FBX-2

MBX-2 Beacon Receiver

PROGRAMMING MANUAL

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Table of Content

1. INTRODUCTION

This manual contains instructions for remote control of the MBX-2 Marine Beacon Receiver, and should be used in conjunction with the MBX-2 and GBX Series User Manual. In this manual, all programming references to MBX-2 also apply to the built-in beacon receiver in the GBX Series.

Remote control can originate in a PC for performance evaluation or data processing. In an integrated system, an embedded processor could interface with the MBX-2. Finally, remote control can be generated by a suitable GPS unit, using standard NMEA sentences. It is assumed that you are familiar with the functional operation of the associated PC or GPS equipment.

The MBX-2 may be controlled locally from the front panel, or remotely via a bi-directional serial I/O port. Local control is always active, while remote control can be shut down by selecting "Input None" on the front panel. In the latter case, the MBX-2 will not respond to any remote commands.

The MBX-2 complies with the NMEA 0183 V.2.0 protocol for remote control by a GPS receiver or PC. Refer to the MBX-2 User Manual for details on the front panel operation, as well as the installation of this receiver and its antenna.

2. QUICK START

- Install all antenna, interface, and power connections as outlined in the MBX-2 User Manual, Section 4. Connect the interface connector to a PC serial port COM1 as follows:

MBX-2 I/O PIN#	COLOR	PC (DB-9) PIN#
3	Brown	3
4	Green	2
6	Black	5

- Start up the PC in "WINDOWS", and insert the enclosed diskette in drive "A". Select "TERMINAL", and "OPEN FILE" A:MBX22.TRM.

- The TERMINAL function keys may be used to query and configure the receiver.

Example: press the STAT? key, and the response is a status report indicating the selected operating frequency and MSK rate.

Example: press the PRF? key, and the response is a report of the received signal strength and SNR.

Example: press the MOD BEX? key, and the stored beacon table will be displayed for viewing or editing. Follow the on-screen instructions.

- If WINDOWS is not available, use any PC in terminal mode set at 8-N-1, 4800 Bd, and manually generate the required character strings described in Section 4.

3. RECEIVER CONFIGURATION

3.1 FACTORY DEFAULT SETTINGS

The standard interface format for the MBX-2 is RS-232. A user selectable RS-232/ RS-422 format is available as a factory option; factory default format is RS-232.

When power is first applied, the receiver will start up in the factory default settings, shown below. After a short (5 second) self test, the unit is operational. Any changes made via a remote command will be effective immediately, and saved automatically to non-volatile memory. These parameters become the new default values on subsequent power up.

The factory default settings are as follows:

Input protocol:	NMEA 0183 (Remote Commands)
Output protocol:	NMEA 0183 (Status); RTCM SC104 (Data)
Baud Rate:	4800 Bd
Frequency:	308.00 KHz
MSK rate:	100 bps

3.2 INTERFACE PROTOCOL

The MBX-2 supports the following data, command, and status formats:

a) RTCM SC-104 standard differential error data format.

b) NMEA 0183 standard command format.

c) NMEA 0183 proprietary command format.

d) NMEA 0183 standard status message format.

e) Magnavox proprietary protocol.

Section 4 explains the details of the various NMEA sentence structures used in the MBX-2. For complete details on all NMEA 0183 sentences and options, please refer to the NMEA 0183 Standard Specification, available from:

National Marine Electronics Association

NMEA Executive Director, Mr. R. Sassaman
P.O. Box 50040, Mobile, Alabama 36605, USA.
Tel (205) 473-1793, Fax (205) 473-1669.

Information on the MAGNAVOX protocol is available form your MAGNAVOX dealer.

4. NMEA PROTOCOL

4.1 DESCRIPTION

The NMEA 0183 standard has no provisions for the transmission of error correction messages, while the RTCM SC-104 standard has no provisions for the transmission or reception of receiver control and status information. For this reason, the MBX-2 is capable of processing both standards, and does it in a manner that can be simply parsed by the GPS receiver. The GPS receiver must also be capable of processing both formats.

The MBX-2 does not pre-process the output data. If the receiver is not locked onto a valid beacon transmitter, there is no output, except for status messages when invoked; when locked, the output will be valid correction errors in RTCM format.

Internally, the MBX-2 performs complete RTCM message synchronization and parity checking in order to provide a true "Signal Lock" indication, and to develop message quality statistics as auxiliary output messages. The correction output data are formatted as described in Section 5 of the RTCM SC-104 Standard Specification. This includes the use of rules regarding the "MSB First" and "Byte" conventions.

NOTE

Any NMEA command or status messages will temporarily interrupt the output of RTCM data!

The correction data are usually sent with bits 7 and 8 of each character set to the pattern '01'. This releases 32 printable characters in the range 20 - 3F (hex), including the "$" symbol. Input commands are invoked using this non-RTCM "$" symbol, while a line feed <LF> character terminates the NMEA sentence.

The MBX-2 uses these two characters to switch between "status" and "error correction" output mode. The associated GPS receiver receives both correction and status data from the MBX-2 over a common serial interface, and uses bit 8 of the receiver characters to separate the two types of responses.

During the time MBX-2 status data are sent, the beacon receiver buffers all received correction data. At the completion of the status message, these data are sent to the GPS receiver as a burst of characters (at 4800 Bd), after which "current" correction is sent as it is received and formatted. The actual delay suffered by the correction data as the result of the transmission of status data depends on the selected baud rate, and the length of the status message.

No operation delay will result in most cases, since the buffering and burst transmission of the correction data will occur in the middle of a type 1 or 9 message. In the worst case, the MBX-2 will respond with a status message of approximately 240 characters, requiring 500 msec for transmission at 4800 Baud. During this time, 100 MSK correction bits will have been received and packed into 100/6=18 buffered characters. Again assuming 4800 baud, these will be burst transmitted in 36 msec (or about the time it takes to form an additional RTCM character at 200 BPS).

These considerations indicate that a worst case delay of a little over 500 msec may be expected. It should be noted that the use of the burst mode requires that the GPS receiver truly be capable of receiving serial data with only single stop bit between characters during the reception of the status data and the buffered RTCM data.

The technique used to provide both RTCM and NMEA output responses over a single serial interface follows the technique successfully employed to integrate MBX-2 input command responses into the RTCM data stream. As each NMEA-0183 sentence starts with a "$" character, this non-RTCM character flags the start of the NMEA response mode. The line feed <LF> character, which terminates all NMEA sentences, flags the resumption of RTCM mode.

RTCM/NMEA mode switching is accomplished as follows:

a) A NMEA sentence starting with the "$" character is sent to the beacon receiver.

b) The GPS receiver continues to process RTCM data until the (non-RTCM) "$" character is detected in the data stream.

c) On detection of the "$" character, the GPS receiver switches to the NMEA response mode, and gathers the NMEA sentence.

d) The NMEA sentence is collected until the sentence terminating <LF> character is detected, or until more than 82 characters have been received since the most recent "$" character. At this time RTCM data collection is resumed.

This also applies to NMEA responses, except that in this case, the shortened (maximum length 82 characters) NMEA sentence will result in a worst case interruption of only several tenths of a second.

NOTE

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4.2 COMMAND SENTENCES

For remote control, connect a PC in terminal mode to the MBX-2 I/O Port. Set the terminal at 4800 Bd, 8 data bits, 1 stop bit, no parity. The MBX-2 receiver accepts the following NMEA-0183 command sentences:

a) $GPMSK standard command.
b) $PCSI,X proprietary commands.
b) $GPCRQ,MSK and $GPCRQ,MSS standard queries.

4.2.1 Receiver Set Command

This standard command sets the receiver's operating parameters.

$GPMSK,x.x,A,x.x,A,x.x<CR><LF>

Field	ASCII	HEX	Description
1	"$"	24	Start of sentence
1	"GPMSK"		Address field
2	"x.x"		Beacon frequency; 283.5 -325.0 KHz
3	"A"		Auto/Man frequency; A/M (Note 1)
4	"x.x"		Beacon bit rate; 25, 50, 100, 200 bps
5	"A"		Auto/Man bit rate; A/M (Note 2)
6	"x.x"		Status Report interval; sec (Note 3)
6	<CR><LF>	0D 0A	Terminates sentence

Note 1: If Auto is specified, Field 2 is ignored; use only with "Auto Beacon Selection" feature. This field must be A or M; do not leave as null field.

Note 2: If Auto is specified, Field 4 is ignored; use only with "Beacon Table" beacons. This field must be A or M; do not leave as null field.

Note 3: When status information is not to be transmitted, use zero; Do not leave as null field

Example: $GPMSK,306.5,M,100,M,0<CR><LF>

This sets the receiver operating frequency to 306.50 KHz, and the MSK rate to 100 bps, with no report interval.

4.2.2 Beacon Table Command

This proprietary command prompts the receiver to generate a menu giving the user the option to "LIST", "EDIT", or "QUIT" the stored Beacon Table. This table is a list of pre-programmed beacons, including their name, frequency, and MSK rate. When invoked, a user friendly menu provides the instructions.

$PCSI,4,M<CR><LF>

Field	ASCII	HEX	Description
1	"$"	24	Start of sentence
1	"PCSI"		Address field
2	"M"		Beacon Table Access Command
2	<CR><LF>	0D 0A	Terminates sentence

After viewing or editing the Beacon Table, be sure to quit (Q) from this command, otherwise the output of RTCM data will remain disabled!

4.2.3 Receiver Status Request

This standard command prompts the receiver to generate a status report of the operating parameters.

$GPCRQ,MSK<CR><LF>

Field	ASCII	HEX	Description
-	"$"	24	Start of sentence
1	"GPCRQ"		Talker/Listener ID field
2	"MSK"		Sentence Formatter
2	<CR><LF>	0D 0A	Terminates sentence

4.2.4 Receiver Performance Request

This standard command prompts the receiver to generate a report of the receiver's performance parameters.

$GPCRQ,MSS<CR><LF>

Field	ASCII	HEX	Description
-	"$"	24	Start of sentence
1	"GPCRQ"		Talker/Listener ID field
2	"MSS"		Sentence Formatter
2	<CR><LF>	0D 0A	Terminates sentence

NOTE

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4.3 STATUS MESSAGES

The MBX-2 receiver responds with the following NMEA-0183 sentences:

a) $CRMSK status message

b) $CRMSS performance message.

4.3.1 Receiver Status Report

This is a standard report of the receiver's operating parameters, generated in response to a $GPCRQ, MSK query.

$CRMSK,x.x,A,x.x,A,x.x<CR><LF>

Field	ASCII	HEX	Description
-	"$"	24	Start of sentence
1	"CRMSK"		Address field
2	"x.x"		Beacon frequency; 283.5 -325.0 KHz
3	"A"		Auto/Man frequency; A/M (Note 1)
4	"x.x"		Beacon bit rate; 25, 50, 100, 200 bps
5	"A"		Auto/Man bit rate; A/M
6	"x.x"		Status Report interval; sec.
6	<CR><LF>	0D 0A	Terminates sentence

Note 1: When not equipped with "Auto Beacon Selection" feature, this field will always indicate Manual ("M").

Example: $CRMSK,293.0,M,100,M,10<CR><LF>

This report shows that the receiver operating frequency is manually set to 293.0 KHz, MSK rate is 100 bps, MSK rate selection is manual, and the status report interval is 10 seconds.

4.3.2 Receiver Performance Report

This is a standard report of the receiver's performance parameters, generated in response to a $GPCRQ,MSS query.

Structure: $CRMSS,x.x,x.x,x.x,x.x<CR><LF>

Field	ASCII	HEX	Description
-	"$"	24	Start of sentence
1	"CRMSS"		Address field
2	"x.x"		Signal Strength (SS), dB re: 1 uV/m
3	"x.x"		Signal-to-Noise ratio (SNR), dB
4	"x.x"		Beacon Frequency (KHz)
5	"x.x"		Beacon MSK Rate (bps)
5	<CR><LF>	0D 0A	Terminates sentence

Example: $CRMSS,50,23,293.0,100<CR><LF>

This report indicates a received Signal Strength (SS) of 50 dBr, an SNR of 23 dB, an operating frequency of 293.0 KHz, and an MSK Rate of 100 bps.

NOTE

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5. TROUBLE SHOOTING

5.1 Diagnostics

The following check list should assist the user with diagnosing operational problems:

Symptom	Diagnostics
No output data	DC Power: 10 -32 VDC ? Data Connector loose ? Check GPS/PC port assignment ! Correct I/O Baud rate ? Failure to quit (Q) Beacon Table access ? Check TXD line with an oscilloscope!
Random output data	Not tuned to a valid beacon ? Beacon in test mode or off the air ? Wrong MSK rate ? Wrong I/O Baud rate ? Measure 12 VDC on antenna coax cable ? Try different antenna !
No "Signal Lock"	DC Power ? Refer to "Random Output Data" !
Low SNR	Check MSK rate ? Antenna ground wire connected? Try different antenna location ! Install filters on noisy electrical equipment on board ! Install grounded shield inside hood of outboard motor !
SS higher than usual	Antenna ground wire still connected ? Move antenna away from interference sources ? Refer to "Low SNR" !
GPS not accepting RTCM	Check DGPS set-up menu on GPS ? Correct I/O Baud Rate ? I/O pin out correct ? I/O cable connector loose ?
MBX not accepting NMEA	Increase inter-bit pacing for commands ? Use 2 stop bits for commands ?
No NMEA output	Check command syntax ? Check DGPS set-up menu on GPS ?