



JAMAR Technologies, Inc.

Public Document - 1000 - RAC Plus III Real Time Interface

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Jamar RAC-Plus III Real Time Specifications

PURPOSE:

This document describes communication protocols between a Jamar RAC-PLUS III and a PC that are necessary for Real Time operation of the RAC-Plus III. Other RAC-Plus operations (such as transferring data stored in the RAC's memory) are addressed elsewhere. This paper is intended to aid development of custom software applications for Jamar customers who want to collect Real Time data from a RAC-PLUS III. This document also includes the format of the GPS information available with the RAC-Plus III. This document does not include information regarding the interface between commercially available GPS units and the RAC PLUS-III. Currently, the RAC-Plus III is designed to work only with the receiver that is available from Jamar.

REAL TIME OPERATION:

Once a Start Real Time command is received by the RAC-Plus III, the DMI enters Real Time mode and the upper DMI display will read "REAL". At this point, all buttons are disabled on the RAC-Plus III and it can only be controlled by subsequent commands issued by the PC. In Real Time mode the DMI sends data to the PC every second. All 36 bytes outlined in the TRANSMITTED DATA table are sent to the PC each second. During Real Time Operation, there are no data stored in the DMI's memory.

The DMI signals the PC twice each second at 9600 baud. At PPS time (PPSTK = 0), a 1-byte SYNC character is sent to the PC (with an ASCII value of "S"). When the time counter reaches 700ms (PPSTK = 700), 36 bytes are sent to the PC. Upon initiation of a Real Time operation, the SYNC byte is always sent first. When running, the RS232 transfers to the PC will alternate: SYNC, DATA, SYNC, DATA, SYNC, etc.

REAL TIME INTERFACE RS232 COMMANDS:

There are 5 Real Time Interface commands for the PC to use during Real Time operations:

- hexC0: START REAL TIME - Real Time Mode without GPS.
- hexC1: START GPS REAL TIME - Real Time Mode with GPS.
- hexC2: STOP REAL TIME - Terminate Real Time Mode
- hexC3: CLEAR DISTANCE - Clears Distance Counter
- hexC4: EVENT MARK - Marks a PC created Event

START REAL TIME (hexC0 code):

This places the DMI in Real Time Mode to function without GPS and is accepted by the DMI in Normal mode (DMI will not accept Command if already in Real Time Mode). The START command also has the following effects:

- Disables all Keys except DIM
- Shows "REAL" on DMI display
- Clears C-HOLD and DMI begins to tally distance
- Transmits a single ASCII byte of 'S' at PPS time (once per second). Since no GPS is specified in this command, the DMI creates the PPS timing internally.
- Transmits 36 bytes of data to the PC 0.7 seconds after PPS time (PPSTK = 700). This format is the same as when functioning with a GPS unit although bytes 15 thru 35 are not valid. The data is transmitted once per second at 9600 baud.

START GPS REAL TIME (hexC1 code):

This command launches the DMI into Real Time Mode to function with the GPS attached. The command byte is accepted by the DMI in Normal mode. The DMI will not accept this command if already in Real Time Mode. The START GPS command also has the following effects:

- Disables all Keys except DIM.
- Shows "rEAL" on DMI display
- DMI now monitors the GPS PPS pulse. When PPS pulses are being received the DMI clears C-HOLD and starts transmission to the PC. NOTE-if the PPS signal is not available in a few seconds, the DMI clears C-HOLD and starts transmission to the PC. The DMI can now function in Real Time without GPS. Another approach is to issue a STOP (hexC2) Command, make appropriate adjustments and retry the Real Time operation.
- Transmits a single ASCII byte of 'S' at PPS time (once per second).
- Transmits 36 bytes of data to the PC 0.7 second after PPS time (PPSTK = 700). The data is transmitted once per second at 9600 baud.
- The DMI takes no specific action as the result of the GPS data. NOTE: If PPS pulses stop during Real Time operations, the operation continues with DMI created PPS timing; the basic 1-second timing interval is not compromised during this transition. Once the GPS stops communicating it will NEVER come back on-line even if PPS pulses resume. The remainder of this Real Time session must function without the GPS.

STOP REAL TIME (hexC2 code):

Accepted by DMI in Real Time Mode, returns DMI to Normal Mode, re-activates Keys, stops sending data to PC, stops receiving GPS data etc.

CLEAR DISTANCE (hexC3 code):

Accepted by DMI in Real Time Mode, clears the Distance Counter at time 0 (beginning) of the next interval, DISTANCE COUNTER at PPS time (bytes 12-14) field of the next interval will be zero; there is no other indication that the Distance Counter was cleared.

EVENT MARK (hexC4 code):

Accepted by the DMI in Real Time Mode, saves the PPSTK counter in EVENT TIME field (byte 10) and Event Distance Counter (bytes 3-5) for this 1-second interval. Once the PC issues the RS232 transmission it takes approx. 1 millisecond for the DMI to receive. From this point the DMI provides the normal 5 millisecond time resolution. An EVENT MARK creates a 'DDDD' EVENT CODE. EVENT MARK commands from the PC may be lost if not separated by a minimum of 1-second!

TRANSMITTED DATA (36 bytes):

Byte Number	Description
0-1	EVENT CODE: BB,BB(hex)-default value; there was no user generated EVENT MARK command received DD,DD(hex)-special value used to signal that an EVENT MARK command was received from the PC; this data set contains information about the previous EVENT MARK in bytes 3-5 and byte 10 (see below)
2	SPEED (Binary ft/sec)
3-5	EVENT DISTANCE COUNTER-distance value captured by the DMI as a result of an EVENT MARK command (binary feet)
6-8	TIME (BCD) (HH,MM,SS)
9	Bit 0: PPS pulse was received from GPS unit at the beginning of this 1-second interval. Bit 1: START TRANSFER - '\$' detected in GPS data. Bit 2: 'GPGGA' Sentence detected Bit 3: VALID FIX - Position Fix Indicator of GGA Sentence was not zero. Bit 4: END_XFER - 'GPGGA' Sentence detected 'End of Transfer'. NOTE: Valid GPS data has a DMI STATUS of hex1F.
10	EVENT TIME: PPSTK value when/if an operator created Event Code occurred during this 1-second time interval. During Real Time Operation, this field holds the PPSTK value resulting from a PC created EVENT MARK. The EVENT MARK also creates a 'DDDD' EVENT CODE. The EVENT TIME field represents 5msec increments, so its value ranges from 0 to 199. This field basically indicates the time within a 1-second period that the Event occurred.
11	SECOND DISTANCE: Distance traveled during this 1-second interval (feet; binary)
12-14	DISTANCE COUNTER at PPS time or time zero for this interval (feet; binary). NOTE: Addition of byte 11 to this field provides the value of the Distance Counter at the end of this 1-second time period.
15-17	GPS UTC Time in packed decimal with format 'HHMMSS'.
18-19	GPS UTC Time Fraction in packed decimal with format '.SSSS'. This 2-byte field is left justified and zero filled if required. For the current GPS unit used, the Time Fraction is not provided and this field is equal to zero.
20-22	GPS Latitude from format 'DDDMM.' in packed decimal and justified.
23-24	GPS Latitude Fraction from format '.MMMM' in packed decimal and left justified.
25	GPS Latitude direction: ASCII 'N' or 'S'.
26-28	GPS Longitude from format 'DDDMM.' in packed decimal and right justified and zero filled if required.
29-30	GPS Longitude Fraction from format '.MMMM' in packed decimal and left justified.
31	GPS Longitude direction: ASCII 'E' or 'W'.
32	Position Fix Indicator: decimal numeric right justified.
33	Number of Satellites in use: decimal numeric right justified.
34	GPS HDOP: decimal numeric; whole number 0-99; right justified.
35	GPS HDOP: decimal numeric; fraction .0-.9; left justified.

NOTES ON REAL TIME MODE:

1. Data (36 bytes) is transmitted every second and there are only two EVENT CODES:
'BBBB' No EVENT MARK from the PC occurred during this 1 second interval.
'DDDD' EVENT MARK from the PC occurred during this 1 second interval.
2. SECOND DISTANCE (byte 11 of data) provides the distance traveled this 1-second interval. This field is in feet (binary).
3. The EVENT MARK PC Command provides for an Event created at the PC to capture the current DMI Distance Counter.
4. To determine GPS validity, the following fields are provided:
 - DMI STATUS (byte 9)
 - GPS Position Fix Indicator (byte 32)
 - GPS HDOP (bytes 34 and 35)

SOFTWARE DESIGN NOTES:

During Real Time mode operations, use of the EVENT MARK command has previously served as the standard method to set distance values for user-generated events from the PC. However, utilization of the EVENT MARK command is not inherently necessary. Programmers may wish to parse the transmitted data every second and rely upon built-in PC timing to keep track of user-generated events. Software design might be simplified in this latter case, but it would be necessary to include some means to record user actions, then interpolate between the distances provided by the DMI each second.

HARDWARE DESIGN NOTES:

Because the GPS relies upon a 1-second interval type of operation, the RAC-Plus III's Real Time functions must also incorporate this 1-second interval approach. This approach provides for consistency in the DMI micro-code design. To correlate DMI distances and time with the GPS, the DMI synchronizes with the GPS's PPS signal. If the GPS unit is not attached or stops sending PPS pulses, the DMI creates an internal Pulse-per-Second timing for Real Time operations.

DEFINITIONS:

Normal Mode:

This is the basic state when the Distance Counter and Speed are displayed. The Displays are under the control of the **C-HOLD** button, the **D-HOLD** button and the Speed keys. Basically, the unit is considered to be in Normal Mode when the unit is not performing a Menu Function or in Real Time mode. Interval Distance is considered a function within Normal Mode.

RS232 Serial Port:

This connector attaches RAC to PC for Real Time Operations.

GPS Port:

This is a second RS232 interface that attaches the GPS unit on the RAC-Plus III.

Sentence:

This is a term that describes a section of data output by a GPS unit in string format. A GPS unit may output several different sentences. Each sentence has a unique name (like GPGGA) and a specific format.

PPS (Pulse-per-Second):

This is a secondary GPS signal that pulses every second in relation to the UTC (Universal Time Coordinated). The GPS unit receives power when the DMI Power Switch is turned on. The PPS signal is generated when power is applied and the initial position fix has been calculated. It may take several minutes to create the initial PPS pulse. The PPS pulse may not be generated if the antenna is sufficiently restricted to satellite access. Once the GPS has generated the first PPS pulse, the PPS pulses continue until power has been removed.

PPSTK (Pulse-per-Second Time Counter):

This DMI counter is cleared to zero when the PPS signal is received. This counter is incremented at a 5 millisecond rate (1/200 sec.). The value of the PPSTK is saved when an Operator created Event occurs. This allows the PC software to more accurately correlate the DMI distance relative to the GPS position.

TIME COUNTER:

- Six digits with format of HHMMSS.
- No battery backup
- Cleared to zero at power ON.
- Free running (cannot be stopped)
- Operator can set via a Menu Function.
- Time Counter rolls over from 23:59:59 to 00:00:00.