Rockwell Semiconductor Systems

LABMON Operation Guide For The "Jupiter" GPS Receiver

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Notice

This document describes version 4.6 of the LABMON evaluation software. LABMON version 4.6 must be used with the Zodiac family of receivers to effectively evaluate all of the functions described herein. Although this software may be used with the MicroTracker/MicroTracker LP, NavCore V, and NavCard/NavCard LP Personal Computer Memory Card International Association (PCMCIA) GPS receivers, some of the functions described in this document are not supported by those receivers.

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Introduction

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The Rockwell Zodiac™ Development Kit is designed to facilitate evaluation of Rockwell's "Jupiter" Global Positioning System (GPS) receiver engine based on the Zodiac chip set. The receiver can be used in both static and mobile operations for evaluation purposes.

The Development Kit implements the receiver control operation and input/output (I/O) functions of the GPS receiver using an IBM-AT compatible personal computer (PC), a serial port, external antenna, and power supply. The GPS receiver is contained in a housing with I/O connectors, status LEDs, and configuration DIP switches.

This document explains the use of the GPS monitor and controller software, referred to as LABMON, provided with the Development Kit. LABMON runs on the PC and allows the user to control the receiver and to display the receiver outputs. Externally supplied Radio Technical Commission for Maritime Services (RTCM SC-104) data can also be logged using a second PC serial port. ASCII files containing the LABMON source code, included on the same diskette as the executable, provide a reference for similar Original Equipment Manufacturer (OEM) code implementations.

LABMON Compatibility With Rockwell Receivers

There are two series of Rockwell commercial GPS receivers to date. The first was the NavCore series and the latest is the Zodiac family. The NavCore series consists of the NavCore V, MicroTracker, MicroTracker LP, NavCard, and NavCard LP receivers. The Zodiac family currently consists of the "Jupiter" board level product and the Zodiac chip set product.

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LABMON 4.6 is designed primarily to support the Zodiac family of receivers. Since it is also backwardly compatible with the NavCore series of receivers, this version of LABMON may be used to monitor and control them as well.

The receivers may use either a binary or NMEA-0183 type of serial interface protocol for communication. The Zodiac and NavCore receivers share a similar Rockwell binary message format, but the messages themselves have different IDs and content. To differentiate between these binary types in this document, they are referred to as Zodiac binary and NavCore binary.

The NMEA-0183 protocol consists of a number of standard messages, and also allows manufacturer specific or proprietary messages for more complete control or monitoring of receivers. While the Zodiac and NavCore receiver NMEA-0183 protocols share a number of standard messages, the number and type of Rockwell proprietary messages differ. To differentiate between these NMEA types in this document, they are referred to as Zodiac NMEA and NavCore NMEA.

The Zodiac receiver series comes standard with both Zodiac binary and Zodiac NMEA. The type used is selected either by software command or by controlling the voltage applied to an external pin on the receiver. The NavCore series is available with Rockwell NavCore binary and NavCore NMEA protocols depending on the model and software options. The type used is selected by controlling the voltage applied to an external pin on the receiver. The NavCard supports only NavCore binary. The NavCard LP is available with either Rockwell NavCore binary or NavCore NMEA-0183 protocols.

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Both Zodiac and NavCore receiver series are supported by LABMON 4.6. To communicate with a receiver, the message protocol used by LABMON is changed to match the current message type in use by that receiver.

It is important to select the correct protocol for LABMON to operate properly. The two binary protocols are not compatible. The NMEA-0183 protocols are similar enough that standard messages can be displayed or received properly, but not all Rockwell proprietary NMEA messages will be output or accepted.

Details on how to set up and configure the Development Kit are found in the corresponding *Development Kit Setup and Operation Guide For The "Jupiter" GPS Receiver*. Further information about GPS and the Zodiac family of GPS receivers is provided in the *Zodiac GPS Receiver Family Designer's Guide.*

2 Installing LABMON

LABMON was designed to run using an MS-DOS/PC-DOS or compatible DOS operating system. It is also possible to run LABMON from the DOS Prompt under Windows 3.x.

Note: *Sometimes, both Windows and DOS will attempt to use the same interrupt for the serial ports and a conflict may occur. If problems are encountered running within Windows, exit to DOS to run LABMON.*

If a mouse driver is installed on a serial port used by LABMON, serial data may be prevented from reaching LABMON. The mouse driver should be removed if LABMON does not function properly.

While LABMON can be run from the 3.5-inch diskette, copying the program and associated files to a hard disk and retaining the diskette as a backup is recommended.

The current version of LABMON can be used to operate MicroTracker/MicroTracker LP, NavCore V, and PCMCIA NavCard/NavCard LP receivers. However, some of the keys and commands used to enable certain features of the current hardware configuration may not be supported by these receivers.

To install LABMON for use with DOS:

1. Create a directory on the PC's hard drive and copy all the LABMON disk files to it.
2. Edit your AUTOEXEC.BAT file to include this directory as part of the path.
3. Remove the LABMON disk and save it as a backup.
4. Reboot the PC to update the path.

To install LABMON for use with Windows 3.x:

1. Perform steps 1 through 4 as for DOS installation above.
2. Start Windows, select the Program Manager, and select New under the File menu.
3. Click on the Program Item within the dialog box which appears and click on OK to exit the dialog box.
4. Enter “LABMON” for the Description.
5. Enter “LABMON” for the Command Line.
6. Enter the full path to the LABMON directory or use Browse to set the Working Directory (i.e., C:\LABMON).
7. To select the program icon, click on Change Icon. Then, enter the full path or use Browse to select the LABMON.ICO file located in the LABMON installation directory and click on OK twice to exit the dialog boxes.

Configuring LABMON

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The LABMON.CFG File

Using function keys or certain <Alt>/function key combinations, LABMON can be configured for the message protocol mode (binary or NMEA), the UTC time offset, display datum, display colors, reference position, and filtering parameters. This is the easiest way to change the configuration settings. These parameters can also be changed by editing the LABMON.CFG file. If difficulties are encountered processing the settings, the LABMON.CFG file should be examined to see if extraneous or incorrect information has corrupted it. This file may be deleted since the program will automatically reconstruct it with defaults which can then be modified.

LABMON checks for the presence of the LABMON.CFG file when the program is invoked and reads parameters from the file if it is present. If the LABMON.CFG file is not present, default configuration parameters are used, and a LABMON.CFG file containing the following lines is created in the local directory:

```
DATA TYPE  4
DATUM NUMBER  0
UTC OFFSET  7
COLORS  10  15  0  14  15  10
LAT  33.661446  LON  - 117.861252  ALT - 8.716304
FILTERS  STATMASK  FFFF  FOM  5  QUALITY  1  SATS
  3   PDOP   6.000000   HDOP   6.000000   VDOP
  6.000000
```

Note: *Although the filter parameters are shown on three lines above, they must all appear on the same line in the configuration file.*

DATA TYPE. The setting for the message protocol type should be set to 1 for Rockwell NavCore binary, 2 for NavCore NMEA-0183, 4 for Rockwell Zodiac binary, and 8 for Zodiac NMEA-0183. This is done using the <Alt>-F2 keys.

DATUM NUMBER. The datum number for display of position output is no longer set from within the configuration file when using the Zodiac family of GPS receivers. Instead, use the Ctrl-<F6> keys to enter any of the datum numbers shown in Appendix C.

The Zodiac family supports many datums internally while the NavCore series of receivers supported only WGS-84 with the desired transformation being performed by LABMON. LABMON 4.6 ignores the datum number contained in the LABMON.CFG file when processing Zodiac data. The inclusion of the datum number in the configuration file is for backward compatibility of LABMON with Rockwell NavCore GPS receivers.

When using LABMON 4.6 with one of these earlier receivers, the datum number may either be changed in the configuration file (using an appropriate text editor) or by using the Ctrl<F6> keys to enter any of the datums shown in Appendix C.

UTC OFFSET. The UTC time offset between local time and UTC should be set to UTC minus local time. The time zones in the United States, for example, have positive time offsets. This time is added to the PC time and used as the default for receiver initialization. It is important to verify and correct, if necessary, the PC time for correct initialization when using the defaults provided by LABMON. This is done using the F1 key.

COLORS. Screen colors are changed using the <Alt>-Function key combinations shown on the screen menu.

LAT, LON, ALT. The reference position is changed using the <Alt>-F3 keys. This position is used as the default for receiver initialization and as the reference for display of position in the "Delta" mode. It is important to verify and correct, if necessary, the reference position for correct initialization when using the LABMON provided defaults.

If the current position is unknown, it may be captured once the receiver is navigating using the <Alt>F3 keys and selecting the current position as the reference position.

FILTERS. The data filtering parameters STATMASK, FOM, QUALITY, SATS, PDOP, HDOP, and VDOP should be set to the desired criteria for solution evaluation using the <F> key. The parameters used depend on the message protocol in use. When the criteria are not all met, the FILTER ON indicator is shown on the display screen and if data is being extracted into a text file for post processing, the data is not written to the file. When the criteria are all met, the indicator is not displayed and the data is extracted and written to the file. This allows filtering or screening of outputs that are computed under conditions which do not meet the user's criteria for solution quality.

Note: *The filter does not prevent any data from being written to the log file when in the recording mode.*

The LABMON.INI File

LABMON can also be configured to select the COM ports it uses for serial I/O either by choosing settings from within the program or by editing the initialization file, LABMON.INI, before starting the program. LABMON checks for the presence of this file when it is invoked and reads parameters from the file if it is present. If the LABMON.INI file is not present, default parameters are used for the GPS and RTCM ports, and a LABMON.INI file is created in the local directory. The I/O addresses and interrupts used are shown at the bottom of the screen when LABMON is first started.

The LABMON.INI file contains one line of parameters each for the GPS and for the RTCM ports. These are used to define the port number, interrupt level, baud rate, parity scheme, number of data bits, and stop bits for each. The I/O address used is the default for the port number selected.

The default settings for the Zodiac receiver are COM1, IRQ4, 9600 baud, no parity, 8 data bits, and 1 stop bit (if this version of LABMON is used with earlier Rockwell GPS receivers, these same settings should be used except that parity should be set to “odd”).

The default parameters provided for the RTCM port are COM0 (which disables the port), IRQ3, 9600 baud, no parity, 8 data bits, and 1 stop bit. However, the user should consult the RTCM receiver hardware documentation or contact the provider of the RTCM data to determine the proper settings for the RTCM port.

The easiest way to change the GPS and RTCM port default settings is to start the program and use the <Alt>-F1 keys to check or modify the port settings.

Alternately, the user may edit the LABMON.INI file. If difficulties are encountered setting the ports, the user should examine the LABMON.INI file to see if extraneous or incorrect information has corrupted it (this file may be deleted since the program will automatically reconstruct it).

The LABMON.INI file initially contains the following lines which provide default values for the GPS port and the RTCM port:

```
GPS       COM1  IRQ4  9600   n   8   1
RTCM      COM0  IRQ3  9600   n   8   1
```

The port parameters may be changed using either lower or uppercase letters, separated by spaces. The syntax for the configuration commands is as follows:

```
[Port][COMn][IRQm][Baud][Parity][DataBits][StopBits]
```

where only the following values are currently allowed:

Port	GPS for the GPS port RTCM for the RTCM port
COMn	n = 1, 2, 3, or 4 (to open the port) n = 0 (to ignore the port)
IRQm	m = 3, 4, 5, or 7
Baud	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, or 115200
Parity	n, o, e (None, Odd, or Even)
DataBits	6, 7, or 8
StopBits	1 or 2

The modified settings are saved in the LABMON.INI file.

Using Differential RTCM Data

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Differential RTCM Data and Zodiac GPS Receivers

When using differential corrections with a Zodiac receiver, the data is directly input using the Zodiac's Auxiliary port. The baud rate, parity, and number of data and stop bits required by the source needs to be determined and the source protocol established using Message 1330 (Serial Port Communication Parameters). The source is then connected using either a straight-through cable or a null-modem cable. The required cable type may be different than that recommended by the provider of the specific correction source.

To change the Auxiliary port parameters, the receiver must be using Zodiac binary protocol. The protocol may be changed to Zodiac NMEA after setting port parameters.

Normally, RTCM data is sent directly to the Auxiliary port of the receiver. In the event that RTCM data needs to be recorded for analysis, a cable with three connectors may be used to send data to both the receiver's Auxiliary port and a second PC serial port. The user must then set the parameters for the second port to match the RTCM SC-104 source protocol as described under Configuring LABMON in Section 3 of this document. Consult the corresponding *Development Kit Setup and Operation Guide For The "Jupiter" GPS Receiver* for additional details.

Note: *An indirect DGPS data input capability is available with Zodiac GPS receivers for those applications that are limited to one serial port. Message 1351 is the Zodiac equivalent of the NavCore Message 210. Setup and operation of LABMON using this feature are identical to the NavCore indirect RTCM input method described in the next section.*

Differential RTCM Data and NavCore GPS Receivers

When using differential corrections with NavCore series receivers, the data may be directly input using the receiver's Auxiliary port or indirectly input with a Message 210 (Differential GPS RTCM SC-104 Data Message) using the Host port. The method used depends on the receiver type and the system configuration. The direct input method is recommended since it is the simplest.

When using direct input, the baud rate, parity, and number of data and stop bits required by the source must be established using Message 217 (Port Configuration Message) if in NavCore binary mode or using the ICOM message if in NavCore NMEA-0183 mode. The source is then connected using either a straight-through cable or a null-modem cable. The required cable type may be different than that recommended by the provider of the specific correction source.

When using indirect input of RTCM SC-104 data, the user connects the source to a second serial port on the PC. LABMON checks for the presence of RTCM SC-104 data on the second serial port and processes it when available.

The user needs to set the source protocol used by LABMON as described under Configuring LABMON in Section 3 of this document. LABMON packages RTCM SC-104 data received from the second serial port into a series of 210 messages. When data is input directly to the receiver using the Auxiliary I/O port, the LABMON port settings are not used and do not affect RTCM receiver operation.

Note that LABMON does not send RTCM data using Message 210 until the required number of RTCM words are received. This number can be set by the user with the <Ctrl>-F10 keys (see Section 7). By reducing the number of required RTCM words, the delay between reception of RTCM data by LABMON and the use of that data by the receiver can be minimized.

Starting LABMON

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In addition to the standard monitoring mode, the LABMON software can run in two optional modes which can record the serial data from either or both of the PC serial ports. The first option allows all data to and from the Zodiac Host port to be written to the disk, and the second option records both this data and the RTCM data from the RTCM port. Rockwell binary Host port data and RTCM Auxiliary port data are written as raw binary files. NMEA-0183 Host port data is written as a raw ASCII text file.

LABMON determines its operating mode by detecting the presence of filenames on the command line that is used to invoke it. Start up is the only opportunity where data recording may be selected. When running under DOS, the data filenames are selected on the command line. When running under Windows, either select the LABMON icon or use the Run command from the Program Manager and specify the files on the command line.

The filenames below are examples only; others may be used.

To run LABMON from DOS:

1. Type “LABMON” for the normal mode.
2. Or type “LABMON GPS.DAT” for the message recording mode.
3. Or type “LABMON GPS.DAT RTCM.RTC” for the message and RTCM recording mode.

To run LABMON from Windows 3.x using the DOS Prompt:

1. Select the MS DOS Prompt icon.
2. Enter the appropriate command for the desired LABMON mode as in steps 1 through 3 above.

3. Type EXIT to return to Windows after quitting LABMON.

To run LABMON within Windows 3.x:

1. Double-click the LABMON icon for the normal mode. (The optional modes require that the program item Command Line field be changed to include the GPS and/or RTCM file-names. To do this, select the LABMON icon and choose Properties from the File menu under the Windows Program Manager.)

Note: *To display data, both the GPS message type and serial communication protocol parameters used for LAB-MON must be set to match those used by the receiver. If data is being received but not displayed by the receiver, a buffer overflow will result after a short time and a message will be displayed to indicate this. If the settings of the receiver are unknown and communication cannot be established, the receiver should be reset after enabling ROM defaults using the appropriate configuration switch as described in the corresponding* ***Development Kit Setup And Operation Guide For The "Jupiter" GPS Receiver.***

Stopping LABMON

Avoid using either Ctrl-Break or Ctrl-C to exit LABMON. LABMON replaces certain interrupt handlers that may be required by other programs during its initialization and restores them upon exiting. Therefore, any abnormal termination may affect the execution of another program. If this occurs, the PC may need to be rebooted.

To terminate the execution of LABMON software, press the <Q> key. This will terminate execution and return the user to either the DOS prompt or to Windows.

LABMON Displays

To support the many new features available in the Zodiac family, the screen display and key functions have been revised from earlier versions of LABMON. There is space provided for many new data items on the screen. Some of these items are not shown if LABMON 4.6 is used with NavCore GPS receivers.

There are two types of displays which LABMON uses to output information, the main display and the Built-In Test (BIT) display.

Main Display

Depending on the message protocol type used (binary or NMEA), the data labels shown on the main display change slightly to more accurately reflect the data available from that configuration. The actual label used for the data is described, together with the output message description, in section 7 of this document.

The main display, shown in Figure 1, appears when LABMON is processing Zodiac binary data. There are two portions to this display in LABMON's normal mode: data and menu options. Additional data is displayed behind the menu that may be viewed by pressing <N>, the No Menu key. The data portion is comprised of satellite data and status information from binary or NMEA messages.

In addition to data from the receiver, additional useful information such as the number of data bytes recorded, the number of messages sent or received, the number of checksum errors, and the number of message "no acknowledgements" is also displayed.

BIT Display

The LABMON display for the BIT mode is different depending on whether a Zodiac GPS receiver or a NavCore GPS receiver is used. For Zodiac receivers, the LABMON display for the BIT mode is shown in Figure 2 (refer to Appendix B for the BIT mode display screen for Rockwell NavCore receivers). This display contains information from Message 1100 (Built-In Test Results). Detailed information on the Zodiac BIT message is available in Rockwell's *Zodiac GPS Receiver Family Designer's Guide.*

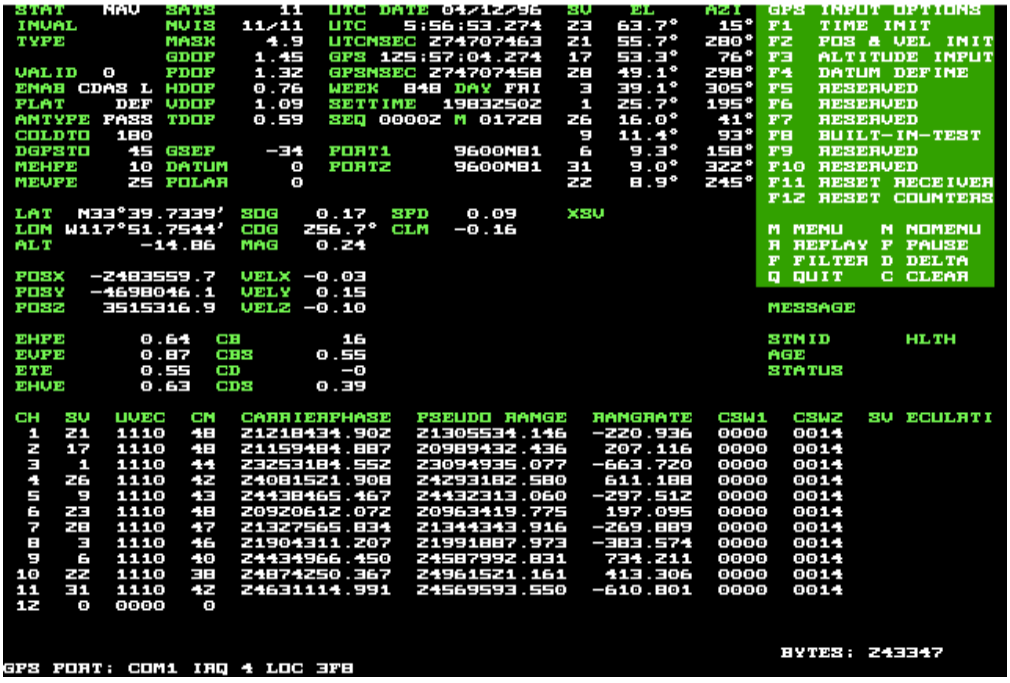

Figure 1. LABMON Main Display

Receiver Output Messages

LABMON decodes and displays most of the available messages. Either Rockwell binary or NMEA messages can be in use at a time. Data from these messages is shown in various fields on the screen. Some of the data from binary messages is converted into more commonly used units of measurement (such as degrees and minutes instead of radians).

Note: *Some of the data contained in messages is not shown on the screen due to space limitations. Data which is omitted is not needed to evaluate receiver performance.*

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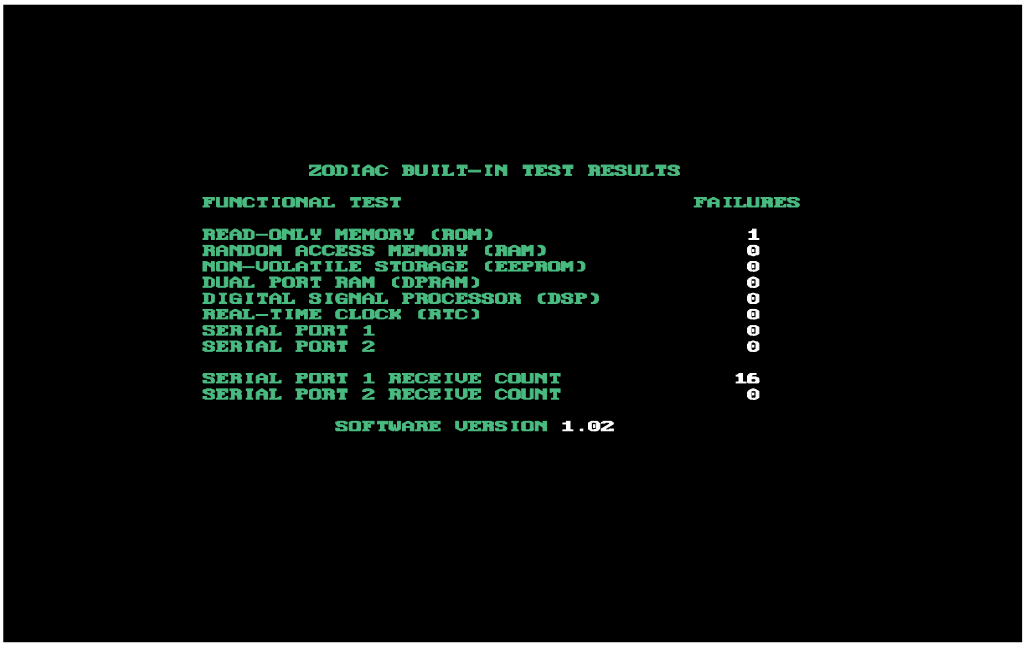

Figure 2. LABMON Built-In-Test Message Display For Zodiac Receivers

Each of the data fields on the LABMON main display screen is listed alphabetically in Table 1 along with a brief description of the data item and the source of the data (i.e., the binary or NMEA messages containing that data item). For more detail on each message used by the receiver, consult the appropriate Designer's Guide for the specific receiver (NavCore, MicroTracker LP, Zodiac, etc.).

Table 1. Output Data Shown On Main Display Screen (1 of 4)

ITEM LABEL	DESCRIPTION	UNITS	SOURCE			
			ZODIAC		NAVCORE	
			BINARY	NMEA	BINARY	NMEA
AGE	Age of last correction	sec	1005	GGA	n/a	GGA
ALT	Height above ellipsoid (Note 1)	m	1000	ALT, GGA	103	ALT, GGA
ANTYPE	Antenna type	n/a	1012	n/a	n/a	n/a
ATO	Acquisition timeout	sec	n/a	n/a	107	n/a
AZI	Visible satellite azimuth	deg	1003	GSV	102	GSV
CARRIERPHASE	Carrier Phase	m	1102	n/a	n/a	n/a
CB	Clock bias	m	1000, 1001	n/a	n/a	n/a
CBS	Clock bias standard deviation	m	1000, 1001	n/a	n/a	n/a
CD	Clock drift	m	1000, 1001	n/a	n/a	n/a
CDS	Clock drift standard deviation	m	1000, 1001	n/a	n/a	n/a
CH	Channel	n/a	1002	ZCH	103, 106 111	n/a
CLM	Climb rate	m/sec	1000	n/a	n/a	n/a
CN	Signal to noise ratio	dBHz	1002	ZCH, GSV	103	GSV
CODE	Tracking state code	n/a	n/a	n/a	111	n/a
COG	Course over ground	deg	1000	RMC	n/a	RMC, VTG
COLDTO	Cold start timeout	sec	1012	n/a	n/a	n/a
COM	Auxiliary port settings	n/a	n/a	n/a	117	n/a
CSW1	Channel Status Word 1	n/a	1102	n/a	n/a	n/a
CSW2	Channel Status Word 2	n/a	1102	n/a	n/a	n/a
DATUM	Datum in use	n/a	1012	n/a	n/a	n/a
DAY	UTC day	n/a	1000, 1001	n/a	103	ZDA
DGPSTO	DGPS correction timeout	sec	1012	n/a	n/a	n/a
ECULRTI	DGPS status bits	n/a	1005	n/a	n/a	n/a

Table 1. Output Data Shown On Main Display Screen (2 of 4)

ITEM LABEL	DESCRIPTION	UNITS	SOURCE			
			ZODIAC		NAVCORE	
			BINARY	NMEA	BINARY	NMEA
ECULRTSI	DGPS status bits	n/a	n/a	n/a	106	DGP
EHPE	Expected horizontal position error	m	1000, 1001	n/a	106	n/a
EHVE	Expected horizontal velocity error	m/sec	1000, 1001	n/a	n/a	n/a
EL	Visible satellite elevation	deg	1003	GSV	102	GSV
ENAB	Receiver enable option bits	n/a	1012	n/a	103, 106 107, 111	DGP
ERPFLBC	Data validity/track state bits	n/a	n/a	n/a	111	n/a
ETE	Expected time error	m	1000, 1001	n/a	n/a	n/a
EVPE	Expected vertical position error	m	1000, 1001	n/a	106	n/a
FIX	Fix mode	n/a	n/a	GSA	n/a	GSA
FOM	Figure of merit	n/a	n/a	n/a	103	n/a
GDOP	Geometric Dilution of Precision	n/a	1003	n/a	103	n/a
GPS	GPS seconds into week	sec	1000, 1001	n/a	102, 103, 104	n/a
GSEP	Geoidal separation	m	1000	ALT, GGA	n/a	ALT, GGA
GSPNSEC	GPS nanoseconds from epoch	nsec	1000, 1001	n/a	n/a	n/a
HDOP	Horizontal Dilution of Precision	n/a	1003	GGA, GSA	103	GGA, GSA
HLTH	DGPS station health	n/a	1005	n/a	106	DGP
INVAL	Solution invalidity bits	n/a	1000, 1001	n/a	n/a	n/a
LAT	Latitude (Note 1)	deg	1000	GGA, GLL RMC	103	GGA, GLL RMC
LON	Longitude (Note 1)	deg	1000	GGA GLL RMC	103	GGA, GLL RMC
LPTO	Low power acquisition timeout	sec	n/a	n/a	107	n/a
M	Measurement sequence number	n/a	1000, 1001, 1002	n/a	n/a	n/a
MAG	Magnetic variation	deg	1000	RMC	n/a	RMC
MASK	Antenna elevation mask angle	deg	1012	n/a	n/a	n/a

Table 1. Output Data Shown On Main Display Screen (3 of 4)

ITEM LABEL	DESCRIPTION	UNITS	SOURCE			
			ZODIAC		NAVCORE	
			BINARY	NMEA	BINARY	NMEA
MEHPE	Minimum expected horizontal position error	m	1012	n/a	n/a	n/a
MESSAGE	Message sent/or acknowledged	n/a	n/a	n/a	n/a	n/a
MEVPE	Minimum expected vertical position error	m	1012	n/a	n/a	n/a
NVIS	Number of visible satellites	n/a	1003	GSV	102	GSV
PDOP	Position Dilution of Precision	n/a	n/a	n/a	n/a	n/a
PLAT	Platform type	n/a	1012	n/a	n/a	n/a
PMGMT	Power management status	n/a	n/a	n/a	107	n/a
POLAR	Polar navigation flag	n/a	1000	n/a	n/a	n/a
PORT1	Host port settings	n/a	1130	n/a	n/a	n/a
PORT2	Auxiliary port settings	n/a	1130	n/a	n/a	n/a
POSX	ECEF position X	m	1001	n/a	103	n/a
POSY	ECEF position Y	m	1001	n/a	103	n/a
POSZ	ECEF position Z	m	1001	n/a	103	n/a
PSEUDO RANGE	Pseudorange	m	1102	n/a	111	n/a
QUAL	GPS quality indicator	n/a	n/a	GGA	n/a	GGA
RANGERATE	Pseudorange rate	m/sec	1102	n/a	111	n/a
RATE	Solution update rate	sec	n/a	n/a	107	n/a
SATS	Satellite used in solution	n/a	1000, 1001	GSV	103	GSV
SEQ	Sequence number	n/a	all	n/a	n/a	n/a
SETTIME	Receiver set time	ticks	all	n/a	102, 103, 104, 107, 111	n/a
SOG	Speed over ground	knots	n/a	RMC	n/a	RMC, VTG

Table 1. Output Data Shown On Main Display Screen (4 of 4)

ITEM LABEL	DESCRIPTION	UNITS	SOURCE			
			ZODIAC		NAVCORE	
			BINARY	NMEA	BINARY	NMEA
SPD	Speed	m/sec	1000	n/a	n/a	n/a
STAT	Navigation status	n/a	1000, 1001	GSA	103	GSA
STATUS	DGPS status	n/a	1005	n/a	103, 106	n/a
STNID	DGPS station ID	n/a	1005	GGA	106	GGA, DGP
SV	Satellite vehicle PRN	n/a	1002, 1003, 1005	GSA, GSV, ZCH	102, 103, 111	GSA, GSV
TDOP	Time Dilution of Precision	n/a	1003	n/a	103	n/a
TRK	Channel tracking status	n/a	n/a	n/a	103	n/a
TYPE	Solution type bits	n/a	1000, 1001	GGA, GSA	n/a	GGA, GSA
UTC	UTC seconds	sec	1000, 1001	GGA, GLL, RMC	n/a	GGA, GLL, RMC, ZDA
UTC DATE	UTC date	n/a	1000, 1001	n/a	103	ZDA
UTCNSEC	UTC nanoseconds from epoch	nsec	1000, 1001	n/a	n/a	n/a
UVEC	Channel tracking status bits	n/a	1002	ZCH	n/a	n/a
VALID	Solution validity bits	n/a	1012	n/a	n/a	n/a
VDOP	Vertical Dilution of Precision	n/a	1003	GSA	103	GSA
VELE	Velocity - East	m/sec	n/a	n/a	103	n/a
VELN	Velocity - North	m/sec	n/a	n/a	103	n/a
VELU	Velocity - Up	m/sec	n/a	n/a	103	n/a
VELX	ECEF Velocity X	m/sec	1001	n/a	n/a	n/a
VELY	ECEF Velocity Y	m/sec	1001	n/a	n/a	n/a
VELZ	ECEF Velocity Z	m/sec	1001	n/a	n/a	n/a
WEEK	GPS week number	weeks	1000, 1001 1002	n/a	102, 103, 104, 111	n/a
XSV	Excluded candidate SV	n/a	1012	n/a	n/a	n/a
ZCOUNT	DGPS modified zcount	counts	n/a	n/a	106	DGP

Note 1: When operating LABMON in the delta position mode, the LAT, LON, and ALT fields display the difference between the current and reference positions in meters.

Receiver Input Messages

LABMON makes extensive use of the keyboard function keys to control program and receiver operation. Most of the keys result in a message being sent to the receiver. The message sent depends on the message protocol in use. When a key is pressed, there is often a prompt or series of prompts which are used to obtain the required data. These prompts may differ in content or number based on the message protocol in use. Only those which are applicable to the current message protocol are shown. In most cases, default values, units, or allowable ranges are supplied.

Each of the function keys, singly or in combination with the <Shift>, <Ctrl>, or <Alt> keys, that are used to control program operation are listed in Table 2 along with their respective functionality and, where applicable, the binary and/or NMEA message that is sent.

Table 2. Input Data Provided By Keyboard Keys (1 of 3)

KEY	FUNCTION	MESSAGE SENT			
		ZODIAC		NAVCORE	
		BINARY	NMEA	BINARY	NMEA
Menu: GPS INPUT OPTIONS					
F1	Time initialization	1200	INIT	201	INIT
F2	Position and velocity initialization	1200	INIT	201	INIT
F3	Altitude input	1219	INIT	201	INIT
F4	Datum definition	1210	n/a	n/a	n/a
F5	Reserved	n/a	n/a	n/a	n/a
F6	Reserved	n/a	n/a	n/a	n/a
F7	Reserved	n/a	n/a	n/a	n/a
F8	Built-In-Test	1300	IBIT	101	n/a
F9	Reserved	n/a	n/a	n/a	n/a
F10	Reserved	n/a	n/a	n/a	n/a
F11	Reset Receiver	1303	INIT	201	INIT
F12	Reset counters	n/a	n/a	n/a	n/a
Menu: GPS I/O OPTIONS					
<Shift>F1	GPS I/O port settings	1330	n/a	217	ICOM
<Shift>F2	GPS message protocol type	1331	IPRO	n/a	n/a
<Shift>F3	Message log control (Note 1)	log	ILOG	213	LOG
<Shift>F4	Message query (Note 1)	query	Q	213	Q
<Shift>F5	NMEA generic message (Note 2)	n/a	n/a	n/a	n/a
<Shift>F6	NMEA typical message request (Note 3)	n/a	n/a	n/a	LOG
<Shift>F7	Reserved	n/a	n/a	n/a	n/a
<Shift>F8	Store almanac data	n/a	n/a	206	n/a

Table 2. Input Data Provided By Keyboard Keys (2 of 3)

KEY	FUNCTION	MESSAGE SENT			
		ZODIAC		NAVCORE	
		BINARY	NMEA	BINARY	NMEA
Menu: GPS I/O OPTIONS (continued)					
<Shift>F9	Request pseudoranges (Note 1)	log	n/a	213	n/a
<Shift>F10	Request ephemeris data	n/a	n/a	213	n/a
<Shift>F11	Request iono and UTC data	n/a	n/a	213	n/a
<Shift>F12	Load almanac data	n/a	n/a	213	n/a
Menu: SOLUTION CONTROL					
<Ctrl>F1	Navigation validity criteria	1217	n/a	201	n/a
<Ctrl>F2	Platform type	1220	n/a	n/a	n/a
<Ctrl>F3	Navigation configuration	1221	n/a	n/a	n/a
<Ctrl>F4	Reserved	n/a	n/a	n/a	n/a
<Ctrl>F5	Cold start	1216	INIT	n/a	INIT
<Ctrl>F6	Datum select	1211	n/a	n/a	n/a
<Ctrl>F7	Antenna type	1218	n/a	n/a	n/a
<Ctrl>F8	Antenna elevation mask	1212	n/a	208	n/a
<Ctrl>F9	SV selection	1213	n/a	208	n/a
<Ctrl>F10	DGPS control	1214	n/a	209	IDGP
<Ctrl>F11	Power management	n/a	n/a	211	n/a
Menu: LABMON CONFIGURATION OPTIONS					
<Alt>F1	LABMON I/O port settings	n/a	n/a	n/a	n/a
<Alt>F2	LABMON message protocol type	n/a	n/a	n/a	n/a
<Alt>F3	Reference position	n/a	n/a	n/a	n/a
<Alt>F4	Main display background color	n/a	n/a	n/a	n/a

Table 2. Input Data Provided By Keyboard Keys (3 of 3)

KEY	FUNCTION	MESSAGE SENT			
		ZODIAC		NAVCORE	
		BINARY	NMEA	BINARY	NMEA
Menu: LABMON CONFIGURATION OPTIONS (continued)					
<Alt>F5	Main display text color	n/a	n/a	n/a	n/a
<Alt>F6	Main display data color	n/a	n/a	n/a	n/a
<Alt>F7	Menu background color	n/a	n/a	n/a	n/a
<Alt>F8	Menu key color	n/a	n/a	n/a	n/a
<Alt>F9	Menu description color	n/a	n/a	n/a	n/a

Note 1: The Zodiac binary "log" and "query" messages inherit the numeric identifier of the message being requested.

Note 2: The <Shift>F5 keys are used to transmit a NMEA message entered by the user.

Note 3: The <Shift>F6 keys are used to send a series of log messages requesting a pre-defined set of output messages which can be used for receiver evaluation.

LABMON's Menu Keys

Many of the key functions from earlier versions of LABMON have been renamed or grouped together with related functions under a single menu or key. For example, the Cold Start Enable function is now under the Cold Start key of the Solution Control menu.

The LABMON software uses several keyboard keys and the keyboard's function keys, alone or together with the <Shift>, <Ctrl>, and <Alt> keys. The functions provided by these keys allow the user to control, and communicate with, the GPS receiver. Each key and key combination is listed below and described on the following pages.

While all of the following key functions are supported in the Rockwell binary mode, all of them are not supported in the NMEA data mode. An error message is displayed if a key is pressed that is not supported by the current data mode.

Keyboard Keys

M:	Menu Change
N:	No Menu
R:	Replay
P:	Pause
F:	Filter
D:	Delta
X:	Extract Data
+, -:	Speed of Replay
< >:	Single Step in Replay
Q:	Quit
C:	Clear Screen
<Esc>:	Exit prompt without changes

Function Keys

F1:	Time Initialization
F2:	Position and Velocity Initialization
F3:	Altitude Input
F4:	Datum Definition
F5:	Reserved
F6:	Reserved
F7:	Reserved
F8:	Built-In-Test
F9:	Reserved
F10:	Reserved
F11:	Reset Receiver
F12:	Reset Counters

Shift + Function Keys

Shift + F1:	GPS I/O Port Settings
Shift + F2:	GPS Message Protocol Type
Shift + F3:	Message Log Control
Shift + F4:	Message Query
Shift + F5:	NMEA Generic Message
Shift + F6:	NMEA Typical Message Request
Shift + F7:	Reserved
Shift + F8:	Store Almanac Data
Shift + F9:	Request Pseudoranges
Shift + F10:	Request Ephemeris Data
Shift + F11:	Request Iono and UTC Data
Shift + F12:	Load Almanac Data

Ctrl + Function Keys

Ctrl + F1:	Navigation Validity Criteria
Ctrl + F2:	Platform Type
Ctrl + F3:	Navigation Configuration
Ctrl + F4:	Reserved
Ctrl + F5:	Cold Start
Ctrl + F6:	Datum Select
Ctrl + F7:	Antenna Type
Ctrl + F8:	Antenna Elevation Mask
Ctrl + F9:	SV Selection
Ctrl + F10:	DGPS Control
Ctrl + F11:	Power Management

Alt + Function Keys

Alt + F1:	LABMON I/O Port Settings
Alt + F2:	LABMON Message Protocol Type
Alt + F3:	Reference Position
Alt + F4:	Main Display Background Color
Alt + F5:	Main Display Text Color
Alt + F6:	Main Display Data Color
Alt + F7:	Menu Background Color
Alt + F8:	Menu Key Color
Alt + F9:	Menu Description Color

Menu Change (M)

Press the "M" key to cycle through the Function, <Shift>+Function, <Ctrl>+Function, and <Alt>+Function key menus.

No Menu (N)

Press the "N" key to toggle the display of the menu option portion of the main display screen on or off. This allows data normally hidden behind the menu options to be viewed.

Replay (R)

Press the "R" key to replay a log file.

Pause (P)

Press the "P" key to pause the receiver output data displayed on the screen. Press the "P" key again to resume data updates. The screen may also be paused by pressing the spacebar.

Filter (F)

Press the "F" key to set the parameters used to "filter," or screen, data (refer to Configuring LABMON, Section 3 of this document).

Delta (D)

Press the "D" key to toggle LABMON between the normal and delta position modes.

Extract Data (X)

Press the "X" key after starting to replay a log file (using the "R" key) to extract data from the file to a selected tab delimited file for plotting purposes.

Speed of Replay (+, -)

Press the "+" or "-" keys to increase or decrease the rate at which messages are processed during the replay of log files.

Single Step in Replay (<, >)

Press the "<" or ">" keys to step a single message backward or forward during replay of log files.

Quit (Q)

Press the Q key to exit LABMON.

Clear Screen (C)

Press the "C" key to clear the LABMON screen outputs until they are refreshed at their normal time.

Exit Prompt Without Changes (Esc)

Press the <Esc> key to exit a prompt without sending the command.

Time Initialization (F1)

Press the F1 key to send the estimated user time and date. The time must be entered in 24-hour format and referenced to UTC or Greenwich Mean Time (GMT) rather than local time. The time input should be accurate to within an hour to acquire the first satellite when Cold Start is disabled. If Cold Start is enabled, the time and position do not need to be initialized.

Position and Velocity Initialization (F2)

Press the F2 key to send latitude, longitude, speed, heading, and height to be used as the estimated user state. The latitude and longitude data must be referenced to the datum selected and entered in decimal degrees rather than degrees:minutes:seconds. South latitude and

west longitude must be entered as negative numbers. The height is the altitude in meters above the datum ellipsoid. The WGS-84 datum is assumed if no datum is selected.

Set Altitude (F3)

Press the F3 key to send a value to be used as the estimated user altitude. Unless the force option is used, this value is only used while in 2-D navigation or acquisition modes.

Datum Definition (F4)

Press the F4 key to send datum definition parameters to be used.

Built-In Test Command (F8)

Press the F8 key to send a Built-In-Test (BIT) command. Navigation and tracking of satellites is interrupted during this test. When the BIT ends, the receiver is reset.

Reset Receiver (F11)

Press the F11 key to send a reset command. This will reset certain receiver parameters. The message counters are reset at this time also.

Reset Counters (F12)

Press the F12 key to reset the message and error counters.

GPS I/O Port Settings (Shift-F1)

Press the <Shift>F1 keys to send the receiver serial port settings for the baud rate, parity, number of data bits, and number of stop bits to be used by the receiver.

GPS Message Protocol Type (Shift-F2)

Press the <Shift>F2 keys to select the message protocol type used by the receiver.

Message Log Control (Shift-F3)

Press the <Shift>-F3 keys to send a log control message to request messages on a periodic basis or upon update. When using Zodiac binary protocol, the message timing may need to be modified to obtain message output.

***Note**: The special values of "???" when using NMEA protocol or "65535" when using Zodiac binary protocol disable all messages. After this, no messages are output by the receiver unless a query message is sent, the receiver is reset, or messages are turned back on using the log control message. To get typical data needed for performance evaluation using NMEA protocol, press the <Shift>-F6 keys after a reset or after messages have been turned off.*

Message Query (Shift-F4)

Press the <Shift>-F4 keys to send a query message to request a one-time output of a message from the Zodiac receiver.

NMEA Generic Message (Shift-F5)

Press the <Shift>-F5 keys to enter the ASCII text for a non-supported generic NMEA message to send to the receiver. The entire message should be entered following the $ prompt; use null fields as required. The checksum will be computed and appended by LABMON before the message is transmitted.

NMEA Typical Message Request (Shift-F6)

Press the <Shift>-F6 keys to send a series of NMEA log messages to enable the receiver to output a set of messages containing the typical data needed for performance evaluation.

Key Function Not Implemented (Shift-F7)	Reserved
Store Almanac Data (Shift-F8)	Press the <Shift>F8 keys to request raw almanac data. LABMON receives the data and stores it in the file ALMANAC.GPS.
Request Pseudoranges (Shift-F9)	Press the <Shift>-F9 keys to request the output of pseudoranges.
Request Ephemeris Data (Shift-F10)	Press the <Shift>-F10 keys to request output of all available ephemeris data or new ephemeris data when available.
Request Iono and UTC Data (Shift-F11)	Press the <Shift>-F11 keys to request output of current ionospheric and UTC time data or new ionospheric and UTC time data when available.
Load Almanac Data (Shift-F12)	Press the <Shift>F12 keys to upload raw almanac data from a selected binary almanac file to the receiver.
Navigation Validity Criteria (Ctrl-F1)	Press the <Ctrl>F1 keys to send navigation solution validity parameters (2-D navigation allowed, DGPS required, number of satellites used, and expected position errors).
Platform Type (Ctrl-F2)	Press the <Ctrl>F2 keys to select the type of application platform to be used.

Navigation Configuration (Ctrl-F3)

Press the <Ctrl>F3 keys to send navigation configuration parameters (held altitude, ground track smoothing, position pinning, measurement filtering)

Cold Start (Ctrl-F5)

Press the <Ctrl>F5 keys to send a Cold Start mode command. When Cold Start is enabled, the receiver will only enter the Cold Start mode after failing to acquire satellites which should be visible based on the current receiver position and time. Once in Cold Start mode, the receiver will automatically search the entire sky for satellites.

Datum Select (Ctrl-F6)

Press the <Ctrl>F6 keys to send a datum number to the Zodiac receiver or to set the datum used by LABMON to transform NavCore receiver outputs. Out of range numbers default to zero which corresponds to WGS-84. Refer to Appendixes C and D for datum names and numbers.

Antenna Type (Ctrl-F7)

Press the <Ctrl>F7 keys to send the receiver the antenna type in use, either passive or active.

***Note**: This command is used by the receiver to set signal processing parameters only. Setting the Development Kit configuration for different antenna types is done as described in the corresponding GPS receiver setup and operation manual.*

Antenna Elevation Mask (Ctrl-F8)

Press the <Ctrl>F8 keys to send the elevation mask angle to be used. Angles below the horizon must be entered as negative numbers. The default value for the Zodiac receiver is +10 degrees.

SV Selection (Ctrl-F9)

Press the <Ctrl>-F9 keys to send satellite selection commands to enable or disable the use of selected satellites by the receiver. Enter a satellite's SV number to toggle between enabled and disabled. Enter zero to enable all satellites. Disabled satellites are displayed after **XSV** beneath the satellite visiblity list on the main display.

DGPS Control (Ctrl-F10)

Press the <Ctrl>-F10 keys to send a Differential GPS Control command.

Power Management (Ctrl-F11)

Press the <Ctrl>-F11 keys to send power management parameters to be used for power conservation. Valid NavCore update rates must be from one to five seconds.

LABMON I/O Port Settings (Alt-F1)

Press the <Alt>-F1 keys to change the parameters associated with the PC serial ports. These include the PC COM port number, the PC IRQ interrupt number, baud rate, parity, number of data bits, and number of stop bits (refer to the *Configuring LABMON* section of this document for additional information about these settings). After these values have all been entered, LABMON displays the selected COM port, the PC interrupt number, and the port address at the bottom of the screen.

LABMON Message Protocol Type (Alt-F2)

Press the <Alt>F2 keys to set the LABMON message processing protocol to Zodiac binary, Zodiac NMEA, NavCore binary, or NavCore NMEA.

Reference Position (Alt-F3)

Press the <Alt>F3 keys to set the reference position as a default for the position initialization function (using the F2 key) and as a reference for computing delta position in the receiver's delta mode.

Main Display Background Color (Alt-F4)

Press the <Alt>F4 keys to change the background color of the data portion of the main display screen.

Main Display Text Color (Alt-F5)

Press the <Alt>F5 keys to change the color of the field titles in the data portion of the main display screen.

Main Display Data Color (Alt-F6)

Press the <Alt>F6 keys to change the color of the data shown in the data portion of the main display screen.

Menu Background Color (Alt-F7)

Press the <Alt>F7 keys to change the background color of the menu options portion of the main display screen.

Menu Function Key Color (Alt-F8)

Press the <Alt>-F8 keys to change the color of the function key designations in the menu options portion of the main display screen.

Menu Description Color (Alt-F9)

Press the <Alt>-F9 keys to change the color of the function key descriptions in the menu options portion of the main display screen.

Receiver Evaluation Using LABMON

There are a number of powerful features in LABMON that are useful for evaluating receiver performance. The features are described below along with other useful information related to receiver configuration and operation.

Message Set

The Zodiac Family and NavCore Series receivers have a very extensive message set which can provide a great deal of information from the receiver. When operating the receiver for evaluation purposes, it is likely that the user will require a different message set than the default set. The default set is chosen to provide typically needed data for use in the OEM product, without extra data needed for detailed evaluation or analysis.

Requesting too much data from the receiver on a periodic basis may result in processing problems by an OEM processor or the receiver. If too many output messages are created, a data checksum error may occur on a receiver output message during receipt of a new input message. This is an indication that a large number of periodic messages are being output.

Baud Rates

The user must ensure that the baud rates chosen will support the number and size of the messages requested. It is possible to request enough messages to prevent the receiver from keeping up at rates lower than 9600 for example. In this case, some of the messages cannot be output until the number is decreased or the baud rate is increased.

Message Logging

The user should turn off unneeded messages which occur at a high periodic rate if others are to be turned on. The default Zodiac message output timing prompt in LABMON is Time, but the Update option for data output should be used where appropriate. The NavCore Series supports message output based on time only.

To obtain a one time output of a message, use a query message. This avoids loading down the receiver with periodic output of fixed data. To obtain message output only when the data has changed or new data is available, use a log message with the Update output option. This will result in a message output upon change of the data only. To obtain periodic output use a log message with the Time output option. To turn off all messages in NMEA mode, use a log message with '???' as the message identifier. To turn off all messages in Zodiac binary mode, use a log message with '65535', which corresponds to FFFF Hex, as the message identifier.

For Zodiac receiver evaluation, the following changes to the default message configuration are recommended:

- Turn on message 1012 for output on update.
- Turn on message 1102 for output at a rate of once per second.
- Message 1005 should also be turned on for output at a rate of once per second for DGPS evaluation. For NavCore receiver evaluation, the 106 message should be turned on for output at a rate of once per second for DGPS evaluation.

Use the message counters to monitor the number and rate at which messages are output from the receiver and to keep track of which input messages have been sent. It is often useful to reset these after changing the output messages to verify the desired configuration has been achieved. If the list of messages sent or received grows long enough to begin blocking other data, the message counters should also be reset.

Screen Clearing

Clearing the screen after the output message configuration has changed is recommended to clear data which will become stale if it is no longer being updated. This also makes it easy to see if data which is no longer requested has been turned off.

Data Logging

In order to review data carefully, it should be logged and then replayed using LABMON. During replay, the user can single step through messages forward and backward to examine events or time periods of interest.

Data Reduction

The Extract function can be used to extract data from a log file, decode it if necessary, and write it into a tab-delimited file for plotting or data reduction using spreadsheet programs.

The Filter parameters are used to control which data points are written to the file. Using different settings for these and plotting the resultant ground tracks may help the user determine what criteria should be used in the OEM application to obtain the best performance in their operating environment. The Filter parameters are also used during normal receiver monitoring to indicate at a glance whether the navigation solution is meeting the current Filter criteria.

DGPS Operation

Whenever DGPS operation is being evaluated, it is recommended that the LABMON logging function be used and that RTCM SC-104 data be gathered so that its format and integrity may be verified with the RTCMCHK utility program provided on the LABMON software disk. Some DGPS reference station equipment may be configured in such a way as to output data which is non-compliant with the RTCM standard. Rockwell GPS receivers are designed to be tolerant of these format errors where possible, but in some circumstances, intermittent loss of DGPS operation may result. There may also be exces-

sive latency or problems in the data links which can be observed and corrected by examination of this raw input data to the receiver.

Delta Position

LABMON's delta position mode is useful to monitor changes in position relative to selected reference positions. The reference position and the PC time, along with the time zone offset, are used as default prompts for receiver initialization.

Appendix A: Acronym and Abbreviation List

The following acronyms and abbreviations, together with their meanings, are used in this document.

2-D	Two-dimensional
3-D	Three-dimensional
ASCII	American Standard Code for Information Interchange
ATO	Acquisition Time-Out
BIT	Built-In Test
C/N_o	Channel Signal-To-Noise
COG	Course Over Ground
dB	Decibel
DB-9	9-Pin D-Subminiature Connector
DB-25	25-Pin D-Subminiature Connector
DGPS	Differential Global Positioning System
DoD	Department of Defense
DOS	Disk Operating System
ESD	Electrostatic Discharge
FOM	Figure Of Merit
GDOP	Geometric Dilution of Precision
GMT	Greenwich Mean Time
GPS	Global Positioning System
HDOP	Horizontal Dilution of Precision
Hz	Hertz
I/O	Input/Output
LED	Light Emitting Diode
MSL	Mean Sea Level
NMEA	National Marine Electronics Association
OEM	Original Equipment Manufacturer
PC	Personal Computer
PCMCIA	Personal Computer Memory Card International Association
PDOP	Position Dilution of Precision
PPS	Pulse Per Second
PRN	Pseudo-Random Noise Number
PRR	Pseudo-Range Rate

Appendix A (continued)

RTC	Real-Time Clock
RTCM	Radio Technical Commission for Maritime Services
SNR	Signal-To-Noise Ratio
SOG	Speed Over Ground
SRAM	Static Random Access Memory
SV	Satellite Vehicle
TDOP	Time Dilution Of Precision
TOW	Time Of Week
TTFF	Time-To-First-Fix
TTL	Transistor-Transistor Logic
UTC	Universal Time Coordinated
VDOP	Vertical Dilution Of Precision

Appendix B: NavCore Built-In Test Display

The BIT mode display screen for Rockwell NavCore receivers is different from the Zodiac receivers. The BIT display for Zodiac receivers is shown in Figure 2 (Section 7 of this document). The BIT display for Rockwell NavCore receivers is shown below. In this display mode, information from Message 101, Built-In Test Results, is shown.

Detailed information on the NavCore series BIT message is available in the Designer's Guide corresponding to the specific NavCore series GPS receiver (NavCore, MicroTracker LP, NavCard LP, etc.).

```
                              B.I.T. RESULTS

SUMMARY:   SYSTEM     ROM     LOW RAM     HIGH RAM     SPI     RAM ADDRESS
            PASS     PASS       PASS        PASS      PASS        PASS

LOW RAM =  PASS     HIGH RAM =  PASS     PRE_PROCESSOR RAM =  PASS

      PP SELF    PP WRAP    CODE VCO    CAR VCO    CODE GEN    SIG PROC
CH1    PASS       PASS       PASS        PASS       PASS        PASS
CH2    PASS       PASS       PASS        PASS       PASS        PASS
CH3    PASS       PASS       PASS        PASS       PASS        PASS
CH4    PASS       PASS       PASS        PASS       PASS        PASS
CH5    PASS       PASS       PASS        PASS       PASS        PASS

INTERRUPT CONTROL: PASS   LOW POWER TIME SOURCE: PASS   OPTIONS REGISTER: PASS

SERIAL I/O:       TRANS ERRORS =   0     CHECKSUM ERRORS =   0
EEPROM:       PROGRAMS ERRORS =   0     CHECKSUM ERRORS =   0

LINK ID:   DGPS WITH SV MEASUREMENTS WITH POWER MANAGEMENT
SOFTWARE VERSION:  3.61


                          PRESS ANY KEY TO CONTINUE
```

LABMON Built-In-Test Message Display For NavCore and MicroTracker GPS Receivers

Appendix C: LABMON Datums For Zodiac Receivers

0 WGS 84 - Default
1 Adindan - MEAN FOR Ethiopia, Sudan
2 Adindan - Burkina Faso
3 Adindan - Cameroon
4 Adindan - Ethiopia
5 Adindan - Mali
6 Adindan - Senegal
7 Adindan - Sudan
8 Afgooye - Somalia
9 Ain el Abd 1970 - Bahrain
10 Ain el Abd 1970 - Saudi Arabia
11 Anna 1 Astro 1965 - Cocos Islands
12 Antigua Island Astro 1943 Antigua (Leeward Islands)
13 Arc 1950 MEAN FOR Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, Zimbabwe
14 Arc 1950 - Botswana
15 Arc 1950 - Burundi
16 Arc 1950 - Lesotho
17 Arc 1950 - Malawi
18 Arc 1950 - Swaziland
19 Arc 1950 - Zaire
20 Arc 1950 - Zambia
21 Arc 1950 - Zimbabwe
22 Arc 1960 - MEAN FOR Kenya, Tanzania
23 Ascension Island 1958 Ascension Island
24 Astro Beacon E 1945 - Iwo Jima
25 Astro DOS 71/4 - St Helena Island
26 Astro Tern Island (FRIG) 1961 Tern Island
27 Astronomical Station 1952 Marcus Island
28 Australian Geodetic 1966 Australia & Tasmania
29 Australian Geodetic 1984 Australia & Tasmania
30 Ayabelle Lighthouse - Djibouti
31 Bellevue (IGN) Efate & Erromango Islands
32 Bermuda 1957 - Bermuda
33 Bissau - Guinea-Bissau
34 Bogota Observatory - Colombia
35 Bukit Rimpah Indonesia (Bangka & Belitung Islands)
36 Camp Area Astro Antarctica (McMurdo Camp Area)
37 Campo Inchauspe - Argentina
38 Canton Astro 1966 - Phoenix Islands
39 Cape - South Africa
40 Cape Canaveral - Bahamas, Florida
41 Carthage - Tunisia
42 Chatham Island Astro 1971 New Zealand (Chatham Island)
43 Chua Astro - Paraguay
44 Corrego Alegre - Brazil
45 Dabola - Guinea
46 Djakarta (Batavia) Indonesia (Sumatra)
47 DOS 1968 New Georgia Islands (Gizo Island)
48 Easter Island 1967 - Easter Island
49 European 1950 MEAN FOR Austria, Belgium, Denmark, Finland, France, West Germany, Gibralter, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland
50 European 1950 MEAN FOR Austria, Denmark, France, West Germany, Netherlands, Switzerland
51 European 1950 MEAN FOR Iraq, Israel, Jordan, Lebanon, Kuwait, Saudi Arabia, Syria
52 European 1950 - Cyprus
53 European 1950 - Egypt
54 European 1950 England, Channel Islands, Ireland, Scotland, Shetland Islands
55 European 1950 - Finland, Norway
56 European 1950 - Greece
57 European 1950 - Iran
58 European 1950 - Italy (Sardinia)
59 European 1950 - Italy (Sicily)
60 European 1950 - Malta
61 European 1950 - Portugal, Spain
62 European 1979 MEAN FOR Austria, Finland, Netherlands, Norway, Spain, Sweden, Switzerland
63 Fort Thomas 1955 Nevis, St. Kitts (Leeward Islands)

C

64 Gan 1970 - Republic of Maldives
65 Geodetic Datum 1949 - New Zealand
66 Graciosa Base SW 1948 Azores (Faial, Graciosa, Pico, Sao Jorge, Terceira)
67 Guam 1963 - Guam
68 Gunung Segara - Indonesia (Kalimantan)
69 GUX 1 Astro - Guadalcanal Island
70 Herat North - Afghanistan
71 Hjorsey 1955 - Iceland
72 Hong Kong 1963 - Hong Kong
73 Hu-Tzu-Shan - Taiwan
74 Indian - Bangladesh
75 Indian - India, Nepal
76 Indian 1954 - Thailand, Vietnam
77 Indian 1975 - Thailand
78 Ireland 1965 - Ireland
79 ISTS 061 Astro 1968 South Georgia Islands
80 ISTS 073 Astro 1969 - Diego Garcia
81 Johnston Island 1961 - Johnston Island
82 Kandawala - Sri Lanka
83 Kerguelen Island 1949 Kerguelen Island
84 Kertau 1948 - West Malaysia & Singapore
85 Kusaie Astro 1951 - Caroline Islands
86 L. C. 5 Astro 1961 - Cayman Brac Island
87 Leigon - Ghana
88 Liberia 1964 - Liberia
89 Luzon Philippines (Excluding Mindanao)
90 Luzon - Philippines (Mindanao)
91 Mahe 1971 - Mahe Island
92 Massawa - Ethiopia (Eritrea)
93 Merchich - Morocco
94 Midway Astro 1961 - Midway Islands
95 Minna - Cameroon
96 Minna - Nigeria
97 Montserrat Island Astro 1958 Montserrat (Leeward Islands)
98 M'Poraloko - Gabon
99 Nahrwan - Oman (Masirah Island)
100 Nahrwan - Saudi Arabia
101 Nahrwan - United Arab Emirates
102 Naparima BWI - Trinidad & Tobago
103 North American 1927 MEAN FOR Antigua, Barbados, Barbuda, Caicos Islands, Cuba, Dominican Republic, Grand Cayman, Jamaica, Turks Islands
104 North American 1927 MEAN FOR Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua
105 North American 1927 - MEAN FOR Canada
106 North American 1927 - MEAN FOR CONUS
107 North American 1927 MEAN FOR CONUS (East of Mississippi River) including Louisiana, Missouri, Minnesota
108 North American 1927 MEAN FOR CONUS (West of Mississippi River)
109 North American 1927 - Alaska
110 North American 1927 Bahamas (Except San Salvador Island)
111 North American 1927 Bahamas (San Salvador Island)
112 North American 1927 Canada (Alberta, British Columbia)
113 North American 1927 Canada (Manitoba, Ontario)
114 North American 1927 Canada (New Brunswick, Newfoundland, Nova Scotia, Quebec)
115 North American 1927 Canada (Northwest Territories, Saskatchewan)
116 North American 1927 - Canada (Yukon)
117 North American 1927 - Canal Zone
118 North American 1927 - Cuba
119 North American 1927 Greenland (Hayes Peninsula)
120 North American 1927 - Mexico

121 North American 1983 Alaska, Canada, CONUS
122 North American 1983 Central America, Mexico
123 Observatorio Metereo 1939 Azores (Corvo & Flores Islands)
124 Old Egyptian 1907 - Egypt
125 Old Hawaiian MEAN FOR Hawaii, Kauai, Maui, Oahu
126 Old Hawaiian - Hawaii
127 Old Hawaiian - Kauai
128 Old Hawaiian - Maui
129 Old Hawaiian - Oahu
130 Oman - Oman
131 Ord. Survey G. Britain 1936 MEAN FOR England, Isle of Man, Scotland, Shetland Islands, Wales
132 Ord. Survey G. Britain 1936 - England
133 Ord. Survey G. Britain 1936 England, Isle of Man, Wales
134 Ord. Survey G. Britain 1936 Scotland, Shetland Islands
135 Ord. Survey G. Britain 1936 - Wales
136 Pico de las Nieves - Canary Islands
137 Pitcairn Astro 1967 - Pitcairn Island
138 Point 58 MEAN FOR Burkina Faso & Niger
139 Pointe Noire 1948 - Congo
140 Porto Santo 1936 Porto Santo, Madeira Islands
141 Provisional S. American 1956 MEAN FOR Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, Venezuela
142 Provisional S. American 1956 - Bolivia
143 Provisional S. American 1956 Chile (Northern, Near 19°S)
144 Provisional S. American 1956 Chile (Southern, Near 43°S)
145 Provisional S. American 1956 - Colombia
146 Provisional S. American 1956 - Ecuador
147 Provisional S. American 1956 - Guyana
148 Provisional S. American 1956 - Peru
149 Provisional S. American 1956 Venezuela
150 Provisional S. Chilean 1963 Chile (South, Near 53°S) (Hito XVIII)
151 Puerto Rico Puerto Rico, Virgin Islands
152 Qatar National - Qatar
153 Qornoq - Greenland (South)
154 Reunion - Mascarene Islands
155 Rome 1940 - Italy (Sardinia)
156 Santo (DOS) 1965 Espirito Santo Island
157 Sao Braz Azores (Sao Miguel, Santa Maria Islands)
158 Sapper Hill 1943 - East Falkland Island
159 Schwarzeck - Namibia
160 Selvagem Grande - Salvage Islands
161 SGS 85 - Soviet Geodetic System 1985
162 South American 1969 MEAN FOR Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Trinidad & Tobago, Venezuela
163 South American 1969 - Argentina
164 South American 1969 - Bolivia
165 South American 1969 - Brazil
166 South American 1969 - Chile
167 South American 1969 - Colombia
168 South American 1969 - Ecuador
169 South American 1969 Ecuador (Baltra, Galapagos)
170 South American 1969 - Guyana
171 South American 1969 - Paraguay
172 South American 1969 - Peru
173 South American 1969 - Trinidad & Tobago
174 South American 1969 - Venezuela
175 South Asia - Singapore
176 Tananarive Observatory 1925 Madagascar

177 Timbalai 1948 Brunei, East Malaysia (Sabah, Sarawak)
178 Tokyo - MEAN FOR Japan, Korea, Okinawa
179 Tokyo - Japan
180 Tokyo - Korea
181 Tokyo - Okinawa
182 Tristan Astro 1968 - Tristan da Cunha
183 Viti Levu 1916 Fiji (Viti Levu Island)
184 Wake-Eniwetok 1960 - Marshall Islands
185 Wake Island Astro 1952 - Wake Atoll
186 WGS 1972 - Global Definition
187 Yacare - Uruguay
188 Zanderij - Suriname

C

Appendix D: LABMON Datums For NavCore Receivers

0 WGS-84 (Default)
1 Adindan
2 AFG
3 AIN EL ABD 1970
4 Anna 1 Astro 1965
5 ARC 1950
6 ARC 1960
7 Ascension Island 1958
8 Astro Beacon “E”
9 Astro B4 SOR. ATOLL
10 Astro POS 71 / 4
11 Astronomic Station 1952
12 Australian Geodetic 1966
13 Australian Geodetic 1984
14 Bellevue (IGN)
15 Bermuda 1957
16 Bogota Observatory
17 Campo Inchauspe
18 Canton Island 1966
19 Cape
20 Cape Canaveral
21 Carthage
22 Chatham 1971
23 Chua Astro
24 Corrogo Alegre
25 Djakarta (Batavia)
26 DOS 1968
27 Easter Island 1967
28 European 1950
29 European 1979
30 Gandajika Base
31 Geodetic Datum 1949
32 Guam 1963
33 GUX 1 Astro
34 Hjorsey 1955
35 Hong Kong 1963
36 Indian Thailand
37 Indian Bangladesh
38 Ireland 1965
39 ISTS 073 Astro 1969
40 Johnston Island 1962
41 Kandawala
42 Kerguelen Island
43 Kertau 1948
44 La Reunion
45 L.C. 5 Astro
46 Liberia 1964
47 Luzon
48 Mindanao Island
49 Mahe 1971
50 Marco Astro
51 Massawa
52 Merchich
53 Midway Astro 1961
54 Minna
55 Nahrwan Masirah Island
56 Narhwan United Arab Emirates
57 Nahrwan Saudia Arabia
58 Namibia
59 Naparima, BWI
60 NAD-27 Conus
61 NAD-27 Alaska
62 NAD-27 Bahamas
63 NAD-27 San Salvador Island
64 NAD-27 Canada
65 NAD-27 Canal Zone
66 NAD-27 Caribbean
67 NAD-27 Central America
68 NAD-27 Cuba
69 NAD-27 Greenland
70 NAD-27 Mexico
71 North America 1983
72 Observatorio 1966
73 Old Egyptian 1960
74 Old Hawaiian
75 Oman
76 Ordinance Survey of Great Britain
77 Pico de las Nieves
78 Pitcairn Astro 1967
79 Provisional South Chilean 1963
80 Provisional South American 1956
81 Puerto Rico
82 Qatar National
83 Qornoq
84 Rome 1940
85 Santa Braz
86 Santo (DOS)
87 Sapper Hill
88 South American 1969
89 South Asia
90 Southeast Base
91 Southwest Base
92 Timbalai 1948
93 Tokyo
94 Tristan Astro 1968
95 Viti Levu 1916
96 Wake-Eniwetok 1960
97 Zanderij

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