA message(s) to output. To enable NMEA output, toggle the NMEA field to ON. Next, with the cursor still positioned on the NMEA field, press the [1] key to access the NMEA Options Menu subscreen. This subscreen allows users to enable or disable output of any of the 22 available NMEA messages. The NMEA output rate can also be set in this subscreen to a a value between 0.5 seconds to 99.5 seconds (in 0.5 second intervals).
REAL-TIME	Real-time GPS measurements can be set to output through any of the 4 serial communication ports. Five real-time messages are available: MBEN, PBEN, SNAV, SALM and DBEN. MBEN and PBEN can be output in either ASCII or binary format; SNAV, SALM and DBEN are available in binary format only. To enable GPS measurement output, toggle the REAL TIME field to ON. Next, with the cursor still positioned on the REAL TIME field, press the [1] key to access the MEASUREMENTS OUTPUT subscreen. The MEASUREMENTS OUTPUT subscreen allows the user to enable or disable output of any of the 5 available real-time messages. Output of any of the 5 messages can be activated by setting the message field to ON. The output format of MBEN and PBEN can be changed via the FORMAT field. Use the [+] or [-] key toggle this field between ASCII format and binary format.
DBEN	The DBEN serial output rate can be independently set via: 1. OUTPUT INTERVAL submenu/REAL TIME/PORT A(B, C, D)/SCREEN 4 2. The serial set command $PASHS, SOI, f (f can be 0.5 to 999.5) The DBEN serial output rate can also be verified by the serial query command $PASHQ, DOI.

Table 4.12: Screen 4, Port A Parameter Selection Field Descriptions (continued)

Field	Description
MET	A meteorological station can be connected to any of the 4 serial ports. The met station provides real-time information about temperature, barometric pressure and humidity. The met station can be powered by the CGRS receiver. A special cable is required for met station operation. This cable is provided by the manufacturer of the met station. This cable is used to connect the met station to a standard CGRS serial cable. Once the met station is connected, toggle the MET field to ON. Next, with the cursor still positioned on the MET field, press the [1] key to access the MET OPTIONS subscreen. This subscreen allows users to define an initialization string, define met commands and set the met sample rate. The initialization string sent to the met station can be selected through the INIT STRING field. This string will be sent to the met station immediately after the MET field is toggled to ON. The initialization string sends startup information to the met station. Several common initialization strings have been programmed into the CGRS receiver. The USER DEFINED field allows users to create new initialization strings as the need arises. A NO INIT STRINGS field is also available which can be selected in the event that no startup strings need to be sent. A complete list of met commands are provided by the met station manufacturer. A command can be sent periodically to the met station. The MET field allows users to define commands that will be sent according to the selected met sample rate. For example, if the met sample rate is set to 5 seconds, then a met command will be sent from the CGRS receiver to the met station every 5 seconds. Several common met commands have been programmed into the CGRS receiver. The USER DEFINED field allows the CGRS user to create new met commands. No met commands will be sent if the USER DEFINED field is programmed to be empty. The complete list of met commands will be provided by the met station manufacturer. The met sample rate is controlled by the MET SAMPLE field. This value can be set from 0.5 to 999.5. (Only half-second increments are valid.)

Table 4.12: Screen 4, Port A Parameter Selection Field Descriptions (continued)

Field	Description
TILT	One or more tiltmeters can be connected to the CGRS receiver. With resolution better than 1 micron per meter, tiltmeters provide the earliest indication of monument deformation. Many continuous GPS arrays employ tiltmeters to precisely measure monument motion. Tiltmeters can be used for a wide variety of other applications as well. The CGRS can manage up to two arrays of tiltmeters for monitoring of large engineered structures and natural hazards, such as volcanos, oil fields, bridges, dams and skyscrapers. The CGRS provides an accurate reference datum for measurements made with tiltmeters. This information is automatically written to memory and can also be output in real-time. Special Windows-based software provides a real-time three-dimensional picture of deformation. Cabling required for tiltmeter operation is provided by the manufacturer of the tiltmeter. Connect the tiltmeter cable to serial port A/B/C or D. Once the cable is connected, toggle the TILT field to ON. Next, with the cursor still positioned on the TILT field, press the [1] key to access the TILT OPTIONS subscreen. This subscreen allows users to define an initialization string, define TILT commands, and set the TILT sample rate. The initialization string sent to the TILT station can be selected through the INIT STRING field. This string will be sent to the TILT station immediately after the TILT field is toggled to ON. The initialization string sends startup information to the tiltmeter(s). Several common initialization strings have been programmed into the CGRS receiver. The USER DEFINED field allows the CGRS user to create new initialization strings as the need arises. A NO INIT STRINGS field is also available which can be selected if no startup strings need to be sent. A complete list of TILT commands are provided by the TILT station manufacturer. A command can be sent periodically to the tiltmeter(s). The TILT CMD field allows the user to define commands that will be sent according to the selected tilt sample rate. For example, if the tilt sample rate is set to 5 seconds, then a tilt command will be sent from the CGRS receiver to the tilt station every 5 seconds. Several common tilt commands have been programmed into the CGRS receiver. The USER DEFINED field allows the CGRS user to create new tilt commands. No tilt commands will be sent if the USER DEFINED field is programmed to be empty. The tilt sample rate is controlled by the TILT SAMPLE field. This value can be set from 5 to 999. (Only second increments are valid.)

Screen 4 - EXT FREQ Submenu

Standard with the CGRS receiver is external frequency input, which allows users to input an external frequency into the CGRS unit to reduce clock drift. The internal oscillator is disabled when an external frequency is input. External frequencies from 1 to 21 MHz may be input in 10KHz steps. The CGRS can be configured such that external frequency input is maintained through a power cycle. To access the EXT FREQ subscreen, position the cursor on the EXT FREQ field and press Enter [e].

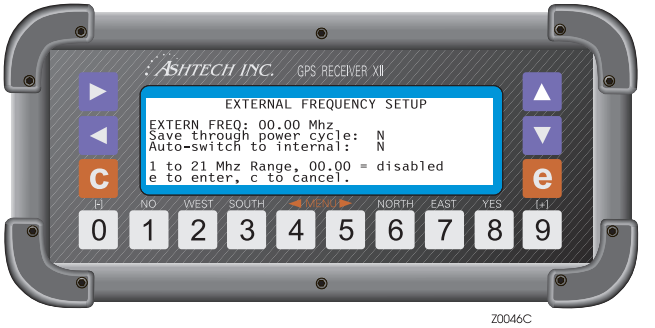


Figure 4.15: Screen 4, External Frequency Setup

Table 4.13: Screen 4, External Frequency Setup Field Descriptions

Field	Description
EXTERN FREQ	This field is used to enter the frequency of the external clock being used. A value ranging from 1 to 21 in 10KHz steps may be entered. Press Enter [e] to save changes made to this field. The default value of the EXTERN FREQ field is 00.00. Entering 00.00 disables the external reference feature.
AUTO-SWITCH	The AUTO-SWITCH field allows users to control whether the external frequency will be used after a power cycle. If this field is set to N, then the external frequency will not be maintained after a power cycle. However, if this field is to Y, external frequency will be used after a power cycle. Press Enter [e] to save changes made to this field.
STATUS	The STATUS field indicates whether an external frequency device is currently being used. This field will display LOCKED when an external frequency device is present and operating correctly. A display of NOT LOCKED indicates that either no external frequency device is present, or that one is present but not functioning properly.

Screen 4 - PULSE GEN Submenu

A pulse generation feature is standard with the CGRS receiver. This signal is synchronized with GPS, and the period of the pulse may be changed from 0.5 seconds to 60 seconds (in half-second increments). The default setting is 1 second (1 PPS).

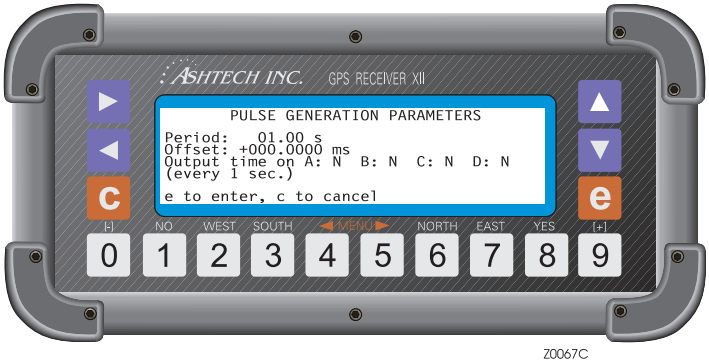


Figure 4.16: Screen 4, Pulse Generation Parameters

The pulse signal is a TTL signal into 75ohm impedance. The signal is normally low and increases 1 to 2 rms before the falling edge. The rising edge is synchronized with GPS time. {diagram}

Subcommand 990 can be used to synchronize the falling edge with GPS time (see SUBCOMMAND MENU section). Issue command 991 to restore the synchronization to the rising edge. .

Table 4.14: Screen 4, Pulse Generation Parameters Field Descriptions

Field	Description
PERIOD	Use the PERIOD field to set the pulse generation period. This field can be set from 0.5 seconds to 60 seconds in half-second intervals.
OFFSET	The pulse signal my be advanced or delayed by as much as 500ms. This time offset may be applied in 100 nanosecond steps. Enter a [+] or [-] to advance or delay the signal.
OUTPUT	The OUTPUT field controls which of the 4 serial ports will output the pulse signal. Select either Y or N to enable or disable output on any particular port.

Screen 4 - DATUM Submenu

Over 49 different geodetic datums are available to the CGRS user. The DATUM menu allows users to compute positions based on local datums instead of the internationally-recognized World Geodetic System 1984 (WGS-84) coordinate system. Note that the datum selected in this screen will be used only for the position computation displayed in Screen 2. The position stored in memory is always computed using WGS-94.

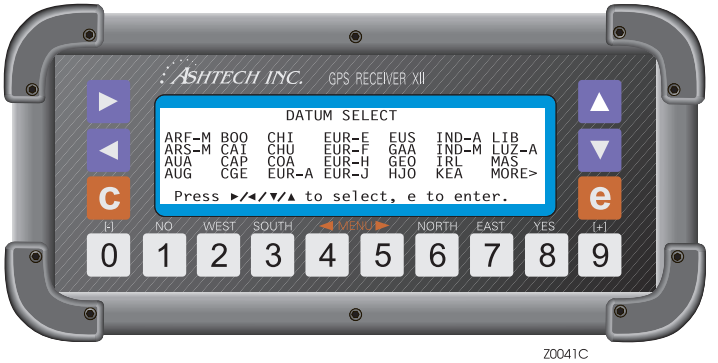


Figure 4.17: Screen 4, Datum Select

A geodetic datum is a coordinate system for surveying and mapping. A reference ellipsoid is associated with each datum. GPS coordinates are typically based on the WGS-84 datum developed by the former Defense Mapping Agency (DMA). The WGS-84 datum provides a global reference frame for GPS users. Because most geodetic datums were developed long before satellite navigation, they are quite different from each other and from the WGS-84 datum.

Each country worldwide typically has one or more local geodetic datums for surveying, mapping and navigation. The DATUM menu provides CGRS users with the world's most common geodetic datums. When a geodetic datum other than WGS-84 (default) is selected, the receiver automatically performs a transformation from the WGS-84 system to the selected system. The coordinates for the local geodetic datum are then displayed in Screen 2.

Note that using the wrong geodetic datum and associated reference ellipsoid for a particular area of the earth can result in errors as large as 1500 meters. It is therefore good practice to be aware of and understand local geodetic datums.

To access the two DATUM subscreens, highlight the DATUM menu field and press Enter [e]. Highlight MORE and press Enter [e] again to access to second subscreen. Position the cursor over the desired datum and press Enter [e] a third time to reach Screen 4. Users can verify selections made by returning to the DATUM subscreens. The selected datum will appear in the upper left of Screen 2.

A USER field within the second subscreen allows users to create transformation parameters. Highlight the USER option and press Enter [e]. Use the number keys to enter values for the following parameters: A delta axis parameter, a delta flattening parameter, and delta x, y and z parameters. Press Enter [e] again to save changes. The position displayed in Screen 2 will now align to the geodetic datum.

Screen 4 - MODEM Submenu

The CGRS receiver provides full modem support on all 4 ports. The MODEM subscreen contains 2 fields which allow users to select the port to which the modem is connected as well as the modem type.

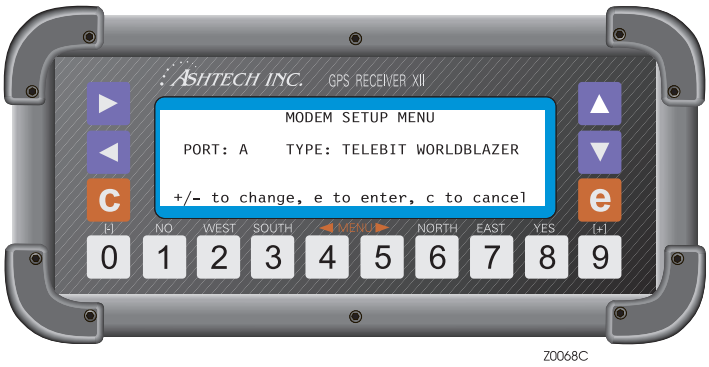


Figure 4.18: Screen 4, Modem Setup Menu

Table 4.15: Screen 4, Modem Setup Menu Field Descriptions

Field	Description
PORT	Use the PORT field to select the port to which the modem is connected. Ports A, B, C and D are all available for modem applications.
TYPE	The TYPE field allows users to select the modem Type being used. Three preprogramming modem types are available: Telebit Trailblazer™, Telebit Worldblazer™ and Telebit Cellblazer™. A USER DEFINED field is provided for all other modems. To use a modem other than one that is preprogrammed, enter its initialization string into the USER DEFINED field. To do this, highlight the Type field and press the [+] key until USER DEFINED appears. Next, press the ▼ key to access the alpha-numeric display. Enter the initialization string for the modem and press Enter [e] to save all changes made.

Screen 4 - SUBCMDS Submenu

The SUBCMDS option lets you enter system-level commands; this can also be done through screen 8. To enter a command, go to Screen 4 and select the SUBCMDS option. You will see this subscreen:

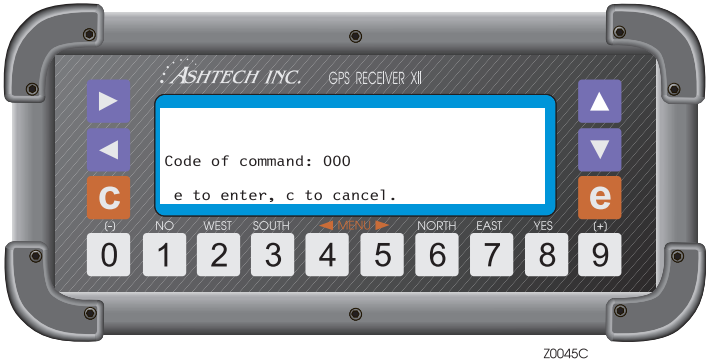


Figure 4.19: Subcommands Menu

To enter system-level commands, start by pressing [e] for data-entry mode, the use the numbered keys. For example, enter the numeric command [5], [5], [5] into the data-entry field and press [e] again. The receiver will execute the command and return you to screen 4.

The table on the next page lists the available commands.

Table 4.16: Screen 4, SUBCMDS Descriptions

Command	Function
100	Turn off backlighting after 2 minutes since last key press (Default).
101	Keep backlighting on. Warning if backlighting is left on, the receiver will draw significantly more power.
123	Close a file.
191	Initalize the modem.
550	Reset receiver to original default values.
555	Save user parameters.
737	Initalize the modem.
888	Display configuration identification (information such as serial number, list of installed options, nav bolard, channel board).
990	Trigger photogrammetry on falling edge.
991	Trigger photogrammetry on rising edge.
999	Delete all photogrammetry pictures.

Screen 5 - Differential Information and Range Residuals/Position Error

Two different displays are available in this screen: Page 1 displays differential information and Page 2 displays range residuals and position error information. To toggle between the pages, press the ▲ or ▼ keys. The mode (BASE or REMOTE) set on the Differential Selection screen (DIFFERNTL submenu of Screen 4) determines the information shown on page 1 of Screen 5. Therefore, interpreting it depends on whether the receiver is in base or remote mode. (The remote mode is not supported in this firmware.)

Page 2, the range residual and position error screen, displays each satellite range residual (difference between the measured and the calculated range), along with the horizontal and vertical position errors.

RTCM Information

The RTCM information displayed on Screen 5 depends on whether the unit is set as a base or remote station. In base mode, it displays information about transmitted messages; in remote mode, data from received messages is displayed.

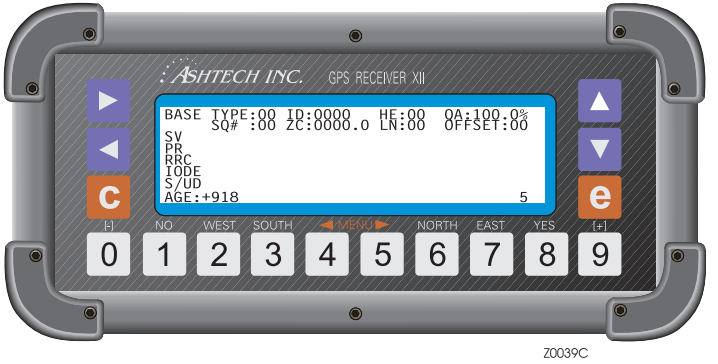


Figure 4.20: Screen 5, Page 1

Table 4.17: Differential Information and Range Residuals Field Descriptions

Field	Description
TYPE	This indicates the type of message to be generated or that is being received.
STID	This refers to the reference station identification, set on the RTCM Options screen (base mode) or received from the base station.
STHE	This is the reference station health, set on the RTCM Options screen or computed based on UDRE values or ones received from the base station.
SYNC	This field indicates that the receiver is synchronous with a message. It has decoded a message, captured its sequence number (SQNU), and found that its parity was good. The receiver displays a question mark (?) when a given message does not carry the next sequential number expected by the receiver. The question mark may be displayed for the first message since there is no previous message with which to be in sequence.
SQNU	This indicates the RTC message sequence number, generated by the base or received by the remote receiver.
ZCNT	This field is the RTCM message Z count.
FLEN	This contains the RTCM message frame length.
PRN	PRN is the pseudo-range correction in meters. Negative numbers are shown in inverse video.
RRC	This field indicates the range-rate correction in centimeters per second. Negative numbers are shown in inverse video.
IODE	IODE is the issue of the data.
S/UD	This is the scale factor and user-differential range error.
AGE	In base mode, AGE provides the time elapsed in seconds since the beginning of the transmission of a Type 1 or Type 9 message until a new Type 1 or Type 9 message is generated.
QA	This field indicates the communication-quality factor, defined as: (number of good messages/total number of messages) x 100
OFFSET	OFFSET represents the number of bits from the beginning of the RTCM byte in case of bit slippage.

Range Residuals

Page 2 of Screen 5 displays the range residuals and position errors determined during position computation. To toggle between pages, press the ▲ or ▼ keys.

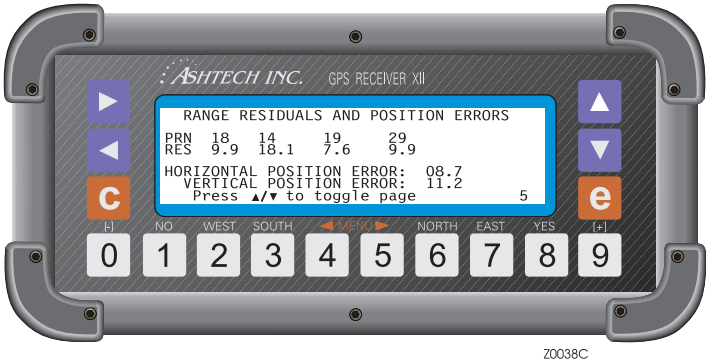


Figure 4.21: Screen 5, Page 2

Table 4.18: Screen 5, Page 2 Field Descriptions

Field	Description
PRN	This indicates the PRN number of satellites being tracked.
RES	RES represents the range residual associated with each satellite.
HORIZONTAL/VERTICAL POSITION ERROR	This is the horizontal/vertical rms position error in meters.

Screen 6 - Waypoint Control

This screen is not supported for CGRS receivers and the following information is presented for educational purposes only.

The Navigation Option defines a navigation route and provides a way to enter the latitude and longitude of each waypoint included in the route. Knowing the route information and the coordinates of each point, the receiver can compute the distance between the present position and the next destination point (DTD), the course to follow to reach the next destination point (CTD), the time it will take to reach this point (TTD) based on the present speed over ground, and the cross-track error (XTE), which is the deviation from the track between the present position and the net destination waypoint. All this navigation information is displayed in Screen 2.

The first line of Screen 6 shows the route information in terms of waypoint numbers, in which the leg currently being followed will be highlighted. The remaining screen displays a list of records showing the current and next waypoints in the route. Each waypoint record consists of a 2-digit waypoint number, a 7 character name, a latitude, and a longitude. Coordinates are entered in degrees, minutes and decimal minutes. Up to 99 waypoints can be stored and a route can be composed of up to 20 waypoints.

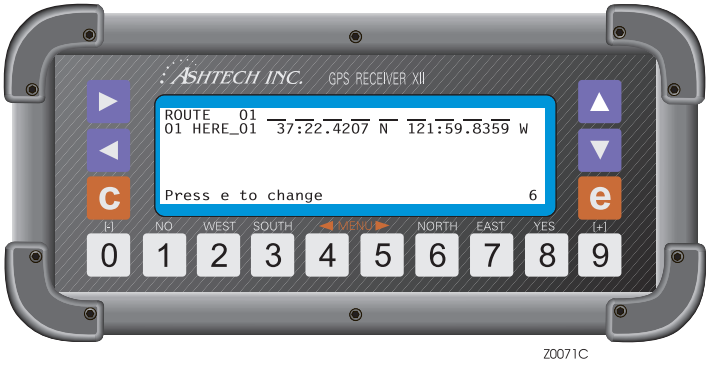


Figure 4.22: Screen 6

If no information has yet been defined, Screen 6 shows the route with only waypoint 01, and the list of records shows waypoint 01 with no name and coordinates.

Within Screen 6, there is a menu of functions that allow users to enter the information required for this option to be active. To access these functions, go to Screen 6 and press Enter [e]. The following display appears:

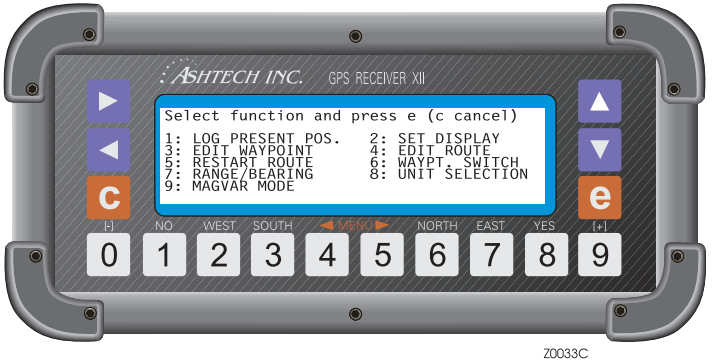


Figure 4.23: Screen 6, Menu

To activate all functions, press the corresponding number and the screen changes for that a function. Alternatively, highlight the function and press Enter [e].

To view the options associated with functions 2, 5 and 6, highlight the function and press [0].

The two main functions within this menu are: 4-EDIT ROUTES and 3-EDIT WAYPOINT. EDIT ROUTES creates or edits a route, and adds or deletes points from the route. EDIT WAYPOINT defines a list of waypoint records (associated or not with the route) where the name and coordinates of each waypoint have to be included.

LOG Present POS

This function saves the present location as a waypoint. When you select 1: LOG PRESENT POS, the receiver records its current latitude and longitude in the next available waypoint in the list and names it HERE_XX, where XX is the next sequential number starting with 01. Up to 99 positions (HERE_01 to HERE_99) can be logged this way. The logged position is momentarily displayed in Screen 6, in the first waypoint line, acknowledging it was stored. The next time Screen 6 is accessed, the first waypoint line shows the first waypoint of the route.

SET DISPLAY

This function specifies whether the list of records displayed in Screen 6 is the list of waypoints that make the route, or a specific set of selected waypoints.

To access this function, highlight “SET DISPLAY” and press [0]. The following screen appears:

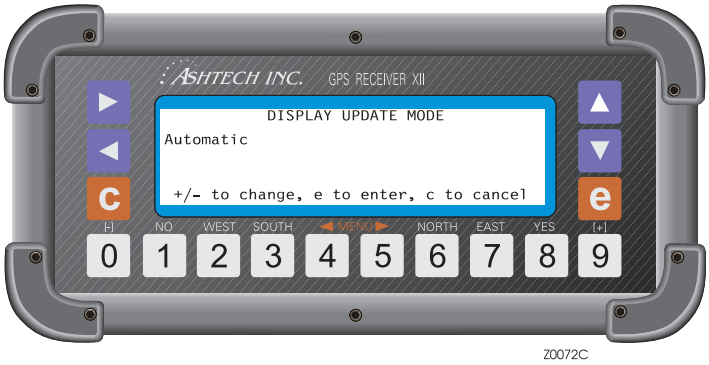


Figure 4.24: Screen 6, Set Display

Press [+] or [-] to toggle between MANUAL and AUTOMATIC. When the AUTOMATIC option is selected, the receiver automatically displays the list of records of the current and next waypoints in the route. By default, the receiver is set to AUTOMATIC. If, instead, MANUAL is selected, the receiver displays a specific set of selected waypoints. To save this selection and return to the main menu, press Enter [e].

To define the set of waypoints displayed in MANUAL mode, proceed as follows:

1. Highlight the function “SET DISPLAY” and press Enter [e]. A simulation of Screen 6 without the route appears.
2. The entry number of the first record is highlighted. Using the ▲ or ▼ keys, scroll through the list until the desired waypoint is found. Or, using the numbered keys, enter the waypoint number, and then the name and coordinates of that waypoint are displayed.
3. Using the ▶ key, select the next waypoint.
4. Continue selecting until satisfied.
5. Press Enter [e] and the set of selected waypoints are displayed in Screen 6.

To return Screen 6 to the waypoints list, select AUTOMATIC

EDIT WAYPOINT

This function creates, edits and/or clears a waypoint, and copies the information of one waypoint to another.

To access this function highlight EDIT WAYPOINT, and press Enter [e]. The following screen appears:

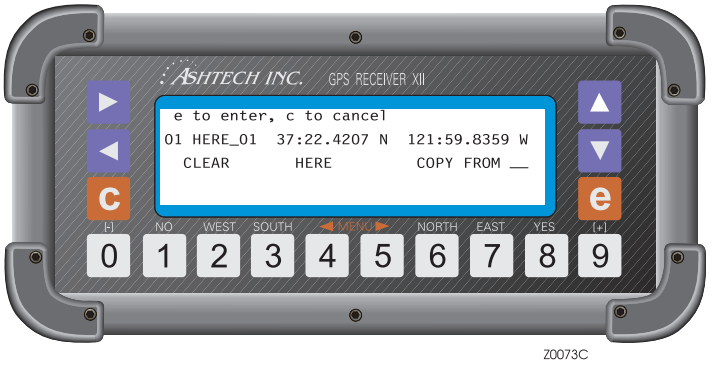


Figure 4.25: Screen 6, Edit Waypoint

To edit a waypoint, proceed as follows:

1. With the waypoint number highlighted, cycle through the list of waypoints, using the ▲ and ▼ keys until the desired waypoint is displayed. Alternatively, using the numbered keys, enter the waypoint number.
2. Press the ► key to move the cursor to the name field and to bring up the alphanumeric conversion table at the bottom of the screen. Enter the waypoint name.
3. Using the t key, move to the next field and overwrite the latitude (including N or S) and the longitude (including E or W). From the data field, press Enter [e] to save the waypoint information. The ▼ and ▲ keys allow you to move from one field to the other, while the ► and ◄ keys allow you to move from one character to the other.

The EDIT WAYPOINT option has three additional functions available: CLEAR, HERE, and COPY FROM. The CLEAR function clears the information of a waypoint. To use this function, do the following:

1. Select a waypoint with the waypoint number highlighted and using the ▼ and ▲ keys, or the numbered keys.
2. Using the cursor, highlight the CLEAR field and press the Enter [e] key. The name of the waypoint is cleared and the latitude and longitude reset to zero.
3. From the data field, press the Enter [e] key to save the changes. If desired, you can edit a new waypoint.
4. Press Enter [e] to return to the main screen.

The HERE function logs the current position into a selected waypoint (similar to the LOG POSITION option).

1. Select a waypoint with the waypoint number highlighted and using the ▼ and ▲ keys, or the numbered keys.
2. Using the cursor, highlight the HERE field and press the Enter [e] key. The current position is logged to that waypoint position and the information displayed. The waypoint is renamed HERE_XX, where XX is the next sequential number assigned to a logged position beginning from 01.
3. From the data field, press the Enter [e] key to save the changes. If desired, edit a new waypoint.
4. Press Enter [e] to return to the main screen.

The COPY FROM function copies the information of one waypoint to another.

1. Using the ▼ and ▲ keys, or the numbered keys, select the waypoint to be copied TO.
2. Using the cursor keys, highlight COPY FROM. A waypoint is displayed by the COPY FROM field and its coordinates will be displayed at the bottom of the screen. Using the ▼ and ▲ keys, or the numbered keys, select the waypoint to be copied FROM.
3. Press [e] and the FROM waypoint information is copied to the TO waypoint. Edit the copied information if necessary.
4. From the data field, press Enter [e] to save the waypoint.
5. If desired, edit a new point. If not, press Enter [e] to return to Screen 6.

EDIT ROUTE

This option creates or modifies a route. You can edit, add or remove waypoints from the route, and also reverse the order of the waypoints in the route.To select this option, highlight EDIT ROUTE and press Enter [e]. The following screen appears:

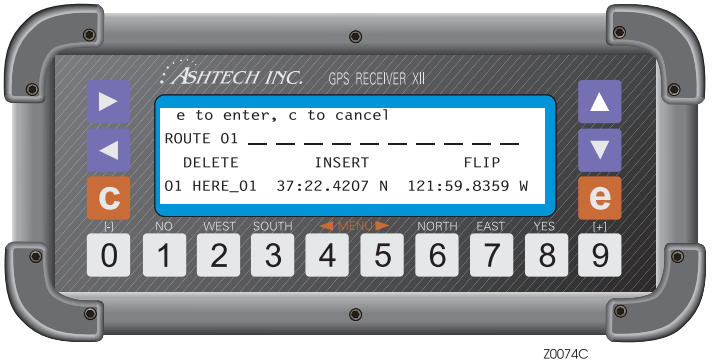


Figure 4.26: Screen 6, Edit Route

The screen shows the current route and, at the bottom of the screen, the information associated with the highlighted waypoint. To edit the route, highlight the point to be edited and modify it as necessary. Use the ▶ and ◀ keys to move the cursor from one waypoint to the other. Use the ▲ key to scroll through the waypoint list and modify a waypoint number. Alternatively, use the numbered keys to modify the waypoint number.

The EDIT ROUTE option has three additional functions: DELETE, INSERT, and FLIP.

The DELETE function allows you to delete a waypoint from the route.

1. Use ▶ and ◀ to highlight the waypoint to be deleted.
2. Using the ▼ key and the ▶ or ◀ key, highlight DELETE. The selected waypoint blinks.
3. Press Enter [e] and the waypoint is deleted.
4. Move the cursor up to the route field and press [e] to save the changes.
5. Press Enter [e] or Cancel [c] to go back to screen 6.

The INSERT function allows you to add waypoints.

1. Using the ▶ and ◀ keys, highlight the position in the route where you want to add the new waypoint.

2. Using the ▼ key, and the ▶ or ◀ key, highlight INSERT. The selected waypoint blinks.
3. Press Enter [e] and waypoint 01 is added. The waypoint previously in that position is moved one location to the right and the added way point blinks.
4. Move the cursor up to the route field to edit the newly entered waypoint and press Enter [e] to save.
5. Press Enter [e] or Cancel [c] to go back to Screen 6.

The FLIP function reverses the order of the waypoints in the route.

1. Using the ▼ and the ▶ or ◀ keys, highlight FLIP.
2. Press Enter [e] and the order of the waypoints in the route is reversed. The last point is the first destination point of the previous route.
3. Move the cursor to route field and press Enter [e] to save the changes.
4. Press Enter [e] or Cancel [c] to go back to Screen 6.

RESTART ROUTE

This function instructs the receiver to modify the route according to two options available: restart the route from the beginning or restart the route from the nearest waypoint to the present position. To select this function do the following:

1. Select RESTART ROUTE and press [0]. The following screen appears:

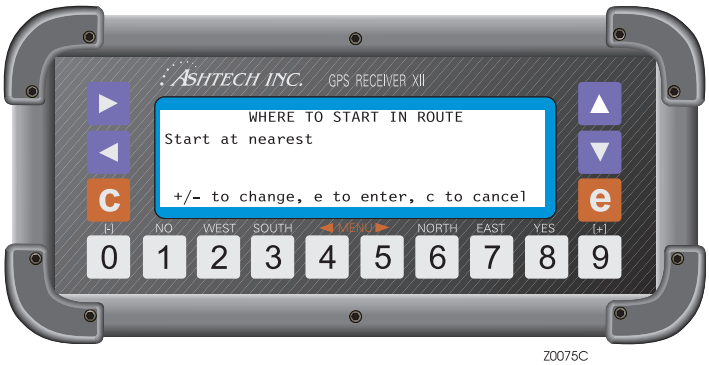


Figure 4.27: Screen 6, Restart Route

2. Using the [+] or [-] keys, toggle between "Start at beginning" and "Start at nearest" and select one.
3. Press Enter [e] and the receiver restarts the route. If "Start at beginning" was selected, the receiver points TO the first waypoint and uses the current position at that time to navigate FROM. The first waypoint is highlighted.

If "Start at nearest" was selected, the receiver computes the closest leg and uses this leg as the navigation reference. This leg in the route is highlighted.

WAYPOINT SWITCH

This function advances manually or automatically to the next leg of the route.

1. To access the options of this function highlight "WAYPT. SWITCH" and press [0]. The following screen appears:

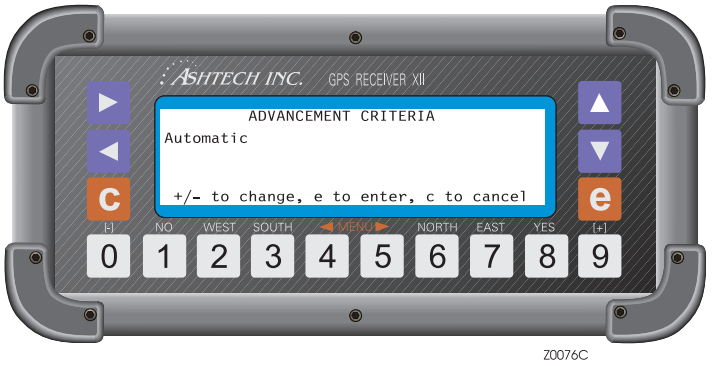


Figure 4.28: Screen 6, Waypoint Switch

2. Press [+] or [-] to toggle between MANUAL and AUTOMATIC, and press Enter [e] to save the selection.

When the AUTOMATIC option is selected, the receiver automatically advances to the next leg of the route every time an imaginary angular bisector line (line divides the angle between the present and next leg of the route in two) under the TO waypoint or a perpendicular line over the TO waypoint, is crossed. When the MANUAL option is selected, whenever the WAYPT. SWITCH function is activated (highlight WAYPT. SWITCH and press Enter[e]), the receiver advances to the next leg of the route.

RANGE/BEARING

This function calculates the range and bearing between any two consecutive waypoints in the route. To use this function, highlight RANGE/BEARING and press Enter [e]. The following screen appears:

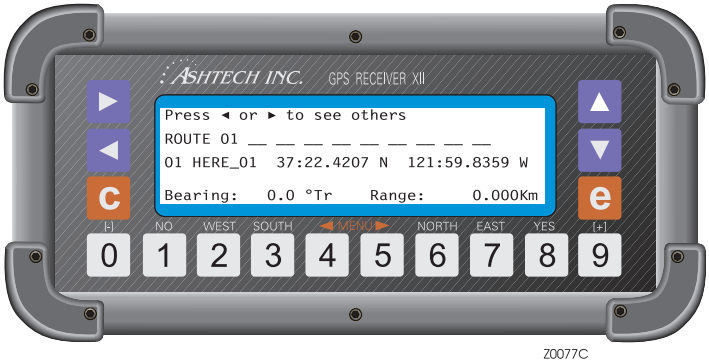


Figure 4.29: Screen 6, Range/Bearing

The display shows the route being followed. One of the legs is highlighted and the coordinates of the waypoints associated with this leg are displayed in the next two lines. The last line shows the bearing and range values for that leg. To display the range and bearing for a different leg, use the ► and ◄ keys to move the cursor, and the information is automatically displayed at the bottom of the screen. Press Enter [e] or Cancel [c] to go back to the main screen.

UNIT SELECTION

This function specifies the units (miles, knots, kilometers) used to display the ALT (altitude), SOG (speed over ground), DTD (distance to destination), and XTE (cross-

track error) values in Screen 2. To select this function, highlight UNIT SELECTION and press Enter [e]. The unit selection screen appears:

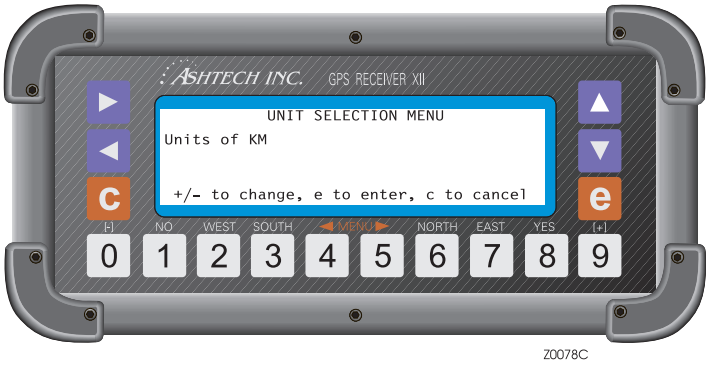


Figure 4.30: Screen 6, Unit Selection

Press [+] or [-] to toggle to MILES, KM, or KNOTS. Then press [e] to save the change and return to the main menu. When MILES or KNOTS are specified, the altitude (ALT on Screen 2) is displayed in feet.

MAGVAR MODE

This function defines the magnetic variation mode used when displaying the COG and CTD values in Screen 2 and VTG NMEA message, and the bearing value displayed in 7: RANGE/BEARING (Screen 6), and the APA and BWC NMEA messages. To select this function, highlight 9: MAGVAR MODE and press Enter [e]. The magnetic variation mode screen appears:

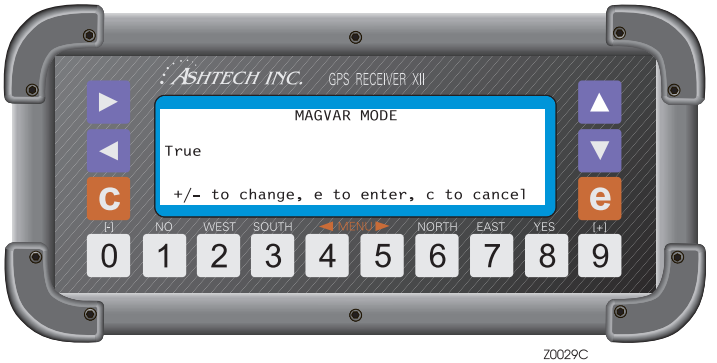


Figure 4.31: Screen 6, MAGVAR Mode

With the magnetic variation field highlighted, press + or - to toggle between the three modes available: TRUE, AUTOMATIC, or MANUAL.

When the TRUE mode is selected, the COG, CTD, and bearing values are displayed using true degrees (°T).

When the AUTOMATIC mode is selected, the magnetic variation used to display the COG, CTD, and bearing values appear on the screen, in the AUTO field. This value is based on the current latitude and longitude from the magnetic variation table. The COG, CTD, and bearing values are displayed in magnetic degrees (°Mg).

When the MANUAL mode is selected, the magnetic variation used to compute the COG, CTD, and bearing values is the one entered in the MANUAL field. These values are displayed in magnetic degrees (°Mg).

Highlight the field by MANUAL and enter the magnetic variation to be used. The value displayed in the AUTO field is the value used when the AUTOMATIC mode is selected and is displayed for reference.

To save the selection, press the Enter [e] key. To exit without saving, press the Cancel [c] key.

Screen 7 - Satellite Selection Control

Screen 7 allows users to enable or disable tracking of individual satellites. A Y under the satellite field instructs the receiver to track a particular satellite; an N under the satellite field instructs the receiver not to track a particular satellite.

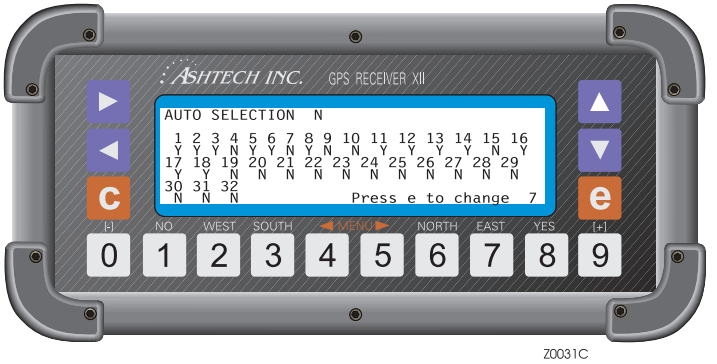


Figure 4.32: Screen 7

The AUTO SELECTION feature at the top of the screen provides additional control over receiver tracking. If AUTO SELECTION is enabled, all satellites flagged as Y will be cycled through the search pattern. If the receiver does not locate a particular satellite in two minutes, a new satellite will be cycled into the current search pattern. The receiver will not attempt to track satellites flagged as N.

Setting the AUTO SELECTION field to N enables MANUAL mode. MANUAL mode allows users to select up to 12 satellites that the receiver will always maintain lock on. The MANUAL mode instructs the receiver to track satellites regardless of whether or not they are visible. If more than 12 satellites are flagged as Y in Screen 7, the receiver will use the 12 PRN numbers displayed on Screen 0 at the exact time the MANUAL mode was selected.

Screen 8 - File Information/Seismic Ring Buffer™

Data can be simultaneously recorded at 2 separate recording intervals using the CGRS. Screen 8 is composed of 2 pages that provide users with information about GPS data stored in the receiver, accessible through a series of system-level commands. These commands allow users the ability to create and delete files, save current receiver parameters, and adjust backlighting.

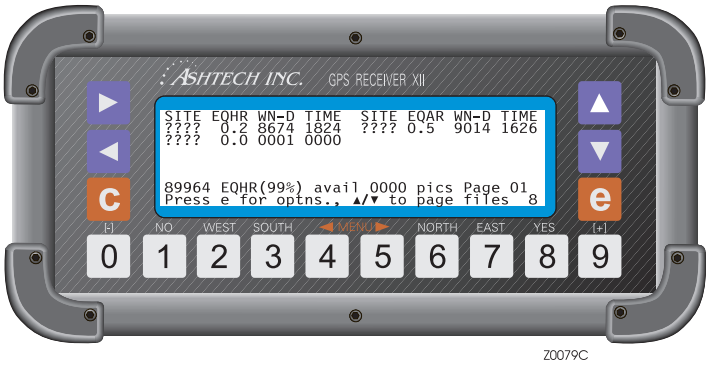


Figure 4.33: Screen 8

To enter a system-level command, press the Enter [e] key and then enter the desired three letter code (refer to Screen 4 - SUBCMDS Submenu for command listing). Press enter again. A dialog screen will appear alerting the user that the command has been accepted.

Page 1 of Screen 8 contains information about the conventional memory of the GPS receiver. Conventional memory is structured similarly to a DOS file system. Individual files can be opened, closed and deleted. The CGRS will automatically

open a new file upon powering up. The current file will automatically be closed when the receiver is powered off.

Table 4.19: Screen 8 Field Descriptions

Field	Description
SITE	The SITE field is a 4 character name used for distinguishing between different GPS data files. Site names must be entered through Screen 9.
EQHR	The equivalent hour field (EQHR) provides a rough estimation of file size. One EQHR is equivalent to 1 hour of data recorded at a 20 second interval (assuming that 5 satellites are being used in position computation).
WN-D	WN is the GPS week number and D is the GPS day. 1=Sunday, 2=Monday, 3=Tuesday, 4=Wednesday, 5=Thursday, 6=Friday and 7=Saturday. For example, a WN-D readout of 9005 indicates GPS week 900 and GPS day 5 (Thursday).
TIME	The TIME field reports when the last epoch of data was recorded. For example, 1850 indicates a GMT time of 18:50.
EQHR(%)	The next to last line of page 1 contains the EQHR(%) field, indicating the total number of equivalent hours that the receiver possesses, as well as the total number of currently available equivalent hours.
PICS	The PICTURE field displays the count of camera signals received by the CGRS. This field is commonly used for photogrammetry applications.
SEISMIC RING BUFFER	The CGRS contains a seismic ring buffer for high-speed data capture, allowing users to record data into the ring buffer at a significantly faster rate than that used for conventional memory. This feature renders the CGRS ideal for detailed seismic studies, crustal deformation studies, and studies involving building response to ground motion. **Note that when the ring buffer is in use, the external memory is divided into 2 partitions. One partition is used for conventional data storage; the other is used for ring buffer data storage.** Each partition utilizes a different data recording strategy. Under conventional data storage, information is written until the partition is full. Once this happens, old files must be deleted in order to continue data recording. This technique is best suitable for applications such as very precise surveying and long-term crustal deformation studies that do not require a fast sampling rate (5-30 seconds). The ring buffer uses an innovative technique that allows continuous high speed data capture without the requirement to delete files. This is accomplished by employing a circular memory architecture. Once the partition becomes full, the ring buffer returns to the start of the file and overwrites the oldest record. This method of data storage provides users with a high-speed data record of the last several hours of data. Before using the ring buffer, users must decide at what interval to sample data, as well as what percentage of the receiver's external memory should be dedicated for ring buffer use.

SEISMIC RING BUFFER MENU

To access the seismic ring buffer, go to Screen 8 and press the ▲ key. The following fields appear:

Table 4.20: Seismic Ring Buffer Menu Field Descriptions

Field	Description
STORAGE RATE (SEC)	The STORAGE RATE field controls the recording interval of the seismic ring buffer. Users may enter a value from 0.5 seconds to 999 seconds. Changing the storage rate will only affect the seismic ring buffer (not conventional memory). In order to take full advantage of the ring buffer, Ashtech recommends selecting a 2 or 1Hz sample rate.
RESET BUF	The RESET BUF field allows users to clear the memory of the ring buffer. By selecting Y and depressing the Enter [e] key, all current data in the ring buffer is lost. The ring buffer will reset and begin collecting new data records.
SIZE (Mb)	The SIZE field controls the percentage of external memory that is dedicated to the ring buffer. Users may enter a value in 1Mb intervals up to the total amount of memory present. For example, users with a 10Mb receiver can enter the following values: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10. If 0 Mb is selected, the external memory will not be partitioned and a ring buffer will not be created. If 10Mb is selected, all external memory will be dedicated to the ring buffer and the conventional memory section will be eliminated.
TOTAL NO. OF REC	This field displays the total number of records in the ring buffer, and will reset to 0 when the ring buffer is reset.
REC. START WN-D/TIME	This field displays the start time ring buffer. If the number is static (not increasing), it indicates that the ring buffer is not full. If the number is increasing in accordance to the number of records, it indicates that the buffer is full and the oldest records are being overwritten.
REC. END WN-D/TIME	This field displays the end time of the ring buffer, and will always increase in accordance to the total number of records.

Screen 9 - Site and Session Control

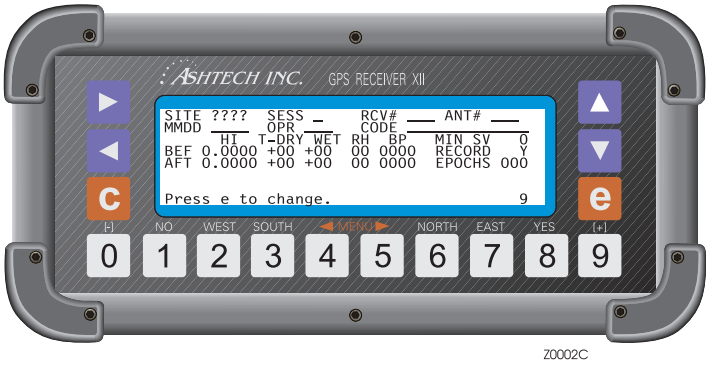


Figure 4.34: Screen 9

Table 4.21: Screen 9, Site & Session Control Field Descriptions

Field	Description
SITE	The SITE field is a 4 character alpha-numeric identifier tagged with the raw data to record which site was occupied during that time period. This same site identifier names the data files when transferring them to a computer. (Refer to Entering Text.) A site name can always be added during downloading if an accurate site name was not present during data logging.
SESS	The SESS field identifies the letter or number of a particular session. The post-processing software specifies this parameter while downloading to the PC after data collection. However, the default sessions can be overridden by entering a letter or number here.
RCV#	This field is a 3 character alpha-numeric receiver identifier.
ANT#	This field is a 3 character alpha-numeric antenna identifier. Entering the last 3 digits of the antenna and receiver serial number is good practice in case problems arise with the equipment. After processing data, if a file has out-of-range data, users can check the equipment that was used to gather it.
MMDD	This field is a 4 character alpha-numeric indicator of the month and day of any given session. Note that this field should only be used to override the file time tag. HOSE calculates the day of the year from the receiver time tag. Entering MMDD overrides the default.
OPR	The OPR field is a 3character alpha-numeric indicator of the operator.

Table 4.21: Screen 9, Site & Session Control Field Descriptions (continued)

Field	Description
CODE	The CODE field can contain up to 13 alpha-numeric characters of user comment to further identify a site. The center of the display has antenna height (HI) and weather conditions, both before (BEF) and after (AFT) data collection.
HI	The HI field refers to the height of the antenna in meters. Entering it during the survey saves having to enter it during post-processing. The post-processing software automatically reads the antenna height and uses it in computing the correct station position. Values must be entered in metric values; otherwise, a correction must be made during post processing. Maximum value is 64.000. Dry temperature, wet temperature, relative humidity and barometric pressure can be entered in Screen 9. As with the HI measurements, the post-processing software reads and uses the meteorologic data in its computations. Most surveys do not need this information and Ashtech recommends not entering values here. All 0's cause the software to use defaults of 20° C, 50% humidity, and 1010 millibars. When entering values, use the correct units (Celsius and millibars) and enter measurements in all fields.
T-DRY	The T-DRY field contains a record of the dry temperature in degrees Celsius.
T-WET	The T-WET field contains a record of the wet temperature in degrees Celsius.
RH	This field records the percentage of relative humidity.
BP	This represents the barometric pressure in millibars. Fields to the right are used to modify receiver tracking and recording procedures.
MIN SV	The MIN SV field sets an alarm that sounds a continuous beep when the number of satellites being tracked above the elevation mask falls below this specified minimum. To silence the alarm, press the Enter [e] key. The parameter is automatically be cleared.
RECORD	This field controls whether or not to record data. Y is the normal mode; N means that data will not be recorded. Use with caution.
EPOCHS	This field specifies the number of measurement epochs to be tagged with the site name in a kinematic survey. It counts down after each epoch until it reaches 0, at which time the site name changes to ????, signaling the receiver is moving to the next site.

To enter or change a value on Screen 9.

1. Press Enter [e] to shift to data-entry mode. (A blinking cursor indicates that the screen in data-entry mode.)
2. Use ▶ and ◀ to highlight the field to be changed.
3. Use ▼ to move the cursor down a line. This function differs from the other data entry screens.
4. Use ▲ to display the alpha-numeric conversion table. Its use is explained in Entering Text.

5. Use [8] for YES and use [1] for NO responses.
6. Examine the entries; they can be changed again by moving the cursor to the desired field and re-entering the information. When the values are acceptable, press Enter [e] again to save them in memory. Pressing Cancel [c] cancels all entries. Pressing Enter [e] or Cancel [c] after data entry returns the screen to display mode. In display mode, pressing ▶ or ◀ changes to other screens. Pressing a number calls up that screen directly.

Screen 10 - All-in-View Information

Screen 10 shows a polar plot of the currently available satellites and their orbital paths. The display is reliable once the receiver has a complete almanac and a valid position in Screen 2. From cleared internal memory, it takes approximately 12 minutes after lock to receive a full almanac and display correct information. With an almanac present (power cycle), approximately 12 seconds are required to obtain a full up-to-date screen.

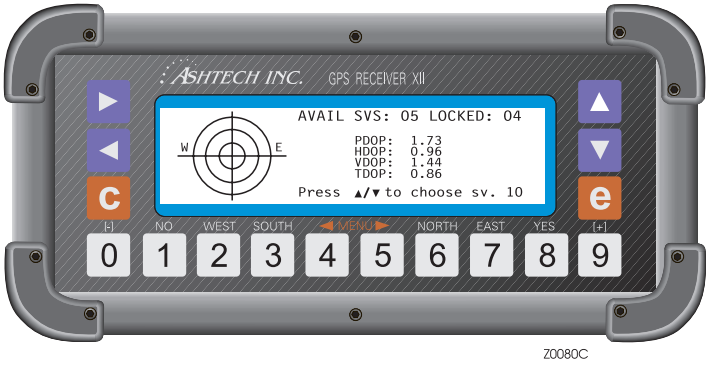


Figure 4.35: Screen 10

Screen 10 is reached in either of 2 ways: Press the [9] key then press the ▶ key OR press the [0] key, then press the ◀ key three times.

The All-in-View screen shows the satellites' overhead position graphically on an azimuth where 0° (north) is located at the top center of the plot and 180° (south) is at the plot's bottom center. East and west are labeled on the plot.

Table 4.22: All-In-View Screen Field Descriptions

Field	Description
■	This symbol indicates a satellite that is visible but not locked.
H	This indicates a satellite that is locked. The circles represent varying satellite elevations: the outer circle is 0° elevation, the middle is 30°, and the innermost is 60°. The center of the axis is 90°.
AVAIL SVS	This field reports how many satellites are visible.

Table 4.22: All-In-View Screen Field Descriptions

Field	Description
LOCKED	The LOCKED field reports how many satellites are locked.
DOPS	The DOPS field displays DOP values computed using satellites with elevation equal to or greater than position elevation mask. Current DOP's of locked satellites are updated every second. The graphic display updates every 12 minutes.To isolate the orbital track of a single available satellite (locked or not), press the ▲ or ▼ key. ▲ displays the orbital track of the next available satellite, in ascending order, starting with the lowest PRN number. ▼ displays the orbital track of the next available satellite, in descending order, starting with the highest PRN number.

Screen 11 - Visibility Information

Screen 11 shows the time when each satellite is visible. The display is fully reliable once the receiver has a complete almanac and a valid position, which can be entered on Screen 4 by users or be computed. From cleared memory without an almanac present, it takes approximately 12 minutes after lock to get full almanac and display complete information. With an almanac present, approximately 12 seconds is required. As with Screen 10, if the receiver has not been used for some time, Screen 11 will display old almanac information.

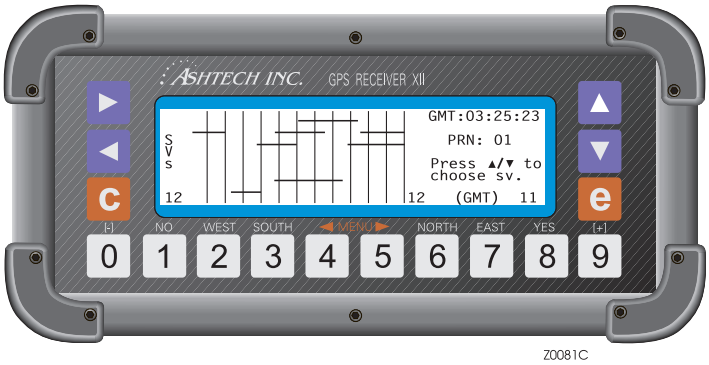


Figure 4.36: Screen 11

This screen is reached in two ways: Press [9], then press the ▶ key twice OR press [0] and the ◀ key until Screen 11 is displayed.

Table 4.23: Screen 11 Field Descriptions

Field	Description
HORIZONTAL LINES	These represent the satellites' availability windows. They are shown in ascending order with PRN 01 at the bottom and PRN 32 at the top. The start/end times are accurate to 10 minutes.
GMT:03:25:23	This marks GMT time

Table 4.23: Screen 11 Field Descriptions

Field	Description
PRN 11	In the upper right corner, PRN 11 represents the number of the PRN whose window is currently marked by the dotted reader-line. Pressing the ▲ or ▼ key raises or lowers the reader-line.
VERTICAL LINES	These represent the 2-hour time marks. The current time is stated as GMT and is rounded to the nearest hour. Each time the screen is entered, the time marks are recalculated to show the previous, nearest 2 hours of availability; 12 and 12 GMT are the times for the first and last vertical lines.

Screen 12 - Bar Code Control

Screen 12 inputs bar code or keyboard data used to mark a survey site or GIS data point. This method allows users to enter more descriptive names for post-processing with the software. In addition, Screen 9, Site and Session Information, can also be entered using the bar code reader. Users must specify 9600 baud to be able to scan bar codes. Only port A is available for bar code scanning.

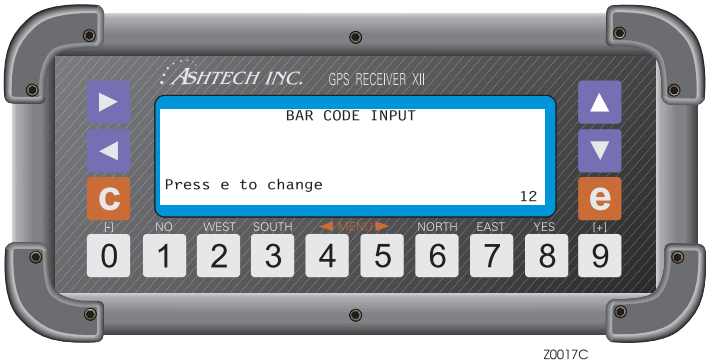


Figure 4.37: Screen 12

Screen 12 is displayed in any of three ways: From Screen 9 press the ▶ key 3 times OR from Screen 0 press the ◀ key OR read a bar code. (If the bar code screen is accessed by reading a bar code, the top level of the previous screen is displayed upon exit.)

Enter a maximum of 80 characters, combining a bar code reader and keyboard. A successful scan is signalled by a short beep from both the bar code reader and receiver. The receiver will reject the scan, display an error message and issue a long

beep if more than 80 characters are entered. Error messages are cleared when an entry is made within the 80-character limit.

Each entry is displayed in inverse (blue numbers in a white field) video. If an error occurs in the entry, it can be deleted by scanning the backspace (BKSP) bar code or pressing the ▼ key. To clear an entire entry sequence, scan the CLEAR ALL bar code or press the Cancel [c] key.

The keyboard can also be used to enter characters into a field. Once data has been entered using the bar code reader, keyboard entry can begin immediately. If the bar code reader has not been used, the Enter [e] key must be pressed first.

To store the entered data and a time tag in an internal file, read the ENTER bar code or press the Enter [e] key. This records the data sequence, emits two short beeps, and exits to screen 12. To clear the entered data, do one of the following:

- Read the CLEAR ALL bar code or press the Cancel [c] key. This clears the entire data sequence and exits to screen 12.
- Read the backspace (BKSP) bar code or press the ▼ key. When only one data entry remains the system goes to Screen 12.

Once entered data has been stored or cleared, press a numbered key to access the corresponding screen.

Serial Port Operation

This chapter describes 2 output options always available on Ashtech Z-12 CGRS receivers: the Real-Time Data output option and the NMEA output option.

Real-Time Data Output

This section explains the Real-Time Data output option, and explains how to access the appropriate screens and enable the various file types. For a description of each file type format, see Chapter 6.

This option allows the receiver to send real-time data through serial ports A, B, C or D and specify the type and format of the outgoing data. The following types and formats are currently available:

Table 5.1: Serial Port Message Type and Formats

Message Type	ASCII Format	Binary Format
MBEN	yes	yes
PBEN	yes	yes
TBEN	yes	yes
SNAV	not available	yes
SALM	not available	yes
DBEN	not available	yes

A MBEN message contains measurement data. A PBEN message contains position data. A TBEN message combines measurement, ephemeris, and almanac data into one message. A SNAV message contains ephemeris data and is output every 15 minutes or when a new IODE starts being used for a particular SV; it can be triggered for immediate output any time. SALM messages contain proprietary almanac data. A DBEN message contains measurement data used for carrier phase differential.

In binary format, the information is output the way it is stored in memory; only a header is added ("$PASHR,MBN,"; "$PASHR,PBN,"; or "$PASHR,SNV,").

The messages can be output through port A, B, C or D. Any combination of these files can be output from the same data port.

The transmission protocol defaults are 8 data bits and 1 stop bit, no parity.

The default value for the receiver to output data is every 20 seconds. This value is set in Screen 4 by the field INTVL.

Setting Up the Receiver

To set up the receiver for real-time data file transmission, connect it to a computer. Connect the RS-232 cable to port A on the receiver and COM1 on the computer. If COM1 on the computer is unavailable, use COM2.

Next, set up the port by following the directions below. Use the same procedure to set up each port. This procedure describes only port A setup with the real-time data output option:

1. On Screen 4, press Enter [e] to shift to data-entry mode:

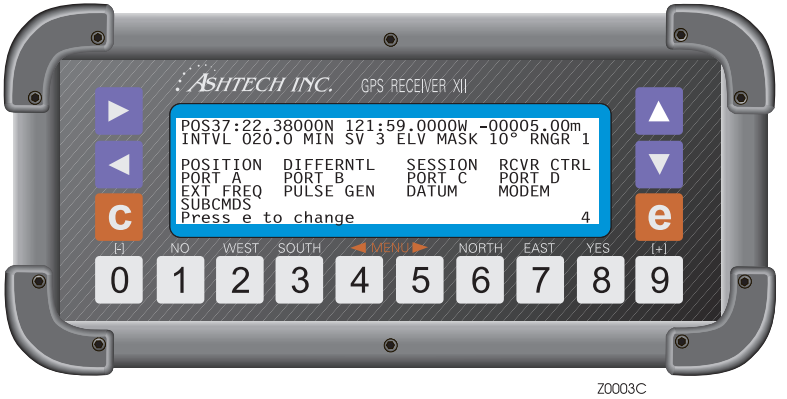


Figure 5.1: Screen 4, Setting up receiver

2. With PORT A highlighted, press Enter [e] to go to the port A Parameter Selection screen:

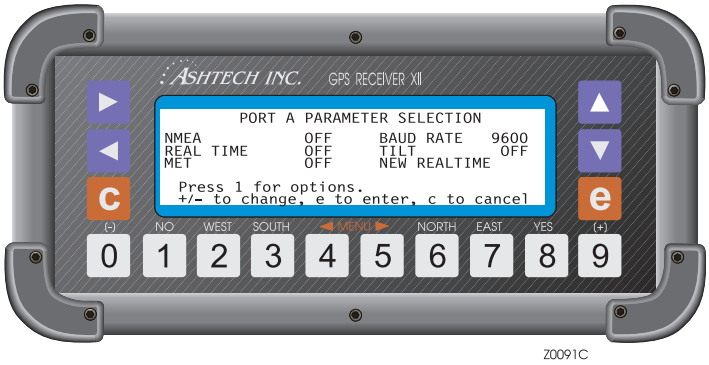


Figure 5.2: Screen 4, Port A Parameter Selection

3. If the baud rate is not satisfactory, highlight it and press [+] or [-] to toggle through the available speeds.
4. Highlight the REAL TIME or NEW REAL TIME indicator and press the [+] or [-] key to toggle it ON.
5. With REAL TIME or NEW REAL TIME highlighted, press [1] to go to the Measurements Output on port A screen:
6. On the Measurements Output on port A screen, highlight a data type and press the [+] or [-] key to toggle it ON.
7. Highlight the next data type and toggle it to the desired state. Continue until all desired data types are turned ON.
8. Highlight the format indicator and press the [+] key to toggle it so it reads ASCII or BINARY format. Note that the format indicator is located only in the REAL TIME menu, but controls format of data in NEW REAL TIME menu also.
9. Press Enter [e] to save the settings and return to the port A Parameter screen.
10. Press Enter [e] once again to return to Screen 4.

If desired, repeat this sequence for Ports B, C, and D. Users can send different data types from each port; for example, send PBEN data through Port A and SNAV data through Port B.

If SNAV, SALM, DBEN, and ASCII formats are selected, only an ASCII header for those messages is displayed. These 3 messages are not available in ASCII.

Commands

Certain parameters can be set through the serial port of a computer. Each command must be followed by a carriage-return/linefeed. The commands fall into two categories: the setting commands and the query commands. All ports of the receiver are set to decode these commands.

Setting Commands

In the following formats, d indicates a digit, str is a string of characters, and x is a single character.

$PASHS,ANT,SLANT,RAD,VERT

slant = slant height of antenna with format d.dddd

rad = radius of antenna with format d.dddd

vert = vertical offset to physical center of antenna with format dd.dddd

$PASHS,DSY,x,y

Specifies daisy chain mode for two parts. That is, when the receiver gets an unrecognizable command from port x, the entry port, it passes it directly out through port y.

$PASHS,DSY,OFF

Disables daisy chain mode on all parts.

$PASHS,RCI,ddd.d

Sets the update rate to the specified value.

$PASHS,ELM,dd

Sets the elevation mask.

$PASHS,MSV,dd

Sets the minimum number of satellites to record.

$PASHS,SIT,xxxx

Sets the site name.

$PASHS,SPD,x,d

Sets serial port (where x is A, B, C, or D) baud rate to d.

Table 5.2: Baud Rate Codes

Code	Baud Rate	Code	Baud Rate
0	300	5	9600
1	600	6	19200
2	1200	7	38400
3	2400	8	57600
4	4800	9	115200

$PASHS,RST

Resets all values to their defaults.

$PASHS,POS,ddmm.mmmm,X,dddmm.mmmm,Y,Sxxxxx.xx

Sets the position of the antenna, where ddmm.mmmm is the latitude in degrees (dd) and minutes (mm.mmmm), X is N(north) or S (south), dddmm.mmmm is the longitude, Y is E (east) or W (west), and Sxxxxx.xx is the altitude where S is the sign (+ or -).

$PASHS,LAT,ddmm.mmmm,X

Sets the latitude of the antenna (Screen 4), where ddmm.mmmm is the latitude in degrees (dd) and minutes (mm.mmmm), and X is N (north) or S (south).

$PASHS,LON,dddmm.mmm,Y

Sets the longitude of the antenna (Screen 4), where dddmm.mmmm is the longitude in degrees (ddd) and minutes (mm.mmmm), and Y is E (east) or W (west).

$PASHS,ALT,Sxxxxx.xx

Sets the altitude of the antenna, where Sxxxxx.xx is the altitude and S is the sign (+ or -).

$PASHS,ZMD,switch

Sets the mode of the receiver, where switch is A for auto switching, Y for Z-mode, and N for P-mode.

$PASHS,INI,u,v,x,y,z,w

Resets the receiver, where u is port A baud rate code, v is port B baud rate code, x is port C baud rate code, and y is port D baud rate code, according to the table in the

$PASHS,SPD command, to which the unit is initialized.

z is the reset memory code according to the following table.

Table 5.3: Z Codes

Z	Action
0	No memory reset
1	Reset internal memory
2	Reset external memory
3	Reset internal and external memory

w is the modem initializing code, as follows

Table 5.4: "w" Codes

w	Action
0	No modem initialization
A	Modem initialization input
B	Modem initialization in port B

$PASHS,USE,dd,x

Enables or disables a satellite where dd is the satellite PRN number and x is uppercase Y (enable) or N (disable). For example, to disable satellite 8, enter:
$PASHS,USE,08,N

$PASHS,FIL,C

Closes the current file.

$PASHS,FIL,D,dd

Deletes file number dd from receiver memory

$PASHS,FIL,D,999

Deletes all files from the receiver external memory

$PASHS,PJT,str

Specifies the project information, up to 24 characters, set in Screen 9. The 24 charac-

ters are as follows:

- character 1 = SESS
- character 2,3,4 = RCV#
- character 5,6,7 = ANT#
- character 8,9,10,11 = MMDD
- character 12,13,14 = OPR
- remaining characters = code

$PASHS,OUT,x

Turns off any previously specified types of output (see next command), where x, the port, is set to A, B, C or D.

$PASHS,OUT,x,str1,str2,str3,...

Turns on the specified output type, where x, the port, is set to A B, C or D. Str can be: NMEA, VTS3, VTS4, MBN, PBN, DBN, SNV, or BIN. For example, to send MBEN and PBEN in ASCII format:

$PASHS,OUT,A,MBN,PBN. To cancel an output, repeat the command excluding the str associated with that output type.

$PASHS,RAW,TBN,port,status,interval,format

Turns of TBEN message with the following parameters:

port=A, B, C, D

status=ON or OFF

interval=output rate in seconds

format=BIN or ASC

$PASHS,NME,str,x,switch

Sets individual NMEA messages where str is GLL, GXP, GGA, VTG, GSN, APA, ALM, MSG, XTE, BWC, DAL, GSA, GSV, TTT, RRE, GRS, UTM, VT3, VT4, POS, SAT, XDR, x is port A, B, C, or D; and switch is ON or OFF.

$PASHS,NME,PER,ddd.d

Sets the send interval time in NMEA messages.

$PASHS,RTC,INI

Initializes RTCM differential related variables.

$PASHS,RTC,F18,A/B

Setup either A, Ashtech standard, or B, RTCM standard for type 18/19 output. Default is B.

$PASHS,RTC,EOT,char sequence

char sequence=”CRLF”, “NONE”, or “CR”. Selects the character sequence to terminate RTCM messages.

$PASHS,RTC,str,x

Sets a receiver to handle RTCM format where str is BAS for base or REM for remote. x is the port and can be A, B, C or D. (In the CGRS, REM or Remote is not supported.)

WARNING
Setting the receiver to BAS or REM will disable that port for any other I/O. If you are talking to the receiver on this port, you will lose ability to talk to it further.

$PASHS,RTC,OFF

Turns off differential mode.

$PASHS,RTC,AUT,switch

Enables or disables RTCM auto differential mode, where switch is ON or OFF.

$PASHS,RTC,COD,str

Sets the receiver to use C/A or L1 P-code for differential corrections, where str is CA or L1P

$PASHS,RTC,SPD,d

Sets the receiver's transmission speed when handling RTCM format where d is a code for the output rate in seconds:

Table 5.5: “d” Code Output Rate

d	Rate
0	25
1	50
2	100
3	110
4	150
5	200
6	250

Table 5.5: "d" Code Output Rate (continued)

d	Rate
7	300
8	1500
9	0

$PASHS,RTC,STH,d

Sets the station health when handling RTCM format where d ranges from 0 to 7.

$PASHS,RTC,STI,d

Sets the station ID when handling RTCM format where d ranges from 0 to 1023.

$PASHS,RTC,MAX,d

Sets the maximum age for messages when handling RTCM format where d ranges from 0 to 1199 seconds.

$PASHS,RTC,QAF,d

Sets the communication quality when handling RTCM format where d ranges from 0 to 999.

$PASHS,RTC,MSG,str

Contains an RTCM message to send from the base station where str is up to 32 characters.

$PASHS,RTC,TYP,str,d

Specifies the type of RTCM format to generate where str is type 1, 2, 3, 6, 9, 15, 16, 18, 19, 22; d is the corresponding period/frequency, ranging from 0 to 99. For types 1, 2, 9, 15, 18, and 19 the period is in seconds; all other message type periods are in minutes.

When d=99, continuous output is set. There is no delay between consecutive messages (Type 18 and 19 cannnot have d=99).

$PASHS,TLT,INIT,x,init_str<CR><LF>

Loads the initialization string for the tilt meter. Where x can be A or B or C or D of the receiver's serial port.
init_str is the initialization string of the tilt meter excluding the starting '*' sign. (The '*' should not be included in the command).

$PASHS,TLT,CMD,x,trig_str<CR><LF>

Loads the command string for the tilt meter. Where x can be A or B or C or D of the receiver's serial port.

trig_str is the trigger string of the tilt meter excluding the starting '*' sign.
(The '*' should not be included in the command).

$PASHS,MET,INIT,x,init_str<CR><LF>

Loads the initalization string for the met station. Where x can be A or B or C or D of the receiver's serial port.
init_str is the initialization string of the met station excluding the starting '*' sign.
(The '*' should not be included in the command).

$PASHS,MET,CMD,x,trig_str<CR><LF>

Loads the command string for the Met station. Where x can be A or B or C or D of the receiver's serial port.
trig_str is the trigger string of the met station excluding the starting '*' sign.
(The '*' should not be included in the command).

$PASHS,TLT,INTVL,x,y<CR><LF>

Sets the sampling interval for the tilt meter. Where x can be A or B or C or D of the receiver's serial port.
y can be from 5 to 9999 seconds.

$PASHS,MET,INTVL,x,y<CR><LF>

Sets the sampling interval for the met station. Where x can be A or B or C or D of the receiver's serial port.
y can be from 5 to 9999 seconds.

$PASHS,OUT,x,TLT<CR><LF>

Sets the tilt field of Port x PARAMETER SELECTION submenu, Screen 4, to on. Where x can be A or B or C or D of the receiver's serial port.

$PASHS,OUT,x,MET<CR><LF>

Sets the met field of Port x PARAMETER SELECTION submenu, Screen 4, to on. Where x can be A or B or C or D of the receiver's serial port.

$PASHS, DOI, X

Sets the DBEN serial output rate where X can be 0.5 to 999.5

Query Commands

Issue query instructions from the computer, commanding that the receiver send the specified structure. Follow each command with a carriage-return/linefeed.

$PASHQ,ANT

Antenna parameters entered with $PASHS,ANT,f1,f2,f3 or using differential mode setup screens.

$PASHQ,MBN

Requests a MBEN structure

$PASHQ,PBN

Requests a PBEN structure

$PASHQ,RTC

Displays RTCM status and setup.

$PASHQ,SNV,PRN

Requests a SNAV structure for a specific PRN. If no PRN number is entered, it outputs SNAV messages for all PRN's.

$PASHQ,PRT

Asks for the port being used and its baud rate.

$PASHQ,RID

Requests the receiver identification. The format of the response message is:

$PASHR,RID,ZM,30,1011,C05,1C00

where ZM = receiver type (Z-12)
30 = channel options (P1, P2)
1C11 = nav firmware version
C05 = loaded options
1C00 = channel firmware version

$PASHQ, MET

Query for meteorological station setup.

$PASHQ, TLT

Query for tilt meter setup.

$PASHQ, DOI

Query for DBEN interval.

The format of the MBEN, PBEN, and SNAV structure sent by the receiver is the one set in the measurements output menu. SNAV is not available in ASCII, so if this format is selected, the receiver outputs an empty message with an ASCII header.

Setting-up Serial Port Real-Time Data Output

This section shows how to use the commands presented in this chapter to setup the

receiver to output real-time data through the serial ports. There are two main types of data that can be output, NMEA text messages, and binary or text format raw measurements. Please refer to the next section "NMEA Output" to learn how to setup using the receiver keypad. Also refer to chapter 4 "Screen Operation" for more detailed information on enabling both NMEA output and measurement data output using the receiver keypad.

To start NMEA message output:

1. Use command $PASHS,NME,str,x,switch to enable each message type that you desire to output.

   For example, $PASHS,NME,GGA,A,ON enables the messsage $GPGGA on port A.

2. After enabling all messages, use command $PASHS,OUT,x,str to begin output of enabled messages on the specified port.

   For example, $PASHS,OUT,A,NMEA will cause messages to start being output on port A.

To stop NMEA message output:

Messages output can be stopped individually or all messages can be stopped at once. To disable individually, use $PASHS,NME,str,x,OFF. For example, $PASHS,NME,GGA,A,OFF disables the messsage $GPGGA on port A. To disable all messages at once, use $PASHS,OUT,x. For example, $PASHS,OUT,A will cause all messages output on port A to stop.

To start raw measurement message output:

1. For raw measurement data, only one command is required $PASHS,OUT,x,str1,str2,str3... to cause the messages to begin outputing.

   For example, $PASHS,OUT,A,MBN,PBN,SNV,BIN will cause the MBN, PBN, & SNV messages to be output on port A in binary format. The command $PASHS,OUT,A,MBN,PBN,SNV will cause the MBN, PBN, & SNV messages to be output on port A in ASCII format.

To stop raw measurement measurement output:

Raw data messages can only be disabled as a group using command $PASHS,OUT,x. For example, $PASHS,OUT,A will cause all message output on port A to stop.

NMEA Output

This section describes the NMEA output installed on Ashtech Z-12 CGRS receivers, and explains how to set up the receiver and enable the various output formats. In addi-

tion, it includes each NMEA message format.

The NMEA message formats can be output through Port A, B, C or D. Any combination of these formats can be output from the same RS-232 data port. The output rate is set on the NMEA OPTIONS screen to any value between 0.5 and 999.5 seconds.

The transmission protocol default is: 8 data bits and 1 stop bit, no parity.

Setting Up the Receiver

To use the receiver with NMEA format messages, users must set up output specifications such as port and baud rate. Any combination of ports A, B, C or D can be used for output. Use the same procedure to set up each one. This procedure describes only port A setup.

1. On Screen 4, press Enter [e] to shift to data-entry mode.
2. Highlight the PORT A indicator and press Enter [e] to go to the port A Parameter Selection screen.
3. On the port A Parameter Selection screen, highlight the NMEA indicator and press the [+] or [-] key and toggle it so that it reads ON. Press Enter [e] to save this specification.
4. To change the baud rate, highlight the BAUD RATE indicator and, using the [+] or [-] key, toggle it the desired baud rate. Press Enter [e] to save this specification.
5. To specify message formats, highlight the NMEA indicator again and press [1] to go to the NMEA OPTIONS Menu-port A screen.

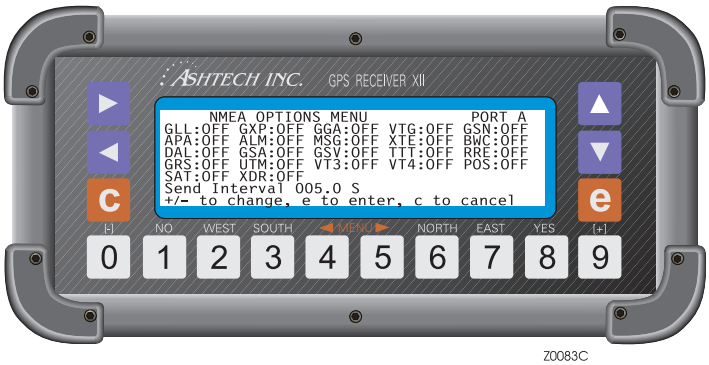


Figure 5.3: Port A NMEA Options Menu

6. On the NMEA Option Menu-port A screen, ON or OFF is flashing by a message format. Using the [+] or [-] key, toggle to ON for the desired message format. Continue until all the formats needed have been turned on.

7. Messages are sent every 5 seconds (default), but the interval can be changed to a value from 000.5 to 999.5 seconds. To change the value, highlight the numeric field next to Send Interval and press the numbered keys.
8. Press Enter [e] to save the settings and return to the PORT A PARAMETER SELECTION screen.
9. Press Enter [e] again to return to Screen 4.

If desired, repeat this sequence for port B. Different types of NMEA messages can be sent from each port; for example, send GLL messages through port A and GXP through port B. However, the same Send Interval applies to both ports. The same procedure applies to ports C and D.

NMEA Message Types

The NMEA sentence that is output is a string of ASCII characters with comma delimiters. The length of the fields varies depending on its precision. When information is not available or output, it is indicated as ",," (a null argument).

The following is an example of an NMEA sentence.

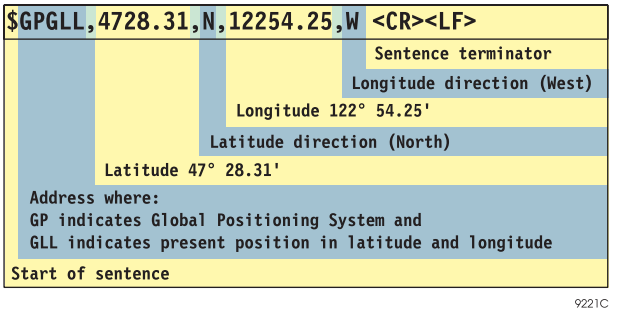


Figure 5.4: NMEA Sentence Example

The message formats are shown on the following pages according to their order on the NMEA Option Menu. Each starts with the talker identifier and 3-character message-type identifier (that is, $GPGLL). The data fields are numbered left to right; x is a decimal digit; ± is a plus or minus sign; and E flags exponential notation.

Refer to Figure 5.4 for more details on sentence format protocols.

Latitude/Longitude for Position

Format:

$GPGLL,xxxx.xxxxx,N,xxxxx.xxxxx,W,hhmmss.ss,A[CR] [LF]

Table 5.6: Latitude/Longitude Field Descriptions

Fields	Significance
1	Latitude in degrees, decimal minutes
2	N = north, S = south
3	Longitude in degrees, decimal minutes
4	W = west, E = east
5	UTC of position (hours, minutes, seconds, tenth of seconds)
6	Status, A = valid, V = invalid

Example:

$GPGLL,3723.28101,N,12202.24101,W,180236.14,A[CR] [LF]

Present Position Fix with Time of Fix

Format:

$GPGXP,hhmmss.ss,xxxx.xxxxx,N,xxxxx.xxxxx,W[CR] [LF]

Table 5.7: Present Position Field Descriptions

Fields	Description
1	UTC of fix (hours, minutes, seconds, tenths of second)
2	Latitude (in degrees, decimal minutes)
3	North or South
4	Longitude (in degrees, decimal minutes)
5	East or West

Example:

$GPGXP,015324.00,3723.28332,N,12202.24301,W [CR] [LF]

Global Positioning System Position

Format:

$GPGGA,hhmmss.ss,xxxx.xxxxx,N,xxxxx.xxxxx,W,x,xx,xx.x,±xxxxx,M,±xxxx.x,M,xx,xxxx [CR] [LF]

Table 5.8: GPS Field Descriptions

Fields	Significance
1	UTC of position (hours, minutes, seconds, tenth of a second)
2	GPS latitude (degrees, decimal minutes)
3	Latitude north (N) or south (S)
4	GPS longitude (degrees, decimal minutes)
5	Longitude east (E) or west (W)
6	GPS quality indicator (where 1 = GPS Available, 2 = DGPS available)
7	Number of GPS satellites being used
8	Horizontal dilution of precision (HDOP)
9,10	Antenna height in meters and M for meters
11,12	Geoidal height in meters and M for meters
13	Age of differential GPS data
14	Differential reference station ID

Example:

$GPGGA,015454.00,3723.28513,N,12202.23851,W,1,4,03.8,+00012,M,+0000.0,M,14,1010 [CR] [LF]

COG/SOG

Format:

$GPVTG,xxx.xx,T,xxx.xx,M,xxx.xx,N,xxx.xx,K [CR] [LF]

Table 5.9: COG/SOG Field Descriptions

Fields	Significance
1,2	COG (Course Over Ground) and T for true
3,4	COG and M for magnetic variation
5,6	SOG (Speed Over Ground) and N for knots
7,8	SOG (Speed Over Ground) and K for km/hr

Example:

$GPVTG,329.01,T,346.31,M,000.07,N,000.13,K [CR] [LF]

SNR of GPS Satellites Being Tracked

Format:

$GPGSN,xx,xx,xxx,xx,xxx,xx,xxx.....xxx [CR] [LF]

Table 5.10: SNR of GPS Field Descriptions

Fields	Description
1	Number of svs currently being tracked. When 0, message terminates after this field. For a nonzero count, the subsequent fields give each satellite number and its SNR.
2	Satellite number
3	Signal-to-noise ratio for satellite
4,5	Two fields for each tracked satellite, similar to fields 2 and 3
Last field	Age of differential data. 999 when in stand-alone mode.

Example:

$GPGSN,04,19,038,14,136,18,117,15,036,999 [CR] [LF]

Autopilot Format

Format:

$GPAPA,A,A,x.xxx,L,N,A,A,xxx,T,xxx [CR] [LF]

Table 5.11: Autopilot Format Field Descriptions

Fields	Description
1	Suspect or ambiguous (where A = valid, V = invalid)
2	Cycle lock (where A = valid, V = invalid)
3	Cross-track error
4	Sense (where L = left, R = right)
5	N for nautical miles
6	Arrival circle (A = valid, V = invalid)
7	A for arrival perpendicular (crossing the line which is perpendicular to the course line and which passes through the destination waypoint)
8	Bearing to destination from origin
9	M for magnetic, T for true north
10	Destination waypoint identifier

Example:

$GPAPA,A,A,9.999,R,N,A,A,069,M,001[CR] [LF]

Almanac Message

Each sentence contains an almanac for each satellite in the GPS constellation.

Format:

$GPALM,xx,xx,xx,xxx,xx,xxxx,xx,xxxx,xxxx,xxxxxx,xxxxxx,xxxxxx,xxx xxx,xxx,xxx [CR] [LF]

Table 5.12: Almanac Messages Field Descriptions

Field	Description
1	Total number of messages
2	Message number
3	Satellite PRN number

Table 5.12: Almanac Messages Field Descriptions

Field	Description
4	GPS week
5	SV health
6	Eccentricity
7	Almanac reference time (seconds)
8	Inclination angle (semicircles)
9	Rate of ascension (semicircles/sec)
10	Root of semimajor axis
11	Argument of perigee (semicircle)
12	Longitude of ascension mode (semicircle)
13	Mean anomaly (semicircle)
14	Clock parameter (seconds)
15	Clock parameter (sec/sec)

Example:

$GPALM,20,01,28,674,00,5C1E,1D,09BC,FD30,A10D27,BBD4EB,
8CB47B,E35E03,FFA,000 [CR] [LF]

RTCM Message

Outputs RTCM Types 1, 2, 3, 9, 15, and 16. The first 7 fields of this message are the same for every RTCM type.

$GPMSG,xx,xxxx,xxxx.x,x,xxx,hhmmss

Table 5.13: RTCM Messages Field Descriptions (1-7)

Field	Description
1	RTCM message type
2	Station Identifier
3	Z count in seconds and tenths
4	Sequence number
5	Station health

Table 5.13: RTCM Messages Field Descriptions (1-7)

Field	Description
6	Total number of characters after the time item
7	UTC time in hours, minutes, seconds

The other fields are defined below for each specific RTCM message type.

Message Type 1 or 9 Format: RTCM Corrections

$GPMSG,xx,xxxx,xxxx.x,x,x,xxx,hhmmss,x,xx+/-xxxx.xx, +/-x.xxx,xxx,...[CR] [LF]

Table 5.14: RTCM Messages Field Descriptions (8-17)

Field	Description
8	User differential range error (UDRE)
9	Satellite PRN number
10	Pseudo-range correction (PRC) in meters
11	Range rate correction (RRE) in meters/second
12	Issue of data (IODE)
13-17	Same as fields 8-12 but for next satellite

Example:

$GPMSG,01,0001,2220.0,1,0,127,213702,1,12,-0081.30,+0.026,235,1,26,-0053.42,-0.070,155,2,02,+0003.56,+0.040,120 [CR] [LF]

Message Type 2 Format: Delta RTCM Corrections

Table 5.15: Message Type 2 Format Field Descriptions

Field	Description
8	User Differential Range Error (URDE)
9	Satellite PRN Number
10	Delta Pseudo-Range Correction (PRC) in meters
11	Delta Range Rate Correction (RRC) in meters/second
12	Issue of Data (IODE)
13-17	Same as fields 8-12 but for next satellite

Message Type 3 Format: Reference Station Coordinates

$GPMSG,xx,xxxx,xxxx.x,x,x,xxx,hhmmss,+/-xxxxxxx.xx,+/-xxxxxxx.xx,+/-xxxxxxx.xx [CR] [LF]

Table 5.16: Message Type 3 Format Field Descriptions

Field	Description
8	Reference station ECEF X component
9	Reference station ECEF Y component
10	Reference station ECEF Z component

Example:

$GPMSG,03,0001,2220.0,1,0,127,213702,-2691561.37,-4301271.02,+3851650.89 [CR] [LF]

Message Type 15 Format: Ionospheric Corrections

Note that this message may contain information for one or two satellites.

$GPMSG,xx,xxxx,xxxx.x,x,x,xxx,hhmmss,xx,xxx.xx,
+/-xxxx.x,xx,xxx.xx,+/-xxxx.x<CR><LF>

Table 5.17: Message Type 15 Field Descriptions

Field	Description
8	Satellite ID #1
9	Ionospheric measurement #1, meters
10	Ionospheric rate measurement #1, cm/min
11	Satellite ID #2
12	Ionospheric measurement #2, meters
13	Ionospheric rate measurement #2, cm/min

Message Type 16 Format: GPS Special Message

$GPMSG,xx,xxxx,xxxx.x,x,x,xxx,hhmmss,aaaaaa...[CR] [LF]

Table 5.18: Message Type 16 Field Descriptions

Field	Significance
8	Message in ASCII text

Cross-Track Error

Format:

$GPXTE,A,A,xxx.xxx,L,N[CR] [LF]

Table 5.19: Cross Track Error Field Description

Fields	Description
1	SNR (where A = valid, V = invalid).
2	Cycle lock (where A = valid, V = invalid)
3	Cross-track error
4	Steer left or right (where L = left, R = right)
5	Units (nautical miles)

Example:

$GPXTE,A,A,019.999,R,N [CR] [LF]

Bearing and Distance

Great Circle Format:

$GPBWC,hhmmss.ss,xxxx.xxxx,N,xxxxx.xxxx,W,xxx.xx,T,xxx.xx,M,xxx.xxx,N,xxx [CR] [LF]

Table 5.20: Bearing and Distance Field Descriptions

Field	Description
1	UTC of bearing (hours, minutes, seconds, tenth of a second)
2	Latitude of waypoint (degrees, decimal minutes)
3	North (N) or south (S)
4	Longitude of waypoint (degrees, decimal minutes)
5	East (E) or west (W)
6,7	True bearing and T for true
8,9	Magnetic bearing and M for magnetic
10,11	Distance and N for nautical miles
12	Waypoint identifier

Example:

$GPBWC,015454.00,0000.0000,N,00000.0000,E,069.00,T,84.73,M,999.999,N,001[CR] [LF]

Almanac

In the DAL format, the [+] sign is suppressed for a positive value in the power of e. The spaces are for readability.

Format:

$PASHR,DAL,xx,xx,x.xxxxxxxE±xx,xxxxxx,x.xxxxxxxE±xx,
±x.xxxxxxxE±xx,x.xxxxxxxE±xx,±x.xxxxxxxE±xx,±x.xxxxxxxE±xx,
±x.xxxxxxxE±xx,±x.xxxxxxxE±xx, x.xxxxxxxE±xx,xxx [CR] [LF]

Table 5.21: Almanac Field Descriptions

Fields	Description
1	Satellite PRN number
2	Satellite health
3	Eccentricity
4	toe, reference time for orbit (in seconds)
5	i0, inclination angle at reference time (semicircles)
6	omegadot, the rate of right ascension (semicircles/sec)
7	root a, the square root of semi-major axis (meters 1/2)
8	omega0, the longitude of the ascension node (semicircle)
9	omega, the argument of perigee (semicircle)
10	m0, the mean anomaly at reference time (semicircle)
11	af0, clock parameter (in seconds)
12	af1, clock parameter (sec/sec)
13	wn, GPS almanac week number

Example:

$GPDAL,14,00,5.2795410E-03,032768,3.0565721E-01,
-2.4811015E-09,5.1536948E03,5.8827317E-01,8.8243234E-01,
-8.8568139E-01,8.2015991E-05,7.2759576E-12,571[CR] [LF]

DOP and Active Satellites

Format:

$GPGSA,x,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x [CR][LF]

Table 5.22: DOP and Active Satellites Field Descriptions

Field	Description
1	Mode: M=manual, A=automatic
2	Mode:1=fix not available, 2=2D, 3=3D
3,4,5,6,7,8,9,10, 11,12,13,14	Satellites used in solution (null for unused fields)
15	PDOP
16	HDOP
17	VDOP

Example:

$GPGSA,M,3,,23,28,11,,,17,,,,21,,3.4,2.0,2.8 [CR] [LF]

Satellites in View

Gives the number of satellites in view, PRN numbers, elevation, azimuth, and SNR. There is a 4 satellite maximum per transmission, and additional satellite data is sent in 2nd or 3rd messages. The total number of messages being transmitted and the number of message are indicated in the first 2 fields.

Format:

$GPGSV,x,x,xx,xx,xx,xxx,xx,xx,xx,xxx,xx,xx,xx,xxx,xx,xx,xx,xxx,xx [CR] [LF]

Table 5.23: Satellites in View Field Descriptions

Field	Description
1	Total number of messages (1 to 3)
2	Message number (1 to 3)
3	Total number of satellites in view
4	Satellite PRN number
5	Elevation (degrees)

Table 5.23: Satellites in View Field Descriptions

Field	Description
6	Azimuth (degrees)
7	SNR (0 to 99 dB)
8,9,10,11	Same as 4,5,6,7 but for second satellite
12,13,14,15	Same as 4,5,6,7 but for third satellite
16,17,18,19	Same as 4,5,6,7 but for fourth satellite

Example:

$GPGSV,2,1,06,23,53,041,99,28,55,273,99,11,24,326,55,17,36,101,68[CR] [LF]

Trigger Time Tag Serial Output Message

This trigger signal is generated through the camera in input located on the backpanel of the receiver. The following message is output on the selected port on each trigger epoch being generated

Format:

$PASHR,TTT,x,hh:mm:ss.sssssss [CR] [LF]

Table 5.24: Trigger Time Tag Field Descriptions

Field	Description
1	Day of the week, with 1 being Sunday and 7 being Saturday
2	GPS time tag in hours, minutes, decimal seconds

Example:

$PASHR,TTT,3,18:01:33.1200417 [CR] [LF]

Satellite Range Residuals and Position Errors

This message displays the satellite residuals and horizontal and vertical position errors displayed in menu 5.

Format:

$GPRRE,xx,xx,sxx.x.....,xx.x,xx.x [CR] [LF]

Table 5.25: Satellite Range Residuals Field Descriptions

Field	Description
1	Number of satellites used to compute position
2,3	Two fields for each tracked satellite with satellite number and range residual
Last 2 fields	Horizontal position error and vertical position error, respectively

Example:

$GPRRE,05,23,+8.4,28,-9.2,11,-2.2,17,+3.2,21,+12.2,34.4,49.7 [CR] [LF]

GPS Satellite Range Residuals

This message displays the range residual for each of the satellites being used to compute position.

Format:

$GPGRS,hhmmss.ss,m,sxx.x,sxx.x,..... [CR] [LF]

Table 5.26: GPS Satellite Range Field Descriptions

Field	Description
1	Current UTC time of GGA position (hours, minutes, decimal seconds)
2	Mode m used to compute range residuals 0 = residuals were used to calculate the position given in the matching GGA line 1 = residuals were recomputed after the GGA position was computed
3	Range residuals for each satellite used in position computation. The order of the residuals matches the order of the satellites in the GSV message, where empty fields indicate that SV is not being used to compute position.

The range residuals are recomputed after the GGA position is computed; therefore, themode m is always 1.

Position Using UTM Coordinates

Format:

$PASHR,UTM,hhmmss.ss,xxx,xxxxxx.xx,xxxxxxx.xx,x,xx,xx.x,±xxxxx,M,±xxxx.x,M,xx,xxxx [CR] [LF]

Table 5.27: Position Using UTM Field Descriptions

Field	Description
1	UTC of position (hours, minutes, decimal seconds)
2	Zone for coordinates
3	East UTM coordinate (meters)
4	North UTM coordinate (meters)
5	GPS quality indicator where 1 = GPS available, 2 = DGPS available
6	Number of GPS satellites being used
7	Horizontal dilution of precision (HDOP)
8,9	Antenna height in meters and M for meters
10,11	Geoidal height in meters and M for meters
12	Age of differential data
13	Differential reference station ID

Example:

$PASHR,UTM,015454.00,10S,588757.62,4136720.05,1,04,03.8,+00012,M,,M,14,1010 [CR] [LF]

Data Formats

Stored Formats

B-files

B-files contain raw measurement data downloaded from GPS receivers. Each record corresponds to one epoch. The file structure consists of a header (the structure RAWHEADER) followed by epoch data. Each epoch of data consists of a RAWNAV structure and a variable number of RAWDATA structures. The number of RAWDATA structures is defined by RAWNAV.NUM_SATS. For example, if RAWNAV.NUM_SATS = 6, then 6 RAWDATA structures will follow.

In turn, each RAWDATA structure contains several CHAN_OBS (channel observations) structures. RAWHEADER.NUM_OBS_TYPES defines the number of CHAN_OBS structures per RAWDATA structure for the entire file. For example, if RAWHEADER.NUM_OBS_TYPES = 2, then each RAWDATA structure in the file will contain 2 CHAN-OBS structures.

Although integrated doppler and fractional phase were stored in previous releases, this is no longer so. Instead, the full carrier phase observable information is stored in CARPHASE.

Satellite transmit time (CODETXMT) has been replaced by RAWRANGE (RECEIVE_TIME-RAW_RANGE=transmit time).

Code smoothing values are also supplied in this release. SMTH_CORR is the code smoothing value (subtracted from RAWRANGE) used by the receiver. SMTH_COUNT is a measure of the smoothness of SMTH-CORR. SMTH-COUNT will always be normalized to 200; that is, 1 will represent the least smoothed and 200 will represent the most.

QA-PHASE provides a measure of receiver performance; its value should generally be between 0 and 5 or 95 and 100.

Note also that the B-file format, version 4.1, is the same as defined here with the exception of the header capability. The capabilities L1CP and L1C_L2P have also been added to version 4.2. The version 5.0 B-file has the following structure.

Each B-file starts with a rawheader struct. The size of a rawstruct header = 90 bytes.

```
struct rawheader {
char        version[101];
unsigned    char raw_version;
char        rcvr_type[101];
char        chan_ver[101];
```

```
char            nav_ver[101];
int             capability;
long            reserved;
char            num_obs types;
char            spare[42];
}
The size of rawnav struct=67 bytes.
struct rawnav {
char            sitename[4];
double          rcv_time;
double          navx;
double          navy;
double          navz;
float           navxdot;
float           navydot;
float           navzdot;
double          navt;
double          navtdot;
unsigned        int pdop;
char            num_sats;

};
Each epoch has a rawdata struct per SV

The size of L1 rawdata struct = (35 * nav.num_sats) bytes
The size of L2C rawdata struct = (66 * nav.num_sats) bytes
The size of L2P rawdata struct = (97 * nav.num_sats) bytes

struct rawdata {
unsigned char svprn;
unsigned char elevation;
unsigned char azimuth;
unsigned char chnind;
struct chan_obs obs[3]; /* This variable is indexed by 3 (currently)  */
                /* to support receivers measuring C/A code */
                /* L1 independently of P-Code L1.  Thus the */
                /* indexing is as follows:*/
                /*          A) For L1 only receivers, L1 is in*/
                /*          slot 0*/
                /*          B) For L2 codeless receivers, L1 is in*/
                /*          slot ) and L2 is in slot 1*/
                /*          C) For our P-code receiver L1 C/A is*/
                /*          in slot 0, L1 P-code is in slot 1,*/
                /*          and L2 P-Code is in slot 2.

};

The size of struct chan_ob s= (31) bytes
The size of struct chan_obs = (31) bytes

struct chan_obs {
```

```
double          rawrange;       /* SV raw range: raw transmit time is the*/
                                /* value subtracted from receive time*/
                                /* (receive time rounded to nearest*/
                                /* millisecond)
float           smth_corr;      /* Smoothing correction for ranges (meters)*/
unsigned int    smth_count;     /*Number of data points in smoothing.*/
char            polarty_known   /* Tracking status: 0 to 3 not usable for*/
                                /* carrier phase.*/
unsigned char warning;          /* Warning flag (BIT flags):*/
                                /* 0 ==> All O.K.*/
                                /* Bit 1 ==>Sv txmt approaching 1ms offset*/
                                /* Bit 2 ==> Sv txmt approaching 1ms offset*/
                                /* but different direction from*/
                                /* Bit 3 ==> Carrier phase questionable*/
                                /* Bit 8 => Lost_lock_counter reset.*/
unsigned char goodbad;          /* Another health indicator:*/
                                /* 22 ==> Code and carrier measured.*/
                                /* 23 ==> Same as 22 but additionally, nav*/
                                /* message obtained but measurement*/
                                /* was not used in position computation*/
                                /* 24 ==> Same as 23 but codephase was used*/
                                /* in position computation.*/
unsigned hcar ireg;             /* Signal to noise.*/
char            qa_phase;       /* QA phase check (0.001 cycles).*/
long            doppler;        /* SV raw doppler.*/
double          carphase;       /* Full carrier phase (cycles).*/
```

E-files

The E-file contains the ephemeris information transmitted from each satellite. Each record consists of a byte identifying the SVPRN, followed by a NAVSTRCT. The data is recorded at hourly intervals and may consist of several records for a single satellite. If a satellite were not tracked during a given hour, there will be no entry for that satellite for that hour.

The NAVSTRCT consists of 32 records per SVPRN. The record definitions and the units of the orbit data conform to GPS-ICD-200. Each file record has the following structure.

```
char        svprn;      struct navstruct
int         wn;         GPS week number.
long        tow;        Seconds of GPS week.
float       tgd;        Group delay (sec).
long        aodc;       Clock data issue.
long        toc;        (sec).
float       af2;        Clock parameters: (sec/sec2)
float       af1;        (sec/sec)
float       af0;        (sec).
long        aode;       Orbit data issue.
float       deltan;     Mean anomaly correction (semi-circle/sec).
double      m0;         Mean anomaly at reference time (semi-circle).
```

double	e;	Eccentricity
double	roots;	Square root of semi-major axis (meters 1/2)
long	toe;	Reference time for orbit (sec).
float	cic;	Harmonic correction term (radians).
float	crc;	Harmonic correction term (meters).
float	cis;	Harmonic correction term (radians).
float	crs;	Harmonic correction term (meters).
float	cuc;	Harmonic correction term (radians).
float	cus;	Harmonic correction term (radians).
double	omega0;	Lon af Asc. node (semi-circles).
double	omega;	Arg. of Perigee (semi-circles).
double	i0;	Inclination angle at reference time (semi-circles).
float	omegadot;	Rate of right Asc. (semi-circles/sec).
float	idot;	Rate of inclination (semi-circles/sec).
int	accuracy;	(coded).
int	health;	(coded).
int	fit;	Curve fit interval (coded).

S-files

The S-file (site file) is an ASCII text file containing the information entered by the field surveyors using the GPS receiver, Screen 9. An example of the data is shown below:

```
*****************************************SITE INFORMATION*****************************
NAME    BYTES   WEEK  TIME    SES   RCR   ANT   MMDD   OPR CODETYPE
RICK    147272  522   211478  A     164   016   0109   RS_____30F _XXIV

                      HI      T-DRY T-WET       HUMIDITY       PRESSURE
BEFORE          2.0900 0       0     0     0.0
AFTER           2.0900 0       0     0     0.0

RECEIVER Type:  L-XII  Nav: 5A  Channel: 2H  Options: COO
*************************************************************************
```

D-File

Meteorological information is written into D-file in the following format:

XDR,P,X.X,B,ID,C,X.X,C,ID,H,X.X,P,ID [CR] [LF]

Table 6.1: D-File Field Information

Field	Significance
1	Message type indicator, XDR
2	Pressure Transducer type, P
3	Pressure measurement data, float value in variable length
4	Unit of measure for pressure, B (bars)
5	Transducer ID, string of variable length

Table 6.1: D-File Field Information

Field	Significance
6	Temperature Transducer type, C
7	Temperature measurement data, float value in variable length
8	Unit of measure for temperature, C (Celsius)
9	Transducer ID, string of variable length
11	Humidity Transducer type, H
12	Humidity measurement data, float value in variable length
13	Unit of measure for humidity, P 9 percent
14	Transducer ID, string of variable length

Tilt meter information is written into D-file in the following format

XDR,Z,S.S,D,ID,A,S.S,D,ID,C,S.S,C,ID [CR] [LF]

Table 6.2: D-File Tilt Meter Data Field Descriptions

Field	Description
1	Message type indicator, XDR
2	Angular Transducer type, A
3	N title value, float value in variable length
4	Unit of measure for N tilt value, D (degrees)
5	Transducer ID, string of variable length
7	E tilt value, float value in variable length
8	Unit of measure for E tilt value, D (degrees)
9	Transducer ID, string of variable length
11	Temperature Transducer type, C
12	Temperature measurement data, float value in variable length
13	Unit of measure for temperature, C (Celsius)
14	Transducer ID, string of variable length

Tilt meter data can follow MET3 data in one XDR string.
XDR,P,X.X,B,ID,C,X.X,C,ID,H,X.X,P,ID, A,X.X,D,ID,A,X.X,D,ID,C,S.S,C,ID [CR] [LF]

There are combinations of tilt data up to three meters in one XDR string
XDR,A,X.X,D,ID,A,X.X,D,ID,C,X.X,C,ID,A,X.X,D,ID,A,X.X,D,ID,C,X.X,C,ID,A,X.X,D,ID,A,X.X, D,ID,C,X.X,C,ID [CR] [LF]

Real-Time Data Files in ASCII

Only MBEN (measurement) and PBEN files can be output in ASCII format. For each satellite and at each epoch (recording time interval), a record is output containing fields in the following order. Each field is separated by a comma. A carriage return/ linefeed separates each satellite record.

MBEN Files in ASCII

The format for MBEN in ASCII is:

Table 6.3: MBEN Format in ASCII

Component	Function
Header	Indicates the type of data sent and allows a resynchronization with the data stream in case some bits were lost in transmission. It reports the receiver configuration. C/A-only contains: $PASHR,MCA, P code L1 and L2 contains: $PASHR,MPC,
Structure Identification	• Sequence tag. Is the time tag used to associate all structures with one epoch. It is in units of 50 ms and modulo 30 minutes (one count = 50 ms and it is reset every 30 minutes). • Number of remaining MBEN structures. There is one structure per locked satellite on every epoch. This parameter tells how many structures remain to be sent for that epoch.
Satellite data	• Satellite PRN number. • Elevation: Satellite elevation angle in degrees. Values range from 0 to 90 degrees. • Azimuth: Satellite azimuth angle in degrees. Values range from 0 to 360 degrees. • Channel index: Receiver channel (1 to 12) to which satellite was locked.

Measurement data for C/A, P-L1, or P-L2	• Warning flag: Flag displaying status of receiver clock, carrier phase signal, and loss of lock.
	  • bit 1 set = see note below
	  • bit 2 set = see note below
	  • bit 3 set = carrier phase questionable
	  • bit 4 set = code phase questionable
	  • bit 5 set = code phase integration not stable
	  • bit 6 set = Z tracking mode
	  • bit 7 set = possible loss of lock
	  • bit 8 set = loss of lock counter reset

Footer	• Checksum (displayed in decimal) a bytewise exclusive OR (XOR) on all bytes from the sequence tag to the checksum. • Carriage return, line feed.

The interpretation of bits 1 and 2 is as follows:

- bit 1 = 0 and bit 2 = 0: same as 22 in good/bad flag (see next field)
- bit 1 = 1 and bit 2 = 0: same as 23 in good/bad flag
- bit 1 = 0 and bit 2 = 1: same as 24 in good/bad fla

More than one bit may be set at the same time. For example, if bits 1, 3, and 6 are set at the same time, the warning flag will be 37 (1 + 4 + 32).

- Measurement quality (Good/bad flag) indicates the quality in the measurement of position.
- 0 = measurement not available and no additional data will be sent
- 22 = code and/or carrier phase measured
- 23 = code and/or carrier phase measured, and navigation message was obtained but measurement was not used to compute position.
- 24 = code and/or carrier phase measured, navigation message was obtained, and measurement was used to compute position.
- Empty field
- Signal to noise ratio (signal/noise): high signal level with low noise level indicates good quality signal. Typical range 15 to 130.
- Phase quality indicator (%): to obtain this value, an equation using carrier phase and integrated doppler is computed. The result should be a value close to an integer. Values from 0 to 5 or 95 to 100 indicate good quality.
- Full carrier phase (in cycles): total number of cycles plus fraction of the range between the antenna and the satellite.
- Code transmit time (ms): length of time of code transmission (Dt or pseudorange). The satellite clock offset correction from GPS time is not included.
- Doppler (10^{-4} Hz): Doppler measurement. To get doppler in units of Hz, divide this number by 10,000. Doppler is positive when the satellite is moving away from the antenna, negative if it is moving toward.
- Range smoothing correction (in meters): raw range minus smoothed range. The smoothed range is obtained by filtering the raw range with the integrated doppler.
- Range smoothing quality: indicates how long the raw range has been smoothed. Increments from 0 to 200 in steps of 2 every ½ second, which is the receiver cycle time.

PBEN Files in ASCII

The format for PBEN in ASCII is:

- "$PASHR,PBN," header string.
- Receive time: GPS time in seconds of week when code was received.
- Station position: ECEF-X (meters).
- Station position: ECEF-Y (meters).
- Station position: ECEF-Z (meters).
- Latitude ("-" before latitude indicates south.)
- Longitude ("-" before longitude indicates west.)
- Altitude (meters).
- Velocity in ECEF-X (m/sec).
- Velocity in ECEF-Y (m/sec).
- Velocity in ECEF-Z (m/sec).
- Number of satellites used for position computation.
- Site name. 4 characters (operator entered.)
- PDOP
- HDOP
- VDOP
- TDOP

Real-Time Data Files in Binary

MBEN Files in Binary

This section describes the binary MBEN (measurement) file. Its length varies depending on the receiver configuration. The table of file lengths shows the total number of bytes sent.

Table 6.4: Total Number of Bytes Sent

Receiver Configuration	Blocks of Code Data in MBEN binary file	Number of bytes in file
C/A only	C/A	50
P code on L1 and L2	C/A, P-L1, P-L2	108

Table 5.10 describes the binary format of the MBEN file:

Table 6.5: MBEN File in Binary

Field	Bytes	Description
header	11	Indicates the type of data sent and allows a resynchronization with the data stream in case some bits were lost in transmission. Header reports the receiver configuration. C/A-only is: $PASHR,MCA P code L1 and L2 is: $PASHR,MPC,
Block identification, 3 bytes:		
unsigned short	2	Sequence id number in units of 50 ms, modulo 30 minutes (sequence tag).
unsigned char left	1	Number of remaining MBEN structures to be sent for current epoch.
Satellite data, 4 bytes:		
unsigned char svprn	1	Satellite PRN number.
unsigned char elevation	1	Satellite elevation angle (degree).
unsigned char azimuth	1	Satellite azimuth angle (degrees).
unsigned char chnind	1	channel ID (1 to 12).
C/A code data block, 29 bytes:		
unsigned char warning	1	Warning flag
unsigned char goodbad	1	Indicates quality of the position measurement.
spare	1	
unsigned char ireg	1	Signal to noise of satellite observation.
unsigned char qa_phase	1	Phase quality indicator: 0 to 5 and 95 to 100 are normal.
double full_phase	8	Full carrier phase measurements in cycles.
double raw_range	8	Raw range to SV (in seconds), i.e., receive_time - raw_range = transmit time
long doppler	4	Doppler (10^{-4} Hz).

Table 6.5: MBEN File in Binary (continued)

Field	Bytes	Description
long smoothing	4	32 bits where 31-24 are the *smooth_count*, unsigned and normalized, representing the amount of smoothing where: • 1 is least smoothed • 200 is most smoothed • 0 is unsmoothed. Bits 23-0 are smooth_corr, where bit 23 (MSB) is the sign and the LSBs (22-0) are the magnitude of correction (centimeters).
	(29)	P code on L1 block, in the same format as the C/A code data block.
	(29)	P code on L2 block, in the same format as the C/A code data block.
spare	2	Footer, 3 bytes:
unsigned char checksum	1	Checksum, a bytewise exclusive OR (XOR) on all bytes from sequence_tag (just after header) to the byte before checksum.
char	1	Carriage return.
char	1	Line feed.

For details on warning flag and good/bad flag, refer to Table 5.10.

PBEN Files in Binary

The PBEN (position data) file corresponds to one epoch. Its format in binary is:

Table 6.6: PBEN File in Binary

Field	Bytes	Contents
$PASHR,PBN,	11	Header
long pbentime;	4	GPS time in 10-3 seconds of the week when data was received.
char sitename [4];	4	4-character site name (operator entered).
double navx;	8	Station position: ECEF-X (meters).
double navy;	8	Station position: ECEF-Y (meters).
double navz;	8	Station position: ECEF-Z (meters).
float navt	4	Clock offset (meters).
float navxdot;	4	Velocity in ECEF-X (m/sec)
float navydot;	4	Velocity in ECEF-Y (m/sec)
float navzdot;	4	Velocity in ECEF-Z (m/sec)

Table 6.6: PBEN File in Binary (continued)

Field	Bytes	Contents
float navtdot;	4	Clock drift (m/sec)
uns. short pdop;	2	PDOP.
unsigned short checksum;	2	Checksum word (sum of words from pbentime to PDOP).
char	1	Carriage return.
char	1	Linefeed.
Total bytes	69	

TBEN File in Binary

This section describes the TBEN binary TBEN file.

The output format is shown below :

$PASHR,TBN,d1,d2,d3,d4,struct1[,struct1,...],struct2[,struct2,...],struct3[,struct3,...],d5<CR><LF>

where :

d1	type long, the GPS week in milliseconds.
d2	type short, number of ranger mode 3 measurements.
d3	type short, number of new ephemenris.
d4	type short, number of new almanac.
struct1	type struct, ranger mode 3 measurement data.
struct2	type struct, new ephemeris data.
struct3	type struct, new almanac data.
d5	type unsigned short, checksum which is the summation of adding all data words.

Commas between data or between header and data or checksum and data are not part of the output. It is there simply for clarity reason.

Definition of struct :

struct1 : Ranger mode 3 measurements.

```
struct tmbenstrct {
    unsigned char   svprn;          /* 1, PRN number */
    unsigned char   chn;            /* 1,   Channel ID */
    unsigned char   wrnflag_L1;     /* 1,   CA/P1 warning */
```

```
    unsigned char   ampl_ca;          /* 1,   CA amplitude (IREG for L1) */
    double  p1_rng;                   /* 8,    P1 range */
    double rng_ca_minus_p1;           /* 8,   CA smooth range - P1 raw range */
    double  totphase_ca;              /* 8,    CA total phase */
    float  smth_cor_p1;               /* 4,    P1 smooth range correction */
    short  smoothcnt_p1;              /* 2     P1 smooth counts */

    unsigned char   wrnflag_L2;       /* 1,    P2 warning */
    unsigned char   ampl_p2;          /* 1,    P2 amplitude (IREG for L2) *
    double rng_p2_minus_p1;           /* 8,    P2 raw range - P1 raw range */
    double  totphase_p2;              /* 8,    P2 total phase */
    floa   smth_cor_p2;               /* 4,    P2 smooth range correction */
    shor   smoothcnt_p2;              /* 2,    P2 smooth counts */
                                      /*---*/
                                      /* 58 */
};
```

struct2 : for ephemeris. Checksum in the struct is not output.

```
struct snavstrct {
        short    wn  ;               /* 2 */
        long     tow ;               /* 4 */
        float    tgd ;               /* 4 */
        long     aodc ;              /* 4 */
        long     toc  ;              /* 4 */
        float    af2  ;              /* 4 */
        float    af1  ;              /* 4 */
        float    af0  ;              /* 4 */
        long     aode  ;             /* 4 */
        float    deltan ;            /* 4 */
        double   m0  ;               /* 8 */
        double   e ;                 /* 8 */
        double   roota  ;            /* 8 */
        long     toe  ;              /* 4 */
        float    cic  ;              /* 4 */
```

```
    float   crc  ;                  /* 4 */
    float   cis  ;                  /* 4 */
    float   crs  ;                  /* 4 */
    float   cuc  ;                  /* 4 */
    float   cus  ;                  /* 4 */
    double  omega0 ;                /* 8 */
    double  omega  ;                /* 8 */
    double  i0  ;                   /* 8 */
    float   omegadot ;              /* 4 */
    float   idot   ;                /* 4 */
    short    accuracy ;             /* 2 */
    short    health   ;             /* 2 */
    short    fit   ;                /* 2 */
    char   prnnum ;                 /* 1 */
    char   res   ;                  /* 1 */
    unsigned short checksum ;       /* 2 */
   }
                                    /*-------------*/
                                    /*    132      */
```

struct3 : for almanac. Checksum in the struct is not output.

```
struct salmstrct {
    short    prn;                   /* 2 */
    short    health ;               /* 2 */
    float     e ;                   /* 4 */
    long     toe ;                  /* 4 */
    float   i0 ;                    /* 4 */
    float   omegadot ;              /* 4 */
    double  roota  ;                /* 8 */
    double  omega0 ;                /* 8 */
    double  omega ;                 /* 8 */
    double  m0 ;                    /* 8 */
    float   af0 ;                   /* 4 */
    float   af1 ;                   /* 4 */
    short    wna ;                  /* 2 */
```

```
    short    wn ;                    /* 2 */
    long     tow ;                   /* 4 */
    unsigned short checksum;         /* 2 */
                                     /*---------------*/
                                     /*      70       */
} ;
```

SNAV Files in Binary

The SNAV file (ephemeris data) is output only in binary. Its record definitions and the units for orbit data conform to the GPS-ICD-200 standard. This structure has 32 records.

Table 6.7: SNAV Files

Field	Bytes	Contents
$PASHR,SNV	11	Header
short wn;	2	GPS week number.
long tow;	4	Seconds of GPS week.
float tgd;	4	Group delay (sec).
long aodc;	4	Clock data issue.
long toc;	4	(sec).
float af2;	4	Clock:(sec/sec2)
float af1;	4	(sec/sec)
float af0;	4	(sec).
long aode;	4	Orbit data issue.
float deltan;	4	Mean anomaly correction (semi-circle/sec).
double m0;	8	Mean anomaly at reference time (semi-circle).
double e;	8	Eccentricity.
double root a;	8	Square root of semi-major axis (meters ½).
long toe;	4	Reference time for orbit (sec).
float cic;	4	Harmonic correction term (radians).
float crc;	4	Harmonic correction term (meters).
float cis;	4	Harmonic correction term (radians).
float crs;	4	Harmonic correction term (meters).

Table 6.7: SNAV Files (continued)

Field	Bytes	Contents
float cuc;	4	Harmonic correction term (radians).
float cus;	4	Harmonic correction term (radians).
double omega0;	8	Lon of Asc. node (semi-circles).
double omega;	8	Arg. of Perigee (semi-circles).
double i0;	8	Inclination angle at reference time (semi-circles).
float omegadot;	4	Rate of right Asc. (semi-circles per sec).
float idot;	4	Rate of inclination (semi-circles per sec).
short accuracy;	2	(coded).
short health;	2	(coded).
short fit;	2	Curve fit interval (coded).
char prnnum;	1	(SV PRN number -1)
char res;	1	Reserved byte.
unsigned short checksum;	2	Checksum word (sum of words from wn to res).
char	1	Carriage return.
char	1	Linefeed.
Total bytes	145	

Raw Broadcast Ephemeris Message

This message contains the raw broadcast ephemeris data. Please refer to ICD-GPS-200 for definition and decoding information. Each subframe word is right-justified in a 32 bit integer.

Table 6.8: Raw Broadcast Ephemeris Data

Field or Type	Bytes	Contents
$PASHR,EPB,	11	message header
char	2	PRN
char	1	delimiter ‘,’
long	4	subframe 1, word 1
long	4	subframe 1, word 2
long	4	subframe 1, word 3

Table 6.8: Raw Broadcast Ephemeris Data (continued)

Field or Type	Bytes	Contents
long	4	subframe 1, word 4
long	4	subframe 1, word 5
long	4	subframe 1, word 6
long	4	subframe 1, word 7
long	4	subframe 1, word 8
long	4	subframe 1, word 9
long	4	subframe 1, word 10
long	4	subframe 2, word 1
long	4	subframe 2, word 2
long	4	subframe 2, word 3
long	4	subframe 2, word 4
long	4	subframe 2, word 5
long	4	subframe 2, word 6
long	4	subframe 2, word 7
long	4	subframe 2, word 8
long	4	subframe 2, word 9
long	4	subframe 2, word 10
long	4	subframe 3, word 1
long	4	subframe 3, word 2
long	4	subframe 3, word 3
long	4	subframe 3, word 4
long	4	subframe 3, word 5
long	4	subframe 3, word 6
long	4	subframe 3, word 7
long	4	subframe 3, word 8
long	4	subframe 3, word 9
long	4	subframe 3, word 10
short	2	word checksum beginning with header ‘P’
total	136	

DBEN Files in Binary

General

DBEN is a binary message which contains the message header, receiver time, receiver site ID, GPS pseudo-range and carrier phase measurements, checksum and message tail. It is similar to an MBEN message but it is bitwise compressed and the decoding program must perform bitwise manipulation in order to decode it properly.

DBEN Message Structure

A complete DBEN message can be divided into three parts:

- Message Header
- Message Data
- Message Tail

More fine division is as follows:

- 0$XXYYR,TZZ
- [DML]
- [Data]
- [ChkSum]
- [CR] [LF]

Number of bits and detailed explanation of each part are listed as follows:

Message Header Part

Table 6.9: Message Header

Num. of bits	Symbol	Content
8	$	To mark the beginning of a message.
8x2	XX	The message sender ID. This is what you would have entered in receiver at field Receiver is: of RECEIVER IDENTIFICATION sub-screen in receiver menu 4/Subcommand
8x2	YY	The message designator ID. This is what you would have entered in receiver at field Remote is: of RECEIVER IDENTIFICATION sub-screen in receiver menu 4/SubCommand
8x2	R,	To indicate it is a responding message (always be "R,").
8	T	To identify if the message is in compressed form (P for PACKED) or uncompressed form (R for UNPACKED)
8x3	ZZ,	Is the message type, This is what you would have selected in the receiver's DBEN DATA FORMAT SELECTION sub-screen.
16	DML	Length of Message Data Part [Data], after DML and before ChkSum, in units of bytes

Message Data Part.

Table 6.10: Message Data

Number of Bits	Symbol	Content
30	RTime	Receiver time in units of GPS milliseconds of week
8x4	Site ID	Receiver four-character site ID
32	PRN	SVPRN for the satellites which have data to be followed. It is a bitwise indication. Starting from least significant bit, bit 1 corresponds to SVPRN #1, bit 2 corresponds to SVPRN #2, and so on. If a given bit is 1, it means that SVPRN has data, 0 otherwise.
31	PR	Pseudorange in units of 1.0e-10 seconds (or 0.1 nanoseconds). Multiply this value by 1.0e-10 to pseudo-range in seconds. A zero value may be sent for bad pseudo-range.
1	WN	Warning bit (1- bad carrier phase, 0 - good carrier phase)
1	SIGN	Sign bit (1 - negative carrier phase value, 0 - positive carrier phase value)

Table 6.10: Message Data

Number of Bits	Symbol	Content
28	PH_I	Integer part of the carrier phase measurement in cycles
11	PH_F	Fractional part of the carrier phase measurement in units of 5e-4 cycles. Multiply this number by 5e-4 to get fractional carrier phase in cycles. Whole carrier phase measurement = PH_I + PH_F*5.0e-4

Zeros are padded so that all of above part are a module of 16 bits

Total bits: ceil $((94 + 72*N_{slot}*N_{svs})/16) * 16$, ceil (a) means truncates to +Inf, e.g., ceil (3.1) = 4, ceil (3.5) = 4, ceil (3.95) = 4.

N_{slot} is number of data slot in given message type, see following table DBEN Message Definition for number of slot in each message type.

N_{svs} is number of SVs.

For Z-XII with firmware version ALS0 (04/14/94 14:05) This is one bit flag right after WN to indicate widelane cycle-slip (for RWL type only, not implemented for other DBEN message type yet). This is interpreted in PNAV software as Type 1 DBEN message (in PNAV version 3.0.00T release Alpha0#, Menu ALT-R/F5). Without this flag is interpreted as Type 0 DBEN message.

Message Tail

Table 6.11: Message Tail

Number of Bits	Symbol	Content
16	[Chk Sum]	The word-wise (16 bits) sum of the [Data] message. It is a cumulative unsigned short sum of the [Data message], after DML, before this ChkSum.
8x2	[CR] [LF]	To mark the end of message.

DBEN Message Types

Five types of DBEN messages are implemented for real-time PNAV, as listed in Table 6.12. Each type of message can be in the form of PACKED or UNPACKED.

The pseudo-range can be raw pseudo-range (UNSMOOTHED) or smoothed pseudo-range with internal carrier phase smoothing (SMOOTHED).

Table 6.12: DBEN Message Definition

Message ID	Message type in receiver screen	Observables	num. of slots
RCA	C/A CODE:	C/A code + CAL1 carrier phase	1
RWL	WIDE LANE:	(PL1 code + PL2 code)/2 + (L1 carrier phase - L2 carrier phase)	1
RP1	L1 P CODE:	C/A code + CAL1 carrier phase + PL1 code + PL1 carrier phase	1
RP2	L2 P CODE:	C/A code + CAL1 carrier phase + PL2 code + PL2 carrier phase	2
RPC	FULL P CODE:	PL1 code + PL1 carrier phase + PL2 code + PL2 carrier phase or CA code + CAL1 carrier phase + PL2 code + PL2 carrier phase	2

Currently, Doppler is not included in the DBEN message.

One epoch message size of each type of DBEN message is listed in Table XXX

Table 6.13: DBEN Message Size (bits)

	Number of satellites								
Message Type	4	5	6	7	8	9	10	11	12
RCA, RWL	520	600	664	744	808	888	952	1032	1096
RP1, RP2, RPC	808	952	1096	1240	1384	1528	1672	1816	1960

With Doppler

Table 6.14: Doppler Message Size (bits)

	Number of Satellites								
RCA, RWL	632	728	824	920	1016	1112	1208	1304	1400
RP1, RP2, RPC	1016	1208	1400	1592	1784	1976	2184	2376	2568

Use this table to determine the data link rate requirement. For example, for a typical application tracking at most eight satellites, if a once-per-second update rate is required, there are 1384 bits of data in the DBEN message. The minimum requirement for a modem would be: 2400 BAUD with nearly 100% duty cycle.

Message Compression

The message is in UNPACKED format. In a future implementation, a PACKED format will reduce the message length by 50%.

Pseudo Range Smoothing

Normally, the raw pseudo-range is output UNSMOOTHED. In a future implementation, the pseudo-range (code) is modified with receiver internal carrier phase smoothing corrections (SMOOTHED).

Maintenance

This chapter provides information about the antenna and power cables used with the CGRS receiver, as well as information about radio interference and various maintenance procedures.

Antenna Cables

The antenna cable shown in Figure 7.1, may be up to 30 meters long. A line amplifier is available for greater distances. Other technical specifications are shown in Figure 7.3. The supplied cable is a 30-meter Belden 8214 (RG-8/U-type, but with better loss specifications).

The cable uses type-N male connectors at both ends which are center captured. If a non-Ashtech cable is to be used, it must be the same type and have the same connectors as noted above.

Type 8214 RG-8 cable meets these specifications, but other RG-58/U and RG-8/U cables may not. Ensure that any substitute cables satisfy Ashtech electrical requirements or the GPS receiver may not perform properly.

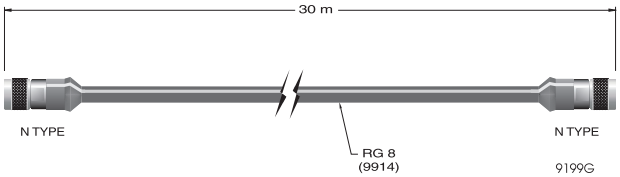


Figure 7.1: Antenna Cable

Table 7.1: Antenna Cable Electrical Specifications

Component	Function
Insertion loss	12 db max. (at 1.5 GHz)
Characteristic impedance	50 ohm (nominal)
DC resistance	0.5 ohm ground braid and center conductor

Power Cables

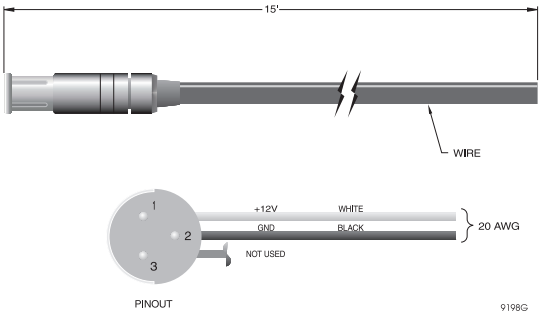


Figure 7.2: Power Cable

The power cable shown in Figure 7.2 mates with a 3-pin connector on the rear panel. If a substitute cable is used, use 20 AWG wire or larger.

RS-232 Pinout

The RS-232 cable used with the Z-12 CGRS receiver should mate with the female 16-pin circular connector on the receiver, as shown in the following figure.

Figure 7.3: 16-pin Circular Connector

Pin assignments are listed in the following table.

Table 7.1: Pin Assignments

16-Pin Circular Connector	Description	Abbreviation
1	Ground	GND
2	Transmit data port A/B	TXD0
3	Receive data port A/B	RXD0
4	Request to send port A/B	RTS0
5	Clear to send port A/B	CTS0
6	Data set ready port A/B	DSR0
7	Ground	GND
8	Data carrier detect port A/B	DCD0
9	Data terminal ready port A/B	DTR0
10	+5 VDC	+5V
11	Ground	GND
12	Transmit data port C/D	TXD2
13	Receive data port C/D	RXD2
14	Request to send port C/D	RTS2
15	Clear to send port C/D	CTS2

Notice that port A/B is configured for full handshake while port C/D is not.

Radio Interference

Ashtech recommends that users verify that the broadcast frequencies of any handheld or mobile communication devices do not interrupt or obstruct GPS receivers during data collection.

WARNING
Some radio transmitters and receivers (such as FM radios) can interfere with the operation of GPS receivers if operated in close proximity.

Power Consumption

The power consumption of the Z-12 CGRS receiver is slightly different depending on whether the screen backlighting is ON or OFF. When the screen backlight is OFF, power consumption is approximately 20W. When ON, it is approximately 22W.

Internal Batteries

One lithium battery maintains saved parameter data. The battery is rated at 1.8 AH and have an operating life of 5 years in this application. The batteries should be monitored after 4 years of use, and replaced after 5 years.

If the batteries need to be replaced, the unit must be returned to Ashtech.

Sleep Mode

If internal voltage drops below 10.4 VDC, the receiver goes into the SLEEP mode. After voltage is restored, the next power cycle resumes normal operation. Memory and stored parameters are protected.

Upgrading Firmware

General

The Z-12 CGRS receiver contains flash EPROMs that can be upgraded with new firmware without opening the unit. Updates are obtained through the Ashtech technical support group, and can be loaded into the receiver using a personal computer.

PLZ is the Ashtech program that updates the firmware in Z-12 CGRS receivers. PLZ uses the following program files:

- NAV.DAT - binary data file containing the Nav firmware
- BIN.DAT - binary data file containing the channel firmware

These files are found on the distribution disk along with PLZ.EXE, the loading program which uploads NAV.DAT and BIN.DAT into the receiver.

It is also possible to upgrade firmware on a remote station by using the CGRemote program. Refer to Appendix B for instructions.

Program Execution

1. Before executing PLZ, either copy PLZ.EXE and the program files from the distribution disk to your computer hard disk, or execute PLZ from the distribution disk. If you execute PLZ from the distribution disk, more execution time is required to read the data file and send it to each receiver.
2. Before executing PLZ, have power supplied to the receiver and the RS-232 communications cable attached to the computer and the receiver. Either COM1 or COM2 on the computer can be used. Only port A on the receiver can be used.
3. With the receiver powered ON, start PLZ by typing the following command at the DOS prompt: PLZ [ENTER]

The program defaults for PLZ.EXE are set to run a main program load from PC serial port COM1 at 115200 baud on an VGA/EGA screen. Different options can be set by using the following format:

PLZ -x -yy +z

where

-x is the PC serial port (-2 for COM2)

-yy can be either :

-bt boots load instead of a main program load

-mn sets the display for monochrome screen

+z sets baud rate where y is an integer from 5-9:

+5 sets the baud rate to 9600

+6 sets the baud rate to 19200

+7 sets the baud rate to 38400

+8 sets the baud rate to 57600

+9 sets the baud rate to 115200

Multiple options may be selected, separated by a space. For example:

PLZ -mn -2 +5

selects COM2 at a baud rate of 38400 and sets the display for monochrome.

WARNING
DO NOT disconnect the cable from the receiver or turn off the receiver until the program completes execution.

Once the program has begun execution, the following information is displayed on the monitor screen:

ASHTECH Z-XII PROGRAM LOADER CSC 1.1

>> SETTING UP INTERFACE TO THE RECEIVER

SENDING PROGRAM TO THE RECEIVER

1ST MEMORY LOADING

2ND MEMORY LOADING

The display shows the program loading status. The symbol >> points to the current process step, and the step is highlighted.

The transmission status consists of two execution steps:

- The interface setup step where an RS-232 connection is established between the receiver and the computer and the receiver is prepared to receive the program data
- The program transfer step where the program data is transferred to the receiver.

The receiver reprogram status consists of 2 stages, represented by 2 separate lines

1ST MEMORY LOADING

2ND MEMORY LOADING

When each stage is in execution, a percentage complete for that stage is displayed. The stage is complete when the percentage indication is 100.

4. After the program has finished execution and returns to the operating system prompt, disconnect the communications cable from the serial port and turn the receiver OFF using the power switch.
5. Reset the receiver's internal and external memory.
6. The receiver firmware program has now been properly updated. To confirm the new version, turn the receiver ON. The new version appears in the lower right corner of menu 0.

Warning Messages

Warning messages are displayed by the PLZ program to inform the user of potential problems during the program execution. When the receiver is in the reprogramming stages, the following message appears at the bottom of the screen:

WARNING
Keep the receiver turned on until the end of program loading!

Do not turn the receiver OFF or disconnect the cable from the receiver until completion of PLZ program execution. The receiver's main program will be corrupted, and a boot load will be necessary.

Error Messages and Abnormal Termination

When errors are detected during program execution, PLZ displays an appropriate error message and terminates the loading process.

1. When the program data files are not found in the default directory, the following message appears:

   ERROR: FAILED TO FIND NAV.DAT FILE

   Correct this error by loading the NAV.DAT and BIN.DAT files into the default directory and restarting the execution of PLZ.

2. If PLZ fails to establish communication with the receiver, the following message appears:

   ERROR: RS232 TRANSMIT PROBLEM PROGRAM LOADING FAILED

   If this problem occurs, ensure that all of the program execution steps above have been followed and both the power supply and cables are working. Also ensure that the receiver is powered ON and that the cable is plugged into the correct port. Restart the receiver and repeat the steps above. If the problem recurs, call Ashtech technical support.

3. When invalid program data is transferred to the receiver, the message

   INVALID CHECKSUM

   may appear at the bottom of the screen.This can occur for either of 2 reasons:

   - The baud rate is too fast for the computer serial port. Set a lower baud rate (9600 suggested). Please refer to the Program Execution section.
   - One of the .DAT files has become corrupted. Either recopy the files from the disk or re-download the files from the Ashtech Bulletin Board.

   In either case, a boot load is necessary. See below for instructions on boot loading. If the problem continues, call Ashtech technical support.

4. If the program abnormally aborts at the SENDING PROGRAM TO THE RECEIVER stage and does not load the program at all, it is likely that the baud rate is too high for the computer. If this happens, the main program is now corrupted and a boot load will be necessary. Exit the program using the [Esc] key

and follow the boot procedure described below, then run the PLZ program at a lower baud rate.

Boot Loading

Once the program has started sending program data to the receiver, any abnormal termination (power failure, program hang up, checksum errors) corrupts the main program, and a normal main program load is no longer possible. In these cases, a boot load is necessary. Perform this as follows:

1. Exit the PLZ program by using the [Esc] key on the computer.
2. Turn the receiver OFF, then ON, while pressing the [0] key. The receiver indicates that the main program has been corrupted by displaying the following message

   SERIAL PORT A HAS BEEN SELECTED. WAITING FOR MAIN PROGRAM LOAD

   If the Hose cable is connected to receiver port B, press and hold the [9] key when turning the receiver back ON. The first part of the message should now read

   SERIAL PORT B HAS BEEN SELECTED
3. At the DOS prompt, enter: PLZ -bt [ENTER]
4. To reduce the baud rate, use one of the baud rate options described in step 3 of Program Execution; for example: PLZ -bt +7 runs the boot load at a baud rate of 38400.
5. The PLZ program should run normally at this point.

Datums

The following transformation parameters from the Defense Mapping Agency are used by GPS receivers to convert pseudo-ranged positions shown on Screen 2 from WGS-84 into the desired datum. The datums have been compiled in a table (from Dept. of Defense document SS-M/V-500, Rev. P, 16 Oct. 1991).

Table A.1: Datums

Rec'r datum codes	Local Geodetic System	Area	Reference Ellipsoid	Parameter Differences		Transformation Parameters		
				a (m)	1 x 10^4	X (M0	Y (M)	Z (M)
ARF-M	ARC 1950	Botswana, Lesotho, Malazi, Swaziland, Zaire, Zambia, Zimbabwe	Clarke 1880	112.145	-0.54750714	-143	-90	-294
ARS-M	ARC 1960	Kenya, Tanzania	Clarke 1880	112.145	-54750714	-160	-8	-300
AUA	Austr. Geod. 1966	Australia, Tasmania Island	Aust. Nat'l.	-23	-0.00081204	-133	-48	148
AUG	Austr. Geod. 1984	Australia, Tasmania Island	Aust. Nat'l.	-23	-0.00081204	-134	-48	149
BOO	Bogota Observatory	Columbia	Int'l	-251	-0.14192702	307	304	-318
CAI	Campo Inchauspe	Argentina	Int'l.	-251	-0.14192702	-148	136	90
CAP	Cape	South Africa	Clarke 1880	112.145	-0.54750714	-136	-108	-292
CGE	Carthage	Tunisia	Clarke 1880	112.145	-0.54750714	-263	6	431
CH	Chatham 1971	Chatham Island, New Zealand	Int'l.	-251	-0.14192702	175	-38	113
CHU	Chua Astro	Paraguay	Int'l.	-251	-0.14192702	-134	229	-29
COA	Corrego Alegre	Brazil	Int'l.	-251	-0.14192702	-206	172	-6

Table A.1: Datums (continued)

Rec'r datum codes	Local Geodetic System	Area	Reference Ellipsoid	Parameter Differences		Transformation Parameters		
				a (m)	1 x 10^4	X (M0	Y (M)	Z (M)
EUR-A	European 1950	Western Europe; Austria, Denmark, France, Germany, Netherlands, Switzerland	Int'l.	-251	-0.14192702	-87	-96	-120
EUR-E	Europe 1950	Cyprus	Int'l	-251	-0.14192702	-104	-101	-140
EUR-F	Europe 1950	Egypt	Int'l.	-251	-0.14192702	-130	-117	-151
EUR-H	Europe 1950	Iran	Int'l.	-251	-0.14192702	-117	-132	-164
EUR-J	Europe 1950	Sicily	Int'l.	-251	-0.14192702	-97	-88	-135
EUS	European 1979	Austria, Finland, Netherlands, Norway, Spain, Sweden, Switzerland	Int'l.	-251	-0.14192702	-86	-98	-119
GAA	Gandajika Base	Rep. of Maldives	Int'l.	-251	-0.14192702	-133	-321	50
GEO	Geodetic Datum 1949	New Zealand	Int'l.	-251	-0.14192702	84	-22	209
HJO	Hijorsey 1955	Iceland	Int'l.	-251	-0.14192702	-73	46	-86
IND-A	Indian	Thailand, Vietnam	Everest	860.655	0.28361368	214	836	303
IND-M	Indian	Bangladesh, India, Nepal	Everest	860.655	0.28361368	289	734	257
IFL	Ireland 1965	Ireland	Modified Airy	796.811	0.11960023	506	-122	611
KEA	Kertau 1948	W. Malaysia, Singapore	Modified Everest	832.937	0.28361368	-11	851	5

Table A.1: Datums (continued)

Rec'r datum codes	Local Geodetic System	Area	Reference Ellipsoid	Parameter Differences		Transformation Parameters		
				a (m)	1 x 10^4	X (M0	Y (M)	Z (M)
LIB	Liberia 1964	Liberia	Clarke 1880	112.145	-0.54750714	-90	40	88
LUZ-A	Luzon	Philippines, excl. Mindanao Island	Clarke 1866	-69.4	-0.37264639	-133	-77	-51
MAS	Massawa	Eritrea, Ethiopia	Bessel 1841	739.845	-0.10037483	639	405	60
MER	Merchich	Morocco	Clarke 1880	112.145	-0.54750714	31	146	47
MIN	Minna	Nigeria	Clarke 1880	112.145	-0.54750714	-92	-93	122
NAH-C	Nahrwan	Saudi Arabia	Clarke 1880	112.145	-0.54750714	-231	-196	482
NAS-C	North American 1927 (CONUS)	North America	Clark 1866	-69.4	-0.37264639	-8	160	176
NAS-D	Alaska	Alaska	Clarke 1866	-69.4	-0.37264639	-5	135	172
NAS-E	Canada	Canada incl. Newfoundland Island	Clarke 1866	-69.4	-0.37264639	-10	158	187
NAS-N	Central America	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Mexico	Clarke 1866	-69.4	-0.37264639	-6	127	192
NAR	North American 1983	Alaska, Canada, Central America, CONUS, Mexico	GRS 80	0	-0.00000016	0	0	0
OEG	Old Egyptian	Eypt	Helmert 1906	-63	0.00480795	-130	110	-13
OHA-M	Old Hawaiian	Hawaii	Clarke 1866	-69.4	-0.37264639	61	-285	-181

Table A.1: Datums (continued)

Rec'r datum codes	Local Geodetic System	Area	Reference Ellipsoid	Parameter Differences		Transformation Parameters		
				a (m)	1 x 10^4	X (M0	Y (M)	Z (M)
FAH	Oman	Oman	Clark 1880	112.145	-054750714	-346	-1	224
OGB-M	Ordinance Survey of Great Britain 1936	England, Isle of Man, Scotland, Shetland Islands, Wales	Airy	573.604	0.11960023	375	-111	431
PIT	Pitcairn Astro 1967	Pitcairn Island	Int'l.	-251	-0.14192702	185	165	42
QAT	Qatar National	Qatar	Int'l.	-251	-0.14192702	-128	-283	22
QUO	Qornoq	South Greesnland	Int'l.	-251	-0.14192702	164	138	-189
SCK	Schwarzeck	Nambia	Bessel 1841	653.135	0.10037483	616	97	-251
SAN-M	South American 1969	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Venzuela, Trinidad, Tobago	South America 1969	-23	-0.00081204	-57	1	-41
TIL	Timbalai 1948	Brunei, East Malaysia, Sarawak, Sabah	Everest	860.655	0.28361368	-689	691	-46
TOY-M	Tokyo	Japan, Korea, Okinawa	Bessel 1841	739.845	0.10037483	-128	481	664
ZAN	Zanderij	Surinam	Int'l.	-251	-0.14192702	-265	120	-358
WGS72	WGS 1972		WGS 72	-2.0	-0.3121057	0	0	-4.5
WGS84	WGS 1984		WGS 84	0	0	0	0	0.0

Supporting Software

CGRS Remote

CGRS REMOTE is a complete communications program for operating an Ashtech Z-12 CGRS receiver by remote control from a computer. Using Hayes®-compatible AT-type commands through modem or direct connection, users can imitate receiver front-panel controls and displays to obtain status information, set tracking parameters, and download and delete data files from the receiver. This section describes the features of CGRS REMOTE software, and explains how to set up the equipment and how to set the communication parameters in the computer and in the receiver.

The Ashtech receiver you want to communicate with using CGRS REMOTE must have the Remote Monitoring option installed. CGRS REMOTE works only with Z-12 CGRS receivers.

System Setup

The CGREMOTE.EXE program requires a communication link between the Personal Computer (PC) and the Ashtech receiver. This link can be established with a direct connection or a modem.

Direct Communication Link

For direct communication, connect one of the COM ports of a computer to one of the receiver serial ports using an RS-232 full-handshake null modem cable or cable adapter.

1. On the receiver, go to Screen 4 and press Enter [e] to shift to data entry mode.
2. Highlight the field associated with the serial port being used (PORT A SETUP or PORT B SETUP), and press Enter [e] to go to the PORT PARAMETER SELECTION subscreen.
3. With the BAUD RATE indicator highlighted, press the [+] or [-] key to toggle through the differential baud rates, and select one.
4. Press Enter [e] to save the setup and return to the main display, Screen 4.
5. On the computer, at the DOS prompt, type:

   CGREMOTE [ENTER]

6. If the communication port and transmission parameters are set correctly, CGRS REMOTE automatically polls the baud rate from the receiver and sets remote to the same baud rate. The baud rate in the status line at the bottom of the screen

will be updated. If not, press [ALT]+[C] to access the Communication Parameter screen and set the correct parameters.

7. Press [F10] to save the changes and return to the main window.

Modem Communication Link

For modem communication, connect one of the receiver serial ports and one of the computer COM ports to their respective modems with a straight-through RS-232 cable.

1. Apply power to the modems and to the receiver.
2. On the receiver, go to Screen 4, and press Enter [e] to shift to data entry mode.
3. Highlight the field associated with the serial port being used (PORT A SETUP or PORT B SETUP), and press Enter [e] to go to the PORT PARAMETER SELECTION subscreen.
4. With the BAUD RATE indicator highlighted, press the [+] or [-] key to toggle through the differential baud rates and select one.
5. Press Enter [e] to save setup and return to main display of Screen 4.
6. In Screen 4, highlight MODEM SETUP and press Enter [e] to go to the MODEM SETUP subscreen.
7. Highlight PORT and press [+] or [-] to toggle through port A or B and select the port connected to the modem.
8. Highlight TYPE, select the type of modem being used (presently, the receiver supports only Telebit modem), and press Enter [e] to save the changes and return to Screen 4
9. In Screen 4, highlight SUBCOMMANDS, and press Enter [e] to go to the subcommands subscreen.
10. Enter the command 191, and press any key to return to Screen 4.
11. Cycle the power of your receiver OFF and ON to initialize the modem with the required parameters.
12. During initialization, verify on the receiver screen the message: “Modem Initialized.”
13. If the screen displays the message: “Can not init Modem”, then repeat this step.
14. On the computer, at the DOS prompt, type: CGREMOTE [ENTER]
15. Press [ALT]+[C] to access the Communication Parameter Screen, and set the correct computer COM port, baud rate, and transmission parameters.
16. Press [F10] to save the changes and return to the main window.

17. Press [ALT]+[M] to access the Modem Parameters Menu and set the modem parameters according to the manufacturers specifications.
18. While in the Modem Parameter Menu, press [F5] to define the modem response strings.
19. Press [F10] twice to save the changes and return to the main screen.
20. Press [ALT]+[I] to send the modem initialization string.
21. Press [ALT]+[D] to dial a telephone number.

Program Operation

CGRS REMOTE stores all downloaded data in the current working directory. To store GPS data files in a different directory, you must change to that directory before executing CGRS REMOTE. To execute CGRS REMOTE, at the DOS prompt, type:

CGREMOTE [ENTER]

CGRS REMOTE obtains the initial configuration from the file called REMOTE.CNF and reads the dialing information from the file PHONENUM.LST. REMOTE.CNF contains the communication parameters, the modem control and response parameters, translation and transfer parameters, and menu attributes. (For details on the information contained within this file, see Input Files Used by CGRS REMOTE). In addition, CGRS REMOTE polls the baud rate information from the receiver and sets remote to the same baud rate.

The baudrate setting completes successfully only for a direct communication link and only if communication ports and transmission parameters (data bits, stop bits, and parity) are defined correctly.

Upon completion of this initialization, users will observe:

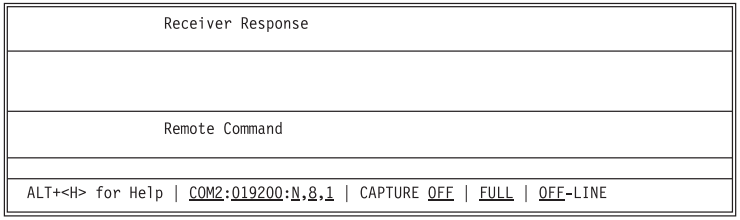


Figure B.1: Receiver Response Screen

This is the main window (or chat window) through which users can direct the CGRS REMOTE program functions.

The screen comprises three sections: Receiver Response, Remote Command, and the status line located at the bottom of the screen. Direct commands will be echoed in the Remote Command areas. Any response by the receiver are displayed in the Receiver Response area.

CGRS REMOTE queues in a buffer all characters that you type and does not send them to the receiver until you press [ENTER]. The [BACKSPACE] character erases characters and the up arrow key repeats the last command sent. The format of the data displayed in the Receiver Response area and the Remote Command area depends on the setting of the [ALT]+[T] Screen.

Status Line

The status line appears at the bottom of most CGRS REMOTE screens:

[ALT]+[H] for Help | COMn:bbbbbb:p,d,s | CAPTURE ccc | dupp | lll-LINE

The fields are defined in Table B.1.

Table B.1: CGRS REMOTE Screen Descriptions

Field	Description
n	Communication port currently active.
bbbbbb	Communication speed.
p	Parity ([n]one, [o]dd or [e]ven).
d	Data bits (7 or 8).
s	Stop bits (1 or 2).
ccc	Capture mode (ON or OFF)
dupp	Duplex (FULL or HALF).
lll	ON-LINE or OFF-line.

Remote Setting Commands

All screens and menus from the CGREMOTE.EXE program are accessed using commands with an [ALT]+[key] format from the main window. These commands are summarized in the Command Summary section; they are described in detail in this section and in the Ashtech Receiver Related Screens and Miscellaneous Commands sections.

Help: Remote Command Menu Screen

[ALT]+[H] Command

From any window, access the Remote Command Menu by pressing [ALT]+[H]; observe, typically:

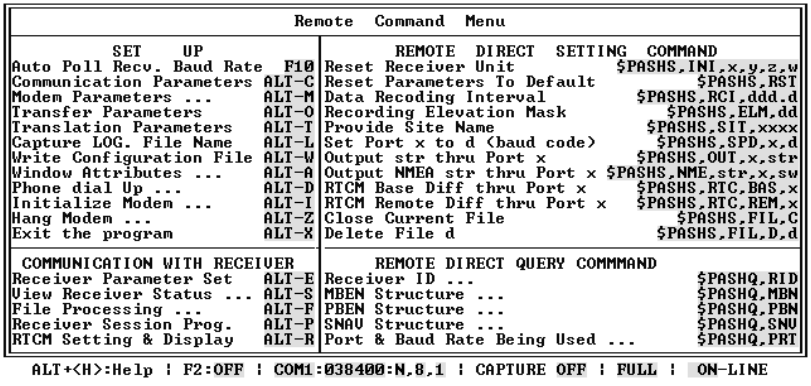


Figure B.2: Remote Command Menu Screen

This help screen comprises 5 sections:

- **SETUP** lists commands associated with the setting of the communication parameters, modem parameters, transfer parameters, receiver parameters, capture mode, write configuration file, window attributes, and RTCM parameters.
- **COMMUNICATION WITH RECEIVER** lists commands associated with the receiver status, the modem communication process, file processing, and exiting CGREMOTE.EXE.
- **CGRS REMOTE DIRECT SETTING COMMAND** lists the most commonly used Ashtech "$PASH"-format setting commands that allow users to set certain receiver parameters remotely through the computer serial port
- **CGRS REMOTE DIRECT QUERY COMMAND** lists the most commonly used Ashtech "$PASH"-format query commands that allow users to request specific structure data from the receiver through the computer serial port.
- **STANDARD STATUS LINE** (previously described).

  The [ALT]+[key] format commands listed on this menu are described in detail in this Remote Setting Commands section and in the sections Ashtech

Receiver-Related Screens and Miscellaneous Commands. The listed "$PASH"-format (and all other "$PASH"-format commands) are described in detail in the operation manual for your Ashtech receiver.

- To exit this screen, press [Esc].

Setup/Communication Parameter

Communication Parameters Screen, [ALT]+[C] Command

From the CGRS REMOTE main window, access the communication parameters pop-up menu by pressing [ALT]+[C]; observe, typically:

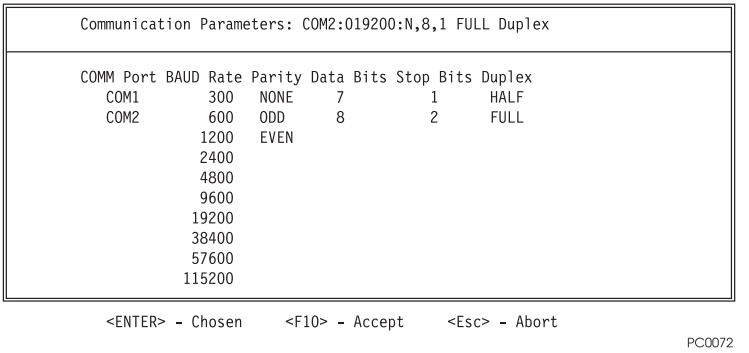


Figure B.3: Communication Parameters Pop-up Menu

The top line displays the current settings.

To change a parameter:

1. Highlight the item and press [ENTER]; each change is reflected in the top line
2. Once all changes have been made, press [F10] to invoke the changes and return to the main window, or press [Esc] to ignore any changes and return to the main window.

When communicating with an Ashtech receiver, you must select Parity NONE, Data Bits 8, and Stop Bits 1.

Receiver Parameter Setup

Receiver Parameter Setup Screen [ALT] + [E]

From the main window, access the receiver parameters pop-up menu by pressing [ALT] + [E].

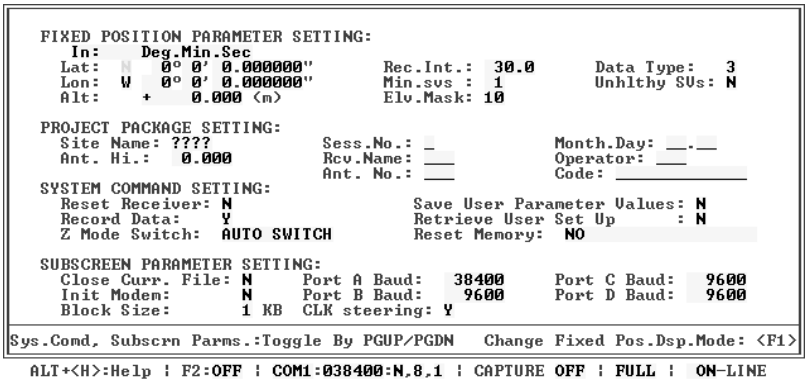


Figure B.4: Receiver Parameters Pop-Up Menu

Fixed Position Parameter Setting

- **Lat, Lon, Alt**: Latitude, Longitude, and ellipsoidal height of the base station reference mark
- **Rec. Int.**: data recording interval for standard memory (not ring buffer)
- **Min. SVs**: minimum SVs to be tracked before data recording begins
- **Elv. Mask**: minimum SV elevation to begin recording data
- **Data Type**: refer to DATA MODE in Table 4.11, “Screen 4, Receiver Control Menu,” on page 75
- **Unhlthy SVs**: use unhealthy SVs in position computation? Y/N

Project Package Setting

- **Site Name**: four character code to identify reference mark
- **Ant. Hi**: antenna vertical height
- Remaining parameters are user-defined

System Command Setting

- **Reset Receiver**: If set to Y, receiver will reset all user parameters to default values when exiting this screen.
- **Record Data**: data recording switch
- **Z Mode Switch**: controls Z-tracking mode
- **Save User Parameter Values**: not used, all user parameters are automatically saved
- **Retrieve User Set Up**: not used
- **Reset Memory**: clears all data from memory

Subscreen Parameter Setting

- **Close Current File**: setting to Y will close current file and open a new one
- **Init Modem**: setting to Y will intialize modem at receiver location. Initalizing modem will cause connection to be dropped. You have to re-connect, after initalizing the modem.
- **Block Size**: 1k, 4k, or 8k for downloading. Use 4k and 8k only with high-speed digital connection
- **Port x Baud**: baud rate for respective port
- **Clock Steering**: clock steering on or off

Press F10 to send new parameters to receiver.

Setup/Transfer Parameter

ASCII Translation Setup Screen, [ALT]+[T] Command

From the main window, access the translation parameters pop-up menu by pressing [ALT]+[T]. For the factory default parameters; observe:

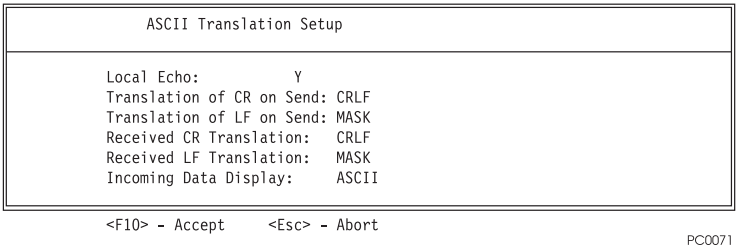


Figure B.5: Translation Parameters Pop-Up Menu

This menu provides the data translation setup parameters during chat mode and has no effect during protocol transfers. The range of each parameter and their descriptions are listed below.

Table B.2: Parameter Range and Description

Parameter	Range	Description
Local Echo	Y/N	With local echo set to "Y", each key pressed will be locally echoed to the display. If you see duplicated characters (ffoorr eexxaammppllee), the remote system is returning each character sent. For this case, set local echo to "N".
Translation of CR on Send Translation of LF on Send Received CR Translation Received LF Translation	CRLF/CR/LF/ MASK	These parameters perform a translation on the incoming and outgoing occurrences of the CR (carriage return) and LF (linefeed) characters. CRLF implies that the character will be translated to the CR and LF characters, CR implies translation to CR, LF implies translation to LF, and Mask implies that the character will be masked: that is, removed from the data stream.
Data Display	ASCII/DECIMAL/HEX	Incoming data will be displayed in either ASCII, Decimal value of each character, or Hexadecimal value of each character.

To change a parameter:

- Highlight the desired field and press [ENTER] until the desired setting is displayed.

Once all changes have been made, press [F10] to invoke the changes and return to the main window, or press [Esc] to ignore any changes and return to the main window.

Setup/Modem Parameter

Modem Parameters Screen, [ALT]+[M] Command

From the main window, access the modem parameters menu by pressing [ALT]+[M]. For the factory default parameters; observe:

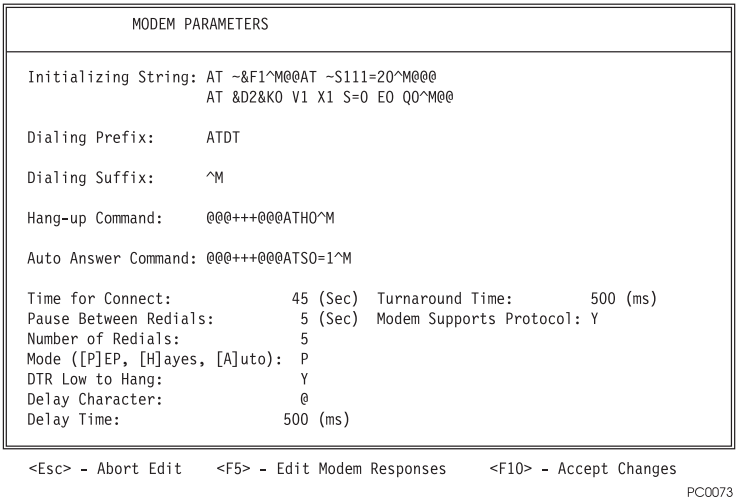


Figure B.6: Modem Parameters Screen

To change a parameter:

- Highlight the desired field and type the desired value.
- Once all changes have been made, press [F10] to invoke the changes and return to the main window, or press [Esc] to ignore any changes and return to the main window.
- This screen allows users to specify the parameters for control of computer modem. The top portion of the screen defines a set of strings to be sent to the modem at various times (defined later in this section). These strings must follow the command structure defined by your modem manual.
- The special character ^ defines the character to be treated as control key. For example, ^M will be translated to [CTRL-M]. To obtain the ^ character itself as part of the command string, use ^^.

The parameters on this screen are defined as:

- **Initializing String** - defines the string of commands to be sent to your modem prior to each dial operation.

- **Dialing Prefix** - defines the string of commands to be sent just prior to the telephone number during dial operations.
- **Dialing Suffix** - defines the characters to be sent to the modem just after the telephone number for dialing.

For example, a Hayes®-compatible modem's dial string appears like this:

ATDT 524-1527 [ENTER]

In this case, the dialing prefix is "ATDT" and the dialing suffix should be "^M" (for [ENTER]).

- **Hang-up Command** - defines the characters used to hang the modem up, that is, place the receiver on-hook.
- **Auto Answer Comman**d - defines the characters used to place the modem in auto-answer mode.
- **Time for Connect** - defines how long the program should wait for the remote system to respond: the timer starts after the dial suffix is sent. If no carrier is detected within the defined time, CGRS REMOTE assumes no connect is made and increments the dial retry count by one.
- **Turnaround Time** - defines the time required to command an Ashtech receiver and receive its response. This parameter can be phone line and/or modem specific. For example, if your modem utilizes a special exchange protocol to optimize large data bursts but delays for short bursts, the time required from issuing a command to the remote (for example, obtaining Ashtech receiver status, parameter, and FAT data) and obtaining the response can increase. This parameter specifies a timeout criterion before CGRS REMOTE assumes that the remote system did not obtain the command correctly. Some suggested nominal times are: 200 milliseconds for modems communicating via X.32 or X.42 protocols; 600-800 milliseconds for modems using the PEP protocol.
- **Pause Between Redials** - defines the delay time between two consecutive attempts to dial and connect to a remote system.
- **Modem Supports Protoco**l - *[not implemented in this release]* indicates that the modem has been configured to support a protocol transfer. Some modems gain transfer speed through this support but tend to queue large amounts of data. When terminating a protocol transfer, however, these modems do not immediately terminate the transfer when the termination request is sent. They still need to dequeue the data that has been stored. Thus, CGREMOTE.EXE needs to know if this data needs to be dequeued when terminations occur. Specifying Y for this parameter will accomplish this.
- **Number of Redials** - Defines the maximum number of attempts to dial and connect to a remote system before terminating a dial sequence.

- **Mode ([P]EP, [H]ayes, [A]uto)** - [not implemented in this release]
- **DTR Low to Hang** - (Specify y or n). When y is specified, CGRS REMOTE drops DTR for approximately 500 milliseconds when disconnecting a remote system.
- **Delay Character** - Specifies which character in the modem control strings should be translated into a delay. The delay is defined by the parameter DELAY TIME. The specified character is translated into a pause and the actual character is not sent. For example, in the hang-up command string shown above, there are six "@" characters, which will be translated into a pause. With a delay time of 500 milliseconds (ms), the following will transpire when the modem hang-up command is sent:
  - 3 consecutive pauses of 500 ms (1.5-second delay)
  - +++ is sent to the modem via the COM port
  - 3 consecutive pauses of 500 ms (1.5-second delay)
  - ATH0 [ENTER] is sent to the modem.
- **Delay time** - defines the amount to delay (in milliseconds) for each delay character found in a modem string.

Setup/Modem Parameter

Modem Response Strings Screen, [ALT]+[M], [F5] Commands

To access the modem response menu, press [F5] while the modem parameters menu is still active; observe:

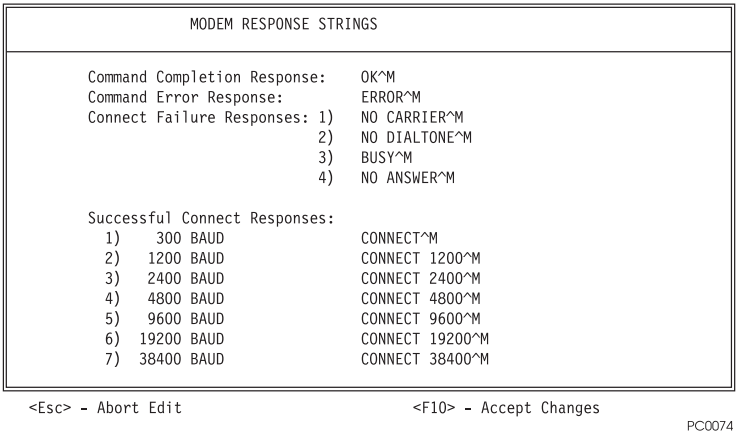


Figure B.7: Modem Response Menu Screen

To change a parameter:

- Highlight the desired field, and type the desired value.
- Once all changes have been made, press [F10] to invoke the changes and return to the Modem Parameters screen, or press [Esc] to ignore any changes and return to the Modem Parameters screen.
- To return to the main window, press [Esc] again.

During CGRS REMOTE operation, the modem may return response codes as a result of a command. These messages help CGRS REMOTE determine the status of the communication link. For example, sometimes when dialing a remote system, the remote system may already be handling a call. Some modems will indicate (with a response message) that the remote is indeed busy; therefore, no connection could be established. (These response codes should be documented in your modem operator's manual.) The definitions used by CGRS REMOTE are:

- **Command Completion Response** - *[not implemented in this release]*
- **Command Error Response** - CGRS REMOTE looks for the error response when initializing the modem (that is, when sending the modem initialization string).
- **Connect Failure Responses/ Successful Connect Responses** - CGRS REMOTE looks for both the connect failure and successful connect responses while dialing a remote system. Upon unsuccessful connect, the former responses should be returned. The successful responses are used to set the computer port speed equivalent to the phone link speed. Therefore, these responses must be different for each communication speed.
- **Setup/Write Configuration File, [ALT]+[W] Command** -CGRS REMOTE maintains a run-time copy of all parameters stored in the configuration file REMOTE.CNF (described in the section Input Files Used by CGRS REMOTE). [ALT]+[W] allows you to you save to REMOTE.CNF any changes made to these parameter settings. CGRS REMOTE uses the new values each time it runs until you change them again.

To restore the factory default parameter values:

- Rename REMOTE.CNF or delete REMOTE.CNF from the directory containing CGRS REMOTE.
- The next CGRS REMOTE runs, it automatically generates REMOTE.CNF containing the default parameters.
- To save any changes made to the current settings, press [ALT]+[W] from the main window.
- As CGRS REMOTE saves the settings, observe the message: writing configuration file

The settings saved comprise:

- Setup/Transfer Parameter: ASCII Translation Setup Screen, [ALT]+[T] Command
- Setup/Modem Parameter: Modem Parameters Screen, [ALT]+[M] Command
- Setup/Modem Parameter: Modem Response Strings Screen, [ALT]+[M], [F5] Commands
- Setup/Transfer Parameters: Miscellaneous Parameters Screen, [ALT]+[O] Command
- Setup/Window Attributes, [ALT]+[A] Command, display attributes associated with each screen.

Communication with Receiver/Phone Dialup

Dialing Screen, [ALT]+[D]Command

From the main window, access the dialing screen by pressing [ALT]+[D]; observe, typically:

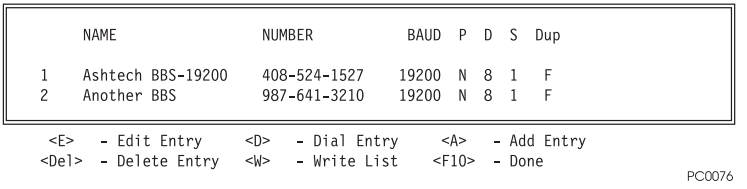


Figure B.8: Dialing Screen

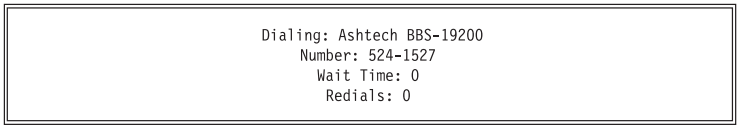
This screen displays the telephone numbers contained in the file PHONENUM.LST. The left column contains the entry number for automatic dialing.

Dialing a Number. In the dialing screen, to dial an entry, highlight the entry and press [D]. CGRS REMOTE then starts dialing by first setting the communication parameters associated with the selected entry, initializing the modem using the modem control strings (explained in the section Modem Parameters), and displaying the message:

Initializing Modem

and then sending to the modem the dialing string which includes the dialing prefix, phone number, and dialing suffix.

During this process, a pop-up screen appears for the selected entry; for example:



PC0077

Figure B.9: Dialing Pop-Up Screen

Once the dialing string has been sent, the Wait Time timer is started. If the remote system fails to respond properly or the call does not connect within the time specified via the Time for Connect parameter in the Modem Parameters Menu, the call is terminated and the Redials counter is incremented. The call sequence is re-initiated if the number of redials has not exceeded the Number of Redials parameter in the Modem Parameters Menu.

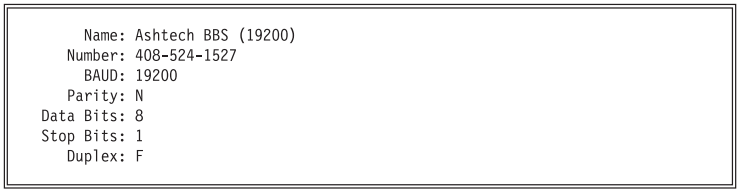
To terminate the dialing sequence in process at any time, press any key, and respond to the termination request prompt:

[C]ontinue dial or [Q]uit?

Once the modem has established a connection, CGRS REMOTE again displays the main window.

Editing a Dialing Entry.

In the dialing screen, to edit an entry, highlight the entry and press Enter [e]; observe the pop-up editing screen, typically:



PC0075

Figure B.10: Pop-Up Editing Screen (When Dialing)

To change an entry:

- Highlight the entry and make the appropriate changes. You can scroll through the BAUD, Parity, Data Bits, Stop Bits, and Duplex settings by pressing [ENTER].

- Once all desired changes have been made, press [F10] to invoke the changes and return to the dialing screen, or press [Esc] to ignore any changes and return to the dialing screen.
- To return to the main window, press [Esc].

The entry for Number is the phone number that is inserted between the dialing prefix and suffix when forming the string to be sent to the modem for dialing. Therefore, the data entered in this field must be acceptable to your modem.

Adding a Dialing Entry

In the dialing screen, to add an entry, press A to access the edit screen as described above.

Deleting an Entry

In the dialing screen, to delete an entry, highlight the entry and press [DELETE].

Saving the Phone Numbers

CGRS REMOTE maintains a run-time copy of the disk resident file PHONE-NUM.LST. In the dialing screen, to save any changes to the phone numbers, press W.

Exiting the Dialing Screen

Control is returned to the main window under the following conditions:

- Pressing [F10] or [Esc] from the dialing screen,
- A valid connect is established when dialing a remote, or
- The number of redial attempts has exceeded the maximum.

Setup/Transfer Parameters

Miscellaneous Parameters Screen, [ALT]+[O] Command

From the main window, access the miscellaneous parameters by pressing [ALT]+[O]. For the factory default parameters, observe:

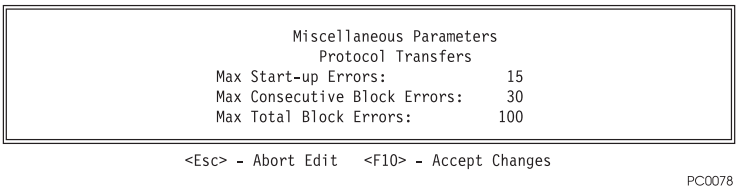


Figure B.11: Factory Default Parameters

To change a parameter:

- Highlight the desired field, and type in the desired value.
- Once all desired changes have been made, press [F10] to invoke the changes and return to the main window, or
- Press [Esc] to ignore any changes and return to the main window.

In this release, the additional parameters which are supported apply only to Protocol Transfers. These are the transfer of files via modem, as is done when downloading receiver image files. These parameters define the maximum number of errors acceptable prior to terminating a protocol transfer. The parameters can be adjusted to suit noisier communication links but can cause the "time-out" of a transfer to grow considerably. For example, in a xmodem transfer, a block error is generated (thus incrementing the error counters) when the remote system does not provide any data within a given time frame (currently 350 times the time it takes to send one character). The available parameters are:

- **Max Start-up Errors** - defines the maximum errors (or wait states of 1.5 seconds) before it is assumed that the remote system has failed to begin protocol transfer.
- **Max Consecutive Block Errors** - defines the maximum number of consecutive blocks in error. This is useful when the remote system is downed for some reason; CGRS REMOTE will time-out and terminate protocol transfer.
- **Max Total Block Errors** - defines the maximum number of blocks in error, total, that is acceptable prior to terminating the transfer.

Ashtech Receiver-Related Screens

The receiver-related screens apply only when the remote system is an Ashtech receiver. These screens are defined in the following paragraphs. Each of these displays can be activated from the main menu or from one another by the key stroke related to that menu. Control is returned to the main window when [Esc] is pressed.

Communication with Receiver/View Receiver Status

Receiver (Tracking) Status Screen, [ALT]+[S] Command

This screen combines information available from several receiver screens into one display. It only provides information; users cannot set receiver parameters through this display. For descriptions of the displayed parameters, see the operating manual for your Ashtech receiver.

- From the main window, access the receiver status menu by pressing [ALT]+[S].

- CGRS REMOTE then attempts to establish communication between the computer and the receiver.
- Until CGRS REMOTE establishes communication, observe:

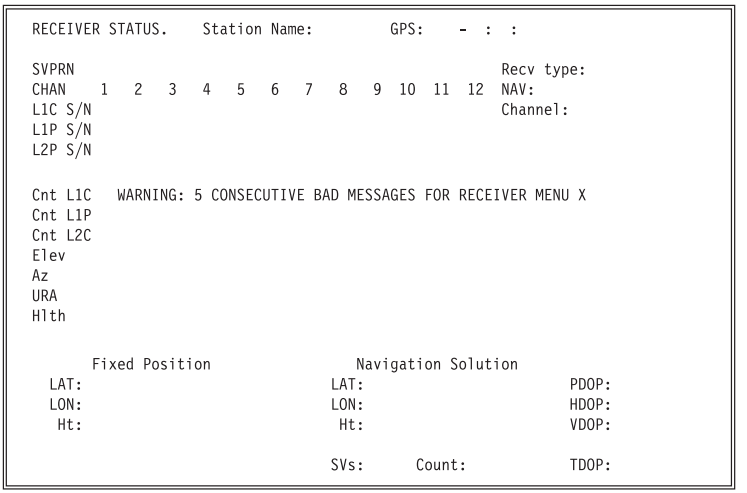


Figure B.12: Remote Screen

This is a blank display template with no data, and X in the WARNING message is 0, 1, 2, 4 or 9, depending on the screen data CGRS REMOTE is polling.

When CGRS REMOTE establishes communication, it updates the data fields in the display template with values from the various receiver screens; observe, typically:

```
RECEIVER STATUS.    Station Name:0000     GPS: 094-16:51:05

SVPRN  30  20  32  19  12   3  25  14  15  31  29  18  Recv type:   LM-XII
CHAN    1   2   3   4   5   6   7   8   9  10  11  12  NAV:         7A
L1 S/N  SNF        030         055 099 048 SNF   041   Channel:     64
L2C S/N            005         033 099 017       013

Cnt L1              99          99  99  99        99   Num Files:   28
Cnt L2C             --          --  --  --        --   Free Memory: 89%
Elev                06          25  86  19        21
Az                 227         046 266 199       285
URA                 07          07  07  07        07
Hlth                00          00  00  00        00


      Fixed Position                Navigation Solution
  LAT: N   0   0   0.000000       LAT: N  37  22  22.310013   PDOP: 002
  LON: E   0   0   0.000000       LON: W 121  59  51.677058   HDOP: 001
   Ht:             0.0000         Ht:            75.4408     VDOP: 001

                                  SVs:  5   Count:  10419     TDOP: 000
```

PC0079

Figure B.13: Display Template

To return to the main window, press [Esc]. On this display:

- **Station Name** - same as SITE identifier on Screen 9
- **GPS: ddd-hh:mm:ss** - is the GPS day (same as Screen 4, subscreen SESSION PGM) and the GPS time (hours:minutes:seconds - same as Screen 0)
- **SVPRN** and **CHAN** - same as sv (satellite PRN) and channel on Screen 0
- **L1 S/N and L2C S/N** (in this case) - same as s/n (signal-to-noise ratio) on screen 1 and L2C on Screen 0
- **Recv type**, **NAV**, and **Channel** - same as: Screen 4, subscreen **SUBCOMMANDS, Code of command: 888**; or Screen 8, system level command 888.

Command 888 displays configuration identification:

- **Cnt L1** and **Cnt L2C** (in this case) - same as epochs of continuous data on Screen 1
- **Elev, Az, URA**, and **Hlth** - same as elv (elevation angle), azm (azimuth angle), ura (range accuracy), and hel (health) on Screen 1

- **Num files** and **Free Memory** - same as, respectively, number of files and EQHR (XX) avail on Screen 8
- **Fixed Position: LAT**itude/**LON**gitude/**Ht** (coordinates in degrees. minutes, and decimal seconds; height in meters) - same as the POS line (in degrees:decimal minutes) on Screen 4
- **Navigation Solution: LAT/LON/Ht, SVs, PDOP, HDOP, VDOP, TDOP**, and **Count** - same as, respectively, LATitude/LONgitude/ALTitude, svs (number of satellites), pdop, hdop, vdop, tdop, and first line position counter on Screen 2

Tracking Mode

The lines of data for the S/N (signal-to-noise) and Cnt (epochs of continuous data) parameters vary according to the receiver's current tracking mode:

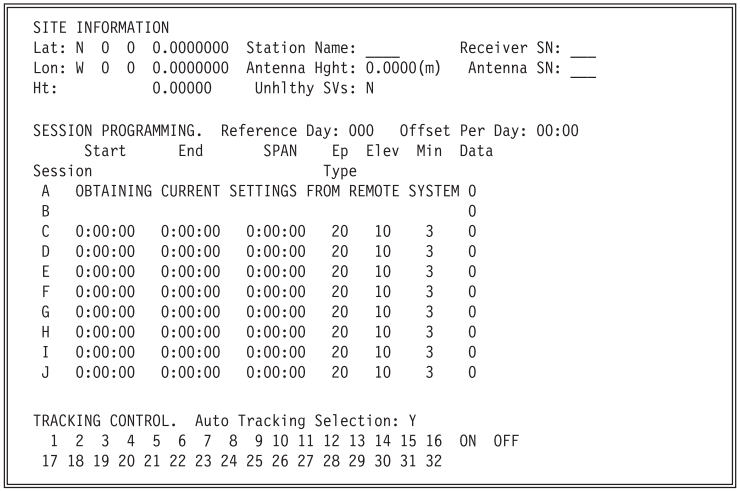
- **L1C** for C/A code only on band L1
- **L1P** for P code on band L1
- **L2P** for P code on band L2
- **L2C** for codeless on band L2

Setup/Receiver Parameters

Settable Parameters Screen, [ALT]+[P] Command

Several parameters governing the receiver can be set from the receiver parameters display (settable parameters menu).

- From the main window, access the settable parameters menu by pressing [ALT]+[P]
- CGRS REMOTE then attempts to establish communication between the computer and the receiver.
- Until CGRS REMOTE establishes communication, observe:



PC0081

Figure B.14: Remote Established Communication

If CGRS REMOTE does not establish communication:

- It overlays this blank settable parameters menu with a message:

WARNING
5 Consecutive Bad Messages for Reciver Menu X.

Where:

- X is 4, 7 or 9, depending on the screen CGRS REMOTE is polling
- The settable parameters information is not updated.

If CGRS REMOTE does establish communication; observe, typically:

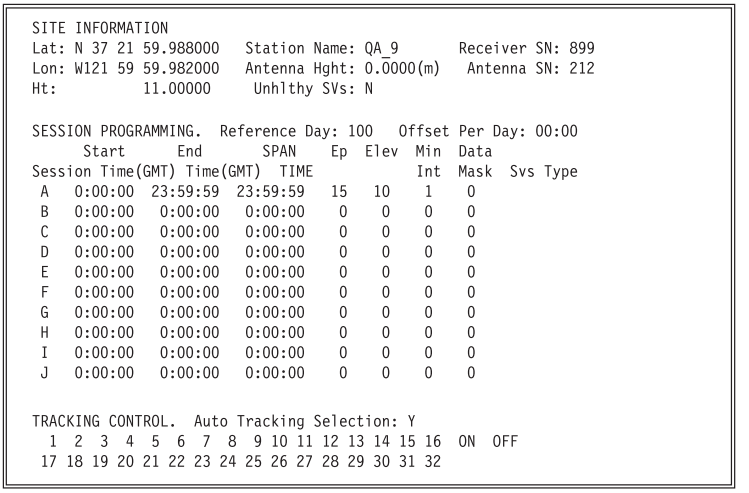


Figure B.15: Remote Established Communication

To change a parameter:

1. Highlight the desired field and type in the desired value.
2. Once all desired changes have been made, press [F10] to send the changes to the remote receiver and return to the main window, or press [Esc] to ignore any changes and return to the main window.

If you send the change, CGRS REMOTE displays the message

- Sending Current Setting to Remote System

If communication with the receiver has been interrupted since you accessed the settable parameters menu, CGRS REMOTE displays:

- **ERROR**: Receiver did not accept requested changes. Try again!
- **SITE INFORMATION**, the top portion of the screen, allows users to set parameters on receiver Screens 4 and 9:
- **Lat**itude, **Lon**gitude, **Ht** (altitude) are the POS coordinates on Screen 4
- **Station Name**, **Antenna Hght**, **Receiver SN**, and **Antenna Sn**, - same as, respectively, SITE identifier, HI Before, RCV#, and ANT# on Screen 9.
- **Unhlthy SVs** - same as Screen 4, subscreen POSITION
- **Session Programming**, the middle portion of the screen, acts the same as receiver screen 4, subscreen SESSION PGM except:

Session programming is disabled (that is, continuous recording) by setting the Reference Day to 000. (This replaces the INUSE parameter in the receiver's session programming.)

A particular session is disabled by setting the Start Time and End Time to 00:00:00. (This replaces the session toggle in the receiver's session programming.)

The session times are automatically sorted by moving the cursor out of the middle portion.

Checking is performed to ensure that no sessions overlap. In such a case, CGRS REMOTE generates an error message and does not allow this information to be sent to the remote receiver.

Checking is performed to ensure that the total time from the beginning of first session to the end of the last session does not exceed 24 hours. If the time does exceed this criterion, an error message is displayed and this information is not sent to the remote receiver.

Tracking Control, the bottom portion of the screen, is used to disable specific satellites. These parameters correspond with receiver Screen 7. However, on this menu, a satellite is toggled between selected and deselected by pressing [ENTER]. The display attribute related to a selected SV corresponds with that of the word ON and deselected with OFF.

Communication with Receiver/File Processing

Receiver Files Screen, [ALT]+[F] Command.

CGRS REMOTE downloads each selected receiver file as a RAM image file (R-file) which is a condensed version of the B-files, E-files and S-files. You must convert the R-files into B-files, E-files and S-files before further processing. (Refer to Converting Receiver Files later in this section for details.) R-files are saved in the current directory. Whenever you download or delete receiver files, CGRS REMOTE creates, in the current directory, a remote summary file called CGREMOTE.SUM describing the delete or download process. If the current directory already contains a CGREMOTE.SUM file, the new information is appended to that file. (For details, see the paragraph Files Generated by CGRS REMOTE in this section.)

- From the main menu, access the receiver files menu by pressing [ALT]+[F]

CGRS REMOTE attempts to establish communication between the computer and the receiver. If CGRS REMOTE does not establish communication within about 10 seconds, it halts the attempt and displays the message:

WARNING
5 Consecutive Bad Messages for Receiver Menu 8.

If communication is established, observe:

- ONE moment receiver FAT being downloaded followed by a display of all receiver files, including the active one, associated with Screen 8; for example:

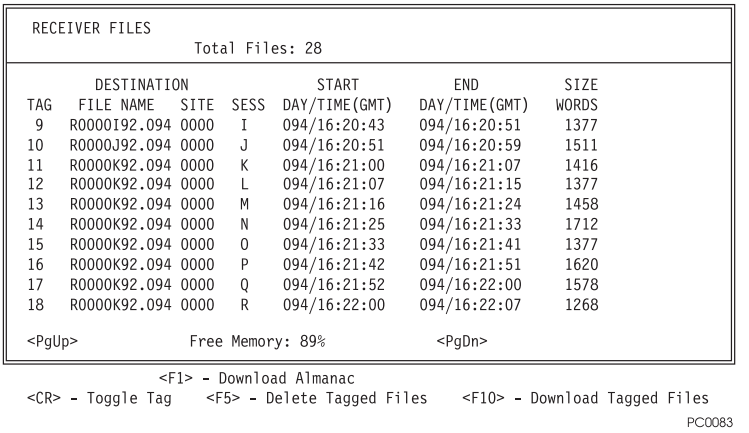


Figure B.16: Receiver Files Commands

The commands (listed at the bottom of the screen) are available.

- [PgUp] displays the previous page (screenful) of file names. This key is available when there are more than 10 files and the current page does not display files higher on the list. When [PgUp] is not available, the [PgUp] label is not displayed.
- [PgDn] displays the next page (screenful) of file names. This key is available when there are more than 10 files and the current page does not display files lower on the list. When [PgDn] is not available, the [PgDn] label is not displayed.
- [F1] downloads an almanac file for use by the Multi-Site Mission Planning program.
- [F5] deletes the selected files from the receiver and downloads the receiver FAT again.
- [F10] downloads the selected files.
- [ENTER] toggles the selection of a given file with the cursor on the selected file TAG

The DESTINATION FILE NAME column listing lists the name of the computer target R-file into which the selected receiver file will be downloaded. The file naming convention is:

tnnnnsyy.ddd

The fields are defined in the table below:

Table B.3: Fields

Field	Description
t	is the file type, by default R for a RAM image file.
nnnn	is the 4-character site name.
s	is the session code (A-Z).
yy	are the last two digits of the year.
ddd	is the day of the year.

During the download, CGRS REMOTE displays the status of the process, as shown:

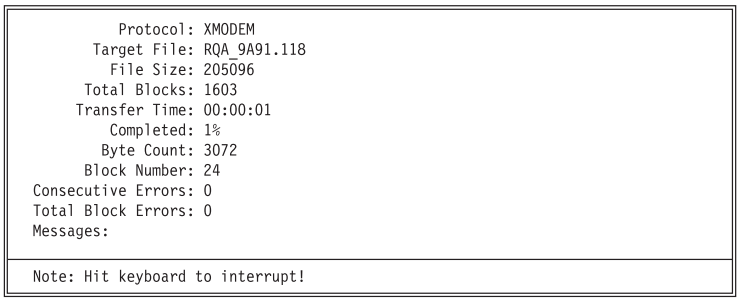


Figure B.17: Remote Display Status

If you press any key during the download, CGRS REMOTE halts the transfer and displays the message:

[C]ontinue or [S]kip curr. file or [A]bort all?

Once a file transfer is complete, CGRS REMOTE returns to the main window, and the current directory contains downloaded files as well as the REMOTE.SUM file.

Converting Receiver Files

CGHOSE -r Option

The RAM image files (R-files) downloaded from the receiver to the computer are a condensed version of the B--files, E-files and S-files. You must convert the R-files into B-files, E-files and S-files using the CGRS HOSE program before further pro-

cessing. This conversion of files in the computer uses the Download receiver files option of CGRS HOSE. The CGRS HOSE display will look and, for the most part, will act as if a receiver is connected.

Once R-files have been downloaded, return to the main menu, and exit CGRS REMOTE.

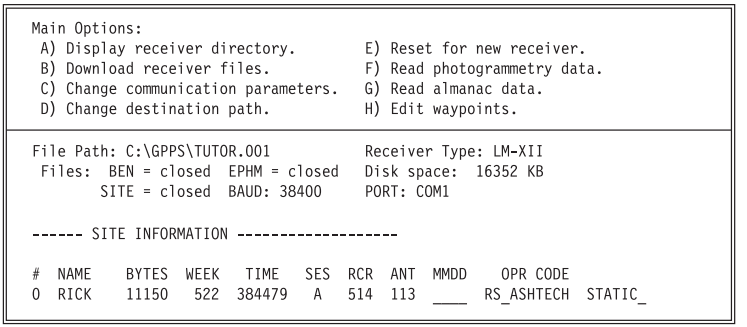
At the DOS prompt, change to the directory containing the desired R-file

Run the program CGHOSE.EXE using the command:

CGHOSE -r rfilename [ENTER]

where rfilename is the name of the desired R-file.

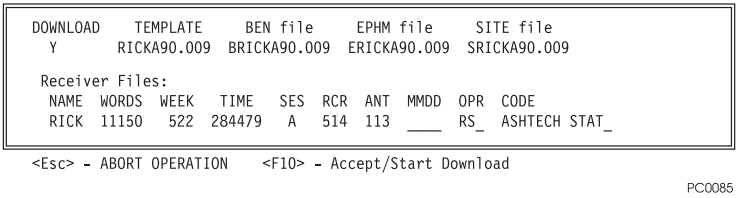
Observe the following screen, typically:



PC0084

Figure B.18: File Options

Select the option B) Download receiver files; observe:



PC0085

Figure B.19: Download Receiver Files

Ensure that the DOWNLOAD field associated with the file to be converted is Y(es); if it shows N, the file conversion will not proceed. Press [F10] to start the conversion.

When conversion is complete, CGRS REMOTE displays a summary of the process, and the corresponding B-files, E-files and S-files appear in the current directory.

Seismic Ring Buffer Screen

The Seismic Ring Buffer Screen can be accessed through the Receiver Files Screen. To do this, press [ALT]+[F] to access the Receiver Files Screen, and then press [F8]. The Receiver Fast Buffer Info Screen will appear. The Receiver Fast Buffer Info Screen extends complete remote control over the Seismic Ring Buffer.

The Fast Buffer Screen is divided into 3 sections. The upper section displays information on the data type, the current number of records, the start and stop times, and the total number of failures. These upper section fields are display-only and cannot be manipulated.

The NUM. RECORDS field indicates the current number of records in the CGRS. Note that once the ring buffer is full, this number will remain constant.

The START and END fields indicate the start and stop times of the data contained in the ring buffer. Once the ring buffer becomes full, the start and stop times will begin to "roll" forward.

The WORD SIZE field indicates the current number of words stored in the ring buffer. Multiply this number by 2 to get bytes.

The TOTAL NUMBER OF POWER FAILS indicates how many power fails the receiver has experienced.

The middle section of the Fast Buffer Screen contains parameters that can be set by users. These include resetting the buffer, changing the buffer size, changing the buffer recording interval, and changing the stop delay.

The Reset Buffer field allows the user to reset the ring buffer. Resetting the buffer will clear all data currently stored in the receiver. Once the reset is complete, the buffer will resume data collection. Press [F5] to send the parameters to the receiver.

The Buffer Size (MB) field allows the user to select the partition size of the ring buffer. Before using this field, determine how many MB's of memory your CGRS unit has. Partitions must be made in MB steps. For example, if the CGRS unit has 10 MB's of memory, setting this field to 5 will designate 5 MB's of memory for the ring buffer, and 5 MB for conventional memory. Press [F5] to send the parameters to the receiver.

CAUTION
The ring buffer maintains only the latest two hours of ephemeris data. If the recording interval and size selected will exceed two hours of data collection, the ephemeris will be outdated for the earliest portions of the data.

The Recording Interval (Sec) field allows users to change the recording interval of the ring buffer. Values from 0.5 seconds to 999.5 seconds can be entered here.

The lower section of the Fast Buffer Screen contains file parameter field that users can set. These parameters include the download interval, the file name, and the partial download start and stop time.

The Download Interval field allows users to set the interval at which data will be downloaded. For example, if the ring buffer recording interval is set to 1.0 seconds, setting the Download Interval to 5 seconds will result in a R file containing data every 5 seconds.

The FILE NAME field allows users to insert a 4-character identifier into the R file name. Ensure that the identifier entered does not exceed 4 characters. If a site name of TEST is entered, the resultant R file will be named RTESTA97.106 where A is the session identifier, 97 is the current year, and 106 is the current Julian day. A site name does not need to be entered in order to download data.

The PARTIAL START AND STOP TIME fields allow users to download a particular section of the ring buffer's contents. Enter a start time in the Partial Start Time (GMT) field, and a stop time in the Partial Ending Time (GMT) field. Ensure that the user-entered start and stop times are valid by comparing them with the reported start and end times of the ring buffer memory. After the partial start and stop times have been entered, press [F10] to partially download the ring buffer.

The ring buffer will function only when data type 3 is selected. Refer to Screen 4, receiver control menu.

RTCM Status Display

Setup/RTCM Setting and Display, [ALT]+[R] Command.

This screen allows you to set the RTCM (Radio Technical Commission for Maritime Service) differential parameters (for Ashtech receivers with the Real-Time Differential Option) and to verify the status of the RTCM differential correction values.

From the main window, access the RTCM status display by pressing [ALT]+[R]. CGRS REMOTE attempts to establish communication between the computer and the receiver. Until CGRS REMOTE establishes communication, observe:

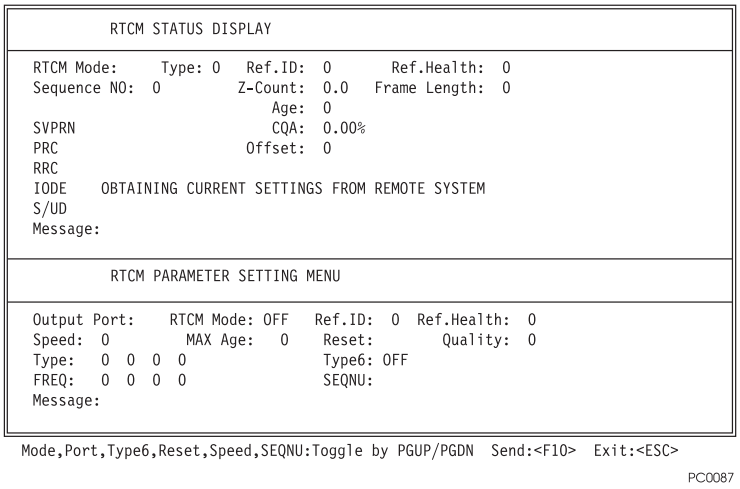


Figure B.20: RTCM Status

If CGRS REMOTE cannot establish communication, it flashes the message:

WARNING
5 Consecutive Bad Messages for Receiver Menu 45.

and returns you to the main menu. When CGRS REMOTE does establish communication, observe, typically:

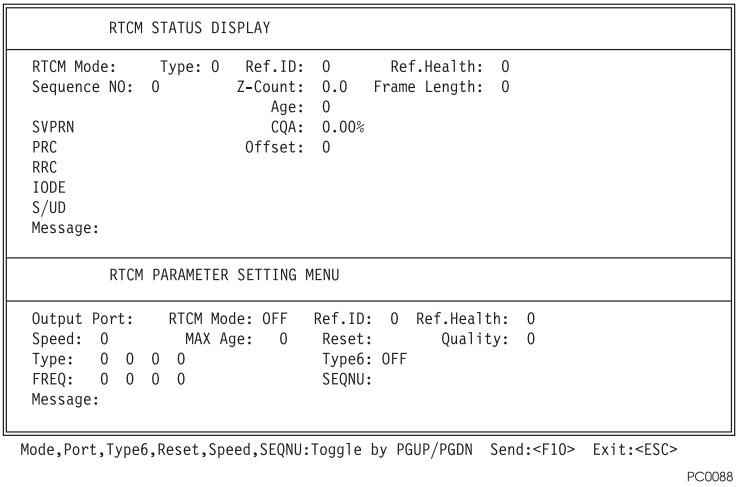


Figure B.21: Established Communication (Remote)

- **RTCM STATUS DISPLAY**, the top section, displays the current status of the RTCM differential corrections and associated parameters.
- **RTCM PARAMETER SETTING MENU**, the bottom section, displays the RTCM differential parameters and allows you to set them.
- **RTCM STATUS DISPLAY**, These parameters are also available on receiver Screen 5 if the differential option is available in the receiver, and on Screen 4, subscreen **DIFFERENTIAL**, **RTCM** format is selected.
- **RTCM Mode, BASE** or **CGRS REMOTE** - matches the **RTCM** field on the top line of the receiver screen
- **Sequence NO** is **SQNU**, RTCM message sequence number
- **Type** indicates the type of message to be generated or being received
- **Ref.ID** is **STID**, the reference station identification
- **Z-Count** is **ZCNT**, the RTCM message Z-count
- **Ref.Health** is **STHE**, the reference station health
- **Frame Length** is **FLEN**, the RTCM message frame length
- **Age** for remote mode, shows the age of received messages in seconds
- **CQA** is **QA**, the communication-quality factor, defined as: (number of good messages / total number of messages) * 100

- **Offset** is the number of bits from the beginning of the RTCM byte in case of bit slippage
- **SVPRN** is the satellite PRN number
- **PRC** is the pseudo-range correction in meters. Negative numbers are shown in inverse video
- **RRC** is the range-rate correction in centimeters per second. Negative numbers are shown in inverse video
- **IODE** is issue of data ephemerides
- **S/UD** is the scale factor and user-differential range error
- **MESSAGE** in remote mode, contains any special messages (Type 16) received from the base station. Messages are scrolled automatically; the old messages are pushed down. In the receiver this message appears in Screen 4, subscreen DIFFERENTIAL, subscreen RTCM OPTIONS MENU.
- RTCM PARAMETER SETTING Menu - These parameters are also available through receiver Screen 4, subscreen DIFFERENTIAL.
- **Output Port** initially matches the receiver output on PORT A or output on PORT B field of receiver subscreen DIFFERENTIAL.
- **Reset**, initialize RTCM - same as receiver subscreen SUBCOMMANDS, Code of command: 737; or Screen 8, system level command 737.

The remaining parameters correspond to the receiver RTCM OPTIONS MENU subscreen.

- **Speed** sets the number of bits per second issuing from the serial port. The available speeds are 25, 50, 100, 110, 150, 200, 250, 300 and 1500. Default is 50 bits per second. Not used in remote mode.
- **RTCM Mode** default is OFF; toggle it to BASE or REMOTE. This parameter sets the receiver to operate RTCM differential in BASE, REMOTE, or OFF (nonactive) mode.
- **MAX Age** is MAXAGE, in remote mode, specifies a maximum age, in seconds, for messages. The user receiver uses differential messages which are not older than MAXAGE. MAXAGE may be set to a value from 0 to 1199 seconds; default is 120; it is not used in base mode.
- **Ref.ID** is STID, the reference station identification supplied by the user. Can be set to any number from 0 to 1023.
- **Ref.Health** is STHE, the reference station health. It can be set to a value from 0 to 7.
- **Quality** is QAFREQ, in remote mode, allows evaluation of the communication quality between the base station and the user equipment.

QAFREQ may be set to any number from 0 to 999. Defaults to 100. Not used in base mode.

- **Type 6** enables or disables the output of type 6 messages.
- **SEQNU** is SEQ, check or not for the sequence number in a message to be sequentially to accept the RTCM message (used in remote mode only).
- **Type** indicates the type of message that will be generated. The receiver can generate message Types 1, 2, 3, 6 and 16. The default is 1.

When PL1 code is selected, Type 24 is displayed instead of Type 1.

- FREQ specifies the period/frequency for message Types 1, 3, and 16. Each can be set to a value that ranges from 0 to 99. 0 means no message is generated. 99 generates a message continuously. A value from 1 to 98 specifies a number of minutes between transmissions.
- MESSAGE contains an RTCM message (up to 32 characters long) to send from the base station to user equipment. To do that, enter the FREQ value directly under message Type 16, and type in the message.

To change a parameter, in the RTCM PARAMETER SETTING Menu section:

- Using the arrow or [TAB] keys, highlight the desired field.
- For the fields Output Port, RTCM Mode, Speed, Reset, Type 6, and SEQNU use the [Page Up] and [Page Down] keys to toggle through the available options.
- For the fields MAX Age, Ref.ID, Ref.Health, and Quality, type in the desired value.
- Once all changes have been made, press [F10] to send the changes to the receiver and return to this RTCM setting and display screen.
- To exit this screen and return to the main menu, press [Esc].

Operational Notes

If CGRS REMOTE is communicating with the same receiver port currently defined as the differential output port, it will not allow changing the differential mode to base or remote unless you first change the RTCM Output Port parameter. CGRE-MOTE.EXE will not accept a change to RTCM Mode and Output Port in the same setting. Instead:

1. Set the port, and press [F10] to send the command to the receiver.
2. Set the mode and other desired parameters, and press [F10] again.

The receiver does not accept changes to the MAX Age and Quality parameters when it is set to base mode; a base receiver does not use these parameters. The same is true for a receiver set to remote mode and the parameters Type 6, Ref.Health, Speed, and FREQuency.

Miscellaneous Commands, [ALT]+[A], [I], [Z], [L], [X].

All these commands work from the main window only, except for the attribute command which works from any display or menu.

Setup/Window Attributes, [ALT]+[A] Command.

To access the display attribute editing window, press [ALT]+[a]. This display has the following format:

[Normal Text]

This display allows users to change display (color and flash) attributes for the currently active display or menu only.

Communication with Receiver/Initialize Modem

Modem Initialization String [ALT]+[I] Command.

To send the modem initialization string to the modem, press [Alt]+[I]. This facilitates debugging the modem initialization string without using the dialing screen.

The modem must be in command mode.

Communication with Receiver/Hang Modem

Modem Hangup Sequence [ALT]+[Z] Command.

To begin the modem hangup sequence, press [ALT]+[Z]. First the modem hang command is sent and, if DTR Low to Hang is set (see the paragraph Modem Parameters in this section), DTR is dropped for 500 milliseconds.

Setup/Capture Log Filename

Capture Mode [ALT]+[L] Command

If CGRS REMOTE is receiving real-time data through the communication port, this command allows users to turn the capture mode ON and open a file to save this information. Press [ALT]+[L]; observe:

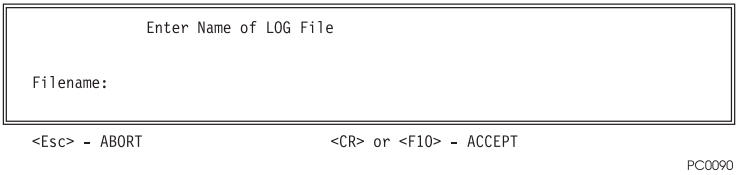


Figure B.22: Capture Mode Screen

Type in the destination file name as desired.

- Press [ENTER] or [F10] to start the capture mode.
- The CAPTURE mode shown on the status line changes to ON.
- To close the file and turn CAPTURE mode OFF, press [ALT]+[L] again.
- Communication with Receiver: Exit Remote, [ALT]+[X] Command.
- Pressing [ALT]+[X] from the main window terminates CGRS REMOTE upon valid response to termination prompt.

Input Files Used by CGRS REMOTE

At program startup. CGREMOTE.EXE reads the files REMOTE.CNF and PHONENUM.LST from the directory in which CGREMOTE.EXE resides. CGRS REMOTE maintains defaults for these files whenever they are not present in that directory. Thus, to return to the factory defaults for a file, simply rename, move, or delete it. To regenerate these files, use [ALT]+[W] for REMOTE.CNF and W when in the dialing screen for PHONENUM.LST.

REMOTE.CNF

The file REMOTE.CNF contains the configuration to be set at program start-up:

- Setup/Transfer Parameter: ASCII Data Translation Setup Parameters Screen, [ALT]+[T] Command
- Setup/Modem Parameter: Modem Parameters Screen, [ALT]+[M] Command

- Setup/Modem Response String: Modem Response Strings Screen, [ALT]+[M], [F5] Commands
- Setup/Transfer Parameters: Miscellaneous Parameters Screen, [ALT]+[O] Command
- Setup/Window: Attributes, [ALT]+[A] Command, display attributes associated with each screen.

These parameters can be changed only using the program CGRS REMOTE. Any change made to these parameters will not be saved until you press [ALT]+[W] while the main window is active.

PHONENUM.LST

The file PHONENUM.LST contains the phone dialing directory and is organized as follows with three lines per phone entry:

Line 1: ENTRY NUMBER space ENTRY NAME

Line 2: 5 spaces PHONE NUMBER

Line 3: 5 spaces, BAUD, PARITY, DATABITS, STOPBITS, DUPLEX

This ASCII file is assumed to be both read and written by CGRS REMOTE and, as such, there exists minimal checking on this file as it is read. You can change this file either through the CGRS REMOTE dialing screen ([ALT]+[D] command) or through an ASCII editor.

If you edit it in CGRS REMOTE, any changes will not be saved until you press W while the dialing screen is active.

If you edit it using a program other than CGRS REMOTE, ensure that the correct format is maintained:

- Each ENTRY NUMBER in this file must be numbered sequentially, starting from 1.
- The individual ENTRY NAME and PHONE NUMBER must not exceed 50 characters each. Lines 2 and 3 must start in column 6.
- The settings for BAUD, PARITY, DATABITS, and DUPLEX must be separated by commas (no spaces) and must be valid (refer to Setting Communications Parameters).

Output Files Generated by CGRS REMOTE

CGRS REMOTE generates the file REMOTE.SUM. It is an ASCII file and contains a summary of the results of Communication with Receiver/File Processing: Receiver Files Screen, [ALT]+[F] Command. [ALT]+[F] allows you to access the receiver file screen and download or delete files as needed. Every time a file is deleted or down-

loaded, CGRS REMOTE creates the REMOTE.SUM file in the current directory. If REMOTE.SUM already exists in the current directory, the new information is appended to the end of the file. The download summary information contains the name of the file, the file size in bytes, the session identifier, the file open and close time and day, and the date and time when the download occurred. The delete summary information contains the name of the file and the date and time when the deletion occurred. Following is an example of a summary file.

```
MENU-DOWNLOAD SUMMART: Mon Feb 08 13:39:16 1993
SITE: DIRECT CONNECT

      FILE      SIZE              START             END
      NAME     (Bytes)    SES.  DAY/TIME(GMT)    DAY/TIME(GMT)    STATUS
1 R7A01A93.039  17408      A    039/21:34:13     039/21:34:52    COMPLETE

MENU-DOWNLOAD SUMMART: Mon Feb 08 13:39:58 1993
SITE: DIRECT CONNECT

      FILE      SIZE              START             END
      NAME     (Bytes)    SES.  DAY/TIME(GMT)    DAY/TIME(GMT)    STATUS
2 RCARMA93.039  18944      A    039/21:34:53     039/21:35:34    COMPLETE
3 RTST_D93.039  18560      D    039/21:39:15     039/21:39:55    COMPLETE

MENU-DELETE SUMMART: Mon Feb 08 13:41:25 1993

 Files deleted from remote System:
  RTST_D93.039
```

PC0091

Figure B.23: Summary File Example

Command Line Options

CGREMOTE.EXE accepts these command line parameters. The command has the following format:

CGREMOTE [option_list] [secondary_args]

-c num for automatic call and download of receiver data. The num option represents the phone entry number. If num is set to 0, CGREMOTE.EXE assumes a direct connection.

If the -g option is not used with -c, all non-active files will be downloaded. A file is active when the receiver is logging data and is labeled -ACTIVE- on the receiver files menu.

When -c is selected, the remote summary file REMOTE.SUM is either created (when it does not exist) or is appended to with a summary of the download.

-c num For automatic call and download of receiver data. "num" represents the phone list entry number.

-g hh.h Used in conjunction with -c to automatically download files with closed less than hh.h hours prior to current receiver time. NOTE: if -g not specified, then all files are downloaded.

-d hh.h Used in conjunction with -c to automatically delete downloaded files. Files over hh.h hours old (by time of closure) will be deleted.

Files which do not download correctly (that is, could not recover from errors), are not deleted from the receiver.

-h fname Used in conjunction with -c to create a HOSE.EXE batch file.

-s Option for SCRIPPS: i.e., delete output files if error during auto-download

-cs num y1/d1/h1:m1 y2/d2/h2:m2
For automatic call and download selected files, which are between two specific times. "num" represents the phone list entry number. y- the year (4 digits), d -GPS day, h -GPS hour (optional), m -GPS minute (optional).

-cp num d1/h1:m1 d2/h2:m2 [interval
For automatic call and partially download ring buffer between two specific times with an optional interval. "num" represents the phone list entry number. d -GPS day, h -GPS hour (optional), m -GPS minute (optional). "[interval]" optional download interval.

-cf num [interval] For automatic call and download full ring buffer with an optional interval. "num" represents the phone list entry number. "[interval]" optional download interval.

-ds num y1/d1/h1:m1 y2/d2/h2:m2
For automatic call and delete selected files, which are between two specific times. The format is the same as -cs op-

tion.

-f Option to change file naming convention. The file name extension (GPS day number) is taken from the opening of the file instead of the closing of the file for both automatic and menu file operations.

-v Option used in conjunction with automatic call. Will automatically change receiver interface baud rate as same as PC side

-md dir Option to choose a directory other than current working directory to store the files downloaded from receiver. "dir": standard DOS format, may contain drive, directory, subdirectory. (i.e. -md f:\database\rfile) If user entry did not exist upon the time, program prompt to create one

For example,

- CGREMOTE -C 5 -D 2.5 - HS DECOMP.BAT [ENTER]

  executes CGRS REMOTE in auto-dial and download mode, dialing phone number entry 5 deleting all files over 2.5 hours old provided there are no fatal download errors, setting up a batch routine to call CGHOSE.EXE for expanding all files downloaded, and automatically deleting any created computer target files corresponding to sessions haveing fatal download errors.

Command Summary

The following is a list of the [Al]+[Key] commands.

[ALT]+[A] From any display, accesses the display attribute editing window.

[ALT]+[C] From the main menu, accesses the communication parameters menu.

[ALT]+[D] From the main menu, accesses the dialing screen.

[ALT]+[F] From the main menu, accesses the receiver files screen.

[ALT]+[H] From any display, accesses the help screen.

[ALT]+[I] From the main menu, sends modem initialization string to the modem.

[ALT]+[L] From the main menu, enables or disables the capture mode.

[ALT]+[M] From the main menu, accesses the modem parameters menu.

[ALT]+[O] From the main menu, accesses the Miscellaneous Parameters menu.

[ALT]+[P] From the main menu, accesses the receiver parameters menu.

[ALT]+[R] From main menu, accesses RTCM differential status and setup menu.

[ALT]+[S] From main menu, accesses current receiver tracking status screen.

[ALT]+[T] From the main menu, accesses the translation parameters menu.

[ALT]+[V] Begins remote receiver firmware update..

[ALT]+[W] writes a copy of current changes to all parameters in the configuration file REMOTE.CNF.

[ALT]+[X] From the main menu, terminates CGREMOTE.EXE upon valid response to termination prompt

[ALT]+[Z] From the main menu, starts the modem hangup sequence

Troubleshooting

CGRS REMOTE maintains a communication speed as does the remote system; they are independent. Therefore, CGRS REMOTE must have its communication speed set the same as the receiver's in order for communication to occur. If the computer is at one speed and the remote system at another, no data can be properly exchanged.

Upgrading Firmware at a Remote Station

The CGRemote program allows the user to update the firmware of a remotely located station using his normal connection; i.e. a phone line with modem or other digital link. This is made possible by temporarily storing the uploaded code into the receiver's external memory. The reliability of this process is ensured because the remote receiver will not begin executing the new firmware code until the new code has been completely received and installed without error. Upon validation by the remote station receiver, it will re-boot using the new firmware code and re-initialize the modem. At this point the user can reconnect and resume normal operation with the new firmware version in place.

Steps to update firmware at remote station

1. Obtain the firmware update files from Ashtech. Also be sure that you received the program PLZM.EXE and that it is in your DOS path. The receiver must have a minimum of 2 Mbytes of memory in order for the firmware upload to be successful.

Upgrading firmware will corrupt all observation data stored in receiver memory, so be sure to download any important data before proceeding.

2. From the directory where the firmware files are stored, start the CGREMOTE program from the DOS prompt.
3. Establish the connection with your remote site as you normally do.
4. Press ALT-V to begin the firmware update process.

5. Choose XMODEM 1k block.
6. Press Y to proceed with upload or N to cancel upload.

If you have not downloaded important data from receiver memory, this is your last chance to do so!

7. The upload should begin and the progress will be noted on the screen. When the upload is finished, press the escape key to exit back to CGREMOTE. The remote receiver will re-boot at this time. Wait about a minute before re-establishing the connection to the remote site.

After re-connecting, you must go to the Alt-E screen, and clear the external memory. Any files that remain in memory are unreliable, and must be cleared to prevent accidental use. There is no need to clear the internal memory.

Troubleshooting

1. If the upload fails for any reason, and you are disconnected, always wait about a minute before re-establishing the connection to the remote site. The remoter reciever will recover if there is a failure.
2. If the ALT-V option does not work, you need to make sure that the PLZM.EXE program is in your DOS path, and that you are working in the directory that contains the firmware update files.
3. Choose XMODEM 1k if you have a “good” connection and choose 128 byte if you have a “not so good” connection. Choose 1k block first then if you have problems completing the upload, switch to 128 byte block.

CGRS HOSE

CGRS HOSE downloads data from the Ashtech Z-12 CGRS receivers. After the receivers have collected the field measurement data, a cable is used to connect a receiver serial port to a computer serial port. This link is used to download the data. When the download is complete, the files are ready for post-processing.

A second function of CGRS HOSE is to convert the files downloaded by CGRS REMOTE to files that can be post-processed. Refer to the section "Converting Receiver Files" in Appendix B for complete instructions for this function.

Input Data Files

When downloading measurement data directly from the receiver with a serial cable, there are no input data files needed. CGRS HOSE extracts the data directly from the receiver memory.

When using CGRS HOSE to convert files downloaded with CGRS REMOTE, those files will be the input to the HOSE program. These files contain measurement, ephemeris, and site identification data in a compressed format. They can be distinguished from other file types by the prefix "R" on the filename. For example, the filename RBASEA98.100 denotes a compressed file from station "BASE", collected as session "A" in the year "98" on day "100" of that year.

Output Data Files

The extracted satellite measurement data is saved as B-files (BEN files), satellite ephemeris (orbit) data into the E-files (EPHM files), and site information into the S-files (SITE files). If the Ranger 2 mode is selected in the receiver, then a C-file will be downloaded instead of a B-file and E-file. Optionally, a photogrammetry data file and the almanac file can be downloaded, and a waypoint file can be downloaded, edited, and uploaded back to the receiver.

Program Execution

In order to download the data, the receiver must be connected to the computer to which the data will be transferred. This connection is made using the full handshake null modem cable provided with the receiver. (The drawing for this cable is shown on the last page of this section). One end of the cable plugs into the receiver via the RS-232 port labeled either Serial Port 1 or Serial Port 2 and the other end of the cable plugs into the computer RS-232 serial port generally labeled COM1 or COM2. CGRS HOSE will attempt to communicate via COM1 at 38400 baud. If either of these parameters differ for your computer, you may also specify the communications port and/or the baud rate via the command line as described later or select the option to change communication parameters.

To start CGRS HOSE, type the following command at the DOS prompt:

CGHOSE [CR]

The program momentarily displays the opening menu:

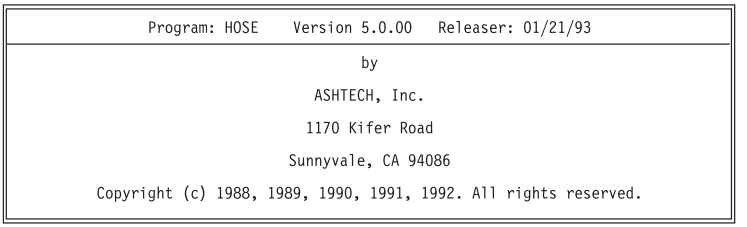


Figure B.24: Menu Screen

The opening menu is followed by status information. This status information describes the program configuration (either the default or command-line selected).

If CGRS HOSE detects a communication problem, it displays an error message:

ERROR: Cannot initialize COMM port.

If this occurs, the only main menu option which can be executed is option C as discussed below.

Main Menu and Display

The CGRS HOSE main menu is displayed below:

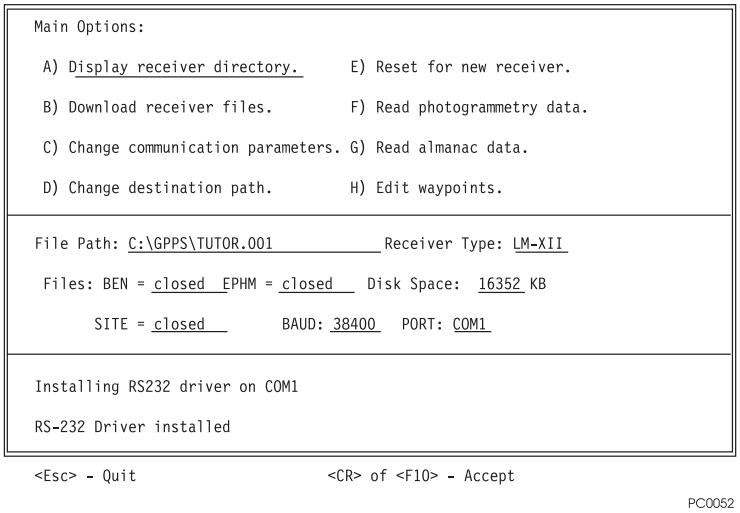


Figure B.25: HOSE Main Menu

The main menu is composed of four sections:

1. Option selection section
2. Status information section
3. Supplementary information section.
4. Quit/Execute section.

Users can select options by: 1) highlighting the desired option and pressing the [CR] key or, 2) by directly pressing the letter associated with the option. The supplementary information section (the bottom portion of the screen) displays various information depending on the option selected.

The middle section of the main menu is called the Status information section. Contained in this section of the display are the following:

1. Destination file path and destination file names.
2. Available disk space.
3. The current communication rate.
4. Receiver type.
5. Active communication port of the target computer.

The destination file names are entered via main menu option B. Once files have been read from the receiver, these files become closed, requiring users to open another set prior to the next read. The project subdirectory destination path may be changed via option D, and the communication speed may be changed via option C.

Option Selection Section

The option selection section of the display provide users with a list of program options:

1. Display Receiver Directory.
2. Download receiver files.
3. Change communication parameters.
4. Change destination path.
5. Reset for new receiver.
6. Read photogrammetry data
7. Read almanac data
8. Edit waypoints

To select an option, highlight it by using an arrow key, then press [CR] or [F10]. Users can also select an option by typing the letter associated with it; for example, to select option A) Display Receiver Directory, type [A].

To terminate the program, press [Esc]. This provides a proper exit from the program, ensuring that all files are properly closed.

Option A: Display Receiver Directory

Option A provides a listing of the files stored in the memory of the receiver. The directory information is displayed in the Supplementary information section of the main display:

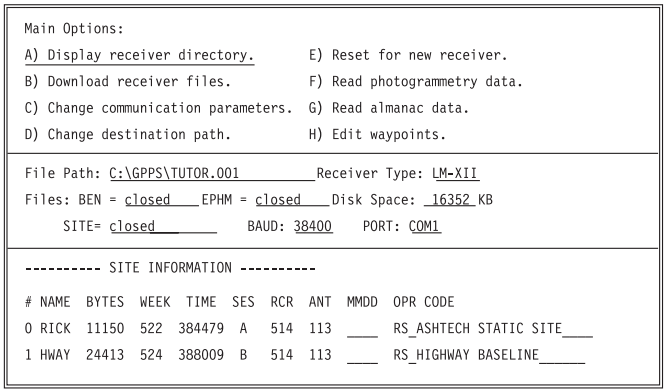


Figure B.26: Main Option Menu

Included in the directory information are the following:

Table B.4: Directory Information

Component	Description
#	Session Number (use this number when selecting files to be read from the receiver).
NAME	The last site name entered by the receiver operator.
BYTES	The number of bytes the file occupies in the memory of the receiver (NOTE: This will NOT be the size of the files stored on disk - the data files on disk will typically be larger).
WEEK	GPS week of the file.
TIME	Seconds of GPS week of the file.
SES	Receiver operator entered information.
RCR	Taken from receiver menu 9; receiver serial number
ANT	Taken from receiver menu 9; antenna serial number
MMDD	Taken from receiver menu 9; month and day entered by operator

Table B.4: Directory Information (continued)

Component	Description
OPR	Taken from receiver menu 9; operator's initials
CODE	Taken from receiver menu 9; operator-entered comments

Option B: Download Receiver Files

This option calls up a selection screen similar to the following:

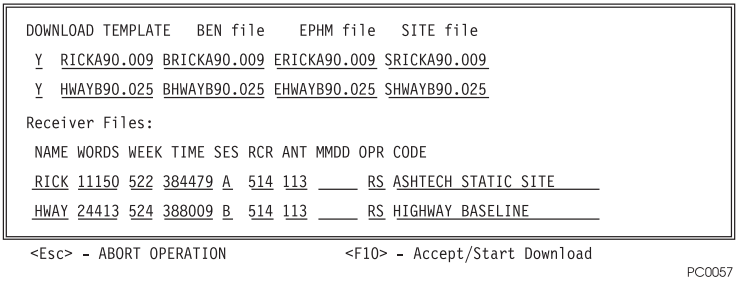


Figure B.27: Selection Screen

The bottom half of the screen shows the directory of the receiver files, while the top half shows the automatically created names for the files to be created on the computer. Each line of the top half corresponds with the bottom half.

Sessions may be selected or de-selected for downloading. If the SELECT column is set to [N], the file will not be downloaded. This screen also allows editing of the filenames, either by changing the template field, or by editing the individual file names.

Users can move between prompts by using the arrow keys and TAB key (and [Shift]+[Tab] for reverse). Normal editing is provided within prompt fields: insert using [Ins]; delete character using [Backspace], and then type in correct information.

When satisfied with the file selections and names, press [F10]. CGRS HOSE attempts to open all of the files prior to downloading. If any files already exist in the current directory, a message similar to the following is displayed:

- Opening output files for session 0
- File BRICKA90.009 already exists on disk.
- Do you wish to [O]verwrite or [A]bort opening: 0

By pressing [A], CGRS HOSE terminates the file naming and downloading procedure. By pressing [O], CGRS HOSE overwrites the existing file. As the files are being downloaded, the downloading status is displayed:

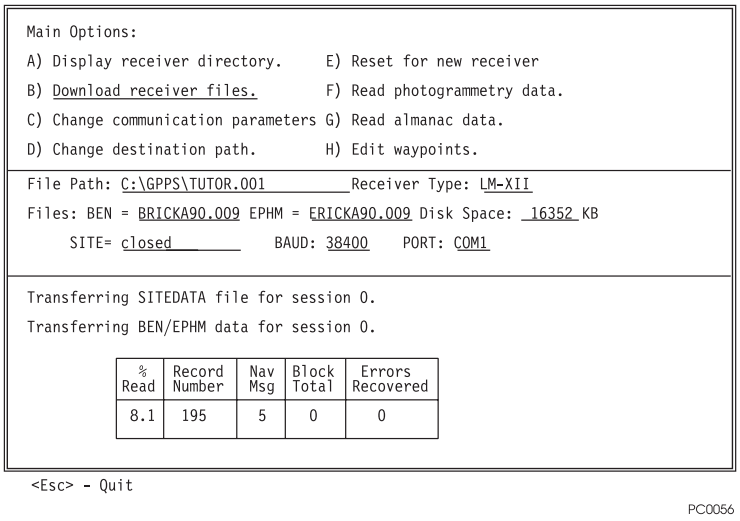


Figure B.28: Main Options menu

CGRS HOSE continuously checks the amount of free disk space available on the target disk. If, during any file transfer, there is not enough space for the remaining data to be transferred, the following message is displayed:

- Not enough free disk space for requested operation.

Many block errors signify that the baud rate for data transfer may be set too high. Use CGRS HOSE option C, “Change Communication Parameters," to lower the baud rate.

When the download is completed, a summary screen is displayed:

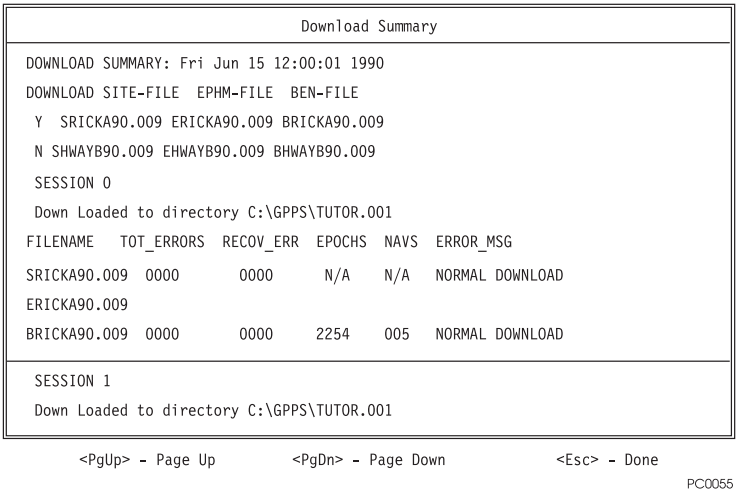


Figure B.29: Download Summary menu

In addition to the [PgUp] and [PgDn] keys, the **s** and **t** keys may be used to scan through the session summary. This summary is appended to the download summary file in the current directory under the filename HOSE.SUM.

Option C: Change Communications Parameters.

Option C provides a means of changing either or both the communication speed or computer communications port. Upon selecting option C, the following selection menu is displayed:

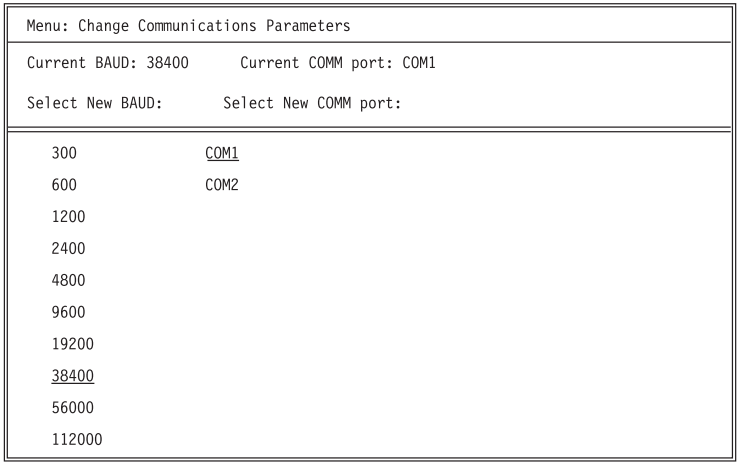


Figure B.30: Option C, Change Communication Parameters

Move the cursor to the desired communication rate via the arrow keys or by the letter associated with the desired speed, and press [CR] or [F10].

This menu provides selectable baud rates which are available for a given receiver. For receivers which are not capable of 56000 and 112000 baud, the menu will not display these selections. Move the cursor to the desired communication rate and/or COMM port and press [CR] or [F10].

If the requested change does not occur due to an error, the following message is displayed:

> ERROR**:** While attempting to initialize the communications port, an RS-232 line status check indicates one of the following conditions:
>
> 1. Cables not connected properly;
> 2. Cables not fastened securely; and/or

3. Receiver power not on.
    - Ensure cables are connected (with FULL NULL MODEM) and receiver power is on.
    - Press any key when ready to try again.

Follow the instructions provided. If the message occurs repeatedly, then it is probable that one of the following conditions exist:

1. Cables are connected to an incorrect port of the target computer.
2. The cable between the receiver and target computer is NOT a Full Handshake Null Modem Cable.
3. Receiver is turned OFF.
4. The computer COMM port is not configured as a data communications equipment (DCE) port. If the computer port is a data terminal equipment (DTE) port, then use a full handshake cable or add a null modem adapter to the CGRS HOSE cable.

If during file transfers a large number of checksum errors occur, the RS-232 connection may not be sound. To remedy the problem, tighten all connections, use a shorter RS-232 cable (maximum length is 100 feet), decrease the communication rate, and/or change communications ports on the receiver or computer, or both.

If power is removed from the receiver while CGRS HOSE is running, users will need to restart the program.

Finally, Ashtech strongly recommends that you do not disconnect communication cables from one receiver to another without using Option E Reset for new receiver. Disconnecting the receiver cable without resetting the computer and receiver could create problems with the computer data files.

Option D: Change Destination Path

This option will display a screen as follows:

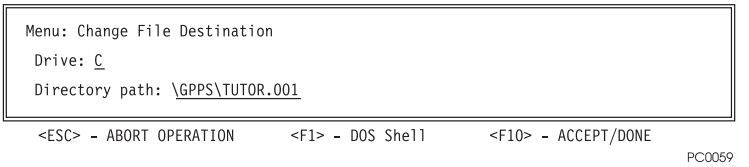


Figure B.31: Option D, Change Destination

To download data into a different drive and/or directory, enter the appropriate drive and path information and press [F10] to accept the new directory path name. Option E: Reset for New Receiver

This option provides a means of properly switching from one receiver to the next without having to restart CGRS HOSE. To use this option, select the option and follow the instructions provided as shown below:

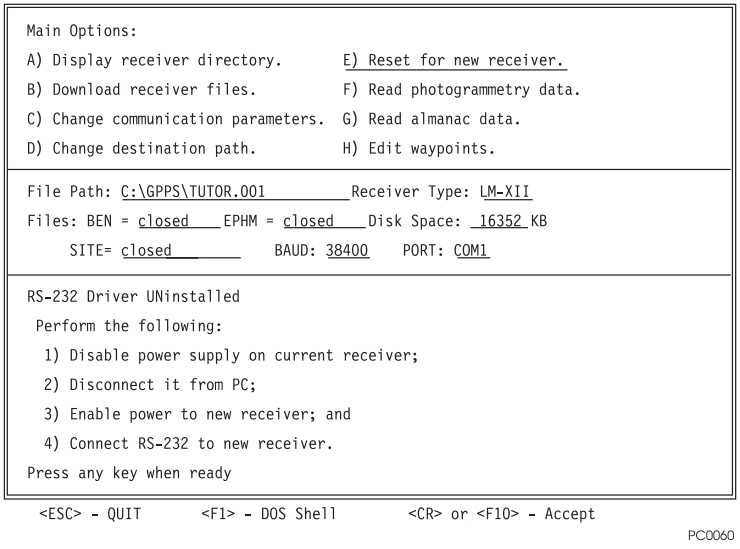


Figure B.32: Option E, Reset for New Receiver

Option F: Read Photogrammetry Data

Option F will read any photogrammetry data stored in the receiver memory. If this option is selected and the receiver has no stored photogrammetry data, the following message will be displayed:

There is not any photogrammetry data to read.

The file generated will either be named PHOTO.DAT or according to the file name template given for session 0 of the file naming menu. Specifically, if the template name is used, then the photogrammetry data file will be named P followed by the file name template.

Option G: Read Almanac Data

Option G will read any almanac data stored in the receiver memory. Choosing this option will cause CGRS HOSE to automatically name and create the output almanac data file.

If the file name generated by CGRS HOSE corresponds with one in the target directory, that file will be overwritten.

The output file name will be of the form ALMyy.ddd where, yy is the year and ddd is the day of the almanac. These dates are taken from the almanac data - not from the computer's internal clock.

Option H: Edit Waypoints

This option allows users to download waypoint files from the receiver or directly create waypoint files. Start by turning ON the power to the receiver and connecting it to the computer with an RS-232 cable. On the GPPS main menu, select option B) Download Receiver, and from the CGRS HOSE menu, select option H:

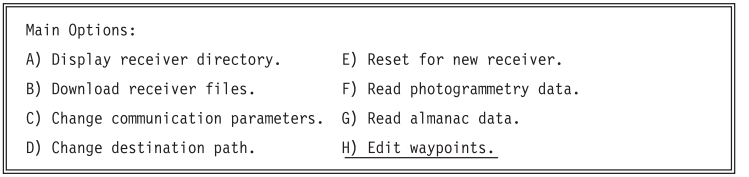


Figure B.33: Option H, Edit Waypoint

By selecting Option H, Edit Waypoints, users will see this screen in which to choose waypoint file to download:

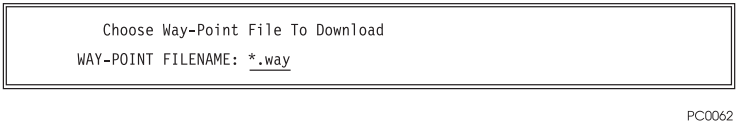


Figure B.34: Option H, Waypoint File to Download

Users can type in a file name or a specification such as *.way to summon a display of all files with that extension. By pressing [CR], a list of all matching files in the current directory will appear:

Select a file to edit by highlighting its name and pressing [CR] again. Its file name is displayed in the WAY-POINT FILENAME field on the second line of the display; its path is displayed on the next line.

- By specifying an existing file, its waypoints are displayed on the Route and Waypoint Line (shown below) so you can edit them.

- By entering the name of a new file, the screen remains blank so that users can enter new waypoints. To summon a blank Route and Waypoint Line, press the [F5] key.

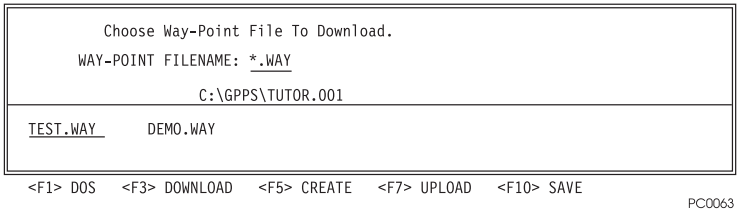


Figure B.35: Waypoint File Name

Alternately, users can download a receiver file that contains waypoints and edit them. To do this, press the [F3] key. This downloads all ninety-nine waypoints and displays them on the Route and Waypoint Line. Unused waypoints have underscores or zero fill.

These functions allow users to edit the waypoint lines:

Table B.5: Waypoint Functions

Field	Description
[CTRL-A]	Adds a waypoint line.
[CTRL-D]	Deletes a waypoint line.
[CTRL-P]	Specifies a position in earth-centered cartesian coordinates.
[CTRL-C]	Clears the current file.
[TAB]	Moves the cursor to the next field.

When the first line has been entered, press [CTRL-A] to add another waypoint line for editing as shown below. Continue until all new waypoints have been entered:

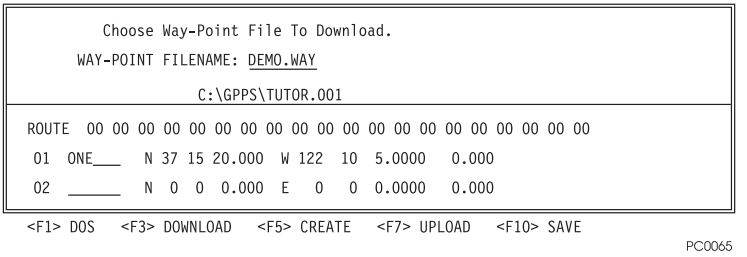


Figure B.36: Editing Waypoint

To delete a line, move the cursor to the line to delete and press [CTRL-D]. To clear all waypoints in a file, press [CTRL-C]. Press [CTRL-P] to see a pop-up screen where you enter a waypoint in earth-centered fixed-cartesian coordinates or in degrees and decimal minutes:

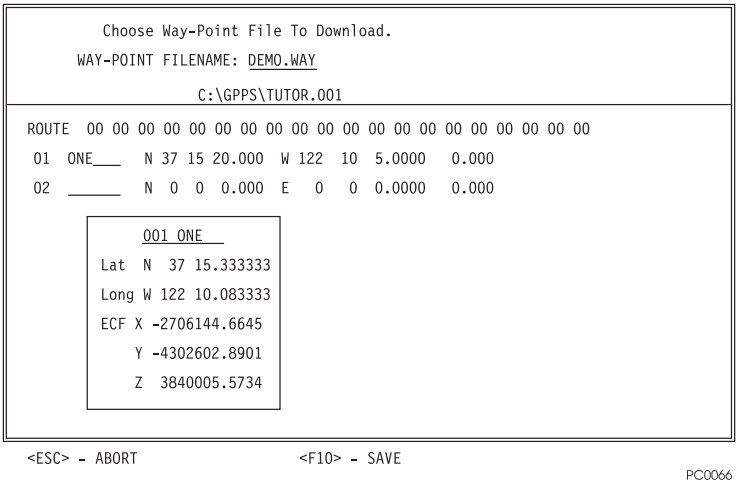


Figure B.37: Clearing Waypoints

After you enter the XYZ coordinates and press [F10], CGRS HOSE converts them to latitude, longitude, and ellipsoidal height. It closes the pop-up screen and automatically updates the Route and Waypoint Line.

1. When you are finished editing the waypoint file, press [F7] to upload the new waypoints to the receiver.
2. Press [Esc] to exit CGRS HOSE and return to the GPPS main menu.
3. Disconnect the receiver from the computer.

Quit/Execute Section

Normal Program Termination

Pressing the [Esc] key from the main menu will cause CGRS HOSE to terminate normally and exit to either the GPPS program or to DOS.

Troubleshooting

If at any time during the execution of the program the receiver does not respond to a command, the screen is cleared and a message similar to the following is displayed:

ERROR: RS-232 receive problem

- Receiver has not responded to most recent command.
- Simply toggle the power on the receiver and run
- CGRS HOSE again.\

Status Registers:

- Modem Status Register:
- Clear To Send Change
- Line Status Register: Normal Status.

Press any key to continue...

If this occurs, follow the instructions provided.

When data will not download normally from the receiver, it may often be recovered by the RAMDUMP procedure. To do this, connect the receiver to the PC, power the receiver ON, start CGRS HOSE, and from the CGRS HOSE main menu, press the [F5] key 3 times. CGRS HOSE will download to a file named "RAMDUMP" (an image of the receiver memory). After this is done, exit to DOS, disconnect the receiver, then from the directory with the RAMDUMP file, use the command CGHOSE-R RAMDUMP. From the CGRS HOSE main menu, download as if performing a normal receiver download. CGRS HOSE will read the RAMDUMP file as if it were in a receiver, and write the B-files, E-files and S-files to disk. If it is necessary to perform a RAMDUMP on more than one receiver, use a separate subdirectory for each one, then combine the data files and process.

Advanced Program Options

Command Line Parameters

CGRS HOSE accepts the following command line parameters:

Table B.6: CGRS HOSE Command Line Parameters

Field	Description
b	To set communication rate (BAUD)
c	To set communication port
?	List options
a	Auto download (use with caution!)
r	Convert image files downloaded by remote program; convert ramdump file
e	Executive overlay
i	Ignore RS-232 status (use with caution)
z	Exit program if data type from receiver is incorrect

These parameters can exist in any order, but their related parameters must follow them in the same order; see examples.

CGRS HOSE, in its default configuration, attempts to communicate via COM1 at 38400 baud. The default start-up configuration can also be set via these command line parameters. To force CGRS HOSE to utilize COM2 at 38400 Baud, enter the following at the DOS prompt:

CGHOSE -c 2 [CR]

To initialize CGRS HOSE on COM1 at 9600 Baud, enter the following command:

CGHOSE -b 9600 [CR]

To start CGRS HOSE on COM2 at 9600 Baud, enter either of the following commands:

CGHOSE -cb 2 9600 [CR] or CGHOSE -bc 9600 2 [CR]

To auto download a Rfile retrieved from the CGRS Remote Program, enter the following at the DOS prompt:

CGHOSE -a -r RBASEA98.100 where RBASEA98.100 is the name of the RFile downloaded from CGRS Remote.

The command line parameters are order-specific and must follow the order of the switches as shown above.

The executive overlay option is for those who wish to call Ashtech programs from their own software. In general, most programs can call CGRS HOSE directly without using it. Use -e only if the calling program is using too much memory to load CGRS HOSE at a higher memory address.

This option informs CGRS HOSE that it was loaded over the space occupied by the calling program and must therefore ensure that the calling program is restarted in the same address space. When using this option it is VERY IMPORTANT that the calling program be able to save and restore its state. Ashtech recommends that users who are unfamiliar with this type of calling sequence NOT utilize this option. Misuse of this option can cause undesirable effects.

To invoke the executive overlay option, users must follow the -e option with the name of the calling program (provide complete path if the program is not in the current working directory or DOS search path). For example,

CGHOSE -e MYPROG [CR]

Hose Cable

The cable (full handshake null modem cable) that goes to the serial port can have either of the following pinout specifications.

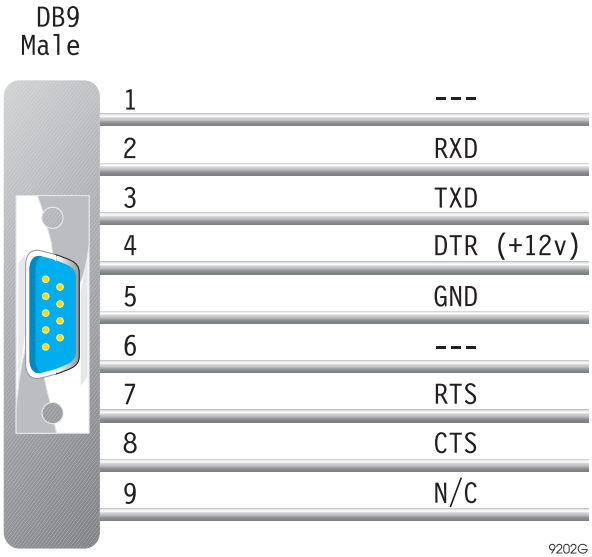


Figure B.38: Serial Port Pin Diagram

ASHTORIN

Ashtech's ASHTORIN software converts Ashtech B-files, E-files, optional S-files, and optional D-files into the RINEX (Receiver INdependent EXchange) format. This allows data collected from receivers of different manufacturers to be combined.

Ensure that there is enough room to create a file on the specified drive; if not, ASHTORIN will terminate with an appropriate error message.

Input Data Files

ASHTORIN uses the Ashtech B-files, E-files, optional S-files, and optional D-files as input data.

Output Data Files

ASHTORIN can generate three different files: an Observation file, a Navigation file, and a Meteorological file. Some applications require one Observation file and one Meteorological file for each site per session; others require only the Observation file. Only one Navigation file must be generated per session, as long as the converted E-file spans the entire session.

Program Execution

Change to the directory containing the receiver files to be converted.

At the DOS prompt, type:

ASHTORIN [ENTER]

to bring up the standard version screen followed by ASHTECH Source Files/RINEX Target Files Menu 2.1:

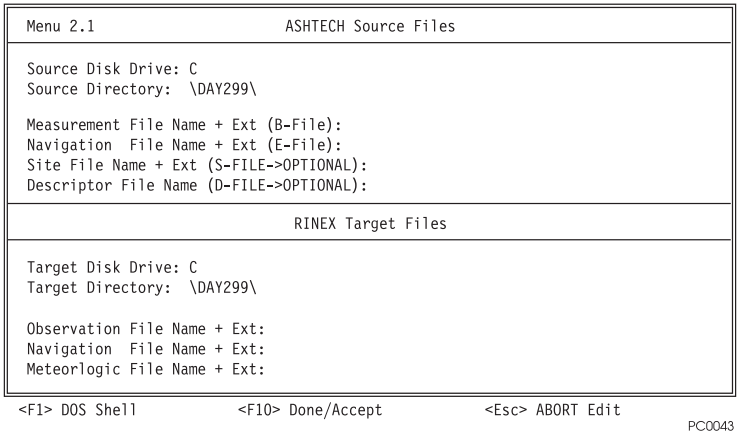


Figure B.39: Ashtech Source File Screen

Ashtech Source Files

The top section, defines the Ashtech files that you want to convert. This section contains the data entry fields:

Source Disk Drive: and Source Directory

Initially, the volume and path from which ASHTORIN was executed (in this case, C:\DAY299). Move the cursor to the field to be change, and type in the desired file location.

File Name + Ext: B-File, E-File, S-FILE(OPTIONAL), and D-FILE (OPTIONAL).

RINEX Target Files

The bottom section, defines the RINEX files that will be created. This section contains the following data entry fields:

Target Disk Drive: and Target Directory

Initially, the volume and path from which ASHTORIN executed (in this case, C:\DAY299). Move the cursor to the field to be changed, and type in the desired file location:

File Name + Ext: Observation, Navigation and Meteorological.

When typing in an ASHTECH Source measurement file name (for example, the sample B-file, BMAPRA90.299), ASHTORIN automatically fills in the corresponding E-file and S-file name in its appropriate field and suggests a set of RINEX file names in the RINEX Target Files section:

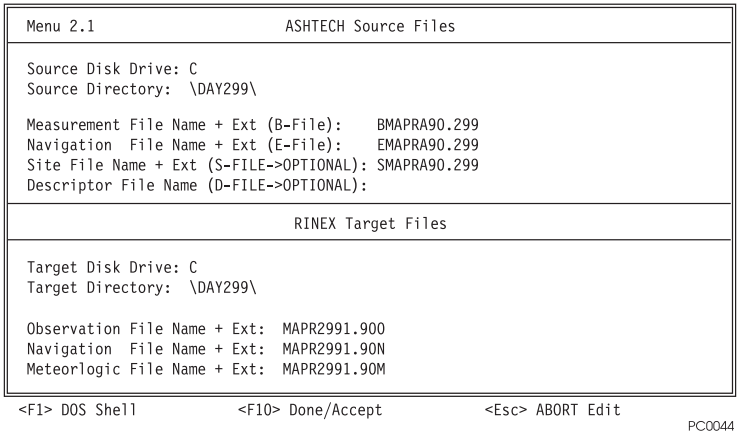


Figure B.40: Menu 2.1 Screen

Ashtech recommends naming the RINEX output files with the O-suffix for the observation filename, N-suffix for the navigation filename, and M-suffix for the meteorological filename. This format follows the standard RINEX naming convention for output files:

ssssdddf.yyt

where:

ssss	is a 4-character station name designator.
ddd	is the day of the year of the first record.
f	is the file sequence number to within a day.
yy	is the year.
t	is the file type where O indicates observation file, **N** indicates navigation file, and M indicates meteorological data file.

After the source files and the target files have been entered and the correct drive and directory established, press [F10] to access the Program Options Menu 2.0:

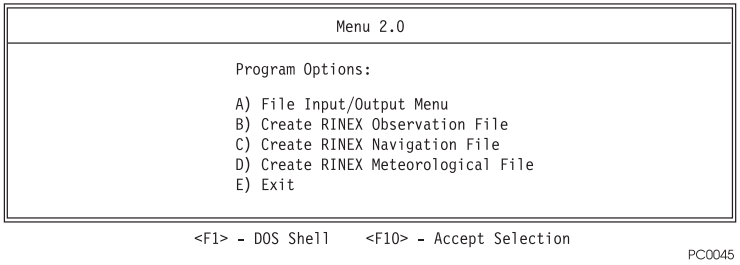


Figure B.41: Menu 2.0, Program Options

This menu provides the options of:

a. Return to the File Input/Output Menu,
2. Create Observation File,
3. Create Navigation File, o
4. Create Meteorological file.

To choose the desired option, use the arrow keys followed by [ENTER] or the [F10] key, or press the letter for the desired action.

1. To create an Observation file a valid B-file and E-file must be found.
2. To create a Navigation file a valid E-file must be found.
3. To create a Meteorological file no input files are required.
4. ASHTORIN creates an output file using the name you specify on Menu 2.1.
5. If the output file already exists, it is overwritten and the original file data is destroyed. In addition, a valid output filename must be entered to access the appropriate option.
6. If the above input file requirements are not met for a particular output file, ASHTORIN will not allow you to enter that menu screen.

Option A: File Input/Output Menu

When selecting this option, the software returns to the ASHTECH Source Files/ RINEX Target Files menu screen, typically after an Ashtech-to-RINEX conversion is completed.

Option B: Create RINEX Observation File

1. Select Program Option B; observe, typically:

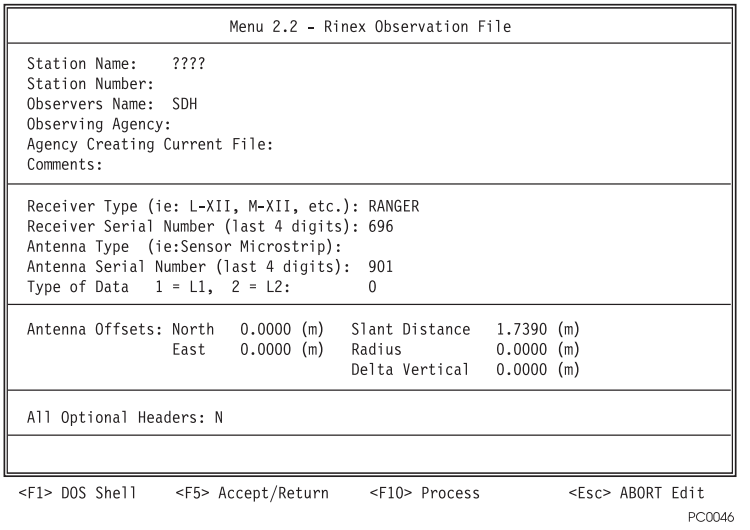


Figure B.42: Menu 2.2

In this screen:

2. ASHTORIN automatically extracts from the B-file and displays the current site identifier in the Station Name data field and the Type of Data in the corresponding field.
3. If the current directory contains a valid S-file associated with the B-file selected, ASHTORIN automatically extracts from the S-file and displays, in the corresponding field, the Observers Name, the receiver type, the receiver serial number, and the slant distance.
4. Menu 2.2 (Figure B.24) consists of four sections:
   - Agency Information
   - Equipment and Data Information
   - Antenna Offsets Information
   - All Optional Headers selector

Any of the entries can be changed and any of the other fields completed in these sections as desired.

The most recent entry to the fields Station name, Agency Creating Current File, and Comments applies globally to the following screens:

- Menu 2.2 - RINEX Observation File
- Menu 2.4 - RINEX Navigation File (except Station Name)
- Menu 2.3 - RINEX Meteorological File

Agency Information (Top Section)

Station Name

Initially contains the site identifier of the first epoch from the B-file; in this case ????. It can contain up to 60 alphanumeric characters.

Observers Name

Is from the S-file (if any), in this case, SDH; ____ means that no name was entered in the receiver.

Station Number

Optionally, up to 20 alphanumeric characters.

Observing Agency

Optionally up to 40 alphanumeric characters identifying the agency that surveyed the point.

Agency Creating Current File

Optionally up to 20 alphanumeric characters identifying the organization post-processing the data.

Comments

Optionally up to 60 alphanumeric characters for other relevant and noncomputational data.

Equipment and Data Information (Second Section)

Receiver Type

Initially displays the parameter from the S-file (if any); in this case, RANGER. It identifies the equipment used in the survey.

Receiver Serial Number

Initially displays the parameter from the S-file (if any); in this case, 696. Ashtech recommends at least the last three digits of the serial number of the equipment used in the survey.

Antenna Type

Fill this optionally, as required.

Antenna Serial Number

Initially displays the parameter from the S-file (if any); in this case, 901. Ashtech recommends at least the last three digits of the serial number.

Type of Data

Displays the parameter from the B-file; in this case, 0. The data type affects subsequent post-processing of the RINEX Observation file. Possible values from the B-file are:

Table B.7: B-File Parameters

Field	Description
0	Code phase only
1	C/A L1-only data
2	C/A L1 and codeless L2
3	C/A and P-code on L1
4	C/A on L1 and P-code on L2
5	C/A, P-code on L1, and P-code on L2

Antenna Offsets (Third Section)

North, East, Radius, and Delta Vertical

Initially default to zero meters. Slant Distance is initially at least 0.0001 meter because it must exceed the radius for antenna height computation. If ASHTORIN finds an S-file, Slant Distance is the value therein; type in accurate data to achieve valid results in post-processing.

All Optional Headers (Bottom Section)

The default is **N**o and puts the required header information in the observation file (that is, RINEX version number and type-through time of last observation). If you type Yes, in addition to the standard information, ASHTORIN first scans the entire B-file so that it can report the number of satellites which were recorded and, for each satellite, its PRN and number of observations of each measurement.

The Observation file will take this form where the optional header information is shaded:

```
               OBSERVATION DATA                    RINEX VERSION/TYPE
ASHTORIN
         21-MAY-92 12:23 PGM/RUN BY/DATE           COMMENT
CN1                                                MARKER NAME
                                                   MARKER NUMBER
PHG                                                OBSERVER/AGENCY
```

```
358            LM-XII2                     6FP3  REC#/TYPE/VERS
                                                 ANT#/TYPE
 -2691570.0600  -4301212.2700   3851725.6600     APPROX POSITION XYZ
        0.0001         0.0000         0.0000     ANTENNA: DELTA H/E/N
N
 1         1                                     WAVELENGTH FACT L1/2
2
 6        L1  L2  C1  P2  D1  D2                 #/TYPES OF OBSERV
 5                                               INTERVAL
1991     10  24  18  15   5.000000              TIME OF FIRST OBS
1991     10  24  19  20   0.003000              TIME OF LAST OBS
 5                                               # OF SATELLITES
 3      780 780 780 780 780 780                  PRN / # OF OBS
16      780 780 780 780 780 780                  PRN / # OF OBS
17      780 780 780 780 780 780                  PRN / # OF OBS
20      780 759 780 759 780 759                  PRN / # OF OBS
23      780 776 780 776 780 776                  PRN / # OF OBS
                                                 END OF HEADER

91 10 24 18 15  5.0000000  0   5   3 23 20 16 17
0.000898760
    987687.82319    769626.25517   28569964.835   21075179.767   -
320.644
      -249.829
    3057595.89416   1747946.15115  31938240.726   24443462.043   -
2743.328
     -2137.674
    -4425084.60818 -3448117.14116  29845916.732   22351133.402
3999.467
      3116.498
    -2913737.44518 -2270439.14116  29673527.704   22178742.396
2920.611
      2275.824
    1583846.53119   1234162.88717  28907100.551   21412313.564   -
707.822
      -551.543
```

Processing the Conversion

1. When all data is properly entered, press [F10] to create the Observation file.
2. ASHTORIN indicates processing in progress by the message WORKING and a rotating line in the upper left corner of the screen.
3. To interrupt processing in progress press the [Esc] key; observe: Are You Sure (Y/N)?

If you type N, ASHTORIN continues to process as if no interruption occurred.

If you type Y, ASHTORIN aborts processing and returns you to Program Options Menu 2.0 without finishing the RINEX Observation file.

When creation is complete, the system returns to Program Options Menu 2.0.

Option C: Create RINEX Navigation File

Select Program Option C; observe:

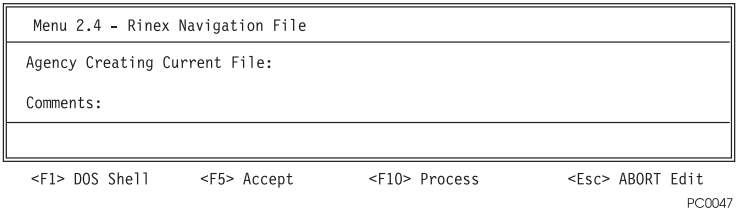


Figure B.43: RINEX Navigation, Option C

Agency Information (Top Section)

Agency Creating Current File

Optionally up to 20 alphanumeric characters identifying the organization post-processing the data.

Comments

Optionally up to 60 alphanumeric characters for other relevant and noncomputational data.

Processing the Conversion

When all data is properly entered, press the [F10] key to create the Navigation File and return to Program Options Menu 2.0 (Figure B.41).

Option D: Create RINEX Meteorological File.

To create a Meteorological file, no input files are required, however ASHTORIN extracts information from S-files and/or B-files (if present) as described later in this section.

Select Program Option D; observe:

```
Menu 2.2 - Rinex Observation File

Station Name:
Agency Creating Current File:
Comment:

PRESS - Preasure            RHUMD - Relative Humidity
DTEMP - Dry Temperature     ZWET  - Wet Zenith Path Delay (for WVR data)

READING    DATE      TIME      PRESS    DTEMP   RHUMD   ZWET
           (YMD)     (UTC)     (mbs)     (C)     (%)    (mm)
  1    1992\12\18   22:54: 2   1010.0    20.0    50.0     0.0
  2    1992\12\18   22:54: 2      0.0     0.0     0.0     0.0
  3    1992\12\18   22:54: 2      0.0     0.0     0.0     0.0
  4    1992\12\18   22:54: 2      0.0     0.0     0.0     0.0
  5    1992\12\18   22:54: 2      0.0     0.0     0.0     0.0
  6    1992\12\18   22:54: 2      0.0     0.0     0.0     0.0
  7    1992\12\18   22:54: 2      0.0     0.0     0.0     0.0
  8    1992\12\18   22:54: 2      0.0     0.0     0.0     0.0
  9    1992\12\18   22:54: 2      0.0     0.0     0.0     0.0
 10    1992\12\18   22:54: 2      0.0     0.0     0.0     0.0

<F1> DOS Shell     <F5> Accept/Return     <F10> Process          <Esc> ABORT Edit
                                                                        PC0048
```

Figure B.44: RINEX Meteorological File, Option D

Station Name

Initially contains the site identifier (if present) of the first epoch from the B-file. It can contain up to 60 alphanumeric characters.

Agency Creating Current File

Optionally up to 20 alphanumeric characters identifying the organization post-processing the data.

Comments

Optionally up to 60 alphanumeric characters for other relevant and noncomputational data.

Up to 10 READINGs are tagged by DATE (year\month\day) and TIME for the defined data fields (PRESS - Pressure, etc.). The DATE and TIME columns initially display the current computer date and time, and the first READING line displays standard conditions.

If an S-file was selected in Menu 2.1, ASHTORIN extracts the meteorological conditions from the S-file into the bottom area of the menu. If an S-file was not specified, ASHTORIN uses default meteorological parameters.

Make any corrections or additions desired.

When all data is properly entered, press [F10], to create the Meteorological file and return to Program Options Menu 2.0.

Option E: Exit

This option returns the system to DOS or the calling program.

Warning Messages

File seems to be Truncated

Means that the input file does not contain complete records (for example, a file with incorrect format).

File Cannot be opened for reading

Means that the file name does not exist in the path declared.

File Cannot be opened for writing

Means that the file could not be written to (may be write protected).

Error Messages

Invalid Drive\Dir

Means that the directory path could not be found on the drive specified. ASHTORIN will not continue until a valid "drive/dir" is specified.

Slant distance and\or radius out of range

Means that the radius input is larger than the slant distance to the antenna and the program can not calculate the correct antenna height. ASHTORIN will not continue until a smaller radius or a larger slant distance is entered.

Bendata file of incorrect format

Means the B-file was downloaded with a version of the CGRS HOSE program prior to Version 4.1.00; such a file must be run through the CONVERT program (as described in this chapter) before using ASHTORIN. If the data was downloaded from a receiver using firmware version 6A or 6B, see the discussion in the CONVERT section of this chapter. ASHTORIN will not work on data files collected using receiver firmware versions prior to 6A.

Receiver frequency entry out-of-range

Means that an illegal value is in the Type-of-Data entry.

RINTOASH

RINTOASH converts RINEX observation, navigation and optional meteorological files into Ashtech raw data files. These Ashtech files can then be post-processed with GPPS software. Converting allows users to combine data collected through several receivers regardless of the manufacturer. RINTOASH supports RINEX format, Versions 1 and 2.

Input Data files

RINTOASH uses RINEX-format observation, navigation and optional meteorological files as input data. RINTOASH works properly only with data measured on an exact interval.

Output Data Files

RINTOASH generates 3 files: an Ashtech B-file, E-file and S-file.

Program Execution

1. Change to the directory containing the RINEX files to convert.
2. At the DOS prompt, type:

   RINTOASH [ENTER]

   to bring up the standard version screen followed by the file input/output screen where users specify the names of the files to convert
3. In the left column, specify the RINEX input file names. Ideally, the RINEX files in the current directory will be named according to the standard RINEX naming convention:

   ssssdddf.yyt

   where:

ssss	is a 4-character station name designator.
ddd	is the day of the year of the first record.
f	is the file sequence number to within a day.
yy	is the year.
t	is the RINEX file type: O indicates the observation file, N is the navigation file, and M is the meteorological data file.

   When you type a valid observation file name (e.g., ROV11011.91O), RINTOASH automatically creates a related name for the navigation file

(e.g., ROV11011.91N) and for the optional meteorological file (e.g., ROV11011.91M). If the supplied names are incorrect, overtype them.

4. In the right column, name the files you want to create. Ashtech strongly recommends that you follow the standard naming convention:

   tsssfyy.ddd

   where *t* is the Ashtech file type; B indicates the observation file; E is the ephemeris file; and S is the site file, and the other elements are as described above for the RINEX convention.

   If the RINEX input file name is in the standard format, you can easily formulate the corresponding output file name in Ashtech format; e.g., RINEX OBS FILE ROV11011.91O rearranges to ASHTECH OBS.FILE BROV1A91.101.

   When you type in a B-file name, RINTOASH automatically generates the related E-file and S-file names.

   To change any names that are not satisfactory, overtype them.

5. When the file names are satisfactory, press {F10].

6. RINTOASH then starts the conversion. Throughout the conversion, RINTOASH displays;

   PROCESSING NOW ... PLEASE WAIT

   In the bottom window, RINTOASH reports the name of the file currently being converted. When RINTOASH begins to create the B-file, it indicates processing in progress by the message WORKING and a rotating line in the upper left corner of the screen.

7. When the conversion is complete, RINTOASH removes all status messages.

   The output files are now ready to be processed with the GPPS software. The file names remain displayed so that users can modify them to the next sequential site name.

DATALOGR

Ashtech's DATALOGR software logs data from the GPS receiver to the computer in real-time. This module works only with those receivers which contain the real-time output option.

Input Data Files

None.

Output Data Files

DATALOGR generates two output files on the target drive of the data logging computer. These files, a B-file and E-file, are directly usable by the Ashtech post-processing software.

It should be noted that the program does not produce an S-file (or site file) which is used to expedite automatic processing. Automatic processing can still be performed without the S-file by entering antenna height data when the project file is edited.

Program Execution

In order to receive the data, the GPS receiver must be connected to the computer to which the data will be transferred. This connection is made using the full handshake null modem cable provided with the receiver. One end of the cable plugs into the GPS receiver via the RS-232 port and the other end of the cable plugs into the computer RS-232 port labeled COM1 or COM2.

To start DATALOGR, at the DOS prompt, type:

DATALOGR [CR]

The screen shows a display similar to following:

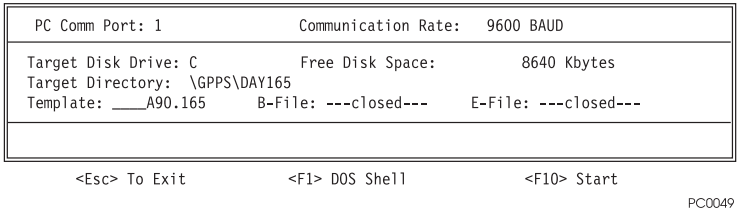


Figure B.45: DATALOGR Screen

The display shows three sections, each in a separate box. They are:

1. Communications

2. Target System
3. Status Information

In the communications section communications parameters can be selected; that is, communication port 1 or 2 (for COM1 and COM2, respectively) and communication speed. To select the communication speed, press the [PgUp] or [PgDn] keys until the desired speed appears.

The target system section allows for the selection of target disk drive, target directory path, and target file names. As in CGRS HOSE, the template prompt allows for the entry of the "base" file name. Specifically, the information entered here will be used to generated the target B-file and E-file names according to the recommended file naming convention. At program start-up, the clock of the target computer is used to generate the session, year, and day fields of the template; that is, only the 4-character site name is not supplied.

The status information section is used to provide status information during communication with the receiver, and is blank for this example.

After the target file names have been entered, press [F10] to begin data logging. At this time, DATALOGR checks that the named files exist and asks permission to overwrite them if they do exist, as shown below:

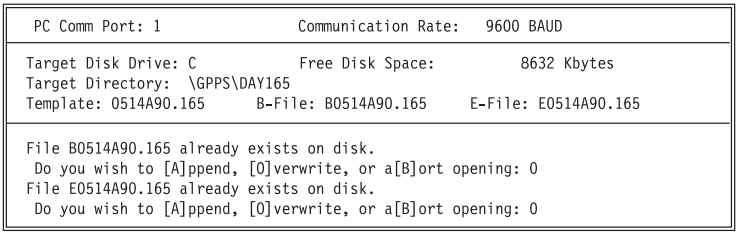


Figure B.46: DATALOGR Status

After the target files have been opened successfully, DATALOGR tries to establish the data link. If the data link has not been established properly, the following message appears in the status section:

> ERROR: While attempting to initialize the communications port, an Ross line status check indicates one of the following conditions:
>
> 1. Cables not connected properly (e.g., wrong receiver port);
> 2. Cables not fastened securely; and/or
> 3. Receiver power not ON.

Ensure cables are connected (with FULL NULL MODEM) and receiver power is ON.

Press any key when ready to try again.

For proper operation of DATALOGR when connected to serial ports C or D of the Z-12-R receiver, include the "-i" option (for example, type "DATALOGR -i").

Once the data link is established, you will see a screen similar to:

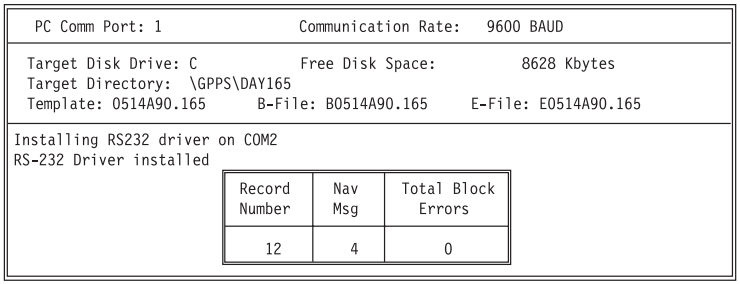


Figure B.47: DATALOGR, Option i

If either the record number or the number of navigation messages do not increase, one of the following conditions exists:

1. Not enough satellites are being tracked by the receiver.
2. An epoch interval has not transpired since the time the connection was established.
3. The communication cable is not properly connected.

To end a data logging session press [Esc]. The output files will then be closed and the data link will be terminated.

Command Line Options

If desired, you can execute DATALOG specifying the following command line parameters:

Table B.8: Command Line Options

Command	Description
?	Lists options.
a	Downloads an almanac file real time.
bS	pacifies the communication rate (BAUD).
c	Sets the communications port.

Table B.8: Command Line Options

Command	Description
f	Updates FAT of the b, c file at t (seconds) interval.
I	Ignores the RS-232 status lines.
p	Logs position data only.
n	Do not poll COMM speed.
y	Specifies the template name to be used for B & E files.

These parameters can exist in any order, but their related parameters must follow them in the same order, as shown in the following examples:

Table B.9: Command Parameters

Command	Function
DATALOGR -?	The (-?) lists the command line options and provides a brief description of what the command does.
DATALOGR -a	The (-a) option downloads an almanac file in real time. This command is typically used on receivers that don't have internal memory.
DATALOGR -b	The (-b) option sets the communication baud rate. To initialize DATALOGR to 9600 baud, enter the following command: • DATALOGR -b 9600 [CR]
DATALOGR -c	The (-c) sets the communication port to either COM1 or COM2. To start DATALOGR on COM2, enter the following command: • DATALOGR -c 2 [CR]
DATALOGR -f	The (-f) option allows you to set a time interval to write the EOF marker. This causes the file to be closed every "N" seconds in order to protect against power outages that typically cause data loss. To set the time interval to 10 seconds, enter the following command: • DATALGR -f 10 [CR]
DATALOGR -I	The (-I) options causes the status information coming through the RS-232 connection to be ignored. Use this command with caution.
DATALOGR -p	The (-p) option causes the logging of only the position data when the data is viewed using the filetool program the code observables are not seen

Additional System Information

This section describes unhealthy GPS codes and default parameters.

Unhealthy Codes

The unhealthy code used with GPS satellite identification consists of 2 hexadecimal digits. They represent 4 bits each and need to be converted to a single 8-bit binary number. The binary number is then broken so the 3 most significant bits represent the health of the data (Table 3.1). The second grouping (5 bits) reflects the health of the signal (Table 3.2). For example, to translate the code 3C (as displayed on the receiver):

1. First, write it as two 4-bit groups: 0 0 1 1 and 1 1 0 0
3. Then write as one 8-bit number: 0 0 1 1 1 1 0 0
4. Regroup to 3 and 5 digits: 0 0 1 and 1 1 1 0 0
5. Read 001 from Table C.1 and 11100 from Table C.2. 001 reports a parity error; 11100 indicates the satellite is temporarily out of range.

Table C.1: NAV Data Health (Bits 0 through 2)

Bit 0	Bit 1	Bit 2	NAV Data Health
0	0	0	All data okay
0	0	1	Parity failure
0	1	0	TLM/HOW format problem
0	1	1	Z count in HOW is bad
1	0	0	Subframes 1, 2, 3: One or more elements in words 3 through 10 of one or more subframes are bad
1	0	1	Subframes 4, 5: One or more elements in words 3 through 10 of one or more subframes are bad
1	1	0	All uploaded data is bad
1	1	1	All data is bad. TLM word and/or HOW and 1 or more elements in any one or more subframes are bad

Table C.2: NAV Data Health (Bits 3 through 7)

Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	NAV Data Health
0	0	0	0	0	All signals okay
0	0	0	0	1	All signals weak
0	0	0	1	0	All signals dead
0	0	0	1	1	All signals- no data modulation
0	0	1	0	0	L1P signal weak
0	0	1	0	1	L1P signal dead
0	0	1	1	0	L1P signal - no data modulation
0	0	1	1	1	L2P signal weak
0	1	0	0	0	L2P signal dead
0	1	0	0	1	L2P signal -- no data modulation
0	1	0	1	0	L1C signal weak
0	1	0	1	1	L1C signal dead
0	1	1	0	0	L1C signal -- no data modulation
0	1	1	0	1	L2C signal weak
0	1	1	1	0	L2C signal dead
0	1	1	1	1	L2C signal -- no data modulation
1	0	0	0	0	L1P and L2P signals weak
1	0	0	0	1	L1P and L2P signals dead
1	0	0	1	0	L1P and L2P signals -- no data modulation
1	0	0	1	1	L1C and L2C signals weak
1	0	1	0	0	L1C and L2C signals dead
1	0	1	0	1	L1C and L2C signals -- no data modulation
1	0	1	1	0	L1 signal weak
1	0	1	1	1	L1 signal dead
1	1	0	0	0	L1 signal -- no data modulation
1	1	0	0	1	L2 signal weak

Table C.2: NAV Data Health (Bits 3 through 7) (continued)

Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	NAV Data Health
1	1	0	1	0	L2 signal dead
1	1	0	1	1	L2 signal -- no data modulation
1	1	1	0	0	SV is temporarily out; do not use during current pass.
1	1	1	0	1	Satellite will be temporarily out. Use with caution.
1	1	1	1	0	Spare
1	1	1	1	1	More than one combination would be required to describe the anomalies found.

Receiver User Parameters

Receiver user parameters are stored in the internal memory of the receiver. Initially, they are set to their default values, but can be overridden. All are overridden automatically when their values are modified through their corresponding screens. Once parameters are saved in the internal memory, powering the receiver OFF does not change their values.

Some of these parameters can be set back to their default values by issuing the command 550. To set all parameters back to their default values, do an internal memory reset of the receiver.

The following table lists all receiver user parameters and shows their default values. It also lists which parameters are saved automatically when their values are modified through their corresponding screen.

Table C.3: Receiver User Parameters

Parameters	Default	Saved Autom	Reset By 550
SCREEN 4			
POS	0	Yes	No
REC INT	30.0	Yes	Yes
MIN SV	1	Yes	Yes
ELEV MASK	10	Yes	Yes
RNGR	3	Yes	Yes

Table C.3: Receiver User Parameters (continued)

Parameters	Default	Saved Autom	Reset By 550
POSITION			
POS MODE	0	Yes	No
ALT MODE	0	Yes	No
ELV MASK	10	Yes	Yes
UNHEALTHY	N	Yes	Yes
PDOP MASK	40	Yes	Yes
HDOP MASK	04	Yes	Yes
VDOP MASK	04	Yes	Yes
COMP POS	Y	Yes	Yes
ION MODEL	N	Yes	Yes
UTM COORD	N	Yes	Yes
DATUM	WGS-84	Yes	No
SESSION			
START, END	0	Yes	No
INT	30.0	Yes	No
MASK, MIN, TYPE	10, 1, 3	Yes	No
INUSE	N	Yes	No
REF	000	Yes	No
OFFSET	00:00	Yes	No
DIFFERNTL			
MODE	Disabled	Yes	Yes
AUTO DIFF	Disabled	Yes	Yes
OUTPUT PORT	A	Yes	Yes
CODE	C/A	Yes	Yes
RTCM			
SPD	0050	Yes	Yes

Table C.3: Receiver User Parameters (continued)

Parameters	Default	Saved Autom	Reset By 550
STID	0000	Yes	No
STHE	0	Yes	No
FREQ (TYPE 1)	99	Yes	Yes
FREQ (TYPE 2)	00	Yes	Yes
FREQ (TYPE 3)	00	Yes	Yes
FREQ (TYPE 16)	00	Yes	Yes
TYPE 6	On	Yes	Yes
SEQ	N	Yes	Yes
MAXAGE	0060	Yes	No
QAFREQ	100	No	No
MESSAGE	Empty	Yes	Yes
PORT A, B, C OR D			
NMEA	Off	Yes	Yes
All NMEA Messages	Off	Yes	No
Send Interval	005	Yes	Yes
Real Time	Off	Yes	Yes
MBEN	Off	Yes	Yes
PBEN	Off	Yes	Yes
SNAV	Off	Yes	Yes
SALM	Off	Yes	Yes
FORMAT	ASCII	Yes	Yes
VTS	Off	Yes	Yes
BAUD RATE	9600	Yes	Yes
MET	Off	Yes	Yes
INIT STRING MET	None	Yes	Yes
MET CMD	*0100PQ	Yes	Yes

Table C.3: Receiver User Parameters (continued)

Parameters	Default	Saved Autom	Reset By 550
MET SAMPLE	0005	Yes	Yes
TILT	Off	Yes	Yes
INIT STRING TILT	No Init Strings	Yes	Yes
TILT CMD	*0100XY	Yes	Yes
TILT SAMPLE	0005	Yes	Yes
PULSE GEN			
PERIOD	01.00	Yes	Yes
OFFSET	+000.0000	Yes	Yes
OUTPUT ON A	N	No	No
OUTPUT ON B	N	No	No
EXT FREQ			
PORT	C	Yes	Yes
PORT	D	Yes	Yes
FREQUENCY	00.00	Yes	Yes
SAVE	N	Yes	Yes
MODEM			
PORT	A	Yes	Yes
TYPE	Telebit World Blazer	Yes	Yes
RCVR CTRL			
Z MODE	A	Yes	No
SCREEN 7			
AUTO SELECTION	Y	Yes	Yes
ALL SATELLITES	Y	Yes	Yes
SCREEN 9			
SITE	????	Yes	Yes

Table C.3: Receiver User Parameters (continued)

Parameters	Default	Saved Autom	Reset By 550
SESS	----	Yes	Yes
RCV#	----	Yes	Yes
ANT#	----	Yes	Yes
MMDD	----	Yes	Yes
OPR	----	Yes	Yes
CODE	----------	Yes	Yes
HI	0.0000	No	No
T-DRY	+00	No	No
WET	+00	No	No
RH	00	No	No
BP	0000	No	No
MIN SV	0	No	No
RECORD	Y	No	No
EPOCHS	000	No	No

Additional Information

Position Determination with GPS

There are 3 methods of determining position using GPS receivers. These are pseudo-kinematic, kinematic, and static, and can be collectively described as relative or differential positioning. The pseudo-kinematic and kinematic methods are not applicable to DGPS reference station operation and are not discussed in this manual.

The static survey measures the phase differences from 2 GPS receivers which are simultaneously locked on several common satellites. One receiver gathers data from a known position; the other from an unknown position.

The static method minimizes errors associated with satellite information and receiver biases, and is the most reliable and accurate method, producing coordinate accuracy-levels to the millimeter. The disadvantage is that the receiver must remain at a site for a relatively long time to get redundant observations, but this is of little consequence for a fixed reference station.

Conducting a Static Survey

The following procedure describes a static survey to show how to use the Z-12 CGRS receiver to determine the exact location of the DGPS reference station. The operations include:

- Setting up the receivers and the antennas.
- Measuring antenna height.
- Operating the receiver to collect data.
- Entering the site name.
- Terminating the survey properly.
- Connecting the receiver to a computer for down loading the data.

A static survey uses at least 2 stationary GPS antennas that simultaneously observe the range and carrier phase of several common satellites over a specific time period. One antenna is centered over a known point; the other antennas occupy unknown stations.

By occupying more than one station, a number of common errors cancel so the accuracy can be greatly improved. To compute accurate baselines and establish accurate positions on the unknown points, the data collected by the receivers is post-processed later with a PC (personal computer). The necessary receiver operations for collecting data necessary for the post-processed solution are discussed

System Set Up

Two receivers are required to perform a static survey with GPS.

1. Set up and level an antenna over a survey mark. The sur-vey point must provide line-of-sight reception of the GPS signals. You should already know the WGS-84 or NAD-83 coordinates of one survey mark in the session. To set up the antenna over the survey mark, a tripod and centering device such as a tribrach with an optical plummet is required. When the tribrach is in level, put the antenna platform on it.
2. Connect the antenna through the pre-amplifier to the receiver with an antenna cable.
3. Measure the antenna height. Use the Ashtech sectioned precision rod or any other accurate method.
4. Connect an external battery or power source to one of the power sockets on the receiver's back panel, making sure to align the red dot of the connector with the red dot of the socket.
5. Repeat these steps for all receivers participating in the survey. For each, set up an antenna over a mark for which you will determine the coordinates. Measure its antenna height and connect it to its receiver.
6. Set the receivers' power switches to ON.

Measuring Antenna Height

In any GPS observation, the measurements are made at the phase center of the top of the antenna receiving the signal. To reduce them to the ground level to serve as a survey control point, you must accurately measure the distance from the antenna to the survey mark. This distance is referred to as the antenna height or height of the instrument (HI).

1. Using the precision HI rod, direct the rod through one of the dog-legged holes around the edge of the antenna platform. The holes (marked A to H) are situated so that the rod will not be blocked by a tripod leg.
2. Put the rod's point at the center of the mark and read the engraved markings.

Measure 3 different holes to confirm the HI and check that the tribrach is in adjustment and indeed over the point. All 3 measurements should be within 1 mm of each other.

If a non-graduated measuring rod is used, lift it up about a 1 inch and place a strip of masking tape on it. Reposition the rod and mark the tape. Measure from 2 other holes for redundancy. Then measure the marked rod to obtain the HI.

To assure that the HI is correct, measure it several times and preferably in 2 systems: feet and meters. It is necessary only to measure the distance from the mark to the top outside edge of the dog-legged hole on the antenna platform. (Later, the processing software corrects this diagonal measurement to vertical.) Measure the HI before and after the observation to check that no settling is experienced during the survey.

Operating the Receiver

1. Connect one end of the power cable to a power source (generally a battery pack) and the other end to either of the power connectors on the back of the receiver.
2. Connect one end of the antenna cable to the antenna and the other end to the antenna connector on the back of the receiver.
3. Check that the antenna height (HI) has been measured.
4. To start data collection, turn the receiver ON by setting the power switch on the back of the receiver to ON.
5. Turning the power ON initiates a self-test and momentarily displays the following messages:
    - EPROM checksum OK
    - XRAM installe
    - Mag var checksum OK
    - Downloading channel

If the receiver finds a problem during self-test, it displays an error message and stops. When there are no problems, the receiver briefly displays the Ashtech copyright before displaying Screen 0.

In theory, no interaction with a receiver is required for static surveys. When the receiver is turned ON, it automatically:

- Searches and locks on all satellites available.
- Makes GPS measurements and computes its position.
- Opens a file and saves all data into this file.

When the receiver is turned OFF after a survey, it automatically closes the file.

Screens 4 and 9 are used for specifying information for a survey. To operate the receiver after it has been turned ON, do the following:

1. On Screen 0, adjust contrast by pressing the ▲ or ▼ key. You do not have to enter any information for the survey if the default parameters are suitable. For a static survey, Ashtech recommends that you accept the defaults and go directly to Screen 9 (step 3).

2. Go to Screen 4, Mode Control, to change operational parameters. To do this, press the [4] key.

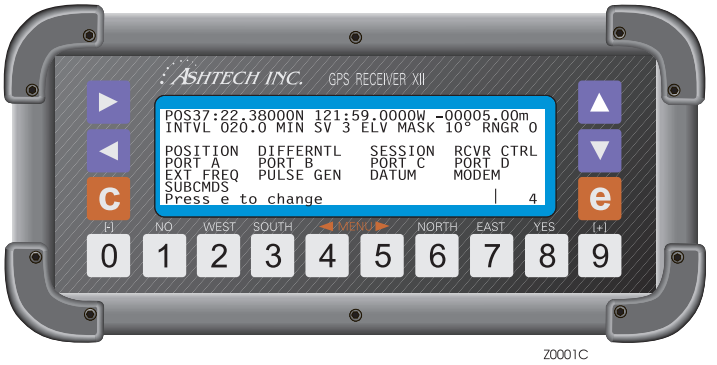


Figure D.1: Screen 4

The default values work very well for static surveys. However, to alter a value, press Enter [e] to shift to data-entry mode. Use an arrow key to move the cursor to the desired parameter and change its value. Press the Enter [e] key to save the changes or Cancel [c] to abandon changes.

1. Go to Screen 9, Site and Session Control: press [9]. Like Screen 4, you do not have to alter information to successfully conduct a static survey. However, Ashtech recommends at least a 4-character site name to assist in automatic processing. For further information, refer to the detailed information about Screen 9 in Chapter 4.

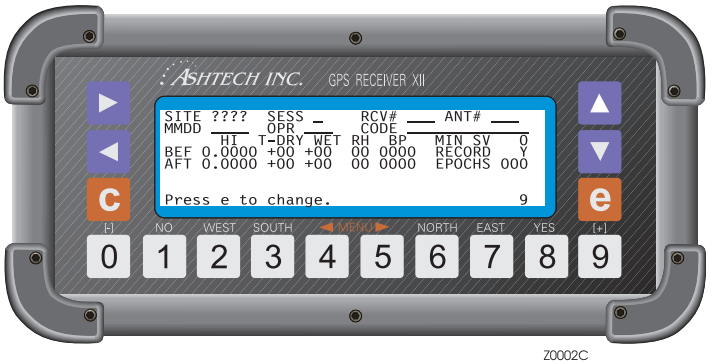


Figure D.2: Screen 1

Site information can be entered during data collection and will not affect or interrupt the collection process. It is output as an ASCII file when the data is downloaded from the receiver. Be aware that external memory, not included with the CGRS receiver, is required to perform these functions.

To conclude data collection, turn the receiver off. The receiver automatically closes the data file.

Entering Site Name

To type in text; that is, a site name for Screen 9:

1. Press Enter [e] to switch to data-entry mode. The following alpha-numeric conversion table appears:

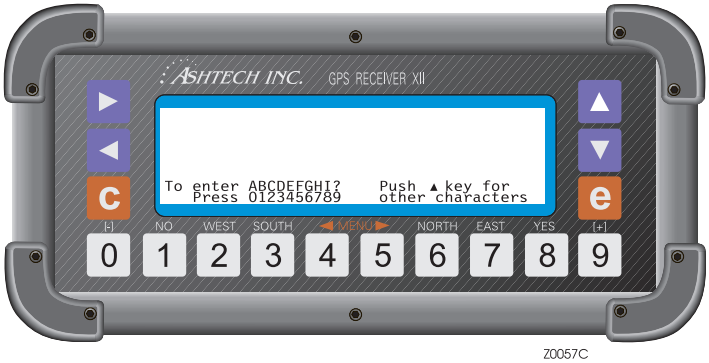


Figure D.3: Screen 9

2. Type in the site name, one number at a time, where each number corresponds to a desired letter.
3. To view another bank of alphanumeric characters, press the ▲ key to cycle through the 5 displays.
4. If the cursor is in the wrong character position, use the ▶ or ◀ key to line it up again.

After the fourth character of the name, the cursor jumps to the session identifier field. To change an entry, move the cursor to the desired field and re-enter the information. When the entries are acceptable, press Enter [e] to save the changes in memory and return to display mode. To cancel the changes before saving them, press Cancel [c].

Ionosphere Information

For the latest ionosphere information, use the Space Environment Services Center BBS:

- 303-497-5000 2400, N, 8, 1 F

Reference Documents

Ashtech recommends the following reference books on GPS theory:

Elementary Reading:

- **Smith**: *Basic Geodesy - An Introduction to the History and Concepts of Modern Geodesy without Mathematics* ISBN 0-910845-33-6
  Landmark Enterprises, 10324 Newton Way, Rancho Cordova CA 95670
- **Wells**: *Guide to GPS Positioning* ISBN 0-920-114-73-3
  Available from Canadian GPS Associates
  Box 5378, Postal Station F, Ottawa, Ontario Canada K2C 3J1

Advanced Reading:

- **B. Hoffman-Wellenhof, H. Lichtenegger, and J. Collins:** : *GPS Theory and Practice*:

- **Leick**: *GPS Satellite Surveying* ISBN 0-471-81990-5
  Wiley Interscience, 605 3rd Avenue, New York NY 10158-0012
  Excellent overview of geodesy:

Sources of GPS Information

- RTCM SC-104, Version 2.2
  Radio Technical Commission for Maritime Services
  P.O. Box 19087 Washington DC 20036-9087
- International GPS Service for Geodynamics (IGS)
  Jet Propulsion Laboratory, MS 238-540, Pasadena CA 91109
  Tel 818-393-6686 Fax 818-354-8330 or -5072
  Internet ren@logos.jpl.nasa.gov.
- National Geodetic Information Center, NOAA
  11400 Rockville Pike, Rockville MD 20852 Tel 301-443-8631
- Institute of Navigation
  1626 16th St. NW, Washington DC 20036
- Scripps Orbit and Permanent Array Center (SOPAC)
  High-Precision GPS BBS Service
  Subscription $7500/year and $3000/year
  SOPAC Coordinator IGPP-UCSD
  9500 Gilman Drive, La Jolla CA 92093-0225
  Tel 619-534-0229 Fax 619-534-8090
- US Coast Guard Navigation Center
  GPS ICD available, everything you need to know about GPS
  www.navcen.uscg.mil/navcon.htm

Common GPS Acronyms

ALT	Altitude
ALM	Almanac
AFT	After
AGE	Age of Data
ANT	Antenna
ASCII	American Standard Code for Information Interchange
AZM	Azimuth
BEF	Before
BIN	Binary Index (file)
BM	Bench Mark
BP	Barometric Pressure
C/A	Coarse/Acquisition
	Clear/Access
COG	Course Over Ground
CTD	Course To Destination
DGPS	Differential GPS
DIFF	Differential
DMS	Degrees, Minutes, Seconds
DOP	Dilution Of Precision
DOS	Disk Operating System
DTD	Distance To Destination
EDOP	Elevation Dilution Of Precision
ELEV	Elevation
ELIP	Ellipsoid
ELLIP	Ellipsoid
ELP	Ellipsoid
ELV	Elevation
EMI	Electromagnetic Interference
ENU	East, North, Up
EPHM	Ephemeris
FCC	Federal Communications Commission
FREQ	Frequency

GH	Geoid Height
GLL	Latitude/Longitude for Position
GMST	Greenwich Mean Sidereal Time
GMT	Greenwich Mean Time
GPPS	GPS Post-Processing Software
GPS	Global Positioning System
GPSIC	GPS Information Center 7323 Telegraph Road Alexandria VA 22310-3998 703-313-5900
HDOP	Horizontal Dilution Of Position
HEL	Health
HI	Height of Instrument
HTDOP	Horizontal/Time Dilution Of Precision
ID	Identification, Integrated Doppler
LAT	Latitude
LAD	Liquid Crystal Display
LNA	Low-Noise Amplifier
LNG	Longitude
LON	Longitude
MMDD	Date format - Month, Date
MSG	RTCM Message
MSL	Mean Sea Level
N	Geodetic Undulation
NAD	North American Datum
NMEA	National Marine Electronics Assoc.
NV	Non-Volatile
PDOP	Position Dilution of Precision
PE	Precise Ephemeris
POS	Position
RAM	Random-Access Memory
RF	Radio Frequency
RFI	Radio Frequency Interference

RH	Relative Humidity
RMS	Root Mean Square
RTCM	Radio Technical Commission for Maritime Services
	P.O. Box 19087
	Washington DC 20036-9087
SE	Site Editor
	Standard Error
SESS	Session
SOG	Speed Over Ground
SS	Static Survey
SV	Satellite Visibility
	Space Vehicle
T-DRY	Temperature - Dry (Celsius)
T-WET	Temperature - Wet (Celsius)
TDOP	Time Dilution Of Precision
UT	Universal Time
UTC	Universal Time Coordinated
VDC	Volts Direct Current
VDOP	Vertical Dilution of Precision
WGS	World Geodetic System
WGS-84	Reference Ellipsoid
WP	Waypoint

Index

A

Acronyms,D-8
AGE,D-8
Age of differential GPS data,128
Almanac,D-8
Amplifier,D-9
Antenna height,140
antenna height,B-64
ASCII,113
ASHTORIN,B-64

B

BAUD,B-56
baud rate,38
B-file,B-64, B-71
B-files,B-66

C

C/A code,149
carrier phase,149
clock,146
Clock data issue,154
Clock drift,151

D

data link,B-72
Data Output,25, 113, 123
data output,114
DATALOGR,B-73
Datum,D-9
DBEN Message,157
DBEN message type,159
DCE,B-50
D-files,B-58
Differential GPS,D-8
Dilution,D-8
Distance,D-8
distance,B-62
Doppler,160, D-9
downloading,B-8, B-17, B-41, B-46
DRY,D-10
DTE,B-50

E

Eccentricity,154
ECEF,133
ECEF-X,148
E-file,B-58, B-71
E-files,B-58
ELV MASK,C-4
External Sensors,24

F

FCC,D-8
firmware,166, B-39, B-68

G

Geoidal height,128
GGA,119
GLL,119, D-9
GMT,D-9
GPPS,D-9
GPS latitude,128
GPS longitude,128
GPS time,138
GPS week,154, B-45
GRS,139
GSN,119

H

handshake,B-71
Harmonic correction,154
HDOP,128, C-4
Health,D-9
Height,D-9
HI,C-7, D-2
Humidity,D-10

I

Inclination,131
initialize the communications port,B-72
integrated doppler,147

L

L1,148, 160, B-64
L2,148, 160, B-64
LNA,D-9

M

Mag var,36, D-3
MBEN,149
Mean anomaly at reference time,154
Mean anomaly correction,154
Memory,D-9
MESSAGE,C-5
meteorological station,24, 76, 78, 123
MIN SV,C-7
Mode,137
MODEM,B-73, C-6
MSG,D-9

N

NMEA,C-5, D-9
NMEA Message Types,126

O

Option,B-66
Orbit,D-7
Orbit data issue,154

P

PBEN,C-5
PBEN Files in ASCII,148
PBN,150
PDOP,151, C-4, D-9
pdop,151
PL1 code,160
PNAV,159
POS,C-4, D-9
post-processing,B-71
PRC,132
Pressure,B-67, D-8
PRN,158, B-64
program options,B-44
pseudo-range,158

R

radius,B-68
RAMDUMP,B-55
Range rate correction,132
Real-Time Data Output,113
Real-Time Data output,113
RECORD,C-7
Reference time,154
reference time,136
Remote,158
Reset,B-44
RMS,D-10
RS-232,B-71
RTCM,131, C-4, D-10
RUN,B-64

S

Satellite,132, D-10
Satellites used,137
Seconds of GPS week,B-45
Sequence number,131
Serial Port,113
serial ports,113
S-files,B-55, B-66
Slant,B-68
SNAV,154, C-5
SNAV Files,154
SOG,D-10
Static,D-10
Station identifier,131
STHE,C-5
STID,C-5
SV PRN number,155

T

TBEN,151
TDOP,148, D-10
tilt meter,121, 122, 123
tiltmeter,76, 79

Troubleshooting,B-55
True bearing,135
true north,130

U

UDRE,132
upgrade firmware,166
Upgrading Firmware,166, B-39
UTC,135
UTC of position,140
UTC time,132
UTM,140, C-4

V

VDOP,148, C-4, D-10
vertical position error,138

W

WET,D-10
Wet,D-10
WGS-84,D-10

Z

Z count,131, C-1