264-21

Range Commanders Council

ELECTRONIC TRAJECTORY
MEASUREMENTS GROUP

MULTIPLE APPLICATION CONDENSED MESSAGE (MACM) DATA FORMAT

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STANDARD 264-21

MULTIPLE APPLICATION CONDENSED MESSAGE (MACM) DATA FORMAT

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Preface

This document provides the standard message format for Global Navigation Satellite System (GNSS) receivers used in high dynamic air/ground missile testing applications. The message, Multiple Application Condensed Message (MACM), is a data format designed for high-speed output of raw GNSS measurement data. This format provides the minimum data necessary to generate a kinetic carrier-phase measurement of receiver position in a near-real-time or post-mission GNSS signal processor. The carrier-to-noise ratio, carrier phase measurement, pseudorange, Doppler shift, elapsed lock time, and condition flags are supplied for each satellite under track.

This standard affords flexibility to meet the specific needs of ranges. It is intended to be a living document with the ability to respond to changes and to future developments in GNSS and range testing requirements.

Commonly used scientific abbreviations/symbols are defined in standard reference dictionaries. Definitions of abbreviations and acronyms with special applications to this document are included where the term first appears or in Section 2.

Previous versions of this standard were named "Missile Application Condensed Message (MACM)". The name was changed to reflect a broader scope of application while keeping the acronym the same.

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Acronyms

GNSS	Global Navigation Satellite System
GPS	Global Positioning System
LSB	least significant bit
MACM	Multiple Application Condensed Message
PRN	Pseudo-Random Number
TFOM	Time Figure of Merit

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1. Introduction

This document defines a data message format for use in Department of Defense testing applications. The intent is to foster compatibility in the exchange and analysis of Global Navigation Satellite System (GNSS) measurement data. This document defines a standard data message format comprised of GNSS receiver output data and related parameters. The message format was developed to optimize data output and transmission in air/ground missile testing applications that require high-speed data output within test communications bandwidth limitations of the user range. This message format is also applicable to a broad array of test scenarios other than missile testing.

This is the second version of the MACM data format. The format has been changed to include a signal type identifier and Time Figure of Merit (TFOM). Associated changes have been made to remove Global Positioning System (GPS)-specific references in favor of multi-constellation GNSS.

A sensor is considered to comply with this standard if it outputs valid messages as defined in this standard with one or more measurements identified in the signal types list (Subsection 2.1). Processing software is considered to comply with this standard if it processes valid messages as defined in this standard with at least one of the identified signal types.

The data format is a fixed packed record consisting of a header field, structure of each satellite under track, and a checksum for the message. The Multiple Application Condensed Message (MACM) length depends on the number of satellites being tracked. Table 1 provides a description of the variables of the MACM record. Table 2 presents an example of the message makeup, including the number of data bytes for each parameter, for a MACM record with seven satellites under track.

Table 1. Parameters of the MACM Message
a. Synchronization string b. Signal type identifier c. Time figure of merit d. Number of remaining satellite structures in the message e. GNSS time tag f. Receiver clock offset g. Satellite identifier h. Satellite status i. Signal carrier-to-noise density ratio at the receiver j. Carrier phase counter output k. Pseudorange from satellite to receiver l. Rate of change of carrier phase counter m. Time satellite is under continuous track n. Message checksum byte
Note: Further definition and description of these individual parameters is provided in Table 2, Table 3, and in Section 2.

Table 2. Example MACM Data Record Format

Data	Function	Total Bytes
[SYNC:4] [TYPE:1] [TFOM:1] [NUMOBS:1] [GNSSTIME:4] [OFFSET: 4]	Header	15
[SID:1][CONDITION:2][C/N0:1][PHASE:8][PR:4][RATE:4][LCK_TIME:4]	OBSERV'N	24
[SID:1][CONDITION:2][C/N0:1][PHASE:8][PR:4][RATE:4][LCK_TIME:4]	OBSERV'N	24
[SID:1][CONDITION:2][C/N0:1][PHASE:8][PR:4][RATE:4][LCK_TIME:4]	OBSERV'N	24
[SID:1][CONDITION:2][C/N0:1][PHASE:8][PR:4][RATE:4][LCK_TIME:4]	OBSERV'N	24
[SID:1][CONDITION:2][C/N0:1][PHASE:8][PR:4][RATE:4][LCK_TIME:4]	OBSERV'N	24
[SID:1][CONDITION:2][C/N0:1][PHASE:8][PR:4][RATE:4][LCK_TIME:4]	OBSERV'N	24
[SID:1][CONDITION:2][C/N0:1][PHASE:8][PR:4][RATE:4][LCK_TIME:4]	OBSERV'N	24
[CHECKSUM:1]	CHECKSUM	1

NOTE The number after the colon is the number of bytes associated with each field. In the example above, a message with seven satellites reported is 184 bytes long.

This document describes various data types used to construct message content. Short and Long are used to describe 16-bit and 32-bit integers, respectively. Signed integer values use the most significant bit to indicate negative values. Float and Double are used to describe 32-bit and 64-bit floating-point values, respectively. All floating-point values use IEEE-754[1] standard definitions. Char is defined as an 8-bit integer. Unsigned char is understood to be an 8-bit integer unsuitable for conversion to ASCII characters. These are used as bit fields or whole integer values.

The definitions of the individual data fields within the MACM message are given in Table 3.

Table 3. MACM Data Field Definitions

Byte #	Name	Type	Content
1	SYNC	char x4	Sync string (name and version of message, ASCII "MAC2")
5	TYPE	unsigned char	Signal Type Identifier. Most significant nibble identifies constellation; least significant nibble identifies frequency/code.
6	TFOM	unsigned char	0xFF = Unusable; ambiguity > 255ms 0x00 = Usable; ambiguity < 1ms
7	NUMOBS	unsigned char	Number of structures (fields SID through LOCKTIME) in the message. Each structure is for one satellite.
8	GNSSTIME	long	Signal received in milliseconds of week GNSS system time. This is the time tag for all measurements.
12	OFFSET	float	Receiver clock offset in meters.
16 + (24 * (j − 1))	SID	unsigned char	Satellite identifier
17 + (24 * (j − 1))	CONDITION	unsigned short	Manufacturer-defined warning and condition flags
19 + (24 * (j − 1))	C/N0	unsigned char	Signal-to-noise density ratio of satellite observation (dB-Hz)
20 + (24 * (j − 1))	PHASE	double	Full carrier phase measurements in cycles.
28 + (24 * (j − 1))	PR	unsigned long	Pseudo-range in seconds. Least significant bit (LSB) = $1/(3.0 \times 10^{10})$ seconds
32 + (24 * (j − 1))	RATE	long	Rate of change of carrier phase; positive for increasing range. LSB = 1×10^{-4} Hz.

[1] IEEE. *IEEE Standard for Floating-Point Arithmetic*. IEEE 754-2019. 22 July 2019. May be superseded by update. Available for purchase at https://ieeexplore.ieee.org/document/8766229.

36 + (24 * (j − 1))	LOCKTIME	unsigned long	Continuous counts since satellite is locked. This number is to be incremented 500 times per second
16 + (24 * N)	CHECKSUM	unsigned char	Checksum does not include bytes 1-4 or the checksum byte itself.

Notes:

- All multi-byte numeric fields are big endian.
- j = 1,2, ..., N; where N = number of satellite structures in the message, i.e., the number of satellite vehicles, which is the value of byte #7.
- When N = 0, there are no measurement blocks to process; checksum immediately follows receiver clock offset (OFFSET).
- The message is variable in length. The number of 24-byte structures is defined by the value of byte #7 in the header.
- The message begins with the 4-byte sync string 0x[4D 41 43 32] (ASCII "MAC2") and ends with the checksum byte.
- The checksum is computed by the bit-by-bit exclusive-*or*ing of all bytes in the block of data defined in the table.
- Signal type is consistent for all observations within the message. For example, a record indicating "GPS L1 C/A" will only contain GPS constellation satellites' L1 C/A observations.
- GNSSTime is recorded in a constellation-specific time base. Processing tools can use the signal type to perform any time base conversions, as necessary.
- Times of validity for MACM records are required to be aligned with the relevant constellation's time base to within one hundred microseconds.

2. Data Descriptions

Interpretation of individual data values are provided below.

2.1 Header Fields

Name: SYNC

This is the four-byte synchronization string "MAC2", 0x[4D 41 43 32], which identifies the start of a MACM message (per this updated standard).

NOTE	The legacy MACM synchronization string is "MACM", 0x[4D 41 43 4D]. A stream of data messages may include both MACM and MAC2 SYNC values identifying messages that comply with the legacy or this updated standard, respectively.

Name: TYPE

This is a single byte that uniquely identifies the signal type (constellation, frequency, and code) of the included satellite observations. Each constellation is identified by the most significant nibble, while specific frequency/code combinations are enumerated in the least significant nibble. Table 4 lists the defined signal types.

Table 4. Signal Types

Constellation	Frequency/Code	Value (Hex)	Value (Dec)
GPS	L1C/A	0x00	0
	L2P	0x01	1
	L2P (Y)	0x02	2
	L5 Q	0x03	3
	L1C (P)	0x04	4
	L2C (M)	0x05	5
Galileo	E1 (C)	0x10	16
	E6B	0x11	17
	E6C	0x12	18
	E5a (Q)	0x13	19
	E5b (Q)	0x14	20
	E5AltBOC (Q)	0x15	21
GLONASS	L1C/A	0x20	32
	L2C/A	0x21	33
	L2P	0x22	34
	L3 (Q)	0x23	35
BeiDou	B1 (I) w/ D1	0x30	48
	B2 (I) w/ D1	0x31	49
	B3 (I) w/ D1	0x32	50
	B1 (I) w/ D2	0x33	51
	B2 (I) w/ D2	0x34	52
	B3 (I) w/ D2	0x35	53
	B1C (P)	0x36	54
	B2a (P)	0x37	55
QZSS	L1C/A	0x40	64
	L5 (Q)	0x41	65
	L1C (P)	0x42	66
	L2C (M)	0x43	67
	L6P	0x44	68
NavIC	L5 SPS	0x50	80

Name: TFOM

This field provides an indication as to how well time, reported out as GNSSTIME in MAC2, is known. If the TFOM is 0x00, then GNSSTIME has an accuracy of <1 ms. If the TFOM is 0xFF, then the accuracy is > 255 ms. If the accuracy is estimated at ±127ms, the TFOM will be 0x7F. This TFOM can be used to correct GNSSTIME in post-mission processing. Once the TFOM achieves a value of 0x00, all the previous time data can be time corrected knowing the Epoch rate between messages and projecting back in time.

Name: NUMOBS

This is a single byte whose numeric value is the number of observed satellite vehicles that are being tracked by the receiver, and whose data are being reported in the body of this message. For example, a value of “0x0A” indicates that 10 satellites are being reported.

Name: GNSSTIME

This is the four-byte GNSS time of validity of this particular message. The times are reported in milliseconds. A GNSSTIME value of 245380000 is a GNSS time value of 245,380.000 seconds of the GNSS week (Tuesday, 20 hours, 9 minutes, 40 seconds for GPS). Note: for GPS, this differs from Greenwich Mean Time by the current number of leap seconds.

This timestamp is in User Equipment time. This can differ from the constellation time base with the difference being reported in the OFFSET field. When corrected by OFFSET, time of validity must be within 100 microseconds of the constellation time base.

When the receiver is first powered up and does not know constellation time, the value of GNSSTIME shall be the time in milliseconds since the power was applied.

Name: OFFSET

This is the four-byte GNSS receiver clock offset, in meters. This is the difference between the User Equipment time and the GNSS time base.

2.2 Satellite Vehicle Fields

There is one record for each satellite being reported.

Name: SID (Abbreviation for “Satellite Identifier”)

This is the single-byte satellite identification number. For the signal types identified in this document except for GLONASS, this is the Pseudo-Random Number (PRN). For GLONASS, this is the slot number.

Name: CONDITION

This is a two-byte status field that is set by the receiver. The defined portions of these two bytes are described in Table 5. The remaining four most significant bits are reserved for the sensor manufacturer.

Table 5. CONDITION Fields

Bit	Name	Note
0	Satellite Health	1 = Healthy
1	PR Validity	1 = PR Valid
2	PHASE Validity	1 = CP Valid
3	RATE Validity	1 = RATE Valid
4	PR Iono Corrected	1 = Corrected
5	PHASE Iono Corrected	1 = Corrected
6	PR Tropo Corrected	1 = Corrected
7	PHASE Tropo Corrected	1 = Corrected

8-10	PHASE Polarity State	0 = Not Known 5 = Not corrected, was correct at initial lock on 7 = Now correct, requires half-cycle adjustment
11	Jam Detect	1 = Jam detected or suspected
12-15	Reserved	Manufacturer-specific elements

Name: C/N0

This is a single-byte carrier-to-noise density ratio (in dB-Hz units) of the signal. Typically values over 34 dB-Hz are considered good carrier-to-noise density ratios. The LSB is 1 dB-Hz.

Name: PHASE

This is an eight-byte output of the receiver phase cycle counter. This is the total number of whole and fractions of cycle where one cycle is the wavelength of the carrier for the referenced measurement type. For example, the GPS L1 carrier wavelength is approximately 19 centimeters, so each full phase cycle represents 19 centimeters of distance. The PHASE value may include an unknown number of whole cycles, but that number must be the same since last phase lock as indicated by the LOCKTIME field.

Name: PR

This is the eight-byte measured pseudorange from the satellite to the receiver, in seconds. For this field, the measurement is scaled by a multiplication factor of $3.0\text{x}10^{10}$. Use the following equation to convert to pseudorange in meters.

Pseudorange (m) = [(speed of light)/$3.0\text{x}10^{10}$] x (PR) = [$0.999308193\text{x}10^{-2}$] x (PR).

The speed of light used is $2.99792458\text{x}10^{8}$ m/sec.

Name: RATE

This is the measured rate of change of the cycle counter (PHASE), in units of 10^{-4} cycles per second. To convert to cycles per second, multiply the reported number by 0.0001.

There is a close correlation between the RATE and the total increment/decrement in the PHASE number from epoch to epoch. The sign convention for the MACM message is that RATE is positive for increasing distance, and therefore increasing PHASE count.

Name: LOCKTIME

This is a four-byte unsigned integer counter that is incremented at a constant rate for as long as an individual satellite is maintained in continuous track or a vendor-specific maximum value is reached. The rate can be vendor-specific but must be equal to or greater than the GNSS epoch rate. An incrementing or repeated non-zero value indicates continual PHASE lock. If the lock counter is reset, track has been broken. This means that the PHASE counter may have missed some changes in cycles while track was broken. This phenomenon is called “cycle slip.”

2.3 Checksum Byte

Name: CHECKSUM

The checksum byte is a method of detecting errors in the message. The checksum is computed by exclusive-*or*ing all bytes between the sync word and the checksum. As an example, the checksum of

	(1001 0110),
	(1000 0101),
And	(1100 0001)
Is	(1101 0010)

Users of the data should independently calculate what the checksum should be and compare it to the transmitted value. A mismatch indicates that this message is corrupted.

The checksum does not provide any way to correct the message. The only choice for the user is to ignore the message. The checksum is not infallible; it is possible for corrupted messages to generate a correct checksum.

3. MACM Example

The MACM message can readily be interpreted when viewed on a hexadecimal viewer/ editor. Figure 1 shows a pair of actual MACM messages.

```
Offset(h) 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F  Decoded text

00000000  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000010  00 00 00 00 00 00 00 00 00 4D 41 43 32 00 00 06  .........MAC2...
00000020  0E A0 0C 90 40 7C 10 00 02 05 3F 24 C1 1C 27 AD  . ..@|....?$Á.'.
00000030  B6 83 39 E0 7A B4 24 64 00 96 BE 29 00 09 6D 48  ¶ƒ9àz´$d.–¾)..mH
00000040  18 05 3F 29 C1 39 82 89 7C 1B 61 A4 89 33 D2 34  ..?)Á9‚‰|.a¤‰3Ò4
00000050  FE 43 11 7E 00 00 95 6A 07 05 3F 2B C1 33 4F 3C  þC.~..•j..?+Á3O<
00000060  9E 05 A3 14 7E 58 D9 A6 00 0D 96 3B 00 0A 49 CB  ž.£.~XÙ¦..–;..IË
00000070  09 05 3F 28 C1 3D 92 F9 54 E0 D4 A0 8C D4 36 FA  ..?(Á=’ùTàÔ ŒÔ6ú
00000080  FF 63 5C 85 00 00 04 65 0E 05 3F 25 C1 2D BF F5  ÿc\.....e..?%Á-¿õ
00000090  B9 4D 05 18 8B F8 67 A3 00 80 9C 42 00 09 CB 08  ¹M..‹øg£.€œB..Ë.
000000A0  10 05 3F 26 C1 37 44 BB 7D 0B C6 E0 84 A7 1C E7  ..?&Á7D»}.Æà„§.ç
000000B0  FF 41 00 68 00 00 60 C7 80 00 00 00 00 00 00 00  ÿA.h..`Ç€.......
000000C0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000000D0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000000E0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000000F0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 4D 41  ..............MA
00000100  43 32 10 00 06 0E A0 33 A0 3F B8 C0 00 02 05 3F  C2.... 3 ?¸À...?
00000110  22 C1 1B 8D 09 D0 27 EE 00 7A B7 03 4B 00 97 7D  "Á...Ð'î.z·.K.—}
00000120  25 00 09 80 D0 18 05 3F 28 C1 39 F4 6A 4C F5 33  %..€Ð..?(Á9ôjLõ3
00000130  D0 89 2B 59 77 FE 43 7E 7A 00 00 A8 F2 07 05 3F  Ð‰+YwþC~z..¨ò..?
00000140  2E C1 33 4B C5 3D B7 31 A0 7E 59 1B 77 00 0D BF  .Á3KÅ=·1 ~Y.w..¿
00000150  CF 00 0A 5D 53 09 05 3F 29 C1 33 AB 98 8D F9 F9  Ï..]S..?)Á3«˜.ùù
00000160  80 8C D1 3B 75 FF 64 11 AD 00 00 12 D9 0E 05 3F  €ŒÑ;uÿd.....Ù..?
00000170  25 C1 2D 7D F9 A9 25 17 A0 8B FA DB BC 00 81 70  %Á-}ù©%. ‹úÛ¼..p
00000180  CF 00 09 DE 90 10 05 3F 26 C1 37 75 8E E2 62 4E  Ï..Þ...?&Á7uŽâbN
00000190  40 84 A3 7A FC FF 41 D6 CC 00 00 74 4F 88 00 00  @„£züÿAÖÌ..tOˆ..
000001A0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000001B0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000001C0  00 00 00 00 00 00 00 00 00 00                    ..........
```

Figure 1. Example MACM v2 Message

The first message begins at offset byte 0x00000019 and ends at byte 0x000000B8. The next message starts at byte 0x000000FE and ends at 0x0000019D. Note that the messages may be preceded and followed by other bytes that are not part of the MACM message itself. These bytes are shown as zeroes, but may be any valid binary data stream, of any length. (The extra bytes, however, should not be so numerous that the message rate cannot be met.) Table 6 is the interpretation of the first of the two MACM messages from the example above.

Table 6. Example MACM Message Breakout

Field Name	Hex Value(s)	Interpretation
MACM	4D 41 43 32	ASCII Text (“MAC2”)
Type	00	GPS L1 C/A
TFOM	00	Time accuracy < 1 ms
NUMOBS	06	6 measurement blocks
GNSSTIME	0E A0 0C 90	245370000 milliseconds 245370.0 seconds
OFFSET	40 7C 10 00	3.938477 meters
PRN	02	2
CONDITION	05 3F	Satellite Health = 1 (Healthy) PR Validity = 1 (Valid) PHASE Validity = 1 (Valid) RATE Validity = 1 (Valid) PR Iono Corrected = 1 (Corrected) PHASE Iono Corrected = 1 (Corrected) PR Tropo Corrected = 0 (Uncorrected) PHASE Tropo Corrected = 0 (Uncorrected) PHASE Polarity State = 5 (Not corrected, was correct at initial lock on) Jam Detect = 0 (None detected or suspected) Reserved = 0000b (No flags)
CN0	24	36 dB-Hz
PHASE	C1 1C 27 AD B6 83 39 E0	−461291.428234963 cycles
PR	7A B4 24 64	2058626148 seconds
RATE	00 96 BE 29	9879081
LCK_TIME	00 09 6D 48	617800
PRN	18	24
CONDITION	05 3F	Satellite Health = 1 (Healthy) PR Validity = 1 (Valid) PHASE Validity = 1 (Valid) RATE Validity = 1 (Valid) PR Iono Corrected = 1 (Corrected) PHASE Iono Corrected = 1 (Corrected) PR Tropo Corrected = 0 (Uncorrected) PHASE Tropo Corrected = 0 (Uncorrected)

		PHASE Polarity State = 5 (Not corrected, was correct at initial lock on) Jam Detect = 0 (None detected or suspected) Reserved = 0000b (No flags)
CN0	29	41 dB-Hz
PHASE	C1 39 82 89 7C 1B 61 A4	−1671817.48479281 cycles
PR	89 33 D2 34	2301874740 seconds
RATE	FE 43 11 7E	−29159042
LCK_TIME	00 00 95 6A	38250
PRN	07	7
CONDITION	05 3F	Satellite Health = 1 (Healthy) PR Validity = 1 (Valid) PHASE Validity = 1 (Valid) RATE Validity = 1 (Valid) PR Iono Corrected = 1 (Corrected) PHASE Iono Corrected = 1 (Corrected) PR Tropo Corrected = 0 (Uncorrected) PHASE Tropo Corrected = 0 (Uncorrected) PHASE Polarity State = 5 (Not corrected, was correct at initial lock on) Jam Detect = 0 (None detected or suspected) Reserved = 0000b (No flags)
CN0	2B	43 dB-Hz
PHASE	C1 33 4F 3C 9E 05 A3 14	−1265468.61727351 cycles
PR	7E 58 D9 A6	2119752102 seconds
RATE	00 0D 96 3B	890427
LCK_TIME	00 0A 49 CB	674251
PRN	09	9
CONDITION	05 3F	Satellite Health = 1 (Healthy) PR Validity = 1 (Valid) PHASE Validity = 1 (Valid) RATE Validity = 1 (Valid) PR Iono Corrected = 1 (Corrected) PHASE Iono Corrected = 1 (Corrected) PR Tropo Corrected = 0 (Uncorrected) PHASE Tropo Corrected = 0 (Uncorrected) PHASE Polarity State = 5 (Not corrected, was correct at initial lock on) Jam Detect = 0 (None detected or suspected) Reserved = 0000b (No flags)
CN0	28	40 dB-Hz
PHASE	C1 3D 92 F9 54 E0 D4 A0	−1938169.33155564 cycles

PR	8C D4 36 FA	2362717946 seconds
RATE	FF 63 5C 85	−10265467
LCK_TIME	00 00 04 65	1125
PRN	0E	14
CONDITION	05 3F	Satellite Health = 1 (Healthy) PR Validity = 1 (Valid) PHASE Validity = 1 (Valid) RATE Validity = 1 (Valid) PR Iono Corrected = 1 (Corrected) PHASE Iono Corrected = 1 (Corrected) PR Tropo Corrected = 0 (Uncorrected) PHASE Tropo Corrected = 0 (Uncorrected) PHASE Polarity State = 5 (Not corrected, was correct at initial lock on) Jam Detect = 0 (None detected or suspected) Reserved = 0000b (No flags)
CN0	25	37 dB-Hz
PHASE	C1 2D BF F5 B9 4D 05 18	−974842.86191574 cycles
PR	8B F8 67 A3	2348312483 seconds
RATE	00 80 9C 42	8428610
LCK_TIME	00 09 CB 08	641800
PRN	10	16
CONDITION	05 3F	Satellite Health = 1 (Healthy) PR Validity = 1 (Valid) PHASE Validity = 1 (Valid) RATE Validity = 1 (Valid) PR Iono Corrected = 1 (Corrected) PHASE Iono Corrected = 1 (Corrected) PR Tropo Corrected = 0 (Uncorrected) PHASE Tropo Corrected = 0 (Uncorrected) PHASE Polarity State = 5 (Not corrected, was correct at initial lock on) Jam Detect = 0 (None detected or suspected) Reserved = 0000b (No flags)
CN0	26	38 dB-Hz
PHASE	C1 37 44 BB 7D 0B C6 E0	−1524923.48846095 cycles
PR	84 A7 1C E7	2225544423 seconds
RATE	FF 41 00 68	−12517272
LCK_TIME	00 00 60 C7	24775
CHECKSUM	80	

4. Format Maintenance/Updating

This document shall be maintained and updated by the Electronic Trajectory Measurements Group of the RCC and is intended to meet the needs of the ranges for high-speed output of raw GNSS measurement data and post-test data exchange of GNSS data.

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APPENDIX A

Citations

IEEE. *IEEE Standard for Floating-Point Arithmetic*. IEEE 754-2019. 22 July 2019. May be superseded by update. Available for purchase at https://ieeexplore.ieee.org/document/8766229.

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