Range Commanders Council

DATA REDUCTION AND
COMPUTER GROUP

IRIG STANDARD 164-91

IRIG STANDARD FORMAT FOR GLOBAL POSITIONING SYSTEM (GPS) DATA FOR POST-OPERATION INTERRANGE EXCHANGE

WHITE SANDS MISSILE RANGE
KWAJALEIN MISSILE RANGE
YUMA PROVING GROUND
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RANGE COMMANDERS COUNCIL

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FOREWORD

This document provides the standard format for post-operation exchange of NAVSTAR/Global Positioning System (GPS) data between the ranges and is designed to produce an efficient and cost effective GPS data exchange format. This format is independent of the GPS receiver and provides a common exchange format minimizing range reformatting of GPS data and cost of processing GPS data and maximizing the speed and ease of GPS data exchange.

Other formats do exist. Some of these formats are F, Floating Point; I, Integer; C, character; A, ASCII (FICA); Automatic Reformatter of GPS Observations (ARGO); Receiver Independent Exchange (RINEX); and Radio Technical Commission for Maritime Service (RTCM) RTCM-104 Differential GPS Service (see references 1, 7, 8, and 9). The FICA, ARGO, and RINEX were designed primarily for the geodetic community of GPS users. The RTCM-104 Differential GPS Service is a real-time oriented format with primary emphasis on exchange of differential correction data, but it also provides for other types of GPS data. The above formats meet specific needs but do not meet the wide scope of use ranges will have for GPS data.

This IRIG 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 GPS.

TABLE OF CONTENTS

	PAGE
INTRODUCTION	1
DATA EXCHANGE MEDIA	1
DATA UNITS AND COORDINATE SYSTEMS	1
CONSTANTS	3
DATA FORMAT STRUCTURE	3
SCALED BINARY DATA	5
CHECKSUM CALCULATION	5
RECORD ID INFORMATION	6
RECORD ID DATA DESCRIPTIONS	7
SPECIAL DATA PROCESSING CONSIDERATIONS	11
FORMAT/MAINTENANCE/UPDATING	12
APPENDIX A - GPS FORMAT DATA RECORDS	A-1
REFFERENCES/BIBLIOGRAPHY	

LIST OF FIGURES

FIGURE NO.		PAGE
1	VEHICLE COORDINATE SYSTEM.....	2
2	FIXED PACKED RECORD (FPR).....	4
3	SCALED BINARY BYTE ORDER.....	5

LIST OF TABLES

TABLE NO.		PAGE
I	RECORD ID ALLOCATIONS.....	6
II	DEFINED DATA RECORDS.....	7

INTRODUCTION

This document defines a standard data format for post-operational exchange of Global Positioning System (GPS) data and related parameters. The media used to exchange GPS data shall be magnetic tape or floppy disk.

The data format is a fixed packed record (FPR) containing two general types of data records. One such record type, the ASCII record, will contain only ASCII data. The second record type, the compressed record, will contain an ASCII header and control information with the data represented as scaled binary numbers.

DATA EXCHANGE MEDIA

The formatted GPS data will be written to either magnetic tape or floppy disk for exchange between ranges. The magnetic tape exchange requirements are

standard: 9-track, 1600 Bits Per Inch
optional: 9-track, 6250 Bits Per Inch

The floppy disk is required to be MS-DOS compatible with each range providing the necessary and sufficient data as to version, density, size, and storage capacity for the floppy.

DATA UNITS AND COORDINATE SYSTEMS

The units for the GPS data shall be in metric measurements such as meters and meters/second. The reference spheroid for the GPS data will be World Geodetic System-1984 (WGS-84). The data reference system for all data will be the WGS-84 geocentric coordinate system. For specific WGS-84 data definitions and conversion from other geodetic reference systems, refer to Defense Mapping Agency (DMA) Technical Report, Supplement To Department Of Defense World Geodetic System 1984 Technical Report, Part I and Part II (see references 2 and 3) and Range Commanders Council Document 151-85, Global Coordinate System.

For local vehicle coordinate offset data, a right-hand coordinate system shall be used with respect to a defined origin on the vehicle. This local system will be used to locate antennas, Inertial Reference Units (IRU), and other equipment with respect to the defined origin on the vehicle. The local vehicle coordinate system shall be defined as

positive x-axis is forward through the front/nose of the vehicle, parallel to the longitudinal axis of vehicle;

positive y-axis is out the right side of the vehicle; and

positive z-axis will be down (see figure 1).

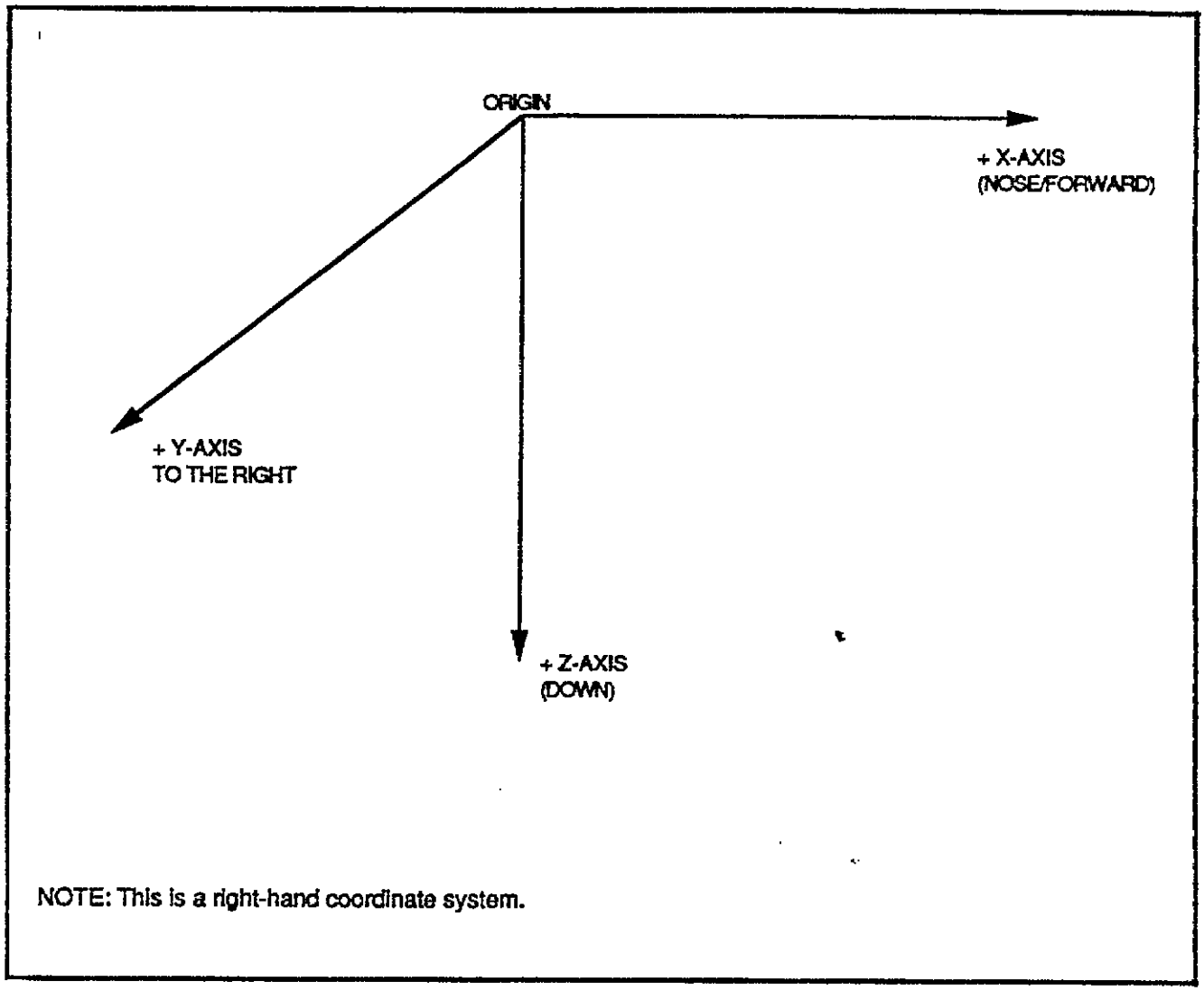

Figure 1. Vehicle coordinate system.

CONSTANTS

All physical constants and conversion factors must be consistent with Interface Control Document (ICD) ICD-GPS-200 (see reference 4). This restriction is to ensure correct conversion and use of the GPS space segment data collected by the GPS User Equipment (UE). The following constants from ICD-GPS-200 are critical for correct use of space segment transmitted data:

$$\text{speed of light (c)} = 2.99792458 \times 10^{8} \text{ meters/second}$$

$$\text{pi} = 3.1415926535898$$

DATA FORMAT STRUCTURE

The data format structure is a set of 1 to n FPR containing 2048 bytes of information. Each FPR will contain a five character record number which is the sequential number of the FPR within the data file. An FPR will contain from 1 to n logical data records and a filler record if required to complete the 2048 bytes.

All logical data records except the filler record will have start and end delimiters to facilitate use when data is exchanged on floppy disk. The start delimiter is 2 bytes in length: an ASCII character DLE (10 Hex) followed by an ASCII character STX (02 Hex). The end is also 2 bytes in length: an ASCII character DLE (10 Hex) followed by an ASCII character ETX (03 Hex).

Following the start delimiter, each logical data record except the filler record, will contain a three-byte record ID and a four-byte record length followed by data. The end delimiter will then terminate the data record.

The filler record is a unique data record which is used to pad the FPR to 2048 bytes when the logical data records do not completely utilize the FPR. A filler record can consist of only the start delimiter and the block ID for a minimum size of 5 bytes. If there are more bytes needed to complete the FPR, all bytes following the block ID are an ASCII character CNTRL-V (16 Hex). The filler record does not use an end delimiter. See figure 2 for a schematic of the data structure.

As stated previously, an FPR is exactly 2048 bytes long. In the case of magnetic tape, it is a physical record with successive FPRs separated by an interrecord gap. However, in the case of a floppy disk, a logical structure is used. In figure 2, within each FPR, the first 5 bytes are reserved for an ASCII record number. The remainder of the record will contain one or more logical data records, and the FPR will most likely be terminated by a filler record (record ID = 999). A filler record contains a minimum of 5 bytes plus 0 to n bytes of CNTRL-V (16 Hex) to fill the FPR.

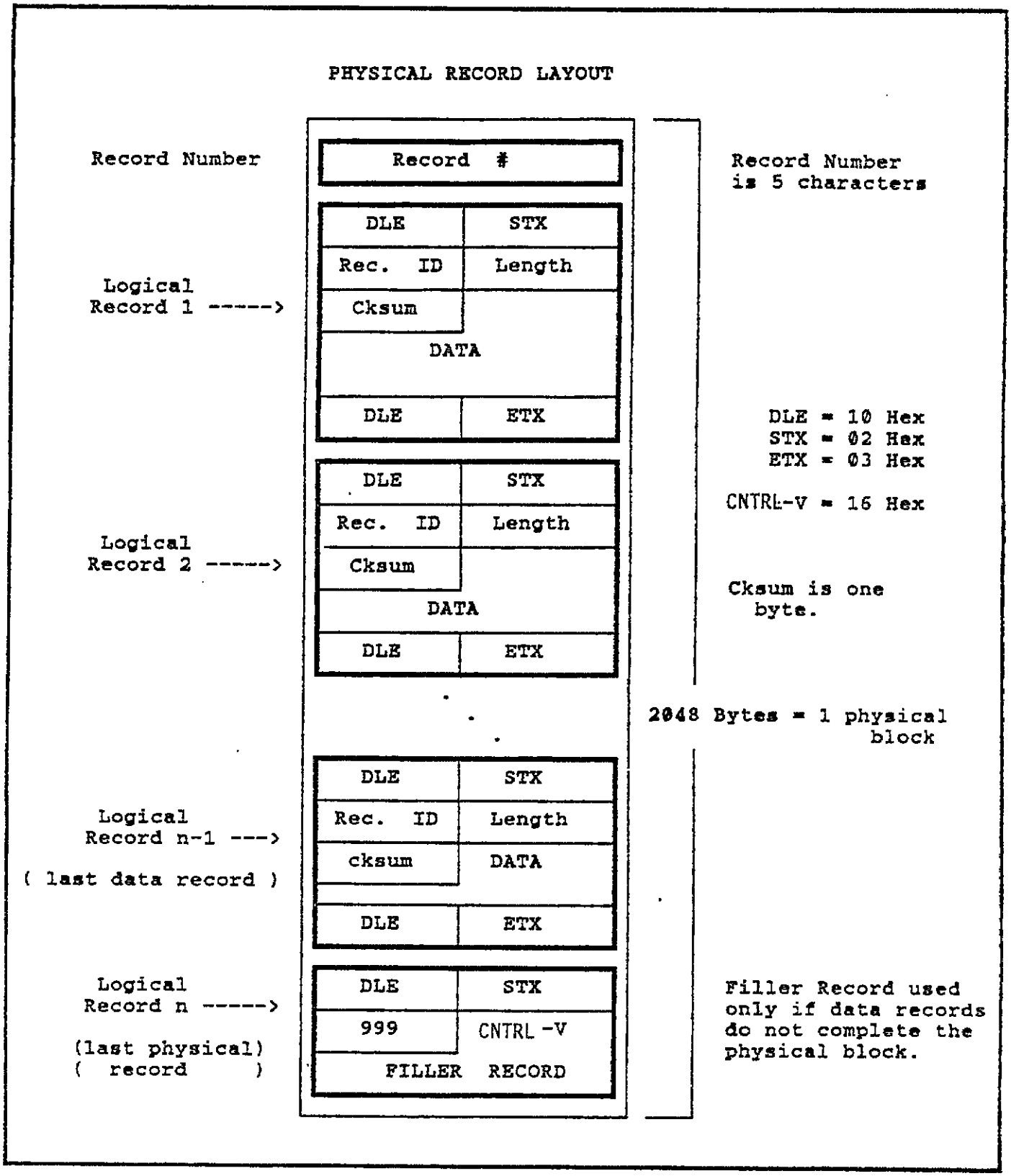

Figure 2. Fixed packed record.

Note that only 2043 bytes are available for logical data records. The FPR shall be generated in such a way that a logical record ends on the FPR byte boundary or at least 5 bytes must be available for a filler record to be output.

SCALED BINARY DATA

The scaled binary data shall be represented using 2, 4, and 8 byte boundaries for the data. Negative numbers shall be represented by the 2s complement form. The scaled binary data shall be represented from left to right with the high order byte of information being in the left most byte. Figure 3 shows the byte order and where the most significant bit (MSB) and the least significant bit (LSB) are in the scaled binary words.

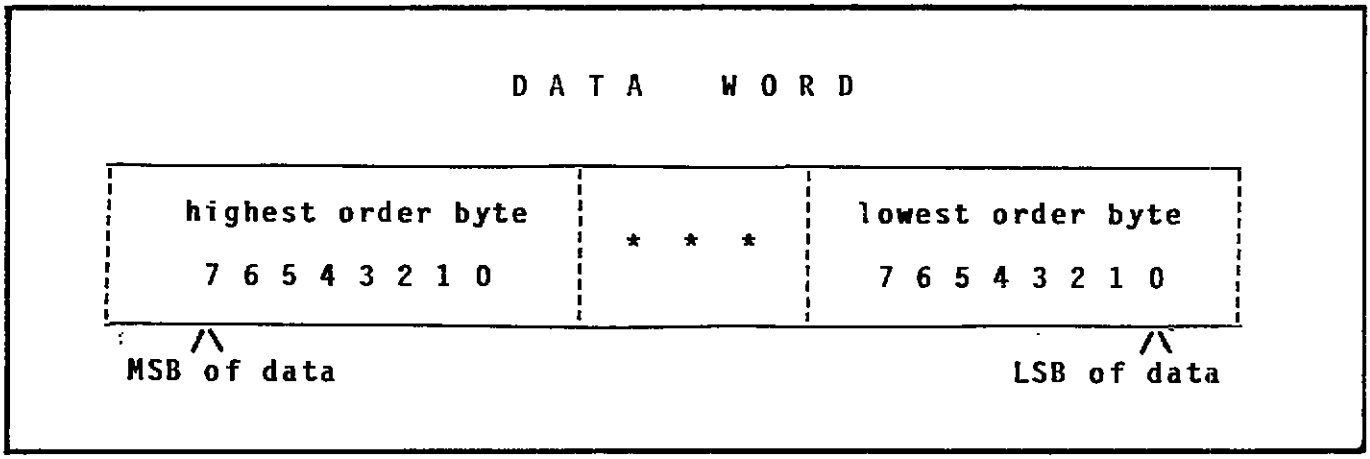

Figure 3. Scaled binary byte order.

CHECKSUM CALCULATION

The checksum of the data shall be computed using the exclusive OR of the data bytes. Compute the checksum (variable cksum) of the data block by

```
cksum = b1
DO i  = 2,n
cksum = XOR (cksum, bi)
ENDDO
```

where b_i is the ith data byte in the record, n = number of data bytes in the record (excluding the record ID, record length, and checksum), and XOR is the bitwise exclusive OR function operator.

RECORD ID INFORMATION

Record IDs shall be defined for specific data and have unique ID numbers from 1 to 999. Record ID numbers 0, 499, 500, 501, 507, and 510 are not defined but held in reserve. Record ID numbers 1 to 498 are used for ASCII data record types. An ASCII record type contains data represented by ASCII characters. Record ID numbers 501 to 998, excluding 501, 507, and 510, are reserved for compressed data records. A compressed data record contains data represented by scaled binary numbers. The compressed record type is used to conserve space and allow more efficient use of the storage media. The intent of the parsing 1 to 498 for ASCII records and 501 to 998 for compressed data records is to have a parallelism between the ASCII and compressed record types. The ASCII record numbers 401 through 498 and compressed record numbers 901 to 998 are reserved for range specific data.

Record IDs 501, 507, and 510 are not defined because they contain primarily descriptive information or commentary which is best provided in ASCII format. Also, it is anticipated these record types will only occur a few times in a data set.

Record ID 999 is the record ID for the filler record described in section Data Format Structure. Record ID assignment for use of these IDs should be coordinated with the Data Reduction and Computer Group, Range Commanders Council. Table I is a summary of the record ID allocations.

TABLE I. RECORD ID ALLOCATIONS

RECORD ID	DATA TYPE	USE
{0, 499, 500 501, 507, 510}	Not specified	Not available
{1 - 498}	ASCII	General data exchange
{401 - 498}	ASCII	Reserved for range specific data
{501 - 998}	COMPRESSED	General data exchange
{501, 507, 510}	COMPRESSED	Not used
{901 - 998}	COMPRESSED	Reserved for range specific data
{999}	ASCII	Unique, used for filler control

Table II is a summary of the presently defined data records.

TABLE II. DEFINED DATA RECORDS

RECORD ID	DATA TYPE	RECORD NAME
001	ASCII	INITIALIZATION
002	ASCII	RAW MEASUREMENT
003	ASCII	SATELLITE VEHICLE (SV) INFO
004	ASCII	ALMANAC
005	ASCII	DIFFERENTIAL CORRECTION GPS
006	ASCII	TSPI
007	ASCII	COMMENTS/MESSAGE
008	ASCII	METEOROLOGY
009	ASCII	IRU/INS DATA
010	ASCII	PARTICIPANT DATA
011	ASCII	TIMING DATA
012	ASCII	EPHEMERIS DATA
501	COMPRESSED	Not defined
502	COMPRESSED	RAW MEASUREMENT
503	COMPRESSED	SATELLITE VEHICLE (SV) INFO
504	COMPRESSED	ALMANAC
505	COMPRESSED	DIFFERENTIAL CORRECTION GPS
506	COMPRESSED	TSPI
507	COMPRESSED	Not defined
508	COMPRESSED	METEOROLOGY
509	COMPRESSED	IRU/INS DATA
510	COMPRESSED	Not defined
511	COMPRESSED	TIMING DATA
512	COMPRESSED	EPHEMERIS DATA
999	ASCII	FILLER RECORD

RECORD ID DATA DESCRIPTIONS

A general description of the data information associated with each data record ID is provided in this section. For the detailed data associated with each data record, see appendix A for the ASCII and compressed data formats and definitions. The header and control for the data records was previously defined in sections Data Format Structure and Record ID Information.

Initialization Data Record (ID = 001)

The initialization data record is a fixed length ASCII data record. Compressed data record ID = 501 is not defined. This record contains the volume serial number of the recording media, information pertaining to date and format version used to generate the subsequent data records, range ID, range point of contact for the data, classification, operation ID, test time and date information, and date and time of data generation. In addition, a comments field is included. The comments field should be used to provide any other pertinent information with respect to the operation or data. The comments are free-form data allowing all ASCII characters. Users of the comment area are encouraged to format comments for 80 character line breaks.

Raw Measurement Data Record (ID = 002/502)

The raw measurement data record is a variable length data record with the size dependent on the number of GPS receiver channels that have collected data. This record has an ASCII format with ID = 002 and has a counterpart compressed data record with ID = 502. The data contained in these records are participant ID, time and date information, and data collected from 1 to 31 satellites. The data associated with each satellite are the code, frequency, estimated signal strength C/N, channel number and bias, antenna ID, pseudo-range, delta range, and integrated carrier phase data. These data are provided for the ranges which elect to generate solutions from the "raw" or fundamental GPS data.

Satellite Vehicle Record Data (ID = 003/503)

The satellite vehicle data record is a fixed length record containing data associated with a particular GPS satellite. This record has an ASCII format with ID = 003 and a counterpart compressed data record with ID = 503. The satellite data record contains the participant ID, time and date information, and data from the space segment transmitted on page 1 of the GPS message defined in ICD-GPS-200. These data provide information for status evaluation and data to compute the geocentric x, y, and z position of the tracked GPS satellite. Additional data in this record from page 1 of the GPS message are satellite status information, clock bias information, and broadcast ephemeris data. This record will be generated for each satellite tracked, and it will also be output every time a satellite has a new or updated ephemeris available.

Almanac Record Data (ID = 004/504)

The almanac data record is a fixed length record associated with the almanac from a particular GPS satellite. This record has an ASCII format with ID = 004 and has a counterpart compressed data record with ID = 504. The almanac data record contains the participant ID, time and date information as to which satellite collected the almanac, identification of the satellite whose almanac data is available in this record, 10 parameters of almanac data for the satellite, and satellite health status. The almanac data are similar to the space segment transmitted GPS message as defined in ICD-GPS-200, except

where noted in the format specification in the appendixes. This record will be generated for each satellite in the constellation.

Differential Data Record (ID = 005/505)

The differential data record is a variable length record with the size dependent on the number of GPS satellites for which differential corrections were calculated. The data in this record are primarily measured space segment bias obtained from a fixed ground reference GPS system. This record has an ASCII format with ID = 005 and has a counterpart compressed data record with ID = 505. This data contains participant ID, time and date information, pseudo-range and range rate data collected from 1 to 15 satellites/pseudo-lites. The data associated with each satellite are the code, frequency, and flags to indicate the application of ionospheric and tropospheric corrections to the differential corrections. The differential correction data (bias) for each satellite are the pseudo-range and range rate data along with their respective 1 σ error estimates. These data are provided for the ranges which elect to improve their GPS solutions using the pseudo-range differential corrections. See section Special Data Processing Considerations for considerations needed to ensure that proper differential correction data are provided in this record.

Time-Space-Position Information (TSPI) Data Record (ID = 006/506)

The TSPI data record is a fixed length record of GPS derived time and space position data for the indicated participant. This record has an ASCII format with ID = 006 and a counterpart compressed data record with ID = 506. The TSPI record contains the participant ID, time and date information, position, and velocity availability flags, acceleration, and attitude data and their associated error estimates (1 σ). Provision is also made for the error estimates (1 σ) in geocentric and local tangent plane position. It is recommended that the local tangent plane data be generated from geocentric data in accordance with the algorithms specified in Range Commanders Council document 151-85 (see reference 6).

Comment Data Record (ID = 007)

The comment data record is a fixed length record used to provide information and comments on the data provided using the GPS exchange format. This record has an ASCII format with ID = 007. Compressed data record ID = 507 is not defined. The comment data record shall contain any information or comments pertinent to the data. It is recommended that users format the data in this record with 80 character line breaks.

Meteorology Data Record (ID = 008/508)

The meteorology data record is a fixed length record used to provide information with respect to collected meteorology data. This record has an ASCII format with ID = 008 and has a counterpart compressed data record with ID = 508. This record shall contain the participant ID, time and data information, meteorology station identification, temperature, pressure, and humidity data along with the

altitude at which these data were collected. These data are provided for those ranges which elect to generate solutions from the "raw" or fundamental GPS data.

Inertial Reference Unit/Inertial Navigation System (IRU/INS) Data Record (ID = 009/509)

The IRU/INS data record is a fixed length data record used to provide information associated with any inertial systems on the vehicle. This record has an ASCII format with ID = 009 and has a counterpart compressed data record with ID = 509. This record shall contain the participant ID, time and date information, output attitude data, delta velocities, accumulated delta velocities and quaternions. Specific status calibration information for the IRU/INS will be found in the participant record (ID = 10). Furthermore, if a range elects to provide more detailed information, the use of range specific 400 ID could be defined by the range to transmit these data/information. These data are provided for those ranges which elect to generate solutions from the "raw" or fundamental GPS data.

Participant Data Record (ID = 10)

The participant data record is a fixed length record used to provide information related to specific GPS UE and its configuration on a vehicle. This record has an ASCII format with ID = 010. Compressed data record ID = 510 is not defined. This record shall contain the participant ID for the specified GPS UE and a field of 80 characters which describe the vehicle/platform configuration. The record also contains a field that indicates how many other GPS UE systems (participants) are on the vehicle. Flags and information are provided to indicate corrections and configuration of the GPS equipment, time frequency standards, antennas, and IRU/INS equipment related to the GPS identified by the participant ID. Provision is made for logging the manufacturer, model, and serial number of the hardware and software used by the participant. Initial participant position/location data fields are provided as are fields for lever-arm/offsets for the IRU/INS and for the antennas. These data are in the vehicle coordinate reference system as defined in section Data Units And Coordinate Systems.

Timing Data Record (ID = 011/511)

The timing data record is a fixed length data record used to provide information to correlate the various time tags associated with GPS and range data on the vehicle/participant. This record has an ASCII format with ID = 001 and a counterpart compressed data record with ID = 511. This record shall contain the participant ID, timing data associated with the range and GPS data, and the data from ICD-GPS-200 available to generate UTC time associated with the GPS time.

Precise Ephemeris Data Record (ID = 012/512)

The precise ephemeris data record will be a variable length record that provides the precise ephemeris data for a specified time frame for all satellites. This record has an ASCII format with

ID = 012 and has a counterpart compressed data record with ID = 512. This record shall contain the participant ID, time and date information, and geocentric position and velocity data for the satellites at specified time intervals.

Filler Data Record (ID = 999)

The filler data record is a unique variable length data record used to pad an FPR to its full 2048 bytes. It is used when the logical data records do not completely fill the FPR. The filler record can consist of only the header delimiters and the record ID for a minimum size of 5 bytes. However, if there are more bytes needed to complete the FPR, all bytes following the record ID are a CNTRL-V (16 Hex). No end delimiter is used with this record. This record has an ASCII format with ID = 999.

SPECIAL DATA PROCESSING CONSIDERATIONS

Because of different satellite ephemeris data possibly being used at the reference site and on GPS instrumented vehicles, care must be taken to provide the proper differential corrections in record ID = 005/505. Ranges calculating GPS differential solution data must provide the correct differential GPS correction data. To ensure proper differential processing, ranges should calculate a GPS differential solution by processing raw measurements (ID = 002/502) using the same satellite vehicle information (ID = 003/503) utilized by the reference receiver participant in calculating the differential corrections (ID = 005/505). That is, the satellite vehicle data Index of Data Clock (IODC) and Index of Data Ephemeris (IODE) should be monitored, so the appropriate ephemeris data will be used to calculate the differential corrections that are applicable to the raw measurement data. See appendix A, space vehicle data ID = 003/503 for definitions of IODE and IODC. For post-mission data, the satellite vehicle data used to calculate the differential data should be the last satellite vehicle data (ID = 003/503) which precedes the differential data record (ID = 005/505) data on the file.

Because ranges may use unique methods for conversion of various UE measurement data/information to calculate GPS pseudo-range and related data, each range shall provide a comment record (ID = 007) defining the methods and algorithms used to provide the data for the raw measurement data record (ID = 002/502).

It is recognized that a supplement to this document is required for definition of optimal conversion of GPS UE output measurements to the format specified for the raw measurement record (ID = 002/502). This supplement should provide algorithms or software that accomplish these conversions. Ideally, such algorithms or software should be provided by the UE manufacturers themselves.

A comment record (ID = 007) to indicate whom or where precise ephemeris data was generated is recommended for ranges which used

precise ephemeris data in generating data or will be exchanging precise ephemeris data for the satellites.

To eliminate input problems with the ASCII records, IDs 001 to 498, fields experiencing either overflow or underflow shall be set to blanks rather than asterisks.

FORMAT MAINTENANCE/UPDATING

This document shall be maintained and updated by the Data Reduction and Computer Group of the Range Commanders Council and is intended to meet the needs of the ranges for post-test data exchange of GPS data.

APPENDIX A

GPS DATA RECORD FORMAT

TABLE OF CONTENTS

ASCII DATA RECORDS:

Record 001 : Initialization Data ..... A- 5

Record 002 : Raw Measurement Data ..... A- 7

Record 003 : Satellite Vehicle Information Data A-10

Record 004 : Almanac Data A-13

Record 005 : Differential Data A-15

Record 006 : Time Space Position Information Data A-17

Record 007 : Comments Data A-20

Record 008 : Meteorology Data A-21

Record 009 : Inertial Reference Unit Data A-22

Record 010 : Participant Data A-24

Record 011 : Timing Data A-28

Record 012 : Ephemeris Data A-30

COMPRESSED DATA RECORDS:

Record 502 : Raw Measurement Data A-32

Record 503 : Satellite Vehicle Information Data A-35

Record 504 : Almanac Data A-38

Record 505 : Differential Data A-40

Record 506 : Time Space Position Information Data A-42

Record 508 : Meteorology Data A-45

Record 509 : Inertial Reference Unit Data A-46

Record 511 : Timing Data A-48

Record 512 : Ephemeris Data A-50

UNIQUE RECORD:

Record 999 : Filler Data A-52

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 001
RECORD NAME: Initialization
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		1	
Record_length	I4	4	Bytes	2031	This record is a fixed length record.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Volume #	I2	2		0 - 99	Volume serial Number of recording media
Date of Format Standard	A6	6	Day Month Year		The date of the format standard being used (ddmmyy).
Format control Number	A5	5			Format Control number/ID.
Data originator	A5	5			Range ID
Pt.of Contact	A20	20			Name of person/organization that generated the data.
Classification	A1	1		[U, C, S, T]	Single character to indicate data classification, e.g. U --> Unclassified, C --> Confidential, S --> Secret, T --> Top Secret
Operation ID	A20	20			Operation ID.
Test year	I2	2	Year	0 - 99	Last two digits of the year of the test.
Test Julian Day	I3	3	Days	0 - 366	Starting Julian day of the test.
Test Hour	I2	2	Hours	0 - 23	Hour of start of the test.
Test Minutes	I2	2	Minutes	0 - 59	Minutes of the start of the test.
Test Seconds	I2	2	Seconds	0 - 59	Seconds of the start of the test.
Data Tape Created Year	I2	2	Year	0 - 99	Last two digits of the year of the tape generation.
Julian Day	I3	3	Days	0 - 366	Julian day of generation of data tape.
Hours	I2	2	Hours	0 - 23	Hour of Tape generation.
Minutes	I2	2	Minutes	0 - 59	Minutes of Tape generation.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 991
RECORD NAME: Initialization
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Comments	Char	1952			Free form character data all ASCII characters allowed. User's are encouraged to format for 81 char line breaks for ease of reading.

RCC DRACG GPS DATA FORMAT

REC ID NO. : 002
RECORD NAME: Raw Measurement
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		2	
Record_length	I4	4	Bytes	141+(n-1)*63 Min = 141 Max = 2031	This record is a variable length record, where n is the number of data set code and freqency combinations and ranges from 1 to 31. See Notes at end of data definition.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS Participant ID
Time Quality	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not avaliable, it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Equip. Time	F17.10	17	Seconds		Equipment clock time of the GPS data. If the value is not valid or not available, it should be to 999999.9999999999.
Delta Range Meas. Time Int.	F14.10	14	Seconds		Measurement time interval of delta range data
Number of measurement sets	I2	2		1 - 31	Number of sets of data reporting for this record.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 002
RECORD NAME: Raw Measurement
DATE: 10/25/89

The following data are repeated for the SV's and associated code and freq. At least 1 SV must be available for this record to exist.

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
SV ID	I2	2	PRN # of SV	1 - 36	Satellite/Pseudolite ID
Code	A4	4		C, P, C+P, Y, C+Y	Tracking code for operation this GPS unit. C--> C/A, P--> P Code, C+P--> C/A and P code Y--> Y code, C+Y--> C/A and Y code operation.
Freq	A4	4		1, 2, 3, 1+2, 1+3 2+3, 1-2, 3-2, 1M2 1M3, 2M3	Freq. the GPS unit was operated. 1--> L1, 2--> L2, 3--> L3, 1+2--> L1 and L2, 1+3--> L1 and L3, 2+3--> L2 and L3, 1-2--> L1-L2, 1M2--> (L1+L2)/2, 1M3--> (L1+L3)/2, 2M3--> (L2+L3)/2
C/N	I2	2	db		Estimated Signal Strength
Channel #	I2	2		0 - 99	Data collection Channel Number
Channel Bias	F6.2	6	Meters		Channel bias
Antenna #	A1	1			Antenna the data collected with (see Participant Data record for antenna information).
Data Quality	I1	1		0 - 8	Data quality indicator where : 0 = No data are valid 1 = Pseudorange data valid 2 = Delta Range data valid 3 = Pseudorange, Delta Range data valid 4 = Int. Carrier Phase data valid 5 = Pseudorange, Int. Carrier Phase data valid 6 = Delta Range, Int. Carrier Phase data valid 7 = All data are valid 8 = Questionable whether all data are valid
Pseudorange	F14.2	14	Meters		Pseudorange data associated with specified code and freq for above Epoch
Delta Range	F12.4	12	Meters		Delta carrier phase data
Integrated Carrier Phase	F15.3	15	Cycles		Integrated Carrier Phase data

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 002
RECORD NAME: Raw Measurement
DATE: 10/25/89

Notes :

All alpha-numeric (A) formats are right justified, i.e. leading blanks if field is not completely filled with characters.

The number of raw data groups in this record is dependent on the satellites tracked and the associated code and frequency data recorded in the particular data set. Thirty-one (31) groups can be written in a record.For example this record could contain 14 satellites with L1 and14 SV's with L2 frequencyand 4 SV's with data available from any combination of the frequenciesi.e. (L1+L2)/2. These combinations are determined from the Code and Freq information.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 003
RECORD NAME: Satellite Vehicle (SV) Information
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		3	
Record_length	I4	4	Bytes	413	This record is a fixed length record.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS Participant ID
Time Quality*	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not avaliable, it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available it should be set to 99999.9999.
Authorized Flag	A1	1		[Y, N]	Flag to indicate authorized data use.
Satellite ID	I2	2	PRN # of SV	0 - 36	PRN number of the satellite or pseudolite
SV Status info:					See ICD-GPS 200 data record 1 page 71 for next 7 items. (Subframe 1 data)
Code on L2	A2	2	Discrete	[00, 01, 10]	L2 channel status 00 = Reserved 01 = P-code on 10 = C/A code on
GPS week	I4	4	Weeks	0 - 9999	Week number associated with ephemeris data
SV Accuracy	A4	4	Discrete		SV Accuracy info
SV Health	A6	6	Discrete		SV Health info

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 003
RECORD NAME: Satellite Vehicle (SV) Information
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
L2 P flag	A1	1	Discrete		L2 P-code on/off flag
T GD	D16.10	16	Seconds		Group Delay time correction term
IODC	I6	6	Seconds		Index of data, Clock
SV clock bias					See ICD-GPS 200 data block 1 page 71 for next 4 items. (Subframe 1 data)
t oc	D16.10	16	Seconds		Time of clock data
a f0	D16.14	16	Seconds		Timing polynomial coefficient
a f1	D16.14	16	Sec/Sec		Timing polynomial coefficient
a f2	D16.14	16	Sec/Sec**2		Timing polynomial coefficient
Ephemeris data:					See ICD-GPS-200 Ephemeris data definitions pgs 80-31
IODE	I6	6			Index of data Ephemeris
C rs	D16.10	16	Meters		Amplitude of Sine Harmonic correction - Orbit Radius
delta n	D16.10	16	Semi-circles/sec		Mean motion difference from computed value
M o	D16.10	16	Semi-circles		Mean Anomaly at ref time
C uc	D16.10	16	Radians		Amplitude of Cosine Harmonic correction - Arg of Lat
Eccentricity	D16.10	16			Eccentricity
C us	D16.10	16	Radians		Amplitude of Sine Harmonic correction - Arg of Lat
A**0.5	D16.10	16	(Meters)**0.5		Sq Rt Semi-major Axis
t oe	D16.10	16	Seconds	0 - 604784	Reference time Ephemeris

RCC DRECG GPS DATA FORMAT

REC ID NO. : 003
RECORD NAME: Satellite Vehicle (SV) Information
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
C_{ic}	D16.10	16	Radians		Amplitude of Cosine Harmonic correction - Ang.of Incl
$(OMEGA)_0$	D16.10	16	Semi-circles		Right Ascension at reference time
C_{is}	D16.10	16	Radians		Amplitude of Sine Harmonic correction - Ang. of Incl
i	D16.10	16	Semi-circles		Inclination angle at reference time
C_{rs}	D16.10	16	Radians		Amplitude of Cosine Harmonic correction-Orbit Radius
omega	D16.10	16	Semi-circles		Argument of Perigee
OMEGADOT	D16.10	16	Semi-circles/Sec		Rate of Right Ascension
IDOT	D16.10	16	Semi-circles/Sec		Rate of Inclination

Notes :

All alpha-numeric (A) formats are right justified, i.e. field has leading blanks if field is not completely filled with characters.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 004
RECORD NAME: Almanac
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		4	
Record_length	I4	4	Bytes	199	This record is a fixed length record.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS Participant ID
Time Quality*	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not avaliable, it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available it should be set to 99999.9999.
GPS Week	I4	4	Weeks	0 - 9999	GPS week of applicability of data (From 8 bits from Subframe 5 page 25 (Wa))
SV Collector	I2	2	PRN # of SV	0 - 36	PRN number of the satellite that collected the almanac data
Satellite ID	I2	2	PRN # of SV	0 - 36	PRN number of the Satellite or Pseudolite
Almanac data:					See ICD-GPS-200 pages 90-91.
Eccentricity	D14.8	14			Eccentricity
t_{oa}	D14.8	14	Seconds	0 - 602112	Reference Time of Almanac
Inclination**	D14.8	14	Semi-circles		Inclination angle at reference time

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 004
RECORD NAME: Almanac
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
OMEGADOT	D14.8	14	Semi-circles/sec		Rate of Right Ascension
A**0.5	D14.8	14	(Meters)**0.5		Sq Rt Semi-major Axis
$(OMEGA)_0$	D14.8	14	Semi-circles		Right Ascension at reference time
omega	D14.8	14	Semi-circles		Argument of Perigee
M_0	F14.8	14	Semi-circles		Mean Anomaly at reference time
a_{f0}	D14.8	14	Seconds		Timing polynomial coefficient
a_{f1}	D14.8	14	Seconds/sec		Timing polynomial coefficient
SV Health	A6	6	Discrete		SV Health Status from Subframes 4&5 page 25.

Note :

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

** This value is the true inclination and not the Del_i, which is relative to i_0 = 0.30 semi-circles. Omegadot, a_{f0}, and a_{f1} have been scaled to allow compression of the data.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 005
RECORD NAME: Differential
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		5	
Record_length	I4	4	Bytes	[87+(n-1)*35] Min = 87 Max = 577	This record is a variable length record, where n is the number of SV's available and ranges from 1 to 15.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS Participant ID
Time Quality*	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Zenith_corr	F5.2	5	Meters		Zenith correction data, if not available, it should be set to 2.20.
Number of SV's	I2	2		1 - 15	Number of SV's and Pseudolites reporting data

The following data are repeated for the number of SV's available, at least 1 SV must be available for this record to exist.

SV ID	I2	2	PRN # of SV	1 - 36	Satellite/Pseudolite ID
Code	A4	4		C, P, C+P, Y, C+Y	Tracking code for operation of this GPS unit. C--> C/A, P--> P Code, C+P--> C/A and P code Y--> Y code, C+Y--> C/A and Y code operation.

RCC DRECG GPS DATA FORMAT

REC ID NO. : #05
RECORD NAME: Differential
DATE: 10/25/89

PARAMETER	TYPE	BITS SIZE	UNITS	RANGE	COMMENTS
Freq	A4	4		1, 2, 3, 1+2, 1+3, 2+3, 1-2, 3-2, 1M2, 1M3, 2M3	Freq. the GPS unit was operated. 1--> L1, 2--> L2, 3--> L3, 1+2--> L1 and L2, 1+3--> L1 and L3, 2+3--> L2 and L3, 1-2--> L1-L2, 1M2--> (L1+L2)/2, 1M3--> (L1+L3)/2, 2M3--> (L2+L3)/2
Authorized Flag	A1	1		[Y,N]	Flag to indicate use of authorized or unauthorized correction
Iono Flag	A1	1		[Y,N]	Flag to indicate ionospheric correction applied
Tropo Flag	A1	1		[Y,N]	Flag to indicate tropospheric correction applied
Diff PseudoRange Correction**	F8.2	8	Meters		Differential Pseudorange correction from ref. site
Diff Range Rate Correction**	F6.3	6	Meters/Sec		Diff. Pseudorange-rate correction from ref. site
1-Sigma Diff PseudoRange Correction	F4.1	4	Meters		1-Sigma Differential Pseudorange correction from ref. site.
1-Sigma Diff Range Rate Correction	F4.1	4	Meters/Sec		1-Sigma Diff Pseudorange-rate correction from ref. site.

Notes :

All alpha-numeric (A) formats are right justified, i.e. field has leading blanks if field is not completely filled with characters.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

** If the values of the Differential Pseudo-range and Differential Range Rate corrections are maximum values of the data field or are minimum values of the data field, then these parameters represent a positive and negative out-of-range value of these data respectively.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 006
RECORD NAME: TSPI
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		6	
Record_length	I4	4	Bytes	276	This record is a fixed length record.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS Participant ID
Time Quality*	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not avaliable, it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Vel Data Flag	A1	1		[Y,N]	Flag to indicate if velocity data are available
Acc Data Flag	A1	1		[Y,N]	Flag to indicate if acceleration data are available
Attitude Flag	A1	1		[Y,N]	Flag to indicate if Attitude data are available
X position	F14.4	14	Meters		Geocentric X position in WGS-84
Y position	F14.4	14	Meters		Geocentric Y position in WGS-84
Z position	F14.4	14	Meters		Geocentric Z position in WGS-84

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 006
RECORD NAME: TSPI
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
X velocity	F10.4	10	Meters/Sec		Geocentric X velocity in WGS-84
Y velocity	F10.4	10	Meters/Sec		Geocentric Y velocity in WGS-84
Z velocity	F10.4	10	Meters/Sec		Geocentric Z velocity in WGS-84
X acceleration	F10.4	10	Meters/Sec**2		Geocentric X acceleration in WGS-84
Y acceleration	F10.4	10	Meters/Sec**2		Geocentric Y acceleration in WGS-84
Z acceleration	F10.4	10	Meters/Sec**2		Geocentric Z acceleration in WGS-84
Heading	F8.5	8	Radians	0 - 2*Pi	True Heading
Pitch	F8.5	8	Radians	± Pi	
Roll	F8.5	8	Radians	± Pi	
Yaw	F8.5	8	Radians	± Pi	
Pitch Rate	F8.5	8	Radians/Sec		
Roll Rate	F8.5	8	Radians/Sec		
Yaw Rate	F8.5	8	Radians/Sec		
1-sigma X	F5.1	5	Meters		1-sigma estimate geocentric X position
1-sigma Y	F5.1	5	Meters		1-sigma estimate geocentric Y position
1-sigma Z	F5.1	5	Meters		1-sigma estimate geocentric Z position
1-sigma X-vel	F5.1	5	Meters/Sec		1-sigma estimate geocentric X velocity
1-sigma Y-vel	F5.1	5	Meters/Sec		1-sigma estimate geocentric Y velocity
1-sigma Z-vel	F5.1	5	Meters/Sec		1-sigma estimate geocentric Z velocity
1-sigma X-acc	F5.1	5	Meters/Sec**2		1-sigma estimate geocentric X acceleration
1-sigma Y-acc	F5.1	5	Meters/Sec**2		1-sigma estimate geocentric Y acceleration
1-sigma Z-acc	F5.1	5	Meters/Sec**2		1-sigma estimate geocentric Z acceleration

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 006
RECORD NAME: TSPI
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
1-sigma Horiz	F5.1	5	Meters		1-sigma estimate (X,Y) Local Tangent Plane position**
1-sigma Vert	F5.1	5	Meters		1-sigma estimate Z Local Tangent Plane position**
1-sigma Pitch	F5.1	5	Radians		1-sigma estimate Pitch
1-sigma Roll	F5.1	5	Radians		1-sigma estimate Roll
1-sigma Yaw	F5.1	5	Radians		1-sigma estimate Yaw

Note :

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

** Use of the transformation algorithms presented in RCC, DR&CG Document 151-85 are recommended to generate these local tangent plane values.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 007
RECORD NAME: Comment
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		7	
Record_length	I4	4	Bytes	2031	This record is a fixed length record.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Comments	Char	2031			This record is available to provide comments as are allowed. Users are encouraged to format data for 80 character line breaks for ease of reading.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 008
RECORD NAME: Meteorology
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		8	
Record_length	I4	4	Bytes	89	This record is a fixed length record.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS Participant ID
Time Quality*	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not avaliable, it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Station Name	A20	20			Station Name
Altitude	I6	6	Meters	[-1000 - 99999]	Signed integer, WGS-84 station altitude.
Temp.	F6.2	6	Degrees C	± 99.99	Air temperature
Pressure	F7.2	7	Millibars	0.0 - 9999.99	Air Pressure.
Humidity	F5.1	5	% Humidity	0 - 100%	% Humidity

Note :

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 009
RECORD NAME: IRU/INS
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		9	
Record_length	I4	4	Bytes	263	This record is a fixed length record.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS Participant ID
Time Quality	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Equip. Time	F17.10	17	Seconds		Equipment clock time of the IRU/INS data. If the value is not valid or not available, it should be set to 999999.9999999999.
Delta Range Meas. Time Int.	F14.10	14	Seconds		Measurement time interval of delta range data
IRU Sample rate	F5.2	5	Hertz		
Heading	F8.5	8	Radians	0 - 2*Pi	True Heading
Pitch	F8.5	8	Radians	± Pi	
Roll	F8.5	8	Radians	± Pi	
Yaw	F8.5	8	Radians	± Pi	

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 009
RECORD NAME: IRU/INS
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Pitch Rate	F8.5	8	Radians/Sec	± Pi	Navigation System Pitch Rate*
Roll Rate	F8.5	8	Radians/Sec	± Pi	Navigation System Roll Rate*
Yaw Rate	F8.5	8	Radians/Sec	± Pi	Navigation System Yaw Rate*
Snsr Pitch Rate	F8.5	8	Radians/Sec	± Pi	Raw IRU/INS Pitch Rate Measurement
Snsr Roll Rate	F8.5	8	Radians/Sec	± Pi	Raw IRU/INS Roll Rate Measurement
Snsr Yaw Rate	F8.5	8	Radians/Sec	± Pi	Raw IRU/INS Yaw Rate Measurement
Del Pitch Rate	F8.5	8	Radians/Sec	± 2*Pi	Change over the sample interval in Snsr Pitch Rate
Del Roll Rate	F8.5	8	Radians/Sec	± 2*Pi	Change over the sample interval in Snsr Roll Rate
Del Yaw Rate	F8.5	8	Radians/Sec	± 2*Pi	Change over the sample interval in Snsr Yaw Rate
Del Vel : X	F8.5	8	Meters/Sec		X Delta velocity from accelerometer
Y	F8.5	8	Meters/Sec		Y Delta velocity from accelerometer
Z	F8.5	8	Meters/Sec		Z Delta velocity from accelerometer
Acc_Del_Vel :					
X	F8.5	8	Meters/Sec		X Accumulated Delta velocity from accelerometer**
Y	F8.5	8	Meters/Sec		Y Accumulated Delta velocity from accelerometer**
Z	F8.5	8	Meters/Sec		Z Accumulated Delta velocity from accelerometer**
					(This data is the sum of the Delta Vel data)
Quaternions:					
1	F9.5	9	Microrad/100Hz		
2	F9.5	9	Microrad/100Hz		
3	F9.5	9	Microrad/100Hz		
4	F9.5	9	Microrad/100hz		

Notes :

* The Navigation System output may result from a Kalman filter rather than be raw measurement data.

** If the Accumulated Delta Velocity is not available, its value will be set to a full scale number.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 010
RECORD NAME: Participant
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		10	
Record_length	I4	4	Bytes	899	This record is a fixed length record.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS Participant ID
Time Quality*	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Vehicle Info.	A80	80			Vehicle information.
No. Nav Sys	I1	1		1 - 9	Number of navigation systems on this vehicle.
GPS Equip Mfg.	A20	20			
GPS Model/ID	A20	20			
GPS Serial no.	A20	20			
No. Channels	I2	2			Number of channels on the GPS unit.
Code	A4	4		C, P, C+P, Y, C+Y	Tracking code for operation this GPS unit. C--> C/A, P--> P Code, C+P--> C/A and P code Y--> Y code, C+Y--> C/A and Y code operation.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 010
RECORD NAME: Participant
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Freq	A4	4		1, 2, 3, 1+2, 1+3 2+3, 1-2, 3-2, 1M2 1M3, 2M3	Freq. the GPS unit was operated. 1--> L1, 2--> L2, 3--> L3, 1+2--> L1 and L2, 1+3--> L1 and L3, 2+3--> L2 and L3, 1-2--> L1-L2, 1M2--> (L1+L2)/2, 1M3--> (L1+L3)/2, 2M3--> (L2+L3)/2
Authorized	A1	1		[Y,N]	Flag to indicate if GPS unit Authorized for SA/AS
Diff. Mode Flag	A1	1		[Y,N]	Flag to indicate if unit operated in differential mode
Iono Corrected	A1	1		[Y,N]	Flag to indicate if Iono corrections applied
Iono Model info	I1	1		[0,1,2,3]	0 -->special User Iono model used, 1 -->1 freq model from ICD-GPS-200, 2 -->2 freq model from ICD-GPS-200 3 --> other model Identified in comment record.
Tropo corrected	A1	1		[Y,N]	Flag to indicate if Tropo corrections applied
Tropo Mod. info	I1	1		[0,1,2]	0 --> Meteorology data used, 1 --> Std Tropo model used in ICD-GPS-200, 2--> other model used see the comments record for description
Frequency STD	A1	1		[Q,R,C,O]	Flag to indicate if Freq standard used with GPS unit Q -->Quartz, R -->Rubidium, C --> Cesium, O -->Blank for other model (identified in comments record).
Freq Std Mfg.	A20	20			
Freq Std Model	A20	20			
Freq Std Ser.#	A20	20			
Phase Noise	F7.2	7	10**-12 s/s**0.5		Allen Variance of Process Noise for phase
Freq Noise	F7.2	7	10**-16 s/s**1.5		Double Allen Variance of Process Noise for freq.
IRU Aided	A1	1		[Y, N]	Flag to indicate if GPS unit aided by Inertial Sys.
IRU Mfg.	A20	20			
IRU Model	A20	20			
IRU Ser.#	A20	20			

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 818
RECORD NAME: Participant
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Participant x	F14.2	14	Meters		Initial position information of participant's IRU.
Participant y	F14.2	14	Meters		Data are Geocentric x,y,z ref WGS-84 spheroid. If
Participant z	F14.2	14	Meters		no data available, these fields are blank.
IRU x	F14.2	14	Meters		Lever-arm data information of participant's IRU.
IRU y	F14.2	14	Meters		Data are in participant body coordinate system
IRU z	F14.2	14	Meters		referenced to a origin on the participant.
S/W Mfg	A20	20			GPS software used to collect data
S/W Name	A20	20			Software Name
S/W version	A20	20			Software version number
No. Antennas	I1	1		[1,4]	Number of antennas connected to GPS unit

The following data are repeated for each antenna on the participant. This section of data uses 194 bytes per antenna, 416 bytes for all 4 antennae. If only 1 antenna is available remaining bytes of data are blanks.

Antenna #	I1	1		[1,4]	Antenna Number <= Number of antenna on GPS unit
Antenna Mfg.	A20	20			
Antenna Model	A20	20			
Antenna Ser.#	A20	20			
Lever-arm data	A1	1		[Y, N]	Flag to indicate if following position data is lever-arm data or geocentric position data of the antenna. Y --> Lever_arm data, N --> Geocentric x,y,z data
Antenna x	F14.2	14	Meters		Position information on antenna. If Lever Flag = N
Antenna y	F14.2	14	Meters		data are Geocentric x,y,z data ref WGS-84, else data
Antenna z	F14.2	14	Meters		are in participant body coordinate ref. system.

If only 1 antenna is available remaining bytes of data are blanks.

RCC DRECG GPS DATA FORMAT

REC ID NO. : 010
RECORD NAME: Participant
DATE: 10/25/89

Notes :

All alpha-numeric (A) formats are right justified, i.e. field has leading blanks if field is not completely filled with characters.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

RCC DRECG GPS DATA FORMAT

REC ID NO. : 011
RECORD NAME: Timing
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		11	
Record_length	I4	4	Bytes	115	This record is a fixed length record.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS participant ID
Time Quality*	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
UTC Time Quality	I1	1		0 - 2	Quality of Range generated UTC time, where 0 = UTC Time Bad 1 = UTC Time Good 2 = UTC Time Questionable
UTC Time	F17.10	17	Seconds	0 - 86400	UTC Time. If the value is not valid or not available, it should be set to 999999.99999999.
A0	F13.10	13	Seconds		Polynomial Constant used to correct GPS Time to UTC (Ref. ICD-GPS 200 page 97).
A1	F10.16	18	Sec/Sec		Polynomial Constant used to correct GPS Time to UTC (Ref. ICD-GPS 200 page 97).
Delta t_{LSF}	I4	4	Seconds		Delta time due to leap seconds (Ref. ICD-GPS 200 page 97).

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 011
RECORD NAME: Timing
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
t_{ot}	I6	6	Seconds	0 - 602112	Reference time for UTC data of the test. (Ref. ICD-GPS 200 page 97).
WN_t	I3	3	Weeks	0 - 999	Universal Time Ref Week Number (Ref. ICD-GPS 200 page 97).
WN_{LSF}	I3	3	Weeks	0 - 999	Week Number (Ref. ICD-GPS 200 page 96).
DN	I1	1	Days	1 - 7	Day number at end of leap second (Ref. ICD-GPS 200 page 96).
Delta t_{LSF}	I4	4	Seconds	-128 to 127	Signed seconds value of the delta time due to leap seconds (Ref. ICD-GPS 200 page 96).

Note :

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 012
RECORD NAME: EPHEMERIS DATA
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		6	
Record_length	I4	4	Bytes	169 + (n-1)*122 Min = 169 Max = 1999	This record is a variable length record, where n is the number of SV's available and ranges from 1 to 16.
Checksum	I1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A8	8			GPS Participant ID
Time Quality*	I1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	I4	4	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	F17.10	17	Seconds	0 - 604800	GPS time. If the value is not valid or not available it should be set to 999999.9999999999.
Year	I2	2	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	I3	3	Days	0 - 366	Julian day the data is collected.
Range Time	F10.4	10	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
No. SV's and Pseudolites	I2	2		1 - 16	No. of Satellites and Pseudolites in record

The following data are repeated for up to a maximum of 16 SVs/Pseudolites.

SV ID	I2	2	PRN # of SV	1 - 36	Satellite/Pseudolite ID
Code	A4	4		C, P, C+P, Y, C+Y	Tracking code for operation this GPS unit. C--> C/A, P--> P Code, C+P--> C/A and P code Y--> Y code, C+Y--> C/A and Y code operation.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 012
RECORD NAME: EPHEMERIS DATA
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Freq	A4	4		1, 2, 3, 1+2, 1+3 2+3, 1-2, 3-2, 1M2 1M3, 2M3	Freq. the GPS unit was operated. 1--> L1, 2--> L2, 3--> L3, 1+2--> L1 and L2, 1+3--> L1 and L3, 2+3--> L2 and L3, 1-2--> L1-L2, 1M2--> (L1+L2)/2,
X position	F14.4	14	Meters		Geocentric X position in WGS-84
Y position	F14.4	14	Meters		Geocentric Y position in WGS-84
Z position	F14.4	14	Meters		Geocentric Z position in WGS-84
X velocity	F10.4	10	Meters/Sec		Geocentric X velocity in WGS-84
Y velocity	F10.4	10	Meters/Sec		Geocentric Y velocity in WGS-84
Z velocity	F10.4	10	Meters/Sec		Geocentric Z velocity in WGS-84
1-sigma X	F5.1	5	Meters		1-sigma estimate Geocentric x position
1-sigma Y	F5.1	5	Meters		1-sigma estimate Geocentric Y position
1-sigma Z	F5.1	5	Meters		1-sigma estimate Geocentric Z position
1-sigma X-vel	F5.1	5	Meters/Sec		1-sigma estimate Geocentric X velocity
1-sigma Y-vel	F5.1	5	Meters/Sec		1-sigma estimate Geocentric Y velocity
1-sigma Z-vel	F5.1	5	Meters/Sec		1-sigma estimate Geocentric Z velocity
1-sigma Horiz	F5.1	5	Meters		1-sigma estimate Horizontal Tangent Plane position
1-sigma Vert	F5.1	5	Meters		1-sigma estimate Vertical Tangent Plane position

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 502
RECORD NAME: Raw Measurement
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Record_id	I3	3	1		502	
Record_length	I4	4	1	Bytes	84 +(n-1)*35 Min = 84 Max = 1134	This record is a variable length record. Where n is the number of data set code and freq combinations for and ranges from 1 to 31. See Notes at end of data definition.
Checksum	I1	1				Check sum is the exclusive or of the data bytes.
Participant ID	A8	8				GPS Participant ID
Time Quality	Binary	1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	Binary	8	2^{-40}	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	Binary	2	1	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	Binary	2	1	Days	0 - 366	Julian day the data is collected.
Range Time	Binary	8	2^{-40}	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Equip. Time	Binary	8	2^{-40}	Seconds		Equipment clock time of the GPS data. If the value is not valid or not available, it should be set to 999999.9999999999.
Delta Range Meas. Time Int.	Binary	8	2^{-40}	Seconds		Measurement time interval of delta range data
Number of Measurement sets	Binary	2	1		1 - 31	Number of sets of data reporting for this record.

RCC DR&CG DATA FORMAT

REC ID NO. : 502
RECORD NAME: Raw Measurement
DATE: 10/25/89

The following data are repeated, except for the Checksum, for the SV's and associated code and freq.
At least 1 SV must be available for this record to exist.

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
SV ID	Binary	2	1	PRN# of SV	1 - 36	Satellite/Pseudolite ID
Code\	/I1\		1		1 - 5	Upper byte: Code data collected 1-->C/A, 2-->P,
)	< >	2				3-->C/A and P code,4-->Y code, 5-->C/A and Y
Freq/	\I1/		1		1 - 11	Lower byte: Freq of data collected 1-->L1, 2-->L2,
						3-->L3, 4-->L1&L2, 5-->L1&L3, 6-->L2&L3,
						7-->L1-L2, 8-->L3-L2, 9-->L1+L2/2,
						10-->L1+L3/2, 11-->L2+L3/2
C/N	Binary	2	1	db		Estimated Signal Strength
Channel #	Binary	2	1		0 - 99	Data collection Channel Number
Channel Bias	Binary	4	2^{-16}	Meters		Channel bias
Antenna #	Binary	2	1			Antenna the data collected with (see Participant Data record for antenna info)
Data Quality	Binary	1	1		0 - 8	Data quality indicator where : 0 = No data are valid 1 = Pseudorange data valid 2 = Delta Range data valid 3 = Pseudorange, Delta Range data valid 4 = Int. Carrier Phase data valid 5 = Pseudorange, Int. Carrier Phase data valid 6 = Delta Range, Int. Carrier Phase data valid 7 = All data are valid 8 = Questionable whether all data are valid
Pseudorange	Binary	8	2^{-16}	Meters		Pseudorange data associated with specified code and freq for above Epoch
Delta Range	Binary	4	2^{-16}	Meters		Delta carrier phase data

RCC DR&CG DATA FORMAT

REC ID NO. : 502
RECORD NAME: Raw Measurement
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Integrated Carrier Phase	Binary	4	2^{-16}	Cycles		Integrated Carrier Phase data

Notes :

All negative numbers are 2's complement form.

The number of raw data groups in this record is dependent on the Satellites tracked and the associated code and frequency data recorded in the particular epoch. Thirty one (31) groups can be written in a record.
For example this record could contain 14 satellites with L1 and 14 SVs with L2 frequency and 3 SVs with data available from any combination of the frequencies i.e. (L1+L2)/2. These combinations are determined from the Code and Freq information.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 503
RECORD NAME: Satellite Vehicle (SV) Information
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Record_id	I3	3	1		503	
Record_length	I4	4	1	Bytes	105	This record is a fixed length record.
Checksum	I1	1				Check sum is the exclusive or of the data bytes.
Participant ID	A8	8	1			GPS Participant ID
Time Quality*	Binary	1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	Binary	8	2^{-40}	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	Binary	2	1	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	Binary	2	1	Days	0 - 366	Julian day the data is collected.
Range Time	Binary	8	2^{-40}	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Authorized Flag	Binary	2	1		[Y, N]	Flag to indicate authorized data use.
Satellite ID	Binary	2	1	PRN # of SV	1 - 36	PRN number of the satellite or pseudolite
SV Status info:						See ICD-GPS 200 data block 1 page 71 for next 7 items.(Subframe 1 data)
Code on L2	Binary	2	1	Discrete	[00, 01, 10]	L2 channel status 00 = Reserved 01 = P-code on 10 = C/A code on
GPS week	Binary	2	1	Weeks	0 - 9999	Week number
SV Accuracy	Binary	2	1	Discrete		SV Accuracy info
Sv Health	Binary	2	1	Discrete		SV Health info

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 503
RECORD NAME: Satellite Vehicle (SV) Information
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
L2 P flag	Binary	2	1	Discrete		L2 P-code on/off flag
T_{GD}	Binary	2	2^{-31}	Seconds		Group Delay time correction term
IODC	Binary	2	1	Seconds		Index of data, Clock
SV Clock Bias :						See ICD-GPS 200 data block 1 page 71 for next 4 items. (Subframe 1 data)
t_{oc}	Binary	2	2^{+04}	Seconds		Time of clock data
a_{f0}	Binary	2	2^{-55}	Seconds		Timing polynomial coefficient
a_{f1}	Binary	2	2^{-43}	Sec/Sec		Timing polynomial coefficient
a_{f2}	Binary	4	2^{-31}	Sec/Sec^2		Timing polynomial coefficient
Ephemeris data:						See ICD-GPS-200 Ephemeris data definitions pgs 40-41
IODE	Binary	2	1			Index of data Ephemeris
C_{rs}	Binary	2	2^{-05}	Meters		Amplitude of Sine Harmonic correction - Orbit Radius
delta n	Binary	2	2^{-43}	Semi-circles/sec		Mean motion difference from computed value
M_0	Binary	4	2^{-31}	Semi-circles		Mean Anomaly at ref time
C_{uc}	Binary	2	2^{-29}	Radians		Amplitude of Cosine Harmonic correction - Arg of Lat
Eccentricity	Binary	4	2^{-33}			Eccentricity
C_{us}	Binary	2	2^{-29}	Radians		Amplitude of Sine Harmonic correction - Arg of Lat
A**0.5	Binary	4	2^{-19}	(Meters)**0.5		Sq Rt Semi-major Axis
t_{oe}	Binary	2	2^{+04}	Seconds	0 - 604714	Reference time Ephemeris
C_{ic}	Binary	2	2^{-29}	Radians		Amplitude of Cosine Harmonic correction - Ang of I
$(OMEGA)_0$	Binary	4	2^{-31}	Semi-circles		Right Ascension at reference time
C_{is}	Binary	2	2^{-29}	Radians		Amplitude of Sine Harmonic correction - Ang. of I

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 503
RECORD NAME: Satellite Vehicle (SV) Information
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
i o	Binary	4	2^{-31}	Semi-circles		Inclination angle at reference time
C rc	Binary	2	2^{-05}	Radians		Amplitude of Cosine Harmonic correction-Orbit Radius
omega	Binary	4	2^{-31}	Semi-circles		Argument of Perigee
OMEGADOT	Binary	2	2^{-43}	Semi-circles/sec		Rate of Right Ascension
IDOT	Binary	2	2^{-43}	Semi-circles/sec		Rate of Inclination

Notes :

All negative numbers are 2's complement form.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 504
RECORD NAME: Almanac
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Record_id	I3	3	1		504	
Record_length	I4	4	1	Bytes	67	This record is a fixed length record.
Checksum	I1	1				Check sum is the exclusive or of the data bytes.
Participant ID	A8	8				GPS Participant ID
Time Quality*	Binary	1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	Binary	8	2^{-40}	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	Binary	2	1	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	Binary	2	1	Days	0 - 366	Julian day the data is collected.
Range Time	Binary	8	2^{-40}	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week of applicability of data (From 8 bits of Subframe 5 page 25 (Wa))
SV Collector	Binary	2	1	PRN # of SV	0 - 36	PRN number of the Satellite that collected the almanac data
Satellite ID	Binary	2	1	PRN # of SV	0 - 36	PRN number of the Satellite or Pseudolite
Almanac data:						See ICD-GPS-200 pages 90-91
Eccentricity	Binary	2	2^{-21}			Eccentricity
t_{oa}	Binary	2	2^{+12}	Seconds	0 - 602112	Reference Time of Almanac
Inclination**	Binary	2	2^{-19}	Semi-circles		Inclination angle at reference time

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 504
RECORD NAME: Almanac
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
OMEGADOT	Binary	2	2^{-38}	Semi-circles/sec		Rate of Right Ascension
A**0.5	Binary	4	2^{-11}	(Meters)**0.5		Sq Rt Semi-major Axis
$(OMEGA)_0$	Binary	4	2^{-23}	Semi-circles		Right Ascension at reference time
omega	Binary	4	2^{-23}	Semi-circles		Argument of Perigee
M_0	Binary	4	2^{-23}	Semi-circles		Mean Anomaly at reference time
a_{f0}	Binary	2	2^{-20}	Seconds		Timing polynomial coefficient
a_{f1}	Binary	2	2^{-38}	Seconds/sec		Timing polynomial coefficient
SV Health	Binary	2	1	Discrete		SV Health Status Form Subframes 4&5 page 25.

Notes :

All negative numbers are 2's complement form.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

** This value is the true inclination and not the Del_i which is relative to i = 0.30 semi-circles.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 505
RECORD NAME: Differential
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Record_id	I3	3	1		505	
Record_length	I4	4	1	Bytes	[55+(n-1)*20] Min = 55 Max = 335	This record is a variable length record. Where n is the number of SV's available and ranges from 1 to 16.
Checksum	I1	1	1			Check sum is the exclusive or of the data bytes.
Participant ID	A6	8				GPS Participant ID
Time Quality*	Binary	1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	Binary	8	2^{-40}	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	Binary	2	1	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	Binary	2	1	Days	0 - 366	Julian day the data is collected.
Range Time	Binary	8	2^{-40}	Seconds	0 - 86400	Range generated time. If the value is not valid or no available, it should be set to 99999.9999.
Zenith_Corr	Binary	2	2^{-8}	Meters		Zenith correction data. If not available, it should be set to 2.20.
Number of SV's	Binary	2	1		1 - 16	Number of SV's and Psuedolites Reporting data

The following data are repeated for the number of SV's available**, at least 1 SV must be available for this record to exist.

SV ID	Binary	2	1	PRN # of SV	1 - 36	Satellite/Pseudolite ID

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 505
RECORD NAME: Differential
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Code \	/I1\		1		1 - 5	Upper byte: Code data collected 1-->C/A, 2-->P,
>	< >	2				3-->C/A and P code,4-->Y code, 5-->C/A and Y
Freq /	\I1/		1		1 - 11	Lower byte: Freq of data collected 1-->L1, 2-->L2,
						3-->L3, 4-->L1&L2, 5-->L1&L3, 6-->L2&L3,
						7-->L1-L2, 8-->L3-L2, 9-->L1+L2/2,
						10-->L1+L3/2, 11-->L2+L3/2
Authorized Flag	A1	2			[Y,N]	Flag to indicate use of authorized or unauthorized correction
/Iono Flag \	/A1\				[Y,N]	Upper byte flag to indicate ionospheric data applied :
< >	< >	2				data.
\Tropo Flag/	\A1/				[Y,N]	Lower byte flag to indicate tropospheric data applied
						data
Diff PseudoRnge Correction***	Binary	4	2^{-16}	Meters		Differential Pseudorange correction from ref. site
Diff Range Rate Correction***	Binary	4	2^{-16}	Meters/Sec		Diff. Pseudorange-rate correction from ref. site
1-Signa Diff PseudoRnge Correction	Binary	2	2^{-08}	Meters		1-Signa Differential Pseudorange correction from ref. site.
1-Signa Diff Range Rate Correction	Binary	2	2^{-08}	Meters/Sec		1-Signa Diff Pseudorange-rate correction from ref. site.

Notes :

All negative numbers are 2's complement form.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

** The number of groups in this record is dependent on the Satellites tracked and the associated code and frequency data recorded in the particular epoch. Sixteen (16) groups can be written in a record depending on the Code and Freq information.

*** If the values of the Differential Pseudo-range and Differential Range Rate corrections are maximum values of the data field or are minimum values of the data field, then these parameters represent a positive and negative out-of-range value of these data respectively.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 506
RECORD NAME: TSPI
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Record_id	I3	3	1		506	
Record_length	I4	4	1	Bytes	139	This record is a fixed length record.
Checksum	I1	1				Check sum is the exclusive or of the data bytes.
Participant ID	A8	8				GPS Participant ID
Time Quality*	Binary	1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good.
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	Binary	8	2^{-40}	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	Binary	2	1	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	Binary	2	1	Days	0 - 366	Julian day the data is collected.
Range Time	Binary	8	2^{-40}	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Vel Data Flg\	/ A1\	2			[Y,N]	Upper byte flag indicates vel data are available
Acc Data Flg/	\ A1/				[Y,N]	Lower byte flag indicates accel data are available
Attitude Flag	A1	2			[Y,N]	Flag to indicate if Attitude data are available
X position	Binary	8	2^{-16}	Meters		Geocentric X position in WGS-84
Y position	Binary	8	2^{-16}	Meters		Geocentric Y position in WGS-84
Z position	Binary	8	2^{-16}	Meters		Geocentric Z position in WGS-84
X velocity	Binary	4	2^{-16}	Meters/Sec		Geocentric X velocity in WGS-84
Y velocity	Binary	4	2^{-16}	Meters/Sec		Geocentric Y velocity in WGS-84
Z velocity	Binary	4	2^{-16}	Meters/Sec		Geocentric Z velocity in WGS-84

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 506
RECORD NAME: TSPI
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
X acceleration	Binary	4	2^{-16}	Meters/Sec**2		Geocentric X acceleration in WGS-84
Y acceleration	Binary	4	2^{-16}	Meters/Sec**2		Geocentric Y acceleration in WGS-84
Z acceleration	Binary	4	2^{-16}	Meters/Sec**2		Geocentric Z acceleration in WGS-84
Heading	Binary	4	2^{-20}	Radians	0 - 2*Pi	True Heading
Pitch	Binary	4	2^{-20}	Radians	± Pi	
Roll	Binary	4	2^{-20}	Radians	± Pi	
Yaw	Binary	4	2^{-20}	Radians	± Pi	
Pitch Rate	Binary	4	2^{-20}	Radians/Sec		
Roll Rate	Binary	4	2^{-20}	Radians/Sec		
Yaw Rate	Binary	4	2^{-20}	Radians/Sec		
1-sigma X	Binary	2	2^{-04}	Meters		1-sigma estimate Geocentric X position
1-sigma Y	Binary	2	2^{-04}	Meters		1-sigma estimate Geocentric Y position
1-sigma Z	Binary	2	2^{-04}	Meters		1-sigma estimate Geocentric Z position
1-sigma X-vel	Binary	2	2^{-04}	Meters/Sec		1-sigma estimate Geocentric X velocity
1-sigma Y-vel	Binary	2	2^{-04}	Meters/Sec		1-sigma estimate Geocentric Y velocity
1-sigma Z-vel	Binary	2	2^{-04}	Meters/Sec		1-sigma estimate Geocentric Z velocity
1-sigma X-acc	Binary	2	2^{-04}	Meters/Sec**2		1-sigma estimate Geocentric X acceleration
1-sigma Y-acc	Binary	2	2^{-04}	Meters/Sec**2		1-sigma estimate Geocentric Y acceleration
1-sigma Z-acc	Binary	2	2^{-04}	Meters/Sec**2		1-sigma estimate Geocentric Z acceleration
1-sigma Horiz	Binary	2	2^{-04}	Meters		1-sigma estimate (X,Y) Local Tangent plane**
1-sigma Vert	Binary	2	2^{-04}	Meters		1-sigma estimate Z Local Tangent plane**

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 586
RECORD NAME: TSPI
DATE: 10/25/89

PARAMETER	TYPE	BITE SIZE	LSB	UNITS	RANGE	COMMENTS
1-sigma Pitch	Binary	2	2^{-24}	Radians		1-sigma estimate Pitch
1-sigma Roll	Binary	2	2^{-24}	Radians		1-sigma estimate Roll
1-sigma Yaw	Binary	2	2^{-24}	Radians		1-sigma estimate Yaw

Notes :

All negative numbers are 2's complement form.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

** Use of the transformation algorithms presented in RCC, DR&CG Document are recommended to generate these local tangent plane values.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 500
RECORD NAME: Meteorology
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Record_id	I3	3	1		500	
Record_length	I4	4	1	Bytes	67	This record is a fixed length record.
Checksum	I1	1				Check sum is the exclusive or of the data bytes.
Participant ID	A8	8	1			Participant ID
Time Quality*	Binary	1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	Binary	8	2^{-40}	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	Binary	2	1	Years	0 - 99	Last two digits of the year the data is collected
Julian Day	Binary	2	1	Days	0 - 366	Julian day the data is collected.
UTC Time	Binary	8	2^{-40}	Seconds	0 - 86400	UTC time. If the value is not valid or not available, it should be set to 999999.9999999999.
Station Name	A20	20				Station Name
Altitude	Binary	4	1	Meters	[-1000 - 99999]	Signed integer, WGS-84 station altitude.
Tempature	Binary	4	2^{-16}	Degrees C	+/- 99.99	Air Temperature
Pressure	Binary	4	2^{-16}	Millibars	0.0 - 9999.99	Air Pressure
Humidity	Binary	4	2^{-16}	% Humidity	0 - 100%	% Humidity

Notes :

All negative numbers are 2's complement form.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

RCC DREGG GPS DATA FORMAT

REC ID NO. : 509
RECORD NAME: IRU/INS
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Record_id	I3	3			9	
Record_length	I4	4		Bytes	141	This record is a fixed length record.
Checksum	I1	1				Check sum is the exclusive or of the data bytes.
Participant ID	A8	8				GPS Participant ID
Time Quality	Binary	1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	Binary	8	2^{-40}	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	Binary	2	1	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	Binary	2	1	Days	0 - 366	Julian day the data is collected.
Range Time	Binary	8	2^{-40}	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
Equip. Time	Binary	8	2^{-40}	Seconds		Equipment clock time of the IRU/INS data. If the value is not valid or not available, it should be set to 999999.9999999999.
Delta Range Meas. Time Int.	Binary	8	2^{-40}	Seconds		Measurement time interval of delta range data
IRU Sample rate	Binary	2	2^{-04}	Hertz		
Heading	Binary	4	2^{-28}	Radians	0 - 2*Pi	True Heading
Pitch	Binary	4	2^{-28}	Radians	± Pi	
Roll	Binary	4	2^{-28}	Radians	± Pi	
Yaw	Binary	4	2^{-28}	Radians	± Pi	

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 509
RECORD NAME: IRU/INS
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Pitch Rate	Binary	4	2^{-20}	Radians/Sec	± Pi	Navigation System Pitch Rate*
Roll Rate	Binary	4	2^{-20}	Radians/Sec	± Pi	Navigation System Roll Rate*
Yaw Rate	Binary	4	2^{-20}	Radians/Sec	± Pi	Navigation System Yaw Rate*
Snsr Pitch Rate	Binary	4	2^{-20}	Radians/Sec	± Pi	Raw IRU/INS Pitch Rate Measurement
Snsr Roll Rate	Binary	4	2^{-20}	Radians/Sec	± Pi	Raw IRU/INS Roll Rate Measurement
Snsr Yaw Rate	Binary	4	2^{-20}	Radians/Sec	± Pi	Raw IRU/INS Yaw Rate Measurement
Del Pitch Rate	Binary	4	2^{-20}	Radians/Sec	± 2*Pi	Change over the sample interval in Snsr Pitch Rate
Del Roll Rate	Binary	4	2^{-20}	Radians/Sec	± 2*Pi	Change over the sample interval in Snsr Roll Rate
Del Yaw Rate	Binary	4	2^{-20}	Radians/Sec	± 2*Pi	Change over the sample interval in Snsr Yaw Rate
Del_Vel :						
x	Binary	4	2^{-20}	Meters/Sec		x Delta velocity from accelerometer
y	Binary	4	2^{-20}	Meters/Sec		y Delta velocity from accelerometer
z	Binary	4	2^{-20}	Meters/Sec		z Delta velocity from accelerometer
Acc_Del_Vel :						
x	Binary	4	2^{-20}	Meters/Sec		x Delta accumulated velocity from accelerometer
y	Binary	4	2^{-20}	Meters/Sec		y Delta accumulated velocity from accelerometer
z	Binary	4	2^{-20}	Meters/Sec		z Delta accumulated velocity from accelerometer
Quaternions:						
1	Binary	4	2^{-20}	Microrad/100Hz		
2	Binary	4	2^{-20}	Microrad/100Hz		
3	Binary	4	2^{-20}	Microrad/100Hz		
4	Binary	4	2^{-20}	Microrad/100Hz		

Notes :

All negative numbers are 2's complement form.

* The Navigation System output may result from a Kalman filter rather than be raw data.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 511
RECORD NAME: Timing
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Record_id	I3	3	1		511	
Record_length	I4	4	1	Bytes	60	This record is a fixed length record.
Checksum	I1	1				Check sum is the exclusive or of the data bytes.
Participant ID	A8	8				GPS participant ID
Time Quality*	Binary	1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	Binary	8	2^{-40}	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	Binary	2	1	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	Binary	2	1	Days	0 - 366	Julian day the data is collected.
Range Time	Binary	8	2^{-40}	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
UTC Time Quality	Binary	1	1		0 - 2	Quality of Range generated UTC Time, where 0 = UTC Time Bad 1 = UTC Time Good 2 = UTC Time Questionable
UTC Time	Binary	8	2^{-40}	Seconds	0 - 86400	Range generated UTC time. If the value is not valid or not available, it should be set to 999999.99999999
A0	Binary	4	2^{-30}	Seconds	± 2	Polynomial Constant used to correct GPS Time to UTC (Ref. ICD-GPS 200 page 97)
A1	Binary	4	2^{-50}	Sec/Sec	$\pm 2^{-27}$	Polynomial Constant used to correct GPS Time to UTC (Ref. ICD-GPS 200 page 97)
Delta t_{LS}	Binary	2	1	Seconds	-128 to 127	Delta time due to leap seconds (Ref. ICD-GPS 200 page 97)

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 511
RECORD NAME: Timing
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
t_{ot}	Binary	2	2^{+12}	Seconds	0 - 602112	Reference time for UTC data of the test. (Ref. ICD-GPS 200 page 97)
WN t	Binary	2	1	Weeks	0 - 255	Universal Time Ref Week Number (Ref. ICD-GPS 200 page 97)
WN_{LSF}	Binary	2	1	Weeks	0 - 255	Week Number (Ref. ICD-GPS 200 page 96)
DN	Binary	2	1	Days	1 - 7	Day number at end of leap second (Ref. ICD-GPS 200 page 96)
Delta t_{LSF}	Binary	2	1	Seconds	-128 to 127	Signed seconds value of the delta time due to leap Seconds (Ref. ICD-GPS 200 page 96)

Notes :

All negative numbers are 2's complement form.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 512
RECORD NAME: EPHEMERIS DATA
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	LSB	UNITS	RANGE	COMMENTS
Record_id	I3	3	1		6	
Record_length	I4	4	1	Bytes	89 + (n-1)*56 Min = 89 Max = 929	This record is a variable record, where n is the number SVs and Pseudolites available and ranges from 1 to 16.
Checksum	I1	1				Check sum is the exclusive or of the data bytes.
Participant ID	A8	8				GPS Participant ID
Time Quality*	Binary	1	1		0 - 8	Time quality indicator where : 0 = No times are good 1 = GPS time good 2 = Range time good 3 = GPS, Range time good 4 = Equip. time good 5 = GPS, Equip. time good 6 = Range, Equip. time good 7 = All times good 8 = Questionable whether all times are good
GPS Week	Binary	2	1	Weeks	0 - 9999	GPS week associated with the data.
GPS Time	Binary	8	2^{-40}	Seconds	0 - 604800	GPS time. If the value is not valid or not available, it should be set to 999999.9999999999.
Year	Binary	2	1	Years	0 - 99	Last two digits of the year the data is collected.
Julian Day	Binary	2	1	Days	0 - 366	Julian day the data is collected.
Range Time	Binary	8	2^{-40}	Seconds	0 - 86400	Range generated time. If the value is not valid or not available, it should be set to 99999.9999.
No. SVs and Pseudolites	Binary	2	1		1 - 16	No. of Satellites and Pseudolites in record

The following data are repeated for up to a maximum of 16 SVs/Pseudolites.

SV ID	Binary	2	1	PRN# of SV	1 - 36	Satellite/Pseudolite ID
Code \	/I1\		1		1 - 5	Upper byte: Code data collected 1-->C/A, 2-->P, 3-->C/A and P code, 4-->Y code, 5-->C/A and Y
>	< >	2				
Freq /	\I1/		1		1 - 11	Lower byte: Freq of data collected 1-->L1, 2-->L2, 3-->L3, 4-->L1&L2, 5-->L1&L3, 6-->L2&L3, 7-->L1-L2, 8-->L3-L2, 9-->L1+L2/2, 10-->L1+L3/2, 11-->L2+L3/2

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 512
RECORD NAME: EPHEMERIS DATA
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE		UNITS	RANGE	COMMENTS
X position	Binary	8	2^{-16}	Meters		Geocentric X position in WGS-84
Y position	Binary	8	2^{-16}	Meters		Geocentric Y position in WGS-84
Z position	Binary	8	2^{-16}	Meters		Geocentric Z position in WGS-84
X velocity	Binary	4	2^{-16}	Meter/Sec		Geocentric X velocity in WGS-84
Y velocity	Binary	4	2^{-16}	Meter/Sec		Geocentric Y velocity in WGS-84
Z velocity	Binary	4	2^{-16}	Meter/Sec		Geocentric Z velocity in WGS-84
1-sigma X	Binary	2	2^{-4}	Meters		1-sigma estimate Geocentric x position
1-sigma Y	Binary	2	2^{-4}	Meters		1-sigma estimate Geocentric Y position
1-sigma Z	Binary	2	2^{-4}	Meters		1-sigma estimate Geocentric Z position
1-sigma X-vel	Binary	2	2^{-4}	Meter/Sec		1-sigma estimate Geocentric X velocity
1-sigma Y-vel	Binary	2	2^{-4}	Meter/Sec		1-sigma estimate Geocentric Y velocity
1-sigma Z-vel	Binary	2	2^{-4}	Meter/Sec		1-sigma estimate Geocentric Z velocity
1-sigma Horiz	Binary	2	2^{-4}	Meters		1-sigma estimate Tangent Plane Horizontal position
1-sigma Vert	Binary	2	2^{-4}	Meters		1-sigma estimate Tangent Plane Vertical position

Notes :

All negative numbers are 2's complement form.

* As Equipment Time is not a part of this record, Time Quality Flag states 4 - 7 are not applicable.

RCC DR&CG GPS DATA FORMAT

REC ID NO. : 999
RECORD NAME: Filler
DATE: 10/25/89

PARAMETER	TYPE	BYTE SIZE	UNITS	RANGE	COMMENTS
Record_id	I3	3		999	
Filler Data (CTRL_V)	II	1		(16 hex)	This is a NON-STANDARD data record and provides fill of each physical record to the 2048 data bytes. Following the record ID all data will be a CTRL-V (16 hex). No checksum will be computed for this record. This record can consist of only the Record header bytes, i.e. Record_ID, if no fill is needed.

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