Interface Control Document (ICD)
For The
Satellite Constellation Simulator (SCS)
Model 2450

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SCOPE

This Interface Control Document (ICD7695000) specifies the computer interface definitions for the Satellite Constellation Simulator System, Model SCS 2450.

APPLICABLE DOCUMENTS

EIA RS-422	EIA Recommended Standard RS-422
EIA RS-485	EIA Recommended Standard RS-485
ICD-GPS-200	NAVSTAR GPS Space Segment/Navigation User Interfaces
ICD-GPS-203 (SECRET)	NAVSTAR GPS Selective Availability/Anti-Spoofing Requirements
ICD-GPS-204	NAVSTAR GPS Instrumentation and Connector Standards
ICD-GPS-224 (SECRET)	NAVSTAR GPS Selective Availability/Anti-Spoofing Receiver Design Requirements
ICD-GPS-225 (SECRET)	NAVSTAR GPS Selective Availability and Anti-Spoofing Host Application Equipment
ICD-GPS-226 (SECRET)	NAVSTAR GPS Precise Positioning Service Satellite Signal Simulator Design Requirements
IEEE STD 488	IEEE Standard Digital Interface for Programmable Instrumentation
MIL-STD-1553B	Aircraft Internal Time Division Command/Response Multiplex Data Bus
SCS2400-E001-xx	GPS Satellite Constellation Simulator System, Model SCS 2400, User’s Manual
SCS2400-E001-S1-xx (SECRET)	Operational Supplement, GPS Satellite Constellation Simulator System, Model SCS 2400, User’s Manual
WGS-84	World Geodetic System 1984

SYSTEM OVERVIEW

The SCS 2450 provides 6,12,18 or 24 channel simulation capability of both Coarse Acquisition (C/A) code and Precision (P(Y)) code on dual independent L1/L2 RF outputs supporting single or dual antennas for differential and translated (optional) GPS simulations.

The SCS 2450 consists of the SCS chassis and an Operator Interface Personal Computer (PC). The SCS chassis is a VME-based unit containing:

1	Simulator Controller (SC) CPU card
1 - 2	Signal Generator Controller (SGC) CPU cards
0 - 1	Input/Output Controller (IOC) CPU card with 1 or more of the following Industry Pack (IP) modules: IP-488, IP-1553, IP-MP Serial
0 - 1	Universal Memory Network (UMN) interface card OR Shared Common Random Access Memory Network (SCRAMNet) interface card
1 - 4	Digital GPS Signal Generator (DGSG) cards (6 channels per card)
1	GPS Upconverter (GUC) module
1	RF Output (ROUT) module
0 - 1	10-MHz rubidium oscillator

The SCS chassis supports the following communications interfaces:

Ethernet: This interface is used by the PC to send commands and scenario override controls to, and receive SCS status, vehicle state and transmitter state data from, the SCS chassis. It can also be used by an external computer to send vehicle motion data to the SCS chassis in real-time at up to 100 Hz for closed-loop operation, and to receive SCS status, vehicle state and transmitter state data from the SCS chassis. Ethernet is standard on all SCS chassis.

Network File System (NFS): This specialization of the Ethernet interface is used by the SCS chassis, at the request of the PC, to download scenario parameter files from the PC's hard disk or to upload the SCS data log to a file on the PC's hard disk. NFS is standard on all SCS chassis.

Debug: This interface provides an interactive shell interface for debugging the SCS chassis CPU's. Debug is standard on all SCS chassis.

RS-422/485: This interface can be used by a GPS receiver or other external computer to receive inertial measurement unit (IMU) data, inertial navigation system (INS) data, doppler navigation system (DNS) data, and/or differential corrections from the SCS chassis. It requires that the SCS chassis have an IOC installed and that the IOC have an IP-MP Serial installed.

IEEE-488: This interface can be used by an external computer to receive SCS status, vehicle state and transmitter state data from the SCS chassis while a scenario is in progress. It requires that the SCS chassis have an IOC installed and that the IOC have an IP-488 installed.

MIL-STD-1553: This can be used by an external computer to receive SCS status, vehicle state and transmitter state data from the SCS chassis while a scenario is in progress. It requires that the SCS chassis have an IOC installed and that the IOC have an IP-1553 installed.

UMN or SCRAMNet: These interfaces are 2 different hardware implementations of a shared memory interface. They are functionally identical and mutually exclusive. They can be used by an external computer to send vehicle motion data and transmitter power level offset data to the SCS chassis in real-time at up to 500 Hz for closed-loop operation. They can also be used to receive aiding (IMU, INS or DNS) data and differential corrections from the SCS chassis. Each of these interfaces requires that the SCS chassis have the appropriate interface card installed.

INTRODUCTION

This document defines the format of all data going in to or out of the SCS chassis, including the data that is logged during a simulation.

The column headers in the block definition tables in this manual are defined as follows:

a.	LONG	Indicates the long word number within the data block. 1 is the first long word of the data block.
b.	BYTE 0	The contents of the first byte within each long word.
c.	BYTE 1	The contents of the second byte within each long word.
d.	BYTE 2	The contents of the third byte within each long word.
e.	BYTE 3	The contents of the fourth byte within each long word.
f.	BYTE	Indicates the byte number within the data block of the first byte (BYTE 0) of the current long word. 0 is the first byte of the data block.

The column headers in the data definition tables in this manual are defined as follows:

a.	BYTE	The BYTE column indicates the starting byte number for the data element in the data block.
b.	NAME	The variable name used to describe the data element.
c.	DESCRIPTION	Describes the function of the data element. Includes a description of the accuracy when it differs from the precision.
d.	UNITS	The units of measure required for the data elements, such as seconds, meters, megahertz (MHz), etc.
e.	RANGE	The limit/range of values required for the data element. If there is no specific range limit for this data item the implied range specified by the data element type is used.
f.	CLASS	Security classification when the SCS is in classified mode. Note that all data is unclassified when the SCS is unclassified. Valid classifications are U = Unclassified, C = Confidential, S = Secret.
g.	DATA TYPE	The storage type of the data. The first character refers to the type (I = Signed Integer, U = Unsigned Integer, H = Hexadecimal, R = Real (float), C = Character. The number following the '*' refers to the number of bytes of storage the data requires. Typical data types are R*8 (Double precision float - IEEE format), R*4 (single precision float - IEEE format), I*4 (signed long integer), U*2 (unsigned short integer), I*1 (signed byte), and C*80 (ASCII string). If the data type is followed by a multiplier, such as x3, it indicates the number of repetitions of the data type. For example, R*8 x3 means that the data consists of 3 double precision floating point quantities.
h.	WIDTH	The field width in characters of IEEE-488 data.

i. FORMAT — The data format of IEEE-488 data. Formats used are ASCII (text string), Dec (ASCII representation of a decimal value), Hex (ASCII representation of a hexadecimal value), and Float (ASCII representation of a floating point value).

Byte Ordering

With the exception of Ethernet and NFS, all interfaces utilize a “big endian” byte ordering, i.e. most significant byte first within each data field. All block definition tables in this ICD, including those in the Ethernet and NFS sections, are formatted utilizing a “big endian” byte ordering.

The Ethernet and NFS interfaces utilize a “little endian” byte ordering, i.e. least significant byte first within each data field. Note that a data type with a multiplier actually consists of multiple separate data fields of the base type (for example, R*8 x3 is 3 fields with 8 bytes each). The C**n* data type is different from other types (such as I*n) in that it actually consists of *n* separate 1-byte fields, not one *n*-byte field.

Example:

Using the following sample data block definition:

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Field A	Field B	Field C		0
2	Field D				4
3	Field E (MSBs)				8
4	Field E (LSBs)				12

With the following byte values:

Field A = 11
Field B = 22
Field C = 33 most significant
= 44 least significant
Field D = 55 most significant
= 66
= 77
= 88 least significant

Field E = 99 most significant
= AA
= BB
= CC
= DD
= EE
= FF
= 00 least significant

Yields the following byte sequences:

“big endian” = 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF 00
“little endian” = 11 22 44 33 88 77 66 55 00 FF EE DD CC BB AA 99

Checksums

Except where otherwise noted, all checksums are 16 bits long and are computed as the 2's complement of the sum of the 16-bit words of the message. Special byte handling is required for a "little endian" interface. Each 16-bit word must be byte swapped before being added to the accumulated sum (but is not swapped in the message itself). The final checksum value must be byte swapped before it is placed in the message.

Examples (continuing the "Byte Ordering" example):

"big endian" checksum calculation:

Message Word	Accumulated Checksum
1122	1122
3344	4466
5566	99CC
7788	11154
99AA	1AAFE
BBCC	266CA
DDEE	344B8
FF00	443B8

2's complement = (0 – 443B8) = FFFBBC48
16 LSB's = BC48

Complete Message = 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF 00 BC 48

"little endian" checksum calculation:

Message Word	Byte-Swapped	Accumulated Sum
1122	2211	2211
4433	3344	5555
8877	7788	CCDD
6655	5566	12243
00FF	FF00	22143
EEDD	DDEE	2FF31
CCBB	BBCC	3BAFD
AA99	99AA	454A7

2's complement = (0 – 454A7) = FFFBAB59
16 LSB's = AB59
Byte-Swapped = 59AB

Complete Message = 11 22 44 33 88 77 66 55 00 FF EE DD CC BB AA 99 59 AB

Bit Numbering

When specific bits are specified within a data element description, they are always numbered such that bit 0 is the least significant bit of the data element, i.e. the 1's bit.

Additional Notes

A number of data elements are described as being referenced to "GPS week 0, time 0". These data elements measure time relative to the origin of GPS time, which is specified as midnight (UTC) on the night of January 5, 1980/morning of January 6, 1980. This "GPS Epoch Time" is the total number of seconds since that reference time, without regard for leap seconds, week rollovers, or the GPS week number rollover (1023 to 0).

Data elements which contain GPS week numbers are NOT limited to the range 0 – 1023, but instead contain the total week number since the origin of GPS time. Thus, there is no ambiguity about GPS week number epochs.

DATA BLOCK INDEX

INDEXED BY INTERFACE AND ID

INTERFACE	ID	BLOCK NAME	IN/OUT	FREQUENCY (* = only if requested)	DATA SIZE (BYTES)	PAGE #
Ethernet	6020	Command Block (undefined)	I	N/A	N/A	30
Ethernet	6027	Vehicle Motion Input Data Block	I	100 / sec (max)	296	31
Ethernet	6055	Vehicle State Vector Block	O	10 / sec (max) *	288	56
Ethernet	6700	SCS Status Block	O	1 / sec *	120	59
Ethernet	6705	Transfer Calibration Data Block	O	as needed *	1336	62
Ethernet	6710	Transmitter Range Data Block	O	10 / sec (max) *	192	63
Ethernet	6715	SCS to PC Info Block	O	as needed *	88	68
Ethernet	6720	Downlink Data Block	O	1 / sec *	24	70
Ethernet	6730	Transmitter State Vector Interpolation Data Block	O	1 / 30 sec *	240	71
Ethernet	6735	24 Channel Summary Data Block	O	1 / sec *	784	74
Ethernet	6740	Override Control Summary Block	O	as needed *	480	77
Ethernet	6750	Detailed Override Control Data Block	O	as needed *	84	79
Ethernet	6800	Connection Request Block	I	as needed	120	35
Ethernet	6810	SCS Control Block	I	as needed	36	36
Ethernet	6820	Transfer Calibration Data Block	I	as needed	1336	38
Ethernet	6830	Filename Block (Load Simulation Parameters)	I	as needed	216	44
Ethernet	6840	Filename Block (Retrieve Data Log)	I	as needed	216	44
Ethernet	6850	Change Display Data Block (Vehicle 1 Data)	I	as needed	40	45
Ethernet	6855	Change Display Data Block (Vehicle 2 Data)	I	as needed	40	45
Ethernet	6880	Filename Block (Load SAAS Overlays)	I	as needed	216	44
Ethernet	6885	Filename Block (Burn Flash ROMs)	I	as needed	216	44
Ethernet	6890	Transmitter Override Control Block	I	as needed	72	46
Ethernet	6892	Jammer Override Control Block	I	as needed	68	49
Ethernet	6894	Differential Data Override Control Block	I	as needed	44	51
Ethernet	6896	Data Logging Override Control Block	I	as needed	40	53
IEEE-488	“send”	Data Request Block	I	as needed	13-15	100
IEEE-488	“status”	SCS Status Block	O	1 / sec *	229	102
IEEE-488	“trnpwr”	Transmitter Power Data Block	O	1 / sec *	187	104
IEEE-488	“trnrng”	Transmitter Range Data Block	O	1 / sec *	175	106
IEEE-488	“vehatt”	Vehicle Attitude Data Block	O	1 / sec *	177	108
IEEE-488	“vehdcm”	Vehicle Attitude DCM Data Block	O	1 / sec *	214	109
IEEE-488	“vehpos”	Vehicle Position Data Block	O	1 / sec *	241	110
MIL-STD-1553	RT 01 Out	SCS Status Block - Packet 0	O	1 / sec *	64	118
MIL-STD-1553	RT 02 Out	SCS Status Block - Packet 1	O	1 / sec *	64	118
MIL-STD-1553	RT 04 Out	Vehicle State Vector Block - Packet 0	O	1 / sec *	64	119
MIL-STD-1553	RT 05 Out	Vehicle State Vector Block - Packet 1	O	1 / sec *	64	119
MIL-STD-1553	RT 06 Out	Vehicle State Vector Block - Packet 2	O	1 / sec *	64	119
MIL-STD-1553	RT 07 Out	Vehicle State Vector Block - Packet 3	O	1 / sec *	64	119
MIL-STD-1553	RT 08 Out	Vehicle State Vector Block - Packet 4	O	1 / sec *	64	119
MIL-STD-1553	RT 10 Out	Transmitter Range Data Block - Packet 0	O	1 / sec *	64	120
MIL-STD-1553	RT 11 Out	Transmitter Range Data Block - Packet 1	O	1 / sec *	64	120
MIL-STD-1553	RT 12 Out	Transmitter Range Data Block - Packet 2	O	1 / sec *	64	120
MIL-STD-1553	RT 13 Out	Transmitter Range Data Block - Packet 3	O	1 / sec *	64	120
MIL-STD-1553	RT 16 In	Data Selector Block	I	as needed	64	116
NFS Data Files	.ANP	Multiple Antenna Patterns File	I	as needed	variable	N/A
NFS Data Files	.ANT	Antenna Pattern File	I	as needed	variable	N/A
NFS Data Files	.APF	Antenna Phase Delta File	I	as needed	variable	N/A
NFS Data Files	.DLG	Data Log Parameters File	I	as needed	variable	N/A
NFS Data Files	.GPS	GPS Constellation File (Truth or Nav)	I	as needed	variable	N/A
NFS Data Files	.IMU	IMU Parameters File	I	as needed	variable	N/A
NFS Data Files	.INS	INS Parameters File	I	as needed	variable	N/A
NFS Data Files	.JAM	Jammer Parameters File	I	as needed	variable	N/A
NFS Data Files	.LOG	Data Log File	O	as needed *	variable	156

INTERFACE	ID	BLOCK NAME	IN/OUT	FREQUENCY (* = only if requested)	DATA SIZE (BYTES)	PAGE #
NFS Data Files	.MOT	Motion Parameters File	I	as needed	variable	142
NFS Data Files	.MPH	High Density Map File	I	as needed	variable	N/A
NFS Data Files	.MPL	Low Density Map File	I	as needed	variable	N/A
NFS Data Files	.PRI	Priority Specifications File	I	as needed	variable	N/A
NFS Data Files	.RCV	Receiver Specifications File	I	as needed	variable	N/A
NFS Data Files	.RNG	Surveyed Locations File	I	as needed	variable	N/A
NFS Data Files	.SCN	Scenario Master File	I	as needed	variable	N/A
NFS Data Files	.SEL	Terrain Map File	I	as needed	variable	N/A
NFS Data Files	.TBL	User-Defined Biases Table File	I	as needed	variable	N/A
NFS Data Files	.UDB	User-Defined Biases File	I	as needed	variable	N/A
NFS Data Log	6000	Data Log Header Block	O	once	8400	160
NFS Data Log	6005	Channel Hardware Data Block	O	500 / sec (max)	144	163
NFS Data Log	6010	Channel Assignments Block	O	1 / sec (max)	80	167
NFS Data Log	6025	Vehicle Motion Input Data Block	O	500 / sec (max)	368	169
NFS Data Log	6026	Power Level Control Block	O	500 / sec (max)	408	170
NFS Data Log	6030	SCS Scenario File Names Block	O	once	1700	171
NFS Data Log	6035	Random Number Seed Block	O	once / seed	16	174
NFS Data Log	6040	Inertial Measurement Unit Data Block (RAP-Litton)	O	100 / sec	120	175
NFS Data Log	6044	Inertial Measurement Unit Data Block (LN-200)	O	1000 / sec (max)	120	175
NFS Data Log	6050	Composite Motion Data Block	O	1000 / sec (max)	2552	176
NFS Data Log	6055	Vehicle State Vector Block	O	10 / sec (max)	288	202
NFS Data Log	6060	Differential Corrections Data Block (RAP-LRIP)	O	1 / sec (max)	120	203
NFS Data Log	6061	Differential Corrections Data Block (RAP-ECP062)	O	1 / sec (max)	120	203
NFS Data Log	6070	WAGE Data Block	O	Once/cutover/ SV	64	204
NFS Data Log	6080	Formatted Almanac Data Block	O	Once/cutover/ spoofer type	2008	205
NFS Data Log	6100	Formatted Clock/Ephemeris Data Block (Satellite)	O	Once/cutover/ SV	176	206
NFS Data Log	6175	Formatted Clock/Ephemeris Data Block (Ground Transmitter)	O	Once/cutover/ GT	176	206
NFS Data Log	6180	Formatted APL Message Data Block	O	once/APL	8	207
NFS Data Log	6700	SCS Status Block	O	1 / sec (max)	120	208
NFS Data Log	6710	Transmitter Range Data Block	O	10 / sec (max)	192	209
NFS Data Log	6720	Downlink Data Block	O	500 / sec (max)	24	210
NFS Data Log	6725	Channel Range Data Block	O	500 / sec (max)	568	211
NFS Data Log	6726	Channel Range Data Block (Broadband Jammer)	O	10 / sec (max)	568	211
NFS Data Log	6730	Transmitter State Vector Interpolation Data Block	O	1 / 30 sec(max)	240	218
NFS Data Log	6760	Downlink Range Data Block	O	500 / sec (max)	520	219
NFS Data Log	6773	Doppler Navigation System Data Block (I-10)	O	50 / sec (max)	120	225
NFS Data Log	6777	Inertial Navigation System Data Block (EGR-14)	O	50 / sec (max)	120	226
NFS Data Log	6778	Inertial Navigation System Data Block (EGR-16)	O	50 / sec (max)	120	226
NFS Data Log	6890	Transmitter Override Control Block	O	as needed	72	227
NFS Data Log	6892	Jammer Override Control Block	O	as needed	68	228
NFS Data Log	6894	Differential Data Override Control Block	O	as needed	44	229
NFS Data Log	6896	Data Logging Override Control Block	O	as needed	40	230
NFS Data Log	6898	“All Override Controls” = Special record ID used in Data Logging requests to request logging of all Override Control Blocks (6890, 6892, 6894 & 6896). No actual data block uses this ID.	N/A	N/A	N/A	N/A
NFS Data Log	7000	Debug Data Block (SC)	O	as needed	288	231
NFS Data Log	7001	Debug Data Block (SGC)	O	as needed	288	231
RS-422/485	14	Inertial Navigation System Data Block (EGR-14)	O	50 / sec (max)	10 + 86	86

INTERFACE	ID	BLOCK NAME	IN/OUT	FREQUENCY (* = only if requested)	DATA SIZE (BYTES)	PAGE #
RS-422/485	16	Inertial Navigation System Data Block (EGR-16)	O	50 / sec (max)	10 + 66	89
RS-422/485	4195	Differential Corrections Data Block (RAP-ECP062)	O	1 / sec (max)	10 + 56	91
RS-422/485	4195	Differential Corrections Data Block (RAP-LRIP)	O	1 / sec (max)	10 + 56	93
RS-422/485	7010	Doppler Navigation System Data Block (I-10)	O	50 / sec (max)	10 + 60	95
RS-422/485	N/A	Inertial Measurement Unit Data Block (LN-200)	O	1000 / sec (max)	26	84
RS-422/485	N/A	Inertial Measurement Unit Data Block (RAP-Litton)	O	100 / sec	30	85
UMN/SCRAMNet	Command Data	Command Block (undefined)	I	N/A	8	128
UMN/SCRAMNet	Differential Data	Differential Corrections Data Block	O	1 / sec (max)	120	136
UMN/SCRAMNet	Power Control Data	Power Level Control Block	I	500 / sec (max)	400	130
UMN/SCRAMNet	Status Data	SCS Status Block	O	1 / sec	120	134
UMN/SCRAMNet	Time Data	SCS Time Data Block	O	1000 / sec	16	137
UMN/SCRAMNet	Vehicle 1 Aiding Data	Aiding Message Data Block (Vehicle 1)	O	1000 / sec (max)	120	135
UMN/SCRAMNet	Vehicle 1 Debug Data	Motion Debug Data Block (Vehicle 1)	O	1000 / sec	56	138
UMN/SCRAMNet	Vehicle 1 Motion Data	Vehicle Motion Input Data Block (Vehicle 1)	I	500 / sec (max)	296	129
UMN/SCRAMNet	Vehicle 2 Aiding Data	Aiding Message Data Block (Vehicle 2)	O	1000 / sec (max)	120	135
UMN/SCRAMNet	Vehicle 2 Debug Data	Motion Debug Data Block (Vehicle 2)	O	1000 / sec	56	138
UMN/SCRAMNet	Vehicle 2 Motion Data	Vehicle Motion Input Data Block (Vehicle 2)	I	500 / sec (max)	296	129

INDEXED BY NAME

BLOCK NAME	**INTERFACE**	**ID**	**IN/OUT**	**FREQUENCY (* = only if requested)**	**DATA SIZE (BYTES)**	**PAGE #**
24 Channel Summary Data Block	Ethernet	6735	O	1 / sec *	784	74
Aiding Message Data Block (Vehicle 1)	UMN/SCRAMNet	Vehicle 1 Aiding Data	O	1000 / sec (max)	120	135
Aiding Message Data Block (Vehicle 2)	UMN/SCRAMNet	Vehicle 2 Aiding Data	O	1000 / sec (max)	120	135
"All Override Controls" = Special record ID used in Data Logging requests to request logging of all Override Control Blocks (6890, 6892, 6894 & 6896). No actual data block uses this ID.	NFS Data Log	6898	N/A	N/A	N/A	N/A
Antenna Pattern File	NFS Data Files	.ANT	I	as needed	variable	N/A
Antenna Phase Delta File	NFS Data Files	.APF	I	as needed	variable	N/A
Burn Flash ROMs (Filename Block)	Ethernet	6885	I	as needed	216	44
Change Display Data Block (Vehicle 1 Data)	Ethernet	6850	I	as needed	40	45
Change Display Data Block (Vehicle 2 Data)	Ethernet	6855	I	as needed	40	45
Channel Assignments Block	NFS Data Log	6010	O	1 / sec (max)	80	167
Channel Hardware Data Block	NFS Data Log	6005	O	500 / sec (max)	144	163
Channel Range Data Block	NFS Data Log	6725	O	500 / sec (max)	568	211
Channel Range Data Block (Broadband Jammer)	NFS Data Log	6726	O	10 / sec (max)	568	211
Command Block (undefined)	Ethernet	6020	I	N/A	N/A	30
Command Block (undefined)	UMN/SCRAMNet	Command Data	I	N/A	8	128
Composite Motion Data Block	NFS Data Log	6050	O	1000 / sec (max)	2552	176
Connection Request Block	Ethernet	6800	I	as needed	120	35
Data Log File	NFS Data Files	.LOG	O	as needed *	variable	156
Data Log Header Block	NFS Data Log	6000	O	once	8400	160
Data Log Parameters File	NFS Data Files	.DLG	I	as needed	variable	N/A
Data Logging Override Control Block	Ethernet	6896	I	as needed	40	53
Data Logging Override Control Block	NFS Data Log	6896	O	as needed	40	230
Data Request Block	IEEE-488	"send"	I	as needed	13-15	100
Data Selector Block	MIL-STD-1553	RT 16 In	I	as needed	64	116
Debug Data Block (SC)	NFS Data Log	7000	O	as needed	288	231
Debug Data Block (SGC)	NFS Data Log	7001	O	as needed	288	231
Detailed Override Control Data Block	Ethernet	6750	O	as needed *	84	79
Differential Corrections Data Block	UMN/SCRAMNet	Differential Data	O	1 / sec (max)	120	136
Differential Corrections Data Block (RAP-ECP062)	NFS Data Log	6061	O	1 / sec (max)	120	203
Differential Corrections Data Block (RAP-ECP062)	RS-422/485	4195	O	1 / sec (max)	10 + 56	91
Differential Corrections Data Block (RAP-LRIP)	NFS Data Log	6060	O	1 / sec (max)	120	203
Differential Corrections Data Block (RAP-LRIP)	RS-422/485	4195	O	1 / sec (max)	10 + 56	93
Differential Data Override Control Block	Ethernet	6894	I	as needed	44	51
Differential Data Override Control Block	NFS Data Log	6894	O	as needed	44	229
Doppler Navigation System Data Block (I-10)	NFS Data Log	6773	O	50 / sec (max)	120	225
Doppler Navigation System Data Block (I-10)	RS-422/485	7010	O	50 / sec (max)	10 + 60	95
Downlink Data Block	Ethernet	6720	O	1 / sec *	24	70
Downlink Data Block	NFS Data Log	6720	O	500 / sec (max)	24	210
Downlink Range Data Block	NFS Data Log	6760	O	500 / sec (max)	520	219
EGR-14 (Inertial Navigation System Data Block)	NFS Data Log	6777	O	50 / sec (max)	120	226
EGR-14 (Inertial Navigation System Data Block)	RS-422/485	14	O	50 / sec (max)	10 + 86	86
EGR-16 (Inertial Navigation System Data Block)	NFS Data Log	6778	O	50 / sec (max)	120	226
EGR-16 (Inertial Navigation System Data Block)	RS-422/485	16	O	50 / sec (max)	10 + 66	89

BLOCK NAME	**INTERFACE**	**ID**	**IN/OUT**	**FREQUENCY (* = only if requested)**	**DATA SIZE (BYTES)**	**PAGE #**
Filename Block (Burn Flash ROMs)	Ethernet	6885	I	as needed	216	44
Filename Block (Load SAAS Overlays)	Ethernet	6880	I	as needed	216	44
Filename Block (Load Simulation Parameters)	Ethernet	6830	I	as needed	216	44
Filename Block (Retrieve Data Log)	Ethernet	6840	I	as needed	216	44
Formatted Almanac Data Block	NFS Data Log	6080	O	once/cutover/ spoofer type	2008	205
Formatted APL Message Data Block	NFS Data Log	6180	O	once/APL	8	207
Formatted Clock/Ephemeris Data Block (Ground Transmitter)	NFS Data Log	6175	O	once/cutover/ GT	176	206
Formatted Clock/Ephemeris Data Block (Satellite)	NFS Data Log	6100	O	once/cutover/ SV	176	206
GPS Constellation File (Truth or Nav)	NFS Data Files	.GPS	I	as needed	variable	N/A
High Density Map File	NFS Data Files	.MPH	I	as needed	variable	N/A
I-10 (Doppler Navigation System Data Block)	NFS Data Log	6773	O	50 / sec (max)	120	225
I-10 (Doppler Navigation System Data Block)	RS-422/485	7010	O	50 / sec (max)	10 + 60	95
IMU Parameters File	NFS Data Files	.IMU	I	as needed	variable	N/A
Inertial Measurement Unit Data Block (LN-200)	NFS Data Log	6044	O	1000 / sec (max)	120	175
Inertial Measurement Unit Data Block (LN-200)	RS-422/485	N/A	O	1000 / sec (max)	26	84
Inertial Measurement Unit Data Block (RAP-Litton)	NFS Data Log	6040	O	100 / sec (max)	120	175
Inertial Measurement Unit Data Block (RAP-Litton)	RS-422/485	N/A	O	100 / sec	30	85
Inertial Navigation System Data Block (EGR-14)	NFS Data Log	6777	O	50 / sec (max)	120	226
Inertial Navigation System Data Block (EGR-14)	RS-422/485	14	O	50 / sec (max)	10 + 86	86
Inertial Navigation System Data Block (EGR-16)	NFS Data Log	6778	O	50 / sec (max)	120	226
Inertial Navigation System Data Block (EGR-16)	RS-422/485	16	O	50 / sec (max)	10 + 66	89
INS Parameters File	NFS Data Files	.INS	I	as needed	variable	N/A
Jammer Override Control Block	Ethernet	6892	I	as needed	68	49
Jammer Override Control Block	NFS Data Log	6892	O	as needed	68	228
Jammer Parameters File	NFS Data Files	.JAM	I	as needed	variable	N/A
LN-200 (Inertial Measurement Unit Data Block)	NFS Data Log	6044	O	1000 / sec (max)	120	175
LN-200 (Inertial Measurement Unit Data Block)	RS-422/485	N/A	O	1000 / sec (max)	26	84
Load SAAS Overlays (Filename Block)	Ethernet	6880	I	as needed	216	44
Load Simulation Parameters (Filename Block)	Ethernet	6830	I	as needed	216	44
Low Density Map File	NFS Data Files	.MPL	I	as needed	variable	N/A
Motion Debug Data Block (Vehicle 1)	UMN/SCRAMNet	Vehicle 1 Debug Data	O	1000 / sec	56	138
Motion Debug Data Block (Vehicle 2)	UMN/SCRAMNet	Vehicle 2 Debug Data	O	1000 / sec	56	138
Motion Parameters File	NFS Data Files	.MOT	I	as needed	variable	142
Multiple Antenna Patterns File	NFS Data Files	.ANP	I	as needed	variable	N/A
Override Control Summary Block	Ethernet	6740	O	as needed *	480	77
Power Level Control Block	NFS Data Log	6026	O	500 / sec (max)	408	170
Power Level Control Block	UMN/SCRAMNet	Power Control Data	I	500 / sec (max)	400	130
Priority Specifications File	NFS Data Files	.PRI	I	as needed	variable	N/A
Random Number Seed Block	NFS Data Log	6035	O	once / seed	16	174
RAP-ECP062 (Differential Corrections Data Block)	NFS Data Log	6061	O	1 / sec (max)	120	203
RAP-ECP062 (Differential Corrections Data Block)	RS-422/485	4195	O	1 / sec (max)	10 + 56	91
RAP-Litton (Inertial Measurement Unit Data Block)	NFS Data Log	6040	O	100 / sec (max)	120	175
RAP-Litton (Inertial Measurement Unit Data Block)	RS-422/485	N/A	O	100 / sec	30	85
RAP-LRIP (Differential Corrections Data Block)	NFS Data Log	6060	O	1 / sec (max)	120	203
RAP-LRIP (Differential Corrections Data Block)	RS-422/485	4195	O	1 / sec (max)	10 + 56	93

BLOCK NAME	**INTERFACE**	**ID**	**IN/OUT**	**FREQUENCY (* = only if requested)**	**DATA SIZE (BYTES)**	**PAGE #**
Receiver Specifications File	NFS Data Files	.RCV	I	as needed	variable	N/A
Retrieve Data Log (Filename Block)	Ethernet	6840	I	as needed	216	44
Scenario Master File	NFS Data Files	.SCN	I	as needed	variable	N/A
SCS Control Block	Ethernet	6810	I	as needed	36	36
SCS Scenario File Names Block	NFS Data Log	6030	O	once	1700	171
SCS Status Block	Ethernet	6700	O	1 / sec *	120	59
SCS Status Block	IEEE-488	"status"	O	1 / sec *	229	102
SCS Status Block	NFS Data Log	6700	O	1 / sec (max)	120	208
SCS Status Block	UMN/SCRAMNet	Status Data	O	1 / sec	120	134
SCS Status Block - Packet 0	MIL-STD-1553	RT 01 Out	O	1 / sec *	64	118
SCS Status Block - Packet 1	MIL-STD-1553	RT 02 Out	O	1 / sec *	64	118
SCS Time Data Block	UMN/SCRAMNet	Time Data	O	1000 / sec	16	137
SCS to PC Info Block	Ethernet	6715	O	as needed *	88	68
Surveyed Locations File	NFS Data Files	.RNG	I	as needed	variable	N/A
Terrain Map File	NFS Data Files	.SEL	I	as needed	variable	N/A
Transfer Calibration Data Block	Ethernet	6820	I	as needed	1336	38
Transfer Calibration Data Block	Ethernet	6705	O	as needed *	1336	62
Transmitter Override Control Block	Ethernet	6890	I	as needed	72	46
Transmitter Override Control Block	NFS Data Log	6890	O	as needed	72	227
Transmitter Power Data Block	IEEE-488	"trnpwr"	O	1 / sec *	187	104
Transmitter Range Data Block	Ethernet	6710	O	10 / sec (max) *	192	63
Transmitter Range Data Block	IEEE-488	"trnrng"	O	1 / sec *	175	106
Transmitter Range Data Block	NFS Data Log	6710	O	10 / sec (max)	192	209
Transmitter Range Data Block - Packet 0	MIL-STD-1553	RT 10 Out	O	1 / sec *	64	120
Transmitter Range Data Block - Packet 1	MIL-STD-1553	RT 11 Out	O	1 / sec *	64	120
Transmitter Range Data Block - Packet 2	MIL-STD-1553	RT 12 Out	O	1 / sec *	64	120
Transmitter Range Data Block - Packet 3	MIL-STD-1553	RT 13 Out	O	1 / sec *	64	120
Transmitter State Vector Interpolation Data Block	Ethernet	6730	O	1 / 30 sec *	240	71
Transmitter State Vector Interpolation Data Block	NFS Data Log	6730	O	1 / 30 sec(max)	240	218
User-Defined Biases File	NFS Data Files	.UDB	I	as needed	variable	N/A
User-Defined Biases Table File	NFS Data Files	.TBL	I	as needed	variable	N/A
Vehicle Attitude Data Block	IEEE-488	"vehatt"	O	1 / sec *	177	108
Vehicle Attitude DCM Data Block	IEEE-488	"vehdcm"	O	1 / sec *	214	109
Vehicle Motion Input Data Block	Ethernet	6027	I	100 / sec (max)	296	31
Vehicle Motion Input Data Block	NFS Data Log	6025	O	500 / sec (max)	368	169
Vehicle Motion Input Data Block (Vehicle 1)	UMN/SCRAMNet	Vehicle 1 Motion Data	I	500 / sec (max)	296	129
Vehicle Motion Input Data Block (Vehicle 2)	UMN/SCRAMNet	Vehicle 2 Motion Data	I	500 / sec (max)	296	129
Vehicle Position Data Block	IEEE-488	"vehpos"	O	1 / sec *	241	110
Vehicle State Vector Block	Ethernet	6055	O	10 / sec (max) *	288	56
Vehicle State Vector Block	NFS Data Log	6055	O	10 / sec (max)	288	202
Vehicle State Vector Block - Packet 0	MIL-STD-1553	RT 04 Out	O	1 / sec *	64	119
Vehicle State Vector Block - Packet 1	MIL-STD-1553	RT 05 Out	O	1 / sec *	64	119
Vehicle State Vector Block - Packet 2	MIL-STD-1553	RT 06 Out	O	1 / sec *	64	119
Vehicle State Vector Block - Packet 3	MIL-STD-1553	RT 07 Out	O	1 / sec *	64	119
Vehicle State Vector Block - Packet 4	MIL-STD-1553	RT 08 Out	O	1 / sec *	64	119
WAGE Data Block	NFS Data Log	6070	O	once/cutover/ SV	64	204

ETHERNET INTERFACE

Every SCS 2450 chassis and PC is equipped with an auto-switching 10/100 Mbit Ethernet interface, using TCP/IP protocol with stream sockets. The SCS chassis functions as a server (port # 5001), the PC as a client.

This interface is used by the PC to send commands and scenario override controls to, and receive SCS status, vehicle state and transmitter range data from, the SCS chassis. It can also be used by an external computer to send vehicle motion data to the SCS chassis in real-time at up to 100 Hz for closed-loop operation, and to receive SCS status, vehicle state and transmitter range data from the SCS chassis.

Messages on the Ethernet interface will be in ICD-GPS-204 format, except that blocks may exceed the size limitation. The general format is shown in the table below.

WORD	DESCRIPTION	BYTE
Header		
1	Sync Word (81FF hex)	0
2	Record ID	2
3	Data word count (N)	4
4	Flag word (unused)	6
5	Header checksum	8
Data		
6	Data Word 1	10
...	...	...
5 + N	Data Word N	8 + (N * 2)
6 + N	Data checksum	10 + (N * 2)

The contents (including the header) of all messages transmitted and received by the SCS chassis are, and must be, organized in a "little endian" fashion, i.e. least significant byte first, on a field-by-field basis. See "**Byte Ordering**" on page 14 for details.

Header and data checksums are calculated independently on all words contained in the header and data sections, respectively. See "**Checksums**" on page 15 for details.

ETHERNET - INPUT TO SCS

Description	Frequency	Record ID(s)	Page #
Command Block (undefined)	N/A	6020	30
Vehicle Motion Input Data Block	100 / sec (max)	6027	31
Connection Request Block	As Needed	6800	35
SCS Control Block	As Needed	6810	36
Transfer Calibration Data Block	As Needed	6820	38
Filename Block	As Needed	6830, 6840, 6880, 6885	44
Change Display Data Block	As Needed	6850, 6855	45
Transmitter Override Control Block	As Needed	6890	46
Jammer Override Control Block	As Needed	6892	49
Differential Data Override Control Block	As Needed	6894	51
Data Logging Override Control Block	As Needed	6896	53

The SCS Control Block contains operator commands. The exact type of command depends on the control bits in the block. Other types of controls are contained in the remaining data blocks in this section. The mere reception of one of these blocks conveys command intent, with the data in the block specifying the parameters to the command.

COMMAND BLOCK

Record ID = 6020

This block is currently undefined and is not used.

VEHICLE MOTION INPUT DATA BLOCK

Record ID = 6027

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Vehicle Number	Data Classification	Vehicle Motion State		0
2	Antenna #1 Pattern ID	Antenna #2 Pattern ID	Time Tag Mode / GPS Week Number		4
3	GPS Time of Week / Scenario Elapsed Time (MSBs)				8
4	GPS Time of Week / Scenario Elapsed Time (LSBs)				12
5	Vehicle Position - E (MSBs)				16
6	Vehicle Position - E (LSBs)				20
7	Vehicle Position - F (MSBs)				24
8	Vehicle Position - F (LSBs)				28
9	Vehicle Position - G (MSBs)				32
10	Vehicle Position - G (LSBs)				36
11	Vehicle Velocity - E (MSBs)				40
12	Vehicle Velocity - E (LSBs)				44
13	Vehicle Velocity - F (MSBs)				48
14	Vehicle Velocity - F (LSBs)				52
15	Vehicle Velocity - G (MSBs)				56
16	Vehicle Velocity - G (LSBs)				60
17	Vehicle Acceleration - E (MSBs)				64
18	Vehicle Acceleration - E (LSBs)				68
19	Vehicle Acceleration - F (MSBs)				72
20	Vehicle Acceleration - F (LSBs)				76
21	Vehicle Acceleration - G (MSBs)				80
22	Vehicle Acceleration - G (LSBs)				84
23	Vehicle Jerk - E (MSBs)				88
24	Vehicle Jerk - E (LSBs)				92
25	Vehicle Jerk - F (MSBs)				96
26	Vehicle Jerk - F (LSBs)				100
27	Vehicle Jerk - G (MSBs)				104
28	Vehicle Jerk - G (LSBs)				108
29	Antenna Lever Arm - R (MSBs)				112
30	Antenna Lever Arm - R (LSBs)				116
31	Antenna Lever Arm - F (MSBs)				120
32	Antenna Lever Arm - F (LSBs)				124
33	Antenna Lever Arm - U (MSBs)				128
34	Antenna Lever Arm - U (LSBs)				132
35	DCM ECEF to Body Frame (1,1) (MSBs)				136

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
36	DCM ECEF to Body Frame (1,1) (LSBs)				140
37	DCM ECEF to Body Frame (2,1) (MSBs)				144
...	...				...
52	DCM ECEF to Body Frame (3,3) (LSBs)				204
53	Spin Vector - E (MSBs)				208
54	Spin Vector - E (LSBs)				212
55	Spin Vector - F (MSBs)				216
56	Spin Vector - F (LSBs)				220
57	Spin Vector - G (MSBs)				224
58	Spin Vector - G (LSBs)				228
59	Spin Vector Rate - E (MSBs)				232
60	Spin Vector Rate - E (LSBs)				236
61	Spin Vector Rate - F (MSBs)				240
62	Spin Vector Rate - F (LSBs)				244
63	Spin Vector Rate - G (MSBs)				248
64	Spin Vector Rate - G (LSBs)				252
65	Spin Vector Acceleration - E (MSBs)				256
66	Spin Vector Acceleration - E (LSBs)				260
67	Spin Vector Acceleration - F (MSBs)				264
68	Spin Vector Acceleration - F (LSBs)				268
69	Spin Vector Acceleration - G (MSBs)				272
70	Spin Vector Acceleration - G (LSBs)				276
71	Spare				280
72	Spare				284
73	Spare				288
74	Spare			G-Sensitivity Clear Flag	292

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Vehicle Number	Vehicle number or antenna ID (for dual antenna vehicles) that this data is for		1 - 2	U	U*1
1	Data Classification	Flag indicating if the data in this block is classified (used to set trajectory classified bit) 0 = Unclassified 1 = Classified		0 - 1	U	U*1
2	Vehicle Motion State	Individual vehicle motion state requested: 1 = Simulate motion for this vehicle 2 = Do not simulate motion for this vehicle		1 - 2	U	U*2
4	Antenna #1 Pattern ID	ID number of antenna pattern to use for antenna/vehicle #1. 255 = use pre-scheduled or operator selected pattern. Ignored if Vehicle Number = 2.		0 - 9, 255	U	U*1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
5	Antenna #2 Pattern ID	ID number of antenna pattern to use for antenna/vehicle #2. 255 = use pre-scheduled or operator selected pattern. Ignored if Vehicle Number = 1 and scenario is not dual antenna.		0 - 9, 255	U	U*1
6	Time Tag Mode / GPS Week Number	Specifies the Time Tag Mode used in this message. 0-2047: The Time Tag Mode is GPS TIME. The value in this field provides the GPS week number, if needed. Note that this week number is NOT limited to 0 - 1023. 65535 (all 1's): The Time Tag Mode is ELAPSED TIME.	weeks	0 – 2047, 65535	U	U*2
8	GPS Time of Week / Scenario Elapsed Time	Time of data validity. If the Time Tag Mode is GPS TIME and the value of this field is in the range 0 - 604800, it is interpreted as GPS time of week. Combine with GPS Week Number to form the complete time tag. If the Time Tag Mode is GPS TIME and the value of this field is greater than 604800, it is interpreted as Time of GPS. The GPS Week Number is not used in this case. * If the Time Tag Mode is ELAPSED TIME, the value of this field is interpreted as elapsed time since the start of the scenario.	seconds		U	R*8
16	Vehicle Position - (E,F,G)	Earth Centered, Earth Fixed (ECEF) center of gravity position (E,F,G) of the receiver vehicle	meters		U	R*8 x3
40	Vehicle Velocity - (E,F,G)	ECEF center of gravity velocity (E,F,G) of the receiver vehicle	met/sec		U	R*8 x3
64	Vehicle Acceleration - (E,F,G)	ECEF center of gravity acceleration (E,F,G) of the receiver vehicle	m/sec^2		U	R*8 x3
88	Vehicle Jerk - (E,F,G)	ECEF center of gravity jerk (E,F,G) of the receiver vehicle	m/sec^3		U	R*8 x3
112	Antenna Lever Arm - (R,F,U)	Antenna Lever Arm offset (Right, Forward, Up) from the vehicle's center of gravity	meters		U	R*8 x3
136	DCM ECEF to Body Frame	ECEF to Body (Right, Forward, Up) Direction Cosine Matrix [(Row 1, Column 1) (R2,C1) (R3,C1) ... (R2,C3) (R3,C3)]			U	R*8 x9
208	Spin Vector - (E,F,G)	Spin Vector (angular velocity) (E,F,G) of Body frame relative to ECEF frame, represented in ECEF	rad/sec		U	R*8 x3
232	Spin Vector Rate - (E,F,G)	Spin Vector Rate (angular acceleration) (E,F,G) of Body frame relative to ECEF frame, represented in ECEF	rad/sec^2		U	R*8 x3
256	Spin Vector Acceleration - (E,F,G)	Spin Vector Acceleration (angular jerk) (E,F,G) of Body frame relative to ECEF frame, represented in ECEF	rad/sec^3		U	R*8 x3
280	Spare	Spare			U	H*4 x3
292	Spare	Spare			U	H*3
295	G-Sensitivity Clear Flag	Flag to remotely command the SCS to reset the accumulated G-sensitivity effects to 0. 0 = Do not clear 1 = Clear		0 - 1	U	H*4 x3

* This mode exists for compatibility with older user applications. Note that the Time of GPS format is subject to a slight degradation of precision as the week number increases. For this reason, IEC recommends that all users use either the GPS Week Number/GPS Time of Week or the Scenario Elapsed Time format.

For additional information on the use of this block, see **APPENDIX D - ETHERNET MOTION PROCEDURE & TIMING** [page 253].

CONNECTION REQUEST BLOCK

Record ID = 6800

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Host Name, char 1	Host Name, char 2	Host Name, char 3	Host Name, char 4	0
...	...				...
10	Host Name, char 37	Host Name, char 38	Host Name, char 39	Host Name, char 40	36
11	Spare				40
...	...				...
30	Spare				116

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Host Name	Name of Host TCP/IP System	ASCII		U	C*40
40	Spare	Spare			U	H*4 x20

SCS CONTROL BLOCK

Record ID = 6810

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Current PC Time of Day				0
2	Current PC Date				4
3	Command ID				8
4	Spare				12
5	Spare				16
6	Spare				20
7	Command Parameter 1				24
8	Command Parameter 2		Spare		28
9	Spare				32

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Current PC Time of Day	PC Time of Day clock			U	H*4
		byte 0: hours	hours	0 - 23		
		byte 1: minutes	minutes	0 - 59		
		byte 2, bits 0-5: seconds	seconds	0 - 59		
		byte 2, bits 6-7 & byte 3: milliseconds	millisec	0 - 999		
4	Current PC Date	Calendar Date from PC clock			U	H*4
		byte 0: month	month	1 - 12		
		byte 1: day	day	1 - 31		
		byte 2-3: year	year	1980-2100		
8	Command ID	Cmd # Description		1 - 22	U	U*4
		1 Start Simulation (also starts data logging)				
		2 Stop Simulation (also stops data logging)				
		3-4 Spare				
		5 Perform Selftest				
		6 Request Status				
		7 Request Calibration Data				
		8 Abort transfer (simulation parameters or data log)				
		9 Clear Alarms				
		10 Request Scenario Multichassis Start Synchronization				
		11 Zeroize				
		12-15 Spare				
		16 Update Hardware Configuration				
		17 Channel Summary Request				
		18 Request Override Control Data				
		19 Request Override Control Summary				
		20 Request Reference Receiver State				
		21 Select Antenna Patterns				
		22 Request Classified Status (requires Classified Overlay)				
		23-30 Spare				
		31 Change Power Level, Absolute Mode				
		32 Change Power Level, Relative Mode				
12	Spare	Spare			U	H*4 x3

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
24	Command Parameter 1	Command parameter. Meaning varies with the value of the Command ID field.			U	I*4
		Cmd # Parameter Description				
		1-8 Spare				
		9 ID code of alarm to be cleared. -1 for all alarms		-1, 0 - 383		
		10-15 Spare				
		16 0 : Update all present/not present		0 - 11		
		1-3 : Update SGC 1-3 present/not present				
		4 : Update IOC present/not present				
		5-8 : Update DGSG 1-4 present/not present				
		9 : Update Rubidium present/not present				
		10 : Update External 1 PPS present/not present				
		11 : Update UMN/SCRAMNet present/ not present				
		17 Spare				
		18 Requested Control Override ID		1 - 30		
		19-20 Spare				
		21 Bits 7-0 :Selected Antenna 1 Pattern ID 255 = Use scenario default		0 - 9, 255		
		Bits 15-8:Selected Antenna 2 Pattern ID 255 = Use scenario default		0 - 9, 255		
		22-30 Spare				
		31 Bits 15-0 : Commanded L2 Power Level	dBm	LSB = 0.01		
		Bits 31-16 : Commanded L1 Power Level	dBm	LSB = 0.01		
		32 Bits 15-0 : Commanded L2 Power Level Change	dBm	LSB = 0.01		
		Bits 31-16 : Commanded L1 Power Level Change	dBm	LSB = 0.01		
28	Command Parameter 2	Command parameter. Meaning varies with the value of the Command ID field.			U	H*2
		Cmd # Parameter Description				
		1 Bit 0 : Start Vehicle 1		0 - 1		
		Bit 1 : Start Vehicle 2		0 - 1		
		2 Bit 0 : Stop Vehicle 1		0 - 1		
		Bit 1 : Stop Vehicle 2		0 - 1		
		3-30 Spare				
		31 Bits 7-0 : Transmitter ID (0 = All ID's)		0 - 50		
		Bits 15-8 : Transmitter Type: 0=SV, 1=SV Spoofer, 2=GT, 3=GT Spoofer, 4=Jammer		0 - 4		
		32 Bits 7-0 : Transmitter ID (0 = All ID's)		0 - 50		
		Bits 15-8 : Transmitter Type: 0=SV, 1=SV Spoofer, 2=GT, 3=GT Spoofer, 4=Jammer		0 - 4		
30	Spare	Spare			U	H*2
32	Spare	Spare			U	H*4

TRANSFER CALIBRATION DATA BLOCK

Record ID = 6820 (Input to SCS)

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Spare		Reference Edges / Polarity		0
2	Cable Length				4
3	Output 1 PPS Retard				8
4	Spare				12
5	Inter-Upconverter #1 L1 Delay (MSBs)				16
6	Inter-Upconverter #1 L1 Delay (LSBs)				20
7	Inter-Upconverter #1 L1 Gain (MSBs)				24
8	Inter-Upconverter #1 L1 Gain (LSBs)				28
9	Inter-Upconverter #1 L2 Delay (MSBs)				32
10	Inter-Upconverter #1 L2 Delay (LSBs)				36
11	Inter-Upconverter #1 L2 Gain (MSBs)				40
12	Inter-Upconverter #1 L2 Gain (LSBs)				44
13	Inter-Upconverter #2 L1 Delay (MSBs)				48
14	Inter-Upconverter #2 L1 Delay (LSBs)				52
15	Inter-Upconverter #2 L1 Gain (MSBs)				56
16	Inter-Upconverter #2 L1 Gain (LSBs)				60
17	Inter-Upconverter #2 L2 Delay (MSBs)				64
18	Inter-Upconverter #2 L2 Delay (LSBs)				68
19	Inter-Upconverter #2 L2 Gain (MSBs)				72
20	Inter-Upconverter #2 L2 Gain (LSBs)				76
21	Interchannel Bias #1 Delay (MSBs)				80
22	Interchannel Bias #1 Delay (LSBs)				84
23	Interchannel Bias #1 Gain (MSBs)				88
24	Interchannel Bias #1 Gain (LSBs)				92
...	...				...
113	Interchannel Bias #24 Delay (MSBs)				448
114	Interchannel Bias #24 Delay (LSBs)				452
115	Interchannel Bias #24 Gain (MSBs)				456
116	Interchannel Bias #24 Gain (LSBs)				460
117	High Power Delay L1 (MSBs)				464
118	High Power Delay L1 (LSBs)				468
119	High Power Gain L1 (MSBs)				472
120	High Power Gain L1 (LSBs)				476
121	High Power Delay L2 (MSBs)				480
122	High Power Delay L2 (LSBs)				484

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
123	High Power Gain L2 (MSBs)				488
124	High Power Gain L2 (LSBs)				492
125	Low Power Delay L1 (MSBs)				496
126	Low Power Delay L1 (LSBs)				500
127	Low Power Gain L1 (MSBs)				504
128	Low Power Gain L1 (LSBs)				508
129	Low Power Delay L2 (MSBs)				512
130	Low Power Delay L2 (LSBs)				516
131	Low Power Gain L2 (MSBs)				520
132	Low Power Gain L2 (LSBs)				524
133	RF 1 Cable Delay (MSBs)				528
134	RF 1 Cable Delay (LSBs)				532
135	RF 1 Cable Gain (MSBs)				536
136	RF 1 Cable Gain (LSBs)				540
137	RF 2 Cable Delay (MSBs)				544
138	RF 2 Cable Delay (LSBs)				548
139	RF 2 Cable Gain (MSBs)				552
140	RF 2 Cable Gain (LSBs)				556
141	Digital to Analog Converter #1 L1 Ant 1 Delay (MSBs)				560
142	Digital to Analog Converter #1 L1 Ant 1 Delay (LSBs)				564
143	Digital to Analog Converter #1 L1 Ant 1 Gain (MSBs)				568
144	Digital to Analog Converter #1 L1 Ant 1 Gain (LSBs)				572
...	...				...
169	Digital to Analog Converter #8 L1 Ant 1 Delay (MSBs)				672
170	Digital to Analog Converter #8 L1 Ant 1 Delay (LSBs)				676
171	Digital to Analog Converter #8 L1 Ant 1 Gain (MSBs)				680
172	Digital to Analog Converter #8 L1 Ant 1 Gain (LSBs)				684
173	Digital to Analog Converter #1 L2 Ant 1 Delay (MSBs)				688
174	Digital to Analog Converter #1 L2 Ant 1 Delay (LSBs)				692
175	Digital to Analog Converter #1 L2 Ant 1 Gain (MSBs)				696
176	Digital to Analog Converter #1 L2 Ant 1 Gain (LSBs)				700
...	...				...
201	Digital to Analog Converter #8 L2 Ant 1 Delay (MSBs)				800
202	Digital to Analog Converter #8 L2 Ant 1 Delay (LSBs)				804
203	Digital to Analog Converter #8 L2 Ant 1 Gain (MSBs)				808
204	Digital to Analog Converter #8 L2 Ant 1 Gain (LSBs)				812
205	Digital to Analog Converter #1 L1 Ant 2 Delay (MSBs)				816

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
206	Digital to Analog Converter #1 L1 Ant 2 Delay (LSBs)				820
207	Digital to Analog Converter #1 L1 Ant 2 Gain (MSBs)				824
208	Digital to Analog Converter #1 L1 Ant 2 Gain (LSBs)				828
...	...				...
233	Digital to Analog Converter #8 L1 Ant 2 Delay (MSBs)				928
234	Digital to Analog Converter #8 L1 Ant 2 Delay (LSBs)				932
235	Digital to Analog Converter #8 L1 Ant 2 Gain (MSBs)				936
236	Digital to Analog Converter #8 L1 Ant 2 Gain (LSBs)				940
237	Digital to Analog Converter #1 L2 Ant 2 Delay (MSBs)				944
238	Digital to Analog Converter #1 L2 Ant 2 Delay (LSBs)				948
239	Digital to Analog Converter #1 L2 Ant 2 Gain (MSBs)				952
240	Digital to Analog Converter #1 L2 Ant 2 Gain (LSBs)				956
...	...				...
265	Digital to Analog Converter #8 L2 Ant 2 Delay (MSBs)				1056
266	Digital to Analog Converter #8 L2 Ant 2 Delay (LSBs)				1060
267	Digital to Analog Converter #8 L2 Ant 2 Gain (MSBs)				1064
268	Digital to Analog Converter #8 L2 Ant 2 Gain (LSBs)				1068
269	DGSG #1 Serial Number				1072
270	DGSG #2 Serial Number				1076
271	DGSG #3 Serial Number				1080
272	DGSG #4 Serial Number				1084
273	GUC Serial Number				1088
274	RF Output Serial Number				1092
275	DGSG #1 Calibration Comments - Char 1	DGSG #1 Calibration Comments - Char 2	DGSG #1 Calibration Comments - Char 3	DGSG #1 Calibration Comments - Char 4	1096
...	...				...
284	DGSG #1 Calibration Comments - Char 37	DGSG #1 Calibration Comments - Char 38	DGSG #1 Calibration Comments - Char 39	DGSG #1 Calibration Comments - Char 40	1132
285	DGSG #2 Calibration Comments - Char 1	DGSG #2 Calibration Comments - Char 2	DGSG #2 Calibration Comments - Char 3	DGSG #2 Calibration Comments - Char 4	1136
...	...				...
294	DGSG #2 Calibration Comments - Char 37	DGSG #2 Calibration Comments - Char 38	DGSG #2 Calibration Comments - Char 39	DGSG #2 Calibration Comments - Char 40	1172
295	DGSG #3 Calibration Comments - Char 1	DGSG #3 Calibration Comments - Char 2	DGSG #3 Calibration Comments - Char 3	DGSG #3 Calibration Comments - Char 4	1176
...	...				...
304	DGSG #3 Calibration Comments - Char 37	DGSG #3 Calibration Comments - Char 38	DGSG #3 Calibration Comments - Char 39	DGSG #3 Calibration Comments - Char 40	1212
305	DGSG #4 Calibration Comments - Char 1	DGSG #4 Calibration Comments - Char 2	DGSG #4 Calibration Comments - Char 3	DGSG #4 Calibration Comments - Char 4	1216

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
...	...				...
314	DGSG #4 Calibration Comments - Char 37	DGSG #4 Calibration Comments - Char 38	DGSG #4 Calibration Comments - Char 39	DGSG #4 Calibration Comments - Char 40	1252
315	GUC Calibration Comments - Char 1	GUC Calibration Comments - Char 2	GUC Calibration Comments - Char 3	GUC Calibration Comments - Char 4	1256
...	...				...
324	GUC Calibration Comments - Char 37	GUC Calibration Comments - Char 38	GUC Calibration Comments - Char 39	GUC Calibration Comments - Char 40	1292
325	RF Output Calibration Comments - Char 1	RF Output Calibration Comments - Char 2	RF Output Calibration Comments - Char 3	RF Output Calibration Comments - Char 4	1296
...	...				...
334	RF Output Calibration Comments - Char 37	RF Output Calibration Comments - Char 38	RF Output Calibration Comments - Char 38	RF Output Calibration Comments - Char 40	1332

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Spare	Spare			U	H*2
2	Reference Edges / Polarity	bit 0: Input 1 PPS mark ref edge - 0=Invert, 1=Normal bit 1: Output 1 PPS mark ref edge - 0=Invert, 1=Normal bit 2: Internal 10 MHz polarity - 0=Invert, 1=Normal		0 - 1 0 - 1 0 - 1	U	H*2
4	Cable Length	Cable length for 1 PPS to next SCS, in odd multiples of 33 feet.	feet	0, 33, 99, 165, …	U	U*4
8	Output 1 PPS Retard	Output 1 PPS Retard with respect 1 Input 1 PPS in 100 ns increments	nsec	LSB = 100	U	I*4
12	Spare	Spare			U	H*4
16	Inter-Upconverter #1 L1 Delay	Inter-upconverter bias #1 L1 Delay	meters		U	R*8
24	Inter-Upconverter #1 L1 Gain	Inter-upconverter bias #1 L1 Gain / Loss	dB		U	R*8
32	Inter-Upconverter #1 L2 Delay	Inter-upconverter bias #1 L2 Delay	meters		U	R*8
40	Inter-Upconverter #1 L2 Gain	Inter-upconverter bias #1 L2 Gain / Loss	dB		U	R*8
48	Inter-Upconverter #2 L1 Delay	Inter-upconverter bias #2 L1 Delay	meters		U	R*8
56	Inter-Upconverter #2 L1 Gain	Inter-upconverter bias #2 L1 Gain / Loss	dB		U	R*8
64	Inter-Upconverter #2 L2 Delay	Inter-upconverter bias #2 L2 Delay	meters		U	R*8
72	Inter-Upconverter #2 L2 Gain	Inter-upconverter bias #2 L2 Gain / Loss	dB		U	R*8
80	Interchannel Bias #1 Delay	Interchannel bias delay for channel #1	meters		U	R*8
88	Interchannel Bias #1 Gain	Interchannel bias gain for channel #1	dB		U	R*8
...	...	...	...		...	...

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
448	Interchannel Bias #24 Delay	Interchannel bias delay for channel #24	meters		U	R*8
456	Interchannel Bias #24 Gain	Interchannel bias gain for channel #24	dB		U	R*8
464	High Power Delay L1	High power crossover switch bias delay, RF 2, L1	meters		U	R*8
472	High Power Gain L1	High power crossover switch bias gain, RF 2, L1	dB		U	R*8
480	High Power Delay L2	High power crossover switch bias delay, RF 2, L2	meters		U	R*8
488	High Power Gain L2	High power crossover switch bias gain, RF 2, L2	dB		U	R*8
496	Low Power Delay L1	Low power crossover switch bias delay, RF 2, L1	meters		U	R*8
504	Low Power Gain L1	Low power crossover switch bias gain, RF 2, L1	dB		U	R*8
512	Low Power Delay L2	Low power crossover switch bias delay, RF 2, L2	meters		U	R*8
520	Low Power Gain L2	Low power crossover switch bias gain, RF 2, L2	dB		U	R*8
528	RF 1 Cable Delay	RF 1 cable coax delay	meters		U	R*8
536	RF 1 Cable Gain	RF 1 cable coax gain	dB		U	R*8
544	RF 2 Cable Delay	RF 2 cable coax delay	meters		U	R*8
552	RF 2 Cable Gain	RF 2 cable coax gain	dB		U	R*8
560	Digital to Analog Converter #1 L1 Ant 1 Delay	Delay through Digital to Analog Converter #1 on the L1 Ant 1 signal path	meters		U	R*8
568	Digital to Analog Converter #1 L1 Ant 1 Gain	Gain through Digital to Analog Converter #1 on the L1 Ant 1 signal path	dB		U	R*8
...	...	...	...		...	...
672	Digital to Analog Converter #8 L1 Ant 1 Delay	Delay through Digital to Analog Converter #8 on the L1 Ant 1 signal path	meters		U	R*8
680	Digital to Analog Converter #8 L1 Ant 1 Gain	Gain through Digital to Analog Converter #8 on the L1 Ant 1 signal path	dB		U	R*8
688	Digital to Analog Converter #1 L2 Ant 1 Delay	Delay through Digital to Analog Converter #1 on the L2 Ant 1 signal path	meters		U	R*8
696	Digital to Analog Converter #1 L2 Ant 1 Gain	Gain through Digital to Analog Converter #1 on the L2 Ant 1 signal path	dB		U	R*8
...	...	...	...		...	...
800	Digital to Analog Converter #8 L2 Ant 1 Delay	Delay through Digital to Analog Converter #8 on the L2 Ant 1 signal path	meters		U	R*8
808	Digital to Analog Converter #8 L2 Ant 1 Gain	Gain through Digital to Analog Converter #8 on the L2 Ant 1 signal path	dB		U	R*8
816	Digital to Analog Converter #1 L1 Ant 2 Delay	Delay through Digital to Analog Converter #1 on the L1 Ant 2 signal path	meters		U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
824	Digital to Analog Converter #1 L1 Ant 2 Gain	Gain through Digital to Analog Converter #1 on the L1 Ant 2 signal path	dB		U	R*8
...	...	...	...		...	...
928	Digital to Analog Converter #8 L1 Ant 2 Delay	Delay through Digital to Analog Converter #8 on the L1 Ant 2 signal path	meters		U	R*8
936	Digital to Analog Converter #8 L1 Ant 2 Gain	Gain through Digital to Analog Converter #8 on the L1 Ant 1 signal path	dB		U	R*8
944	Digital to Analog Converter #1 L2 Ant 2 Delay	Delay through Digital to Analog Converter #1 on the L2 Ant 2 signal path	meters		U	R*8
952	Digital to Analog Converter #1 L2 Ant 2 Gain	Gain through Digital to Analog Converter #1 on the L2 Ant 2 signal path	dB		U	R*8
...	...	...	...		...	...
1056	Digital to Analog Converter #8 L2 Ant 2 Delay	Delay through Digital to Analog Converter #8 on the L2 Ant 2 signal path	meters		U	R*8
1064	Digital to Analog Converter #8 L2 Ant 2 Gain	Gain through Digital to Analog Converter #8 on the L2 Ant 2 signal path	dB		U	R*8
1072	DGSG #1 Serial Number	Serial Number for DGSG #1	meters		U	U*4
1076	DGSG #2 Serial Number	Serial Number for DGSG #2	meters		U	U*4
1080	DGSG #3 Serial Number	Serial Number for DGSG #3	meters		U	U*4
1084	DGSG #4 Serial Number	Serial Number for DGSG #4	meters		U	U*4
1088	GUC Serial Number	Serial Number for GPS Upconverter Unit	meters		U	U*4
1092	RF Output Serial Number	Serial Number for RF Output Unit	meters		U	U*4
1096	DGSG #1 Calibration Comments	Calibration Comments (date/time) for DGSG #1	meters		U	C*40
1136	DGSG #2 Calibration Comments	Calibration Comments (date/time) for DGSG #2	meters		U	C*40
1176	DGSG #3 Calibration Comments	Calibration Comments (date/time) for DGSG #3	meters		U	C*40
1216	DGSG #4 Calibration Comments	Calibration Comments (date/time) for DGSG #4	meters		U	C*40
1256	GUC Calibration Comments	Calibration Comments (date/time) for GPS Upconverter Unit	meters		U	C*40
1296	RF Output Calibration Comments	Calibration Comments (date/time) for RF Output Unit	meters		U	C*40

FILENAME BLOCK

Record ID = 6830 (Load Simulation Parameters)
6840 (Retrieve Data Log)
6880 (Load SAAS Overlays)
6885 (Burn Flash ROMs)

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Internet Address, Char 1	Internet Address, Char 2	Internet Address, Char 3	Internet Address, Char 4	0
...	...				...
4	Internet Address, Char 13	Internet Address, Char 14	Internet Address, Char 15	Internet Address, Char 16	12
5	Host Name, Char 1	Host Name, Char 2	Host Name, Char 3	Host Name, Char 4	16
...	...				...
14	Host Name, Char 37	Host Name, Char 38	Host Name, Char 39	Host Name, Char 40	52
15	File System, Char 1	File System, Char 2	File System, Char 3	File System, Char 4	56
...	...				...
34	File System, Char 77	File System, Char 78	File System, Char 79	File System, Char 80	132
35	File Name, Char 1	File Name, Char 2	File Name, Char 3	File Name, Char 4	136
...	...				...
54	File Name, Char 77	File Name, Char 78	File Name, Char 79	File Name, Char 80	212

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Internet Address	Internet address of connecting PC	ASCII		U	C*16
16	Host Name	Host Name of connecting PC	ASCII		U	C*40
56	File System	File System exported by connecting PC	ASCII		U	C*80
136	File Name	File Name to be transferred to/from PC	ASCII		U	C*80

CHANGE DISPLAY DATA BLOCK

Record ID = 6850 (Vehicle 1 Data)
6855 (Vehicle 2 Data)

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Block Rate #1		Request ID #1		0
...	...		...		...
10	Block Rate #10		Request ID #10		36

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Block Rate #1	The rate at which to send the requested block, in terms of the time interval from the start of one block to the start of the next	msec	LSB = 100	U	U*2
2	Request ID #1	Request ID corresponding to one or more blocks of data to send for display. 0 indicates that there are no more records to request. See below for list of blocks which may be requested this way.		See Below	U	U*2
...	...	...	...	...	...	...
36	Block Rate #10	The rate at which to send the requested block, in terms of the time interval from the start of one block to the start of the next	msec	LSB = 100	U	U*2
38	Request ID #10	Request ID corresponding to one or more blocks of data to send for display. 0 indicates that there are no more records to request. See below for list of blocks which may be requested this way.		See Below	U	U*2

The following blocks may be requested by this method:

Request ID	Block
6055	Vehicle State Vector Block (6055) for this vehicle
6250+N	Transmitter Range Data Block (6710) for SV #N (1 ≤ N ≤ 32)
6282+N	Transmitter Range Data Block (6710) for SV Spoofer #N (1 ≤ N ≤ 32)
6325+N	Transmitter Range Data Block (6710) for GT #N (1 ≤ N ≤ 37)
6362+N	Transmitter Range Data Block (6710) for GT Spoofer #N (1 ≤ N ≤ 37)
6400+N	Transmitter Range Data Block (6710) for Jammer #N (1 ≤ N ≤ 50)
6475+N	Transmitter State Vector Interpolation Data Block (6730) for SV #N (1 ≤ N ≤ 32)
6507+N	Transmitter State Vector Interpolation Data Block (6730) for SV Spoofer #N (1 ≤ N ≤ 32)
6550+N	Transmitter State Vector Interpolation Data Block (6730) for GT #N (1 ≤ N ≤ 37)
6587+N	Transmitter State Vector Interpolation Data Block (6730) for GT Spoofer #N (1 ≤ N ≤ 37)
6625+N	Transmitter State Vector Interpolation Data Block (6730) for Jammer #N (1 ≤ N ≤ 50)
6720	Downlink Data Block (6720) for this vehicle
6735	24 Channel Summary Data Block (6735)
6870	Transmitter Range Data Blocks (6710) for every active channel

Notes: 1. To disable a request, send a Change Display Data block containing that request with the block rate set to 0.
2. A request ID of 0 will cause all following requests in the same Change Display Data Block to be ignored.

TRANSMITTER OVERRIDE CONTROL BLOCK

Record ID = 6890

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Override Control ID		Spare		0
2	Control Mode				4
3	Control Type				8
4	Start Time				12
5	Stop Time				16
6	Change Data				20
7	Transmitter ID		Transmitter Type		24
8	Transmitter Enable		L1 Modulation Control		28
9	L2 Modulation Control		L1 Power Specification Mode		32
10	L2 Power Specification Mode		L1 Power Level Change Mode		36
11	L2 Power Level Change Mode		Spare		40
12	L1 Power Change				44
13	L2 Power Change				48
14	Parity Errors Enable		Parity Errors - Subframe		52
15	Parity Errors - Page		Parity Errors - Word		56
16	Spare				60
17	Ephemeris Health		Almanac Health		64
18	Summary Health		Spare		68

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Override Control ID	Unique control ID - Override ID number		1 - 30	U	U*2
2	Spare	Spare			U	H*2
4	Control Mode	Mode of override control: 0=New Control, 1=Modify Control, 2=Delete Control		0 - 2	U	U*4
8	Control Type	Type of control (2 = Transmitter Control)		2	U	U*4
12	Start Time	Time of initiation for the control - time of week	seconds	0-604799	U	U*4
16	Stop Time	Time of conclusion for the control - time of week (All one’s = last forever)	seconds	0-604799	U	U*4

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
20	Change Data	Bit # Definition			U	H*4
		0 1 = Transmitter Enable changed		0 - 1		
		1 1 = Modulation on L1 changed		0 - 1		
		2 1 = Modulation on L2 changed		0 - 1		
		3 1 = L1 Power Specification Mode changed		0 - 1		
		4 1 = L1 Power Level Change Mode changed		0 - 1		
		5 1 = L2 Power Level Change Mode changed		0 - 1		
		6 1 = L1 Power Level Change changed		0 - 1		
		7 1 = L2 Power Level Change changed		0 - 1		
		8 1 = Parity Errors Enable changed		0 - 1		
		9 1 = Subframe Parity Errors changed		0 - 1		
		10 1 = Page Parity Errors changed		0 - 1		
		11 1 = Word Parity Errors changed		0 - 1		
		12 1 = Ephemeris Health changed		0 - 1		
		13 1 = Almanac Health changed		0 - 1		
		14 1 = Summary Health changed		0 - 1		
		15 1 = L2 Power Specification Mode changed		0 - 1		
		16- 31 Unused				
24	Transmitter ID	Transmitter ID (0 = All ID's)		0 - 37	U	U*2
26	Transmitter Type	Transmitter Type: 0=SV, 1=SV Spoofer, 2=GT, 3=GT Spoofer		0 - 3	U	U*2
28	Transmitter Enable	Bit 0: 0 = Transmitter Disabled for use 1 = Transmitter Enabled for use		0 - 1	U	H*2
30	L1 Modulation Control	L1 Modulation Control: 0=C/A+P Code+Nav Message, 1=P Code+Nav Message, 2=Carrier Only, 3=C/A+Y Code+Nav Message, 4=Y Code+Nav Message, -1=Default		-1, 0 - 4	U	U*2
32	L2 Modulation Control	L2 Modulation Control: 0=C/A+P Code+Nav Message, 1=P Code+Nav Message, 2=Carrier Only, 3=C/A+Y Code+Nav Message, 4=Y Code+Nav Message, -1=Default		-1, 0 - 4	U	U*2
34	L1 Power Specification Mode	Bit 0: 0 = Power on L1 specified at the receiver 1 = Power on L1 specified at the transmitter		0 - 1	U	H*2
36	L2 Power Specification Mode	Bit 0: 0 = Power on L2 specified at the receiver 1 = Power on L2 specified at the transmitter		0 - 1	U	H*2
38	L1 Power Level Change Mode	Bit 0: 0 = Power level on L1 specified as relative change 1 = Power level on L1 specified as absolute change		0 - 1	U	H*2
40	L2 Power Level Change Mode	Bit 0: 0 = Power level on L2 specified as relative change 1 = Power level on L2 specified as absolute change		0 - 1	U	H*2
42	Spare	Spare			U	H*2
44	L1 Power Change	L1 power level change	dBm		U	R*4
48	L2 Power Change	L2 power level change	dBm		U	R*4
52	Parity Errors Enable	Bit 0: 0 = Disable parity errors 1 = Enable parity errors <not currently implemented>		0 - 1	U	H*2
54	Parity Errors - Subframe	Nav message subframe in which parity errors to occur <not currently implemented>		1 - 5	U	U*2
56	Parity Errors - Page	Nav message page in which parity errors to occur <not currently implemented>		1 - 25	U	U*2
58	Parity Errors - Word	Nav message word in which parity errors to occur <not currently implemented>		1 - 10	U	U*2

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
60	Spare	Spare			U	H*4
64	Ephemeris Health	Ephemeris Health		0 - 0x3F	U	H*2
66	Almanac Health	Almanac Health		0 - 0xFF	U	H*2
68	Summary Health	Summary Health		0 - 0x3F	U	H*2
70	Spare	Spare			U	H*2

JAMMER OVERRIDE CONTROL BLOCK

Record ID = 6892

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Override Control ID		Spare		0
2	Control Mode				4
3	Control Type				8
4	Start Time				12
5	Stop Time				16
6	Change Data				20
7	Jammer ID		Jammer Type		24
8	Jammer Enable		L1 & L2 Power Specification Mode		28
9	L1 & L2 Frequency Specification Mode		L1 & L2 Power Level Change Mode		32
10	L1 & L2 Frequency Change Mode		Pulse Width Change Mode		36
11	Pulse Recurrence Change Mode		Spare		40
12	Jammer L1 Power Change				44
13	Jammer L1 Frequency Change				48
14	Jammer Pulse Width Change				52
15	Jammer Pulse Recurrence Change				56
16	Jammer L2 Power Change				60
17	Jammer L2 Frequency Change				64

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Override Control ID	Unique control ID - Override ID number		1 - 30	U	U*2
2	Spare	Spare			U	H*2
4	Control Mode	Mode of override control: 0=New Control, 1=Modify Control, 2=Delete Control		0 - 2	U	U*4
8	Control Type	Type of control (1 = Jammer Control)		1	U	U*4
12	Start Time	Time of initiation for the control - time of week	seconds	0-604799	U	U*4
16	Stop Time	Time of conclusion for the control - time of week (All one’s = last forever)	seconds	0-604799	U	U*4

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
20	Change Data	Bit # Definition			U	H*4
		0 Jammer Enable changed		0 - 1		
		1 L1 Power Specification Mode changed		0 - 1		
		2 L1 Frequency Specification Mode changed		0 - 1		
		3 L1 Power Level Change Mode changed		0 - 1		
		4 L1 Frequency Change Mode changed		0 - 1		
		5 Pulse Width Change Mode changed		0 - 1		
		6 Pulse Recurrence Change Mode changed		0 - 1		
		7 Jammer L1 Power Change changed		0 - 1		
		8 Jammer L1 Frequency Change changed		0 - 1		
		9 Jammer Pulse Width Change changed		0 - 1		
		10 Jammer Pulse Recurrence Change changed		0 - 1		
		11 Jammer Type changed		0 - 1		
		12 Jammer L2 Power Change changed		0 - 1		
		13 Jammer L2 Frequency Change changed		0 - 1		
		14 L2 Power Specification Mode changed		0 - 1		
		15 L2 Power Level Change Mode changed		0 - 1		
		16 L2 Frequency Specification Mode changed		0 - 1		
		17 L2 Frequency Change Mode changed		0 - 1		
		18 - 31 Unused				
24	Jammer ID	Jammer ID (0 = All ID's)		0 - 50	U	U*2
26	Jammer Type	Jammer Type: -1=Default, 0=CW Jammer, 1=Pulsed Jammer, 2=Broadband Noise Jammer		-1, 0 - 2	U	U*2
28	Jammer Enable	bit 0: 0 = Jammer Disabled for use 1 = Jammer Enabled for use		0 - 1	U	H*2
30	L1 & L2 Power Specification Mode	bit 0: 0 = Power is specified at the receiver 1 = Power is specified at the transmitter		0 - 1	U	H*2
32	L1 & L2 Frequency Specification Mode	bit 0: 0 = Frequency is specified at the receiver 1 = Frequency is specified at the transmitter		0 - 1	U	H*2
34	L1 & L2 Power Level Change Mode	bit 0: 0 = Power level is specified as a relative change 1 = Power level is specified as a absolute change		0 - 1	U	H*2
36	L1 & L2 Frequency Change Mode	bit 0: 0 = Frequency is specified as a relative change 1 = Frequency is specified as a absolute change		0 - 1	U	H*2
38	Pulse Width Change Mode	bit 0: 0 = Pulse width is specified as a relative change 1 = Pulse width is specified as a absolute change		0 - 1	U	H*2
40	Pulse Recurrence Change Mode	bit 0: 0 = Pulse recurrence is specified as a relative change 1 = Pulse recurrence is specified as a absolute change		0 - 1	U	H*2
42	Spare	Spare			U	H*2
44	Jammer L1 Power Change	Jammer L1 power level change	dBm		U	R*4
48	Jammer L1 Frequency Change	Jammer L1 frequency change	Hz		U	R*4
52	Jammer Pulse Width Change	Jammer pulse width change	seconds		U	R*4
56	Jammer Pulse Recurrence Change	Jammer pulse recurrence change	pulses /sec		U	R*4
60	Jammer L2 Power Change	Jammer L2 power level change	dBm		U	R*4
64	Jammer L2 Frequency Change	Jammer L2 frequency change	Hz		U	R*4

DIFFERENTIAL DATA OVERRIDE CONTROL BLOCK

Record ID = 6894

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Override Control ID		Spare		0
2	Control Mode				4
3	Control Type				8
4	Start Time				12
5	Stop Time				16
6	Change Data				20
7	Differential Corrections Enable		Include SV Clock Errors		24
8	Include Ephemeris Errors		Include Ionospheric Errors		28
9	Include Tropospheric Errors		Include SA Errors		32
10	Dropout Enable		Spare		36
11	Dropout Interval				40

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Override Control ID	Unique control ID - Override ID number		1 - 30	U	U*2
2	Spare	Spare			U	H*2
4	Control Mode	Mode of override control: 0=New Control, 1=Modify Control, 2=Delete Control		0 - 2	U	U*4
8	Control Type	Type of control (0 = Differential Control)		0	U	U*4
12	Start Time	Time of initiation for the control - time of week	seconds	0-604799	U	U*4
16	Stop Time	Time of conclusion for the control - time of week (All one's = last forever)	seconds	0-604799	U	U*4
20	Change Data	Bit # / Definition			U	H*4
		0 Differential Corrections Enable changed		0 - 1		
		1 SV Clock Errors changed		0 - 1		
		2 Ephemeris Errors changed		0 - 1		
		3 Ionospheric Errors changed		0 - 1		
		4 Tropospheric Errors changed		0 - 1		
		5 SA Errors changed		0 - 1		
		6 Drop Out Enable changed		0 - 1		
		7 Drop Out Rate changed		0 - 1		
		8 - 31 Unused				
24	Differential Corrections Enable	bit 0: 0 = Don't Generate Differential Corrections 1 = Generate Differential Corrections		0 - 1	U	H*2
26	Include SV Clock Errors	bit 0: 0 = Don't include compensation for SV clock errors 1 = Include compensation for SV clock errors		0 - 1	U	H*2
28	Include Ephemeris Errors	bit 0: 0 = Don't include compensation for ephemeris errors 1 = Include compensation for ephemeris errors		0 - 1	U	H*2
30	Include Ionospheric Errors	bit 0: 0 = Don't include compensation for ionospheric errors 1 = Include compensation for ionospheric errors		0 - 1	U	H*2
32	Include Tropospheric Errors	bit 0: 0 = Don't include compensation for tropospheric errors 1 = Include compensation for tropospheric errors		0 - 1	U	H*2

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
34	Include SA Errors	bit 0: 0 = Don't include compensation for selective availability errors 1 = Include compensation for selective availability errors		0 - 1	U	H*2
36	Dropout Enable	bit 0: 0 = Disable periodic DC dropouts 1 = Enable periodic DC dropouts		0 - 1	U	H*2
38	Spare	Spare			U	H*2
40	Dropout Interval	Number of valid DC samples between dropouts			U	U*4

DATA LOGGING OVERRIDE CONTROL BLOCK

Record ID = 6896

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Override Control ID		Spare		0
2	Control Mode				4
3	Control Type				8
4	Start Time				12
5	Stop Time				16
6	Change Data				20
7	Record ID		Data Logging Enable		24
8	Logging Start Time				28
9	Logging Stop Time				32
10	Logging Interval				36

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Override Control ID	Unique control ID - Override ID number		1 - 30	U	U*2
2	Spare	Spare			U	H*2
4	Control Mode	Mode of override control: 0=New Control, 1=Modify Control, 2=Delete Control		0 - 2	U	U*4
8	Control Type	Type of control (3 = Data Logging Control)		3	U	U*4
12	Start Time	Time of initiation for the control - time of week	seconds	0-604799	U	U*4
16	Stop Time	Time of conclusion for the control - time of week (All one's = last forever)	seconds	0-604799	U	U*4
20	Change Data	Bit # Definition			U	H*4
		0 Data Logging Enable changed		0 - 1		
		1 Logging Start Time changed		0 - 1		
		2 Logging Stop Time changed		0 - 1		
		3 Logging Interval changed		0 - 1		
		4 - 31 Unused				
24	Record ID	Logging record ID to be object of control (-1 = all)		-1, 6000 - 7000	U	I*2
26	Data Logging Enable	bit 0: 0 = Disable record for logging 1 = Enable record for logging		0 - 1	U	H*2
28	Logging Start Time	Elapsed time at which record ID logging will begin	millisec		U	U*4
32	Logging Stop Time	Elapsed time at which record ID logging will end	millisec		U	U*4
36	Logging interval	Interval at which record ID will be logged	millisec		U	U*4

ETHERNET - OUTPUT FROM SCS

Description	Frequency	Record ID	Page #
Vehicle State Vector Block	10 / sec (max) (by request)	6055	56
SCS Status Block	1 / sec (by request)	6700	59
Transfer Calibration Data Block	As Needed (by request)	6705	62
Transmitter Range Data Block	10 / sec (max) (by request)	6710	63
SCS to PC Info Block	As Needed (by request)	6715	68
Downlink Data Block	1 / sec (by request)	6720	70
Transmitter State Vector Interpolation Data Block	1 / 30 sec (by request)	6730	71
24 Channel Summary Data Block	1 / sec (by request)	6735	74
Override Control Summary Block	As Needed (by request)	6740	77
Detailed Override Control Data Block	As Needed (by request)	6750	79

VEHICLE STATE VECTOR BLOCK

Record ID = 6055

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Week Number		System Classification	Vehicle Number	0
2	Spare				4
3	GPS Time Of Week (MSBs)				8
4	GPS Time Of Week (LSBs)				12
5	Test Elapsed Time (MSBs)				16
6	Test Elapsed Time (LSBs)				20
7	Position - Latitude (MSBs)				24
8	Position - Latitude (LSBs)				28
9	Position - Longitude (MSBs)				32
10	Position - Longitude (LSBs)				36
11	Position - Altitude (MSBs)				40
12	Position - Altitude (LSBs)				44
13	Position - E (MSBs)				48
14	Position - E (LSBs)				52
15	Position - F (MSBs)				56
16	Position - F (LSBs)				60
17	Position - G (MSBs)				64
18	Position - G (LSBs)				68
19	Velocity - E				72
20	Velocity - N				76
21	Velocity - U				80
22	Velocity - E				84
23	Velocity - F				88
24	Velocity - G				92
25	Acceleration - E				96
26	Acceleration - N				100
27	Acceleration - U				104
28	Acceleration - E				108
29	Acceleration - F				112
30	Acceleration - G				116
31	Yaw				120
32	Pitch				124
33	Roll				128
34	Yaw Rate				132
35	Pitch Rate				136

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
36	Roll Rate				140
37	G-Sensitive Clock Delay				144
38	G-Sensitive Clock Drift				148
39	Spare				152
40	Angular Velocity - E				156
41	Angular Velocity - N				160
42	Angular Velocity - U				164
43	Angular Acceleration - E				168
44	Angular Acceleration - N				172
45	Angular Acceleration - U				176
46	DCM Body to Local Tangent Plane Frame (1, 1)				180
47	DCM Body to Local Tangent Plane Frame (2, 1)				184
...	...				...
54	DCM Body to Local Tangent Plane Frame (3, 3)				212
55	DCM Local Tangent Plane to ECEF Frame (1, 1)				216
56	DCM Local Tangent Plane to ECEF Frame (2, 1)				220
...	...				...
63	DCM Local Tangent Plane to ECEF Frame (3, 3)				248
64	Spare				252
65	Spare				256
66	Spare				260
67	Spare				264
68	Spare				268
69	Spare				272
70	Spare				276
71	Spare				280
72	Spare				284

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Week Number	GPS week number that data is valid	weeks	0 - 2047	U	U*2
2	System Classification	Flags identifying which classified features of the SCS are installed/loaded:			U	H*1
		bit 0: 1 = PPSSMs installed		0 - 1		
		bit 1: 1 = Keys loaded		0 - 1		
		bit 2: 1 = Classified software loaded		0 - 1		
		bit 3: 1 = Classified trajectory loaded		0 - 1		
3	Vehicle Number	Vehicle number or antenna ID (for dual antenna vehicles) that this data is for		1 - 2	U	U*1
4	Spare	Spare			U	H*4

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
8	GPS Time Of Week	GPS time of week that data is valid	seconds	0 - 604800	U	R*8
16	Test Elapsed Time	Time elapsed since beginning of simulation	seconds		U	R*8
24	Position - Latitude	Vehicle center of gravity Latitude; Positive = North	degrees		U	R*8
32	Position - Longitude	Vehicle center of gravity Longitude; Positive = East	degrees		U	R*8
40	Position - Altitude	Vehicle center of gravity altitude; WGS-84	meters		U	R*8
48	Position - (E,F,G)	Vehicle ECEF center of gravity position (E,F,G)	meters		U	R*8 x3
72	Velocity - (E,N,U)	Vehicle center of gravity velocity (East, North, Up)	m/sec		U	R*4 x3
84	Velocity - (E,F,G)	Vehicle ECEF center of gravity velocity (E,F,G)	m/sec		U	R*4 x3
96	Acceleration - (E,N,U)	Vehicle center of gravity acceleration (East, North, Up)	m/sec^2		U	R*4 x3
108	Acceleration - (E,F,G)	Vehicle ECEF center of gravity acceleration (E,F,G)	m/sec^2		U	R*4 x3
120	Yaw	Vehicle yaw	radians		U	R*4
124	Pitch	Vehicle pitch	radians		U	R*4
128	Roll	Vehicle roll	radians		U	R*4
132	Yaw Rate	Yaw angular velocity	rad/sec		U	R*4
136	Pitch Rate	Pitch angular velocity	rad/sec		U	R*4
140	Roll Rate	Roll angular velocity	rad/sec		U	R*4
144	G-Sensitive Clock Delay	Clock delay due to the receiver clock's g-sensitivity	seconds		U	R*4
148	G-Sensitive Clock Drift	Clock drift due to the receiver clock’s g-sensitivity	sec/sec		U	R*4
152	Spare	Spare			U	H*4
156	Angular Velocity - (E,N,U)	Angular velocity (spin vector) (East, North, Up) of Body frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec		U	R*4 x3
168	Angular Acceleration - (E,N,U)	Angular acceleration (spin vector rate) (East, North, Up) of Body frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec^2		U	R*4 x3
180	DCM Body to Local Tangent Plane Frame	Transformation matrix to convert position data from the Body frame to the Local Tangent Plane frame [(Row 1, Column 1) (R2,C1) (R3,C1) ... (R2,C3) (R3,C3)]			U	R*4 x9
216	DCM Local Tangent Plane to ECEF Frame	Transformation matrix to convert position data from the Local Tangent Plane frame to the ECEF frame [(Row 1, Column 1) (R2,C1) (R3,C1) ... (R2,C3) (R3,C3)]			U	R*4 x9
252	Spare	Spare			U	H*4 x9

SCS STATUS BLOCK

Record ID = 6700

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Elapsed Time (MSBs)				0
2	Elapsed Time (LSBs)				4
3	GPS Time of Week (MSBs)				8
4	GPS Time of Week (LSBs)				12
5	System Classification	Simulation State	GPS Week Number		16
6	SC CPU Throughput	Spare	# Ethernet Connections	SCS ID	20
7	SGC #1 CPU Throughput	SGC #2 CPU Throughput	SGC #3 CPU Throughput	IOC CPU Throughput	24
8	SC Status		SC Version		28
9	SGC #1 Status		SGC #2 Status		32
10	SGC #3 Status		IOC Status		36
11	SGC #1 Version		SGC #2 Version		40
12	SGC #3 Version		IOC Version		44
13	DGSG #1 Status		DGSG #2 Status		48
14	DGSG #3 Status		DGSG #4 Status		52
15	GUC Status		UMN/SCRAMNet Status		56
16	GUC Delta 1 PPS				60
17	Alarm Summary (error #'s 0-31)				64
...	...				...
28	Alarm Summary (error #'s 352-383)				108
29	RF #1 Broadband Noise Jammer Power		RF #2 Broadband Noise Jammer Power		112
30	GUC Control Register Settings		Spare		116

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Elapsed Time	Time since beginning of test	seconds		U	R*8
8	GPS Time of Week	GPS time of week corresponding to elapsed time	seconds	0 - 604800	U	R*8
16	System Classification	Flags identifying which classified features of the SCS are installed/loaded:			U	H*1
		bit 0: 1 = PPSSMs installed		0 - 1		
		bit 1: 1 = Keys loaded		0 - 1		
		bit 2: 1 = Classified software loaded		0 - 1		
		bit 3: 1 = Classified trajectory loaded		0 - 1		
17	Simulation State	bits 0 - 2: Mode: 1=Idle, 2=Ready (simulation parameters loaded), 3=Test in Progress, 4=Selftest in progress		1 - 4	U	H*1
18	GPS Week Number	GPS week number corresponding to elapsed time	weeks	0 - 2047	U	U*2
20	SC CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	U*1
21	Spare	Spare			U	H*1
22	# Ethernet Connections	Reports the number of Ethernet TCP/IP connections that have been made with the SCS unit		1 - 4	U	U*1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
23	SCS ID	ID number assigned to this SCS by the user			U	U*1
24	SGC #1 CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	U*1
25	SGC #2 CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	U*1
26	SGC #3 CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	U*1
27	IOC CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	U*1
28	SC Status	All One's = Not Present			U	H*2
		bit 0: 1 = CPU Error		0 - 1		
		bit 1: 1 = RAM Read/Write Error		0 - 1		
		bit 2: 1 = ROM Checksum Error		0 - 1		
		bit 3: 1 = NVRAM Read/Write Error		0 - 1		
		bit 4: 1 = NVRAM Checksum Error		0 - 1		
		bit 5: 1 = SC Shared Memory Error		0 - 1		
		bit 6: 1 = SGC #1 Shared Memory Error		0 - 1		
		bit 7: 1 = SGC #2 Shared Memory Error		0 - 1		
		bit 8: 1 = SGC #3 Shared Memory Error		0 - 1		
		bit 9: 1 = IOC Shared Memory Error		0 - 1		
		bit 10: 1 = Clock Rate Error		0 - 1		
		bit 11: 1 = Interrupt Error		0 - 1		
		bit 12: 1 = 1K PPS Error		0 - 1		
		bit 13: 1 = 1 PPS Error		0 - 1		
		bit 14: 1 = CPU Clock Error		0 - 1		
		bit 15: Spare				
30	SC Version	Version number of the SCS Controller software used. (Written as "MajorVersion.MinorVersion")			U	H*2
		bits 0 - 7: minor version		0 - 0xFF		
		bits 8 - 15: major version		1 - 0xFF		
32	SGC #1 Status	Same as SC			U	H*2
34	SGC #2 Status	Same as SC			U	H*2
36	SGC #3 Status	Same as SC			U	H*2
38	IOC Status	Same as SC			U	H*2
40	SGC #1 Version	Version number of the Signal Generator Controller #1 software used. (Written as "MajorVersion.MinorVersion")			U	H*2
		bits 0 - 7: minor version		0 - 0xFF		
		bits 8 - 15: major version		1 - 0xFF		
42	SGC #2 Version	Version number of the Signal Generator Controller #2 software used. (Written as "MajorVersion.MinorVersion")			U	H*2
		bits 0 - 7: minor version		0 - 0xFF		
		bits 8 - 15: major version		1 - 0xFF		
44	SGC #3 Version	Version number of the Signal Generator Controller #3 software used. (Written as "MajorVersion.MinorVersion")			U	H*2
		bits 0 - 7: minor version		0 - 0xFF		
		bits 8 - 15: major version		1 - 0xFF		
46	IOC Version	Version number of the Input/Output Controller software used. (Written as "MajorVersion.MinorVersion")			U	H*2
		bits 0 - 7: minor version		0 - 0xFF		
		bits 8 - 15: major version		1 - 0xFF		

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
48	DGSG #1 Status	All One's = Not Present			U	H*2
		bit 0: 1 = ASIC #1 Error		0 - 1		
		bit 1: 1 = ASIC #2 Error		0 - 1		
		bit 2: Spare				
		bit 3: 1 = PPSSM Not Present		0 - 1		
		bit 4: 1 = PPSSM Error		0 - 1		
		bits 5-15: Spare				
50	DGSG #2 Status	Same as DGSG #1			U	H*2
52	DGSG #3 Status	Same as DGSG #1			U	H*2
54	DGSG #4 Status	Same as DGSG #1			U	H*2
56	GUC Status	All One's = Not Present			U	H*2
		bit 0: 1 = 10 MHz Not Locked		0 - 1		
		bit 1: 1 = Rubidium Not Present		0 - 1		
		bit 2: 1 = Rubidium Not Locked		0 - 1		
		bit 3: 1 = External 1 PPS Not Present		0 - 1		
		bit 4: 1 = External 1 PPS Not Locked		0 - 1		
		bits 5-15: Spare				
58	UMN/SCRAMNet Status	All One's = Not Present			U	H*2
		bit 0: 1 = UMN/SCRAMNet Failed		0 - 1		
		bits 1-15: Spare				
60	GUC Delta 1 PPS	Difference between input 1 PPS & output 1 PPS, as measured by the GUC	microsec		U	R*4
64	Alarm Summary	1 bit per alarm; 1 = alarm occurred since the alarm summary was last cleared. See Appendix C for alarm code definitions.			U	H*4 x12
		word 0, bit 0: alarm #0		0 - 1		
		...		...		
		word 11, bit 31: alarm #383		0 - 1		
112	RF #1 Broadband Noise Jammer Power	Power output into 20 mHz bandwidth of RF #1 by broadband noise jammer	dBm	-122 to -60	U	I*2
114	RF #2 Broadband Noise Jammer Power	Power output into 20 mHz bandwidth of RF #2 by broadband noise jammer	dBm	-122 to -60	U	I*2
116	GUC Control Register Settings	bits 0-5: RF #1 Broadband Noise Jammer Attenuator setting		0 - 63	U	H*2
		bits 6-11: RF #2 Broadband Noise Jammer Attenuator setting		0 - 63		
		bit 12: 1 = RF Crossover Enabled		0 - 1		
		bit 13: 1 = RF Crossover Low Gain Mode		0 - 1		
		bit 14: 1 = RF #1 & #2 Broadband Noise Jammer Enabled		0 - 1		
		bit 15: Spare				
118	Spare	Spare			U	H*2

TRANSFER CALIBRATION DATA BLOCK

Record ID = 6705 (Output from SCS)

This block has an identical format to the Ethernet input block of the same name (see **ETHERNET - INPUT TO SCS** section [page 38]).

TRANSMITTER RANGE DATA BLOCK

Record ID = 6710

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Transmitter Type	Transmitter ID	Vehicle #	System Classification	0
2	L2 EMP Channel #	L1 EMP Channel #	L2 Channel #	L1 Channel #	4
3	L2 VMP Channel #	L1 VMP Channel #	L2 Priority Index #	L1 Priority Index #	8
4	L2 VMP Priority Index #	L1 VMP Priority Index #	L2 EMP Priority Index #	L1 EMP Priority Index #	12
5	GPS Week Number		Translator Flag	Multipath Flags	16
6	APL Code Delay		L2 Modulation Control	L1 Modulation Control	20
7	GPS Time Of Week (MSBs)				24
8	GPS Time Of Week (LSBs)				28
9	Test Elapsed Time (MSBs)				32
10	Test Elapsed Time (LSBs)				36
11	Pseudorange (MSBs)				40
12	Pseudorange (LSBs)				44
13	Geometric Range (MSBs)				48
14	Geometric Range (LSBs)				52
15	Pseudorange Rate				56
16	Ionospheric Delay				60
17	Tropospheric Delay				64
18	L2 Ionospheric Delay Delta				68
19	Elevation Angle				72
20	Azimuth Angle				76
21	Earth Multipath				80
22	Vehicle Multipath				84
23	Transmitter Visibility	Vehicle Visibility	Terrain Visibility	Horizon Visibility	88
24	L1 Receive Power Level				92
25	Transmitter Selection Power				96
26	L1 Transmit Power				100
27	L1 Receiver Antenna Gain				104
28	L1 Transmitter Antenna Gain				108
29	L1 Path Loss				112
30	L2 Receive Power Level				116
31	Spare				120
32	L2 Transmit Power				124
33	L2 Receiver Antenna Gain				128
34	L2 Transmitter Antenna Gain				132
35	L2 Path Loss				136

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
36	L1 EMP Receive Power Level				140
37	L2 EMP Receive Power Level				144
38	L1 VMP Receive Power Level				148
39	L2 VMP Receive Power Level				152
40	Receiver Antenna Delays				156
41	Dither Errors 1 (MSBs)				160
42	Dither Errors 1 (LSBs)				164
43	Dither Errors 2 (MSBs)				168
44	Dither Errors 2 (LSBs)				172
45	Downlink Range (MSBs)				176
46	Downlink Range (LSBs)				180
47	Downlink Range Rate				184
48	Downlink Horizon Visibility	Downlink Terrain Visibility	Downlink Earth Multipath Visibility	Downlink Vehicle Multipath Visibility	188

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Transmitter Type	Transmitter Type: 0=Satellite, 1=Ground Transmitter (GT), 2=Satellite Spoofer, 3=GT Spoofer, 4=CW Jammer, 5=Pulsed Jammer, 6=Broadband Jammer		0 - 6	U	U*1
1	Transmitter ID	Transmitter ID		1 - 100	U	U*1
2	Vehicle #	Vehicle number or antenna ID (for dual antenna vehicles) that this transmitter is output on		1 - 3	U	U*1
3	System Classification	Flags identifying which classified features of the SCS are installed/loaded:			U	H*1
		bit 0: 1 = PPSSMs installed		0 - 1		
		bit 1: 1 = Keys loaded		0 - 1		
		bit 2: 1 = Classified software loaded		0 - 1		
		bit 3: 1 = Classified trajectory loaded		0 - 1		
4	L2 EMP Channel #	Hardware channel # for L2 earth multipath signal. -1 = No channel assigned		-1, 1 - 24	U	I*1
5	L1 EMP Channel #	Hardware channel # for L1 earth multipath signal. -1 = No channel assigned		-1, 1 - 24	U	I*1
6	L2 Channel #	Hardware channel # for L2 signal. -1 = No channel assigned		-1, 1 - 24	U	I*1
7	L1 Channel #	Hardware channel # for L1 signal. -1 = No channel assigned		-1, 1 - 24	U	I*1
8	L2 VMP Channel #	Hardware channel # for L1 vehicle multipath signal. -1 = No channel assigned		-1, 1 - 24	U	I*1
9	L1 VMP Channel #	Hardware channel # for L1 vehicle multipath signal. -1 = No channel assigned		-1, 1 - 24	U	I*1
10	L2 Priority Index #	Priority index # for this transmitter on L2		1 - 100	U	U*1
11	L1 Priority Index #	Priority index # for this transmitter on L1		1 - 100	U	U*1
12	L2 VMP Priority Index #	Priority index # for this transmitter’s vehicle multipath on L2		1 - 100	U	U*1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
13	L1 VMP Priority Index #	Priority index # for this transmitter's vehicle multipath on L1		1 - 100	U	U*1
14	L2 EMP Priority Index #	Priority index # for this transmitter's earth multipath on L2		1 - 100	U	U*1
15	L1 EMP Priority Index #	Priority index # for this transmitter's earth multipath on L1		1 - 100	U	U*1
16	GPS Week Number	GPS week number that data is valid	weeks	0 - 2047	U	U*2
18	Translator Flag	1 = Vehicle is a GPS translator		0 - 1	U	U*1
19	Multipath Flags	bit 0: 1 = Earth Multipath signal data bit 1: 1 = Vehicle Multipath signal data		0 - 1 0 - 1	U	H*1
20	APL Code Delay	Code delay (offset) of LAAS APL. Not applicable to any non-APL transmitter.	minutes	1 - 10079	U	U*2
22	L2 Modulation Control	0 = C/A and P code with Nav message 1 = P code with Nav message 2 = Carrier Only 3 = C/A and Y code with Nav message 4 = Y code with Nav message		0 - 4	U	U*1
23	L1 Modulation Control	0 = C/A and P code with Nav message 1 = P code with Nav message 2 = Carrier Only 3 = C/A and Y code with Nav message 4 = Y code with Nav message		0 - 4	U	U*1
24	GPS Time Of Week	GPS time of week that data is valid	seconds	0 - 604800	U	R*8
32	Test Elapsed Time	Elapsed time since start of test	seconds		U	R*8
40	Pseudorange	Range from vehicle to transmitter, including atmospheric & other delays	meters		S	R*8
48	Geometric Range	Range from vehicle to transmitter, without taking atmospheric & other delays into account	meters		S	R*8
56	Pseudorange Rate	Rate of change of pseudorange, including atmospheric & other delays	m/sec		S	R*4
60	Ionospheric Delay	Delay caused by the signal going through the ionosphere	meters		U	R*4
64	Tropospheric Delay	Delay caused by signal going through the troposphere	meters		U	R*4
68	L2 Ionospheric Delay Delta	Difference between L1 and L2 ionospheric delays	meters		U	R*4
72	Elevation Angle	Elevation angle from vehicle to transmitter	degrees	-90 - 90	S	R*4
76	Azimuth Angle	Azimuth angle from vehicle to transmitter	degrees	-180 - 180	S	R*4
80	Earth Multipath	Delay due to transmitter signal bouncing off of a spherical earth	meters		U	R*4
84	Vehicle Multipath	Delay due to transmitter signal bouncing off the vehicle	meters		U	R*4
88	Transmitter Visibility	1 = Line of sight from antenna to transmitter is not blocked by the transmitter's antenna		0 - 1	U	U*1
89	Vehicle Visibility	1 = Line of sight from antenna to transmitter is not blocked by the vehicle's antenna		0 - 1	U	U*1
90	Terrain Visibility	1 = Line of sight from antenna to transmitter is not blocked by the terrain map		0 - 1	U	U*1
91	Horizon Visibility	1 = Line of sight from antenna to transmitter is not blocked by the earth		0 - 1	U	U*1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
92	L1 Receive Power Level	Based on transmit power, transmitter antenna gain, path loss, receive antenna gain, in view (horizon, terrain, vehicle), and multipath (earth, vehicle)	dBm		U	R*4
96	Transmitter Selection Power	Based on transmit power, transmitter antenna gain, path loss, and in view (horizon, terrain) (used for transmitter selection)	dBm		U	R*4
100	L1 Transmit Power	L1 Signal power at transmitter	dBm		U	R*4
104	L1 Receiver Antenna Gain	Gain of L1 signal through receiver antenna	dB		U	R*4
108	L1 Transmitter Antenna Gain	Gain of L1 signal through transmitter antenna	dB		U	R*4
112	L1 Path Loss	Total loss of L1 signal power from the transmitter antenna to the receiver antenna	dB		U	R*4
116	L2 Receive Power Level	Based on transmit power, transmitter antenna gain, path loss, receive antenna gain, in view (horizon, terrain, vehicle), and multipath (earth, vehicle)	dBm		U	R*4
120	Spare	Spare				H*4
124	L2 Transmit Power	L2 Signal power at transmitter	dBm		U	R*4
128	L2 Receiver Antenna Gain	Gain of L2 signal through receiver antenna	dB		U	R*4
132	L2 Transmitter Antenna Gain	Gain of L2 signal through transmitter antenna	dB		U	R*4
136	L2 Path Loss	Total loss of L2 signal power from the transmitter antenna to the receiver antenna	dB		U	R*4
140	L1 EMP Receive Power Level	Based on L1 transmit power, transmitter antenna gain, path loss, receive antenna gain, in view, earth multipath	dBm		U	R*4
144	L2 EMP Receive Power Level	Based on L2 transmit power, transmitter antenna gain, path loss, receive antenna gain, in view, earth multipath	dBm		U	R*4
148	L1 VMP Receive Power Level	Based on L1 transmit power, transmitter antenna gain, path loss, receive antenna gain, in view, vehicle multipath	dBm		U	R*4
152	L2 VMP Receive Power Level	Based on L2 transmit power, transmitter antenna gain, path loss, receive antenna gain, in view, vehicle multipath	dBm		U	R*4
156	Receiver Antenna Delays	Not currently used	meters		U	R*4
160	Dither Errors 1	Transmitter clock dither error - term 1	meters		S	R*8
168	Dither Errors 2	Transmitter clock dither error - term 2	meters		S	R*8
176	Downlink Range	Range from tracking antenna to GPS translator	meters		U	R*8
184	Downlink Range Rate	Rate of change of range from tracking antenna to GPS translator	m/sec		U	R*4
188	Downlink Horizon Visibility	1 = Line of sight from GPS translator to tracking antenna is not blocked by the earth		0 - 1	U	U*1
189	Downlink Terrain Visibility	1 = Line of sight from GPS translator to tracking antenna is not blocked by the terrain map		0 - 1	U	U*1
190	Downlink Earth Multipath Visibility	1 = Transmission path from GPS translator to tracking antenna with a single bounce off a spherical earth is not blocked		0 - 1	U	U*1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
191	Downlink Vehicle Multipath Visibility	1 = Transmission path from GPS translator to tracking antenna with a single bounce off the tracking vehicle is not blocked		0 - 1	U	U*1

SCS TO PC INFO BLOCK

Record ID = 6715

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Message Code		Message Data		0
2	Message String				4
...	...				...
22	Message String				84

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Message Code	Code indicating intent of message (error, display data, transfer status, etc.)		0 - 110	U	U*2

Code	Message Type
0	Simulation parameter transfer status/progress
10	Datalog transfer status/progress
20	Simulation duration progress
30	NFS file system mount error
50	Simulation parameter file read error
60	No primary connection privileges errors
70	Primary connection granted
71	Secondary connection granted
80	Scenario multichassis start synchronization succeeded
81	Scenario multichassis start synchronization failed
85	Scenario started by interface (UMN/SCRAMNet/Ethernet)
87	UMN interface not initialized
88	Ethernet motion interface not initialized
90	Signal summary data
92	Channel assignment data
100	Reference receiver present
110	Zeroize failed error

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
2	Message Data	Integer data content of message			U	I*2

Code	Message Data Definition	UNITS	RANGE
0	Percent of transfer completed	percent	0 - 100
10	Percent of datalog transfer completed	percent	0 - 100
20	Percent of total scenario completed	percent	0 - 100
30	Unused		
50	Unused		
60	Unused		
70	Unused		
71	Unused		
80	Unused		
81	Unused		
85	Start source (1=UMN/SCRAMNet, 2=Ethernet)		1 - 2
87	Unused		
88	Unused		
90	Unused		
92	Unused		
100	Reference receiver number (1 or 3)		1, 3
110	Zeroize failed error (0=Zeroize Successful, 1=Zeroize Failed)		0 - 1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
4	Message String	String data content of message			U	C*84

Code	Message String Definition
0	Unused
10	Unused
20	Unused
30	Filename that failed to mount
50	Filename of bad simulation parameter file
60	Host name of primary connection
70	Unused
71	Host name of primary connection
80	Unused
81	Unused
85	Start source (1=UMN/SCRAMNet, 2=Ethernet)
87	Unused
88	Unused
90	Array of boolean bit flags indicating signal data available for receiver/transmitter combination (see note 1 below) (0=Signal type not present, 1=Signal type present)
92	Array of boolean byte flags (1 byte each) (0=Channel Unassigned, 1=Channel Assigned)
100	Unused

Note 1. Indexed by [Vehicle ID (1 or 2), Transmitter Type (SV, GT, SV Spoofer, GT Spoofer, Jammer), Transmitter ID (1-50)]

Examples:
Message byte 4, bit 7 = [Vehicle 1, SV, #1]
Message byte 7, bit 0 = [Vehicle 1, SV, #32]
Message byte 35, bit 5 = [Vehicle 2, SV, #1]
Message byte 66, bit 4 = [Vehicle 2, Jammer, #50]

DOWNLINK DATA BLOCK

Record ID = 6720

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Test Elapsed Time				0
2	Spare				4
3	Downlink Range (MSBs)				8
4	Downlink Range (LSBs)				12
5	Downlink Range Rate				16
6	Downlink Horizon Visibility	Downlink Terrain Visibility	Downlink Earth Multipath Visibility	Downlink Vehicle Multipath Visibility	20

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Test Elapsed Time	Time elapsed since start of test	seconds		U	R*4
4	Spare	Spare			U	H*4
8	Downlink Range	Range from translator to receiver's antenna	meters		U	R*8
16	Downlink Range Rate	Rate of change of Downlink Range	m/sec		U	R*4
20	Downlink Horizon Visibility	1 = Line of sight from GPS translator to tracking antenna is not blocked by the earth		0 - 1	U	U*1
21	Downlink Terrain Visibility	1 = Line of sight from GPS translator to tracking antenna is not blocked by the terrain map		0 - 1	U	U*1
22	Downlink Earth Multipath Visibility	1 = Transmission path from GPS translator to tracking antenna with a single bounce off a spherical earth is not blocked		0 - 1	U	U*1
23	Downlink Vehicle Multipath Visibility	1 = Transmission path from GPS translator to tracking antenna with a single bounce off the tracking vehicle is not blocked		0 - 1	U	U*1

TRANSMITTER STATE VECTOR INTERPOLATION DATA BLOCK

Record ID = 6730

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Spare	System Classification	GPS Week Number		0
2	Spare				4
3	Transmitter ID	Transmitter Type	Transmitter Valid	Spare	8
4	APL Code Delay		Spare		12
5	GPS Time 1 (MSBs)				16
6	GPS Time 1 (LSBs)				20
7	Transmitter Position 1 - E (MSBs)				24
8	Transmitter Position 1 - E (LSBs)				28
9	Transmitter Position 1 - F (MSBs)				32
10	Transmitter Position 1 - F (LSBs)				36
11	Transmitter Position 1 - G (MSBs)				40
12	Transmitter Position 1 - G (LSBs)				44
13	Transmitter Velocity 1 - E (MSBs)				48
14	Transmitter Velocity 1 - E (LSBs)				52
15	Transmitter Velocity 1 - F (MSBs)				56
16	Transmitter Velocity 1 - F (LSBs)				60
17	Transmitter Velocity 1 - G (MSBs)				64
18	Transmitter Velocity 1 - G (LSBs)				68
19	Clock Bias 1 (MSBs)				72
20	Clock Bias 1 (LSBs)				76
21	Clock Drift 1 (MSBs)				80
22	Clock Drift 1 (LSBs)				84
23	Group Delay 1 (MSBs)				88
24	Group Delay 1 (LSBs)				92
25	GPS Time 2 (MSBs)				96
26	GPS Time 2 (LSBs)				100
27	Transmitter Position 2 - E (MSBs)				104
28	Transmitter Position 2 - E (LSBs)				108
29	Transmitter Position 2 - F (MSBs)				112
30	Transmitter Position 2 - F (LSBs)				116
31	Transmitter Position 2 - G (MSBs)				120
32	Transmitter Position 2 - G (LSBs)				124
33	Transmitter Velocity 2 - E (MSBs)				128
34	Transmitter Velocity 2 - E (LSBs)				132
35	Transmitter Velocity 2 - F (MSBs)				136

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
36	Transmitter Velocity 2 - F (LSBs)				140
37	Transmitter Velocity 2 - G (MSBs)				144
38	Transmitter Velocity 2 - G (LSBs)				148
39	Clock Bias 2 (MSBs)				152
40	Clock Bias 2 (LSBs)				156
41	Clock Drift 2 (MSBs)				160
42	Clock Drift 2 (LSBs)				164
43	Group Delay 2 (MSBs)				168
44	Group Delay 2 (LSBs)				172
45	Acceleration Interpolation Coefficient - E (MSBs)				176
46	Acceleration Interpolation Coefficient - E (LSBs)				180
47	Acceleration Interpolation Coefficient - F (MSBs)				184
48	Acceleration Interpolation Coefficient - F (LSBs)				188
49	Acceleration Interpolation Coefficient - G (MSBs)				192
50	Acceleration Interpolation Coefficient - G (LSBs)				196
51	Jerk Interpolation Coefficient - E (MSBs)				200
52	Jerk Interpolation Coefficient - E (LSBs)				204
53	Jerk Interpolation Coefficient - F (MSBs)				208
54	Jerk Interpolation Coefficient - F (LSBs)				212
55	Jerk Interpolation Coefficient - G (MSBs)				216
56	Jerk Interpolation Coefficient - G (LSBs)				220
57	Clock Acceleration (MSBs)				224
58	Clock Acceleration (LSBs)				228
59	Clock Jerk (MSBs)				232
60	Clock Jerk (LSBs)				236

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Spare	Spare			U	H*1
1	System Classification	Flags identifying which classified features of the SCS are installed/loaded:			U	H*1
		bit 0: 1 = PPSSMs installed		0 - 1		
		bit 1: 1 = Keys loaded		0 - 1		
		bit 2: 1 = Classified software loaded		0 - 1		
		bit 3: 1 = Classified trajectory loaded		0 - 1		
2	GPS Week Number	GPS week number in which Time 1 is in	weeks	0 - 2047	U	U*2
4	Spare	Spare			U	H*4
8	Transmitter ID	Satellite ID.		1 - 50	U	U*1
9	Transmitter Type	Type of transmitter to which this data applies: 0=SV, 1=GT, 2=SV Spoofer, 3=GT Spoofer, 4=CW Jammer, 5=Pulsed Jammer, 6=Broadband Jammer		0 - 6	U	U*1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
10	Transmitter Valid	1 = Block has valid data		0 - 1	U	U*1
11	Spare	Spare			U	H*1
12	APL Code Delay	Code delay (offset) of LAAS APL. Not applicable to any non-APL transmitter.	minutes	1 - 10079	U	U*2
14	Spare	Spare			U	H*2
16	GPS Time 1	GPS Epoch Time at which Transmitter Position 1 and Velocity 1 are valid	seconds		U	R*8
24	Transmitter Position 1 - (E,F,G)	ECEF position (E,F,G) at GPS Time 1	meters		S	R*8 x3
48	Transmitter Velocity 1 - (E,F,G)	ECEF velocity (E,F,G) at GPS Time 1	m/sec		S	R*8 x3
72	Clock Bias 1	Satellite clock bias at GPS Time 1	meters		U	R*8
80	Clock Drift 1	Satellite clock drift at GPS Time 1	m/sec		U	R*8
88	Group Delay 1	Satellite group delay at GPS Time 1	meters		U	R*8
96	GPS Time 2	GPS Epoch Time of at which Transmitter Position 2 and Velocity 2 are valid	seconds		U	R*8
104	Transmitter Position 2 - (E,F,G)	ECEF position (E,F,G) at GPS Time 2	meters		S	R*8 x3
128	Transmitter Velocity 2 - (E,F,G)	ECEF velocity (E,F,G) at GPS Time 2	m/sec		S	R*8 x3
152	Clock Bias 2	Satellite clock bias at GPS Time 2	meters		U	R*8
160	Clock Drift 2	Satellite clock drift at GPS Time 2	m/sec		U	R*8
168	Group Delay 2	Satellite group delay at GPS Time 2	meters		U	R*8
176	Acceleration Interpolation Coefficient - (E,F,G)	ECEF acceleration (E,F,G) interpolation coefficient calculated using the transmitter state vectors at GPS Time 2 and GPS Time 2	m/sec^2		S	R*8 x3
200	Jerk Interpolation Coefficient - (E,F,G)	ECEF jerk (E,F,G) interpolation coefficient calculated using the transmitter state vectors at GPS Time 2 and GPS Time 2	m/sec^3		S	R*8 x3
224	Clock Acceleration	Satellite clock acceleration	m/sec^2		U	R*8
232	Clock Jerk	Satellite clock jerk	m/sec^3		U	R*8

24 CHANNEL SUMMARY DATA BLOCK

Record ID = 6735

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time Of Week				0
2	Elapsed Time				4
3	Time Fraction				8
4	GPS Week Number		System Classification	Spare	12
5	Channel Number #1	Vehicle Number #1	Transmitter Type #1	Transmitter ID #1	16
6	Frequency #1	Multipath Type #1	Modulation Control #1	Visibility Flags #1	20
7	Signal Power #1		Azimuth Angle #1		24
8	Elevation Angle #1		Spare		28
9	Pseudorange #1 (MSBs)				32
10	Pseudorange #1 (LSBs)				36
11	Pseudorange Rate #1				40
12	Spare				44
...	...				...
189	Channel Number #24	Vehicle Number #24	Transmitter Type #24	Transmitter ID #24	752
190	Frequency #24	Multipath Type #24	Modulation Control #24	Visibility Flags #24	756
191	Signal Power #24		Azimuth Angle #24		760
192	Elevation Angle #24		Spare		764
193	Pseudorange #24 (MSBs)				768
194	Pseudorange #24 (LSBs)				772
195	Pseudorange Rate #24				776
196	Spare				780

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time Of Week	GPS time of week (truncated to most recent second) of validity for this block of data.	seconds	0 - 604799	U	U*4
4	Elapsed Time	Time (truncated to most recent second) since beginning of test.	seconds		U	U*4
8	Time Fraction	Residual fraction for both GPS Time Of Week and Elapsed Time.	nsec	0 - 10^9	U	U*4
12	GPS Week Number	GPS week number of validity for this block of data.	weeks	0 - 2047	U	U*2
14	System Classification	Flags identifying which classified features of the SCS are installed/loaded:			U	H*1
		bit 0: 1 = PPSSMs installed		0 - 1		
		bit 1: 1 = Keys loaded		0 - 1		
		bit 2: 1 = Classified software loaded		0 - 1		
		bit 3: 1 = Classified trajectory loaded		0 - 1		
15	Spare	Spare			U	U*1
16	Channel Number #1	Hardware channel number to which channel summary #1 applies.		1 - 24	U	U*1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
17	Vehicle Number #1	Vehicle number or antenna ID (for dual antenna vehicles) for channel summary #1. 0 = Channel not assigned (i.e. not in use).		0 - 2	U	U*1
18	Transmitter Type #1	Transmitter type for channel summary #1: 0 = Satellite 1 = Ground Transmitter 2 = Satellite Spoofer 3 = Ground Transmitter Spoofer 4 = CW Jammer 5 = Pulsed Jammer		0 - 5	U	U*1
19	Transmitter ID #1	Transmitter ID for channel summary #1.		1 - 50	U	U*1
20	Frequency #1	Frequency for channel summary #1: 0 = L1 1 = L2		0 - 1	U	U*1
21	Multipath Type #1	Multipath type for channel summary #1: 0 = Direct Path 1 = Earth Multipath 2 = Vehicle Multipath		0 - 2	U	U*1
22	Modulation Control #1	Data modulated onto carrier for channel summary #1: 0 = C/A and P code with Nav message 1 = P code with Nav message 2 = Carrier Only 3 = C/A and Y code with Nav message 4 = Y code with Nav message		0 - 4	U	U*1
23	Visibility Flags #1	Flags identifying the source of signal blockage for channel summary #1. If the entire field is 0, the signal is not blocked: bit 0: 1 = Blocked by transmitting antenna bit 1: 1 = Blocked by vehicle antenna bit 2: 1 = Blocked by terrain bit 3: 1 = Blocked by horizon bit 4: 1 = Downlink* blocked by terrain bit 5: 1 = Downlink* blocked by horizon bit 6: 1 = Downlink* earth multipath blocked bit 7: 1 = Downlink* vehicle multipath blocked *Downlink applies to translated signals only, referring to the path from the GPS translator to the tracking antenna.		 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1	U	H*1
24	Signal Power #1	Signal power output at the SCS RF output, for channel summary #1.	dBm	LSB = 0.1	U	I*2
26	Azimuth Angle #1	Azimuth angle from vehicle to transmitter, for channel summary #1.	0.1 degrees	-180 - 180	S	I*2
28	Elevation Angle #1	Elevation angle from vehicle to transmitter, for channel summary #1.	0.1 degrees	-90 - 90	S	I*2
30	Spare	Spare			U	U*2
32	Pseudorange #1	Range from vehicle to transmitter, including atmospheric & other delays, for channel summary #1.	meters		S	R*8
40	Pseudorange Rate #1	Rate of change of pseudorange, including atmospheric & other delays, for channel summary #1.	m/sec		S	R*4
44	Spare	Spare			U	U*4
...	...	...		...	...	...
752	Channel Number #24	Hardware channel number to which channel summary #24 applies.		1 - 24	U	U*1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
753	Vehicle Number #24	Vehicle number or antenna ID (for dual antenna vehicles) for channel summary #24. 0 = Channel not assigned (i.e. not in use).		0 - 2	U	U*1
754	Transmitter Type #24	Transmitter type for channel summary #24: 0 = Satellite 1 = Ground Transmitter 2 = Satellite Spoofer 3 = Ground Transmitter Spoofer 4 = CW Jammer 5 = Pulsed Jammer		0 - 5	U	U*1
755	Transmitter ID #24	Transmitter ID for channel summary #24.		1 - 50	U	U*1
756	Frequency #24	Frequency for channel summary #24: 0 = L1 1 = L2		0 - 1	U	U*1
757	Multipath Type #24	Multipath type for channel summary #24: 0 = Direct Path 1 = Earth Multipath 2 = Vehicle Multipath		0 - 2	U	U*1
758	Modulation Control #24	Data modulated onto carrier for channel summary #24: 0 = C/A and P code with Nav message 1 = P code with Nav message 2 = Carrier Only 3 = C/A and Y code with Nav message 4 = Y code with Nav message		0 - 4	U	U*1
759	Visibility Flags #24	Flags identifying the source of signal blockage for channel summary #24. If the entire field is 0, the signal is not blocked: bit 0: 1 = Blocked by transmitting antenna bit 1: 1 = Blocked by vehicle antenna bit 2: 1 = Blocked by terrain bit 3: 1 = Blocked by horizon bit 4: 1 = Downlink* blocked by terrain bit 5: 1 = Downlink* blocked by horizon bit 6: 1 = Downlink* earth multipath blocked bit 7: 1 = Downlink* vehicle multipath blocked *Downlink applies to translated signals only, referring to the path from the GPS translator to the tracking antenna.		 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1	U	H*1
760	Signal Power #24	Signal power output at the SCS RF output, for channel summary #24.	dBm	LSB = 0.1	U	I*2
762	Azimuth Angle #24	Azimuth angle from vehicle to transmitter, for channel summary #24.	0.1 degrees	-180 - 180	S	I*2
764	Elevation Angle #24	Elevation angle from vehicle to transmitter, for channel summary #24.	0.1 degrees	-90 - 90	S	I*2
766	Spare	Spare			U	U*2
768	Pseudorange #24	Range from vehicle to transmitter, including atmospheric & other delays, for channel summary #24.	meters		S	R*8
776	Pseudorange Rate #24	Rate of change of pseudorange, including atmospheric & other delays, for channel summary #24.	m/sec		S	R*4
780	Spare	Spare			U	U*4

OVERRIDE CONTROL SUMMARY BLOCK

Record ID = 6740

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Override #1 ID	Override #1 Status	Spare	Override #1 Control Type	0
2	Override #1 Start Time				4
3	Override #1 Stop Time				8
4	Override #1 Data Item 1	Override #1 Data Item 2	Spare		12
...	...				...
117	Override #30 ID	Override #30 Status	Spare	Override #30 Control Type	464
118	Override #30 Start Time				468
119	Override #30 Stop Time				472
120	Override #30 Data Item 1	Override #30 Data Item 2	Spare		476

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Override #1 ID	Unique override ID for record #1		1 - 30	U	U*1
1	Override #1 Status	Status of record #1 override: 0=Pending, 1=Active, 2=Complete		0 - 2	U	U*1
2	Spare	Spare			U	H*1
3	Override #1 Control Type	Control type for record #1 override: 0=Differential, 1=Jammer, 2=Transmitter, 3=Logging		0 - 3	U	U*1
4	Override #1 Start Time	Time of control #1 initiation (time of GPS)	seconds		U	U*4
8	Override #1 Stop Time	Time of control #1 conclusion (time of GPS)	seconds		U	U*4
12	Override #1 Data Item 1	Data Value for record #1 control			U	U*1
		Control Type / Data Item 1 Definition				
		Differential Control / Spare				
		Jammer Control / Jammer ID		1 - 50		
		Transmitter Control / Transmitter ID		1 - 37		
		Logging Control / Logging record ID (high byte)		23 - 27		
13	Override #1 Data Item 2	Data Value for record #1 control			U	U*1
		Control Type / Data Item 2 Definition				
		Differential Control / Spare				
		Jammer Control / Jammer Type		0 - 2		
		Transmitter Control / Transmitter Type		0 - 3		
		Logging Control / Logging record ID (low byte)		0 - 255		
14	Spare	Spare			U	H*2
...	...	...		...	...	...
464	Override #30 ID	Unique override ID for record #1		1 - 30	U	U*1
465	Override #30 Status	Status of record #30 override: 0=Pending, 1=Active, 2=Complete		0 - 2	U	U*1
466	Spare	Spare			U	H*1
467	Override #30 Control Type	Control type for record #30 override: 0=Differential, 1=Jammer, 2=Transmitter, 3=Logging		0 - 3	U	U*1
468	Override #30 Start Time	Time of control #30 initiation (time of GPS)	seconds		U	U*4

BYTE	NAME	DESCRIPTION		UNITS	RANGE	CLASS	DATA TYPE
472	Override #30 Stop Time	Time of control #30 conclusion (time of GPS)		seconds		U	U*4
476	Override #30 Data Item 1	Data Value for record #30 control				U	U*1
		Control Type	Data Item 1 Definition				
		Differential Control	Spare				
		Jammer Control	Jammer ID		1 - 50		
		Transmitter Control	Transmitter ID		1 - 37		
		Logging Control	Logging record ID (high byte)		23 - 27		
477	Override #30 Data Item 2	Data Value for record #30 control				U	U*1
		Control Type	Data Item 2 Definition				
		Differential Control	Spare				
		Jammer Control	Jammer Type		0 - 2		
		Transmitter Control	Transmitter Type		0 - 3		
		Logging Control	Logging record ID (low byte)		0 - 255		
478	Spare	Spare				U	H*2

DETAILED OVERRIDE CONTROL DATA BLOCK

Record ID = 6750

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Override ID	Override Status	Spare	Override Control Type	0
2	Control Data - Byte 1	Control Data - Byte 2	Control Data - Byte 3	Control Data - Byte 4	4
...	...				...
21	Control Data - Byte 76	Control Data - Byte 78	Control Data - Byte 79	Control Data - Byte 80	80

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Override ID	Unique override ID for record #1		1 - 30	U	U*1
1	Override Status	Status of record #1 override: 0=Pending, 1=Active, 2=Complete		0 - 2	U	U*1
2	Spare	Spare			U	H*1
3	Override Control Type	Control type for record #1 override: 0=Differential, 1=Jammer, 2=Transmitter, 3=Logging		0 - 3	U	U*1
4	Control Data	Detailed override data. The format and the length is specified by Override Control Type. All bytes of this field in excess of the defined control length are Spare.			U	H*1 x80

For details of the control data formats, see **ETHERNET - INPUT TO SCS** section as follows:

Control Type	Page #
Differential Control	51
Jammer Control	49
Transmitter Control	46
Logging Control	53

RS-422/485 INTERFACE

An SCS chassis may be equipped with an RS-422/485 interface. This optional interface requires that the SCS chassis have an Input/Output Controller (IOC) installed and that the IOC have an RS-422/485 interface module installed.

This interface is used by the SCS to send simulated inertial measurement unit (IMU) data, inertial navigation system (INS) data, doppler navigation system (DNS) data and/or differential corrections to a GPS receiver or other external computer. If configured for use by a scenario, this data will be sent by the SCS without any interaction or control of any kind by the external computer. There is no input to the SCS on this interface.

This interface consists of two completely independent RS-422/485 serial ports. Port A can be configured to transmit either IMU/INS/DNS data for vehicle 1 or differential corrections. Port B can be configured to transmit either IMU/INS/DNS data for vehicle 2 or differential corrections. If two IMU/INS/DNS's are simulated, they need not be of the same type. Differential corrections can only be sent over one port at a time (either A or B). The communications protocol used by the serial ports (baud rate, parity, etc.) is independently variable, based on the data types being simulated. See each individual output format for details. Messages may or may not be transmitted with an ICD-GPS-204 header, depending on the particular message.

The following are the pin assignments for the 2 RS-422/485 connectors (DB25's):

Pin #	Signal	I[1]/O
1	GND	
2		
3	RxD-	I
4		
5	CTS+	I
6	DSR+	I
7	GND	
8	DCD+	I
9	RxC-	I
10	DCD-	I
11	TxD+	O
12	TxC+	I/O
13	CTS-	I

Pin #	Signal	I[1]/O
14	TxD-	O
15	TxC-	I/O
16	RxD+	I
17	RxC+	I
18	RTS+	O
19	RTS-	O
20		
21	DTR+	O
22	DSR-	I
23	DTR-	O
24		
25	Fused +5V	

Note 1: The SCS does not currently use any of the input capabilities of this interface.

RS-422/485 - OUTPUT FROM SCS

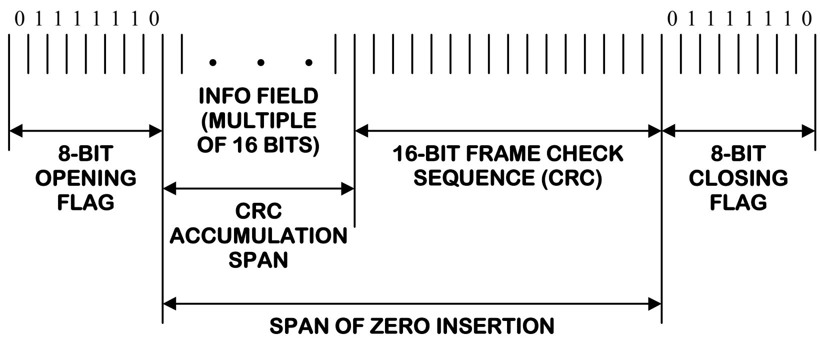
Description	Frequency	Record ID(s)	Page #
Inertial Measurement Unit Data Block (LN-200)	1000 / sec (max)	N/A	84
Inertial Measurement Unit Data Block (RAP-Litton)	100 / sec	N/A	85
Inertial Navigation System Data Block (EGR-14)	50 / sec (max)	14	86
Inertial Navigation System Data Block (EGR-16)	50 / sec (max)	16	89
Differential Corrections Data Block (RAP-ECP062)	1 / sec (max)	4195	91
Differential Corrections Data Block (RAP-LRIP)	1 / sec (max)	4195	93
Doppler Navigation System Data Block (I-10)	50 / sec (max)	7010	95

Each of these messages represents a different IMU, INS, DNS or Differential Corrections interface with its own communications protocol. The specific interface attributes are described with the block definitions.

INERTIAL MEASUREMENT UNIT DATA BLOCK (LN-200)

Record ID = N/A

RS-485 - Attributes: Synchronous SDLC (simplified), 1 Mbps, 16-Bit CRC, Transmission Frame as follows:



LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Delta Velocity - X		Delta Velocity -Y		0
2	Delta Velocity - Z		Delta Angle - X		4
3	Delta Angle - Y		Delta Angle - Z		8
4	IMU Status		Reserved		12
5	Reserved		Reserved		16
6	Reserved		Reserved		20
7	Checksum				24

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Delta Velocity - (X,Y,Z)	Change in velocity in body axes (X,Y,Z)	m/sec	$LSB^{*} = 2^{-14}$	U	I*2 x3
6	Delta Angle - (X,Y,Z)	Change in angle in body axes (X,Y,Z)	radians	$LSB^{*} = 2^{-19}$	U	I*2 x3
12	IMU Status	IMU status summary word, SCS sets to 0		0	U	H*2
14	Reserved	Reserved			U	H*2 x5
24	Checksum	16-bit, 1's complement checksum of the 12 I*2's contained in bytes 0-23			U	H*2

* This is the LSB used by the SCS Post Test Analysis Application, based on a typical LN-200 IMU. However, these values can be set by the user to any desired value in the scenario parameters (in the .imu file). If a scaling different from the one shown is chosen, the output of the Post Test Application will NOT reflect the change.

INERTIAL MEASUREMENT UNIT DATA BLOCK (RAP-LITTON)

Record ID = N/A

RS-422 - Attributes: Asynchronous, 125 Kbps, 8 Data Bits, 1 Start Bit, 2 Stop Bits, No Parity

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Status		Delta Velocity (Inertial) - X		0
2	Delta Velocity (Inertial) - Y		Delta Velocity (Inertial) - Z		4
3	Quaternion - Q_1		Quaternion - Q_2		8
4	Quaternion - Q_3		Quaternion - Q_4		12
5	Delta Velocity (Body) - X		Delta Velocity (Body) - Y		16
6	Delta Velocity (Body) - Z		Delta Theta - X		20
7	Delta Theta - Y		Delta Theta - Z		24
8	Checksum				28

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Status	Built-in test status, SCS sets to 0		0	U	H*2
2	Delta Velocity (Inertial) - (X,Y,Z)	Inertially stabilized delta velocity (X,Y,Z)	ft/sec/100 Hz	LSB = 2^{-12}	U	I*2 x3
8	Quaternion - (Q_1,Q_2,Q_3,Q_4)	Quaternion transformation parameters (Q_1,Q_2,Q_3,Q_4). These satisfy the following: $\delta V_i = \delta V_b + 2Q_4 (P \text{ X } \delta V_b) + 2P \text{ X } (P \text{ X } \delta V_b)$ where: δV_i = the inertially stabilized velocity vector δV_b = the velocity vector in the body frame P = a vector = (Q_1, Q_2, Q_3)		LSB = $2^{-14.5}$	U	I*2 x4
16	Delta Velocity (Body) - (X,Y,Z)	Change in velocity in body axes (X,Y,Z)	ft/sec/100 Hz	LSB = 2^{-12}	U	I*2 x3
22	Delta Theta - (X,Y,Z)	Change in angle in body axes (X,Y,Z)	rad/100 Hz	LSB = 2^{-18}	U	I*2 x3
28	Checksum	16-bit, 2's complement checksum of the 14 I*2's contained in bytes 0-27			U	H*2

INERTIAL NAVIGATION SYSTEM DATA BLOCK (EGR-14)

Record ID = 14

RS-422 - Attributes: Asynchronous, 76.8 or 153.6 Kbps, 8 Data Bits, 1 Start Bit, 1 Stop Bit, Odd Parity

ICD-GPS-204 Message Header

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Sync Word (= 81FF hex)		Record ID (= 14 = 000E hex)		0
2	Data Word Count (= 42 = 002A hex)		Flag Word (= 8000 hex)		4
3	Header Checksum (= FDC9 hex)				8

Message Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GCU Mode Word		Reserved		0
2	Platform Velocity - X				4
3	Platform Velocity - Y				8
4	Platform Velocity - Z				12
5	Platform Azimuth		Platform Acceleration - X		16
6	Platform Acceleration - Y		Platform Acceleration - Z		20
7	Earth-to-Local Level Direction Cosines - zx				24
8	Earth-to-Local Level Direction Cosines - zy				28
9	Earth-to-Local Level Direction Cosines - zz				32
10	Longitude				36
11	Altitude				40
12	Local Level-to-Body Direction Cosines - xx				44
13	Local Level-to-Body Direction Cosines - xy				48
14	Local Level-to-Body Direction Cosines - xz				52
15	Local Level-to-Body Direction Cosines - yx				56
16	Local Level-to-Body Direction Cosines - yy				60
17	Local Level-to-Body Direction Cosines - yz				64
18	Body Rate - X		Body Rate - Y		68
19	Body Rate - Z		GPS Time (High Byte)		72
20	GPS Time (Middle Bytes)				76
21	GPS Time (Low Byte)		Reserved		80
22	Data Checksum				84

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GCU Mode Word	Bit 0: Reserved Bit 1: 1 = Failure detected, message invalid Bit 2: Reserved Bit 3: 1 = INS not in Nav mode, message invalid Bits 4-11: Reserved Bit 12: 1 = GPS Time invalid Bit 13: Platform Velocity/Acceleration frame 0 = Platform (wander azimuth), 1 = ECEF Bit 14: 1 = Platform Acceleration invalid Bit 15: 1 = Gravity not included in Platform Acceleration			U	H*2
2	Reserved	Reserved			U	H*2
4	Platform Velocity - (X,Y,Z)	Vehicle velocity in coordinates as specified by bit 13 of GCU Mode Word (0=platform (wander azimuth) - see note 1, 1=ECEF).	ft/sec	LSB = 2^{-18}	U	I*4 x3
16	Platform Azimuth	Angle measured positive clockwise from platform X-axis to aircraft nose.	semi-circles	LSB = 2^{-15}	U	I*2
18	Platform Acceleration - (X,Y,Z)	Vehicle acceleration in coordinates as specified by bit 13 of GCU Mode Word (0=platform (wander azimuth) - see note 1, 1=ECEF). Gravity is included if specified by bit 15 of GCU Mode Word (0=gravity included, 1=gravity not included). Nominal stationary inputs are (0, 0, -1g) if gravity is included, (0, 0, 0) if gravity is not included.	ft/sec^2	LSB = 2^{-8}	U	I*2 x3
24	Earth-to-Local Level Direction Cosines - (zx,zy,zz)	zx, zy & zz components of direction cosine matrix (C_EL) for transforming earth coordinates (E, F, G) to local level (platform) coordinates (X, Y, Z). C_EL_{zx} = cos(latitude) * cos(wander angle) C_EL_{zy} = -cos(latitude) * sin(wander angle) C_EL_{zz} = -sin(latitude)		LSB = 2^{-30}	U	I*4 x3
36	Longitude	Longitude of vehicle	semi-circles	LSB = 2^{-31}	U	I*4
40	Altitude	Altitude of vehicle	feet	LSB = 2^{2}	U	I*4
44	Local Level-to-Body Direction Cosines - (xx,xy,xz,yx,yy,yz)	xx, xy, xz, yx, yy, & yz components of direction cosine matrix (C_LB) for transforming local level (platform) coordinates (X, Y, Z) to body coordinates (forward, right, down - see note 2). C_LB_{xx} = cos(yaw) * cos(pitch) C_LB_{xy} = cos(yaw) * sin(pitch) * sin(roll) - sin(yaw) * cos(roll) C_LB_{xz} = cos(yaw) * sin(pitch) * cos(roll) + sin(yaw) * sin (roll) C_LB_{yx} = sin(yaw) * cos(pitch) C_LB_{yy} = sin(yaw) * sin(pitch) * sin(roll) + cos(yaw) * cos(roll) C_LB_{yz} = sin(yaw) * sin(pitch) * cos(roll) - cos(yaw) * sin (roll)		LSB = 2^{-30}	U	I*4 x6
68	Body Rate - (X,Y,Z)	Spin vector (angular velocity) of body frame (defined by Body-to-Local Level Direction Cosines) - see note 2. Includes earth rate terms and transport rate (when in motion).	rad/sec	LSB = 2^{-12}	U	I*2 x3

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
74	GPS Time	GPS Time of week of IMU validity	seconds	LSB = 2^{-31}	U	U*8
82	Reserved	Reserved			U	H*2
84	Data Checksum	16-bit, 2's complement checksum of the 42 I*2's contained in bytes 0-83			U	H*2

Note 1: In the platform (wander azimuth) coordinate frame, the positive x-axis is defined to be locally level and pointed an angle α (the wander angle) east of north, the positive y-axis is defined to be locally level and pointed α south of east, and the positive z-axis is pointed downward.

Note 2: The body coordinate frame used in this message is different from the standard SCS body frame described in Appendix B. The body x, y & z axes used in this message point forward, right & down, instead of right, forward & up as in the standard SCS body frame.

INERTIAL NAVIGATION SYSTEM DATA BLOCK (EGR-16)

Record ID = 16

RS-422 - Attributes: Asynchronous, 76.8 or 153.6 Kbps, 8 Data Bits, 1 Start Bit, 1 Stop Bit, Odd Parity

ICD-GPS-204 Message Header

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Sync Word (= 81FF hex)		Record ID (= 16 = 0010 hex)		0
2	Data Word Count (= 32 = 0020 hex)		Flag Word (= 8000 hex)		4
3	Header Checksum (= FDD1 hex)				8

Message Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time - Integer				0
2	GPS Time - Fraction				4
3	Mode Word		Reserved		8
4	Reserved				12
5	ECEF Position of Antenna - X				16
6	ECEF Position of Antenna - Y				20
7	ECEF Position of Antenna - Z				24
8	ECEF Velocity of Antenna - X				28
9	ECEF Velocity of Antenna - Y				32
10	ECEF Velocity of Antenna - Z				36
11	ECEF Acceleration of Antenna - X				40
12	ECEF Acceleration of Antenna - Y				44
13	ECEF Acceleration of Antenna - Z				48
14	ECEF Antenna Vector - X Projection				52
15	ECEF Antenna Vector - Y Projection				56
16	ECEF Antenna Vector - Z Projection				60
17	Data Checksum				64

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time - Integer	Integer part of GPS time of week of IMU validity	seconds	0-604799	U	U*4
4	GPS Time - Fraction	Fractional part of GPS time of week of IMU validity	seconds	LSB = 2^{-31}	U	U*4
8	Mode Word	bit 0: 1 = Suitable for aided tracking bit 1: 1 = Host vehicle has incorporated a step change in position and velocity bits 2-15: Reserved			U	H*2
10	Reserved	Reserved			U	H*6

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
16	ECEF Position of Antenna - (X,Y,Z)	Position of vehicle antenna in ECEF coordinates	meters	LSB = 2^{-7}	U	I*4 x3
28	ECEF Velocity of Antenna - (X,Y,Z)	Velocity of vehicle antenna in ECEF coordinates	m/sec	LSB = 2^{-20}	U	I*4 x3
40	ECEF Acceleration of Antenna - (X,Y,Z)	Acceleration of vehicle antenna in ECEF coordinates	m/sec^2	LSB = 2^{-10}	U	I*4 x3
52	ECEF Antenna Vector Projection - (X,Y,Z)	Antenna lever arm in ECEF coordinates, normalized to a unit vector	meters	LSB = 2^{-7}	U	I*4 x3
64	Data Checksum	16-bit, 2's complement checksum of the 32 I*2's contained in bytes 0-63			U	H*2

DIFFERENTIAL CORRECTIONS DATA BLOCK (RAP-ECP062)

Record ID = 4195

RS-422 - Attributes: Asynchronous, 19.2 Kbps, 8 Data Bits, 1 Start Bit, 1 Stop Bit, Odd Parity

ICD-GPS-204 Message Header

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Sync Word (= 81FF hex)		Record ID (= 4195 = 1063 hex)		0
2	Data Word Count (= 27 = 001B hex)		Flag Word (= 8000 hex)		4
3	Header Checksum (= ED83 hex)				8

Message Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time / RR Status			Zenith Tropo Correction	0
2	Satellite #1 Status	Satellite #2 Status	Satellite #3 Status	Satellite #4 Status	4
3	Satellite #5 Status	Satellite #6 Status	Satellite #7 Status	Satellite #8 Status	8
4	Satellite #9 Status	Satellite #10 Status	Satellite #1 Pseudorange Correction		12
5	Satellite #2 Pseudorange Correction		Satellite #3 Pseudorange Correction		16
6	Satellite #4 Pseudorange Correction		Satellite #5 Pseudorange Correction		20
7	Satellite #6 Pseudorange Correction		Satellite #7 Pseudorange Correction		24
8	Satellite #8 Pseudorange Correction		Satellite #9 Pseudorange Correction		28
9	Satellite #10 Pseudorange Correction		Satellite #1 Pseudorange Rate Correction		32
10	Satellite #2 Pseudorange Rate Correction		Satellite #3 Pseudorange Rate Correction		36
11	Satellite #4 Pseudorange Rate Correction		Satellite #5 Pseudorange Rate Correction		40
12	Satellite #6 Pseudorange Rate Correction		Satellite #7 Pseudorange Rate Correction		44
13	Satellite #8 Pseudorange Rate Correction		Satellite #9 Pseudorange Rate Correction		48
14	Satellite #10 Pseudorange Rate Correction		Data Checksum		52

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time / RR Status	Bits 0-19: GPS Time of week of differential data Bit 20: Spare Bit 21: 1 = Iono corrected Bit 22: 1 = Tropo corrected Bit 23: 1 = SA corrected	seconds	0- 604799 0 - 1 0 - 1 0 - 1	U	H*3
3	Zenith Tropo Correction	Tropospheric correction at mean sea level for 90 degrees elevation (defaults to 2.203)	meters	LSB = 2^{-6}	U	U*1

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
4	Satellite #n Status	Bits 0 - 4: Satellite (PRN) number 0 = No satellite or SV PRN32 1 - 31 = Satellite PRN number Bits 5-6: Age of data flag (IODE state) 0 = current ephemeris 1 = previous ephemeris 2 = more than 1 hr old 3 = mid-hour cutover Bit 7: 1 = RR/P lost track, data is old, or no SV		0 - 31 0 - 3 0 - 1	U	H*1 x10
14	Satellite #n Pseudorange Correction	Computed pseudorange correction	meters	LSB = 2^{-4}	S	I*2 x10
34	Satellite #n Pseudorange Rate Correction	Predicted rate of change of pseudorange correction	m/sec	LSB= 2^{-10}	S	I*2 x10
54	Data Checksum	16-bit, 2's complement checksum of the 27 I*2's contained in bytes 0-53			U	H*2

DIFFERENTIAL CORRECTIONS DATA BLOCK (RAP-LRIP)

Record ID = 4195

RS-422 - Attributes: Asynchronous, 19.2 Kbps, 8 Data Bits, 1 Start Bit, 1 Stop Bit, Odd Parity

ICD-GPS-204 Message Header

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Sync Word (= 81FF hex)		Record ID (= 4195 = 1063 hex)		0
2	Data Word Count (= 27 = 001B hex)		Flag Word (= 8000 hex)		4
3	Header Checksum (= ED83 hex)				8

Message Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time				0
2	Satellite #1 Status	Satellite #2 Status	Satellite #3 Status	Satellite #4 Status	4
3	Satellite #5 Status	Satellite #6 Status	Satellite #7 Status	Satellite #8 Status	8
4	Reference Receiver Status	Zenith Tropo Correction	Satellite #1 Pseudorange Correction (MSBs)		12
5	SV #1 PR Corr (LSBs)	Satellite #2 Pseudorange Correction			16
6	Satellite #3 Pseudorange Correction			SV #4 PR Corr (MSBs)	20
7	Satellite #4 Pseudorange Correction (MSBs)		Satellite #5 Pseudorange Correction (LSBs)		24
8	SV #5 PR Corr (LSBs)	Satellite #6 Pseudorange Correction			28
9	Satellite #7 Pseudorange Correction			SV #8 PR Corr (MSBs)	32
10	Satellite #8 Pseudorange Correction (LSBs)		Satellite #1 Pseudorange Rate Correction		36
11	Satellite #2 Pseudorange Rate Correction		Satellite #3 Pseudorange Rate Correction		40
12	Satellite #4 Pseudorange Rate Correction		Satellite #5 Pseudorange Rate Correction		44
13	Satellite #6 Pseudorange Rate Correction		Satellite #7 Pseudorange Rate Correction		48
14	Satellite #8 Pseudorange Rate Correction		Data Checksum		52

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time	GPS Time of week of differential data	seconds	0 - 604799	U	U*4
4	Satellite #n Status	Bits 0 - 4: Satellite (PRN) number 0 = No satellite or SV PRN32 1 - 31 = Satellite PRN number		0 - 31	U	H*1 x8
		Bits 5-6: Age of data flag (IODE state) 0 = current ephemeris 1 = previous ephemeris 2 = more than 1 hr old 3 = mid-hour cutover		0 - 3		
		Bit 7: 1 = RR/P lost track, data is old, or no SV		0 - 1		

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
12	Reference Receiver Status	Bits 0-2: UDRE, expected accuracy 7 = do not use 6 = spare 5 = 1 sigma >= 16 m 4 = 1 sigma >= 8 m 3 = 1 sigma >= 4 m 2 = 1 sigma >= 2 m 1 = 1 sigma >= 1 m 0 = 1 sigma < 1 m		0 - 5	U	H*1
		Bit 3: 0 = Ionospheric errors included 1 = Ionospheric errors not included		0 - 1		
		Bit 4: 0 = Tropospheric errors included 1 = Tropospheric errors not included		0 - 1		
		Bit 5: 1 = C/A only used		0 - 1		
		Bit 6: 0 = S/A errors included 1 = S/A errors not included		0 - 1		
		Bit 7: 1 = clock bias shift has occurred		0 - 1		
13	Zenith Tropo Correction	Tropospheric correction at mean sea level for 90 degrees elevation (defaults to 2.203)	meters	LSB $=2^{-6}$	U	U*1
14	Satellite #n Pseudorange Correction	Computed pseudorange correction	meters	LSB $=2^{-7}$	S	I*3 x8
38	Satellite #n Pseudorange Rate Correction	Predicted rate of change of pseudorange correction	m/sec	LSB $=2^{-8}$	S	I*2 x8
54	Data Checksum	16-bit, 2's complement checksum of the 27 I*2's contained in bytes 0-53			U	H*2

DOPPLER NAVIGATION SYSTEM DATA BLOCK (I-10)

Record ID = 7010

RS-422 - Attributes: Asynchronous, 76.8 or 153.6 Kbps, 8 Data Bits, 1 Start Bit, 1 Stop Bit, Odd Parity

ICD-GPS-204 Message Header

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Sync Word (= 81FF hex)		Record ID (= 7010 = 1B62 hex)		0
2	Data Word Count (= 58 = 003A hex)		Flag Word (= 8000 hex)		4
3	Header Checksum (= E265 hex)				8

Message Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time of Transmission (MSBs)				0
2	GPS Time of Transmission (LSBs)				4
3	Time of Transmission		Time of Validity		8
4	Mode		Altitude		12
5	Baro Reference Altitude		True Speed		16
6	Latitude				20
7	Longitude				24
8	Velocity - East				28
9	Velocity - North				32
10	Velocity - Up				36
11	Heading		Pitch		40
12	Roll		Velocity - X (MSBs)		44
13	Velocity - X (LSBs)		Velocity - Y (MSBs)		48
14	Velocity - Y (LSBs)		Velocity - Z (MSBs)		52
15	Velocity - Z (LSBs)		Data Checksum		56

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time of Transmission	GPS time of week of message transmission	seconds	0-604799	U	R*8
8	Time of Transmission	Time tag of message transmission. LSB is specified by scenario parameters (.INS file)	seconds	LSB = 50 or 64 microsec	U	U*2
10	Time of Validity	Time tag of message validity. LSB is specified by scenario parameters (.INS file)	seconds	LSB = 50 or 64 microsec	U	U*2

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
12	Mode	bit 0: 1 = Pitch/Roll not valid bit 1: Heading frame - 0=Magnetic, 1=True bit 2: True Speed frame - 0=True Airspeed, 1=Water Speed bit 3: Altitude source - 0=Pressure, 1=Radar bit 4: 1=Velocity X/Y/Z not valid bit 5: 1=Velocity E/N/U not valid bit 6: 1=True Speed not valid bit 7: Reserved bit 8: 1=Heading not valid bit 9: Velocity E/N/U quality - 1=DRNS quality, 0=Don't use bit 10: 1=Lat/Lon not valid bit 11: 1=Baro Reference Altitude not valid bit 12: 1=Time of Transmission not valid bit 13: 1=Time of Validity not valid bit 14-15: Reserved			U	H*2
14	Altitude	MSL altitude of vehicle. Source is specified by Mode, bit3	feet	LSB = 2^{2}	U	I*2
16	Baro Reference Altitude	Reference altitude of baro-altimeter	feet	LSB = 2^{2}	U	I*2
18	True Speed	Speed of vehicle relative to either air or water (specified by Mode, bit 2)	ft/sec	LSB = 2^{2}	U	U*2
20	Latitude	Latitude of vehicle	semi-circles	LSB = 2^{-31}	U	I*4
24	Longitude	Longitude of vehicle	semi-circles	LSB = 2^{-31}	U	I*4
28	Velocity - (East,North,Up)	Velocity of vehicle in Local Tangent Plane frame (East, North, Up)	ft/sec	LSB = 2^{-18}	U	I*4
40	Heading	Heading attitude of vehicle. Frame (Magnetic or True) is specified by Mode, bit 1	semi-circles	LSB = 2^{-15}	U	I*2
42	Pitch	Pitch attitude of vehicle	semi-circles	LSB = 2^{-15}	U	I*2
44	Roll	Roll attitude of vehicle	semi-circles	LSB = 2^{-15}	U	I*2
46	Velocity - (X,Y,Z)	Velocity of vehicle in vehicle’s body frame (X = Forward, Y = Left, Z = Up)	ft/sec	LSB = 2^{-18}	U	I*4
58	Data Checksum	16-bit, 2’s complement checksum of the 29 I*2’s contained in bytes 0-57			U	H*2

IEEE-488 INTERFACE

An SCS chassis may be equipped with an IEEE-488 (GPIB) interface. This optional interface requires that the SCS chassis have an Input/Output Controller (IOC) installed and that the IOC have an IEEE-488 interface module installed.

This interface is used by the SCS to send SCS status, vehicle state and transmitter range data to an external computer. The transmission of this data is at the request of the external computer. Each iteration of each individual data block is requested and transmitted separately as described in the following paragraphs.

All data transfers between the Controller (external computer) and the Instrument (SCS Input/Output Controller) implement EOI (End Of Interrupt) data block handshaking. This allows data block integrity to be maintained without requiring stream headers/separators.

The interface protocol consists of the following:

I. The Instrument will begin to respond after an IFC (InterFace Clear) signal is brought active by the Controller.

II. The Instrument will remain passive until requested to send data by the Controller. The requests shall be formatted as ASCII text. The Instrument will have been commanded to go to the Talker mode when it is time to send a block of data.

III. When requested, the Instrument will send blocks formatted as ASCII text.

IEEE-488 - INPUT TO SCS

Description	Frequency	Block ID	Page #
Data Request Block	As Needed	“send”	100

DATA REQUEST BLOCK

Record ID = “send”

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
0	Send	Indicates a request to the Input/Output Controller to send a data block, terminated by a comma		“send,”	U	5	ASCII
5	Record ID	Record ID of requested data block, terminated by a comma		“status,” “trnpwr,” “trnrng,” “vehatt,” “vehdcm,” “vehpos,”	U	7	ASCII
12	Vehicle/Channel #	Parameter applicable to requested data block, terminated by a comma: status - none trnpwr, trnrng - channel # for which data is requested vehatt, vehdcm, vehpos - vehicle # for which data is requested		status: “,” trnpwr, trnrng: 1-24 + “,” vehatt, vehdcm, vehpos: 1-3 + “,”	U	1-3	Dec

Total Block Length = 13, 14 or 15

Examples:

“send,status,,”	Requests SCS Status Block
“send,trnpwr,1,”	Requests Transmitter Power Data for channel #1
“send,trnrng,24,”	Requests Transmitter Range Data for channel #24
“send,vehatt,1,”	Requests Vehicle Attitude Data for vehicle #1

IEEE-488 - OUTPUT FROM SCS

Description	Frequency	Block ID	Page #
SCS Status Block	1 / sec (by request)	"status"	102
Transmitter Power Data Block	1 / sec (by request)	"trnpwr"	104
Transmitter Range Data Block	1 / sec (by request)	"trnrng"	106
Vehicle Attitude Data Block	1 / sec (by request)	"vehatt"	108
Vehicle Attitude DCM Data Block	1 / sec (by request)	"vehdcm"	109
Vehicle Position Data Block	1 / sec (by request)	"vehpos"	110

SCS STATUS BLOCK

Record ID = "status"

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
0	Record ID	Name of this message block, delimited by periods		".status."	U	8	ASCII
8	Elapsed Time	Time since beginning of test	seconds		U	10	Float
18	GPS Time of Week	GPS time of week corresponding to elapsed time	seconds	0 - 604800	U	10	Float
28	System Classification	Flags identifying which classified features of the SCS are installed/loaded: bit 0: 1 = PPSSMs installed bit 1: 1 = Keys loaded bit 2: 1 = Classified software loaded bit 3: 1 = Classified trajectory loaded		 0 - 1 0 - 1 0 - 1 0 - 1	U	1	Hex
29	Simulation State	bits 0 - 2: Mode - 1=Idle, 2=Ready (simulation parameters loaded), 3=Test in Progress, 4=Selftest in progress		1 - 4	U	2	Hex
31	GPS Week Number	GPS week number corresponding to elapsed time	weeks	0 - 2047	U	4	Dec
35	SC CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	3	Dec
38	# Ethernet Connections	Reports the number of Ethernet TCP/IP connections that have been made with the SCS unit		1 - 4	U	1	Dec
39	SCS ID	ID number assigned to this SCS by the user		> 0	U	5	Dec
44	SGC #1 CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	3	Dec
47	SGC #2 CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	3	Dec
50	SGC #3 CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	3	Dec
53	IOC CPU Throughput	CPU throughput for the last 1 second	percent	0 - 100	U	3	Dec
56	SC Status	All One's = Not Present bit 0: 1 = CPU Error bit 1: 1 = RAM Read/Write Error bit 2: 1 = ROM Checksum Error bit 3: 1 = NVRAM Read/Write Error bit 4: 1 = NVRAM Checksum Error bit 5: 1 = SC Shared Memory Error bit 6: 1 = SGC #1 Shared Memory Error bit 7: 1 = SGC #2 Shared Memory Error bit 8: 1 = SGC #3 Shared Memory Error bit 9: 1 = IOC Shared Memory Error bit 10: 1 = Clock Rate Error bit 11: 1 = Interrupt Error bit 12: 1 = 1K PPS Error bit 13: 1 = 1 PPS Error bit 14: 1 = CPU Clock Error bit 15: Spare		 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1	U	4	Hex
60	SC Version	Version number of the SCS Controller software used. (Written as "MajorVersion.MinorVersion") bits 0 - 7: minor version bits 8 - 15: major version		 0 - 255 1 - 255	U	4	Hex
64	SGC #1 Status	Same as SC			U	4	Hex

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
68	SGC #2 Status	Same as SC			U	4	Hex
72	SGC #3 Status	Same as SC			U	4	Hex
76	IOC Status	Same as SC			U	4	Hex
80	SGC #1 Version	Version number of the Signal Generator Controller #1 software used. (Written as "MajorVersion.MinorVersion") bits 0 - 7: minor version bits 8 - 15: major version		 0 - 255 1 - 255	U	4	Hex
84	SGC #2 Version	Version number of the Signal Generator Controller #2 software used. (Written as "MajorVersion.MinorVersion") bits 0 - 7: minor version bits 8 - 15: major version		 0 - 255 1 - 255	U	4	Hex
88	SGC #3 Version	Version number of the Signal Generator Controller #3 software used. (Written as "MajorVersion.MinorVersion") bits 0 - 7: minor version bits 8 - 15: major version		 0 - 255 1 - 255	U	4	Hex
92	IOC Version	Version number of the Input/Output Controller software used. (Written as "MajorVersion.MinorVersion") bits 0 - 7: minor version bits 8 - 15: major version		 0 - 255 1 - 255	U	4	Hex
96	DGSG #1 Status	All One's = Not Present bit 0: 1 = ASIC #1 Error bit 1: 1 = ASIC #2 Error bit 2: Spare bit 3: 1 = PPSSM Not Present bit 4: 1 = PPSSM Error bits 5-15: Spare		 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1	U	4	Hex
100	DGSG #2 Status	Same as DGSG #1			U	4	Hex
104	DGSG #3 Status	Same as DGSG #1			U	4	Hex
108	DGSG #4 Status	Same as DGSG #1			U	4	Hex
112	GUC Status	All One's = Not Present bit 0: 1 = 10 MHz Not Locked bit 1: 1 = Rubidium Not Present bit 2: 1 = Rubidium Not Locked bit 3: 1 = External 1 PPS Not Present bit 4: 1 = External 1 PPS Not Locked bits 5-15: Spare		 0 - 1 0 - 1 0 - 1 0 - 1 0 - 1	U	4	Hex
116	UMN/SCRAMNet Status	All One's = Not Present bit 0: 1 = UMN/SCRAMNet Failed bits 1-15: Spare		 0 - 1	U	4	Hex
120	GUC Delta 1 PPS	Difference between input 1 PPS & output 1 PPS, as measured by the GUC	microsec		U	13	Float
133	Alarm Summary	1 bit per alarm; 1 = alarm occurred since the alarm summary was last cleared. See Appendix C for alarm code definitions. word 0, bit 0: alarm #0 ... word 11, bit 31: alarm #383		 0 - 1 ... 0 - 1	U	8 x12	Hex

Total Block Length = 229

TRANSMITTER POWER DATA BLOCK

Record ID = “trnpwr”

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
0	Record ID	Name of this message block, delimited by periods		“.trnpwr.”	U	8	ASCII
8	Channel ID	Channel ID		1 - 24	U	2	Dec
10	System Classification	Flags identifying which classified features of the SCS are installed/loaded: bit 0: 1 = PPSSMs installed bit 1: 1 = Keys loaded bit 2: 1 = Classified software loaded bit 3: 1 = Classified trajectory loaded		 0 - 1 0 - 1 0 - 1 0 - 1	U	1	Hex
11	GPS Week Number	GPS week number that data is valid	weeks	0 - 2047	U	4	Dec
15	GPS Time	GPS Time of week that data is valid	seconds	0 - 604800	U	10	Float
25	Test Elapsed Time	Elapsed time since start of test	seconds		U	10	Float
35	Transmitter Visibility	1 = Line of sight from antenna to transmitter is not blocked by the transmitter’s antenna		0 - 1	U	1	Hex
36	Vehicle Visibility	1 = Line of sight from antenna to transmitter is not blocked by the vehicle’s antenna		0 - 1	U	1	Hex
37	Terrain Visibility	1 = Line of sight from antenna to transmitter is not blocked by the terrain map		0 - 1	U	1	Hex
38	Horizon Visibility	1 = Line of sight from antenna to transmitter is not blocked by the earth		0 - 1	U	1	Hex
39	L1 Receive Power Level	Based on transmit power, transmitter antenna gain, path loss, receive antenna gain, in view (horizon, terrain, vehicle), and multipath (earth, vehicle)	dBm		U	8	Float
47	Transmitter Selection Power	Based on transmit power, transmitter antenna gain, path loss, and in view (horizon, terrain) (used for transmitter selection)	dBm		U	8	Float
55	L1 Transmit Power	L1 Signal power at transmitter	dBm		U	8	Float
63	L1 Receiver Antenna Gain	Gain of L1 signal through receiver antenna	dB		U	8	Float
71	L1 Transmitter Antenna Gain	Gain of L1 signal through transmitter antenna	dB		U	8	Float
79	L1 Path Loss	Total loss of L1 signal power from the transmitter antenna to the receiver antenna	dB		U	8	Float
87	L2 Receive Power Level	Based on transmit power, transmitter antenna gain, path loss, receive antenna gain, in view (horizon, terrain, vehicle), and multipath (earth, vehicle)	dBm		U	8	Float
95	L2 Transmit Power	L2 Signal power at transmitter	dBm		U	8	Float
103	L2 Receiver Antenna Gain	Gain of L2 signal through receiver antenna	dB		U	8	Float
111	L2 Transmitter Antenna Gain	Gain of L2 signal through transmitter antenna	dB		U	8	Float
119	L2 Path Loss	Total loss of L2 signal power from the transmitter antenna to the receiver antenna	dB		U	8	Float

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
127	L1 EMP Receive Power Level	Based on L1 transmit power, transmitter antenna gain, path loss, receive antenna gain, in view, earth multipath	dBm		U	8	Float
135	L2 EMP Receive Power Level	Based on L2 transmit power, transmitter antenna gain, path loss, receive antenna gain, in view, earth multipath	dBm		U	8	Float
143	L1 VMP Receive Power Level	Based on L1 transmit power, transmitter antenna gain, path loss, receive antenna gain, in view, vehicle multipath	dBm		U	8	Float
151	L2 VMP Receive Power Level	Based on L2 transmit power, transmitter antenna gain, path loss, receive antenna gain, in view, vehicle multipath	dBm		U	8	Float
159	Receiver Antenna Delays	Not currently used	meters		U	8	Float
167	Dither Errors 1	Transmitter clock dither error - term 1	meters		S	10	Float
177	Dither Errors 2	Transmitter clock dither error - term 2	meters		S	10	Float

Total Block Length = 187

TRANSMITTER RANGE DATA BLOCK

Record ID = "trnrng"

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
0	Record ID	Name of this message block, delimited by periods		".trnrng."	U	8	ASCII
8	Channel ID	Channel ID		1 - 24	U	2	Dec
10	Transmitter Type	Transmitter Type: 0=Satellite, 1=Ground Transmitter (GT), 2=Satellite Spoofer, 3=GT Spoofer, 4=CW Jammer, 5=Pulsed Jammer, 6=Broadband Jammer		0 - 6	U	1	Dec
11	Transmitter ID	Transmitter ID		1 - 100	U	3	Dec
14	Vehicle #	Vehicle number or antenna ID (for dual antenna vehicles) that this transmitter is output on		1 - 3	U	1	Dec
15	System Classification	Flags identifying which classified features of the SCS are installed/loaded: bit 0: 1 = PPSSMs installed bit 1: 1 = Keys loaded bit 2: 1 = Classified software loaded bit 3: 1 = Classified trajectory loaded		 0 - 1 0 - 1 0 - 1 0 - 1	U	1	Hex
16	L2 EMP Channel #	Hardware channel # for L2 earth multipath signal		-1 - 24	U	2	Dec
18	L1 EMP Channel #	Hardware channel # for L1 earth multipath signal		-1 - 24	U	2	Dec
20	L2 Channel #	Hardware channel # for L2 signal		-1 - 24	U	2	Dec
22	L1 Channel #	Hardware channel # for L1 signal		-1 - 24	U	2	Dec
24	L2 VMP Channel #	Hardware channel # for L1 vehicle multipath signal		-1 - 24	U	2	Dec
26	L1 VMP Channel #	Hardware channel # for L1 vehicle multipath signal		-1 - 24	U	2	Dec
28	L2 Priority Index #	Priority index # for this transmitter on L2		1 - 100	U	3	Dec
31	L1 Priority Index #	Priority index # for this transmitter on L1		1 - 100	U	3	Dec
34	L2 VMP Priority Index #	Priority index # for this transmitter's vehicle multipath on L2		1 - 100	U	3	Dec
37	L1 VMP Priority Index #	Priority index # for this transmitter's vehicle multipath on L1		1 - 100	U	3	Dec
40	L2 EMP Priority Index #	Priority index # for this transmitter's earth multipath on L2		1 - 100	U	3	Dec
43	L1 EMP Priority Index #	Priority index # for this transmitter's earth multipath on L1		1 - 100	U	3	Dec
46	GPS Week Number	GPS week number that data is valid	weeks	0 - 2047	U	4	Dec
50	Multipath Flags	bit 0: 1 = Earth Multipath signal data bit 1: 1 = Vehicle Multipath signal data		0 or 1 0 or 1	U	1	Hex
51	GPS Time	GPS Time of week that data is valid	seconds	0 - 604800	U	10	Float
61	Test Elapsed Time	Elapsed time since start of test	seconds		U	10	Float
71	Pseudorange	Range from vehicle to transmitter, including atmospheric & other delays	meters		S	13	Float

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
84	Geometric Range	Range from vehicle to transmitter, without taking atmospheric & other delays into account	meters		S	13	Float
97	Pseudorange Rate	Rate of change of pseudorange, including atmospheric & other delays	m/sec		S	11	Float
108	Ionospheric Delay	Delay caused by the signal going through the ionosphere	meters		U	10	Float
118	Tropospheric Delay	Delay caused by signal going through the troposphere	meters		U	10	Float
128	L2 Ionospheric Delay Delta	Difference between L1 and L2 ionospheric delays	meters		U	10	Float
138	Elevation Angle	Elevation angle from vehicle to transmitter	degrees	-90 - 90	S	7	Float
145	Azimuth Angle	Azimuth angle from vehicle to transmitter	degrees	-180 - 180	S	8	Float
153	Earth Multipath	Delay due to transmitter signal bouncing off of a spherical earth	meters		U	11	Float
164	Vehicle Multipath	Delay due to transmitter signal bouncing off the vehicle	meters		U	11	Float

Total Block Length = 175

VEHICLE ATITUDE DATA BLOCK

Record ID = “vehatt”

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
0	Record ID	Name of this message block, delimited by periods		“.vehatt.”	U	8	ASCII
8	GPS Week Number	GPS week number that data is valid	weeks	0 - 2047	U	4	Dec
12	System Classification	Flags identifying which classified features of the SCS are installed/loaded: bit 0: 1 = PPSSMs installed bit 1: 1 = Keys loaded bit 2: 1 = Classified software loaded bit 3: 1 = Classified trajectory loaded		 0 - 1 0 - 1 0 - 1 0 - 1	U	1	Hex
13	Vehicle Number	Vehicle number or antenna ID (for dual antenna vehicles) that this data is for		1 - 2	U	1	Dec
14	GPS Time	GPS time of week that data is valid	seconds	0 - 604800	U	10	Float
24	Test Elapsed Time	Time elapsed since beginning of simulation	seconds		U	10	Float
34	Yaw	Vehicle yaw	radians		U	9	Float
43	Pitch	Vehicle pitch	radians		U	9	Float
52	Roll	Vehicle roll	radians		U	9	Float
61	Yaw Rate	Yaw angular velocity	rad/sec		U	9	Float
70	Pitch Rate	Pitch angular velocity	rad/sec		U	9	Float
79	Roll Rate	Roll angular velocity	rad/sec		U	9	Float
88	G-Sensitive Clock Delay	Clock delay due to the receiver clock's g-sensitivity	seconds		U	13	Float
101	G-Sensitive Clock Drift	Clock drift due to the receiver clock’s g-sensitivity	sec/sec		U	13	Float
114	Zenith Tropospheric Delay	Tropospheric delay introduced by a satellite directly over the receiver vehicle (satellite is at zenith; elevation = 90 deg)	meters		U	9	Float
123	Angular Velocity - (E,N,U)	Angular velocity (spin vector) (East, North, Up) of Body frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec		U	9 x3	Float
150	Angular Acceleration - (E,N,U)	Angular acceleration (spin vector rate) (East, North, Up) of Body frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec^2		U	9 x3	Float

Total Block Length = 177

VEHICLE ATTITUDE DCM DATA BLOCK

Record ID = "vehdcm"

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
0	Record ID	Name of this message block, delimited by periods		".vehdcm."	U	8	ASCII
8	GPS Week Number	GPS week number that data is valid	weeks	0 - 2047	U	4	Dec
12	System Classification	Flags identifying which classified features of the SCS are installed/loaded: bit 0: 1 = PPSSMs installed bit 1: 1 = Keys loaded bit 2: 1 = Classified software loaded bit 3: 1 = Classified trajectory loaded		 0 - 1 0 - 1 0 - 1 0 - 1	U	1	Hex
13	Vehicle Number	Vehicle number or antenna ID (for dual antenna vehicles) that this data is for		1 - 2	U	1	Dec
14	GPS Time	GPS time of week that data is valid	seconds	0 - 604800	U	10	Float
24	Test Elapsed Time	Time elapsed since beginning of simulation	seconds		U	10	Float
34	DCM Body to Local Tangent Plane Frame	Transformation matrix to convert position data from the Body frame to the Local Tangent Plane frame [(Row 1, Column 1) (R2,C1) (R3,C1) ... (R2,C3) (R3,C3)]			U	10 x9	Float
124	DCM Local Tangent Plane to ECEF Frame	Transformation matrix to convert position data from the Local Tangent Plane frame to the ECEF frame [(Row 1, Column 1) (R2,C1) (R3,C1) ... (R2,C3) (R3,C3)]			U	10 x9	Float

Total Block Length = 214

VEHICLE POSITION DATA BLOCK

Record ID = "vehpos"

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	WIDTH	FORMAT
0	Record ID	Name of this message block, delimited by periods		".vehpos."	U	8	ASCII
8	GPS Week Number	GPS week number that data is valid	weeks	0 - 2047	U	4	Dec
12	System Classification	Flags identifying which classified features of the SCS are installed/loaded: bit 0: 1 = PPSSMs installed bit 1: 1 = Keys loaded bit 2: 1 = Classified software loaded bit 3: 1 = Classified trajectory loaded		 0 - 1 0 - 1 0 - 1 0 - 1	U	1	Hex
13	Vehicle Number	Vehicle number or antenna ID (for dual antenna vehicles) that this transmitter is output on		1 - 2	U	1	Dec
14	GPS Time	GPS time of week that data is valid	seconds	0- 604800	U	10	Float
24	Test Elapsed Time	Time elapsed since beginning of simulation	seconds		U	10	Float
34	Position - Latitude	Vehicle center of gravity Latitude; Positive = North	degrees		U	11	Float
45	Position - Longitude	Vehicle center of gravity Longitude; Positive = East	degrees		U	12	Float
57	Position - Altitude	Vehicle center of gravity altitude; WGS-84	meters		U	13	Float
70	Position - (E,F,G)	Vehicle ECEF center of gravity position (E,F,G)	meters		U	13	Float
109	Velocity - (E,N,U)	Vehicle center of gravity velocity (East, North, Up)	m/sec		U	11 x3	Float
142	Velocity - (E,F,G)	Vehicle ECEF center of gravity velocity (E,F,G)	m/sec		U	11 x3	Float
175	Acceleration - (E,N,U)	Vehicle center of gravity acceleration (East, North, Up)	m/sec		U	11 x3	Float
208	Acceleration - (E,F,G)	Vehicle ECEF center of gravity acceleration (E,F,G)	m/sec^2		U	11 x3	Float

Total Block Length = 241

MIL-STD-1553 INTERFACE

An SCS chassis may be equipped with a MIL-STD-1553 interface. This optional interface requires that the SCS chassis have an Input/Output Controller (IOC) installed and that the IOC have a 1553 interface module installed.

The SCS can currently only operate as a Remote Terminal (RT).

MIL-STD-1553 - REMOTE TERMINAL (RT) MODE

This mode is used by the SCS to make SCS status, vehicle state and transmitter range data available to an external computer.

In this mode, the SCS is configured as a Remote Terminal (RT). The RT address is configurable to any non-broadcast address (0-30) via hardware switches, but is normally set as RT 0. Mode control is not available.

Each data block is available as a group of 1553 subaddresses collected in parallel and pieced together into a single data block.

Data blocks which have multiple simultaneous data sets, such as for multiple vehicles or for multiple channels, will only have one data set available at any given time. Which data set is available is controlled by the external computer via the Data Selector Block.

MIL-STD-1553 (RT MODE) - INPUT TO SCS

Description	Frequency	Subaddress	Page #
Data Selector Block	As Needed	16	116

DATA SELECTOR BLOCK

Subaddress = 16

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Vehicle Selection		Channel Selection		0
2	Spare				4
...	...				...
16	Spare				60

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Vehicle Selection	Selects the ID of the vehicle for which data is to be placed in the Vehicle State Vector message. A minus one (-1) in this field leaves the previous selection in effect.		1-3 or -1	U	I*2
2	Channel Selection	Selects the ID of the channel for which data is to be placed in the Transmitter Range Data message. A minus one (-1) in this field leaves the previous selection in effect.		1-24 or -1	U	I*2
4	Spare	Spare			U	H*4 x15

MIL-STD-1553 (RT MODE) - OUTPUT FROM SCS

Description	Frequency	Subaddresses	Page #
SCS Status Block	1 / sec (by request)	01-02	118
Vehicle State Vector Block	1 / sec (by request)	04-08	119
Transmitter Range Data Block	1 / sec (by request)	10-13	120

Each message is divided into 60 byte packets, each of which has its own 1553 subaddress. Each subaddress contains a 4 byte header in addition to the 60 byte message packet. After all the packets (verifying that the issue numbers match) for a given message are “stitched” together, the resulting message has a format identical to that of an SCS standard Ethernet message (without the ICD 204 header) padded to the next multiple of 60 bytes. The format of each subaddress is as follows:

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Issue Number		Packet Number	Channel Number	0
2	Message Packet (Bytes 0-3)				4
...	...				...
16	Message Packet (Bytes 56-59)				60

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Issue Number	A serial number for one full copy of a message, allowing its component packets to be properly matched together.			U	U*2
2	Packet Number	Packet ID number.		SCS Status Block: 0-1 Vehicle State Vector: 0-4 Transmitter Range Data: 0-3	U	U*1
3	Channel Number	Channel ID to which this data applies. Spare for SCS Status Block and Vehicle State Vector messages.		Transmitter Range Data: 1-24	U	U*1
4	Message Packet (Bytes 0-3)	First 4 bytes of message packet.			see message definition	H*1 x4
...	...	...			...	...
60	Message Packet (Bytes 56-59)	Last 4 bytes of message packet.			see message definition	H*1 x4

SCS STATUS BLOCK

Subaddresses = 01-02

This block has an identical format to the Ethernet output block of the same name (see **ETHERNET - OUTPUT FROM SCS** section [page 59]).

VEHICLE STATE VECTOR BLOCK

Subaddresses = 04-08

This block has an identical format to the Ethernet output block of the same name (see **ETHERNET - OUTPUT FROM SCS** section [page 56]).

TRANSMITTER RANGE DATA BLOCK

Subaddresses = 10-13

This block has an identical format to the Ethernet output block of the same name (see **ETHERNET - OUTPUT FROM SCS** section [page 63]).

UMN/SCRAMNET INTERFACE

An SCS chassis may be equipped with a UMN/SCRAMNet interface. UMN (Computer Sciences Corporation) and SCRAMNet (Systran Corporation) are two different hardware implementations of a high-speed shared memory interface. This optional interface requires that the SCS chassis have the appropriate interface card installed.

This interface can be used by an external computer to send vehicle motion data to the SCS chassis in real-time at up to 500 Hz for closed-loop operation, and to receive SCS status, simulated inertial measurement unit (IMU), inertial navigation system (INS), doppler navigation system (DNS) and/or simulated differential corrections data from the SCS chassis.

UMN/SCRAMNET - UMN

Universal Memory Network (UMN) is a proprietary implementation of a high-speed shared memory network by Computer Sciences Corporation. The SCS chassis uses a Host Processor Interface (HPI-VME) card for its UMN connection. All additional UMN hardware, including a General Bus Adapter (GBA) for the SCS to connect to, is external to the SCS and must be provided by the user. Prior to booting the SCS, the UMN network must be connected and powered up. Prior to downloading a scenario that uses UMN, the GUMM mapping table in UMN memory must be set up by the external computer as follows:

Offset	Contents	Description	
0xA4B8	“MMUG”	GUMM header (used to determine if the table has been initialized)	
0xA4B9	0	Validation flag (set by SCS to hardware UMN id while using the GUMM mapping table)	
0xA4BA	<Don’t Care>	Header start (not used by SCS)	
0xA4BB	<Don’t Care>	Header end (not used by SCS)	
0xA4BC	1 - 30	Number of GUMM mapping table entries (30 max)	
0xA4BD	1	UMN major version number	
0xA4BE	1	UMN minor version number	
0xA4BF	<Don’t Care>	Spare	
0xA4C0	4 ASCII Chars	UMN Block name (first 4 bytes) - byte order reversed	First GUMM Mapping Table Entry
0xA4C1	4 ASCII Chars	UMN Block name (next 4 bytes) - byte order reversed	
0xA4C2	4 ASCII Chars	UMN Block name (next 4 bytes) - byte order reversed	
0xA4C3	4 ASCII Chars	UMN Block name (next 4 bytes) - byte order reversed	
0xA4C4	4 ASCII Chars	UMN Block name (last 4 bytes) - byte order reversed	
0xA4C5	4 Byte Integer	UMN Block start offset	
0xA4C6	4 Byte Integer	UMN Block end offset	
0xA4C7	<Don’t Care>	Spare	
...	...	...	...
0xA4C0+8*(N-1)	4 ASCII Chars	UMN Block name (first 4 bytes) - byte order reversed	Nth GUMM Mapping Table Entry
0xA4C1+8*(N-1)	4 ASCII Chars	UMN Block name (next 4 bytes) - byte order reversed	
0xA4C2+8*(N-1)	4 ASCII Chars	UMN Block name (next 4 bytes) - byte order reversed	
0xA4C3+8*(N-1)	4 ASCII Chars	UMN Block name (next 4 bytes) - byte order reversed	
0xA4C4+8*(N-1)	4 ASCII Chars	UMN Block name (last 4 bytes) - byte order reversed	
0xA4C5+8*(N-1)	4 Byte Integer	UMN Block start offset	
0xA4C6+8*(N-1)	4 Byte Integer	UMN Block end offset	
0xA4C7+8*(N-1)	<Don’t Care>	Spare	

Where: Offset = The offset (in long words) from the start address of the UMN shared memory space. The origin for these offsets is 1. Thus, if the base address of the UMN shared memory space is 0xDC010000:

Address of GUMM header = 0xDC010000 + (0xA4B8 - 1) * 4 = 0xDC0392DC

Notes: The block start and end offsets may represent any area in available UMN shared memory, but the blocks must be listed in the table in an order such that the block offsets increase monotonically.

The difference between the block start and end offsets (end - start) must exactly equal the size of the allocated block minus 1, including the three control words (Initialization Word, Top Count & Bottom Count).

Both the SCS and the UMN itself are big-endian, i.e. the most significant byte of a long word is stored in the lowest address.

There are currently 3 blocks defined for SCS:

Block	SCS Input Block	SCS Output Block	Support Block
UMN Block Name	“UMN TO SCS“	“SCS TO UMN”	“SUPPORT”
UMN Block Size in long words (including 3 control words)	253	123	35
GUMM Mapping Table Entry	“ NMU”	“ SCS”	“PPUS”
	“S OT”	“U OT”	“ TRO”
	“ SC”	“ NM”	“ “
	“ “	“ “	“ “
	“ “	“ “	“ “
	<Start Offset>	<Start Offset>	<Start Offset>
	<Start Offset + 252>	<Start Offset +122>	<Start Offset + 34>
	<Don’t Care>	<Don’t Care>	<Don’t Care>

These blocks may be allocated anywhere in UMN shared memory, at the user’s discretion. Each defined block in UMN shared memory must be initialized by the external computer as follows:

Offset	Contents	Description
<Start Offset - 1>	0xBADC0DE	Clobber detection word
<Start Offset>	0xA1B2C3D4	Initialization word
<Start Offset + 1>	1	Top count
...	<Don’t Care>	Data words
<End Offset>	0	Bottom count
<End Offset + 1>	0xBADC0DE	Clobber detection word

Note that the clobber detection word can be shared between 2 adjacent blocks.

UMN/SCRAMNET - SCRAMNET

Shared Common Random Access Memory Network (SCRAMNet) is a proprietary implementation of a high-speed shared memory network by Systran Corporation. The SCS chassis uses a SCRAMNet+ VME6U card for its SCRAMNet connection. All additional SCRAMNet hardware is external to the SCS and must be provided by the user. The SCRAMNet memory (SCS has 4K bytes) is allocated as follows:

Address Range	Description
0x0000 - 0x03F3	SCS Input Block
0x03F4 - 0x05DF	SCS Output Block
0x05E0 - 0x066B	Support Block

Where: Address = The offset (in bytes) from the start address of the SCRAMNet shared memory space. The origin for these offsets is 0x0000. Thus, if the base address of the SCRAMNet shared memory space is 0xDC400000:

First address of SCS Output Block = 0xDC400000 + 0x03F4 = 0xDC4003F4

Each block in SCRAMNet shared memory will be initialized by the SCS as follows:

Address	Contents	Description
<First long word>	0xA1B2C3D4	Initialization word
<Second long word>	1	Top count
...	<Don't Care>	Data words
<Last long word>	0	Bottom count

UMN/SCRAMNET - INPUT TO SCS

Description	Frequency	Input Area(s)	Page #
Command Block (undefined)	N/A	Command Data	128
Vehicle Motion Input Data Block	500 / sec (max)	Vehicle 1 Motion Data, Vehicle 2 Motion Data	129
Power Level Control Block	500 / sec (max)	Power Control Data	130

All the data is grouped together into one input block to the SCS:

SCS Input Block
Initialization Word = 0xA1B2C3D4
Top Count*
Command Data (8 bytes)
Vehicle 1 Motion Data (296 bytes)
Vehicle 2 Motion Data (296 bytes)
Power Control Data (400 bytes)
Bottom Count*

* The Top and Bottom Counts must both be incremented and must be equal for the SCS to accept new data.

COMMAND BLOCK

Input Area = Command Data

This block has an identical format to the Ethernet input block of the same name (see **ETHERNET - INPUT TO SCS** section [page 30]). This block is currently undefined and is not used.

VEHICLE MOTION INPUT DATA BLOCK

Input Areas = Vehicle 1 Motion Data
Vehicle 2 Motion Data

This block has an identical format to the Ethernet input block of the same name (see **ETHERNET - INPUT TO SCS** section [page 31]).

For additional information on the use of this block, see **APPENDIX E - UMN/SCRAMNET MOTION PROCEDURE & TIMING** [page 255].

POWER LEVEL CONTROL BLOCK

Output Area = Power Control Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Cmd #1 - Transmitter ID	Cmd #1 - Vehicle Number	Cmd #1 - Transmitter Type	Cmd #1 - Multipath Type	0
2	Cmd #1 - L1 Power Offset		Cmd #1 - L2 Power Offset		4
...	...				...
99	Cmd #50 - Transmitter ID	Cmd #50 - Vehicle Number	Cmd #50 - Transmitter Type	Cmd #50 - Multipath Type	392
100	Cmd #50 - L1 Power Offset		Cmd #50 - L2 Power Offset		396

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Cmd #1 - Transmitter ID	ID number of the transmitter being commanded. A value of 0 indicates that this is a null command and should be ignored (other commands is the same block may be valid)		SV: 0-32 GT: 0-37 Jammers: 0 - 50	U	U*1
1	Cmd #1 - Vehicle Number	Vehicle number or antenna ID (for dual antenna vehicles) that this data is for		1 - 2	U	U*1
2	Cmd #1 - Transmitter Type	Indicates the type of transmitter being commanded: 0=SV, 1=GT, 2=CW Jammer, 3=Pulsed Jammer, 4=No Transmitter, 5=SV Spoofer, 6=GT Spoofer		0 - 6	U	U*1
3	Cmd #1 - Multipath Type	Indicates the type of multipath channel being commanded: 0=No multipath, 1=Earth multipath, 2=Vehicle multipath		0 - 2	U	U*1
4	Cmd #1 - L1 Power Offset	The offset value to be added to the L1 power level for the specified channel specified by transmitter type, multipath type, transmitter ID and vehicle number. This replaces any previously commanded L1 offset for this channel	dBm	LSB = 2^{-4}	U	I*2
6	Cmd #1 - L2 Power Offset	The offset value to be added to the L2 power level for the specified channel specified by transmitter type, multipath type, transmitter ID and vehicle number. This replaces any previously commanded L2 offset for this channel	dBm	LSB = 2^{-4}	U	I*2
...	...	...		...	...	...
392	Cmd #50 - Transmitter ID	ID number of the transmitter being commanded. A value of 0 indicates that this is a null command and should be ignored (other commands is the same block may be valid)		SV: 0-32 GT: 0-37 Jammers: 0-50	U	U*1
393	Cmd #50 - Vehicle Number	Vehicle number or antenna ID (for dual antenna vehicles) that this data is for		1-2	U	U*1
394	Cmd #50 - Transmitter Type	Indicates the type of transmitter being commanded: 0=SV, 1=GT, 2=CW Jammer, 3=Pulsed Jammer, 4=No Transmitter, 5=SV Spoofer, 6=GT Spoofer		0-6	U	U*1
395	Cmd #50 - Multipath Type	Indicates the type of multipath channel being commanded: 0=No multipath, 1=Earth multipath, 2=Vehicle multipath		0-2	U	U*1
396	Cmd #50 - L1 Power Offset	The offset value to be added to the L1 power level for the specified channel specified by transmitter type, multipath type, transmitter ID and vehicle number. This replaces any previously commanded L1 offset for this channel	dBm	LSB = 2^{-4}	U	I*2

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
398	Cmd #50 - L2 Power Offset	The offset value to be added to the L2 power level for the specified channel specified by transmitter type, multipath type, transmitter ID and vehicle number. This replaces any previously commanded L2 offset for this channel	dBm	LSB = 2^{-4}	U	I*2

UMN/SCRAMNET - OUTPUT FROM SCS

Description	Frequency	Output Area(s)	Page #
SCS Status Block	1 / sec	Status Data	134
Aiding Message Data Block	1000 / sec (max)	Vehicle 1 Aiding Data, Vehicle 2 Aiding Data	135
Differential Corrections Data Block	1 / sec	Differential Data	136
SCS Time Data Block	1000 / sec	Time Data	137
Motion Debug Data Block	1000 / sec	Vehicle 1 Debug Data, Vehicle 2 Debug Data	138

All the data is grouped together into two output blocks from the SCS.

SCS Output Block
Initialization Word = 0xA1B2C3D4
Top Count *
Status Data (120 bytes)
Vehicle 1 Aiding Data (120 bytes)
Vehicle 2 Aiding Data (120 bytes)
Differential Data (120 bytes)
Bottom Count *

Support Block
Initialization Word = 0xA1B2C3D4
Top Count *
Time Data (16 bytes)
Vehicle 1 Debug Data (56 bytes)
Vehicle 2 Debug Data (56 bytes)
Bottom Count *

* The Top and Bottom Counts for a block will both be incremented (and will be equal) each time the SCS writes new data into the output block.

SCS STATUS BLOCK

Output Area = Status Data

This block has an identical format to the Ethernet output block of the same name (see **ETHERNET - OUTPUT FROM SCS** section [page 59]).

AIDING MESSAGE DATA BLOCK

Output Areas = Vehicle 1 Aiding Data
Vehicle 2 Aiding Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time of Week (MSBs)				0
2	GPS Time of Week (LSBs)				4
3	GPS Week Number		Vehicle Number		8
4	Message Format				12
5	Message Length		System Classification		16
6	Message Type				20
7	Message (Bytes 0-3)				24
...	...				...
30	Message (Bytes 92-95)				116

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time of Week	GPS time of week for which data was generated	seconds	0 - 604800	U	R*8
8	GPS Week Number	GPS week number for which data was generated	weeks	0 - 2047	U	U*2
10	Vehicle Number	Number of which vehicle to this data applies		1 - 2	U	U*2
12	Message Format	Identifies the specific message format of aiding message: 0=RAP-Litton, 4=LN-200, 103=EGR-14, 104=EGR-16, 201=I-10		0, 4, 103, 104, 201	U	U*4
16	Message Length	Length in bytes of aiding message.	bytes	0 - 96	U	U*2
18	System Classification	Flags identifying which classified features of the SCS are installed/loaded:			U	H*2
		bit 0: 1 = PPSSMs installed		0 - 1		
		bit 1: 1 = Keys loaded		0 - 1		
		bit 2: 1 = Classified software loaded		0 - 1		
		bit 3: 1 = Classified trajectory loaded		0 - 1		
20	Message Type	Identifies the general type of aiding message: 0=IMU, 1=INS, 3=DNS.		0 - 1, 3	U	U*4
24	Message	An aiding message, exactly as it would be sent to a receiver (minus the ICD-GPS-204 header, if any). The format of the message is specified by Message Format and the length is specified by Message Length. All bytes of this field in excess of Message Length are Spare.			U	H*1 x96

For details of the message formats, see **RS-422/485 - OUTPUT FROM SCS** section as follows:

Format	Page #
LN-200	84
RAP-Litton	85
EGR-14	86
EGR-16	89
I-10	95

DIFFERENTIAL CORRECTIONS DATA BLOCK

Output Area = Differential Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time of Week (MSBs)				0
2	GPS Time of Week (LSBs)				4
3	GPS Week Number		Spare		8
4	Differential Message Format				12
5	Differential Message Length		System Classification		16
6	Spare				20
7	Differential Message (Bytes 0-3)				24
...	...				...
30	Differential Message (Bytes 92-95)				116

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time of Week	GPS time of week for which data was generated	seconds	0 - 604800	U	R*8
8	GPS Week Number	GPS week number for which data was generated	weeks	0 - 2047	U	U*2
10	Spare	Spare			U	H*2
12	Differential Message Format	Identifies the message format of differential message: 0=RAP-LRIP, 1=RAP-ECP062.		0 - 1	U	U*4
16	Differential Message Length	Length in bytes of differential message.	bytes	0 - 96	U	U*2
18	System Classification	Flags identifying which classified features of the SCS are installed/loaded:			U	H*2
		bit 0: 1 = PPSSMs installed		0 - 1		
		bit 1: 1 = Keys loaded		0 - 1		
		bit 2: 1 = Classified software loaded		0 - 1		
		bit 3: 1 = Classified trajectory loaded		0 - 1		
20	Spare	Spare				H*4
24	Differential Message	A differential message, exactly as it would be sent to a receiver (minus the ICD-GPS-204 header, if any). The format of the message is specified by Differential Message Format and the length is specified by Differential Message Length. All bytes of this field in excess of Differential Message Length are Spare. For details of the message formats, see **RS-422/485 - OUTPUT FROM SCS** section as follows:			U	H*1 x96

Format	Page #
RAP-ECP062	91
RAP-LRIP	93

SCS TIME DATA BLOCK

Output Area = Time Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Initialization Time Count				0
2	Motion Time Count				4
3	Scenario Elapsed Time (MSBs)				8
4	Scenario Elapsed Time (LSBs)				12

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Initialization Time Count	Time since last 1 PPS mark. This field is updated every 100 milliseconds, even when no scenario is loaded or running.	msec	0 - 900	U	I*4
4	Motion Time Count	Time since last 1 PPS mark. This field is updated every 5 milliseconds at the time that the vehicle motion calculations are performed, but only while a scenario is in progress.	msec	0 - 995	U	I*4
8	Scenario Elapsed Time	Elapsed time since the start of the current scenario. This field is updated every 5 milliseconds at the time that the vehicle motion calculations are performed, but only while a scenario is in progress. A negative value indicates that the scenario has not yet started.	seconds		U	R*8

MOTION DEBUG DATA BLOCK

Output Areas = Vehicle 1 Debug Data
Vehicle 2 Debug Data

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Decay Interval (MSBs)				0
2	Decay Interval (LSBs)				4
3	Delta Time (MSBs)				8
4	Delta Time (LSBs)				12
5	Maximum Delta Time (MSBs)				16
6	Maximum Delta Time (LSBs)				20
7	Discontinuity (MSBs)				24
8	Discontinuity (LSBs)				28
9	Maximum Discontinuity (MSBs)				32
10	Maximum Discontinuity (LSBs)				36
11	Latency (MSBs)				40
12	Latency (LSBs)				44
13	Maximum Latency (MSBs)				48
14	Maximum Latency (LSBs)				52

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Decay Interval	Time constant used for smoothing of discontinuities.	seconds		U	R*8
8	Delta Time	Difference between the time tag of the most recently received Vehicle Motion Input Data Block and the preceding block.	seconds		U	R*8
16	Maximum Delta Time	Maximum value observed for Delta Time since the start of the scenario or since the last time the maximum values were cleared via the debug shell.	seconds		U	R*8
24	Discontinuity	RSS of the difference between the position data contained in the most recently received Vehicle Motion Input Data Block and the extrapolated position (at the same time value and including smoothing effects) from the preceding block.	meters		U	R*8
32	Maximum Discontinuity	Maximum value observed for Discontinuity since the start of the scenario or since the last time the maximum values were cleared via the debug shell.	meters		U	R*8
40	Latency	Difference between the time tag of the most recently received Vehicle Motion Input Data Block and the SCS simulation time at the time of the motion update calculation when the block was first used. (Simulation Time – Input Time)	seconds		U	R*8
48	Maximum Latency	Observed latency value with the largest absolute value since the start of the scenario or since the last time the maximum values were cleared via the debug shell.	seconds		U	R*8

NFS DATA FILES INTERFACE

The NFS (Network File System) interface is a specialization of the Ethernet interface used by the SCS (see **ETHERNET INTERFACE** - page 27). NFS is standard on all SCS chassis and PC's.

The PC functions as an NFS Server to allow the SCS chassis to directly read or write files on the PC's hard disk. The NFS Server on the PC must be configured to export the PC's hard drive with the following user information:

Local User = "nobody", No Local Password, Remote UID = 2001, Remote GID = 100, No Remote Host

This interface is used by the SCS chassis, at the request of the PC, to download scenario parameter files from the PC's hard disk or to upload the scenario data log to a file on the PC's hard disk.

The contents (including the header) of all messages transmitted and received by the SCS chassis are, and must be, organized in a "little endian" fashion, i.e. least significant byte first, on a field-by-field basis. See "**Byte Ordering**" on page 14 for details. Note that the scenario parameter files generally contain ASCII text with an implicit field width of one byte (character) throughout.

NFS DATA FILES- INPUT TO SCS

Description	File Extension	Page #
Multiple Antenna Patterns File	.ANP	N/A
Antenna Pattern File	.ANT	N/A
Antenna Phase Delta File	.APF	N/A
Data Log Parameters File	.DLG	N/A
GPS Constellation File (Truth or Nav)	.GPS	N/A
IMU Parameters File	.IMU	N/A
INS Parameters File	.INS	N/A
Jammer Parameters File	.JAM	N/A
Motion Parameters File	.MOT	142
High Density Map File	.MPH	N/A
Low Density Map File	.MPL	N/A
Priority Specifications File	.PRI	N/A
Receiver Specifications File	.RCV	N/A
Surveyed Locations File	.RNG	N/A
Scenario Master File	.SCN	N/A
Terrain Map File	.SEL	N/A
User-Defined Biases Table File	.TBL	N/A
User-Defined Biases File	.UDB	N/A

N/A = Not available. No detailed description of this file is currently available, although it may be added to this document in the future.

MOTION PARAMETERS FILE (.MOT)

A. General

The SCS motion generator receives an ASCII text file as input. This motion file contains a motion profile defining both translational and attitude motion. This text file can be generated using the SCS user interface software, specifically the motion window, or can be entered directly by hand. Motion files consist of a series of state update blocks. Each block contains a set of state vector updates (changes in motion) and the elapsed time to the next update, hereafter referred to as delta time. The motion file uses the delta time format to add flexibility and portability that is difficult to get out of other absolute time styles.

Three different types of motion in two different propagational modes are supported. The motion types are translational, attitude, and superimposed sinusoidal. Translational motion defines the movement of the center of gravity of some object. In other words, the translational motion describes how a vehicle/receiver is moving through space. Attitude motion describes how an object is oriented in space with respect to some established plane, as well as how that orientation is changing. The plane used throughout the SCS is the Local Tangent Plane (LTP), East/North/Up. Superimposed sinusoidal motion is motion that is added to the nominal trajectory, leading to some deviation from the desired path or orientation. This can be used to simulate things such as wind, waves, or bumps.

The two motion modes are state propagation and waypoint. State propagation uses an initial state vector to generate a final state vector after propagating over a set time interval. Waypoint uses initial and final states and rates to calculate the required initial jerk and acceleration to reach the final states. Attitude, translational and sinusoidal motion are considered separate cases when considering the propagation mode. Therefore, the user can enter attitude way points, while providing state propagated translational jerk, for example.

Motion can be defined in a variety of reference frames. Currently, the SCS supports three position frames, World Geodetic Survey, Mean Sea Level, and Earth Centered Earth Fixed. It also supports three translational frames, standard Navigational coordinates, Local Tangent Plane, and Earth Centered Earth Fixed.

In the motion file, any mix of reference frames and/or any mix of Waypoint (WP) / State Propagation (SP) / Superimposed Sinusoidal Motion (SSM) is acceptable data if entered in the manner outlined below. The only restriction is that the initial entry must contain position information at a minimum. A complete state vector is preferred, and highly recommended.

General notes concerning motion file format:

- Comment delimiter lines must start with at least ten non-blank repeating characters.
- An End of Block line must start with at least eight “=“.
- A blank line must have at least eight spaces.
- The motion file is completely case-insensitive. Any combination of lower-case and upper-case letters may be used for the various keywords.

In the definitions below, an ‘ * ‘ indicates that an entry item and/or group of items is optional in the respective context. In state triads (e.g. **pos**, **vel**), not all three components need to be specified, except at the initial point. To leave component unchanged, simply do not enter a value, but include all the commas as delimiters. (Note: ‘*’ is **not** a valid character outside of comments.)

Examples: **pos**: , 40,
vel: 30,,10

B. Translational Motion

1. Translational Modes:

<u>Translational State Propagation Mode</u>

State propagated motion uses an initial state vector (position and three derivatives) and a delta time to calculate the final state vector. State propagation is done in the reference frame of the initial point. Therefore, there are three different types of translational state propagation: Nav propagation, ENU propagation, or ECEF propagation. All three are unique to their own reference frames; hence, results are not always the same by comparison.

```
    time: ____
    pref: ___,___,___
*   pos:  * ,  * ,  *
    tref: ___,___,___
   *vel:  * ,  * ,  *
*  *acc:  * ,  * ,  *
   *jerk:  * ,  * ,  *
    ==========End of Block ==============
```

pos must be specified at the initial point
if any **pos** data is specified, then **pref** must also be specified
if any **vel**, **acc** or **jerk** data is specified, then **tref** must also be specified

Translational State Propagation Entry Fields:

time: delta time (time to completion) (sec)

Time signifies how long the current states will be propagated before new state vector updates are read.

pref: reference frame, linear units, angular units

Defines the position reference frame and units associated with that frame.

1. ref frames - 1. WGS (World Geodetic Survey - latitude/longitude/altitude)
2. MSL (Mean Sea Level - latitude/longitude/altitude)
3. ECEF or EFG (Earth Centered Earth Fixed - E/F/G)

2. linear units - for altitude (WGS & MSL) and ECEF
    1. meters
    2. feet

3. angular units- for latitude and longitude (WGS & MSL), unused for ECEF
    1. deg (degrees)
    2. dms (deg/min/sec)

pos:

Ref Frame	Field Format
WGS	**pos**: latitude, longitude, altitude
MSL	**pos**: latitude, longitude, altitude
ECEF	**pos**: E, F, G

pos contains the position updates in the frame specified in the **pref** entry. If **pos** is included (a position update), then **pref** must also be specified.

tref: reference frame, linear units, angular units

Defines the translational reference frame and the units associated with that frame. **tref** also determines the frame in which the motion is propagated, or driven.

1. ref frames -
    1. NAV (Navigational Coordinates - heading/horizontal/vertical)
    2. ENU (Local Tangent Plane - east/north/up)
    3. ECEF or EFG (Earth Centered Earth Fixed - E/F/G)

2. linear units - for horizontal and vertical (NAV) and ENU & ECEF
    1. meters
    2. feet

3. angular units- for heading (NAV), unused for ENU & ECEF
    1. deg (degrees)
    2. rad (radians)

vel:

Ref Frame	Field Format
NAV	**vel**: heading, horizontal velocity, vertical velocity
ENU	**vel**: velocity east, velocity north, velocity up
ECEF	**vel**: velocity E, velocity F, velocity G

vel contains the velocity updates in the frame specified in the **tref** entry. If **vel** is included (a velocity update), then **tref** must also be specified.

acc:

Ref Frame	Field Format
NAV	**acc**: heading rate, horizontal acceleration, vertical acceleration
ENU	**acc**: acceleration east, acceleration north, acceleration up
ECEF	**acc**: acceleration E, acceleration F, acceleration G

acc contains the acceleration updates in the frame specified in the **tref** entry. If **acc** is included (an acceleration update), then **tref** must also be specified.

jerk:

Ref Frame	Field Format
NAV	**jerk**: heading acceleration, horizontal jerk, vertical jerk
ENU	**jerk**: jerk east, jerk north, jerk up
ECEF	**jerk**: jerk E, jerk F, jerk G

jerk contains the jerk updates in the frame specified in the **tref** entry. If **jerk** is included (a jerk update), then **tref** must also be specified.

Translational Waypoint Mode:

Waypoint mode allows the user to specify motion by entering absolute position and velocity at a certain time. The motion generator will then generate both the required jerk and acceleration to move from the current state to the next desired state. Thus, each waypoint entry defines a vector describing the position and velocity at a specified time. Each way point definition marks the base of the vector, whereas the next point indicates the end. The motion generator will determine the required jerk and acceleration based on the reference frame information. Two types of propagation are possible, ECEF and Lat/Lon/Alt propagation. ECEF takes the current ECEF data and calculates the jerk and acceleration in the ECEF frame. Lat/Lon/Alt propagation takes the current state data, and transforms it into a reference frame defined by Latitude, Longitude, Altitude and their three derivatives each (velocity, acceleration, jerk). The waypoint data is then calculated in this frame, and then the data is transformed back into the original reference frames.

Propagation will occur in the frame based on the frame specified in the **tref** (translational reference frame) line. In the single case where **tref** need not be specified (an initial or transitional way point), the motion generator will use the last point's reference frame to determine the frame in which to propagate. If the translational frame is ECEF, the way point calculation will be completed in the ECEF frame. Given a Nav or ENU frame selection, the current way point data will be computed in the Lat/Lon/Alt frame.

time:____
pref: ___,___,___
wp_pos : ___,___,___
tref: ___,___,___
vel : ___,___,___
==========End of Block ==============

pref and **tref** must be specified at every waypoint, except the initial (or transitional) way point.

Waypoint Entry Fields:

wp_pos - indicates that the translational acceleration and jerk should be calculated using the waypoint calculations based on the components of velocity and position specified.

other fields - same format as translational state propagation fields

2. Translational Mode Transitions

State Propagation to Waypoint:

Transition occurs when a **wp_pos** label is first encountered after **pos** labels have been in use.

```
    time:____
   *pref: ___,___,___
    wp_pos :  * , * , *
 ┌─ tref: ___,___,___
*└─*vel: ___,___,___
    ==========End of Block ==============
```

Warning: Generally, position and velocity data will not be entered at the transition point, as the starting waypoint position/velocity should be the values resulting from the previous state propagation. If a position or velocity is entered, the motion generator will treat this as a state update; thus, it is very probable that a discontinuity in position or velocity will occur.

Waypoint to State Propagation:

Transition occurs when **pos** label is first encountered after **wp_pos** labels have been in use.

For this transition, acceleration and jerk are optional. However, position and velocity are not optional, as this data is required to complete the way point calculation specified in the previous point.

```
    time:____
    pref: ___,___,___
    pos : ___,___,___
    tref: ___,___,___
    vel: ___,___,___
   *acc: ___,___,___
   *jerk: ___,___,___
    ==========End of Block ==============
```

The first five entries are required to complete the waypoint calculations from the previous point.

C. Attitude Motion

1. Attitude Definition:

Attitude is the orientation of the vehicle body (and hence the antenna) with respect to the Local Tangent Plane frame (east/north/up). The rotations occur in the order: yaw then pitch then roll.

It is important to note that attitude is completely independent of the vehicle's velocity vector. The SCS has no knowledge of or concern for whether the vehicle is traveling forward, backwards, sideways or somewhere in between. Changes in vehicle attitude will have no effect on translational motion, regardless of the translational mode. Likewise, changes in the direction of vehicle motion will have no effect on vehicle attitude.

2. Attitude Modes:

<u>Attitude State Propagation Mode</u>

State propagated motion uses an initial state vector (position and three derivatives) and a delta time to calculate the final state vector.

time: ___
att units: ___
*__yaw__: * , * , *
*__pitch__: * , * , *
*__roll__: * , * , *
==========End of Block ==============

State Propagation Entry Fields:

time: delta time (time to completion)

time signifies how long the current states will be propagated before new state vector updates are read.

att units: angular units

Defines the units that the attitude data is entered in.

angular units- 1. deg (degrees)
2. rad (radians)

yaw: yaw, yaw rate, yaw acceleration

Contains the yaw updates in the Local Tangent Plane frame.

pitch: pitch, pitch rate, pitch acc

Contains the pitch updates in the Local Tangent Plane frame.

roll: roll, roll rate, roll acceleration

Contains the roll updates in the Local Tangent Plane frame.

Attitude Waypoint Mode:

Waypoint mode allows the user to specify attitude motion by entering absolute attitude state at a certain time. The motion generator will then generate both the required velocities/rates and acceleration to change the attitude from the current state to the next desired state. Each way point definition marks the base of the waypoint, whereas the next point indicates the end.

The attitude waypoint calculation requires both the initial and final attitudes. In addition, one other variable must be used in the computation. Either initial or final attitude rate, or the initial attitude acceleration is required for the computation. If the user does not specify any of these, the motion generator will use the current initial rate as default. If more than one of these additional components are included, the waypoint calculation will use initial attitude rate first, then initial attitude acceleration, and finally final rate in order of priority. Regardless of this computation, if final attitude rate is specified, a state update in this component will occur after the waypoint calculation.

time: ____
att units: ___
*__wp_yaw__: ___, * , *
*__wp_pitch__: ___, * , *
*__wp_roll__: ___, * , *
==========End of Block ==============

Waypoint Entry Fields:

wp_yaw, **wp_pitch**, **wp_roll** - indicates that for given the specified component of attitude, the corresponding rate and acceleration should be calculated using the waypoint calculations. The **wp_** label can be used with any combination of attitudes.
other fields - same format as attitude state propagation fields

3. Attitude Mode Transitions

State Propagation to Waypoint:

Yaw transition occurs when a **wp_yaw** label is first encountered after **yaw** labels have been in use. Pitch and roll are not affected.
Pitch transition occurs when a **wp_pitch** label is first encountered after **pitch** labels have been in use. Yaw and roll are not affected.

Roll transition occurs when a **wp_roll** label is first encountered after **roll** labels have been in use. Yaw and pitch are not affected.

time: ____
att units: ___
wp_yaw: * , * , *
wp_pitch: * , * , *
wp_roll: * , * , *
==========End of Block ==============

Warning: Generally, attitude state data will not be entered at the transition point, as the starting waypoint attitude should be the attitude state resulting from the previous state propagation. If an attitude is entered, the motion generator will treat this as a state update; thus, it is very probable that a discontinuity in attitude state will occur.

<u>Waypoint to State Propagation:</u>

Yaw transition occurs when a **yaw** label is first encountered after **wp_yaw** labels have been in use. Pitch and roll are not affected.
Pitch transition occurs when a **pitch** label is first encountered after **wp_pitch** labels have been in use. Yaw and roll are not affected.
Roll transition occurs when a **roll** label is first encountered after **wp_roll** labels have been in use. Yaw and pitch are not affected.

For this transition, velocity and acceleration are optional. However, the transitioning attitude state is not optional, as this data is required to complete the way point calculation specified in the previous point.

time: ____
att units: ___
yaw: ___, * , *
pitch: ___, * , *
roll: ___, * , *
==========End of Block ==============

D. Sinusoidal Motion

1. Sinusoidal Mode:

Sinusoidal motion is a superimposed motion which affects the final state after all other motion has been propagated. Any definition of SSM will turn the effects on at that time for the specified component. The motion will continue to be superimposed until the component is redefined at a later time.

The basic equation used to inject this sinusoid is a sine wave.

$$s = A * \sin (\omega * t + \phi) = A * \sin ((t / T) + \phi)$$

where:

s	output sine wave
A	amplitude (meters or degrees)
t	time (seconds)
ω	frequency (Hz)
T	period (seconds)
ϕ	phase shift (radians)

The user specifies the amplitude, period and phase shift parameters.

State Propagation Mode

time: ____
*__ssm east__: * , * , *
*__ssm north__: * , * , *
*__ssm upenu__: * , * , *
*__ssm right__: * , * , *
*__ssm forward__: * , * , *
*__ssm uprfu__: * , * , *
*__ssm yaw__: * ,* , *
*__ssm pitch__ * , * , *
*__ssm roll__: * , * , *
==========End of Block ==============

Superimposed Sinusoidal Motion Format:

ssm xxxx: amplitude, period, phase shift

1. ENU SSM: (east/north/up)

Superimposed sinusoidal motion in the ENU frame is motion that effects the vehicle's nominal motion independent of its current attitude. ENU SSM can be used to simulate natural effects, like wind and waves.

Units: amplitude: meters
period: seconds
phase shift: degrees

2. RFU SSM: (right/forward/up)

Superimposed sinusoidal motion in the RFU frame is motion that effects the vehicle's nominal motion based on its current attitude. RFU SSM can be used to simulate vehicle effects, like variable engine thrust.

Units: amplitude: meters
period: seconds
phase shift: degrees

3. Attitude SSM: (yaw, pitch, roll)

Superimposed sinusoidal motion in the attitude frame is motion that effects the vehicle's nominal attitude. Attitude SSM can be used to simulate natural effects, like wind and waves. It can also be used in conjunction with the other two SSM types to simulate effects in both the nominal trajectory and attitude orientation.

Units: amplitude: degrees
period: seconds
phase shift: degrees

E. Examples

(State Propagation)

time: 30
pref: msl, feet, deg
pos: 45.3456, -32.8673, 1000
tref: nav, feet, deg
vel: 90, 300, 0
jerk: 0, 0, 16

yaw: 90, 0, 0
pitch: 0, 0, 0
roll: 0, 0, 1

ssm north: 10, 5, 0
ssm yaw: 10, 5, 0
==========End of Block ==============

(Transition from Translational State Propagation to Translational Waypoint)

time: 130
wp_pos:
roll: ,,0.5
==========End of Block ==============

(Transition from Pitch State Propagation to Pitch Waypoint &
Transition from Translational Waypoint to Translational State Propagation)

time: 230
pref: wgs, feet
pos: 45.3456, -32.8673, 1000
tref: nav, feet, deg
vel: 0, 200, 0
acc: 0, 0, 0
jerk: 0, 0, 0

att units: deg
wp_pitch:
roll: ,,0
==========End of Block ==============

(Pitch Waypoint)

time: 230
att units: deg
wp_pitch: 10
roll: ,,-0.5
==========End of Block ==============

(Pitch Waypoint)

time: 260
att units: deg
pitch: 0, 0
roll: ,,-1
==========End of Block ==============
(End of File)

F. Motion File Memory Requirements

The motion file is read in by the System Controller (SC) and saved in memory as a linked list of linked lists. The nodes (time nodes) of the main list are made up of time, a pointer to the next time node in the list, and a pointer to the first node (data node) in the data list for that time. The data nodes are made up of a node type indicator, a pointer to the next data node in the list, and one of the following types of data:

I. a double precision value
II. a translational reference (**tref**) mode change type (Nav, ENU, EFG, LLA)
III. a waypoint structure (time, position, velocity, acceleration, and jerk)
IV. an attitude waypoint structure (time, final attitude, and final attitude derivative)

Time nodes and type I and II data nodes each require 24 bytes of memory. Type III (waypoint) data nodes require 120 bytes. Type IV (attitude waypoint) data nodes require 40 bytes.

Data lines in the motion file generate nodes as follows:

pref: 0 nodes (the mode information is represented in the node type for each of the position values and all data is converted to meters and radians in memory).
tref: 1 type II node per translational mode change (if the **tref** line is present but it does not change the translational mode, no node is generated).
att units: 0 nodes (all data is converted to radians in memory).
wp_pos: 1 type III data node.
wp_[**yaw**|**pitch**|**roll**]: 1 type IV data node.
all other lines: 1 type I node for each value (up to three) on the line.

There is approximately 208 MB of memory available for motion data storage, terrain map storage and data logging in the SC. This memory is dynamically allocated, so it is possible to use all of it for motion data if terrain map and data logging are not required. If a dual vehicle scenario or a single vehicle/dual antenna scenario is selected, storage is allocated for the motion data for each antenna, even if they use the same motion data file, thus potentially doubling the rate at which memory is consumed by motion data.

Example:

time: .100000000000001
pref: efg, meters, deg
pos: -2485034.263,-4673669.705, 3546446.564

tref: efg, meters, deg
vel: 10.0000000000, 10.0000000000, 10.0000000000
acc: 0.1000000000, 0.1000000000, 0.1000000000
jerk: 0.0010000000, 0.0010000000, 0.0010000000
=================End of Block===================

A motion file made up of the preceding block type repeated 10 times a second for 900 seconds would use 2,808,024 bytes. The memory usage for each line in the example is as follows:

time: 24 bytes per block
pref: 0 bytes
pos: 72 bytes per block (24 bytes for each value on the line)
tref: 24 bytes once (since the translational mode does not change)
vel: 72 bytes per block (24 bytes for each value on the line)
acc: 72 bytes per block (24 bytes for each value on the line)
jerk: 72 bytes per block (24 bytes for each value on the line)

total size = 900 * 10 * (24 + (3 * 24) + (3 * 24) + (3 * 24) + (3 * 24)) + 24
= 2808024

NFS DATA FILES - OUTPUT FROM SCS

Description	File Extension	Page #
Data Log File	.LOG	156

DATA LOG FILE (.LOG)

The SCS chassis writes this file upon receiving a “Retrieve Data Log” message (record ID = 6840, see **ETHERNET - INPUT TO SCS** section [page 44]). The file is written to the host, file system and file name specified in the “Retrieve Data Log” message.

The data log file is a binary file containing a number of data log messages (see **NFS DATA LOG - OUTPUT FROM SCS** section [page 159]). Each message is in the ICD-GPS-204 format (as shown on page 27), including header. There are no extraneous bytes anywhere in the data log, just complete messages output end to end.

The first message in the data log file is always a Data Log Header Block (record ID = 6000**,** see **NFS DATA LOG - OUTPUT FROM SCS** section [page 160]), which contains summary and indexing information to the other messages in the log. After the Data Log Header, all the messages of a single record ID are placed sequentially before any messages of the next type.

Example:

```
< beginning of file >
Data Log Header Block (Record ID = 6000)
Record ID r1:   message m1
                message m2
                     .
                     .
                     .
Record ID r1:   message mn
Record ID r2:   message m1
                message m2
                     .
                     .
                     .
Record ID r2:   message mn
      .
      .
      .
Record ID rn:   message m1
                message m2
                     .
                     .
                     .
Record ID rn:   message mn
< end of file >
```

NFS DATA LOG INTERFACE

The NFS (Network File System) interface is a specialization of the Ethernet interface used by the SCS (see **ETHERNET INTERFACE** section [page 27]). The PC functions as the NFS server, the SCS chassis as the client. NFS is standard on all SCS chassis and PC's.

This interface describes the individual messages contained in the Data Log File (see **NFS DATA FILES - OUTPUT FROM SCS** section [page 155]). The Data Log File is uploaded to the PC's hard disk by the SCS at the request of the PC.

The contents (including the header) of all messages transmitted and received by the SCS chassis are, and must be, organized in a "little endian" fashion, i.e. least significant byte first, on a field-by-field basis. See "**Byte Ordering**" on page 14 for details.

NFS DATA LOG - OUTPUT FROM SCS

Description	Frequency	Record ID(s)	Page #
Data Log Header Block	Once	6000	160
Channel Hardware Data Block	500 / sec (max)	6005	163
Channel Assignments Block	1 / sec (max)	6010	167
Vehicle Motion Input Data Block	500 / sec (max)	6025	169
Power Level Control Block	500 / sec (max)	6026	170
SCS Scenario File Names Block	Once	6030	171
Random Number Seed Block	Once / Seed	6035	174
Inertial Measurement Unit Data Block	1000 / sec (max)	6040, 6044	175
Composite Motion Data Block	1000 / sec (max)	6050	176
Vehicle State Vector Block	10 / sec (max)	6055	202
Differential Corrections Data Block	1 / sec (max)	6060, 6061	203
WAGE Data Block	Once/Cutover/SV	6070	204
Formatted Almanac Data Block	Once/Cutover/Spoofer Type	6080	205
Formatted Clock/Ephemeris Data Block	Once/Cutover/SV(GT)	6100, 6175	206
Formatted APL Message Data Block	Once/APL	6180	207
SCS Status Block	1 / sec (max)	6700	208
Transmitter Range Data Block	10 / sec (max)	6710	209
Downlink Data Block	10 / sec (max)	6720	210
Channel Range Data Block	500 / sec (max)	6725, 6726	211
Transmitter State Vector Interpolation Data Block	1 / 30 sec (max)	6730	218
Downlink Range Data Block	500 / sec (max)	6760	219
Doppler Navigation System Data Block	50 / sec (max)	6773	225
Inertial Navigation System Data Block	50 / sec (max)	6777, 6778	226
Transmitter Override Control Block	As Needed	6890	227
Jammer Override Control Block	As Needed	6892	228
Differential Data Override Control Block	As Needed	6894	229
Data Logging Override Control Block	As Needed	6896	230
"All Override Controls"[*]	N/A	6898[1]	N/A
Debug Data Block	As Needed	7000, 7001	231

Note 1: "All Override Controls" = Special record ID used in Data Logging requests to request logging of all Override Control Blocks (6890, 6892, 6894 & 6896). No actual data block uses this ID.

DATA LOG HEADER BLOCK

Record ID = 6000

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Scenario Type		SC Version Number		0
2	SGC #1 Version Number		SGC #2 Version Number		4
3	SGC #3 Version Number		IOC Version Number		8
4	SC Classified Overlay Version Number		SGC #1 Classified Overlay Version Number		12
5	SGC#2 Classified Overlay Version Number		SGC #3 Classified Overlay Version Number		16
6	IOC Classified Overlay Version Number		Test Start GPS Week		20
7	Test Start GPS Time of Week (MSBs)				24
8	Test Start GPS Time of Week (LSBs)				28
9	Test Elapsed Time (MSBs)				32
10	Test Elapsed Time (MSBs)				36
11	Total Block Count				40
12	Data Availability Bit Array (Bits 0-31)				44
...	...				...
1980	Data Availability Bit Array (Bits 62976-63007)				7916
1981	Block #0 ID		Spare		7920
1982	Block #0 Data First Byte Index				7924
1983	Block #0 Message Count				7928
1984	Block #0 Initial Logging Frequency				7932
...	...				...
2096	Block #29 ID		Spare		8384
2907	Block #29 Data First Byte Index				8388
2908	Block #29 Message Count				8392
2909	Block #29 Initial Logging Frequency				8396

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Scenario Type	Type of receiver(s) to be simulated: 0=No Receiver, 1=Single Antenna, 2=Dual Antenna, 3=Static Reference Receiver (No RF output)			U	H*2
		bits 0 - 2: Receiver #1		1 - 2		
		bits 3 - 5: Receiver #2		0 - 1		
		bits 6 - 8: Receiver #3		0 or 3		
2	SC Version Number	Version number of the SCS Controller software used. (Written as “MajorVersion.MinorVersion”)			U	H*2
		bits 0 - 7: minor version		0 - 0xFF		
		bits 8 - 15: major version		1 - 0xFF		

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
4	SGC #1 Version Number	Version number of the Signal Generator Controller #1 software used. (Written as “MajorVersion.MinorVersion”) bits 0 - 7: minor version bits 8 - 15: major version		 0 - 0xFF 1 - 0xFF	U	H*2
6	SGC #2 Version Number	Version number of the Signal Generator Controller #2 software used. (Written as “MajorVersion.MinorVersion”) bits 0 - 7: minor version bits 8 - 15: major version		 0 - 0xFF 1 - 0xFF	U	H*2
8	SGC #3 Version Number	Version number of the Signal Generator Controller #3 software used. (Written as “MajorVersion.MinorVersion”) bits 0 - 7: minor version bits 8 - 15: major version		 0 - 0xFF 1 - 0xFF	U	H*2
10	IOC Version Number	Version number of the Input/Output Controller software used. (Written as “MajorVersion.MinorVersion”) bits 0 - 7: minor version bits 8 - 15: major version		 0 - 0xFF 1 - 0xFF	U	H*2
12	SC Classifed Overlay Version Number	Version number of the SCS Controller classified overlay used. (Written as “MajorVersion.MinorVersion”) bits 0 - 7: minor version bits 8 - 15: major version		 0 - 0xFF 1 - 0xFF	U	H*2
14	SGC #1 Classified Overlay Version Number	Version number of the Signal Generator Controller #1 classified overlay used. (Written as “MajorVersion.MinorVersion”) bits 0 - 7: minor version bits 8 - 15: major version		 0 - 0xFF 1 - 0xFF	U	H*2
16	SGC #2 Classified Overlay Version Number	Version number of the Signal Generator Controller #2 classified overlay used. (Written as “MajorVersion.MinorVersion”) bits 0 - 7: minor version bits 8 - 15: major version		 0 - 0xFF 1 - 0xFF	U	H*2
18	SGC #3 Classified Overlay Version Number	Version number of the Signal Generator Controller #3 classified overlay used. (Written as “MajorVersion.MinorVersion”) bits 0 - 7: minor version bits 8 - 15: major version		 0 - 0xFF 1 - 0xFF	U	H*2
20	IOC Classified Overlay Version Number	Version number of the Input/Output Controller classified overlay used. (Written as “MajorVersion.MinorVersion”) bits 0 - 7: minor version bits 8 - 15: major version		 0 - 0xFF 1 - 0xFF	U	H*2
22	Test Start GPS Week	GPS week number at the start of simulation	weeks	0 - 2047	U	U*2
24	Test Start GPS Time of Week	GPS time of week at the start of simulation	seconds	0 - 604800	U	R*8
32	Test Elapsed Time	Duration of simulation	seconds		U	R*8
40	Total Block Count	# of records in the datalog			U	U*4

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
44	Data Availability Bit Array	This is a packed array of bits with dimensions (30,3,7,50,2). Index 1 (0-29) is the block index used in this message. Index 2 (0-2) is <vehicle number - 1>. Index 3 (0-6) is transmitter type: 0=SV, 1=GT, 2=SV Spoofer, 3=GT Spoofer, 4=CW Jammer, 5=Pulsed Jammer, 6=Broadband Noise Jammer. Index 4 (0-49) is <transmitter ID - 1>. Index 5 (0-1) is transmitter frequency: 0=L1, 1=L2. If an index does not apply to a block type (such as transmitter ID for the Vehicle State Vector Block), a value of zero is used for that index. The array elements map to bits using the relationship: bit # = (((block index * 3 + vehicle number) * 7 + transmitter type) * 50 + transmitter ID) * 2 + transmitter frequency For each bit in the array, a 1 indicates that at least one log entry exists in the data file with that combination of characteristics. A 0 indicates that no such log entry exists.		0 - 1	U	H*4 x1969
7920	Block #0 ID	Record ID of block type #0 in datalog. 0 = None.		0, 6000 - 7000	U	U*2
7922	Spare	Spare			U	H*2
7924	Block #0 Data First Byte Index	Byte index into log file pointing to the first byte of the first block of block type #0. The very first byte of the data log file is byte index 1.			U	U*4
7928	Block #0 Message Count	Total number of blocks of block type #0 in datalog			U	U*4
7932	Block #0 Initial Logging Frequency	Initial logging frequency of block type #0			U	R*4
...	...	...			...	...
8384	Block #29 ID	Record ID of block type #29 in datalog. 0 = None.		0, 6000 - 7000	U	U*2
8386	Spare	Spare			U	H*2
8388	Block #29 Data First Byte Index	Byte index into log file pointing to the first byte of the first block of block type #29. The very first byte of the data log file is byte index 1.			U	U*4
8392	Block #29 Message Count	Total number of blocks of block type #29 in datalog			U	U*4
8396	Block #29 Initial Logging Frequency	Initial logging frequency of block type #29			U	R*4

CHANNEL HARDWARE DATA BLOCK

Record ID = 6005

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time of Week (MSBs)				0
2	GPS Time of Week (LSBs)				4
3	GPS Epoch Time (MSBs)				8
4	GPS Epoch Time (LSBs)				12
5	Vehicle / Antenna ID		Channel Number		16
6	Transmitter ID		Channel Type		20
7	Spoofer Type		Transmitter Type		24
8	Carrier Frequency (Low Bytes)		Carrier Frequency (High Bytes)		28
9	Carrier Phase (Low Bytes)		Carrier Phase (High Bytes)		32
10	Code Frequency (Low Bytes)		Code Frequency (Middle Bytes)		36
11	Code Frequency (High Bytes)		Code Phase Spare		40
12	Code Phase (Low Bytes)		Code Phase (High Bytes)		44
13	Z-Count (Low Bytes)		Z-Count (High Bytes)		48
14	P-Code X1A Register		P-Code X1A Count Register		52
15	P-Code X1B Register		P-Code X2A Register		56
16	P-Code X2A Count Register		P-Code X2B Register		60
17	Satellite ID		C/A-Code Phase		64
18	C/A-Code G1 Register		C/A-Code G2 Register		68
19	Open 1		Open 2		72
20	Modulation Control		Digitally Controlled Attenuator Control		76
21	Nav Message Word - High Half		Nav Message Word - Low Half		80
22	Switched Carrier Phase Offset		Telemetry Phase		84
23	Asic Register Loader Control		APL Code Delay		88
24	Jammer Pulse Frequency (Low Bytes)		Jammer Pulse Frequency (High Bytes)		92
25	Jammer Pulse ON Duty Cycle		Spare		96
26	Spare		Spare		100
27	Jammer Frequency (MSBs)				104
28	Jammer Frequency (LSBs)				108
29	Test Elapsed Time (MSBs)				112
30	Test Elapsed Time (LSBs)				116
31	Calibration Delay (MSBs)				120
32	Calibration Delay (LSBs)				124
33	Pseudorange (MSBs)				128
34	Pseudorange (LSBs)				132
35	P-Code Chip (MSBs)				136

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
36	P-Code Chip (LSBs)				140

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time of Week	GPS time of week that this set of data is valid for (time of reception of signal)	seconds	0 - 604800	U	R*8
8	GPS Epoch Time	Time of GPS since GPS week 0, time 0	seconds	0 - (2048 * 604800)	U	R*8
16	Vehicle / Antenna ID	Vehicle number or antenna ID (for dual antenna vehicles) that this transmitter is output on		1 - 2	U	U*2
18	Channel Number	Hardware channel number this transmitter is assigned to		0 - 23	U	U*2
20	Transmitter ID	ID number of the transmitter broadcasting a signal on this channel		1 - 100	U	U*2
22	Channel Type	Generic type of transmitter on this channel: 0=SV, 1=GT, 2=CW Jammer, 3=Pulsed Jammer, 4=Broadband Jammer, 5=Unassigned.		0 - 5	U	U*2
24	Spoofer Type	Indicates whether transmitter is a spoofer: 0=NonSpoofer, 1=Spoofer		0 - 1	U	U*2
26	Transmitter Type	Specific type of transmitter on this channel: 0=SV, 1=GT, 2=SV Spoofer, 3=GT Spoofer, 4=CW Jammer, 5=Pulsed Jammer, 6=Broadband Jammer		0 - 6	U	U*2
28	Carrier Frequency	Carrier Frequency at IF (L1 center = 35.42 MHz, L2 center = 32.4 MHz)	carrier cycles / system clock cycle <160 MHz>	LSB = 2^{-33}	U	U*4 RWO
32	Carrier Phase	Carrier Phase (= 1 - fractional carrier cycle)	carrier cycles	LSB = 2^{-32}	U	U*4 RWO
36	Code Frequency	Code Frequency	P chips / system clock cycle <160 MHz>	LSB = 2^{-40}	U	U*6 RWO
42	Code Phase Spare	Spare word in code phase register			U	U*2
44	Code Phase	Code Phase	P chips	LSB = 2^{-24}	U	U*4 RWO
48	Z-Count	Current simulation z-count		0 - 403199	U	U*4 RWO
52	P-Code X1A Register	P-Code X1A register			U	H*2
54	P-Code X1A Count Register	P-Code X1A count register		0 - 3749	U	U*2
56	P-Code X1B Register	P-Code X1B register			U	H*2
58	P-Code X2A Register	P-Code X2A register			U	H*2
60	P-Code X2A Count Register	P-Code X2A count register		0 - 3749	U	U*2
62	P-Code X2B Register	P-Code X2B register			U	H*2
64	Satellite ID	ID of Satellite on this channel (if applicable)		0 - 32	U	U*2

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
66	C/A-Code Phase	C/A-code phase relative to P-code, biased by 64	P chips	64 - 73	U	U*2
68	C/A-Code G1 Register	C/A-code G1 register			U	H*2
70	C/A-Code G2 Register	C/A-code G2 register			U	H*2
72	Open 1	Open hardware address			U	H*2
74	Open 2	Open hardware address			U	H*2
76	Modulation Control	Modulation control: 0x4100 = CA+P+Nav 0x4102 = CA+Y+Nav 0x4112 = Y+Nav 0x4120 = P+Nav 0x4136 = Carrier Only(CW)		0x4100, 0x4102, 0x4112, 0x4120, 0x4136	U	H*2
78	Digitally Controlled Attenuator Control	Digitally controlled attenuator control: bits 15 - 8: asr bits 7 - 0: multiplier		 1 - 8 0 - 127	U	H*2
80	Nav Message Word - High Half	High half of current or next nav message word: bit 15: spare bits 14 - 0: first 15 bits of message word, in reverse order (i.e. bit 0 is the MSB) Note that this is not always part of the same nav message word as Nav Message Word - Low Half			U	H*2
82	Nav Message Word - Low Half	Low half of current nav message word: bit 15: spare bits 14 - 0: last 15 bits of message word, in reverse order (i.e. bit 0 is the MSB) Note that this is not always part of the same nav message word as Nav Message Word - High Half			U	H*2
84	Switched Carrier Phase Offset	Offset value to carrier phase to be switched in/out by control frequency external to ASIC	carrier cycles	LSB = 2^{-9}	U	I*2
86	Telemetry Phase	Telemetry phase control: bits 15 - 10: decimal 19 bits 9 - 5: bit in nav word bits 4 - 0: telemetry bit phase	 bits msec	 19 0 - 29 0 - 19	U	H*2
88	ASIC Register Loader Control	ASIC register loader control (0 = Load Disabled, -1 = Load on next 1K PPS mark)		-1 - 0	U	I*2
90	APL Code Delay	Code delay (offset) of LAAS APL. Not applicable to any non-APL transmitter.	minutes	1 - 10079	U	U*2
92	Jammer Pulse Frequency	Frequency of signal pulsing. Applicable only to pulsed jammers.	pulses / system clock cycle <160 MHz>	LSB = 2^{-32}	U	U*4 RWO
96	Jammer Pulse ON Duty Cycle	Fractional portion of each pulse cycle during which a jammer is ON. Applicable only to pulsed jammers.		LSB = 2^{-16}	U	U*2
98	Spare	Spare			U	H*2 x3
104	Jammer Frequency	Frequency of jammer signal at the receiver antenna. Applicable only to CW and pulsed jammers.	Hz		U	R*8
112	Test Elapsed Time	Current scenario elapsed time	seconds		U	R*8
120	Calibration Delay	Total calibration delay for this hardware path	meters		U	R*8
128	Pseudorange	Pseudorange for signal on this channel	meters		U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
136	P-Code Chip	P-Code chip at time of transmission	P chips	0 - (604800 * 10.23e6)	U	R*8

RWO = Reverse Word Order, i.e. least significant first

CHANNEL ASSIGNMENTS BLOCK

Record ID = 6010

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Epoch Time (MSBs)				0
2	GPS Epoch Time (LSBs)				4
3	Channel Number		Priority Number		8
4	Selection Number		Vehicle / Antenna ID		12
5	Antenna Pattern ID		APL Code Delay		16
6	Transmitter Index		Transmitter ID		20
7	Specific Transmitter Type		General Transmitter Type		24
8	Spoofer Type		Transmitter Frequency		28
9	Modulation Control		Multipath Type		32
10	Previous Channel Number		Bias Index		36
11	Summary Bits				40
12	Translator Flag		Spare		44
13	Calibration Path Delay (MSBs)				48
14	Calibration Path Delay (LSBs)				52
15	Calibration Path Gain (MSBs)				56
16	Calibration Path Gain (LSBs)				60
17	Calibration Crossover Delay (MSBs)				64
18	Calibration Crossover Delay (LSBs)				68
19	Calibration Crossover Gain (MSBs)				72
20	Calibration Crossover Gain (LSBs)				76

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Epoch Time	Time of GPS since GPS week 0, time 0	seconds	0 - (2048 * 604800)	U	R*8
8	Channel Number	Hardware channel number this transmitter is assigned to		0 - 23	U	U*2
10	Priority Number	Selection number on the input priority list that this assignment corresponds to		1 - 100	U	U*2
12	Selection Number	The order that this assignment was made in channel assignments		1 - 24	U	U*2
14	Vehicle / Antenna ID	Vehicle number or antenna ID (for dual antenna vehicles) that this transmitter is output on		1 - 2	U	U*2
16	Antenna Pattern ID	ID of the antenna pattern currently in use for the vehicle/antenna identified above		0 - 9	U	U*2
18	APL Code Delay	Code delay (offset) of LAAS APL. Not applicable to any non-APL transmitter.	minutes	1 - 10079	U	U*2
20	Transmitter Index	Internal index used for transmitters. Number is 1 less than the ID, and spoofer indices start after the non-spoofer indices (i.e. SV spoofer 1 corresponds to transmitter index 32).		0 - 73	U	U*2

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
22	Transmitter ID	Actual transmitter ID. Spoofers and non-spoofers all start at ID 1. -1 = No transmitter assigned to this channel.		-1, 1 - 50	U	U*2
24	Specific Transmitter Type	Type of transmitter being simulated on this channel: 0=SV, 1=GT, 2=SV Spoofer, 3=GT Spoofer, 4=CW Jammer, 5=Pulsed Jammer, 6=Broadband Jammer		0 - 6	U	U*2
26	General Transmitter Type	0=SV, 1=GT, 2=CW Jammer, 3=Pulsed Jammer, 4=Broadband Jammer, 5=Unassigned		0 - 5	U	U*2
28	Spoofer Type	0=Nonspoofer, 1=Spoofer		0 - 1	U	U*2
30	Transmitter Frequency	0=L1, 1=L2		0 - 1	U	U*2
32	Modulation Control	0=C/A and P code with Nav message, 1=P code with Nav message, 2=Carrier only, 3=C/A and Y code with Nav message, 4=Y code with Nav message		0 - 4	U	U*2
34	Multipath Type	Type of multipath being simulated on this channel: 0=no multipath, 1=Earth multipath, 2=Vehicle multipath		0 - 2	U	U*2
36	Previous Channel Number	Channel number this assignment was assigned to in the previous channel assignment period		0 - 23	U	U*2
38	Bias Index	Index into table of user defined biases			U	U*2
40	Summary Bits	Combined summary of channel assignment:			U	H*4
		bits 31-24: Channel Number		0 - 23		
		bits 23-21: General Transmitter Type		0 - 5		
		bit 21: Spoofer Type		0 - 1		
		bits 19-16: Modulation Control		0 - 4		
		bits 15-12: Antenna Pattern ID		0 - 9		
		bit 11: Vehicle/Antenna ID - 1		0 - 1		
		bit 10: Transmitter Frequency		0 - 1		
		bits 9-8: Multipath Type		0 - 2		
		bits 7-0: Transmitter ID		1 - 50		
44	Translator Flag	1 = Vehicle is a GPS translator		0 - 1	U	U*2
46	Spare	Spare			U	H*2
48	Calibration Path Delay	Hardware channel calibration path delay based on the assignment made to this channel	meters		U	R*8
56	Calibration Path Gain	Hardware channel calibration path gain	dB		U	R*8
64	Calibration Crossover Delay	Hardware channel calibration crossover delay	meters		U	R*8
72	Calibration Crossover Gain	Hardware channel calibration crossover gain	dB		U	R*8

VEHICLE MOTION INPUT DATA BLOCK

Record ID = 6025

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Elapsed Time (MSBs)				0
2	Elapsed Time (LSBs)				4
3	Motion Computation Time (MSBs)				8
4	Motion Computation Time (LSBs)				12
5	Vehicle Motion Input Data Message (Bytes 0-3)				16
...	...				...
78	Vehicle Motion Input Data Message (Bytes 292-295)				308
79	Motion Debug Data Message (Bytes 0-3)				312
...	...				...
92	Motion Debug Data Message (Bytes 52-55)				364

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Elapsed Time	Arrival time of the external motion data, expressed as time elapsed since the beginning of the simulation	seconds		U	R*8
8	Motion Computation Time	Reference time of first motion computation to use the external motion data, expressed as time elapsed since the beginning of the simulation. Note that this is nominally 5 milliseconds later than the Elapsed Time.	seconds		U	R*8
16	Vehicle Motion Input Data Message	A Vehicle Motion Input Data message, exactly as it was received by the SCS. For details of the message format, see UMN/SCRAMNET - INPUT TO SCS section [page 129]			U	H*1 x296
312	Motion Debug Data Message	A Motion Debug Data message, exactly as it would be sent by the SCS. The data in this message is applicable to the accompanying Vehicle Motion Input Data message. For details of the message format, see UMN/SCRAMNET - OUTPUT FROM SCS section [page 138]			U	H*1 x56

POWER LEVEL CONTROL BLOCK

Record ID = 6026

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Elapsed Time (MSBs)				0
2	Elapsed Time (LSBs)				4
3	Power Level Control Message (Bytes 0-3)				8
...	...				...
102	Power Level Control Message (Bytes 396-399)				404

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Elapsed Time	Time elapsed since the beginning of the simulation	seconds		U	R*8
8	Power Level Control Message	A Power Level Control message, exactly as it was received by the SCS. For details of the message format, see UMN/SCRAMNET - INPUT TO SCS section [page 130]			U	H*1 x400

SCS SCENARIO FILE NAMES BLOCK

Record ID = 6030

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Receiver Specs Filename, Char 1	Receiver Specs Filename, Char 2	Receiver Specs Filename, Char 3	Receiver Specs Filename, Char 4	0
...	...				...
25	Receiver Specs Filename, Char 97	Receiver Specs Filename, Char 98	Receiver Specs Filename, Char 99	Receiver Specs Filename, Char 100	96
26	Receiver 1 Antenna 1 Filename, Char 1	Receiver 1 Antenna 1 Filename, Char 2	Receiver 1 Antenna 1 Filename, Char 3	Receiver 1 Antenna 1 Filename, Char 4	100
...	...				...
50	Receiver 1 Antenna 1 Filename, Char 97	Receiver 1 Antenna 1 Filename, Char 98	Receiver 1 Antenna 1 Filename, Char 99	Receiver 1 Antenna 1 Filename, Char 100	196
51	Receiver 1 Antenna 2 Filename, Char 1	Receiver 1 Antenna 2 Filename, Char 2	Receiver 1 Antenna 2 Filename, Char 3	Receiver 1 Antenna 2 Filename, Char 4	200
...	...				...
75	Receiver 1 Antenna 2 Filename, Char 97	Receiver 1 Antenna 2 Filename, Char 98	Receiver 1 Antenna 2 Filename, Char 99	Receiver 1 Antenna 2 Filename, Char 100	296
76	Receiver 1 Motion Filename, Char 1	Receiver 1 Motion Filename, Char 2	Receiver 1 Motion Filename, Char 3	Receiver 1 Motion Filename, Char 4	300
...	...				...
100	Receiver 1 Motion Filename, Char 97	Receiver 1 Motion Filename, Char 98	Receiver 1 Motion Filename, Char 99	Receiver 1 Motion Filename, Char 100	396
101	Receiver 1 IMU/INS Filename, Char 1	Receiver 1 IMU/INS Filename, Char 2	Receiver 1 IMU/INS Filename, Char 3	Receiver 1 IMU/INS Filename, Char 4	400
...	...				...
125	Receiver 1 IMU/INS Filename, Char 97	Receiver 1 IMU/INS Filename, Char 98	Receiver 1 IMU/INS Filename, Char 99	Receiver 1 IMU/INS Filename, Char 100	496
126	Receiver 2 Antenna Filename, Char 1	Receiver 2 Antenna Filename, Char 2	Receiver 2 Antenna Filename, Char 3	Receiver 2 Antenna Filename, Char 4	500
...	...				...
150	Receiver 2 Antenna Filename, Char 97	Receiver 2 Antenna Filename, Char 98	Receiver 2 Antenna Filename, Char 99	Receiver 2 Antenna Filename, Char 100	596
151	Receiver 2 Motion Filename, Char 1	Receiver 2 Motion Filename, Char 2	Receiver 2 Motion Filename, Char 3	Receiver 2 Motion Filename, Char 4	600
...	...				...
175	Receiver 2 Motion Filename, Char 97	Receiver 2 Motion Filename, Char 98	Receiver 2 Motion Filename, Char 99	Receiver 2 Motion Filename, Char 100	696
176	Receiver 2 IMU/INS Filename, Char 1	Receiver 2 IMU/INS Filename, Char 2	Receiver 2 IMU/INS Filename, Char 3	Receiver 2 IMU/INS Filename, Char 4	700
...	...				...
200	Receiver 2 IMU/INS Filename, Char 97	Receiver 2 IMU/INS Filename, Char 98	Receiver 2 IMU/INS Filename, Char 99	Receiver 2 IMU/INS Filename, Char 100	796

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
201	GPS Truth Filename, Char 1	GPS Truth Filename, Char 2	GPS Truth Filename, Char 3	GPS Truth Filename, Char 4	800
...	...				...
225	GPS Truth Filename, Char 97	GPS Truth Filename, Char 98	GPS Truth Filename, Char 99	GPS Truth Filename, Char 100	896
226	GPS Navigation Filename, Char 1	GPS Navigation Filename, Char 2	GPS Navigation Filename, Char 3	GPS Navigation Filename, Char 4	900
...	...				...
250	GPS Navigation Filename, Char 97	GPS Navigation Filename, Char 98	GPS Navigation Filename, Char 99	GPS Navigation Filename, Char 100	996
251	Jammers Filename, Char 1	Jammers Filename, Char 2	Jammers Filename, Char 3	Jammers Filename, Char 4	1000
...	...				...
275	Jammers Filename, Char 97	Jammers Filename, Char 98	Jammers Filename, Char 99	Jammers Filename, Char 100	1096
276	User Defined Biases Filename, Char 1	User Defined Biases Filename, Char 2	User Defined Biases Filename, Char 3	User Defined Biases Filename, Char 4	1100
...	...				...
300	User Defined Biases Filename, Char 97	User Defined Biases Filename, Char 98	User Defined Biases Filename, Char 99	User Defined Biases Filename, Char 100	1196
301	Priority Filename, Char 1	Priority Filename, Char 2	Priority Filename, Char 3	Priority Filename, Char 4	1200
...	...				...
325	Priority Filename, Char 97	Priority Filename, Char 98	Priority Filename, Char 99	Priority Filename, Char 100	1296
326	Map Filename, Char 1	Map Filename, Char 2	Map Filename, Char 3	Map Filename, Char 4	1300
...	...				...
350	Map Filename, Char 97	Map Filename, Char 98	Map Filename, Char 99	Map Filename, Char 100	1396
351	Surveyed Locations Filename, Char 1	Surveyed Locations Filename, Char 2	Surveyed Locations Filename, Char 3	Surveyed Locations Filename, Char 4	1400
...	...				...
375	Surveyed Locations Filename, Char 97	Surveyed Locations Filename, Char 98	Surveyed Locations Filename, Char 99	Surveyed Locations Filename, Char 100	1496
376	Data Log Filename, Char 1	Data Log Filename, Char 2	Data Log Filename, Char 3	Data Log Filename, Char 4	1500
...	...				...
400	Data Log Filename, Char 97	Data Log Filename, Char 98	Data Log Filename, Char 99	Data Log Filename, Char 100	1596

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Receiver Specs Filename	Name of Receiver Specifications File	ASCII		U	C*100
100	Receiver 1 Antenna 1 Filename	Name of Receiver 1 Antenna 1 File	ASCII		U	C*100

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
200	Receiver 1 Antenna 2 Filename	Name of Receiver 1 Antenna 2 File	ASCII		U	C*100
300	Receiver 1 Motion Filename	Name of Receiver 1 Motion File	ASCII		U	C*100
400	Receiver 1 IMU/INS Filename	Name of Receiver 1 IMU/INS File	ASCII		U	C*100
500	Receiver 2 Antenna Filename	Name of Receiver 2 Antenna File	ASCII		U	C*100
600	Receiver 2 Motion Filename	Name of Receiver 2 Motion File	ASCII		U	C*100
700	Receiver 2 IMU/INS Filename	Name of Receiver 2 IMU/INS File	ASCII		U	C*100
800	GPS Truth Filename	Name of GPS Truth Data File	ASCII		U	C*100
900	GPS Navigation Filename	Name of GPS Nav Message Data File	ASCII		U	C*100
1000	Jammers Filename	Name of Jammer Data File	ASCII		U	C*100
1100	User Defined Biases Filename	Name of User Defined Biases File	ASCII		U	C*100
1200	Priority Filename	Name of Priority Selections File	ASCII		U	C*100
1300	Map Filename	Name of Map File	ASCII		U	C*100
1400	Surveyed Locations Filename	Name of Surveyed Locations File	ASCII		U	C*100
1500	Data Log Filename	Name of Data Logging Selections File	ASCII		U	C*100

RANDOM NUMBER SEED BLOCK

Record ID = 6035

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Time of Week (MSBs)				0
2	Time of Week (LSBs)				4
3	GPS Week		Stream ID		8
4	Seed				12

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Time of Week	GPS time of week when seed is first used	seconds	0 - 604800	U	R*8
8	GPS Week	GPS week number when seed is first used	weeks	0 - 2047	U	U*2
10	Stream ID	ID of stream to which this seed applies: ID — Random Number Stream -1 — Master seed 1-32 — Seed for unclassified SA for SV's 1-32 101-137 — Seed for unclassified SA for GT's 1-37 901-902 — Seed for IMU errors for vehicles 1 & 2		-1 - 999	U	I*2
12	Seed	Random number seed		0-2147483647	U	U*4

INERTIAL MEASUREMENT UNIT DATA BLOCK

Record ID = 6040 (RAP-Litton)
6044 (LN-200)

This block has an identical format to the UMN/SCRAMNet output block "Aiding Message Data Block" (see **UMN/SCRAMNET - OUTPUT FROM SCS** section [page 135]) with the following contents:

Record ID	Message Format	Message Type	Message*
6040	0 (= RAP-Litton)	0 (= IMU)	(see page 85)
6044	4 (= LN-200)	0 (= IMU)	(see page 84)

* (see referenced page in **RS-422/485 - OUTPUT FROM SCS** section)

COMPOSITE MOTION DATA BLOCK

Record ID = 6050

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Vehicle ID		Spare		0
2	Spare				4
3	GPS Epoch Time (MSBs)				8
4	GPS Epoch Time (LSBs)				12
5	Propagation Mode				16
6	Motion Input Mode				20
7	Nominal Latitude (MSBs)				24
8	Nominal Latitude (LSBs)				28
9	Nominal Longitude (MSBs)				32
10	Nominal Longitude (LSBs)				36
11	Nominal Altitude (MSBs)				40
12	Nominal Altitude (LSBs)				44
13	Nominal Latitude Rate (MSBs)				48
14	Nominal Latitude Rate (LSBs)				52
15	Nominal Longitude Rate (MSBs)				56
16	Nominal Longitude Rate (LSBs)				60
17	Nominal Altitude Rate (MSBs)				64
18	Nominal Altitude Rate (LSBs)				68
19	Nominal Latitude Acceleration (MSBs)				72
20	Nominal Latitude Acceleration (LSBs)				76
21	Nominal Longitude Acceleration (MSBs)				80
22	Nominal Longitude Acceleration (LSBs)				84
23	Nominal Altitude Acceleration (MSBs)				88
24	Nominal Altitude Acceleration (LSBs)				92
25	Nominal Latitude Jerk (MSBs)				96
26	Nominal Latitude Jerk (LSBs)				100
27	Nominal Longitude Jerk (MSBs)				104
28	Nominal Longitude Jerk (LSBs)				108
29	Nominal Altitude Jerk (MSBs)				112
30	Nominal Altitude Jerk (LSBs)				116
31	Nominal DCM EFG to ENU (1,1) (MSBs)				120
32	Nominal DCM EFG to ENU (1,1) (LSBs)				124
33	Nominal DCM EFG to ENU (2,1) (MSBs)				128
...	...				...
48	Nominal DCM EFG to ENU (3,3) (LSBs)				188

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
49	Nominal WETT - E (MSBs)				192
50	Nominal WETT - E (LSBs)				196
51	Nominal WETT - N (MSBs)				200
52	Nominal WETT - N (LSBs)				204
53	Nominal WETT - U (MSBs)				208
54	Nominal WETT - U (LSBs)				212
55	Nominal WETT Rate - E (MSBs)				216
56	Nominal WETT Rate - E (LSBs)				220
57	Nominal WETT Rate - N (MSBs)				224
58	Nominal WETT Rate - N (LSBs)				228
59	Nominal WETT Rate - U (MSBs)				232
60	Nominal WETT Rate - U (LSBs)				236
61	Nominal WETT Acceleration - E (MSBs)				240
62	Nominal WETT Acceleration - E (LSBs)				244
63	Nominal WETT Acceleration - N (MSBs)				248
64	Nominal WETT Acceleration - N (LSBs)				252
65	Nominal WETT Acceleration - U (MSBs)				256
66	Nominal WETT Acceleration - U (LSBs)				260
67	Nominal Velocity - E (MSBs)				264
68	Nominal Velocity - E (LSBs)				268
69	Nominal Velocity - N (MSBs)				272
70	Nominal Velocity - N (LSBs)				276
71	Nominal Velocity - U (MSBs)				280
72	Nominal Velocity - U (LSBs)				284
73	Nominal Acceleration - E (MSBs)				288
74	Nominal Acceleration - E (LSBs)				292
75	Nominal Acceleration - N (MSBs)				296
76	Nominal Acceleration - N (LSBs)				300
77	Nominal Acceleration - U (MSBs)				304
78	Nominal Acceleration - U (LSBs)				308
79	Nominal Jerk - E (MSBs)				312
80	Nominal Jerk - E (LSBs)				316
81	Nominal Jerk - N (MSBs)				320
82	Nominal Jerk - N (LSBs)				324
83	Nominal Jerk - U (MSBs)				328
84	Nominal Jerk - U (LSBs)				332
85	Nominal Heading (MSBs)				336

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
86	Nominal Heading (LSBs)				340
87	Nominal Heading Rate (MSBs)				344
88	Nominal Heading Rate (LSBs)				348
89	Nominal Heading Acceleration (MSBs)				352
90	Nominal Heading Acceleration (LSBs)				356
91	Nominal Horizontal Velocity (MSBs)				360
92	Nominal Horizontal Velocity (LSBs)				364
93	Nominal Horizontal Acceleration (MSBs)				368
94	Nominal Horizontal Acceleration (LSBs)				372
95	Nominal Horizontal Jerk (MSBs)				376
96	Nominal Horizontal Jerk (LSBs)				380
97	Nominal Position - E (MSBs)				384
98	Nominal Position - E (LSBs)				388
99	Nominal Position - F (MSBs)				392
100	Nominal Position - F (LSBs)				396
101	Nominal Position - G (MSBs)				400
102	Nominal Position - G (LSBs)				404
103	Nominal Velocity - E (MSBs)				408
104	Nominal Velocity - E (LSBs)				412
105	Nominal Velocity - F (MSBs)				416
106	Nominal Velocity - F (LSBs)				420
107	Nominal Velocity - G (MSBs)				424
108	Nominal Velocity - G (LSBs)				428
109	Nominal Acceleration - E (MSBs)				432
110	Nominal Acceleration - E (LSBs)				436
111	Nominal Acceleration - F (MSBs)				440
112	Nominal Acceleration - F (LSBs)				444
113	Nominal Acceleration - G (MSBs)				448
114	Nominal Acceleration - G (LSBs)				452
115	Nominal Jerk - E (MSBs)				456
116	Nominal Jerk - E (LSBs)				460
117	Nominal Jerk - F (MSBs)				464
118	Nominal Jerk - F (LSBs)				468
119	Nominal Jerk - G (MSBs)				472
120	Nominal Jerk - G (LSBs)				476
121	Nominal Yaw (MSBs)				480
122	Nominal Yaw (LSBs)				484

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
123	Nominal Pitch (MSBs)				488
124	Nominal Pitch (LSBs)				492
125	Nominal Roll (MSBs)				496
126	Nominal Roll (LSBs)				500
127	Nominal Yaw Rate (MSBs)				504
128	Nominal Yaw Rate (LSBs)				508
129	Nominal Pitch Rate (MSBs)				512
130	Nominal Pitch Rate (LSBs)				516
131	Nominal Roll Rate (MSBs)				520
132	Nominal Roll Rate (LSBs)				524
133	Nominal Yaw Acceleration (MSBs)				528
134	Nominal Yaw Acceleration (LSBs)				532
135	Nominal Pitch Acceleration (MSBs)				536
136	Nominal Pitch Acceleration (LSBs)				540
137	Nominal Roll Acceleration (MSBs)				544
138	Nominal Roll Acceleration (LSBs)				548
139	Sinusoidal Attitude Motion “On”				552
140	Spare				556
141	Sinusoidal Yaw Component “On”				560
142	Spare				564
143	Sinusoidal Yaw Reference Elapsed Time (MSBs)				568
144	Sinusoidal Yaw Reference Elapsed Time (LSBs)				572
145	Sinusoidal Yaw Amplitude (MSBs)				576
146	Sinusoidal Yaw Amplitude (LSBs)				580
147	Sinusoidal Yaw Amplitude * Angular Frequency (MSBs)				584
148	Sinusoidal Yaw Amplitude * Angular Frequency (LSBs)				588
149	Sinusoidal Yaw Amplitude * Angular Frequency Squared (MSBs)				592
150	Sinusoidal Yaw Amplitude * Angular Frequency Squared (LSBs)				596
151	Sinusoidal Yaw Amplitude * Angular Frequency Cubed (MSBs)				600
152	Sinusoidal Yaw Amplitude * Angular Frequency Cubed (LSBs)				604
153	Sinusoidal Yaw Angular Frequency (MSBs)				608
154	Sinusoidal Yaw Angular Frequency (LSBs)				612
155	Sinusoidal Yaw Phase at Reference Time (MSBs)				616
156	Sinusoidal Yaw Phase at Reference Time (LSBs)				620
157	Sinusoidal Pitch Component “On”				624
158	Spare				628
159	Sinusoidal Pitch Reference Elapsed Time (MSBs)				632

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
160	Sinusoidal Pitch Reference Elapsed Time (LSBs)				636
161	Sinusoidal Pitch Amplitude (MSBs)				640
162	Sinusoidal Pitch Amplitude (LSBs)				644
163	Sinusoidal Pitch Amplitude * Angular Frequency (MSBs)				648
164	Sinusoidal Pitch Amplitude * Angular Frequency (LSBs)				652
165	Sinusoidal Pitch Amplitude* Angular Frequency Squared (MSBs)				656
166	Sinusoidal Pitch Amplitude * Angular Frequency Squared (LSBs)				660
167	Sinusoidal Pitch Amplitude* Angular Frequency Cubed (MSBs)				664
168	Sinusoidal Pitch Amplitude * Angular Frequency Cubed (LSBs)				668
169	Sinusoidal Pitch Angular Frequency (MSBs)				672
170	Sinusoidal Pitch Angular Frequency (LSBs)				676
171	Sinusoidal Pitch Phase at Reference Time (MSBs)				680
172	Sinusoidal Pitch Phase at Reference Time (LSBs)				684
173	Sinusoidal Roll Component “On”				688
174	Spare				692
175	Sinusoidal Roll Reference Elapsed Time (MSBs)				696
176	Sinusoidal Roll Reference Elapsed Time (LSBs)				700
177	Sinusoidal Roll Amplitude (MSBs)				704
178	Sinusoidal Roll Amplitude (LSBs)				708
179	Sinusoidal Roll Amplitude * Angular Frequency (MSBs)				712
180	Sinusoidal Roll Amplitude * Angular Frequency (LSBs)				716
181	Sinusoidal Roll Amplitude * Angular Frequency Squared (MSBs)				720
182	Sinusoidal Roll Amplitude * Angular Frequency Squared (LSBs)				724
183	Sinusoidal Roll Amplitude * Angular Frequency Cubed (MSBs)				728
184	Sinusoidal Roll Amplitude * Angular Frequency Cubed (LSBs)				732
185	Sinusoidal Roll Angular Frequency (MSBs)				736
186	Sinusoidal Roll Angular Frequency (LSBs)				740
187	Sinusoidal Roll Phase at Reference Time (MSBs)				744
188	Sinusoidal Roll Phase at Reference Time (LSBs)				748
189	Sinusoidal Yaw (MSBs)				752
190	Sinusoidal Yaw (LSBs)				756
191	Sinusoidal Pitch (MSBs)				760
192	Sinusoidal Pitch (LSBs)				764
193	Sinusoidal Roll (MSBs)				768
194	Sinusoidal Roll (LSBs)				772
195	Sinusoidal Yaw Rate (MSBs)				776
196	Sinusoidal Yaw Rate (LSBs)				780

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
197	Sinusoidal Pitch Rate (MSBs)				784
198	Sinusoidal Pitch Rate (LSBs)				788
199	Sinusoidal Roll Rate (MSBs)				792
200	Sinusoidal Roll Rate (LSBs)				796
201	Sinusoidal Yaw Acceleration (MSBs)				800
202	Sinusoidal Yaw Acceleration (LSBs)				804
203	Sinusoidal Pitch Acceleration (MSBs)				808
204	Sinusoidal Pitch Acceleration (LSBs)				812
205	Sinusoidal Roll Acceleration (MSBs)				816
206	Sinusoidal Roll Acceleration (LSBs)				820
207	Sinusoidal Yaw Jerk (MSBs)				824
208	Sinusoidal Yaw Jerk (LSBs)				828
209	Sinusoidal Pitch Jerk (MSBs)				832
210	Sinusoidal Pitch Jerk (LSBs)				836
211	Sinusoidal Roll Jerk (MSBs)				840
212	Sinusoidal Roll Jerk (LSBs)				844
213	Sinusoidal Body RFU Motion “On”				848
214	Spare				852
215	Sinusoidal Body Right Component “On”				856
216	Spare				860
217	Sinusoidal Body Right Reference Elapsed Time (MSBs)				864
218	Sinusoidal Body Right Reference Elapsed Time (LSBs)				868
219	Sinusoidal Body Right Amplitude (MSBs)				872
220	Sinusoidal Body Right Amplitude (LSBs)				876
221	Sinusoidal Body Right Amplitude * Angular Frequency (MSBs)				880
222	Sinusoidal Body Right Amplitude * Angular Frequency (LSBs)				884
223	Sinusoidal Body Right Amplitude * Angular Frequency Squared (MSBs)				888
224	Sinusoidal Body Right Amplitude * Angular Frequency Squared (LSBs)				892
225	Sinusoidal Body Right Amplitude * Angular Frequency Cubed (MSBs)				896
226	Sinusoidal Body Right Amplitude * Angular Frequency Cubed (LSBs)				900
227	Sinusoidal Body Right Angular Frequency (MSBs)				904
228	Sinusoidal Body Right Angular Frequency (LSBs)				908
229	Sinusoidal Body Right Phase at Reference Time (MSBs)				912
230	Sinusoidal Body Right Phase at Reference Time (LSBs)				916
231	Sinusoidal Body Forward Component “On”				920
232	Spare				924
233	Sinusoidal Body Forward Reference Elapsed Time (MSBs)				928

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
234	Sinusoidal Body Forward Reference Elapsed Time (LSBs)				932
235	Sinusoidal Body Forward Amplitude (MSBs)				936
236	Sinusoidal Body Forward Amplitude (LSBs)				940
237	Sinusoidal Body Forward Amplitude * Angular Frequency (MSBs)				944
238	Sinusoidal Body Forward Amplitude * Angular Frequency (LSBs)				948
239	Sinusoidal Body Forward Amplitude * Angular Frequency Squared (MSBs)				952
240	Sinusoidal Body Forward Amplitude * Angular Frequency Squared (LSBs)				956
241	Sinusoidal Body Forward Amplitude * Angular Frequency Cubed (MSBs)				960
242	Sinusoidal Body Forward Amplitude * Angular Frequency Cubed (LSBs)				964
243	Sinusoidal Body Forward Angular Frequency (MSBs)				968
244	Sinusoidal Body Forward Angular Frequency (LSBs)				972
245	Sinusoidal Body Forward Phase at Reference Time (MSBs)				976
246	Sinusoidal Body Forward Phase at Reference Time (LSBs)				980
247	Sinusoidal Body Up Component "On"				984
248	Spare				988
249	Sinusoidal Body Up Reference Elapsed Time (MSBs)				992
250	Sinusoidal Body Up Reference Elapsed Time (LSBs)				996
251	Sinusoidal Body Up Amplitude (MSBs)				1000
252	Sinusoidal Body Up Amplitude (LSBs)				1004
253	Sinusoidal Body Up Amplitude * Angular Frequency (MSBs)				1008
254	Sinusoidal Body Up Amplitude * Angular Frequency (LSBs)				1012
255	Sinusoidal Body Up Amplitude * Angular Frequency Squared (MSBs)				1016
256	Sinusoidal Body Up Amplitude * Angular Frequency Squared (LSBs)				1020
257	Sinusoidal Body Up Amplitude * Angular Frequency Cubed (MSBs)				1024
258	Sinusoidal Body Up Amplitude * Angular Frequency Cubed (LSBs)				1028
259	Sinusoidal Body Up Angular Frequency (MSBs)				1032
260	Sinusoidal Body Up Angular Frequency (LSBs)				1036
261	Sinusoidal Body Up Phase at Reference Time (MSBs)				1040
262	Sinusoidal Body Up Phase at Reference Time (LSBs)				1044
263	Sinusoidal Body Position - R (MSBs)				1048
264	Sinusoidal Body Position - R (LSBs)				1052
265	Sinusoidal Body Position - F (MSBs)				1056
266	Sinusoidal Body Position - F (LSBs)				1060
267	Sinusoidal Body Position - U (MSBs)				1064
268	Sinusoidal Body Position - U (LSBs)				1068
269	Sinusoidal Body Velocity - R (MSBs)				1072
270	Sinusoidal Body Velocity - R (LSBs)				1076

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
271	Sinusoidal Body Velocity - F (MSBs)				1080
272	Sinusoidal Body Velocity - F (LSBs)				1084
273	Sinusoidal Body Velocity - U (MSBs)				1088
274	Sinusoidal Body Velocity - U (LSBs)				1092
275	Sinusoidal Body Acceleration - R (MSBs)				1096
276	Sinusoidal Body Acceleration - R (LSBs)				1100
277	Sinusoidal Body Acceleration - F (MSBs)				1104
278	Sinusoidal Body Acceleration - F (LSBs)				1108
279	Sinusoidal Body Acceleration - U (MSBs)				1112
280	Sinusoidal Body Acceleration - U (LSBs)				1116
281	Sinusoidal Body Jerk - R (MSBs)				1120
282	Sinusoidal Body Jerk - R (LSBs)				1124
283	Sinusoidal Body Jerk - F (MSBs)				1128
284	Sinusoidal Body Jerk - F (LSBs)				1132
285	Sinusoidal Body Jerk - U (MSBs)				1136
286	Sinusoidal Body Jerk - U (LSBs)				1140
287	Sinusoidal Body Position - E (MSBs)				1144
288	Sinusoidal Body Position - E (LSBs)				1148
289	Sinusoidal Body Position - N (MSBs)				1152
290	Sinusoidal Body Position - N (LSBs)				1156
291	Sinusoidal Body Position - U (MSBs)				1160
292	Sinusoidal Body Position - U (LSBs)				1164
293	Sinusoidal Body Velocity - E (MSBs)				1168
294	Sinusoidal Body Velocity - E (LSBs)				1172
295	Sinusoidal Body Velocity - N (MSBs)				1176
296	Sinusoidal Body Velocity - N (LSBs)				1180
297	Sinusoidal Body Velocity - U (MSBs)				1184
298	Sinusoidal Body Velocity - U (LSBs)				1188
299	Sinusoidal Body Acceleration - E (MSBs)				1192
300	Sinusoidal Body Acceleration - E (LSBs)				1196
301	Sinusoidal Body Acceleration - N (MSBs)				1200
302	Sinusoidal Body Acceleration - N (LSBs)				1204
303	Sinusoidal Body Acceleration - U (MSBs)				1208
304	Sinusoidal Body Acceleration - U (LSBs)				1212
305	Sinusoidal Body Jerk - E (MSBs)				1216
306	Sinusoidal Body Jerk - E (LSBs)				1220
307	Sinusoidal Body Jerk - N (MSBs)				1224

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
308	Sinusoidal Body Jerk - N (LSBs)				1228
309	Sinusoidal Body Jerk - U (MSBs)				1232
310	Sinusoidal Body Jerk - U (LSBs)				1236
311	Sinusoidal ENU Motion “On”				1240
312	Spare				1244
313	Sinusoidal East Component “On”				1248
314	Spare				1252
315	Sinusoidal East Reference Elapsed Time (MSBs)				1256
316	Sinusoidal East Reference Elapsed Time (LSBs)				1260
317	Sinusoidal East Amplitude (MSBs)				1264
318	Sinusoidal East Amplitude (LSBs)				1268
319	Sinusoidal East Amplitude * Angular Frequency (MSBs)				1272
320	Sinusoidal East Amplitude * Angular Frequency (LSBs)				1276
321	Sinusoidal East Amplitude * Angular Frequency Squared (MSBs)				1280
322	Sinusoidal East Amplitude * Angular Frequency Squared (LSBs)				1284
323	Sinusoidal East Amplitude * Angular Frequency Cubed (MSBs)				1288
324	Sinusoidal East Amplitude * Angular Frequency Cubed (LSBs)				1292
325	Sinusoidal East Angular Frequency (MSBs)				1296
326	Sinusoidal East Angular Frequency (LSBs)				1300
327	Sinusoidal East Phase at Reference Time (MSBs)				1304
328	Sinusoidal East Phase at Reference Time (LSBs)				1308
329	Sinusoidal North Component “On”				1312
330	Spare				1316
331	Sinusoidal North Reference Elapsed Time (MSBs)				1320
332	Sinusoidal North Reference Elapsed Time (LSBs)				1324
333	Sinusoidal North Amplitude (MSBs)				1328
334	Sinusoidal North Amplitude (LSBs)				1332
335	Sinusoidal North Amplitude * Angular Frequency (MSBs)				1336
336	Sinusoidal North Amplitude * Angular Frequency (LSBs)				1340
337	Sinusoidal North Amplitude * Angular Frequency Squared (MSBs)				1344
338	Sinusoidal North Amplitude * Angular Frequency Squared (LSBs)				1348
339	Sinusoidal North Amplitude * Angular Frequency Cubed (MSBs)				1352
340	Sinusoidal North Amplitude * Angular Frequency Cubed (LSBs)				1356
341	Sinusoidal North Angular Frequency (MSBs)				1360
342	Sinusoidal North Angular Frequency (LSBs)				1364
343	Sinusoidal North Phase at Reference Time (MSBs)				1368
344	Sinusoidal North Phase at Reference Time (LSBs)				1372

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
345	Sinusoidal Up Component "On"				1376
346	Spare				1380
347	Sinusoidal Up Reference Elapsed Time (MSBs)				1384
348	Sinusoidal Up Reference Elapsed Time (LSBs)				1388
349	Sinusoidal Up Amplitude (MSBs)				1392
350	Sinusoidal Up Amplitude (LSBs)				1396
351	Sinusoidal Up Amplitude * Angular Frequency (MSBs)				1400
352	Sinusoidal Up Amplitude * Angular Frequency (LSBs)				1404
353	Sinusoidal Up Amplitude * Angular Frequency Squared (MSBs)				1408
354	Sinusoidal Up Amplitude * Angular Frequency Squared (LSBs)				1412
355	Sinusoidal Up Amplitude * Angular Frequency Cubed (MSBs)				1416
356	Sinusoidal Up Amplitude * Angular Frequency Cubed (LSBs)				1420
357	Sinusoidal Up Angular Frequency (MSBs)				1424
358	Sinusoidal Up Angular Frequency (LSBs)				1428
359	Sinusoidal Up Phase at Reference Time (MSBs)				1432
360	Sinusoidal Up Phase at Reference Time (LSBs)				1436
361	Sinusoidal Position - E (MSBs)				1440
362	Sinusoidal Position - E (LSBs)				1444
363	Sinusoidal Position - N (MSBs)				1448
364	Sinusoidal Position - N (LSBs)				1452
365	Sinusoidal Position - U (MSBs)				1456
366	Sinusoidal Position - U (LSBs)				1460
367	Sinusoidal Velocity - E (MSBs)				1464
368	Sinusoidal Velocity - E (LSBs)				1468
369	Sinusoidal Velocity - N (MSBs)				1472
370	Sinusoidal Velocity - N (LSBs)				1476
371	Sinusoidal Velocity - U (MSBs)				1480
372	Sinusoidal Velocity - U (LSBs)				1484
373	Sinusoidal Acceleration - E (MSBs)				1488
374	Sinusoidal Acceleration - E (LSBs)				1492
375	Sinusoidal Acceleration - N (MSBs)				1496
376	Sinusoidal Acceleration - N (LSBs)				1500
377	Sinusoidal Acceleration - U (MSBs)				1504
378	Sinusoidal Acceleration - U (LSBs)				1508
379	Sinusoidal Jerk - E (MSBs)				1512
380	Sinusoidal Jerk - E (LSBs)				1516
381	Sinusoidal Jerk - N (MSBs)				1520

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
382	Sinusoidal Jerk - N (LSBs)				1524
383	Sinusoidal Jerk - U (MSBs)				1528
384	Sinusoidal Jerk - U (LSBs)				1532
385	Center of Gravity Yaw (MSBs)				1536
386	Center of Gravity Yaw (LSBs)				1540
387	Center of Gravity Pitch (MSBs)				1544
388	Center of Gravity Pitch (LSBs)				1548
389	Center of Gravity Roll (MSBs)				1552
390	Center of Gravity Roll (LSBs)				1556
391	Center of Gravity Yaw Rate (MSBs)				1560
392	Center of Gravity Yaw Rate (LSBs)				1564
393	Center of Gravity Pitch Rate (MSBs)				1568
394	Center of Gravity Pitch Rate (LSBs)				1572
395	Center of Gravity Roll Rate (MSBs)				1576
396	Center of Gravity Roll Rate (LSBs)				1580
397	Center of Gravity Yaw Acceleration (MSBs)				1584
398	Center of Gravity Yaw Acceleration (LSBs)				1588
399	Center of Gravity Pitch Acceleration (MSBs)				1592
400	Center of Gravity Pitch Acceleration (LSBs)				1596
401	Center of Gravity Roll Acceleration (MSBs)				1600
402	Center of Gravity Roll Acceleration (LSBs)				1604
403	Center of Gravity Yaw Jerk (MSBs)				1608
404	Center of Gravity Yaw Jerk (LSBs)				1612
405	Center of Gravity Pitch Jerk (MSBs)				1616
406	Center of Gravity Pitch Jerk (LSBs)				1620
407	Center of Gravity Roll Jerk (MSBs)				1624
408	Center of Gravity Roll Jerk (LSBs)				1628
409	Center of Gravity DCM RFU to ENU (1-1) (MSBs)				1632
410	Center of Gravity DCM RFU to ENU (1-1) (LSBs)				1636
411	Center of Gravity DCM RFU to ENU (2-1) (MSBs)				1640
...	...				...
426	Center of Gravity DCM RFU to ENU (3-3) (LSBs)				1700
427	Center of Gravity WTBT - E (MSBs)				1704
428	Center of Gravity WTBT - E (LSBs)				1708
429	Center of Gravity WTBT - N (MSBs)				1712
430	Center of Gravity WTBT - N (LSBs)				1716
431	Center of Gravity WTBT - U (MSBs)				1720

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
432	Center of Gravity WTBT - U (LSBs)				1724
433	Center of Gravity WTBT Rate - E (MSBs)				1728
434	Center of Gravity WTBT Rate -E (LSBs)				1732
435	Center of Gravity WTBT Rate -N (MSBs)				1736
436	Center of Gravity WTBT Rate -N (LSBs)				1740
437	Center of Gravity WTBT Rate -U (MSBs)				1744
438	Center of Gravity WTBT Rate - U (LSBs)				1748
439	Center of Gravity WTBT Acceleration -E (MSBs)				1752
440	Center of Gravity WTBT Acceleration - E (LSBs)				1756
441	Center of Gravity WTBT Acceleration -N (MSBs)				1760
442	Center of Gravity WTBT Acceleration -N (LSBs)				1764
443	Center of Gravity WTBT Acceleration - U (MSBs)				1768
444	Center of Gravity WTBT Acceleration - U (LSBs)				1772
445	Center of Gravity WEBT - E (MSBs)				1776
446	Center of Gravity WEBT - E (LSBs)				1780
447	Center of Gravity WEBT - N (MSBs)				1784
448	Center of Gravity WEBT - N (LSBs)				1788
449	Center of Gravity WEBT - U (MSBs)				1792
450	Center of Gravity WEBT - U (LSBs)				1796
451	Center of Gravity WEBT Rate - E (MSBs)				1800
452	Center of Gravity WEBT Rate - E (LSBs)				1804
453	Center of Gravity WEBT Rate - N (MSBs)				1808
454	Center of Gravity WEBT Rate - N (LSBs)				1812
455	Center of Gravity WEBT Rate - U (MSBs)				1816
456	Center of Gravity WEBT Rate - U (LSBs)				1820
457	Center of Gravity WEBT Acceleration - E (MSBs)				1824
458	Center of Gravity WEBT Acceleration - E (LSBs)				1828
459	Center of Gravity WEBT Acceleration - N (MSBs)				1832
460	Center of Gravity WEBT Acceleration - N (LSBs)				1836
461	Center of Gravity WEBT Acceleration - U (MSBs)				1840
462	Center of Gravity WEBT Acceleration - U (LSBs)				1844
463	Center of Gravity Latitude (MSBs)				1848
464	Center of Gravity Latitude (LSBs)				1852
465	Center of Gravity Longitude (MSBs)				1856
466	Center of Gravity Longitude (LSBs)				1860
467	Center of Gravity Altitude (MSBs)				1864
468	Center of Gravity Altitude (LSBs)				1868

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
469	Center of Gravity Latitude Rate (MSBs)				1872
470	Center of Gravity Latitude Rate (LSBs)				1876
471	Center of Gravity Longitude Rate (MSBs)				1880
472	Center of Gravity Longitude Rate (LSBs)				1884
473	Center of Gravity Altitude Rate (MSBs)				1888
474	Center of Gravity Altitude Rate (LSBs)				1892
475	Center of Gravity Latitude Acceleration (MSBs)				1896
476	Center of Gravity Latitude Acceleration (LSBs)				1900
477	Center of Gravity Longitude Acceleration (MSBs)				1904
478	Center of Gravity Longitude Acceleration (LSBs)				1908
479	Center of Gravity Altitude Acceleration (MSBs)				1912
480	Center of Gravity Altitude Acceleration (LSBs)				1916
481	Center of Gravity Latitude Jerk (MSBs)				1920
482	Center of Gravity Latitude Jerk (LSBs)				1924
483	Center of Gravity Longitude Jerk (MSBs)				1928
484	Center of Gravity Longitude Jerk (LSBs)				1932
485	Center of Gravity Altitude Jerk (MSBs)				1936
486	Center of Gravity Altitude Jerk (LSBs)				1940
487	Center of Gravity DCM EFG to ENU (1-1) (MSBs)				1944
488	Center of Gravity DCM EFG to ENU (1-1) (LSBs)				1948
489	Center of Gravity DCM EFG to ENU (2-1) (MSBs)				1952
...	...				...
504	Center of Gravity DCM EFG to ENU (3-3) (LSBs)				2012
505	Center of Gravity WETT - E (MSBs)				2016
506	Center of Gravity WETT - E (LSBs)				2020
507	Center of Gravity WETT - N (MSBs)				2024
508	Center of Gravity WETT - N (LSBs)				2028
509	Center of Gravity WETT - U (MSBs)				2032
510	Center of Gravity WETT - U (LSBs)				2036
511	Center of Gravity WETT Rate - E (MSBs)				2040
512	Center of Gravity WETT Rate - E (LSBs)				2044
513	Center of Gravity WETT Rate - N (MSBs)				2048
514	Center of Gravity WETT Rate - N (LSBs)				2052
515	Center of Gravity WETT Rate - U (MSBs)				2056
516	Center of Gravity WETT Rate - U (LSBs)				2060
517	Center of Gravity WETT Acceleration - E (MSBs)				2064
518	Center of Gravity WETT Acceleration - E (MSBs)				2068

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
519	Center of Gravity WETT Acceleration - N (MSBs)				2072
520	Center of Gravity WETT Acceleration - N (MSBs)				2076
521	Center of Gravity WETT Acceleration - U (MSBs)				2080
522	Center of Gravity WETT Acceleration - U (MSBs)				2084
523	Center of Gravity Velocity - E (MSBs)				2088
524	Center of Gravity Velocity - E (LSBs)				2092
525	Center of Gravity Velocity - N (MSBs)				2096
526	Center of Gravity Velocity - N (LSBs)				2100
527	Center of Gravity Velocity - U (MSBs)				2104
528	Center of Gravity Velocity - U (LSBs)				2108
529	Center of Gravity Acceleration - E (MSBs)				2112
530	Center of Gravity Acceleration - E (LSBs)				2116
531	Center of Gravity Acceleration - N (MSBs)				2120
532	Center of Gravity Acceleration - N (LSBs)				2124
533	Center of Gravity Acceleration - U (MSBs)				2128
534	Center of Gravity Acceleration - U (LSBs)				2132
535	Center of Gravity Jerk - E (MSBs)				2136
536	Center of Gravity Jerk - E (LSBs)				2140
537	Center of Gravity Jerk - N (MSBs)				2144
538	Center of Gravity Jerk - N (LSBs)				2148
539	Center of Gravity Jerk - U (MSBs)				2152
540	Center of Gravity Jerk - U (LSBs)				2156
541	Center of Gravity Position - E (MSBs)				2160
542	Center of Gravity Position - E (LSBs)				2164
543	Center of Gravity Position - F (MSBs)				2168
544	Center of Gravity Position - F (LSBs)				2172
545	Center of Gravity Position - G (MSBs)				2176
546	Center of Gravity Position - G (LSBs)				2180
547	Center of Gravity Velocity - E (MSBs)				2184
548	Center of Gravity Velocity - E (LSBs)				2188
549	Center of Gravity Velocity - F (MSBs)				2192
550	Center of Gravity Velocity - F (LSBs)				2196
551	Center of Gravity Velocity - G (MSBs)				2200
552	Center of Gravity Velocity - G (LSBs)				2204
553	Center of Gravity Acceleration - E (MSBs)				2208
554	Center of Gravity Acceleration - E (LSBs)				2212
555	Center of Gravity Acceleration - F (MSBs)				2216

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
556	Center of Gravity Acceleration - F (LSBs)				2220
557	Center of Gravity Acceleration - G (MSBs)				2224
558	Center of Gravity Acceleration - G (LSBs)				2228
559	Center of Gravity Jerk - E (MSBs)				2232
560	Center of Gravity Jerk - E (LSBs)				2236
561	Center of Gravity Jerk - F (MSBs)				2240
562	Center of Gravity Jerk - F (LSBs)				2244
563	Center of Gravity Jerk - G (MSBs)				2248
564	Center of Gravity Jerk - G (LSBs)				2252
565	Antenna Lever Arm - R (MSBs)				2256
566	Antenna Lever Arm - R (LSBs)				2260
567	Antenna Lever Arm - F (MSBs)				2264
568	Antenna Lever Arm - F (LSBs)				2268
569	Antenna Lever Arm - U (MSBs)				2272
570	Antenna Lever Arm - U (LSBs)				2276
571	Antenna Lever Arm - E (MSBs)				2280
572	Antenna Lever Arm - E (LSBs)				2284
573	Antenna Lever Arm - N (MSBs)				2288
574	Antenna Lever Arm - N (LSBs)				2292
575	Antenna Lever Arm - U (MSBs)				2296
576	Antenna Lever Arm - U (LSBs)				2300
577	Antenna Lever Arm - E (MSBs)				2304
578	Antenna Lever Arm - E (LSBs)				2308
579	Antenna Lever Arm - F (MSBs)				2312
580	Antenna Lever Arm - F (LSBs)				2316
581	Antenna Lever Arm - G (MSBs)				2320
582	Antenna Lever Arm - G (LSBs)				2324
583	Antenna Position - E (MSBs)				2328
584	Antenna Position - E (LSBs)				2332
585	Antenna Position - F (MSBs)				2336
586	Antenna Position - F (LSBs)				2340
587	Antenna Position - G (MSBs)				2344
588	Antenna Position - G (LSBs)				2348
589	Antenna Velocity - E (MSBs)				2352
590	Antenna Velocity - E (LSBs)				2356
591	Antenna Velocity - F (MSBs)				2360
592	Antenna Velocity - F (LSBs)				2364

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
593	Antenna Velocity - G (MSBs)				2368
594	Antenna Velocity - G (LSBs)				2372
595	Antenna Acceleration - E (MSBs)				2376
596	Antenna Acceleration - E (LSBs)				2380
597	Antenna Acceleration - F (MSBs)				2384
598	Antenna Acceleration - F (LSBs)				2388
599	Antenna Acceleration - G (MSBs)				2392
600	Antenna Acceleration - G (LSBs)				2396
601	Antenna Jerk - E (MSBs)				2400
602	Antenna Jerk - E (LSBs)				2404
603	Antenna Jerk - F (MSBs)				2408
604	Antenna Jerk - F (LSBs)				2412
605	Antenna Jerk - G (MSBs)				2416
606	Antenna Jerk - G (LSBs)				2420
607	Clock G-Sensitivity Vector - R (MSBs)				2424
608	Clock G-Sensitivity Vector - R (LSBs)				2428
609	Clock G-Sensitivity Vector - F (MSBs)				2432
610	Clock G-Sensitivity Vector - F (LSBs)				2436
611	Clock G-Sensitivity Vector - U (MSBs)				2440
612	Clock G-Sensitivity Vector - U (LSBs)				2444
613	Clock G-Sensitivity Vector - E (MSBs)				2448
614	Clock G-Sensitivity Vector - E (LSBs)				2452
615	Clock G-Sensitivity Vector - F (MSBs)				2456
616	Clock G-Sensitivity Vector - F (LSBs)				2460
617	Clock G-Sensitivity Vector - G (MSBs)				2464
618	Clock G-Sensitivity Vector - G (LSBs)				2468
619	Inertial Acceleration - E (MSBs)				2472
620	Inertial Acceleration - E (LSBs)				2476
621	Inertial Acceleration - F (MSBs)				2480
622	Inertial Acceleration - F (LSBs)				2484
623	Inertial Acceleration - G (MSBs)				2488
624	Inertial Acceleration - G (LSBs)				2492
625	Inertial Jerk - E (MSBs)				2496
626	Inertial Jerk - E (LSBs)				2500
627	Inertial Jerk - F (MSBs)				2504
628	Inertial Jerk - F (LSBs)				2508
629	Inertial Jerk - G (MSBs)				2512

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
630	Inertial Jerk - G (LSBs)				2516
631	G-Sensitivity Clock Bias (MSBs)				2520
632	G-Sensitivity Clock Bias (LSBs)				2524
633	G-Sensitivity Clock Drift (MSBs)				2528
634	G-Sensitivity Clock Drift (LSBs)				2532
635	G-Sensitivity Clock Drift Rate (MSBs)				2536
636	G-Sensitivity Clock Drift Rate (LSBs)				2540
637	Motion Structure Memory Start Pointer				2544
638	Motion Structure Memory Next Pointer				2548

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Vehicle ID	Vehicle number or antenna ID (for dual antenna vehicles) that this data is for		1 - 2	U	U*2
2	Spare	Spare			U	H*2
4	Spare	Spare			U	H*4
8	GPS Epoch Time	Time of GPS since GPS week 0, time 0	seconds	0 - (2048 * 604800)	U	R*8
16	Propagation Mode	0=Nav, 1=ENU, 2=EFG, 3=LLA		0 - 3	U	U*4
20	Motion Input Mode	0=Nav, 1=ENU, 2=EFG		0 - 2	U	U*4
24	Nominal Latitude	Nominal latitude of vehicle	radians		U	R*8
32	Nominal Longitude	Nominal longitude of vehicle	radians		U	R*8
40	Nominal Altitude	Nominal altitude of vehicle (WGS-84)	meters		U	R*8
48	Nominal Latitude Rate	Nominal latitude rate of vehicle	rad/sec		U	R*8
56	Nominal Longitude Rate	Nominal longitude rate of vehicle	rad/sec		U	R*8
64	Nominal Altitude Rate	Nominal altitude rate of vehicle	m/sec		U	R*8
72	Nominal Latitude Acceleration	Nominal latitude acceleration of vehicle	rad/sec^2		U	R*8
80	Nominal Longitude Acceleration	Nominal longitude acceleration of vehicle	rad/sec^2		U	R*8
88	Nominal Altitude Acceleration	Nominal altitude acceleration of vehicle	m/sec^2		U	R*8
96	Nominal Latitude Jerk	Nominal latitude jerk of vehicle	rad/sec^3		U	R*8
104	Nominal Longitude Jerk	Nominal longitude jerk of vehicle	rad/sec^3		U	R*8
112	Nominal Altitude Jerk	Nominal altitude jerk of vehicle	m/sec^3		U	R*8
120	Nominal DCM EFG to ENU	Direction cosine matrix from ECEF frame to Local Tangent Plane frame [(Row 1, Column 1) (R2,C1) (R3,C1) ... (R2,C3) (R3,C3)]			U	R*8 x9
192	Nominal WETT - (E,N,U)	Spin vector (angular velocity) (East, North, Up) of Local Tangent Plane frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec		U	R*8 x3

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
216	Nominal WETT Rate - (E,N,U)	Spin vector rate (angular acceleration) (East, North, Up) of Local Tangent Plane frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec^2		U	R*8 x3
240	Nominal WETT Acceleration - (E,N,U)	Spin vector acceleration (angular jerk) (East, North, Up) of Local Tangent Plane frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec^3		U	R*8 x3
264	Nominal Velocity - (E,N,U)	Nominal velocity (East, North, Up) in Local Tangent Plane frame	m/sec		U	R*8 x3
288	Nominal Acceleration - (E,N,U)	Nominal acceleration (East, North, Up) in Local Tangent Plane frame	m/sec^2		U	R*8 x3
312	Nominal Jerk - (E,N,U)	Nominal jerk (East, North, Up) in Local Tangent Plane frame	m/sec^3		U	R*8 x3
336	Nominal Heading	Heading of nominal velocity with respect to North	radians		U	R*8
344	Nominal Heading Rate	Heading rate of nominal motion	rad/sec		U	R*8
352	Nominal Heading Acceleration	Heading acceleration of nominal motion	rad/sec^2		U	R*8
360	Nominal Horizontal Velocity	Horizontal speed of nominal velocity in direction of heading	m/sec		U	R*8
368	Nominal Horizontal Acceleration	Horizontal acceleration component of nominal acceleration in direction of heading	m/sec^2		U	R*8
376	Nominal Horizontal Jerk	Horizontal jerk component of nominal jerk in direction of heading	m/sec^3		U	R*8
384	Nominal Position - (E,F,G)	Nominal position (E,F,G) of vehicle in ECEF	meters		U	R*8 x3
408	Nominal Velocity - (E,F,G)	Nominal velocity (E,F,G) of vehicle in ECEF	m/sec		U	R*8 x3
432	Nominal Acceleration - (E,F,G)	Nominal acceleration (E,F,G) of vehicle in ECEF	m/sec^2		U	R*8 x3
456	Nominal Jerk - (E,F,G)	Nominal jerk (E,F,G) of vehicle in ECEF	m/sec^3		U	R*8 x3
480	Nominal Yaw	Nominal yaw attitude of vehicle	radians		U	R*8
488	Nominal Pitch	Nominal pitch attitude of vehicle	radians		U	R*8
496	Nominal Roll	Nominal roll attitude of vehicle	radians		U	R*8
504	Nominal Yaw Rate	Nominal yaw rate attitude of vehicle	rad/sec		U	R*8
512	Nominal Pitch Rate	Nominal pitch rate attitude of vehicle	rad/sec		U	R*8
520	Nominal Roll Rate	Nominal roll rate attitude of vehicle	rad/sec		U	R*8
528	Nominal Yaw Acceleration	Nominal yaw acceleration of vehicle	rad/sec^2		U	R*8
536	Nominal Pitch Acceleration	Nominal pitch acceleration of vehicle	rad/sec^2		U	R*8
544	Nominal Roll Acceleration	Nominal roll acceleration of vehicle	rad/sec^2		U	R*8
552	Sinusoidal Attitude ‘On’	1 = Attitude sinusoidal motion is enabled		0 -1	U	U*4
556	Spare	Spare			U	H*4
560	Sinusoidal Yaw Component ‘On’	1 = Yaw component of sinusoidal motion is enabled		0 - 1	U	U*4

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
564	Spare	Spare			U	H*4
568	Sinusoidal Yaw Reference Elapsed Time	Time of last yaw sinusoidal motion update	seconds		U	R*8
576	Sinusoidal Yaw Amplitude	Amplitude of yaw sinusoidal motion	radians		U	R*8
584	Sinusoidal Yaw Amplitude * Angular Frequency	Amplitude of yaw sinusoidal motion multiplied by the yaw sinusoidal angular frequency	rad^2/sec		U	R*8
592	Sinusoidal Yaw Amplitude * Angular Frequency Squared	Amplitude of yaw sinusoidal motion multiplied by the yaw sinusoidal angular frequency squared	rad^3/sec^2		U	R*8
600	Sinusoidal Yaw Amplitude * Angular Frequency Cubed	Amplitude of yaw sinusoidal motion multiplied by the yaw sinusoidal angular frequency cubed	rad^4/sec^3		U	R*8
608	Sinusoidal Yaw Angular Frequency	Angular frequency of yaw sinusoidal motion	rad/sec		U	R*8
616	Sinusoidal Yaw Phase at Reference Time	Phase of yaw sinusoidal motion with respect to yaw reference time	radians		U	R*8
624	Sinusoidal Pitch Component ‘On’	1 = Pitch component of sinusoidal motion is enabled		0 - 1	U	U*4
628	Spare	Spare			U	H*4
632	Sinusoidal Pitch Reference Elapsed Time	Time of last pitch sinusoidal motion update	seconds		U	R*8
640	Sinusoidal Pitch Amplitude	Amplitude of pitch sinusoidal motion	radians		U	R*8
648	Sinusoidal Pitch Amplitude * Angular Frequency	Amplitude of pitch sinusoidal motion multiplied by the pitch sinusoidal angular frequency	rad^2/sec		U	R*8
656	Sinusoidal Pitch Amplitude * Angular Frequency Squared	Amplitude of pitch sinusoidal motion multiplied by the pitch sinusoidal angular frequency squared	rad^3/sec^2		U	R*8
664	Sinusoidal Pitch Amplitude * Angular Frequency Cubed	Amplitude of pitch sinusoidal motion multiplied by the pitch sinusoidal angular frequency cubed	rad^4/sec^3		U	R*8
672	Sinusoidal Pitch Angular Frequency	Angular frequency of pitch sinusoidal motion	rad/sec		U	R*8
680	Sinusoidal Pitch Phase at Reference Time	Phase of pitch sinusoidal motion with respect to pitch reference time	radians		U	R*8
688	Sinusoidal Roll Component ‘On’	1 = Roll component of sinusoidal motion is enabled		0 - 1	U	U*4
692	Spare	Spare			U	H*4
696	Sinusoidal Roll Reference Elapsed Time	Time of last roll sinusoidal motion update	seconds		U	R*8
704	Sinusoidal Roll Amplitude	Amplitude of roll sinusoidal motion	radians		U	R*8
712	Sinusoidal Roll Amplitude * Angular Frequency	Amplitude of roll sinusoidal motion multiplied by the roll sinusoidal angular frequency	rad^2/sec		U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
720	Sinusoidal Roll Amplitude * Angular Frequency Squared	Amplitude of roll sinusoidal motion multiplied by the roll sinusoidal angular frequency squared	rad^3/sec^2		U	R*8
728	Sinusoidal Roll Amplitude * Angular Frequency Cubed	Amplitude of roll sinusoidal motion multiplied by the roll sinusoidal angular frequency cubed	rad^4/sec^3		U	R*8
736	Sinusoidal Roll Angular Frequency	Angular frequency of roll sinusoidal motion	rad/sec		U	R*8
744	Sinusoidal Roll Phase at Reference Time	Phase of roll sinusoidal motion with respect to roll reference time	radians		U	R*8
752	Sinusoidal Yaw	Total sinusoidal yaw component	radians		U	R*8
760	Sinusoidal Pitch	Total sinusoidal pitch component	radians		U	R*8
768	Sinusoidal Roll	Total sinusoidal roll component	radians		U	R*8
776	Sinusoidal Yaw Rate	Total sinusoidal yaw rate	rad/sec		U	R*8
784	Sinusoidal Pitch Rate	Total sinusoidal pitch rate	rad/sec		U	R*8
792	Sinusoidal Roll Rate	Total sinusoidal roll rate	rad/sec		U	R*8
800	Sinusoidal Yaw Acceleration	Total sinusoidal yaw acceleration	rad/sec^2		U	R*8
808	Sinusoidal Pitch Acceleration	Total sinusoidal pitch acceleration	rad/sec^2		U	R*8
816	Sinusoidal Roll Acceleration	Total sinusoidal roll acceleration	rad/sec^2		U	R*8
824	Sinusoidal Yaw Jerk	Total sinusoidal yaw jerk	rad/sec^3		U	R*8
832	Sinusoidal Pitch Jerk	Total sinusoidal pitch jerk	rad/sec^3		U	R*8
840	Sinusoidal Roll Jerk	Total sinusoidal roll jerk	rad/sec^3		U	R*8
848	Sinusoidal RFU Body Motion 'On'	1 = Right/Forward/Up (Body) frame sinusoidal motion is enabled		0 - 1	U	U*4
852	Spare	Spare			U	H*4
856	Sinusoidal Body Right Component 'On'	1 = Right component of sinusoidal motion is enabled		0 - 1	U	U*4
860	Spare	Spare			U	H*4
864	Sinusoidal Body Right Reference Elapsed Time	Time of last right sinusoidal motion update	seconds		U	R*8
872	Sinusoidal Body Right Amplitude	Amplitude of right sinusoidal motion	meters		U	R*8
880	Sinusoidal Body Right Amplitude * Angular Frequency	Amplitude of right sinusoidal motion multiplied by the right sinusoidal angular frequency	m*rad /sec		U	R*8
888	Sinusoidal Body Right Amplitude * Angular Frequency Squared	Amplitude of right sinusoidal motion multiplied by the right sinusoidal angular frequency squared	$m*rad^2/sec^2$		U	R*8
896	Sinusoidal Body Right Amplitude * Angular Frequency Cubed	Amplitude of right sinusoidal motion multiplied by the right sinusoidal angular frequency cubed	$m*rad^3/sec^3$		U	R*8
904	Sinusoidal Body Right Angular Frequency	Angular frequency of right sinusoidal motion	rad/sec		U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
912	Sinusoidal Body Right Phase at Reference Time	Phase of right sinusoidal motion with respect to right reference time	radians		U	R*8
920	Sinusoidal Body Forward Component 'On'	1 = Forward component of sinusoidal motion is enabled		0 - 1	U	U*4
924	Spare	Spare			U	H*4
928	Sinusoidal Body Forward Reference Elapsed Time	Time of last forward sinusoidal motion update	seconds		U	R*8
936	Sinusoidal Body Forward Amplitude	Amplitude of forward sinusoidal motion	meters		U	R*8
944	Sinusoidal Body Forward Amplitude * Angular Frequency	Amplitude of forward sinusoidal motion multiplied by the forward sinusoidal angular frequency	m*rad /sec		U	R*8
952	Sinusoidal Body Forward Amplitude * Angular Frequency Squared	Amplitude of forward sinusoidal motion multiplied by the forward sinusoidal angular frequency squared	$m*rad^2$ $/sec^2$		U	R*8
960	Sinusoidal Body Forward Amplitude * Angular Frequency Cubed	Amplitude of forward sinusoidal motion multiplied by the forward sinusoidal angular frequency cubed	$m*rad^3$ $/sec^3$		U	R*8
968	Sinusoidal Body Forward Angular Frequency	Angular frequency of forward sinusoidal motion	rad/sec		U	R*8
976	Sinusoidal Body Forward Phase at Reference Time	Phase of forward sinusoidal motion with respect to forward reference time	radians		U	R*8
984	Sinusoidal Body Up Component 'On'	1 = Up component of sinusoidal motion is enabled		0 - 1	U	U*4
988	Spare	Spare			U	H*4
992	Sinusoidal Body Up Reference Elapsed Time	Time of last up sinusoidal motion update	seconds		U	R*8
1000	Sinusoidal Body Up Amplitude	Amplitude of up sinusoidal motion	meters		U	R*8
1008	Sinusoidal Body Up Amplitude * Angular Frequency	Amplitude of up sinusoidal motion multiplied by the up sinusoidal angular frequency	m*rad /sec		U	R*8
1016	Sinusoidal Body Up Amplitude * Angular Frequency Squared	Amplitude of up sinusoidal motion multiplied by the up sinusoidal angular frequency squared	$m*rad^2$ $/sec^2$		U	R*8
1024	Sinusoidal Body Up Amplitude * Angular Frequency Cubed	Amplitude of up sinusoidal motion multiplied by the up sinusoidal angular frequency cubed	$m*rad^3$ $/sec^3$		U	R*8
1032	Sinusoidal Body Up Angular Frequency	Angular frequency of up sinusoidal motion	rad/sec		U	R*8
1040	Sinusoidal Body Up Phase at Reference Time	Phase of up sinusoidal motion with respect to up reference time	radians		U	R*8
1048	Sinusoidal Body Position - (R,F,U)	Total body sinusoidal position contribution (Right, Forward, Up) in Body frame	meters		U	R*8 x3
1072	Sinusoidal Body Velocity - (R,F,U)	Total body sinusoidal velocity contribution (Right, Forward, Up) in Body frame	m/sec		U	R*8 x3
1096	Sinusoidal Body Acceleration - (R,F,U)	Total body sinusoidal acceleration (Right, Forward, Up) contribution in Body frame	m/sec^2		U	R*8 x3

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
1120	Sinusoidal Body Jerk - (R,F,U)	Total body sinusoidal jerk (Right, Forward, Up) contribution in Body frame	m/sec^3		U	R*8 x3
1144	Sinusoidal Body Position - (E,N,U)	Total body sinusoidal position contribution (East, North, Up) in Local Tangent Plane frame	meters		U	R*8 x3
1168	Sinusoidal Body Velocity - (E,N,U)	Total body sinusoidal velocity contribution (East, North, Up) in Local Tangent Plane frame	m/sec		U	R*8 x3
1192	Sinusoidal Body Acceleration - (E,N,U)	Total body sinusoidal acceleration contribution (East, North, Up) in Local Tangent Plane frame	m/sec^2		U	R*8 x3
1216	Sinusoidal Body Jerk - (E,N,U)	Total body sinusoidal jerk contribution (East, North, Up) in Local Tangent Plane frame	m/sec^3		U	R*8 x3
1240	Sinusoidal ENU Motion 'On'	1 = ENU (Local Tangent Plane) frame sinusoidal motion is enabled		0 - 1	U	U*4
1244	Spare	Spare			U	H*4
1248	Sinusoidal East Component 'On'	1 = East component of sinusoidal motion is enabled		0 - 1	U	U*4
1252	Spare	Spare			U	H*4
1256	Sinusoidal East Reference Elapsed Time	Time of last east sinusoidal motion update	seconds		U	R*8
1264	Sinusoidal East Amplitude	Amplitude of east sinusoidal motion	meters		U	R*8
1272	Sinusoidal East Amplitude * Angular Frequency	Amplitude of east sinusoidal motion multiplied by the east sinusoidal angular frequency	m*rad /sec		U	R*8
1280	Sinusoidal East Amplitude * Angular Frequency Squared	Amplitude of east sinusoidal motion multiplied by the east sinusoidal angular frequency squared	$m*rad^2 /sec^2$		U	R*8
1288	Sinusoidal East Amplitude * Angular Frequency Cubed	Amplitude of east sinusoidal motion multiplied by the east sinusoidal angular frequency cubed	$m*rad^3 /sec^3$		U	R*8
1296	Sinusoidal East Angular Frequency	Angular frequency of east sinusoidal motion	rad/sec		U	R*8
1304	Sinusoidal East Phase at Reference Time	Phase of east sinusoidal motion with respect to east reference time	radians		U	R*8
1312	Sinusoidal North Component 'On'	1 = North component of sinusoidal motion is enabled		0 - 1	U	U*4
1316	Spare	Spare			U	H*4
1320	Sinusoidal North Reference Elapsed Time	Time of last north sinusoidal motion update	seconds		U	R*8
1328	Sinusoidal North Amplitude	Amplitude of north sinusoidal motion	meters		U	R*8
1336	Sinusoidal North Amplitude * Angular Frequency	Amplitude of north sinusoidal motion multiplied by the forward sinusoidal angular frequency	m*rad /sec		U	R*8
1344	Sinusoidal North Amplitude * Angular Frequency Squared	Amplitude of north sinusoidal motion multiplied by the forward sinusoidal angular frequency squared	$m*rad^2 /sec^2$		U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
1352	Sinusoidal North Amplitude * Angular Frequency Cubed	Amplitude of north sinusoidal motion multiplied by the forward sinusoidal angular frequency cubed	$m*rad^3/sec^3$		U	R*8
1360	Sinusoidal North Angular Frequency	Angular frequency of north sinusoidal motion	rad/sec		U	R*8
1368	Sinusoidal North Phase at Reference Time	Phase of north sinusoidal motion with respect to forward reference time	radians		U	R*8
1376	Sinusoidal Up Component 'On'	1 = Up component of sinusoidal motion is enabled		0 - 1	U	U*4
1380	Spare	Spare			U	H*4
1384	Sinusoidal Up Reference Elapsed Time	Time of last up sinusoidal motion update	seconds		U	R*8
1392	Sinusoidal Up Amplitude	Amplitude of up sinusoidal motion	meters		U	R*8
1400	Sinusoidal Up Amplitude * Angular Frequency	Amplitude of up sinusoidal motion multiplied by the up sinusoidal angular frequency	m*rad /sec		U	R*8
1408	Sinusoidal Up Amplitude * Angular Frequency Squared	Amplitude of up sinusoidal motion multiplied by the up sinusoidal angular frequency squared	$m*rad^2/sec^2$		U	R*8
1416	Sinusoidal Up Amplitude * Angular Frequency Cubed	Amplitude of up sinusoidal motion multiplied by the up sinusoidal angular frequency cubed	$m*rad^3/sec^3$		U	R*8
1424	Sinusoidal Up Angular Frequency	Angular frequency of up sinusoidal motion	rad/sec		U	R*8
1432	Sinusoidal Up Phase at Reference Time	Phase of up sinusoidal motion with respect to up reference time	radians		U	R*8
1440	Sinusoidal Position - (E,N,U)	Total sinusoidal position contribution (East, North, Up)	meters		U	R*8 x3
1464	Sinusoidal Velocity - (E,N,U)	Total sinusoidal velocity contribution (East, North, Up)	m/sec		U	R*8 x3
1488	Sinusoidal Acceleration - (E,N,U)	Total sinusoidal acceleration contribution (East, North, Up)	m/sec^2		U	R*8 x3
1512	Sinusoidal Jerk - (E,N,U)	Total sinusoidal jerk contribution (East, North, Up)	m/sec^3		U	R*8 x3
1536	Center of Gravity Yaw	Yaw component of center of gravity motion	radians		U	R*8
1544	Center of Gravity Pitch	Pitch component of center of gravity motion	radians		U	R*8
1552	Center of Gravity Roll	Roll component of center of gravity motion	radians		U	R*8
1560	Center of Gravity Yaw Rate	Yaw rate of center of gravity motion	rad/sec		U	R*8
1568	Center of Gravity Pitch Rate	Pitch rate of center of gravity motion	rad/sec		U	R*8
1576	Center of Gravity Roll Rate	Roll rate of center of gravity motion	rad/sec		U	R*8
1584	Center of Gravity Yaw Acceleration	Yaw acceleration of center of gravity motion	rad/sec^2		U	R*8
1592	Center of Gravity Pitch Acceleration	Pitch acceleration of center of gravity motion	rad/sec^2		U	R*8
1600	Center of Gravity Roll Acceleration	Roll acceleration of center of gravity motion	rad/sec^2		U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
1608	Center of Gravity Yaw Jerk	Yaw jerk of center of gravity motion	rad/sec^3		U	R*8
1616	Center of Gravity Pitch Jerk	Pitch jerk of center of gravity motion	rad/sec^3		U	R*8
1624	Center of Gravity Roll Jerk	Roll jerk of center of gravity motion	rad/sec^3		U	R*8
1632	Center of Gravity DCM RFU to ENU	Center of gravity motion direction cosine matrix from Body frame to Local Tangent Plane frame [(Row 1, Column 1) (R2,C1) (R3,C1) ... (R2,C3) (R3,C3)]			U	R*8 x9
1704	Center of Gravity WTBT - (E,N,U)	Center of gravity spin vector (angular velocity) (East, North, Up) of Body frame with respect to Local Tangent Plane frame, represented in Local Tangent Plane frame	rad/sec		U	R*8 x3
1728	Center of Gravity WTBT Rate - (E,N,U)	Center of gravity spin vector rate (angular acceleration) (East, North, Up) of Body frame with respect to Local Tangent Plane frame, represented in Local Tangent Plane frame	rad/sec^2		U	R*8 x3
1752	Center of Gravity WTBT Acceleration - (E,N,U)	Center of gravity spin vector acceleration (angular jerk) (East, North, Up) of Body frame with respect to Local Tangent Plane frame, represented in Local Tangent Plane frame	rad/sec^3		U	R*8 x3
1776	Center of Gravity WEBT - (E,N,U)	Center of gravity spin vector (angular velocity) (East, North, Up) of Body frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec		U	R*8 x3
1800	Center of Gravity WEBT Rate - (E,N,U)	Center of gravity spin vector rate (angular acceleration) (East, North, Up) of Body frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec^2		U	R*8 x3
1824	Center of Gravity WEBT Acceleration - (E,N,U)	Center of gravity spin vector acceleration (angular jerk) (East, North, Up) of Body frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec^3		U	R*8 x3
1848	Center of Gravity Latitude	Latitude of vehicle center of gravity	radians		U	R*8
1856	Center of Gravity Longitude	Longitude of vehicle center of gravity	radians		U	R*8
1864	Center of Gravity Altitude	Altitude of vehicle center of gravity (WGS-84)	meters		U	R*8
1872	Center of Gravity Latitude Rate	Latitude rate of vehicle center of gravity	rad/sec		U	R*8
1880	Center of Gravity Longitude Rate	Longitude rate of vehicle center of gravity	rad/sec		U	R*8
1888	Center of Gravity Altitude Rate	Altitude rate of vehicle center of gravity	m/sec		U	R*8
1896	Center of Gravity Latitude Acceleration	Latitude of acceleration vehicle center of gravity	rad/sec^2		U	R*8
1904	Center of Gravity Longitude Acceleration	Longitude acceleration of vehicle center of gravity	rad/sec^2		U	R*8
1912	Center of Gravity Altitude Acceleration	Altitude acceleration of vehicle center of gravity	m/sec^2		U	R*8
1920	Center of Gravity Latitude Jerk	Latitude of jerk vehicle center of gravity	rad/sec^3		U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
1928	Center of Gravity Longitude Jerk	Longitude jerk of vehicle center of gravity	rad/sec^3		U	R*8
1936	Center of Gravity Altitude Jerk	Altitude jerk of vehicle center of gravity	m/sec^3		U	R*8
1944	Center of Gravity DCM EFG to ENU	Center of gravity direction cosine matrix from ECEF frame to Local Tangent Plane frame [(Row 1, Column 1) (R2,C1) (R3,C1) ... (R2,C3) (R3,C3)]			U	R*8 x9
2016	Center of Gravity WETT - (E,N,U)	Center of gravity spin vector (angular velocity) (East, North, Up) of Local Tangent Plane frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec		U	R*8 x3
2040	Center of Gravity WETT Rate - (E,N,U)	Center of gravity spin vector rate (angular acceleration) (East, North, Up) of Local Tangent Plane frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec^2		U	R*8 x3
2064	Center of Gravity WETT Acceleration - (E,N,U)	Center of gravity spin vector acceleration (angular jerk) (East, North, Up) of Local Tangent Plane frame with respect to ECEF frame, represented in Local Tangent Plane frame	rad/sec^3		U	R*8 x3
2088	Center of Gravity Velocity - (E,N,U)	Center of gravity velocity (East, North, Up) in Local Tangent Plane frame	m/sec		U	R*8 x3
2112	Center of Gravity Acceleration - (E,N,U)	Center of gravity acceleration (East, North, Up) in Local Tangent Plane frame	m/sec^2		U	R*8 x3
2136	Center of Gravity Jerk - (E,N,U)	Center of gravity jerk (East, North, Up) in Local Tangent Plane frame	m/sec^3		U	R*8 x3
2160	Center of Gravity Position - (E,F,G)	Position (E,F,G) of vehicle center of gravity	meters		U	R*8 x3
2184	Center of Gravity Velocity - (E,F,G)	Velocity (E,F,G) of vehicle center of gravity	m/sec		U	R*8 x3
2208	Center of Gravity Acceleration - (E,F,G)	Acceleration (E,F,G) of vehicle center of gravity	m/sec^2		U	R*8 x3
2232	Center of Gravity Jerk - (E,F,G)	Jerk (E,F,G) of vehicle center of gravity	m/sec^3		U	R*8 x3
2256	Antenna Lever Arm - (R,F,U)	Position offset (Right, Forward, Up) of antenna lever arm from vehicle center of gravity in Body frame	meters		U	R*8 x3
2280	Antenna Lever Arm - (E,N,U)	Position (East, North, Up) offset of antenna lever arm from vehicle center of gravity in Local Tangent Plane frame	meters		U	R*8 x3
2304	Antenna Lever Arm - (E,F,G)	Position offset (E,F,G) of antenna lever arm from vehicle center of gravity in ECEF frame	meters		U	R*8 x3
2328	Antenna Position - (E,F,G)	Antenna position (E,F,G) in ECEF frame	meters		U	R*8 x3
2352	Antenna Velocity - (E,F,G)	Antenna velocity (E,F,G) in ECEF frame	m/sec		U	R*8 x3
2376	Antenna Acceleration - (E,F,G)	Antenna acceleration (E,F,G) in ECEF frame	m/sec^2		U	R*8 x3
2400	Antenna Jerk - (E,F,G)	Antenna jerk (E,F,G) in ECEF frame	m/sec^3		U	R*8 x3
2424	Clock G-Sensitivity Vector - (R,F,U)	Receiver clock g-sensitivity (Right, Forward, Up) in Body frame	sec/sec/g		U	R*8 x3
2448	Clock G-Sensitivity Vector - (E,F,G)	Receiver clock g-sensitivity (E,F,G) in ECEF frame	sec/sec/g		U	R*8 x3

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
2472	Inertial Acceleration - (E,F,G)	Inertial acceleration (E,F,G) in ECEF frame	m/sec^2		U	R*8 x3
2496	Inertial Jerk - (E,F,G)	Inertial jerk (E,F,G) in ECEF frame	m/sec^3		U	R*8 x3
2520	G-Sensitive Clock Bias	Total clock bias due to g-sensitivity	sec/sec		U	R*8
2528	G-Sensitive Clock Drift	Total clock drift due to g-sensitivity	sec/sec^2		U	R*8
2536	G-Sensitive Clock Drift Rate	Total clock drift rate due to g-sensitivity	sec/sec^3		U	R*8
2544	Motion Structure Memory Start Pointer	Address pointer to SCS memory containing the first motion data point			U	H*4
2548	Motion Structure Memory Next Pointer	Address pointer to SCS memory containing the next motion data point			U	H*4

Note: Center of Gravity = Nominal + Sinusoidal

VEHICLE STATE VECTOR BLOCK

Record ID = 6055

This block has an identical format to the Ethernet output block of the same name (see **ETHERNET - OUTPUT FROM SCS** section [page 56]).

DIFFERENTIAL CORRECTIONS DATA BLOCK

Record ID = 6060 (RAP-LRIP)
6061 (RAP-ECP062)

This block has an identical format to the UMN/SCRAMNet output block of the same name (see **UMN/SCRAMNET - OUTPUT FROM SCS** section [page 136]) with the following contents:

Record ID	Differential Message Format	Differential Message*
6060	0 (= RAP-LRIP)	(see page 93)
6061	1 (= RAP-ECP062)	(see page 91)

* (see referenced page in **RS-422/485 - OUTPUT FROM SCS** section)

WAGE DATA BLOCK

Record ID = 6070

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Transmitter ID	Transmitter Type	Cutover Week		0
2	Cutover Time				4
3	NMCT Reference Time				8
4	Spare				12
5	AODO				16
6	Availability Indicator				20
7	SV #1 ERD	SV #2 ERD	SV #3 ERD	SV #4 ERD	24
...	...	...	...	...	...
14	SV #29 ERD	SV #30 ERD	SV #31 ERD	SV #32 ERD	52
15	System Classification		Spare		56
16	Spare				60

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Transmitter ID	Transmitter PRN number.		1 - 32	U	U*1
1	Transmitter Type	0=Satellite, 5=Satellite Spoofer		0 or 5	U	U*1
2	Cutover Week	GPS week number that this set of data took effect	weeks	0 - 2047	U	U*2
4	Cutover Time	GPS time of week that this set of data took effect	seconds	0 - 604799	U	U*4
8	NMCT Reference Time	True reference time of week of NMCT data -1 = No NMCT available	seconds	-1 - 604799	U	I*4
12	Spare 1	Spare				H*4
16	AODO	Age Of Data Offset reported in Nav message -1 = NMCT data is invalid	seconds	-1 - 30 LSB = 900	U	I*4
20	Availability Indicator	Nav message availability indicator bits 0 = NMCT data is unencrypted 1 = NMCT data is encrypted 2 = No NMCT data available 3 = Reserved		0-3	U	U*4
24	SV #n ERD	Estimated Range Deviation for SV #n in this NMCT -32 = No ERD for this SV in this NMCT (Note that ERD’s for the transmitting SV and SV 32 are not broadcast)	meters	-32 - 31 LSB = 0.3	S	I*1 x32
56	System Classification	Flags identifying which classified features of the SCS are installed/loaded: bit 0: 1 = PPSSMs installed bit 1: 1 = Keys loaded bit 2: 1 = Classified software loaded bit 3: 1 = Classified trajectory loaded		 0 - 1 0 - 1 0 - 1 0 - 1	U	H*2
58	Spare 2	Spare				H*2
60	Spare 3	Spare				H*4

FORMATTED ALMANAC DATA BLOCK

Record ID = 6080

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Almanac Record ID	Transmitter Type	Cutover Week		0
2	Cutover Time				4
3	Subframe 4 of Nav Message, Page 1, Word 1				8
4	Subframe 4 of Nav Message, Page 1, Word 2				12
...	...				...
251	Subframe 4 of Nav Message, Page 25, Word 9				1000
252	Subframe 4 of Nav Message, Page 25, Word 10				1004
253	Subframe 5 of Nav Message, Page 1, Word 1				1008
254	Subframe 5 of Nav Message, Page 1, Word 2				1012
...	...				...
501	Subframe 5 of Nav Message, Page 25, Word 9				2000
502	Subframe 5 of Nav Message, Page 25, Word 10				2004

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Almanac Record ID	ID indicating that this record contains almanac data = 0		0	U	U*1
1	Transmitter Type	0=SV's or GT's, 2=SV or GT Spoofers		0 or 2	U	U*1
2	Cutover Week	GPS week number that this set of data took effect	weeks	0 - 2047	U	U*2
4	Cutover Time	GPS time of week that this set of data took effect	seconds	0 - 604799	U	U*4
8	Subframe 4 of Nav Message	All 25 pages of subframe 4 of the navigation message, as defined in ICD-GPS-200/203. Page 1, word 1 is first, page 25, word 10 is last. Each 30 bit nav word is left justified in the 32 bit physical word.	See ICD-GPS-200	See ICD-GPS-200	U	H*4 x250
1008	Subframe 5 of Nav Message	All 25 pages of subframe 5 of the navigation message, as defined in ICD-GPS-200/203. Page 1, word 1 is first, page 25, word 10 is last. Each 30 bit nav word is left justified in the 32 bit physical word.	See ICD-GPS-200	See ICD-GPS-200	U	H*4 x250

Note: The 24 data bits of a word may be complemented, based on the value of the last parity bit of the previous word, as per section 20.3.5, figure 20-5 in ICD-GPS-200.

FORMATTED CLOCK/EPHEMERIS DATA BLOCK

Record ID = 6100 (Satellite)
6175 (Ground Transmitter)

LONG	BYTE 3	BYTE 2	BYTE 1	BYTE 0	BYTE
1	Transmitter ID	Transmitter Type	Cutover Week		0
2	Cutover Time				4
3	Telemetry Word				8
4	Handover Word				12
5	Subframe 1 of Nav Message, Word 1				16
...	...				...
14	Subframe 1 of Nav Message, Word 10				52
15	Subframe 2 of Nav Message, Word 1				56
...	...				...
24	Subframe 2 of Nav Message, Word 10				92
25	Subframe 3 of Nav Message, Word 1				96
...	...				...
34	Subframe 3 of Nav Message, Word 10				132
45	Subframe 4, Page 13 of Nav Message, Word 1				136
...	...				...
44	Subframe 4, Page 13 of Nav Message, Word 10				172

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Transmitter ID	Transmitter PRN number.		1 - 50	U	U*1
1	Transmitter Type	0=Satellite, 1=Ground Transmitter, 5=Satellite Spoofer, 6=GT Spoofer		0, 1, 5, or 6	U	U*1
2	Cutover Week	GPS week number that this set of data took effect	weeks	0 - 2047	U	U*2
4	Cutover Time	GPS time of week that this set of data took effect	seconds	0 - 604799	U	U*4
8	Telemetry Word	Telemetry word mask used to build the telemetry words for all subframes / pages of this satellite’s navigation message.	See ICD-GPS-200	See ICD-GPS-200	U	H*4
12	Handover Word	Handover word mask used to build the handover words for all subframes / pages of this satellite’s navigation message.	See ICD-GPS-200	See ICD-GPS-200	U	H*4
16	Subframe 1 of Nav Message	Subframe 1 of this satellite's nav message. Word 1 is first, word 10 is last. Each 30 bit nav word is left justified in the 32 bit physical word.	See ICD-GPS-200	See ICD-GPS-200	U	H*4 x10
56	Subframe 2 of Nav Message	Subframe 2 of this satellite's nav message. Format is the same as for subframe 1.	See ICD-GPS-200	See ICD-GPS-200	U	H*4 x10
96	Subframe 3 of Nav Message	Subframe 3 of this satellite's nav message. Format is the same as for subframe 1.	See ICD-GPS-200	See ICD-GPS-200	U	H*4 x10
136	Subframe 4, Page 13 of Nav Message	Subframe 4, page 13 of this satellite's nav message. Format is the same as for subframe 1.	See ICD-GPS-200	See ICD-GPS-200	U	H*4 x10

Note: The 24 data bits of a word may be complemented, based on the value of the last parity bit of the previous word, as per section 20.3.5, figure 20-5 in ICD-GPS-200.

FORMATTED APL MESSAGE DATA BLOCK

Record ID = 6180

LONG	BYTE 3	BYTE 2	BYTE 1	BYTE 0	BYTE
1	Transmitter ID	Transmitter Type	APL Code Delay		0
2	APL Message				4

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Transmitter ID	Transmitter PRN number.		1 - 37	U	U*1
1	Transmitter Type	1=Ground Transmitter, 6=GT Spoofer		0 or 6	U	U*1
2	APL Code Delay	Code delay (offset) of LAAS APL	minutes	1 - 10079	U	U*2
4	APL Message	Message broadcast by LAAS APL bits 31-7: 25 bit APL message bits 6-0: Spare			U	H*4

SCS STATUS BLOCK

Record ID = 6700

This block has an identical format to the Ethernet output block of the same name (see **ETHERNET - OUTPUT FROM SCS** section [page 59]).

TRANSMITTER RANGE DATA BLOCK

Record ID = 6710

This block has an identical format to the Ethernet output block of the same name (see **ETHERNET - OUTPUT FROM SCS** section [page 63]).

DOWNLINK DATA BLOCK

Record ID = 6720

This block has an identical format to the Ethernet output block of the same name (see **ETHERNET - OUTPUT FROM SCS** section [page 70]).

CHANNEL RANGE DATA BLOCK

Record ID = 6725
6726 (Broadband Jammer)

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time of Week (MSBs)				0
2	GPS Time of Week (LSBs)				4
3	GPS Epoch Time (MSBs)				8
4	GPS Epoch Time (LSBs)				12
5	Channel Number		Priority Number		16
6	Selection Number		Vehicle / Antenna ID		20
7	Antenna Pattern ID		APL Code Delay		24
8	Transmitter Index		Transmitter ID		28
9	Specific Transmitter Type		General Transmitter Type		32
10	Spoofer Type		Transmitter Frequency		36
11	Modulation Control		Multipath Type		40
12	Previous Channel Number		Bias Index		44
13	Summary Bits				48
14	Translator Flag		Spare		52
15	Calibration Path Delay (MSBs)				56
16	Calibration Path Delay (LSBs)				60
17	Calibration Path Gain (MSBs)				64
18	Calibration Path Gain (LSBs)				68
19	Calibration Crossover Delay (MSBs)				72
20	Calibration Crossover Delay (LSBs)				76
21	Calibration Crossover Gain (MSBs)				80
22	Calibration Crossover Gain (LSBs)				84
23	Latitude (MSBs)				88
24	Latitude (LSBs)				92
25	Longitude (MSBs)				96
26	Longitude (LSBs)				100
27	Altitude (MSBs)				104
28	Altitude (LSBs)				108
29	Antenna Position - E (MSBs)				112
30	Antenna Position - E (LSBs)				116
31	Antenna Position - F (MSBs)				120
32	Antenna Position - F (LSBs)				124
33	Antenna Position - G (MSBs)				128
34	Antenna Position - G (LSBs)				132

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
35	Antenna Velocity - E (MSBs)				136
36	Antenna Velocity - E (LSBs)				140
37	Antenna Velocity - F (MSBs)				144
38	Antenna Velocity - F (LSBs)				148
39	Antenna Velocity - G (MSBs)				152
40	Antenna Velocity - G (LSBs)				156
41	Antenna Acceleration - E (MSBs)				160
42	Antenna Acceleration - E (LSBs)				164
43	Antenna Acceleration - F (MSBs)				168
44	Antenna Acceleration - F (LSBs)				172
45	Antenna Acceleration - G (MSBs)				176
46	Antenna Acceleration - G (LSBs)				180
47	Antenna Jerk - E (MSBs)				184
48	Antenna Jerk - E (LSBs)				188
49	Antenna Jerk - F (MSBs)				192
50	Antenna Jerk - F (LSBs)				196
51	Antenna Jerk - G (MSBs)				200
52	Antenna Jerk - G (LSBs)				204
53	G-Sensitivity Clock Bias (MSBs)				208
54	G-Sensitivity Clock Bias (LSBs)				212
55	G-Sensitivity Clock Drift (MSBs)				216
56	G-Sensitivity Clock Drift (LSBs)				220
57	Satellite GPS Epoch Time (MSBs)				224
58	Satellite GPS Epoch Time (LSBs)				228
59	Satellite Position - E (MSBs)				232
60	Satellite Position - E (LSBs)				236
61	Satellite Position - F (MSBs)				240
62	Satellite Position - F (LSBs)				244
63	Satellite Position - G (MSBs)				248
64	Satellite Position - G (LSBs)				252
65	Satellite Velocity - E (MSBs)				256
66	Satellite Velocity - E (LSBs)				260
67	Satellite Velocity - F (MSBs)				264
68	Satellite Velocity - F (LSBs)				268
69	Satellite Velocity - G (MSBs)				272
70	Satellite Velocity - G (LSBs)				276
71	Satellite Clock Bias (MSBs)				280

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
72	Satellite Clock Bias (LSBs)				284
73	Satellite Clock Drift (MSBs)				288
74	Satellite Clock Drift (LSBs)				292
75	Satellite Group Delay (MSBs)				296
76	Satellite Group Delay (LSBs)				300
77	Dither Errors 1 (MSBs)				304
78	Dither Errors 1 (LSBs)				308
79	Dither Errors 2 (MSBs)				312
80	Dither Errors 2 (LSBs)				316
81	Geometric Range (MSBs)				320
82	Geometric Range (LSBs)				324
83	Geometric Range Rate (MSBs)				328
84	Geometric Range Rate (LSBs)				332
85	L2 Range Delta (MSBs)				336
86	L2 Range Delta (LSBs)				340
87	Multipath Range Delta (MSBs)				344
88	Multipath Range Delta (LSBs)				348
89	Transmitter Antenna Phase (MSBs)				352
90	Transmitter Antenna Phase (LSBs)				356
91	Vehicle Antenna Phase (MSBs)				360
92	Vehicle Antenna Phase (LSBs)				364
93	Ionospheric Delay (MSBs)				368
94	Ionospheric Delay (LSBs)				372
95	Tropospheric Delay (MSBs)				376
96	Tropospheric Delay (LSBs)				380
97	Pseudorange (MSBs)				384
98	Pseudorange (LSBs)				388
99	Carrier Pseudorange (MSBs)				392
100	Carrier Pseudorange (LSBs)				396
101	Previous Pseudorange (MSBs)				400
102	Previous Pseudorange (LSBs)				404
103	Previous Carrier Pseudorange (MSBs)				408
104	Previous Carrier Pseudorange (LSBs)				412
105	Pseudorange Rate (MSBs)				416
106	Pseudorange Rate (LSBs)				420
107	Downlink Carrier Pseudorange (MSBs)				424
108	Downlink Carrier Pseudorange (LSBs)				428

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
109	Previous Downlink Carrier Pseudorange (MSBs)				432
110	Previous Downlink Carrier Pseudorange (LSBs)				436
111	Code Delay (MSBs)				440
112	Code Delay (LSBs)				444
113	Azimuth (Local Tangent Plane Frame) (MSBs)				448
114	Azimuth (Local Tangent Plane Frame) (LSBs)				452
115	Elevation (Local Tangent Plane Frame) (MSBs)				456
116	Elevation (Local Tangent Plane Frame) (LSBs)				460
117	Azimuth (Body Frame) (MSBs)				464
118	Azimuth (Body Frame) (LSBs)				468
119	Elevation (Body Frame) (MSBs)				472
120	Elevation (Body Frame) (LSBs)				476
121	Terrain Visibility		Horizon Visibility		480
122	Vehicle Visibility		Transmitter Visibility		484
123	Overall Visibility		Spare		488
124	Reserved				492
125	Transmitter Power (MSBs)				496
126	Transmitter Power (LSBs)				500
127	Transmitter Antenna Gain (MSBs)				504
128	Transmitter Antenna Gain (LSBs)				508
129	Path Loss (MSBs)				512
130	Path Loss (LSBs)				516
131	Vehicle Signal Power (MSBs)				520
132	Vehicle Signal Power (LSBs)				524
133	Receiver Antenna Gain (MSBs)				528
134	Receiver Antenna Gain (LSBs)				532
135	Received Signal Power (MSBs)				536
136	Received Signal Power (LSBs)				540
137	Code User Defined Bias (MSBs)				544
138	Code User Defined Bias (LSBs)				548
139	Carrier User Defined Bias (MSBs)				552
140	Carrier User Defined Bias (LSBs)				556
141	Power User Defined Bias (MSBs)				560
142	Power User Defined Bias (LSBs)				564

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time of Week	GPS time of week that this set of data is valid for (time of reception of signal)	seconds	0 - 604800	U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
8	GPS Epoch Time	Time of GPS since GPS week 0, time 0	seconds	0 - (2048 * 604800)	U	R*8
16	Channel Number	Hardware channel number this transmitter is assigned to		0 - 23	U	U*2
18	Priority Number	Selection number on the input priority list that this assignment corresponds to		1 - 100	U	U*2
20	Selection Number	The order that this assignment was made in channel assignments		1 - 24	U	U*2
22	Vehicle / Antenna ID	Vehicle number or antenna ID (for dual antenna vehicles) that this transmitter is output on		1 - 2	U	U*2
24	Antenna Pattern ID	ID of the antenna pattern currently in use for the vehicle/antenna identified above		0 - 9	U	U*2
26	APL Code Delay	Code delay (offset) of LAAS APL. Not applicable to any non-APL transmitter.	minutes	1 - 10079	U	U*2
28	Transmitter Index	Internal index used for transmitters. Number is 1 less than the ID, and spoofer indices start after the non-spoofer indices (i.e. SV spoofer 1 corresponds to transmitter index 32).		0 - 73	U	U*2
30	Transmitter ID	Actual transmitter ID. Spoofers and non-spoofers all start at ID 1.		1 - 50	U	U*2
32	Specific Transmitter Type	Specific type of transmitter being simulated on this channel: 0=SV, 1=GT, 2=SV Spoofer, 3=GT Spoofer, 4=CW Jammer, 5=Pulsed Jammer, 6=Broadband Jammer		0 - 6	U	U*2
34	General Transmitter Type	General type of transmitter being simulated on this channel: 0=SV, 1=GT, 2=CW Jammer, 3=Pulsed Jammer, 4=Broadband Jammer, 5=Unassigned		0 - 5	U	U*2
36	Spoofer Type	0=Nonspoofer, 1=Spoofer		0 - 1	U	U*2
38	Transmitter Frequency	0=L1, 1=L2		0 - 1	U	U*2
40	Modulation Control	0=C/A and P code with Nav message, 1=P code with Nav message, 2=CW only, 3=C/A and Y code with Nav message, 4=Y code with Nav message		0 - 4	U	U*2
42	Multipath Type	Type of multipath being simulated on this channel: 0=no multipath, 1=Earth multipath, 2=Vehicle multipath		0 - 2	U	U*2
44	Previous Channel Number	Channel number this assignment was assigned to in the previous channel assignment period		0 - 23	U	U*2
46	Bias Index	Index into table of user defined biases			U	U*2
48	Summary Bits	Combined summary of channel assignment:			U	H*4
		bits 31-24: Channel Number		0 - 23		
		bits 23-21: General Transmitter Type		0 - 5		
		bit 21: Spoofer Type		0 - 1		
		bits 19-16: Modulation Control		0 - 4		
		bits 15-12: Antenna Pattern ID		0 - 9		
		bit 11: Vehicle/Antenna ID - 1		0 - 1		
		bit 10: Transmitter Frequency		0 - 1		
		bits 9-8: Multipath Type		0 - 2		
		bits 7-0: Transmitter ID		1 - 50		
52	Translator Flag	1 = Vehicle is a GPS translator		0 - 1	U	U*2
54	Spare	Spare			U	H*2
56	Calibration Path Delay	Hardware channel calibration path delay based on the assignment made to this channel	meters		U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
64	Calibration Path Gain	Hardware channel calibration path gain	dB		U	R*8
72	Calibration Crossover Delay	Hardware channel calibration crossover delay	meters		U	R*8
80	Calibration Crossover Gain	Hardware channel calibration crossover gain	dB		U	R*8
88	Latitude	Latitude of the vehicle center of gravity	radians		U	R*8
96	Longitude	Longitude of the vehicle center of gravity	radians		U	R*8
104	Altitude	WGS-84 altitude of the vehicle center of gravity	meters		U	R*8
112	Antenna Position - (E,F,G)	ECEF position (E,F,G) of the antenna based on the input antenna lever arm offset from the center of gravity	meters		U	R*8 x3
136	Antenna Velocity - (E,F,G)	ECEF velocity (E,F,G) of the antenna	m/sec		U	R*8 x3
160	Antenna Acceleration - (E,F,G)	ECEF acceleration (E,F,G) of the antenna	m/sec^2		U	R*8 x3
184	Antenna Jerk - (E,F,G)	ECEF jerk (E,F,G) of the antenna	m/sec^3		U	R*8 x3
208	G-Sensitivity Clock Bias	Clock bias caused by receiver clock G-sensitivity	seconds		U	R*8
216	G-Sensitivity Clock Drift	Clock drift caused by receiver clock G-sensitivity	sec/sec		U	R*8
224	Satellite GPS Epoch Time	Time of GPS since week 0 that the satellite state vector is valid for	seconds	0 - (2048 * 604800)	U	R*8
232	Satellite Position - (E,F,G)	ECEF position (E,F,G) of the satellite	meters		S	R*8 x3
256	Satellite Velocity - (E,F,G)	ECEF velocity (E,F,G) of the satellite	m/sec		S	R*8 x3
280	Satellite Clock Bias	Clock bias based on input truth SV clock parameters	seconds		S	R*8
288	Satellite Clock Drift	Clock drift based on input truth SV clock parameters	sec/sec		S	R*8
296	Satellite Group Delay	Group delay term from truth SV clock parameters	seconds		U	R*8
304	Dither Errors 1	Transmitter clock dither error - term 1	meters		S	R*8
312	Dither Errors 2	Transmitter clock dither error - term 2	meters		S	R*8
320	Geometric Range	Geometric range from antenna to transmitter	meters		S	R*8
328	Geometric Range Rate	Geometric range rate from antenna to transmitter	m/sec		S	R*8
336	L2 Range Delta	Delta to Geometric Range for L2 frequency	meters		U	R*8
344	Multipath Range Delta	Delta to Geometric Range for multipath transmission path	meters		U	R*8
352	Transmitter Antenna Phase	Not currently used	meters		U	R*8
360	Vehicle Antenna Phase	Phase delay due to receivers antenna	meters		U	R*8
368	Ionospheric Delay	Signal delay due to the ionosphere	seconds		U	R*8
376	Tropospheric Delay	Signal delay due to the troposphere	seconds		U	R*8
384	Pseudorange	Pseudorange from vehicle to transmitter	meters		S	R*8
392	Carrier Pseudorange	Pseudorange from vehicle to transmitter used to generate the signal carrier	meters		S	R*8
400	Previous Pseudorange	Pseudorange from the last time this data was generated	meters		S	R*8
408	Previous Carrier Pseudorange	Carrier Pseudorange from the last time this data was generated	meters		S	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
416	Pseudorange Rate	Rate of change of Pseudorange	m/sec		U	R*8
424	Downlink Carrier Pseudorange	Combined carrier pseudorange for both uplink and downlink. This data is valid only if Translator Flag equals 1.	meters		S	R*8
432	Previous Downlink Carrier Pseudorange	Combined carrier pseudorange for both uplink and downlink generated the last time this data was generated. This data is valid only if Translator Flag equals 1.	meters		S	R*8
440	Code Delay	Pseudorange expressed in seconds	seconds		S	R*8
448	(Local Tangent Plane Frame)	Relative azimuth from vehicle to transmitter in the Local Tangent Plane frame	radians	-π/2 - π/2	U	R*8
456	Elevation (Local Tangent Plane Frame)	Relative elevation from vehicle to transmitter in the Local Tangent Plane frame	radians	-π - π	U	R*8
464	Azimuth (Body Frame)	Relative azimuth from vehicle to transmitter in the Body frame	radians	-π/2 - π/2	U	R*8
472	Elevation (Body Frame)	Relative elevation from vehicle to transmitter in the Body frame	radians	-π - π	U	R*8
480	Terrain Visibility	1 = Line of sight from antenna to transmitter is not blocked by the terrain map		0 - 1	U	U*2
482	Horizon Visibility	1 = Line of sight from antenna to transmitter is not blocked by the earth		0 - 1	U	U*2
484	Vehicle Visibility	1 = Line of sight from antenna to transmitter is not blocked by the vehicle's antenna		0 - 1	U	U*2
486	Transmitter Visibility	1 = Line of sight from antenna to transmitter is not blocked by the transmitter's antenna		0 - 1	U	U*2
488	Overall Visibility	1 = Line of sight from antenna to transmitter is not blocked by anything (combination of all above flags)		0 - 1	U	U*2
490	Spare	Spare			U	H*2
492	Reserved	Reserved for internal SCS use			U	H*4
496	Transmitter Power	Signal power output from the antenna of the transmitter	dBm		U	R*8
504	Transmitter Antenna Gain	Signal gain due to the antenna of the transmitter	dB		U	R*8
512	Path Loss	Includes multipath and other losses	dB		U	R*8
520	Vehicle Signal Power	Signal power input to the antenna of the receive	dBm		U	R*8
528	Receiver Antenna Gain	Signal gain due to the antenna of the receiver	dB		U	R*8
536	Received Signal Power	Signal power output from the antenna of the receiver	dBm		U	R*8
544	Code User Defined Bias	Current user defined bias included in pseudorange	meters		U	R*8
552	Carrier User Defined Bias	Current user defined bias included in carrier pseudorange	meters		U	R*8
560	Power User Defined Bias	Current user defined bias included in signal power	dBm		U	R*8

TRANSMITTER STATE VECTOR INTERPOLATION DATA BLOCK

Record ID = 6730

This block has an identical format to the Ethernet output block of the same name (see **ETHERNET - OUTPUT FROM SCS** section [page 71]).

DOWNLINK RANGE DATA BLOCK

Record ID = 6760

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	GPS Time of Week (MSBs)				0
2	GPS Time of Week (LSBs)				4
3	GPS Epoch Time (MSBs)				8
4	GPS Epoch Time (LSBs)				12
5	Processor Number		Antenna Pattern Index		16
6	Downlink Horizon Visibility		Downlink Range Visibility		20
7	Downlink Terrain Visibility		Downlink EMP Visibility		24
8	Downlink VMP Visibility		Downlink Overall Visibility		28
9	Vehicle 1 Latitude (MSBs)				32
10	Vehicle 1 Latitude (LSBs)				36
11	Vehicle 1 Longitude (MSBs)				40
12	Vehicle 1 Longitude (LSBs)				44
13	Vehicle 1 Altitude (MSBs)				48
14	Vehicle 1 Altitude (LSBs)				52
15	Vehicle 1 Antenna Position - E (MSBs)				56
16	Vehicle 1 Antenna Position - E (LSBs)				60
17	Vehicle 1 Antenna Position - F (MSBs)				64
18	Vehicle 1 Antenna Position - F (LSBs)				68
19	Vehicle 1 Antenna Position - G (MSBs)				72
20	Vehicle 1 Antenna Position - G (LSBs)				76
21	Vehicle 1 Antenna Velocity - E (MSBs)				80
22	Vehicle 1 Antenna Velocity - E (LSBs)				84
23	Vehicle 1 Antenna Velocity - F (MSBs)				88
24	Vehicle 1 Antenna Velocity - F (LSBs)				92
25	Vehicle 1 Antenna Velocity - G (MSBs)				92
26	Vehicle 1 Antenna Velocity - G (LSBs)				100
27	Vehicle 1 Antenna Acceleration - E (MSBs)				104
28	Vehicle 1 Antenna Acceleration - E (LSBs)				108
29	Vehicle 1 Antenna Acceleration - F (MSBs)				112
30	Vehicle 1 Antenna Acceleration - F (LSBs)				116
31	Vehicle 1 Antenna Acceleration - G (MSBs)				120
32	Vehicle 1 Antenna Acceleration - G (LSBs)				124
33	Vehicle 1 Antenna Jerk - E (MSBs)				128
34	Vehicle 1 Antenna Jerk - E (LSBs)				132
35	Vehicle 1 Antenna Jerk - F (MSBs)				136

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
36	Vehicle 1 Antenna Jerk - F (LSBs)				140
37	Vehicle 1 Antenna Jerk - G (MSBs)				144
38	Vehicle 1 Antenna Jerk - G (LSBs)				148
39	Vehicle 1 Clock Bias (MSBs)				152
40	Vehicle 1 Clock Bias (LSBs)				156
41	Vehicle 1 Clock Drift (MSBs)				160
42	Vehicle 1 Clock Drift (LSBs)				164
43	Vehicle 2 Latitude (MSBs)				168
44	Vehicle 2 Latitude (LSBs)				172
45	Vehicle 2 Longitude (MSBs)				176
46	Vehicle 2 Longitude (LSBs)				180
47	Vehicle 2 Altitude (MSBs)				184
48	Vehicle 2 Altitude (LSBs)				188
49	Vehicle 2 Antenna Position - E (MSBs)				192
50	Vehicle 2 Antenna Position - E (LSBs)				196
51	Vehicle 2 Antenna Position - F (MSBs)				200
52	Vehicle 2 Antenna Position - F (LSBs)				204
53	Vehicle 2 Antenna Position - G (MSBs)				208
54	Vehicle 2 Antenna Position - G (LSBs)				212
55	Vehicle 2 Antenna Velocity - E (MSBs)				216
56	Vehicle 2 Antenna Velocity - E (LSBs)				220
57	Vehicle 2 Antenna Velocity - F (MSBs)				224
58	Vehicle 2 Antenna Velocity - F (LSBs)				228
59	Vehicle 2 Antenna Velocity - G (MSBs)				232
60	Vehicle 2 Antenna Velocity - G (LSBs)				236
61	Vehicle 2 Antenna Acceleration - E (MSBs)				240
62	Vehicle 2 Antenna Acceleration - E (LSBs)				244
63	Vehicle 2 Antenna Acceleration - F (MSBs)				248
64	Vehicle 2 Antenna Acceleration - F (LSBs)				252
65	Vehicle 2 Antenna Acceleration - G (MSBs)				256
66	Vehicle 2 Antenna Acceleration - G (LSBs)				260
67	Vehicle 2 Antenna Jerk - E (MSBs)				264
68	Vehicle 2 Antenna Jerk - E (LSBs)				268
69	Vehicle 2 Antenna Jerk - F (MSBs)				272
70	Vehicle 2 Antenna Jerk - F (LSBs)				276
71	Vehicle 2 Antenna Jerk - G (MSBs)				280
72	Vehicle 2 Antenna Jerk - G (LSBs)				284

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
73	Vehicle 2 Clock Bias (MSBs)				288
74	Vehicle 2 Clock Bias (LSBs)				292
75	Vehicle 2 Clock Drift (MSBs)				296
76	Vehicle 2 Clock Drift (LSBs)				300
77	Iono Altitude Factor (MSBs)				304
78	Iono Altitude Factor (LSBs)				308
79	Vehicle 2 Antenna Position At Time Of Translation - E (MSBs)				312
80	Vehicle 2 Antenna Position At Time Of Translation - E (MSBs)				316
81	Vehicle 2 Antenna Position At Time Of Translation - F (MSBs)				320
82	Vehicle 2 Antenna Position At Time Of Translation - F (MSBs)				324
83	Vehicle 2 Antenna Position At Time Of Translation - G (MSBs)				328
84	Vehicle 2 Antenna Position At Time Of Translation - G (MSBs)				332
85	Vehicle 2 Antenna Velocity At Time Of Translation - E (MSBs)				336
86	Vehicle 2 Antenna Velocity At Time Of Translation - E (MSBs)				340
87	Vehicle 2 Antenna Velocity At Time Of Translation - F (MSBs)				344
88	Vehicle 2 Antenna Velocity At Time Of Translation - F (MSBs)				348
89	Vehicle 2 Antenna Velocity At Time Of Translation - G (MSBs)				352
90	Vehicle 2 Antenna Velocity At Time Of Translation - G (MSBs)				356
91	Downlink Geometric Range (MSBs)				360
92	Downlink Geometric Range (LSBs)				364
93	Downlink Geometric Range Rate (MSBs)				368
94	Downlink Geometric Range Rate (LSBs)				372
95	Downlink EMP Range Delta (MSBs)				376
96	Downlink EMP Range Delta (LSBs)				380
97	Downlink VMP Range Delta (MSBs)				384
98	Downlink VMP Range Delta (LSBs)				388
99	Downlink Ionospheric Delay (MSBs)				392
100	Downlink Ionospheric Delay (LSBs)				396
101	Downlink Tropospheric Delay (MSBs)				400
102	Downlink Tropospheric Delay (LSBs)				404
103	Downlink Delays (MSBs)				408
104	Downlink Delays (LSBs)				412
105	Azimuth (Local Tangent Plane Frame) (MSBs)				416
106	Azimuth (Local Tangent Plane Frame) (LSBs)				420
107	Elevation (Local Tangent Plane Frame) (MSBs)				424
108	Elevation (Local Tangent Plane Frame) (LSBs)				428
109	Azimuth (Body Frame) (MSBs)				432

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
110	Azimuth (Body Frame) (LSBs)				436
111	Elevation (Body Frame) (MSBs)				440
112	Elevation (Body Frame) (LSBs)				444
113	Downlink Pseudorange (MSBs)				448
114	Downlink Pseudorange (LSBs)				452
115	Downlink Carrier Pseudorange (MSBs)				456
116	Downlink Carrier Pseudorange (LSBs)				460
117	Previous Downlink Pseudorange (MSBs)				464
118	Previous Downlink Pseudorange (LSBs)				468
119	Downlink Pseudorange Rate (MSBs)				472
120	Downlink Pseudorange Rate (LSBs)				476
121	Translator Multiplier Epsilon Phase L1 (MSBs)				480
122	Translator Multiplier Epsilon Phase L1 (LSBs)				484
123	Translator Multiplier Epsilon Phase L2 (MSBs)				488
124	Translator Multiplier Epsilon Phase L2 (LSBs)				492
125	VMP Receiver Antenna Gain Delta (MSBs)				496
126	VMP Receiver Antenna Gain Delta (LSBs)				500
127	EMP Loss (MSBs)				504
128	EMP Loss (LSBs)				508
129	Antenna Switch Frequency				512
130	Pilot Carrier Control Frequency				516

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	GPS Time of Week	GPS time of week that this set of data is valid for (time of reception of signal)	seconds	0 - 604800	U	R*8
8	GPS Epoch Time	Time of GPS since GPS week 0, time 0	seconds	0 - (2048 * 604800)	U	R*8
16	Processor Number	Processor (SGC) which generated this data		1 - 3	U	U*2
18	Antenna Pattern Index	Index of the antenna pattern currently in use for vehicle		0 - 9	U	U*2
20	Downlink Horizon Visibility	1 = Line of sight from GPS translator to tracking antenna is not blocked by the earth		0 - 1	U	U*2
22	Downlink Range Visibility	1 = GPS translator is with 60 km of tracking antenna		0 - 1	U	U*2
24	Downlink Terrain Visibility	1 = Line of sight from GPS translator to tracking antenna is not blocked by the terrain map		0 - 1	U	U*2
26	Downlink EMP Visibility	1 = Transmission path from GPS translator to tracking antenna with a single bounce off a spherical earth is not blocked		0 - 1	U	U*2
28	Downlink VMP Visibility	1 = Transmission path from GPS translator to tracking antenna with a single bounce off the tracking vehicle is not blocked		0 - 1	U	U*2

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
30	Downlink Overall Visibility	1 = Direct transmission path from GPS translator to tracking antenna is not blocked		0 - 1	U	U*2
32	Vehicle 1 Latitude	Latitude of the vehicle 1 center of gravity	radians		U	R*8
40	Vehicle 1 Longitude	Longitude of the vehicle 1 center of gravity	radians		U	R*8
48	Vehicle 1 Altitude	WGS-84 altitude of the vehicle 1 center of gravity	meters		U	R*8
56	Vehicle 1 Antenna Position - (E,F,G)	ECEF position (E,F,G) of the vehicle 1 antenna based on the input antenna lever arm offset from the center of gravity	meters		U	R*8 x3
80	Vehicle 1 Antenna Velocity - (E,F,G)	ECEF velocity (E,F,G) of the vehicle 1 antenna	m/sec		U	R*8 x3
104	Vehicle 1 Antenna Acceleration - (E,F,G)	ECEF acceleration (E,F,G) of the vehicle 1 antenna	m/sec^2		U	R*8 x3
128	Vehicle 1 Antenna Jerk - (E,F,G)	ECEF jerk (E,F,G) of the vehicle 1 antenna	m/sec^3		U	R*8 x3
152	Vehicle 1 Clock Bias	Time bias of the vehicle 1 receiver clock	seconds		U	R*8
160	Vehicle 1 Clock Drift	Rate of change of the time bias of the vehicle 1 receiver clock	sec/sec		U	R*8
168	Vehicle 2 Latitude	Latitude of the vehicle 2 center of gravity	radians		U	R*8
176	Vehicle 2 Longitude	Longitude of the vehicle 2 center of gravity	radians		U	R*8
184	Vehicle 2 Altitude	WGS-84 altitude of the vehicle 2 center of gravity	meters		U	R*8
192	Vehicle 2 Antenna Position - (E,F,G)	ECEF position (E,F,G) of the vehicle 2 antenna based on the input antenna lever arm offset from the center of gravity	meters		U	R*8 x3
216	Vehicle 2 Antenna Velocity - (E,F,G)	ECEF velocity (E,F,G) of the vehicle 2 antenna	m/sec		U	R*8 x3
240	Vehicle 2 Antenna Acceleration - (E,F,G)	ECEF acceleration (E,F,G) of the vehicle 2 antenna	m/sec^2		U	R*8 x3
264	Vehicle 2 Antenna Jerk - (E,F,G)	ECEF jerk (E,F,G) of the vehicle 2 antenna	m/sec^3		U	R*8 x3
288	Vehicle 2 Clock Bias	Time bias of the vehicle 2 receiver clock	seconds		U	R*8
296	Vehicle 2 Clock Drift	Rate of change of the time bias of the vehicle 2 receiver clock	sec/sec		U	R*8
304	Iono Altitude Factor	Not currently used			U	R*8
312	Vehicle 2 Antenna Position At Time Of Translation - (E,F,G)	ECEF position (E,F,G) of vehicle 2 antenna at the time at which GPS translation occurred	m/sec		U	R*8 x3
336	Vehicle 2 Antenna Velocity At Time Of Translation - (E,F,G)	ECEF velocity (E,F,G) of vehicle 2 antenna at the time at which GPS translation occurred	m/sec^2		U	R*8 x3
360	Downlink Geometric Range	Geometric range from vehicle 1 antenna to vehicle 2 antenna	meters		U	R*8
368	Downlink Geometric Range Rate	Geometric range rate from vehicle 1 antenna to vehicle 2 antenna	m/sec		U	R*8
376	Downlink EMP Range Delta	Delta to Downlink Geometric Range for Earth Multipath transmission path with a single bounce off a spherical earth	meters		U	R*8
384	Downlink VMP Range Delta	Delta to Downlink Geometric Range for Vehicle Multipath transmission path with a single bounce off the tracking vehicle	meters		U	R*8

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
392	Downlink Ionospheric Delay	Not currently used			U	R*8
400	Downlink Tropospheric Delay	Not currently used			U	R*8
408	Downlink Delays	Signal path delay from vehicle 2 to vehicle 1 including internal translator delay	seconds		U	R*8
416	Azimuth (Local Tangent Plane Frame)	Relative azimuth from vehicle 1 to vehicle 2 in the Local Tangent Plane frame	radians		U	R*8
424	Elevation (Local Tangent Plane Frame)	Relative elevation from vehicle 1 to vehicle 2 in the Local Tangent Plane frame	radians		U	R*8
432	Azimuth (Body Frame)	Relative azimuth from vehicle 1 to vehicle 2 in the vehicle 1 Body frame	radians		U	R*8
440	Elevation (Body Frame)	Relative elevation from vehicle 1 to vehicle 2 in the vehicle 1 Body frame	radians		U	R*8
448	Downlink Pseudorange	Pseudo range from vehicle 1 to vehicle 2	meters		U	R*8
456	Downlink Carrier Pseudorange	Pseudorange from vehicle 1 to vehicle 2 used to generate the signal carrier	meters		U	R*8
464	Previous Downlink Pseudorange	Downlink Pseudorange from the last time this data was generated	meters		U	R*8
472	Downlink Pseudorange Rate	Rate of change of Downlink Pseudorange	m/sec		U	R*8
480	Translator Multiplier Epsilon Phase L1	Intermediate value used in L1 downlink carrier calculations			U	R*8
488	Translator Multiplier Epsilon Phase L2	Intermediate value used in L2 downlink carrier calculations			U	R*8
496	VMP Receiver Antenna Gain Delta	Addition to tracking vehicle antenna gain due to vehicle multipath	dB		U	R*8
504	EMP Loss	Subtraction from tracking vehicle antenna gain due to vehicle multipath	dB		U	R*8
512	Antenna Switch Frequency	Control frequency for antenna multiplexing in translator	cycles / system clock cycle <160 MHz>	LSB = 2^{-34}	U	U*4
516	Pilot Carrier Control Frequency	Control frequency for translator downlink carrier frequency	cycles / system clock cycle <160 MHz>	LSB = 2^{-34}	U	U*4

DOPPLER NAVIGATION SYSTEM DATA BLOCK

Record ID = 6773 (I-10)

This block has an identical format to the UMN/SCRAMNet output block "Aiding Message Data Block" (see **UMN/SCRAMNET - OUTPUT FROM SCS** section [page 135]) with the following contents:

Record ID	Message Format	Message Type	Message*
6773	201 (= I-10)	3 (= DNS)	(see page 95)

* (see referenced page in **RS-422/485 - OUTPUT FROM SCS** section)

INERTIAL NAVIGATION SYSTEM DATA BLOCK

Record ID = 6777 (EGR-14)
6778 (EGR-16)

This block has an identical format to the UMN/SCRAMNet output block "Aiding Message Data Block" (see **UMN/SCRAMNET - OUTPUT FROM SCS** section [page 135]) with the following contents:

Record ID	Message Format	Message Type	Message*
6777	103 (= EGR-14)	1 (= INS)	(see page 86)
6778	104 (= EGR-16)	1 (= INS)	(see page 89)

* (see referenced page in **RS-422/485 - OUTPUT FROM SCS** section)

TRANSMITTER OVERRIDE CONTROL BLOCK

Record ID = 6890

This block has an identical format to the Ethernet input block of the same name (see **ETHERNET - INPUT TO SCS** section [page 46]).

JAMMER OVERRIDE CONTROL BLOCK

Record ID = 6892

This block has an identical format to the Ethernet input block of the same name (see **ETHERNET - INPUT TO SCS** section [page 49]).

DIFFERENTIAL DATA OVERRIDE CONTROL BLOCK

Record ID = 6894

This block has an identical format to the Ethernet input block of the same name (see **ETHERNET - INPUT TO SCS** section [page 51]).

DATA LOGGING OVERRIDE CONTROL BLOCK

Record ID = 6896

This block has an identical format to the Ethernet input block of the same name (see **ETHERNET - INPUT TO SCS** section [page 53]).

DEBUG DATA BLOCK

Record ID = 7000 (SC)
7001 (SGC)

LONG	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE
1	Time Tag (MSBs)				0
2	Time Tag (LSBs)				4
3	Double Data [0] (MSBs)				8
4	Double Data [0] (LSBs)				12
...	...				...
41	Double Data [19] (MSBs)				160
42	Double Data [19] (LSBs)				164
43	Integer Data [0]				168
...	...				...
62	Integer Data [19]				244
63	Character Data [0]	Character Data [1]	Character Data [2]	Character Data [3]	248
...	...				...
72	Character Data [36]	Character Data [37]	Character Data [38]	Character Data [39]	284

BYTE	NAME	DESCRIPTION	UNITS	RANGE	CLASS	DATA TYPE
0	Time Tag	Time tag associated with this block of debug data. May be any format	*	*	*	R*8
8	Double Data	Array of 20 double precision floating point values	*	*	*	R*8 x20
168	Integer Data	Array of 20 4-byte integer values	*	*	*	I*4 x20
248	Character Data	Array of 40 1-byte integer values	*	*	*	I*1 x40

* = Unknown, the contents of this block are defined as needed by IEC software development personnel, and are subject to change

DEBUG INTERFACE

Each SCS 2450 chassis is equipped with 4 RS-232 ports (connectors J106-109 on the rear panel), each of which connects to a different one of the SCS CPU boards as indicated below. These ports exist solely for simulator debugging purposes and must be connected to an ASCII terminal (or terminal emulator) to be used. Usage of these ports is via an interactive debug shell. Normal operation of the SCS does not require that any of these ports be connected.

Connector	CPU
J106	SC
J107	SGC #1
J108	SGC #2
J109	IOC

The communications settings for these ports are: 9600 bps, 8 Data Bits, 1 Start Bit, 1 Stop Bit, No Parity

The following are the pin assignments for the RS-232 (DB9) connectors:

Pin #	Signal	I/O
1		
2	RxD	I
3	TxD	O
4		
5	GND	
6		
7		
8		
9		

The debug shell for any CPU can also be accessed via Telnet connection across the Ethernet using the following IP addresses:

CPU	IP Address
SC	SCS Base Address[1]
SC	SCS Base Address + 1[1]
SGC #1	SCS Base Address + 2
SGC #2	SCS Base Address + 3
Reserved	SCS Base Address + 4
IOC	SCS Base Address + 5

Note 1: The first two IP addresses both access the same CPU (the SC).

FREQUENCY & RF INTERFACES

This section describes the various non-communications input and output ports on the SCS, including reference frequencies and GPS RF outputs.

FREQUENCY & RF INTERFACES - INPUT TO SCS

10 MHz Input (J110)

- Reference frequency of the SCS. It is critical that this be accurate and reliable. An atomic standard (rubidium or cesium) is strongly recommended.
- If the SCS is equipped with the optional internal 10 MHz reference oscillator (rubidium), this input should be looped back from the 10 MHz output port.
- Signal characteristics:
    - Sine wave with input power of 0-14 dBm (50 Ohm load).
    - When the “Internal 10 MHz Signal - Polarity” calibration value is set to **normal**, the SCS uses the rising edge of the signal, when set to **inverted,** the SCS uses the falling edge of the signal.

1 PPS Input (J116)

- Used for time synchronization with external user equipment or other SCS units.
- If synchronization is not in use, this input should be looped back from the 1 PPS output port.
- Signal characteristics:
    - Minimum ±0.25 V peak-to-peak centered on +1.25 V (50 Ohm load). The SCS uses a 26L32 receiver chip operating in single-ended mode.
    - A minimum time of 500 ns is required in both the high & low states.
    - When the “Input 1 PPS Signal - Reference Edge” calibration value is set to **normal**, the SCS interprets the rising edge of the signal as the 1 PPS time mark. When set to **inverted**, the SCS uses the falling edge of the signal.

Jammer Inputs (1 & 2)

- 2 independent jammer inputs, each feeding into the corresponding RF output through 30 dB of attenuation.
- See diagram - page 241.
- Signal characteristics:
    - Maximum input power of -30 dBW in 2 MHz bandwidth centered on L1 (1575.42 MHz) and/or L2 (1227.60 MHz).

FREQUENCY & RF INTERFACES - OUTPUT FROM SCS

10 MHz Output (J111)

- Only available if optional internal 10 MHz reference oscillator (rubidium) is installed in SCS.
- Used only to provide 10 MHz reference frequency looped back into 10 MHz input.
- Signal characteristics:
    - 1.0 V RMS (power of 13 dBm) sine wave (50 Ohm load).

1 PPS Output (J117)

- Available for time synchronization with external user equipment or other SCS units.
- If input time synchronization is not in use, this signal should be looped back to the 1 PPS input.
- May be offset from simulation truth 1 PPS, due to the effects of the “Cable Length” and “Output 1 PPS Retard” calibration values.
- Signal characteristics:
    - TTL level (up to 10 TTL loads).
    - When the “Output 1 PPS Signal - Reference Edge” calibration value is set to **normal**, this signal has an 80/20 (high/low) duty cycle with the rising edge being the 1 PPS time mark.
    - When the “Output 1 PPS Signal - Reference Edge” calibration value is set to **inverted**, this signal has an 20/80 (high/low) duty cycle with the falling edge being the 1 PPS time mark.
    - In either mode, the trailing edge of the 200 ms pulse (be it high or low) is the 1 PPS time mark.

NCO Outputs #1-4 (J112-J115)

- Up to 4 (one per DGSG board in the chassis) independent frequency generators available for special purpose applications.
- Signal characteristics:
    - Frequency adjustable and controllable by software within a range of 0-20 MHz.
    - Minimum 0.4 V peak-to-peak sine wave (50 Ohm load).

RF Outputs (1 & 2)

- 2 independent GPS outputs, each with L1 (1575.42 MHz) and L2 (1227.60 MHz) combined.
- See diagram - page 241.
- Signal characteristics:
    - Nominal output power levels for each satellite, ground transmitter or spoofer signal are -160 dBW for L1 C/A-code, -163 dBW for L1 P-code, and -166 dBW for L2 P-code (50 Ohm load).
    - Nominal output power levels for each CW or pulsed Jammer are -140 dBW.
    - Output power is adjustable by software within an offset range of -20 to +20 dB from nominal if both RF Outputs are in use by the scenario.
    - Output power is adjustable by software within an offset range of -20 to +60 dB from nominal if only RF Output 1 is in use by the scenario.
- Injected noise (broadband noise jamming) characteristics:
    - When enabled, the noise source injects noise into both RF outputs. This noise source is used to simulate the cumulative effects of all broadband noise jammers in the simulation.
    - Nominal power level for the noise source is -90 dBW (20 MHz bandwidth) into each RF output (50 Ohm load).
    - Output power of the noise source is adjustable by software within an offset range of 0 to -62 dB from nominal, independently controlled for each RF output.

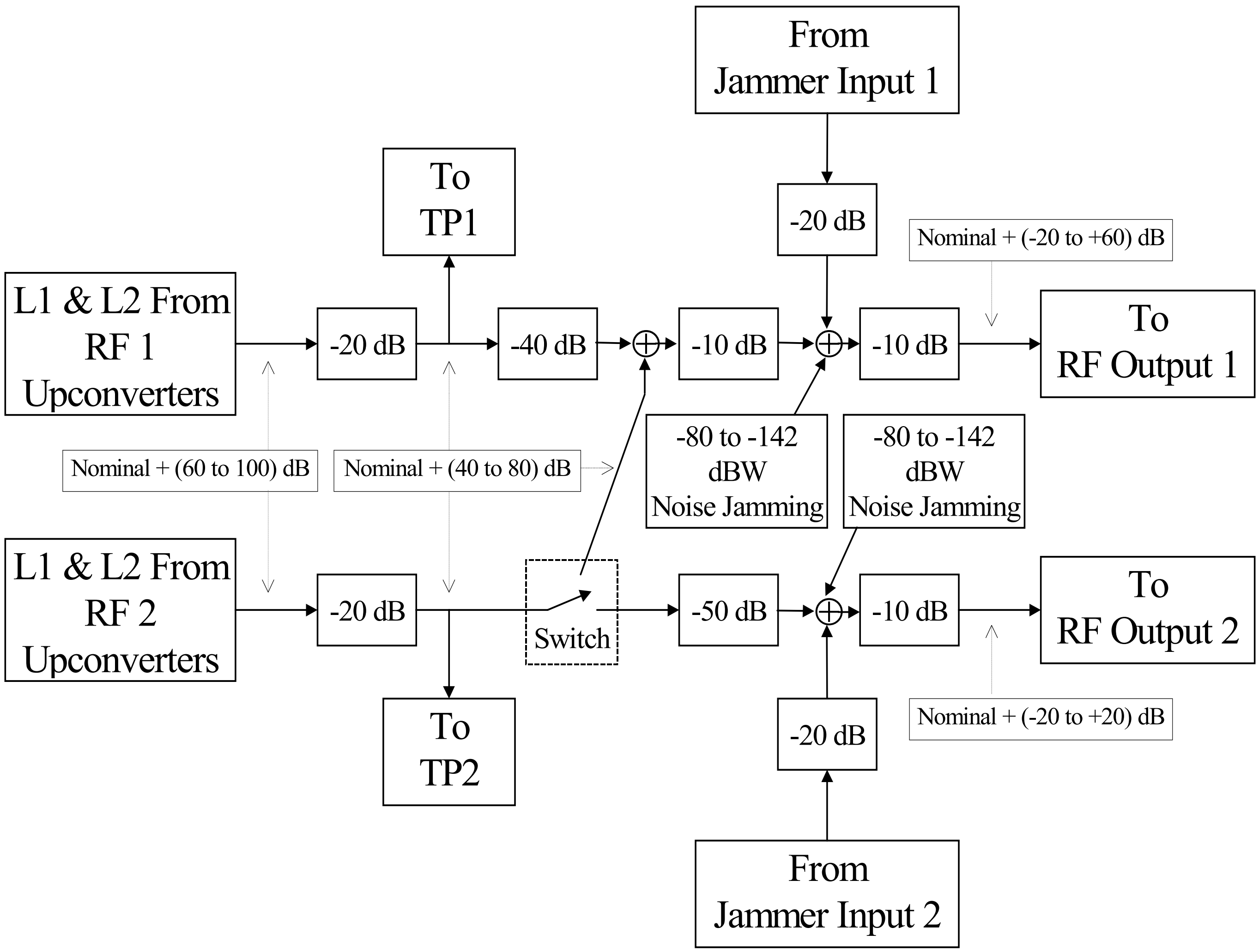
- **Important Note:** Over time, a DC voltage (such as that used to power a preamplifier) applied to the SCS RF outputs could result in damage to the SCS RF Output (ROUT) module. To guard against this possibility, **IEC recommends that all users attach a DC block to any SCS RF Output that is in use.**

+60 dB Outputs (TP1 & TP2)

- 2 independent GPS output test points provided for diagnostic purposes, each with L1 (1575.42 MHz) and L2 (1227.60 MHz) combined.
- Non-calibrated path - **NOT INTENDED FOR GENERAL USE**.
- Jammer inputs and injected noise (broadband noise jamming) are **NOT** included.
- See diagram - page 241.
- Signal characteristics if both RF Outputs are in use by the scenario:
  - TP1 duplicates RF Output 1 for all signals (except external jammer input and noise source). Output power is +60 dB from RF Output 1 (50 Ohm load).
  - TP2 duplicates RF Output 2 for all signals (except external jammer input and noise source). Output power is +60 dB from RF Output 2 (50 Ohm load).
- Signal characteristics if only RF Output 1 is in use by the scenario:
  - TP1 duplicates RF Output 1 for all signals (except external jammer input and noise source) in the range -20 to +20 dB offset from nominal. Output power is +60 dB from RF Output 1 (50 Ohm load).
  - TP2 duplicates RF Output 1 for all signals (except external jammer input and noise source) in the range +20 to +60 dB offset from nominal. Output power of +20 dB from RF Output 1 (50 Ohm load).
- **Important Note:** Over time, a DC voltage (such as that used to power a preamplifier) applied to the SCS RF outputs could result in damage to the SCS RF Output (ROUT) module. To guard against this possibility, **IEC recommends that all users attach a DC block to any SCS RF Output that is in use.**

FREQUENCY & RF INTERFACES - RF PATHS

Note: This diagram is not intended to be an accurate block diagram of the SCS hardware, but rather to show the various RF paths, along with the associated levels of signal attenuation. The net attenuation effects along any given path through this diagram is accurate to the SCS hardware.



APPENDIX A - GLOSSARY

AODO	Age Of Data Offset
APL	Airport Pseudolite
AS	Anti-Spoofing
ASCII	American Standard Code for Information Interchange
ASIC	Application Specific Integrated Circuit
BB	Broad Band
BBNJ	Broad Band Noise Jammer
BIT	Built-In Tests
BM	Bus Monitor
C/A-Code	Coarse Acquisition Code
CG	Center Of Gravity
CPU	Central Processor Unit
CRC	Cyclic Redundancy Check
CW	Continuous Wave
DC	Differential Correction
DCM	Direction Cosine Matrix
DGSG	Digital GPS Signal Generator
DL	Downlink
DMA	Direct Memory Access
DNS	Doppler Navigation System
ECEF	Earth Centered, Earth Fixed
ECP	Engineering Change Proposal
EEPROM	Electrically Erasable, Programmable, Read-Only Memory
EFG	Earth Fixed Geocentric
EFG	E/F/G (ECEF)
EGR	Embedded GPS Receiver
EIA	Electronic Industries Association
EMP	Earth Multipath
ENU	East/North/Up
EOI	End Of Interrupt
ERD	Estimated Range Deviation
GBA	General Bus Adapter
GPIB	General Purpose Interface Bus
GPS	Global Positioning System
GT	Ground Transmitter
GUC	GPS Up-Converter Module
GUMM	GWEF Universal Memory Map
GWEF	Guided Weapons Evaluation Facility
HOW	Hand Over Word
HPI	Host Processor Interface
ICD	Interface Control Document
ID	Identifier
IEC	L3 Communications/Interstate Electronics Corporation
IEEE	Institute of Electrical and Electronics Engineers

IF	Intermediate Frequency
IFC	Interface Clear
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
IOC	Input/Output Controller
IODC	Issue Of Data, Clock
IODE	Issue Of Data, Ephemeris
IP	Industry Pack
IP-1553	Industry Pack for Mil-Std-1553 Interface
IP-488	Industry Pack for IEEE-488 Interface
IP-MP Serial	Industry Pack for RS-422/485 Interface
LAAS	Local Area Augmentation System
L1	GPS Frequency L1 (1575.42 MHz)
L2	GPS Frequency L2 (1227.6 MHz)
LLA	Latitude/Longitude/Altitude
LRIP	Low Rate Initial Production
LSB(s)	Least Significant Bit(s)
LTP	Local Tangent Plane
MSB(s)	Most Significant Bit(s)
MSL	Mean Sea Level
N/A	Not Applicable
NCO	Numerically Controlled Oscillator
NFS	Network File System
NMCT	Navigation Message Correction Table
NVRAM	Non-Volatile Random Access Memory
OI	Operator Interface
P-Code	Precision Code
PC	Personal Computer
PPS	Pulse Per Second
PPSSM	Precise Positioning Service Security Module
PR	Pseudo-Range
PRN	Pseudo-Random Code Number
PRR	Pseudo-Range Rate
RAM	Random Access Memory
RAP	Range Applications Program
RF	Radio Frequency
RFU	Right/Forward/Up
RMS	Root Mean Square
ROM	Read Only Memory
ROUT	RF Output Module
RR/P	Reference Receiver/Processor
RT	Remote Terminal
RWO	Reverse Word Order
S/A	Selective Availability
SA	Selective Availability
SA/AS	Selective Availability/Anti-Spoofing
SAAS	Selective Availability/Anti-Spoofing

SC	Simulator Controller
SCRAMNet	Shared Common Random Access Memory Network
SCS	Satellite Constellation Simulator
SDLC	Synchronous Data Link Controller
SGC	Signal Generator Controller
SV	Space Vehicle (Satellite)
TCP/IP	Transmission Control Protocol/Internet Protocol
TLM	Telemetry Word
T_{GD}	Group Delay Time
Toc	Time Of Clock Data (T_{OC})
Toe	Time Of Ephemeris Data (T_{OE})
TP	Test Point
UDB	User-Defined Biases
UDRE	User Differential Range Error
UMN	Universal Memory Network
URA	User Range Accuracy
UTC	Universal Time, Coordinated
VME	Versa-Module European
VMP	Vehicle Multipath
WAGE	Wide Area GPS Enhancement
WETT	ω_{ET}^{T}
WTBT	ω_{TB}^{T}
WEBT	ω_{EB}^{T}
WGS	World Geodetic System
WGS-84	World Geodetic System – 1984
WN	Week Number
WN_a	Week Number of Almanac Data
Y-Code	Encrypted P-Code

APPENDIX B - COORDINATE SYSTEMS

E = Earth Centered Earth Fixed (ECEF) a.k.a. Earth Fixed Geocentric (EFG)

X^E (E)	Through Intersection of Greenwich Meridian and Equator
Y^E (F)	In Equatorial Plane such that (X^E, Y^E, Z^E) axes form a right-handed Cartesian reference system
Z^E (G)	Coincident with the earth's spin axis, positive through North Pole

G = Geodetic - World Geodetic System (WGS-84)

ϕ	Geodetic latitude
λ	Longitude: rotation about $+Z^E$-axis from X^E-axis
h	Height above the plane tangent to the reference ellipsoid
R_p	$a / (1 - e^2 \sin^2\phi)^{1/2}$ = Prime vertical radius of curvature
R_M	Meridional radius of curvature
R_H	Horizontal radius of curvature
e^2	$(a^2 - b^2) / a^2$ = Eccentricity squared
a	Semi-Major axis of ellipsoid
b	Semi-Minor axis of ellipsoid

Geodetic to ECEF Conversion (G $\rightarrow$ E)

$$X^E = \left(R_p + h\right)\cos\phi\cos\lambda$$
$$Y^E = \left(R_p + h\right)\cos\phi\sin\lambda$$
$$Z^E = \left(\left(b^2/a^2\right)R_p + h\right)\sin\phi$$

T = Local Tangent Plane Frame (ENU)

X^T (X^R)	East pointing in local tangent plane
Y^T (Y^R)	North pointing in local tangent plane
Z^T (Z^R)	Up pointing normal to local tangent plane

ECEF to Local Tangent Plane Conversion (E $\rightarrow$ T)

$$\begin{bmatrix} X^T \\ Y^T \\ Z^T \end{bmatrix} = \begin{bmatrix} -\sin\lambda & \cos\lambda & 0 \\ -\sin\phi\cos\lambda & -\sin\phi\sin\lambda & \cos\phi \\ \cos\phi\cos\lambda & \cos\phi\sin\lambda & \sin\phi \end{bmatrix} \begin{bmatrix} X^E \\ Y^E \\ Z^E \end{bmatrix}$$

B = Body Frame (RFU)

X^B Right
Y^B Forward
Z^B Up

ψ Yaw (Positive rotation about $-Z^B$)
θ Pitch (Positive rotation about $+X^B$)
φ Roll (Positive rotation about $+Y^B$)

Sequence of rotations = Yaw, then Pitch, then Roll

Local Tangent Plane to Body Conversion (T → B)

$$\begin{bmatrix} X^B \\ Y^B \\ Z^B \end{bmatrix} = \begin{bmatrix} \cos\varphi & 0 & -\sin\varphi \\ 0 & 1 & 0 \\ \sin\varphi & 0 & \cos\varphi \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} \cos\psi & -\sin\psi & 0 \\ \sin\psi & \cos\psi & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} X^T \\ Y^T \\ Z^T \end{bmatrix}$$

APPENDIX C - ALARM CODE DEFINITIONS

0 = Error code not used
1 = Timing marks missed in scheduler
2 = GPS Upconverter 1PPS interrupt not present
3 = GPS Upconverter not present
4 = Error opening Flash module
5 = Error loading SC Flash module
6 = Error loading SGC #1 Flash module
7 = Error loading SGC #2 Flash module
8 = Error loading SGC #3 Flash module
9 = Error loading IOC Flash module
10 = Error burning SC Flash ROM
11 = Error burning SGC #1 Flash ROM
12 = Error burning SGC #2 Flash ROM
13 = Error burning SGC #3 flash ROM
14 = Error burning IOC flash ROM
15 = Unable to open UMN/SCRAMNet shared memory
16 = Unable to initialize UMN/SCRAMNet shared memory
17 = UMN/SCRAMNet memory overflow
18 = UMN/SCRAMNet shared memory unavailable
19 = Field overflow generating IMU data
20 = Motion throughput exceeded
21 = Error receiving motion timing semaphore
22 = Error receiving/propagating data from UMN/SCRAMNet
23 = Error updating standalone motion data
24 = Error generating IMU data
25 = Error logging motion data
26 = Error logging IMU data
27 = Error generating downlink motion data
28 = Error in motion routine EFG_LLAENU
29 = Error in motion routine ENU_NAV
30 = Error freeing data logging memory
31 = Data Logging: Out of memory
32 = Error allocating memory for data logging
33 = Invalid record received from data logging buffer
34 = End of data logging buffer reached, SC
35 = End of data logging buffer reached, SGC #1
36 = End of data logging buffer reached, SGC #2
37 = End of data logging buffer reached, SGC #3
38 = UMN motion time error
39 = IMU port configuration error
40 = Error receiving Update Data timing semaphore
41 = Error - attempted to update truth almanac initialization
42 = Error - attempted to update truth almanac
43 = Error - attempted to update nav jammer data
44 = Error - attempted to update nav priority disable list
45 = Error - attempted to update nav priority list
46 = Error - attempted to update nav GT specific data
47 = Readbias: Error opening .UDB file
48 = Readbias: Error skipping comments
49 = Readbias: Error allocating memory
50 = Error receiving Channel Mgmt timing semaphore
51 = Invalid selection index for channel mgmt
52 = Error logging channel assignments
53 = Channel Management throughput exceeded
54 = WageCalc: No previous NMCT to copy
55 = Error receiving BBNJ timing semaphore
56 = Error logging BBNJ data
57 = WageCalc: AODO overflow
58 = WageCalc: Bad NMCT reference time
59 = WageCalc: ERD overflow
60 = Error creating OI socket
61 = Error binding OI socket
62 = Error listening to OI socket
63 = O I socket accept failed
64 = Error spawning operator interface dispatch task
65 = Error reading O I initial data
66 = Error spawning Primary operator interface task
67 = Error spawning operator interface log request task
68 = Unexpected O I initial data
69 = Error code not used
70 = O I Prime: Error adding host
71 = O I Prime: Error mounting file system
72 = O I Prime: Error reading data
73 = O I Prime: Socket disconnected
74 = O I Prime: Unexpected ID
75 = O I Primary Processor: Unexpected command
76 = APL Disable in Nav file overridden by Truth
77 = APL Enable in Nav file overridden by Truth
78 = O I Log: Transfer failed: No logged data
79 = APL Truth code delay range error
80 = O I Read Message (header): data read failed
81 = O I Read Message (header): Header size incorrect
82 = O I Read Message (header): Header checksum incorrect
83 = O I Read Message: data read failed
84 = O I Read Message: Message checksum incorrect
85 = Error code not used
86 = Start 1 PPS Mark not present
87 = Ethernet Motion Socket: Unexpected ID
88 = Ethernet Motion Socket: Socket Disconnected
89 = Ethernet Motion Socket: Error reading data
90 = Error reading transfer file name message
91 = Attempt to transfer parameters while mission in progress
92 = Error code not used
93 = Error reading transfer log name message
94 = Attempt to transfer log while mission in progress
95 = Cnfginit: Error opening .SCN file
96 = Cnfginit: Error reading comments
97 = Cnfginit: Error reading filenames
98 = Rcvrinit: No .RCV file name entered
99 = Rcvrinit: Error opening .RCV file
100 = Rcvrinit: Error reading comments
101 = Rcvrinit: Block header Rcvr 1 incorrect
102 = Rcvrinit: Error reading Rcvr 1 data
103 = Rcvrinit: Block header Rcvr 2 incorrect
104 = Rcvrinit: Error reading Rcvr 2 data
105 = Rcvrinit: Block header Rcvr 3 incorrect
106 = Rcvrinit: Error reading Rcvr 3 data
107 = Moinit: Error no .MOT file name

108 = Moinit: Error opening .MOT file name
109 = Moinit: Error skipping comments
110 = Moinit: Error reading waypoint data
111 = Moinit: Error reading data
112 = Moinit: Error reading Translational reference line
113 = Moinit: Tref linear units bad
114 = Moinit: Tref angular units bad
115 = Moinit: Error reading Position reference line
116 = Moinit: Pref linear units bad
117 = Moinit: Pref angular units bad
118 = Moinit: Error reading Pos line
119 = Moinit: Error reading wp position
120 = Moinit: Error reading Vel line
121 = Moinit: Error reading wp velocity
122 = Moinit: Error reading acc line
123 = Moinit: Error reading jerk line
124 = Moinit: Attitude angular units bad
125 = Moinit: Error reading yaw line
126 = Moinit: Error reading yaw wp
127 = Moinit: Error reading pitch line
128 = Moinit: Error reading pitch wp
129 = Moinit: Error reading roll line
130 = Moinit: Error reading roll wp
131 = Moinit: Error reading ssm line
132 = Moinit: Error unexpected line type
133 = Molstadd: MSL without lat and lon
134 = IMUinit: Error opening .IMU file
135 = IMUinit: Error skipping comments
136 = IMUinit: Unknown type read
137 = IMUinit: Error reading IMU data
138 = AntInit: Error opening .ANT file
139 = AntInit: Block header incorrect
140 = Readantt: Error reading .ANT file
141 = Readsatd: Error opening file
142 = Readsatd: Unrecognized entry
143 = Insertev: Error allocating memory
144 = Ralminit: Sequence error
145 = Ralminit: Error reading data
146 = Error code not used
147 = Ralmanac: Error reading file
148 = Error code not used
149 = Ratmos: Error reading file
150 = Rephem: Invalid unclassified SA parameter
151 = Rutc: Error reading file
152 = Rephem: Error reading SV ID
153 = Rephem: Error reading type
154 = Rephem: Error reading file
155 = Readgtsp: Error reading file
156 = Jaminit: Error opening .JAM file
157 = Jaminit: Error skipping comments
158 = Jaminit: Error reading jammer data
159 = Jaminit: Error calculating pulsed jammer phase
160 = Prioinit: Priority file name is NONE
161 = Prioinit: Error opening .PRI file
162 = Prioinit: Error reading bracket data
163 = Prioinit: Error reading initial data
164 = Mapinit: Error opening .MPL file
165 = Mapinit: Error opening .MPH file
166 = Mapinit: Error reading low resolution map data
167 = Mapinit: Error reading high resolution map data
168 = Dloginit: Error opening .DLG file
169 = Dloginit: Error skipping comments
170 = Dloginit: Error, ID out of range
171 = Dloginit: Error reading data
172 = Writelog: Error opening .LOG file
173 = Oiwrmsg: Header data write failed
174 = Oiwrmsg: Header checksum incorrect
175 = Oiwrmsg: Message data write failed
176 = Oiwrmsg: Message checksum incorrect
177 = O I Child: Error reading data
178 = O I Child: Socket disconnected
179 = O I Child: Unexpected ID
180 = O I Child Processor: Unexpected command
181 = Error opening SC SAAS module
182 = Error loading SC SAAS module
183 = Error opening SGC SAAS module
184 = Error loading SGC SAAS module
185 = Error receiving Channel timing semaphore
186 = Ch 1: Pulse jammer conflict - signal not generated
187 = Ch 2: Pulse jammer conflict - signal not generated
188 = Ch 3: Pulse jammer conflict - signal not generated
189 = Ch 4: Pulse jammer conflict - signal not generated
190 = Ch 5: Pulse jammer conflict - signal not generated
191 = Ch 6: Pulse jammer conflict - signal not generated
192 = Ch 7: Pulse jammer conflict - signal not generated
193 = Ch 8: Pulse jammer conflict - signal not generated
194 = Ch 9: Pulse jammer conflict - signal not generated
195 = Ch 10: Pulse jammer conflict - signal not generated
196 = Ch 11: Pulse jammer conflict - signal not generated
197 = Ch 12: Pulse jammer conflict - signal not generated
198 = Ch 13: Pulse jammer conflict - signal not generated
199 = Ch 14: Pulse jammer conflict - signal not generated
200 = Ch 15: Pulse jammer conflict - signal not generated
201 = Ch 16: Pulse jammer conflict - signal not generated
202 = Ch 17: Pulse jammer conflict - signal not generated
203 = Ch 18: Pulse jammer conflict - signal not generated
204 = Ch 19: Pulse jammer conflict - signal not generated
205 = Ch 20: Pulse jammer conflict - signal not generated
206 = Ch 21: Pulse jammer conflict - signal not generated
207 = Ch 22: Pulse jammer conflict - signal not generated
208 = Ch 23: Pulse jammer conflict - signal not generated
209 = Ch 24: Pulse jammer conflict - signal not generated
210 = Ch 1: Signal level too strong - Clipping On
211 = Ch 2: Signal level too strong - Clipping On
212 = Ch 3: Signal level too strong - Clipping On
213 = Ch 4: Signal level too strong - Clipping On
214 = Ch 5: Signal level too strong - Clipping On
215 = Ch 6: Signal level too strong - Clipping On
216 = Ch 7: Signal level too strong - Clipping On
217 = Ch 8: Signal level too strong - Clipping On
218 = Ch 9: Signal level too strong - Clipping On
219 = Ch 10: Signal level too strong - Clipping On
220 = Ch 11: Signal level too strong - Clipping On
221 = Ch 12: Signal level too strong - Clipping On

222 = Ch 13: Signal level too strong - Clipping On
223 = Ch 14: Signal level too strong - Clipping On
224 = Ch 15: Signal level too strong - Clipping On
225 = Ch 16: Signal level too strong - Clipping On
226 = Ch 17: Signal level too strong - Clipping On
227 = Ch 18: Signal level too strong - Clipping On
228 = Ch 19: Signal level too strong - Clipping On
229 = Ch 20: Signal level too strong - Clipping On
230 = Ch 21: Signal level too strong - Clipping On
231 = Ch 22: Signal level too strong - Clipping On
232 = Ch 23: Signal level too strong - Clipping On
233 = Ch 24: Signal level too strong - Clipping On
234 = Ch 1: Signal level within normal range - Clipping Off
235 = Ch 2: Signal level within normal range - Clipping Off
236 = Ch 3: Signal level within normal range - Clipping Off
237 = Ch 4: Signal level within normal range - Clipping Off
238 = Ch 5: Signal level within normal range - Clipping Off
239 = Ch 6: Signal level within normal range - Clipping Off
240 = Ch 7: Signal level within normal range - Clipping Off
241 = Ch 8: Signal level within normal range - Clipping Off
242 = Ch 9: Signal level within normal range - Clipping Off
243 = Ch 10: Signal level within normal range - Clipping Off
244 = Ch 11: Signal level within normal range - Clipping Off
245 = Ch 12: Signal level within normal range - Clipping Off
246 = Ch 13: Signal level within normal range - Clipping Off
247 = Ch 14: Signal level within normal range - Clipping Off
248 = Ch 15: Signal level within normal range - Clipping Off
249 = Ch 16: Signal level within normal range - Clipping Off
250 = Ch 17: Signal level within normal range - Clipping Off
251 = Ch 18: Signal level within normal range - Clipping Off
252 = Ch 19: Signal level within normal range - Clipping Off
253 = Ch 20: Signal level within normal range - Clipping Off
254 = Ch 21: Signal level within normal range - Clipping Off
255 = Ch 22: Signal level within normal range - Clipping Off
256 = Ch 23: Signal level within normal range - Clipping Off
257 = Ch 24: Signal level within normal range - Clipping Off
258 = Ch 1: Signal level below normal range - Low Resolution Control On
259 = Ch 2: Signal level below normal range - Low Resolution Control On
260 = Ch 3: Signal level below normal range - Low Resolution Control On
261 = Ch 4: Signal level below normal range - Low Resolution Control On
262 = Ch 5: Signal level below normal range - Low Resolution Control On
263 = Ch 6: Signal level below normal range - Low Resolution Control On
264 = Ch 7: Signal level below normal range - Low Resolution Control On
265 = Ch 8: Signal level below normal range - Low Resolution Control On
266 = Ch 9: Signal level below normal range - Low Resolution Control On
267 = Ch 10: Signal level below normal range - Low Resolution Control On
268 = Ch 11: Signal level below normal range - Low Resolution Control On
269 = Ch 12: Signal level below normal range - Low Resolution Control On
270 = Ch 13: Signal level below normal range - Low Resolution Control On
271 = Ch 14: Signal level below normal range - Low Resolution Control On
272 = Ch 15: Signal level below normal range - Low Resolution Control On
273 = Ch 16: Signal level below normal range - Low Resolution Control On
274 = Ch 17: Signal level below normal range - Low Resolution Control On
275 = Ch 18: Signal level below normal range - Low Resolution Control On
276 = Ch 19: Signal level below normal range - Low Resolution Control On
277 = Ch 20: Signal level below normal range - Low Resolution Control On
278 = Ch 21: Signal level below normal range - Low Resolution Control On
279 = Ch 22: Signal level below normal range - Low Resolution Control On
280 = Ch 23: Signal level below normal range - Low Resolution Control On
281 = Ch 24: Signal level below normal range - Low Resolution Control On
282 = Ch 1: Signal level within normal range - High Resolution Control On
283 = Ch 2: Signal level within normal range - High Resolution Control On
284 = Ch 3: Signal level within normal range - High Resolution Control On
285 = Ch 4: Signal level within normal range - High Resolution Control On
286 = Ch 5: Signal level within normal range - High Resolution Control On
287 = Ch 6: Signal level within normal range - High Resolution Control On
288 = Ch 7: Signal level within normal range - High Resolution Control On
289 = Ch 8: Signal level within normal range - High Resolution Control On
290 = Ch 9: Signal level within normal range - High Resolution Control On
291 = Ch 10: Signal level within normal range - High Resolution Control On
292 = Ch 11: Signal level within normal range - High Resolution Control On
293 = Ch 12: Signal level within normal range - High Resolution Control On
294 = Ch 13: Signal level within normal range - High Resolution Control On
295 = Ch 14: Signal level within normal range - High Resolution Control On

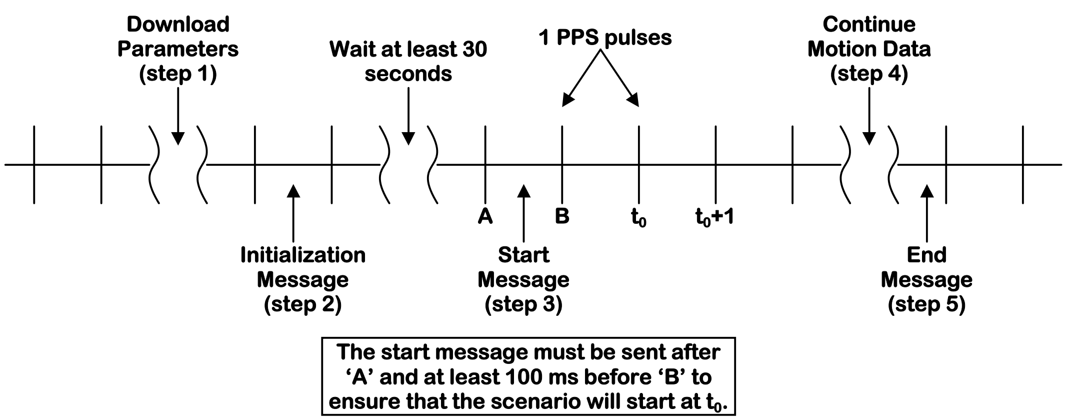
296 = Ch 15: Signal level within normal range - High Resolution Control On
297 = Ch 16: Signal level within normal range - High Resolution Control On
298 = Ch 17: Signal level within normal range - High Resolution Control On
299 = Ch 18: Signal level within normal range - High Resolution Control On
300 = Ch 19: Signal level within normal range - High Resolution Control On
301 = Ch 20: Signal level within normal range - High Resolution Control On
302 = Ch 21: Signal level within normal range - High Resolution Control On
303 = Ch 22: Signal level within normal range - High Resolution Control On
304 = Ch 23: Signal level within normal range - High Resolution Control On
305 = Ch 24: Signal level within normal range - High Resolution Control On
306 = Attempted to put earth multipath on a jammer
307 = Attempted to put vehicle multipath on a jammer
308 = Attempted to put earth multipath on a GT
309 = Error! Attempt to key unclassified simulator!
310 = Error zeroizing keys
311 = Error - not enough keys loaded for downloaded simulation
312 = Error - PPSSM lost keys
313 = Error receiving SA/AS timing semaphore
314 = Error logging dither data
315 = Error opening SA data file
316 = Unrecognized entry in SA data file
317 = Error reading epsilon data
318 = Error reading dither data
319 = Error reading GUV cutover data
320 = Channel Control throughput exceeded
321 = Differential Corrections throughput exceeded
322 = Iono Corrections throughput exceeded
323 = Data Logging throughput exceeded
324 = Data Update throughput exceeded
325 = Orbit calculations throughput exceeded
326 = BB Noise Jammer throughput exceeded
327 = Log Intermittent throughput exceeded
328 = Map Visibility throughput exceeded
329 = Unclassified SA throughput exceeded
330 = SC failure
331 = SGC #1 failure
332 = SGC #2 failure
333 = SGC #3 failure
334 = IOC failure
335 = DGSG #1 failure
336 = DGSG #2 failure
337 = DGSG #3 failure
338 = DGSG #4 failure
339 = GUC failure
340 = Rubidium Oscillator failure
341 = PPSSM #1 failure
342 = PPSSM #2 failure
343 = PPSSM #3 failure
344 = PPSSM #4 failure
345 = Hardware configuration updated in NVRAM
346 = Error code not used
347 = Error code not used
348 = SC DMA Initialization failure
349 = SGC #1 DMA Initialization failure
350 = SGC #2 DMA Initialization failure
351 = SGC #3 DMA Initialization failure
352 = IOC DMA Initialization failure
353 = SC DMA Write failure
354 = SGC #1 DMA Write failure
355 = SGC #2 DMA Write failure
356 = SGC #3 DMA Write failure
357 = IOC DMA Write failure
358 = Error code not used
359 = IMU/INS Buffer Overflow – IMU/INS Halt
360 = UMN expected, but not present
361 = UMN present when not expected
362 = SC not found
363 = SGC #1 expected, but not present
364 = SGC #1 present when not expected
365 = SGC #2 expected, but not present
366 = SGC #2 present when not expected
367 = SGC #3 expected, but not present
368 = SGC #3 present when not expected
369 = IOC expected, but not present
370 = IOC present when not expected
371 = DGSG #1 expected, but not present
372 = DGSG #1 present when not expected
373 = DGSG #2 expected, but not present
374 = DGSG #2 present when not expected
375 = DGSG #3 expected, but not present
376 = DGSG #3 present when not expected
377 = DGSG #4 expected, but not present
378 = DGSG #4 present when not expected
379 = Rubidium expected, but not present
380 = Rubidium present when not expected
381 = Rubidium expected, but not locked or not present
382 = External 1 PPS expected, but not present
383 = External 1 PPS present when not expected

APPENDIX D - ETHERNET MOTION PROCEDURE & TIMING

Define the simulation start time (t_0) in the Constellation Truth file. t_0 is expressed in GPS format (week number and time of week). The time of week must be a whole number of seconds.

To use motion data furnished by the external host via Ethernet, the SCS requires five steps:

1. Transfer the scenario parameters from the SCS Controller. Wait for the “Ready” indication on the controller.
2. Initialize the motion by sending message 6027 with the Vehicle State flag set to 2. This message may be sent at any time. The time tag should be equal to t0 (but expressed in accordance with the ICD.) The state vector data should be appropriate data applicable at t0.
3. Start the simulation by sending message 6027 with the Vehicle State flag set to 1. This message should be sent at least 30 seconds after the previous message. Its time tag should also be equal to t_0. SCS will start its computation of GPS time at the second 1 PPS pulse after receiving this message, assuming the message was received more than 100 msec before the 1 PPS pulse. (See diagram.)
4. Continue to send message 6027 (with the Vehicle State flag set to 1) until the end of the scenario. These messages may be sent at any rate, but SCS samples them at 500 Hz.
5. End the simulation by sending message 6027 with the Vehicle State flag set to 2. **Note:** If the scenario is going to be rerun without transferring the scenario parameters again, this message must be the initial message sent in step 2 above. After a wait of 30 seconds or more the simulation can be restarted at step 3 above.



The key requirement is how the time tags are computed for the messages sent in step 4. The messages sent before t_0 are irrelevant, since SCS doesn’t begin operation until then. However, the messages after t_0 must be time-tagged with SCS’s value of GPS time. In particular, the message sent at t_0 should have a time tag approximately equal to t_0.

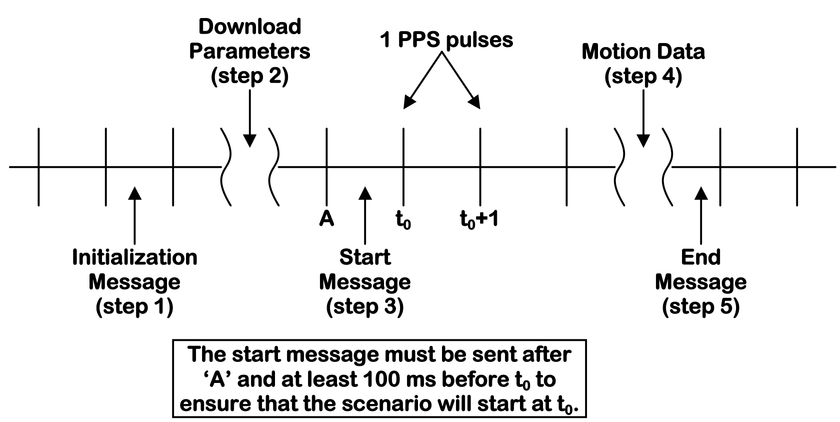
Suppose the external host defines its own time (t) that isn’t synchronized with SCS. Send the start message and record the time (t_1) when it was sent, as well as the elapsed time ($\Delta t = 0$ to 1 sec) since the last 1 Hz SCS pulse. Then the correct time tag t’ for a message sent at user time t is $t' = t - t_1 + t_0 + \Delta t - 2$. Note that it isn’t necessary to monitor the 1 Hz pulses after initialization.

APPENDIX E - UMN/SCRAMNET MOTION PROCEDURE & TIMING

Define the simulation start time (t_0) in the Constellation Truth file. t_0 is expressed in GPS format (week number and time of week). The time of week must be a whole number of seconds.

To use motion data furnished by the external host via UMN or SCRAMNet, the SCS requires five steps:

1. Initialize the motion by sending the UMN/SCRAMNET Input message with the Vehicle State flag set to 2. This message may be sent at any time. The time tag should be equal to t0 (but expressed in accordance with the ICD.) The state vector data should be appropriate data applicable at t0.
2. Transfer the scenario parameters from the SCS Controller. Wait for the "Ready" indication on the controller.
3. Start the simulation by sending the UMN/SCRAMNET Input message with the Vehicle State flag set to 1. Its time tag should also be equal to t_0. SCS will start its computation of GPS time at the next 1 PPS pulse after receiving this message, assuming the message was received more than 100 msec before the next 1 PPS pulse. (See diagram.)
4. Continue to send the UMN/SCRAMNET Input message (with the Vehicle State flag set to 1) until the end of the scenario. These messages may be sent at any rate, but SCS samples them at 200 Hz.
5. End the simulation by sending the UMN/SCRAMNET Input message with the Vehicle State flag set to 2. **Note:** If the scenario is going to be rerun without transferring the scenario parameters again, this message must be the initial message sent in step 1 above. After a wait of 30 seconds or more the simulation can be restarted at step 3 above.



The key requirement is how the time tags are computed for the messages sent in step 4. The messages sent before t_0 are irrelevant, since SCS doesn't begin operation until then. However, the messages after t_0 must be time-tagged with SCS's value of GPS time. In particular, the message sent at t_0 should have a time tag approximately equal to t_0.

Suppose the external host defines its own time (t) that isn't synchronized with SCS. Send the start message and record the time (t_1) when it was sent, as well as the elapsed time (Δt = 0 to 1 sec) since the last 1 Hz SCS pulse. Then the correct time tag t' for a message sent at user time t is $t' = t - t_1 + t_0 + \Delta t - 1$. Note that it isn't necessary to monitor the 1 Hz pulses after initialization.