

Missile Application Condensed Measurements Record (MACM)



This application note describes the MACM message. This message was produced to optimize data output and data transmission in missile applications requiring high speed data output with communications bandwidth limitations.

Missile Applications Present Data Output Challenges

1. High Speed Data Output

Integrators of GPS receivers designed to output raw data messages for on-the-fly tracking, or data downlink and storage for later use in processors are often challenged by the sheer volume of data involved. At 20Hz data output rate the volume of data generated can overwhelm data ports and memory areas. HDMA customers (High Dynamics for Missile Applications) often find that they are tracking vehicles that move at many times the speed of sound and these high output rates are required. Often, over the course of one second, many things can change with respect to the location device.

2. Bandwidth Limitations

Even general uses of GPS receivers for accurate positioning sometimes have the problem of band width limitations. These receivers are capable of outputting data at very high rates but the actual utility of these features can be limited because the radio modem or other data transmission devices used can only convey the messages at a lower rate. In some cases the data radio may have other information to transmit along with the GPS derived location information. This can further reduce the amount of data that can be transmitted.

3. Multiple Messages

Often the user is forced to request the receiver to output several different messages only to use bits and pieces and ignore the unused portions. This can quickly overburden a

position data transmission device and reduce the efficiency of the communication link by a great deal.

Customer Defined Message Addresses Data Output Challenges

In the case of data transmissions for scoring and tracking missiles or other high speed vehicles, these issues are very important. On the recommendation of the Joint Advanced Missile Instrumentation Group and Waypoint Consulting, Ashtech Precision Products has incorporated an application unique message into its G12-HDMA receiver to increase the efficiency of the trajectory reporting system in which the receiver is found. This message has been incorporated into several other Ashtech receivers and can be used for other applications as well.

Missile Application Condensed Measurements record (MACM)

The MACM message has the following response format. Each field is described in detail on the next page.

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[MACM:4][COUNT:2][RCVTIME:4][NAVT:4]
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[PRN:1][WRN:1][POL:1][CNO:1][PHASE:8][RANGE:4][DPL:4][LCK_TIME:4]
[PRN:1][WRN:1][POL:1][CNO:1][PHASE:8][RANGE:4][DPL:4][LCK_TIME:4]
[PRN:1][WRN:1][POL:1][CNO:1][PHASE:8][RANGE:4][DPL:4][LCK_TIME:4]
[PRN:1][WRN:1][POL:1][CNO:1][PHASE:8][RANGE:4][DPL:4][LCK_TIME:4]
[PRN:1][WRN:1][POL:1][CNO:1][PHASE:8][RANGE:4][DPL:4][LCK_TIME:4]
[PRN:1][WRN:1][POL:1][CNO:1][PHASE:8][RANGE:4][DPL:4][LCK_TIME:4]
[PRN:1][WRN:1][POL:1][CNO:1][PHASE:8][RANGE:4][DPL:4][LCK_TIME:4]
[PRN:1][WRN:1][POL:1][CNO:1][PHASE:8][RANGE:4][DPL:4][LCK_TIME:4]
[PRN:1][WRN:1][POL:1][CNO:1][PHASE:8][RANGE:4][DPL:4][LCK_TIME:4]
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```
[CHECKSUM:1]
```

Header: 14

Prn Data: 24

Prn Data: 24

Prn Data: 24

Prn Data: 24

Prn Data: 24

Prn Data: 24

Prn Data: 24

Prn Data: 24

Checksum: 1

Total message length for 8 SV measurements: 207 bytes.

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Missile Application Condensed Measurements Record (MACM) Data String

Byte#	Name	Type	Size	Content	Origin
1	MACM	char	4	Name of Message ("MACM")	sync_word(ASCII"MACM")
5	COUNT	char	2	Number of structures (PRN record) to be sent for the current epoch.	MBN record, count
7	RCVTIME	long	4	Signal received in milliseconds of week GPS system time. This is the time tag for all measurements and position data.	PBN record, rcvtime
11	NAVT	float	4	Receiver clock offset in meters.	PBN record, navt
24*j-9	PRN	unsigned char	1	Satellite PRN number	MCA record, svprn
24*j-8	WRN	unsigned char	1	Warning flag, where: 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 questionable Bit 6 set = not used Bit 7 set = possible loss of lock Bit 8 set = loss of lock counter reset The interpretation of bits 1 and 2 is as follows: <u>Bit 1</u> <u>Bit 2</u> 0 0 Same as 22 in goodbad flag (see next field) 1 0 Same as 23 in goodbad flag 0 1 Same as 24 in goodbad flag Note that more than one bit may be set at the same time, e.g., if bits 1, 3, and 6 are set at the same time, the warning flag is 37 (1 + 4 + 32)	MCA record, warning
24*j-7	POL	unsigned char	1	This number is either 0 or 5, 0 meaning satellite is justlocked, and 5 meaning the beginning of the first frame has been found.	MCA record, polarity_known
24*j-6	CNO	unsigned char	1	Signal-to-noise of satellite observation	MCA record, ireg
24*j-5	PHASE	double	8	Full carrier phase measurements in cycles. Not available unless carrier phase option is installed.	MCA record, full_phase
24*j+3	RANGE	unsigned long	4	Pseudo-range in seconds, sf=3.0e10	G-8 ITA record, raw_range
24*j+7	DPL	long	4	Doppler (10-4 Hz)	MCA record, doppler
24*j+11	LCK_TIME	unsigned long	4	Continuous counts since satellite is locked.This number is incremented about 500 times per second	MBN record, lost_lock_ctr
24*N+15	checksum	unsigned char	1	Checksum, a bitwise exclusive OR (XOR) of all bytes from count (just after header) to the byte before checksum.	MCA record

Note: j = 1,2, ..., N where N = the order # of the PRN record in message

The message is variable in length. The length depends on the number of PRN records, which is indicated by the Count field. The message begins with the 4 byte sync word [4D 41 43 4D](ASCII "MACM") and ends with the checksum byte. There are no CR, LF pairs associated with the message.

The MACM message is accessed through standard Ashtech SPASH "set" and "query" commands described in detail in the G12 OEM Board Reference Manual.

Note: HDMA products are designed for operation beyond 60,000 feet of altitude and 1,000 knots of velocity. Therefore, they are subject to the International Traffic in Arms Regulations (ITAR) and require a U.S. Government license prior to export.

