DGP00814AAA

SPIRENT
Communications

GSS6100

USER MANUAL

Issue 1.00, October 2005

RECORD OF ISSUE

Issue	Date	Reason for Change
1-00	Oct 2005	First issue

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1 INTRODUCTION

Thank you for purchasing a GSS6100 GPS/SBAS Simulator from SPIRENT, world leaders in the field of Satellite Navigation Systems Simulation.

The Global Positioning System (GPS) is based upon a constellation of earth-orbiting satellites supporting world-wide precise positioning, navigation and timing for both terrestrial and earth orbiting vehicles.

Satellite Based Augmentation Systems (SBAS) provide enhanced accuracy, availability and integrity for GPS users in the civil community via one or more geosynchronous satellites. The Wide Area Augmentation System (WAAS) is a system planned for the continental United States. Similar compatible systems are also planned for Europe (EGNOS) and the Far East (MSAS). The GSS6100 fully supports both standard GPS and SBAS.

The GSS6100 is a standalone single-channel L1 C/A code GPS Simulator. It has been designed as precision test equipment for evaluating GPS/SBAS receivers, in the areas of design verification, production test, comparative evaluation, statistical data-generation through extended and repeated tests, and incoming product test.

1.1 GUI OR REMOTE OPERATION

The GSS6100 can be controlled in one of two ways[1]:

- GUI

A user-friendly software package called SimCHAN which communicates with the GS6100 via USB.

- Remote Controll

In this mode, simulation control is via Spirent's proprietary remote command set, which can be applied via IEEE or RS232 interfaces. This command set is closely aligned with Spirent's previous single channels products, the GSS4100 and GSS4700 (STR4775 with IEEE control) so porting existing remote control applications to the GSS6100 is a straightforward exercise.

[1] It should be noted that both modes of operation offer identical control capability.

1.2 REFERENCED DOCUMENTS

a) ICD-GPS-200 The document defining the GPS system space and user segments.

b) STANAG 4294 The NATO equivalent of the above document.

c) NMEA 0183 – Document defining a standard set of navigational messages supported by many GPS receivers.

d) RTCM-SC104 – Document defining a set of differential correction messages accepted by many GPS receivers.

e) RTCA-DO229 Minimum operational performance standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment

1.3 DELIVERABLES

1. GSS6100 GPS/SBAS Signal Generator
2. User Manual (This book)
4. SimCHAN software on CD-ROM
5. USB cable
6. Power cables (Country specific)
7. SPIRENT mouse mat

2 SOFTWARE INSTALLATION

The SimCHAN software controls the GSS6100 via the USB. The SimCHAN USB interface uses the Microsoft Plug and Play Manager to install a GSS6100 USB driver. In consequence the SimCHAN software must be installed BEFORE the GSS6100 is connected to the PC. The Plug and Play system will then automatically install the driver the first time that the GSS6100 USB cable is plugged in.

2.1 SOFTWARE INSTALLATION PROCEDURE

Leave the GSS6100 switched off.

To install the operating software on your system hard disk, place the supplied CD into the CD-ROM drive. The SETUP program will normally auto-run, if it does not then simply run the application SETUP.EXE in the root directory on the CD.

This will start an InstallShield script that will guide you through the Installation process.

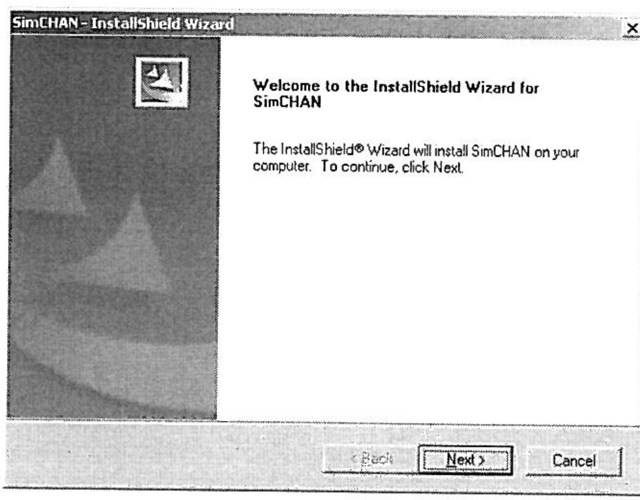


Figure 1 Installation Welcome

The Welcome screen confirms that you are about to install the SimCHAN software. You progress through the installation stages by clicking on the

Next button. You may backtrack the stages to change items you have entered or selected by clicking the Back button. Cancel aborts the installation.

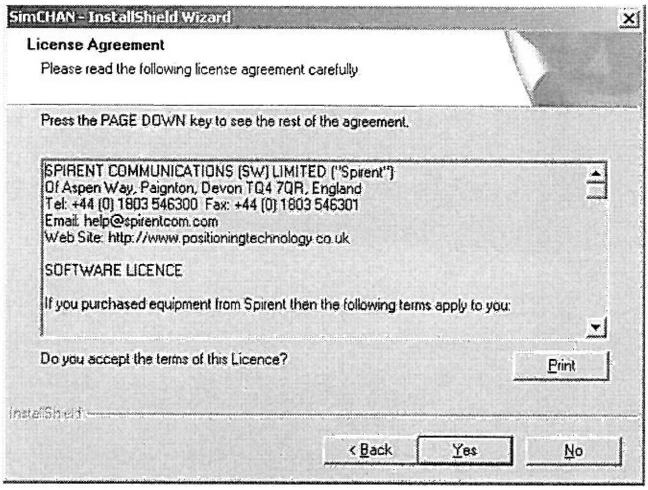


Figure 2 Agree Software Licence Conditions

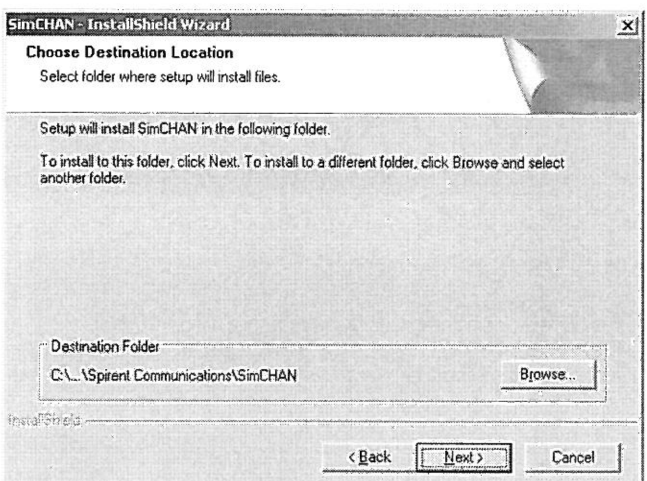


Figure 3 Installation Folder

The Installation program will offer to install the SimCHAN software in a sub-folder of C:\Program Files. You may select another location or folder name by clicking the Browse button.

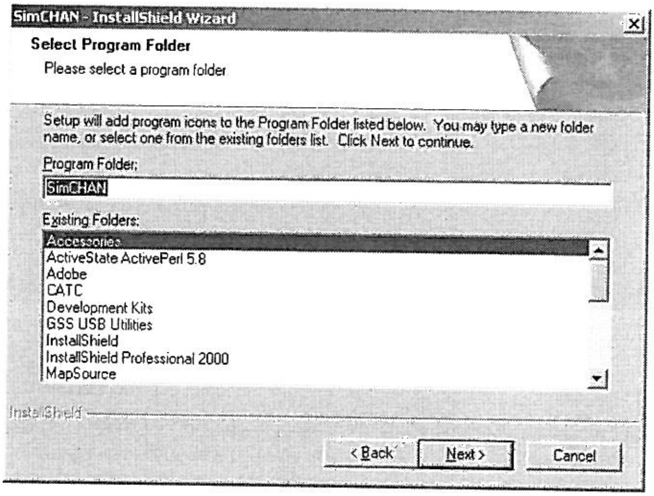


Figure 4 Start Menu Folder

The Installation program creates shortcuts that may be used to start SimCHAN. The start menu shortcut will be called SimCHAN and will be placed in a new Spirent Communications folder. You elect to have the shortcut placed in another existing folder by selecting it from the list.

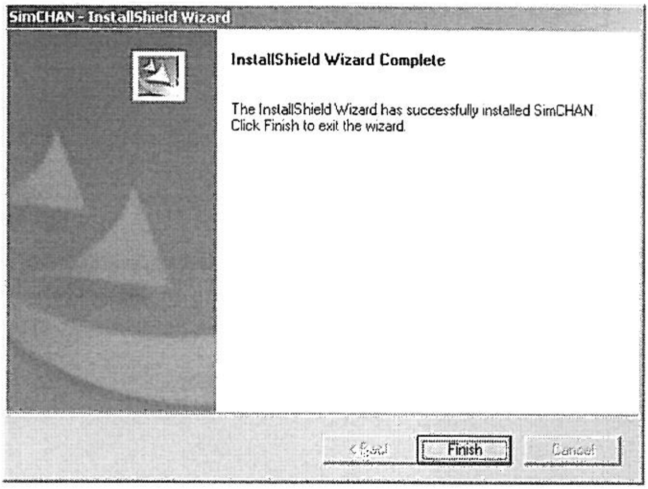


Figure 5 Confirmation Installation Complete

Once the folder selections are accepted the Installation proceeds to copy the files. In addition to the SimCHAN program files, two driver files are also copied to system folders. A file GSS6100.INF is added to the Windows\INF or WINNT\INF folder and a file GSS6100.SYS is added to Windows\System32\Drivers or WINNT\System32\Drivers. These two driver files will be recognised by the Plug and Play process and become active when the GSS6100 is connected to the USB port.

It will not be necessary to reboot the PC.

If it becomes necessary to remove the SimCHAN software, re-activate the Installation program by either inserting the Installation CD or via the Add/Remove Programs facility in the PC's Control Panel folder. The initial installation creates an Uninstall file that enables the installed files to be identified and removed.

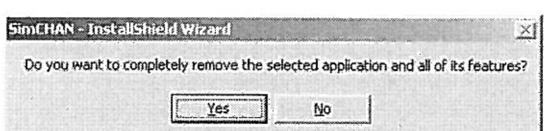


Figure 6 Confirm Uninstall

The Uninstall program will prompt you to confirm that you wish to perform this action. The Uninstall program removes the files created by the

Installation process and any folders that are thus left empty. If further files have been added to these folders since installation then they will be left in place and the folders will not be deleted.

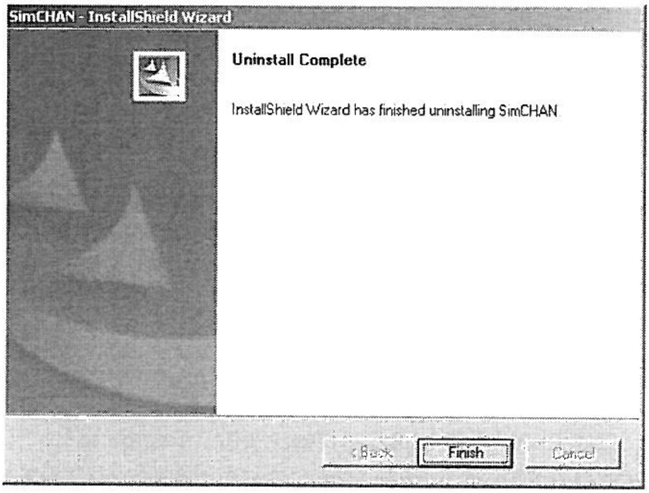


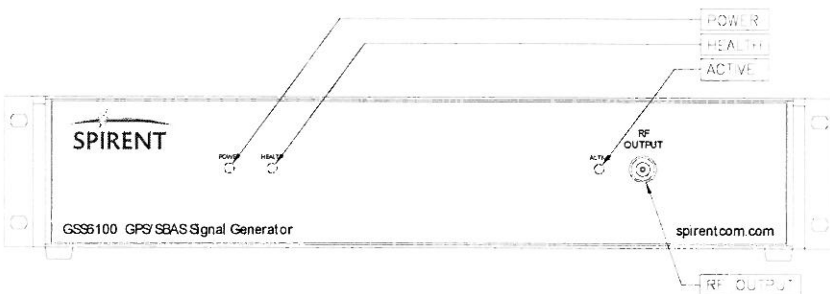
Figure 7 Uninstall Complete

The Uninstall process will confirm successful completion.

3 HARDWARE OVERVIEW AND INSTALLATION

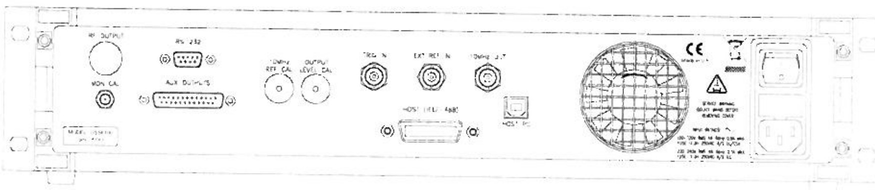
This section gives a brief overview of the indicators and connectors on the GSS6100 and how to connect it to the host PC. Signals are fully characterised in the Technical Specifications, Appendices C, D, and E.

3.1.1 FRONT PANEL



POWER	LED	ON when power is connected and internal power supply is operational.
HEALTH	LED	ON unless the internal monitoring detects: a) An error, in which case it flashes at a 1Hz rate. b) Whilst acquiring external reference lock, when it flashes at a 4Hz rate.
ACTIVE	LED	ON when a simulation is in progress. Flashes when awaiting an external trigger signal on rear panel TRIG IN
Primary RF Output	'N' Type connector	Provides a composite GPS/SBAS signal

3.1.2 REAR PANEL



Connector	Type	Description
MON/CAL Output	SMA female connector	Provides a high level version of the front panel RF output.
AUX OUTPUT	25 way Dtype	See Appendix C.
TRIG IN	BNC	Allows an external trigger signal to start a simulation.
EXT REF IN	BNC	Allows unit to be locked to an external frequency reference.
10 MHz OUT	BNC	Internal OCXO reference output.
HOST (USB)	USB downstream connector	Control and data connection to the host PC.
RS232	9 way Dtype	Control and data connection to a remote terminal.
HOST (IEEE488)	IEEE488	Control and data connection to a remote terminal.
Power in/switch/fuse	IEC	Power in, refer to Appendix C

Further details of these connectors are given in Appendix C.

3.2 INSTALLATION AND CONNECTION TO HOST PC

When the software Installation is complete you may proceed to power on the GSS6100 and connect, via, your chosen interface to the controlling host PC, either USB for SimCHAN Software operation or RS232 / IEEE.488 cable for remote control[2].

The power input to the GSS6100 is auto sensing for 100-120V or 220-240V operation. Connect the power cord to the GSS6100.

Turn on the GSS6100.

After a brief power-up sequence the POWER and HEALTH LEDs on the GSS6100 front panel illuminate continuously to show that everything is operating correctly.

If you have opted for remote control, the unit is now ready for operation.

If you have opted for SimCHAN software control the Plug and Play process will recognise that a new device is connected to the USB bus and search for the device's driver. A message box with the legend 'Found New Device' is displayed, this will change to indicate device 'GSS6100 L1 Simulator' found and the message box will then close. If you are running Windows 2000 an icon will appear in the system tray on the Taskbar. If you position the cursor over this icon a list of the connected USB devices will appear.

Start the SimCHAN software by double clicking the SimCHAN Icon on the desktop or via the shortcut in the Start Menu.

[2] It should be noted that new users to the GSS6100 may benefit from using SimCHAN before moving onto remote operation as they may find simulation set-up, control and adjustment via the GUI initially more instructive.

3.3 SAFETY NOTICE

PRODUCT TITLE : GPS/SBAS Signal Generator
PRODUCT CODE : GSS6100
DATA SHEET No : N/A

PRODUCT SAFETY INFORMATION SHEET

This safety Information Sheet should be read in conjunction with the Product Data Sheet (where applicable).

Failure to observe the ratings and the information on this sheet may result in a safety hazard.

This PSIS applies to the signal generator unit of the simulator only. For information on the computer workstation (where applicable) see safety section of the manufacturer's handbook.

1.MATERIAL CONTENT
This unit contains Printed Circuit Board semi-conductor assemblies. Materials contained within the unit include PTFE, ABS and epoxy/glass laminate.

2.PHYSICAL FORM
The equipment is housed in a vented aluminium enclosure.
Enclosure dimensions are 449mm x 386mm x 89mm
Total weight of the Simulator Unit is 5kg (approx).

3.INTRINSIC PROPERTIES

(a) Non-operating
Safe, when isolated from primary power source.

(b) Operating
Removing fixed panels during operation presents an electric shock hazard. Fixed panels may only be removed by suitably qualified personnel. High voltage hazard warning labels are affixed to the outside of the Unit.

WARNING: This equipment must be earthed.

4.FIRE CHARACTERISTICS

Primary
Overload conditions could present a fire hazard.
The limiting oxygen index value of the glass/epoxy laminate is 25-32.
Protection circuits incorporated minimise the overload and/or component failure hazards.
The case is vented to minimise heat and gas concentration.

(b) Secondary
Under overload conditions the external finishing paint will burn. Excessive overload/heating of materials will cause emission of toxic gases.

5.HANDLING
The unit is sensibly robust but dropping or excessive vibration may lead to immediate damage or later component failure with consequent damage.
The portable unit weighs 5kg (approx).
The unit is supplied in an approved design package to minimise damage in transit.

6 STORAGE
Care should be observed when storing to ensure units cannot be subjected to environmental conditions in excess of those given in the relevant data.
Units should not be stored in conditions exceeding the temperature range of -20°C to +60°C.

7.DISPOSAL
Disposal of the unit should be accordance with the toxic waste disposal procedure, current at the time of disposal.
Units must not be incinerated due to the presence of PTFE which would emit toxic fumes.

8.UNSAFE USE
Electric shock hazard is present if panels are removed during operation. Fire hazard could occur during overload conditions.
Replacement fuses should be of the correct rating and type to minimise overload conditions.
Toxic fume hazard possible if unit is overheated from internal or external source.
Mechanical hazard can occur if the unit is mishandled or incorrectly secured.
Under damage conditions do not use.

3.3.1 EMC AND SAFETY COMPLIANCE

The GSS6100 complies with the Low Voltage Directive 73/23/EEC by application of the harmonised standard EN60950.

The GSS6100 complies with the EEC EMC Directive 89/336/EEC by application of the following harmonised standard:

EN61326-1 Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements.

4 PRINCIPLES OF OPERATION

4.1 OVERVIEW

The GSS6100 Simulator requires instructions to configure and commence a simulation, from either the SimCHAN software via the USB or by command sequences transmitted to the IEEE.488 (GPIB) or RS232 ports.

Regardless of which method of control is selected the simulator has three software states, **Halt**, **Arm** and **Run**.

Essentially, whilst in the Halted State the user configures the next simulation run, i.e. selects the satellite PRN number, navigation message parameters (TOW, Week Number), initial power/velocity and any hardware conditions such as external reference lock or external trigger control. Once all those attributes have been set, the simulator is ARMed. The ARM mode is an interim step prior to RUNing to configure the hardware and to allow the user an opportunity to make any final adjustments to certain parameter types. Finally, once in the RUN state the Simulator is actually operational, i.e. the all requested simulation characteristics will be present on the RF output port. Whilst in the RUN mode many parameters can be re-adjusted and controlled to suit whatever simulation profile is required. At the end of the run the simulator is again Halted and the process repeated as required.

Now that the basic fundamentals have been considered the following sub-sections work through each of the available simulation and hardware control parameters. For clarity these descriptions revolve around the GUI software, but for ease of use a cross-reference to all applicable remote control commands is also included.

A full alphabetical listing of all the remote control commands can be found in section 5.

4.2 GUI INTERFACE

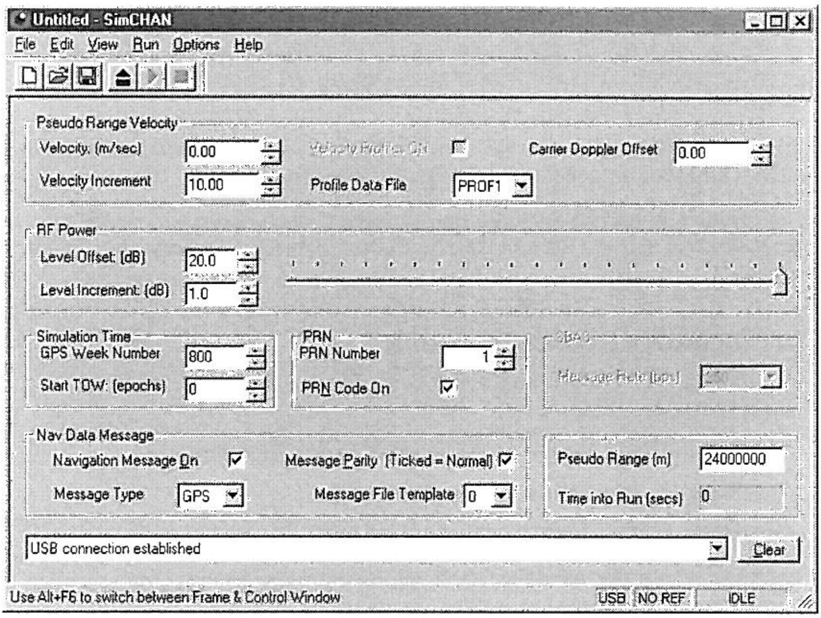


Figure 8 SimCHAN Display

The SimCHAN software allows the operating parameters of the GSS6100 to be set and adjusted in real time and any responses to be displayed.

The display has three main elements:

- The Outer Frame with Drop Down Menus and Toolbar,
- The main Control Display,
- Status Bar

4.2.1 ENTERING PARAMETERS

The interface uses a combination of the standard Windows Edit fields, toggled button controls, and drop-down list selection controls.

Data values may be entered directly to the Edit fields by selecting the field, typing the value and then pressing the Enter key. Alternatively most fields are equipped with Spin button controls (Up/Down arrow buttons) that can be selected to scan through the range of allowed values. The Spin buttons may be operated by the mouse or by the keyboard cursor keys. The Velocity and RF Power fields each have an associated Increment field that adjust the step size of changes to the main Velocity and RF Power ranges. This allows the Velocity & RF power fields to be varied by both fine and coarse increments. The RF Power may also be set by the horizontal slider control.

Some parameters have just two states and these are operated by selecting the Check marks on or off to enable or disable the function.

Other multiple choice selections are made from drop-down lists. Here the user opens the list and then picks one of the options to become the active selection.

4.2.2 CONTROLLING SIMULATIONS

The Arm, Run and Halt control actions may be invoked in each of three ways to suit user preference:

By selecting with the mouse or keyboard from the Run Menu.

By clicking the buttons of the application Toolbar.

By the Hot keys: Ctrl+A, Ctrl+R and Ctrl+H.

In common with most Windows applications you may find that the mouse is the most useful method of control.

N.B. Due to a limitation of the Windows interface the Hot keys and keyboard menu actions are only effective when the application frame is active, i.e. the Title bar is highlighted. The standard Windows Hot key Alt+F6 toggles the frame to the active state.

4.2.3 HELP

Clicking on the Help option allows the user to select this document in HTML format.

In addition the Status bar will show a prompt appropriate to the screen element under the mouse cursor.

4.2.4 STATUS BAR

In addition to the Quick Help prompts the Status Bar has fields that show:

- The Application/ Simulation state,
- Internal/External Frequency Reference signal,
- Presence of a working USB connection.

4.2.5 MAKING AND USING STANDARD SIMULATIONS

The Control application follows the document paradigm. As the user applies parameter settings these are recorded in an internal document. This document may be saved to disk using the File menu options, and is given the extension .GSS by default. Documents saved in this manner may be loaded while the application is not running a simulation thereby setting the simulation parameters to a known state with the minimum of effort.

Following this document analogy the New document options reset the application parameters to the basic default states.

4.2.6 SELECTING GPS OR SBAS SIMULATION MODE

*[Remote Command:, **SIGT** see section 5.1.31]*

Under the Nav Data Message settings for Message Type, select either GPS or SBAS from the drop-down list.

On the GPS setting the RF signal from a GPS type satellite will be simulated and the control options appropriate to GPS are activated.

On the SBAS setting the RF signal from an SBAS type satellite will be simulated and the control options appropriate to SBAS are activated.

4.2.7 SIMULATION CONTROL

The primary method of control is via the application Toolbar.

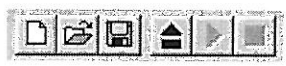


Figure 9 Control Bar

The toolbar offers a quick method to execute the basic control functions of ARM, RUN and HALT.

It also gives access to the document functions of:

 New — Close any open parameters document and Reset Simulation Parameters.

 Open — Offers the standard Windows document location Window to select a file.

 Save — Records the current parameters to an open file or prompts for a new name.

4.2.7.1 ARM the Simulation

*[Remote Command: **ARMS** see section 5.1.6]*

Select the ARM button to load the selected simulation parameters to the GSS6100 and to prepare for a simulation run. Completion of the Arming sequence is indicated by the Status 'Ready to Run'.

4.2.7.2 Start the Simulation Running

*[Remote Command: **RUNS** see section 5.1.28]*

This button releases the GSS6100 to begin the prepared simulation. Independent of mode (see section 4.5.1.2) the user **must** use this button to start the simulation.

It should also be noted that the front panel 'Active' LED will become illuminated[3].

To return to the idle state without running the simulation, select the Halt button.

[3] The time at which the RUN command is actioned in the hardware is dependent upon the selected Ext Trigger mode. The simulation start time will coincide with the next rising edge of 1PPS OUT, if Ext Trigger is 'disabled' or in 'delayed' mode, or immediately if Trigger mode 'immediate' has been selected.

4.2.7.3 Halt the Simulation

*[Remote Command: **HALT** see section 5.1.12]*

The Halt button aborts the simulation in progress or terminates the Ready to Run state and returns the Application to the Idle state, allowing parameters to be altered if desired.

4.2.8 PSEUDO RANGE (DOPPLER) VELOCITY

*[Remote Command: see **VCTY** section 5.1.38]*

This value is the rate of change of the Satellite's simulated Pseudo Range in metres per second. The allowed values range from -15000.00 to +15000.00 at a resolution of 0.01 meters per second.

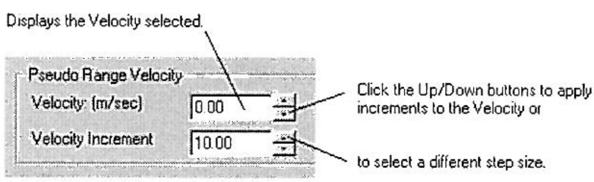


Figure 10 Setting Pseudo Range Velocity

The velocity may be set by typing the desired value and pressing the Enter key or by clicking the Up or Down arrow buttons next to the value. On clicking these buttons the value shown in the Pseudo Range Increment field will be added or subtracted to the Pseudo Range Velocity.

4.2.8.1 Stepping Rate for the Pseudo Range Velocity

This value is added or subtracted from the Pseudo Range Velocity when an Up or Down arrow next to the Pseudo Range value is clicked.

The value may be set to any value in range by typing a new value and pressing Enter or by clicking on the Up or Down arrow buttons next to the value.

The allowed values range from 0.01 to 5000.00 metres per second.

4.2.8.2 Stepping through the Range of Pseudo Range Velocity

The Up and Down arrow controls next to the Velocity display may be used to step the velocity from –15000.00 through to +15000.00 m/s. The step size may be adjusted by setting the Increment value in the control below.

When the Pseudo Range Velocity edit box is the active control (i.e. its value is highlighted) the Up and Down arrow controls will respond to the keyboard up and down cursor keys in addition to mouse clicks when the screen cursor is placed over the up or down control.

4.2.9 ENABLE OR DISABLE A VELOCITY PROFILE

*[Remote Command: **PROF** see section 5.1.24]*

This option only becomes available when the simulation is running.

On selecting this option the Profile with the identifier shown is activated and used to superimpose a cyclic sequence of changes to the Pseudo Range Velocity in force.

The sequence will continue to be applied until the user cancels this option.

4.2.9.1 Selecting the Required Velocity Profile

*[Remote Command: **PFIL** see section 5.1.23]*

Click on the arrow button to show a drop down list of the Profile Identifiers available.

Eight standard profiles (PROF1 through PROF8) are incorporated in the GSS6100 firmware.

These correspond to the Standard Receiver Performance Test profiles defined in ICD-GPS-204.

4.2.10 CARRIER DOPPLER OFFSET

[Remote Command: **VCTY** *section 5.1.38]*

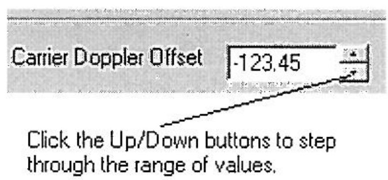


Figure 11 Setting Carrier Doppler Offset

The Carrier Doppler Velocity Offset can be used to simulate Ionospheric delay type effects by applying a fixed doppler velocity offset to the current carrier doppler velocity. The code Doppler velocity remains unchanged.

The value has a range from –1000.00 through +1000.00 to a resolution of 0.01 m/s.

It may be set by entering a value and pressing the Enter key or by selecting the Up and Down arrow buttons next to the control. The buttons also respond to the keyboard up/down cursor keys.

4.2.11 RF POWER LEVEL

[Remote Command: ***LEVL*** *see section 5.1.15]*

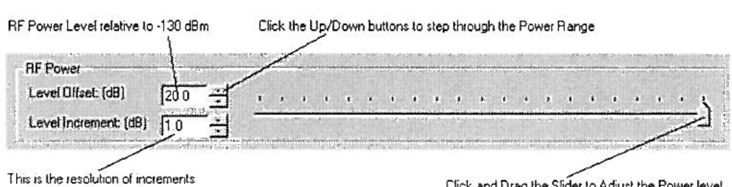


Figure 12 Setting RF Power Level

The RF Output power level may be varied to + or – 20.0 dB of the base level to a resolution of 0.1 dB.

The level may be set by entering a value and pressing the Enter key on the keyboard, by clicking and holding the Up/Down arrow buttons next to the control or by dragging the associated slider control. The buttons also respond to the keyboard up/down cursor keys when this is the active control. If a value is entered that is outside the allowed range, it will be truncated to the limit value.

The Up and Down buttons increment and decrement the level by a value defined by the step size control below the level control. The Up or Down buttons just add or subtract the increment value, the slider also forces the level to a multiple of the selected increment value.

4.2.11.1 Stepping Rate for the RF Power Level controls

A stepping rate or increment value may be set by entering a value and pressing the keyboard Enter key. Any value may be set including values greater than the RF Power Level range of 40.0 dB.

Alternatively a value may be selected from the range of pre-defined values by selecting the Up/Down arrow buttons next to the control.

4.2.11.2 RF Power Control

The RF Power Slider Control allows the level to be set quickly and easily by either dragging the slider with the mouse cursor or by pressing the left/right keyboard cursor keys. The slider control adjusts the level to values that are multiples of the Stepping Rate defined for the RF Power Level.

If a user defined Stepping Rate is in force, to avoid discontinuities at the range limits the value used is the nearest pre-defined Stepping Rate value rather than the user's value.

To adjust the power level by fine amounts ensure that a small stepping rate is selected.

4.2.12 GPS WEEK NUMBER

*[Remote Command: **WEEK** see section 5.1.39]*

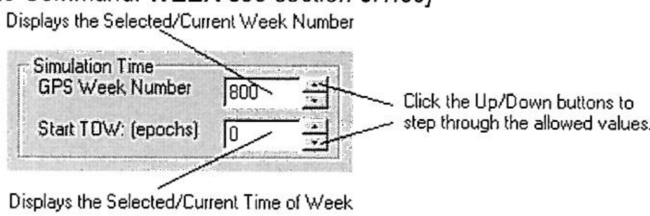


Figure 13 Setting Simulation Time

This parameter is closely linked with the start of week since it defines the GPS week for the simulation. GPS week zero is defined as starting at 00:00 hours, Sunday 6th January 1980.

For example, the default value of 800 corresponds to the week starting Sunday, 7th May 1995. GPS week numbers greater than 1023 will be truncated internally modulo 1024, i.e. Week 1025 is treated as week 1.

The week number may be entered as a value between 0 through 9999, by typing the number and pressing the Keyboard Enter key or by clicking the Up and Down arrow buttons next to the control. The arrow buttons also respond to the Up and Down cursor keys on the Keyboard.

The Up/Down buttons apply acceleration i.e. the rate at which the week value increments or decrements increases if a button is held for a period, being initially in units, then tens, then hundreds and later in thousands.

4.2.13 TIME OF WEEK

*[Remote Command: **ZCNT** see section 5.1.41]*

This value is the time into the week expressed in GPS Epochs that will be applied at the start of the simulation. When the simulation is running, this value increments to show the current Time of Week.

The time may be entered by typing the desired value and pressing the Enter key or by clicking the Up or Down arrow buttons next to the value. The allowed values range from 0 through 403196 in steps of 4 GPS Epochs.

1 GPS Epoch = 1.5 Seconds

4.2.14 PRN NUMBER

*[Remote Command: **SVID** see section 5.1.34 & **SG2D** see section 5.1.30]*

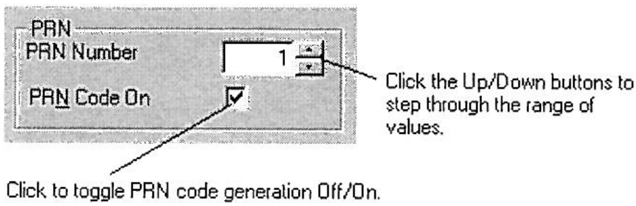


Figure 14 Setting The PRN

The Pseudo Random Noise (PRN) Number defines the C/A code for the satellite being simulated and equates to the SV ID (Satellite Vehicle Identity).

The PRN value is constrained to the range 1 to 37 for GPS type satellites and 120 to 138 for SBAS satellites.

The application offers a default value of 1 for the GPS constellation and 120 for an SBAS constellation.

The value may be selected by typing a value and pressing the Enter key on the keyboard or by clicking the Up and Down arrow buttons next to the control. The Up/Down buttons will also respond to the keyboard up/down cursor keys.

4.2.14.1 PRN Code Selection

The GSS6100 is capable of generating any one of the 1023 possible random sequences associated with the GPS C/A encoder. Each sequence or code is determined by the start conditions of the G1 and G2 encoders. The G1 encoder is hardwired to start in the all one state, the G2 encoder, can start in any state except all zeros. The G2 start conditions can be described by a 'G2 delay'. This G2 delay can take on values between 0 and 1022. By convention several of the 1023 codes (mainly codes with good orthogonal properties i.e. Low cross correlation) have had assigned to them PRN numbers. The table overpage details the PRN assignments to date.

PRN No.	Assignment
1-37	GPS
38-61	GLONASS
62-119	Future GLONASS
120-140	GEO/SBAS
141-210	Future GNSS/GEO/SBAS/Pseudolites

The SimCHAN software constrains the PRN assignment to the values allocated for GPS or SBAS satellites.

4.2.14.2 Enable or Disable PRN code

*[Remote Command: **COSW** see section 5.1.8]*

PRN code generation may be suppressed by clearing the check mark against the 'PRN Code On' button.

This may be achieved by clicking with the mouse or by pressing the Tab key until the 'PRN Code On' legend is surrounded by a dashed rectangle, indicating that it is the active control, and then pressing the space bar or by pressing the 'Hot Key' Alt+N.

4.2.14.3 Navigation and Correction Data Messages

*[Remote Command: **NDSW** see section 5.1.19]*

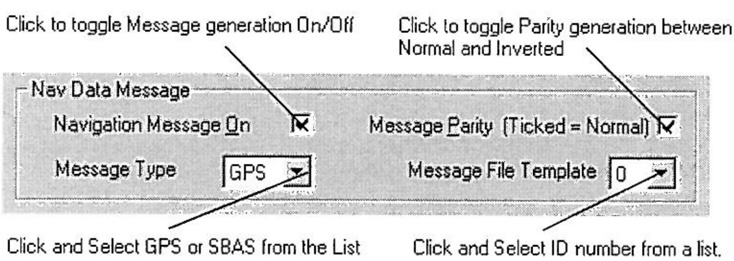


Figure 15 Navigation Message Controls

Generation of the Navigation Message may be suppressed by clearing the check mark against the 'Message On' button.

This may be achieved by clicking with the mouse or by pressing the Tab key until the 'Message On' legend is surrounded by a dashed rectangle, indicating that it is the active control, and then pressing the space bar or by pressing the 'Hot Key' Alt+O.

4.2.14.4 Selecting Parity Normal/inverted for the Navigation Message

*[Remote Command: **PRTY** see section 5.1.26]*

Parity errors may be simulated on the Navigation Message by clearing the check mark against the 'Message Parity' button. This inverts each parity bit, thus invalidating it.

This may be achieved by clicking with the mouse or by pressing the Tab key until the 'Message Parity' legend is surrounded by a dashed rectangle, indicating that it is the active control, and then pressing the space bar or by pressing the 'Hot Key' Alt+P.

Note: The data message is buffered in hardware. When the parity status is changed whilst the simulation is running a delay will elapse before the change is reflected in the RF output. It is recommended that this feature be only set up while the application is idle without a simulation in progress.

4.2.14.5 Selecting a Message Definition file

*[Remote Command: **NSEL** see section 5.1.22]*

The GSS6100 has provision to store up to 8 Message Definition Templates in its Flash memory storage. These memory slots may be filled with four GPS Navigation Message Templates and four SBAS Correction Data message Templates. When the GPS constellation is selected then Templates for GPS Navigation Messages are selected; otherwise SBAS Correction Message Templates are selected.

An ID number in the range 0 to 3 identifies the Templates. The Template ID shown will be the active selection during a simulation and used to generate the Navigation/Correction message component of the RF signal.

To select a file using a mouse: click the down arrow button to open the list of file then click on an ID number to make it the active selection.

To select a file using the keyboard: tab through the various controls until the Message Definition file control is highlighted. Then use the up/down cursor keys on the keyboard to move the highlight to the desired ID Number, and then press the Enter key on the keyboard or the tab to mark that ID as the active selection.

4.2.15 SBAS MESSAGE TRANSMISSION RATE

*[Remote Command: **WRTE** see section 5.1.40]*

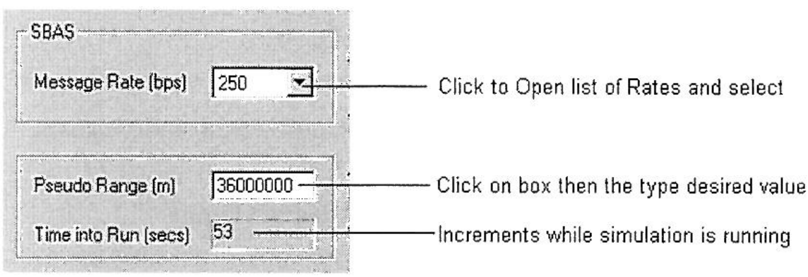


Figure 16 Setting SBAS Data Rate

The rate may be varied for SBAS type simulations only. The value shown as the active value will control the rate at which the Correction message is transmitted during an SBAS type simulation.

There are four rates available: 50, 100, 125 and 250 data bits per second with 250 bps being set by default, equivalent to 500 symbols per second when forward error corrected.

To select a rate using a mouse: click the down arrow button to open the list of rates then click on a value to make it the active selection.

To select a rate using the keyboard: tab through the various controls until the Message Transmission Rate control is highlighted. Then use the up/down cursor keys on the keyboard to move the highlight to the desired value, and then press the Enter key on the keyboard or the tab to mark that value as the active selection.

N.B. The Message Transmission rate for GPS satellites is fixed at 50 bps.

4.2.16 TIME INTO RUN IN SECONDS

This shows the elapsed time into the simulation in seconds.

4.2.17 INITIAL PSEUDO RANGE

*[Remote Command: **IPRG** see section 5.1.14]*

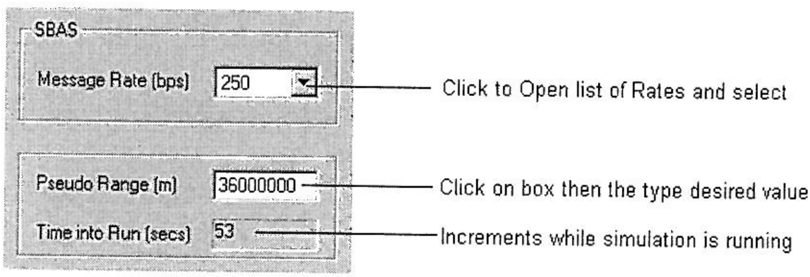


Figure 17 Setting The Initial Pseudo Range

This value may be set while the simulation is idle only. It simulates the distance between the receiver and the satellite at the start of the run. This ranging effect is produced by delaying the start of the PRN and data message signals to simulate the desired pseudo range. The time delay is relative to rising edge of the 1PPS OUT signal (Ext Trigger mode 'disabled' or 'delayed' or relative to the External Trigger pulse itself if Trigger mode 'immediate' has been selected, (see section 4.5.1.2).

The pseudo range can take any value between 0 and 99999999 metres (equivalent to 333 ms time delay) and has a resolution of 1 metre.

To set the value: select the control with the mouse or by tabbing through the various controls until it is highlighted. Type the required value and press the Enter key on the Keyboard.

4.2.18 LOG OF PROMPTS, WARNINGS AND ERRORS

*[Remote Command: **BITE** see section 5.1.7]*

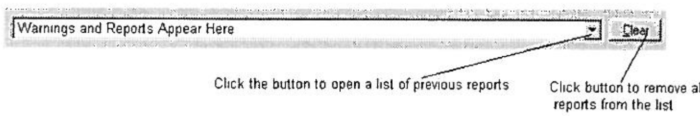


Figure 18 Warning & Prompts Log Window

The application will display single line texts describing events that occur during execution of the program. The texts are stored in time sequence with the latest on display. The record of events may be viewed by selecting the down arrow button to open the list and then operating the scrollbar to scan the recorded events.

The record of events may be cleared by clicking the Clear button.

4.2.18.1 Removing the stored Warning and Error Message Texts

Clicking the Clear button will remove all the event texts recorded in the Log Window.

It is not normally necessary to do this as the application will automatically remove the oldest records but may be useful to confirm that no new events are occurring.

4.2.19 VELOCITY PROFILES

*[Remote Command: **PROS** see section 5.1.25]*

The velocity profiles are described in terms of maximum jerk (A), maximum acceleration (E), constant acceleration period (C) and constant velocity period (D). The profile takes the form of a series of step jerk periods of equal amplitude and period. These jerk periods then translate into acceleration, velocity and finally range profiles.

Maximum Jerk, A, units: m/s^3
Jerk Period, B, units: s
Constant acceleration period, C, units: s
Constant velocity period, D, units: s
Maximum acceleration, E, units: m/s^2

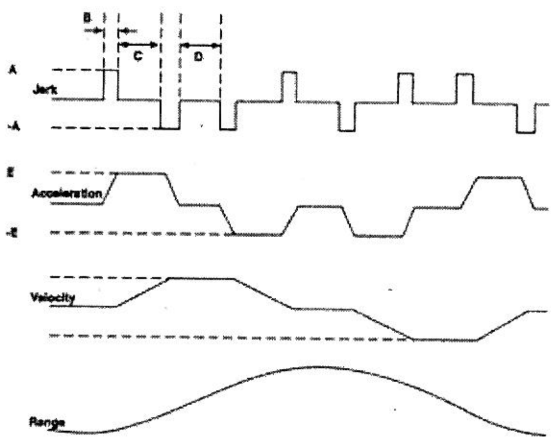


Figure 19 Velocity Profile Elements

Note: The velocity profile has been drawn showing either constant or linearly changing velocity. It should be noted however, that during the jerk period (period of linearly increasing/decreasing acceleration) the velocity will actually be changing non-linearly. These effects are fully modelled by the GSS6100.

The profile is documented in The Standard Receiver Performance Tests, ICD-GPS-204, and comprises the following sequence:

Constant Initial Velocity Period (D)

Positive Jerk Period (B = Max Acceleration/ Maximum Jerk (A))

Constant Acceleration Period (C)

Negative Jerk Period (as ii)

Constant Positive Velocity Period (D)

Negative Jerk Period (as ii)

Constant Deceleration period (C)

Positive Jerk Period (as ii)

The profile then repeats but with the Jerk sign reversed, producing negative velocities. Finally, the entire profile repeats from the start.

The four input parameters are:

Jerk amplitude (range –100 to +100m/s^3), Zero Jerk is not allowed.

Maximum acceleration (range –100 to +100m/s^2)

Period of constant acceleration (0 to 540 seconds)

Period of constant velocity (0 to 540 seconds)

The velocities generated by the profile are in addition to any fixed velocity specified. The maximum achievable velocity is +/-15000m/s. All values exceeding these limits will be clipped to the appropriate maximum velocity.

The eight receiver velocity profile tests documented in The Standard Receiver Performance Tests, ICD-GPS-204 are included on the distribution diskette as read only files PROF1.DAT through to PROF8.DAT.

Note: Jerk period = (max acceleration / 10msecs)

The jerk application period must be divisible by the interrupt step size, i.e. 10ms. To ensure this case is always true the entered jerk is modified accordingly. For example a jerk value of 20 m/s^2 and acceleration of 15.5 m/s^2 produces a jerk period of 0.775 seconds. This value is not divisible by 10ms and so the jerk period will be rounded down to 0.770 seconds and the jerk will be modified to 19.4805m/s^3.

4.3 NAVIGATION DATA TEMPLATES

The GPS Navigation message and the Correction Data message in SBAS mode are generated from templates stored in the GSS6100 flash memory. A template is provided for each of these modes that should suffice for most test purposes. These are pre-loaded to the GSS6100 before delivery and are also provided as ASCII test files.

The GPS Navigation Message carries date and time information that increments at the 6 second GPS Epoch rate. This is inserted automatically by the GSS6100 to match the simulation time. The parity field is also computed dynamically by the GSS6100 but data other than the Epoch time remains fixed.

To allow users to adjust data fields to meet specific testing requirements there is provision for users to load a further 3 templates of each type. This may be achieved by either the NSAV command or via the GUI Interface and USB.

The Templates are plain text files and may be examined and altered by any basic editor program such as Windows Notepad. Save the modified Template to the SimCHAN program folder (Typically C:\Program Files\Spirent Communications\SimCHAN). A GPS Navigation message Template must be of type *.NAV and an SBAS Correction data message of type *.WAS.

To load a Template open the Load Navigation Message Template screen from the Options Menu.

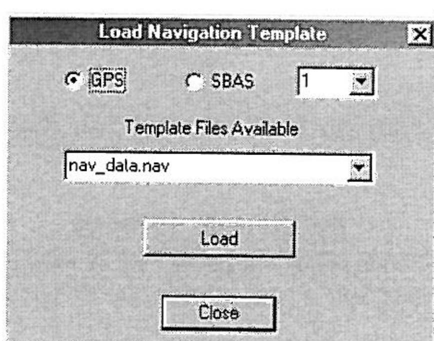


Figure 20 Loading a Navigation Message Template

Select the type of template to be loaded, either GPS or SBAS. SimCHAN will display the Templates available in the SimCHAN folder.

Select the ID number of the GSS6100 flash memory location that will hold the Template. There are four locations numbered 0 to 3. ID number 1 is offered as the first choice to discourage you from overwriting the GSS supplied Template pre-loaded in Template number 0.

Select Load to transfer the file.

For a full description of default message parameters and how to define user *.NAV and *.WAS files see Appendices G, H and I.

4.3.1 NAV DATA FILES & WINDOWS XP

For SimCHAN installations under Windows XP, user-defined Nav Data files must be saved in the following location to enable their use in SimCHAN:

C:\Documents and Setting\All Users\Application Data\Spirent Communications\SimCHAN\

In the Load Navigation Message Template screen, the full path and filename for user-defined Nav Data files must be entered:

eg. C:\Documents and Setting\All Users\Application Data\Spirent Communications\SimCHAN\filename.nav

4.4 AutoGO MODE

The GSS6100 has an alternative operating mode that when enabled causes the unit to commence running a stored scenario immediately it is powered on, without any external command.

To enable AutoGO mode:

a. Start SimCHAN and ensure the GSS6100 is connected,
b. Using the GUI controls apply the desired Initial settings,
c. On the Options menu select 'Set AutoGO'
d. The cursor will change to an Hourglass while the settings are applied.
e. The Options menu will now show 'Disable AutoGO' indicating that the unit is set to run in the alternate mode.
f. Now when the GSS6100 is powered on the unit will immediately commence running using the stored settings.

If SimCHAN is started while the GSS6100 is operating in AutoGO mode, SimCHAN will display the initial setting that are stored in the unit's flash memory. The unit will continue to run with SimCHAN active but SimCHAN will not display the running state or update the scenario time displays to reflect the progress of the scenario.
To stop the automatic run and use SimCHAN, click the ARM button and then the STOP button and the unit will halt. SimCHAN may then be used normally and the unit will still start in the saved settings on being powered on, unless AutoGO is disabled.

To disable AutoGO mode:

a. Start SimCHAN and ensure the GSS6100 is connected,
b. On the Options menu select 'Disable AutoGO'
c. The cursor will change to an Hourglass while the settings are deleted from the unit's flash memory and the normal operating mode is enabled.

Limitations of AutoGO mode.
External Trigger cannot be utilised.
If an external reference frequency signal is applied there will be a period after the unit starts running when the RF signal is disturbed and out of specification. This will continue until the unit locks to the reference signal, during this period the Health LED on the front panel will flash.

4.5 HARDWARE SETTINGS DISPLAY

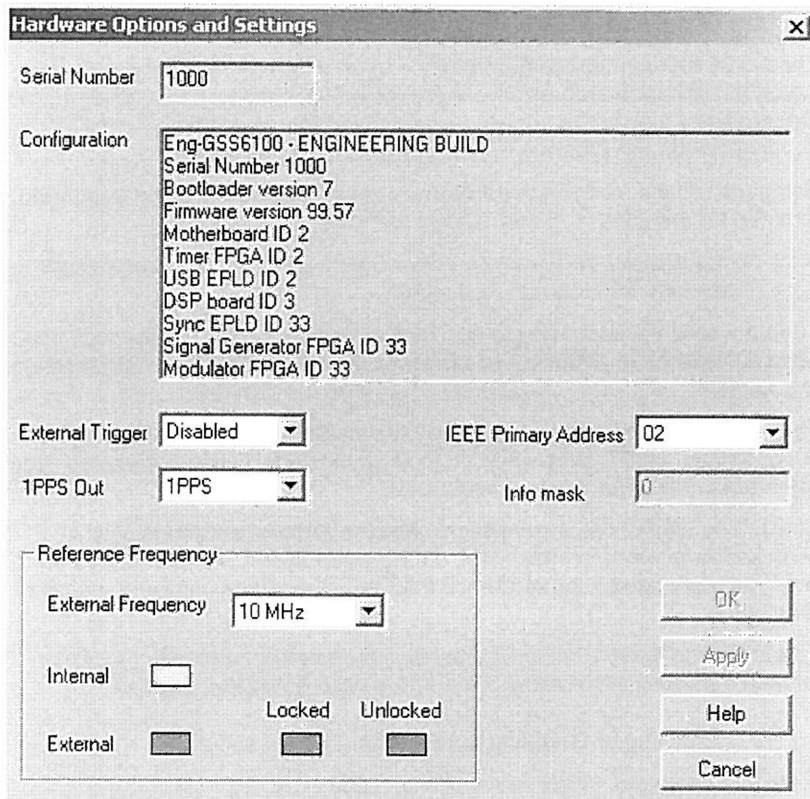


Figure 21 Hardware Settings Display

This displays the Serial Number of the connected GSS6100 unit and the Versions/Release numbers of the various Firmware elements loaded into the unit. Together with this information, several hardware related parameters can be controlled and selected.

*[Remote Command to check firmware version: *IDN? See 5.1.4]*

4.5.1.1 Selecting the Frequency of the External Reference Signal

*[Remote Command: **EREF** see section 5.1.9 & **EREF ?** see section 5.1.10]*

The GSS6100 can detect the presence of an external frequency reference signal but cannot automatically determine the frequency. The GSS6100 will automatically lock to the supplied signal but a fully stable lock is only achieved when the External Frequency is correctly declared.

Using the mouse, click on the arrow key to bring down the list of supported external frequencies: 1, 5 and 10MHz are valid.

Click on the desired frequency to select. The GSS6100 will automatically seek phase lock with the supplied signal.

The Locked/Unlocked markers with indicate when a stable phase lock has been achieved and generally phase lock takes between 10 and 20 seconds to complete.

The External Reference Phase lock is replicated on the Status Bar of the Main Display. This is grey when no Reference signal is being detected, Red when out of lock and Green when locked

Note1: You cannot run a simulation while the reference frequency is Unlocked or attempt to phase lock during a simulation. Further to this an error will be flagged if the reference frequency becomes unlocked during a simulation.

Note2: Wait at least 15minutes after switch on before attempting external reference phase lock to allow GSS6100 10MHz OCXO to stabilise.

4.5.1.2 Enabling or Disabling the External Trigger

*[Remote Command: **TRIG** see section 5.1.37]*

External Trigger: If the system is to be started from an external event set the required mode.

Regardless of Trigger mode the RUN button must be pressed to invoke a simulation[4].

Options are:

[4] It should be noted that this is different to the STR4775 product where the External Trigger is applied whilst the Simulator is in the ARMED state. With the GSS6100 the simulator must be in the RUN state before for the Ext Trigger signal will be actioned.

1) Disabled No external trigger is required to start the run. The run will start when the next internal 1PPS event occurs ('RUN' 1PPS event). Simulation start time is coincident with the rising edge of the 1PPS OUT signal

2) Immediate In this mode the internal 1PPS signal is stopped and restarted immediately on the rising edge of a signal applied to the External Trigger connector. The simulation will start and 1PPS OUT will transition high approximately 600-700nsecs after the applied External Trigger signal.

3) Delayed In this mode the GSS6100 waits for the External Trigger signal to be applied but will hold off commencing the simulation until the next internal 1PPS event occurs ('RUN' 1PPS event). Simulation start time is coincident with the rising edge of the 1PPS OUT signal

4.5.1.3 1PPS Output Options

*[Remote Command: **TIOP** see section 5.1.35 & **TIOP ?** section 5.1.36]*

The **1PPS Out** field is used to select the signal on the rear panel connector of the same name. Options available are:

1PPS	Continuously outputs 1Hz pulses with the rising edge of each pulse coincident with the simulated GPS 1-second epoch
Gated	As above but the signal is disabled before a run, so that the first rising edge coincides with simulation time 0, start of run.
Rising	A single rising edge occurs at simulation time 0, start of run
High	Sets signal permanently high
Low	Sets signal permanently low

4.5.1.4 IEEE Primary Address

*[Remote Command: **GPIB** see section 5.1.11]*

The GSS6100 will use the displayed primary address number (PAD) when operating under control of the IEEE.488 bus port at the rear of the unit.

The address may be changed by selecting the desired value, in the range 1 through 30, from the drop-down list.

4.5.1.5 Info Mask.

This is a debug facility and users should leave this on the default setting of zero.

4.6 SYNCHRONISATION

The GSS6100 simulator incorporates a number of input and output signal ports which can be used in various ways to synchronise time between the simulator and the remainder of a user's system. This note describes how to use the 1PPS IN and/or TRIG IN inputs to achieve synchronisation.

The GSS6100 simulator maintains time internally by means of a time counter clocked by an internal 10MHz clock. Simulations always start on a one-second rollover of this timer. The timer may be synchronised to an external system before starting a simulation by applying a rising edge to the 1PPS IN rear panel input[5]. Once this has been done, simulations may be started either by appropriate timing of the software run command (Trigger Mode: Disabled) or by selecting Delayed Trigger Mode and applying a rising edge to the TRIG IN input. Both cause the simulation to start on the next one-second rollover of the timer. Alternatively, the user can select Immediate Trigger Mode which forces the timer to a point just before the one second rollover and freezes it until a rising edge is detected on the TRIG IN input, whereupon the simulation starts running after a short delay. Note that the use of TRIG IN (immediate mode) together with 1PPS IN is inappropriate, as both would be attempting to control the timer, however TRIG IN (delayed mode) can be used with 1PPS IN.

If coarse synchronisation to the user's system is sufficient, the above methods may be used with no additional considerations, however certain fixed delays, and uncertainties of the order of 100ns will exist. In order to attain precise synchronisation it is necessary to supply the unit with an external 10MHz frequency reference, and to observe certain timing requirements between the 1PPS IN and/or TRIG IN signals and the EXT REF IN signal. These requirements are detailed below.

[5] Note this is a 50Ω input and the pulse width of incoming signals should be ≥120nsecs.

4.6.1 1PPS IN

The required timing of the rising edge of 1PPS IN with respect to EXT REF IN, and the resulting timing of the start of simulation is shown in Figure 22. Provided these timing requirements are adhered to, the RF signal timing will be fixed and repeatable with respect to REF IN every time a simulation is run.

The EXT REF IN signal may be a square wave as shown, (for example a TTL/CMOS signal) or a sinusoid. Whatever the REF IN input waveform, the timing reference point is the ac zero crossing of the signal. Note that alignment of 1PPS OUT as shown in the diagram does not occur immediately, but one second after 1PPS IN is detected. Note also that the 1PPS IN input is disabled whilst a simulation is running, i.e. synchronisation can only take place whilst in the HALTED state.

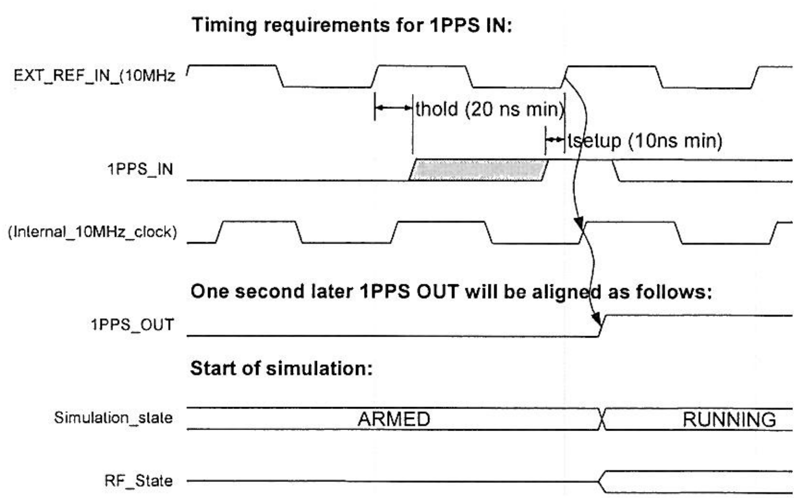


Figure 22 Timing Requirements For 1PPS IN And Resulting Start Timing[6]

[6] It should be noted that the delay between the 1PPS OUT rising edge and its resulting phase transition at RF, seen at the RF Output Port, is nominally 0secs ±5 nsecs (1σ) RSS

4.6.2 TRIG IN – IMMEDIATE MODE

When using the Immediate Trigger mode, the timing requirements for the rising edge of TRIG IN with respect to EXT REF IN are the same as for the 1PPS IN input (i.e. 10ns setup, 20ns hold). However there is a delay of six 10MHz clock cycles after the trigger is recognised before the simulation starts. This is shown in Figure 23.

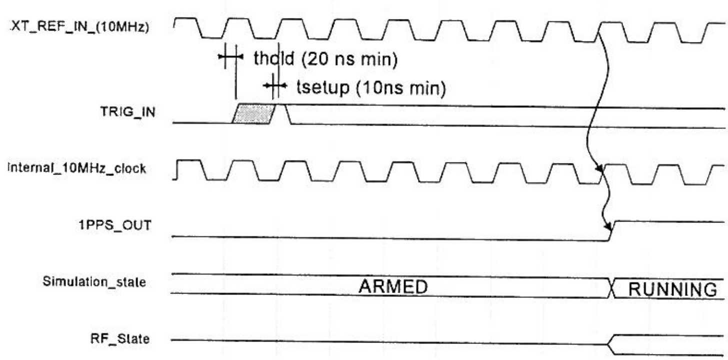


Figure 23 Timing Requirements For TRIG IN (Immediate Mode) And Resultant Start Timing

4.6.3 TRIG IN – DELAYED MODE

In delayed trigger mode, to start on a defined 1PPS event, the rising edge of TRIG IN must occur at least 1.1 milliseconds before the 1PPS OUT rising edge.

4.7 UPDATING SOFTWARE

GSS6100 Firmware updates are applied via the USB Link. A utility that performs this task is available from the Spirent Communications Support Team. It is not anticipated that users will need to change or replace Firmware elements but if this becomes necessary then the Support Team will provide full instructions and a copy of the utility as part of the update package.

To update the Firmware. Connect the unit using USB and Start the update utility.

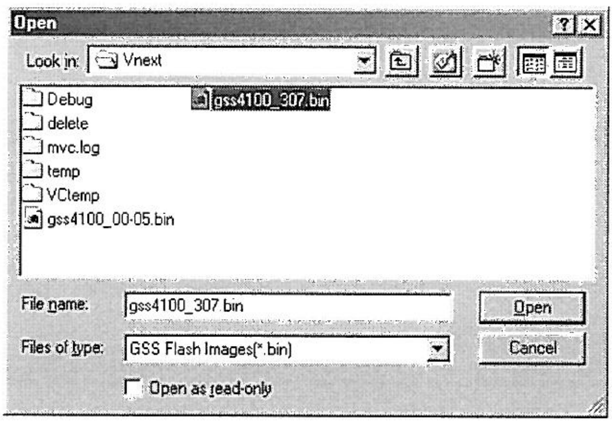


Figure 24 Open The Update File

You will be prompted to select the file carrying the updated firmware, in this example a file of type *.bin.

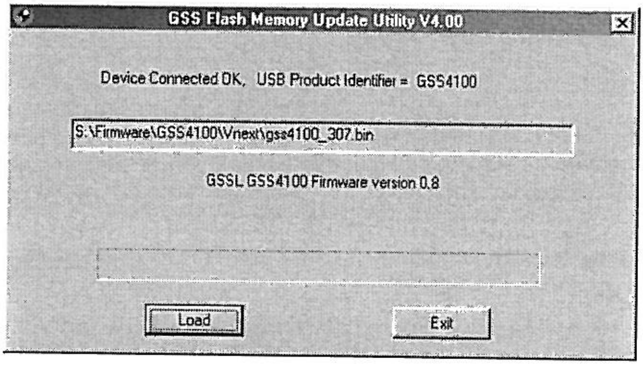


Figure 25 Firmware Ready To Load

The utility will only proceed if a recognised Spirent unit is connected to the USB. The utility also checks the selected update file and displays its embedded identification string and version number.

Check that this is the Firmware you intend to install, then click the Load button. Loading the GSS6100 firmware takes ~15 seconds. The utility displays an approximate indication of progress and indicates completion by a Message.

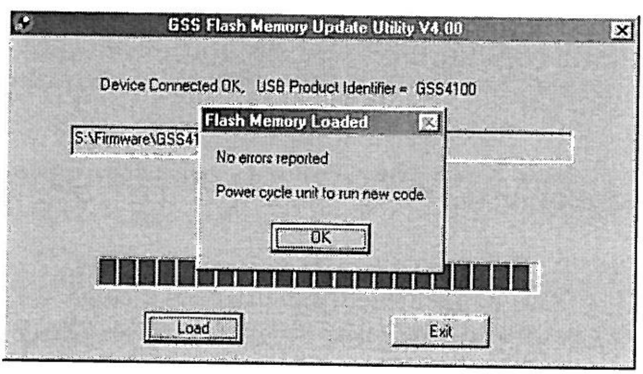


Figure 26 Firmware Update Complete

The Firmware will have copied to a holding area in internal memory. This will be copied to the appropriate memory location the next time that the unit is switched on.

5 REMOTE INTERFACE

The GSS6100 can be remote controlled via GPIB (IEEE-488) or RS232[7] and the identical set of control commands are used for each interface type.

5.1 NOTES ON INTERFACE TYPES

5.1.1 GPIB

The IEEE Std 488.1 Interface Functions subsets implemented are:
SH1, AH1, T6, TE0, L4, LE0, RL0, PP0, DT0, and C0.

Limited Query/response message handshakes are implemented for the initial release. Status indication is provided by bit settings of the standard GPIB serial poll register to enable the remote controller to monitor basic operation only.

5.1.1.1 DEFAULT GPIB ADDRESS

The GSS6100 is delivered with the IEEE.488 (GPIB) Primary Address set to 02. This may be inspected and changed if desired with either the SimCHAN software over the USB or directly by the GPIB command on the IEEE.488 interface.

To set the address with SimCHAN, start the SimCHAN software and connect the GSS6100 via the USB. Select 'Hardware Settings' on the Options menu. The current address is displayed and an alternate address may be selected from a dropdown list. Select OK or Apply to effect the change.

5.1.2 RS232

The serial port is configured to 38400 BAUD, with 8 data-bits, no parity and 1 stop bit. No handshaking is implemented.

5.1.3 COMMAND SET

All messages are initiated by an ASCII character identifier, such as IDEN, of at least 4 bytes in length. This may be followed by a variable number of ASCII encoded parameters depending on the message type, each separated by one or more space characters.

[7] Either of the communication interfaces may be used one after the other as long as ONLY one interface is used at a time.

Several messages may be sent in a single transfer but they must be separated by one or more space characters, and the complete transfer must end with EOI asserted for IEEE or <CR><LF> for RS232. The maximum length of a message transfer must not exceed 256 bytes; if it does the entire transfer will be discarded.

The maximum length of each ASCII encoded parameter is 9 bytes (digits) for integer parameters and 64 bytes for floating point parameters (up to 9 decimal places).

Floating point parameters may be supplied in integer or floating point form. Values will be limited to the ranges and precision stated. Units will be as stated, qualifying unit codes are not permitted or recognised.

The query response remains valid until one of the following occur; the response is read, another command query message is received; the RSET command is received; a DCL or SDC (IEEE only) command is received.

IEEE query responses have EOI asserted on the last byte of the response and RS232 responses are terminated with a <LF> character.

5.1.4 GENERAL NOTES ON THE SYNTAX DEFINITION

The following syntax elements are used to define the command set options and constraints.

The short form of terms is indicated in capitals. Otherwise the names are not case sensitive.

Parameter values are separated from the sub command string by white space.

[]	Items in brackets are optional.
|	Indicates a choice of items, one of which must be supplied
<>	These items are to be replaced by numeric values etc.
{}	Groups Items to form a single syntax item
...	Ellipsis indicates an inclusive range of values

5.1.5 *IDN?

Query IEEE-488 Device ID String

This query is sent by some IEEE-488 Controller applications, e.g. National Instruments Test and Measurement Explorer, to identify devices on the IEEE-488 bus. The device responds with a user-friendly name in ASCII.

The message format is:

*IDN?

Response:

<Manufacturer>,<Model>,<serial number>,<firmware>

Where

<Manufacturer> is Spirent Communications

<Model> is GSS6100

<serial number> is the serial number or zero if not known

<firmware> is the firmware or software revision level, or zero if not known

Example Response:

Spirent Communications, GSS6100,1234,1-01

5.1.6 ARMS

Prepare to Run

This command informs the simulator that all the initial conditions for the simulation are complete, and that the simulator should prepare for a run command (RUNS).

The message format is:

ARMS

5.1.7 BITE

Query the Bite Status

Commands the device to return the state of the various BITE (i.e. error) flags encoded in an ASCII string. The BITE flags indicate various status and error conditions.

The response format varies according to the device type.

The message format is:

BITE ?

Response:

Refer to section 6.2.

On the GSS6100 BITE conditions cause the front panel HEALTH LED to flash and the appropriate flag in the BITE response becomes set. In general, both the LED flashing condition and the flag in the BITE response are reset by querying the BITE. Certain fatal conditions are not cleared by querying BITE. To query and clear Command Syntax errors use the SERR command, see 5.1.29. An exception to the above is the external reference out of lock indication, where the LED will stop flashing and the flag in the BITE flag is cleared when lock is achieved without the need to query BITE, provided the unit is in the Halted state. If an out of lock condition occurs in the Armed or Running state the flashing LED and BITE flag are latched until queried.

5.1.8 COSW

PRN Code Enable/Disable

Commands the device to transmit or suppress the PRN code modulation. The code signal sequence progresses whilst modulation is suppressed. Note that Nav Data modulation is controlled separately (see NDSW)

The message format is:

COSW <code>

Where <code>

0	PRN code turned off
1	PRN code turned on. This is the default state.

5.1.9 EREF

Set External Reference Frequency

Sets the expected External Reference Frequency to the specified value. The value is stored in non-volatile memory for use on power-up. The unit automatically switches to external reference and seeks Phase Lock whenever a signal is present on the rear panel connector.

The message format is:

EREF 1MHz | 5MHz | 10MHz

Note the parameter is an ASCII string and must be exactly as shown.

5.1.10 EREF ?

Query External Reference Frequency

Commands the unit to return an ASCII string describing the current External Reference Frequency setting and the lock status.

The message format is:

EREF ?

Example Response:

EREF 10MHz INT *or*

EREF 10MHz EXT UNLOCKED *or*

EREF 10MHz EXT LOCKED

5.1.11 GPIB

Set the GPIB Primary Address

Set the IEEE-488 bus Primary Address of the device. The Primary Address is saved in non-volatile memory. The unit is supplied with the GPIB address set to 2. The change takes immediate effect and remains in force indefinitely.

The message format is:

GPIB <gpib address>

Where

<gpib address> An integer in the range 1 to 30.

5.1.12 HALT

Stop the Simulation

Commands the device to terminate the current run and return to the Idle State. The Z count and Week Number return to the values used to start the run and the trigger mode is reset to 0 (disabled). All other settings remain unchanged.

The message format is:

HALT

5.1.13 IDEN

Query the Unit Configuration Details

Commands the device to return an ASCII string describing the Unit's identification, and the firmware release numbers.

The message format is:

IDEN

Example Response:

Type GSS6100

Serial Number 0001

Firmware Issue 1.00

Motherboard Revision 1

5.1.14 IPRG

Set Initial Pseudorange

Sets the initial simulated pseudorange. This is manifest as a time delay relative to the 1PPS OUT signal.

The message format is:

IPRG <initial pseudo range>

Where

<initial pseudo range> an integer in the range 0 to 99999999 meters

5.1.15 LEVL

Set the RF Output Power Level

Sets the power level for the simulated RF signal at the front panel RF output. The setting is relative to a base level of –130dBm. The command accepts any value but clips this to the maximum level, if applicable, and rounds to the stated resolution.

The message format is:

LEVL <rf power>

Where

<rf power>	A floating point number specifying the level in dB.
Range	+20.0 to –20.0 to a resolution of 0.1 dB.

5.1.16 LEVL ?

Query the front panel RF signal power level.

Commands the unit to return an ASCII string detailing the current RF signal power.

The message format is:

LEVL ?

Example Response:

LEVL –5.6

5.1.17 MODE

Set the operational mode

Commands the unit into AutoGO mode. A running channel is not halted by sending the MODE command.

The message format is:

MODE <type>

Where

<type>	1	Sets unit into normal operation.
	2 "<string>"	Sets unit into AutoGO mode. Signal Generator configuration is controlled by <string>, e.g. SVID 5 LEVL 0.To action a new script the GSS6100 must be powered cycled. No error checking applied. To initiate an automatic run, the entered "string" must complete with ARMS RUNS. e.g. To achieve PRN 5, power level +15dB, doppler velocity 100 m/s. Use the following: SVID 5 LEVL 15 VCTY 100 ARMS RUNS

5.1.18 MODE ?

Query the current operational Mode. This command will not affect a running channel

The message format is:

MODE ?

Example Response:

MODE 1

5.1.19 NDSW

Enable/Disable the Navigation Data Message

Commands the device to transmit or suppress the Navigation Data Message. The message bit sequence progresses whilst the message is suppressed during a simulation run.

The message format is:

NDSW <code>

Where

<code>	0	Suppress transmission of the message
	1	Transmit the message

5.1.20 NSAV

Save Navigation Template

Commands the device to record and save a Navigation Message template 'file'. A sequence of messages are sent to first select one of the eight template files, then send text for that file, and finally save the text in the template file. The template information is multi-line ASCII text and is sent sequentially line by line using the NSAV #FILE.TEXT# message. The sequence of messages must be terminated by the NSAV #FILE.SAVE# message. Each individual message must not exceed 256 characters in length including the line terminating 'newline' character. The complete file must not exceed 32 Kbytes including comments.

The message formats are:

NSAV {GPS | SBAS} <template>

NSAV #FILE.TEXT# <text>

NSAV #FILE.SAVE#

Where

<template>	Integer value as one of 0 | 1 | 2 | 3.
<text>	A line of text to be stored in the currently selected template.

The format rules of each line of text are as follows.

All lines must end with a newline character.
Any line starting with a ! is deemed to be a comment.
All other lines contain data.

Further details are given in Appendices H and I, plus the example files supplied.

5.1.21 NSAV ?

Query Navigation Template
Commands the unit to return the GPS and SBAS template information.

The message format is:
NSAV ?

The GSS6100 will reply to the query with the size (in bytes) and title string for each of the GPS and SBAS templates.

```
GPS  0  6995 !NAV_DATA.NAV
GPS  1  6995 No Record
GPS  2     0 Empty
GPS  3     0 Empty
SBAS 0 25889 !SBAS_CN3.WAS
SBAS 1     0 Empty
SBAS 2     0 Empty
SBAS 3     0 Empty
```

Templates marked "No Record" were downloaded with earlier firmware versions and no record was stored.

5.1.22 NSEL

Select Navigation Template

Commands the device to generate the Navigation Message from the named template. The unit has the capability to store four templates for each of GPS and SBAS mode. The unit is supplied with the default navigation message stored in <template> = 0.

The message format is:

NSEL {GPS|SBAS} <template>

Where

<template> Integer value as one of 0 | 1 | 2 | 3.

5.1.23 PFIL

Select Pre-defined Velocity Profile

Commands the device to use a named set of parameters for generation of the next velocity profile sequence. In the GSS6100 these sets of parameters are incorporated in the firmware.

The parameter sets each comprise four floating-point values that together define the profile. See section 4.2.19 for a detailed description of the profile shape and its relation to the four parameters.

The selection remains effective until the next RSET, PROS or PFIL command is processed or the device is powered down.

The message format is:

PFIL <profile name>

Where:

<profile name> PROF1 | PROF2 | ... | PROF8

An ASCII string defining the standard profile to be applied.

The PROF1 values will be applied by default.

5.1.24 PROF

Enable/Disable Velocity Profile

Commands the device to either commence or terminate a velocity profile sequence. The sequence will be either the most recent sequence selected/defined by the PROF or PROS commands or the default sequence defined by PROF1.

The message format is:

PROF <code>

Where:

<code>	1	Initiates the velocity profile sequence.
	0	Aborts an active sequence.

5.1.25 PROS

Select Velocity Profile Parameters

Commands the device to generate the next velocity profile sequence from the supplied parameters. The supplied parameters are not stored permanently. It is recommended that this command be sent just prior to each occasion the Velocity Profile is enabled by the PROF command.

The message format is:

PROS <jerk amplitude><max accel><period const accel><period const vel>

Where:

<jerk amplitude>	floating point number in the range: -100 to +100 m/s/s/s
<max accel>	floating point number in the range: -100 to +100 m/s/s
<period const accel>	floating point number in the range: 0 to 540 seconds
<period const vel>	floating point number in the range: 0 to 540 seconds

5.1.26 PRTY

Enable/Disable Set Parity State

Selects the Navigation Message Data Parity as either Normal (as per ICD-GPS-200) or Inverted.

The message format is:
PRTY <code>

Where
<code> 1 Set Message Parity to Normal
0 Set Message Parity to Inverted

5.1.27 RSET

Reset Device

Commands the device to reset its parameters and operating condition to the power up state. In practice, HALT and RSET perform quite similar functions, with the exception that RSET defaults all parameters to a known state.

The message format is:

RSET

5.1.28 RUNS

Begin Simulation

Commands the device to start running in simulation mode.

The message format is:

RUNS

5.1.29 SERR

Query and Clear Syntax Error

Commands the device to return the state of the Command Error flags, encoded in an ASCII string, together with a string describing the error(s) and the Command String that caused the error.

The message format is:

SERR ?

Example Response:

SERR 00000001
0, Command not recognised
WEAK 987

5.1.30 SG2D

Select PRN by G2 Delay

Commands the device to use a specific G2 delay for its C/A code generator.

The simulator is capable of generating any one of the 1023 possible random sequences associated with the GPS C/A encoder. Each sequence or code is determined by the start conditions of the G1 and G2 coders. The G1 encoder is hardwired to start in the all one state, the G2 encoder, can start in any state except all zeros. The G2 start conditions can be described by a 'G2 delay'. This G2 delay can take on values between 0 and 1022. Some of the 1023 codes (mainly codes with good orthogonal properties i.e. Low cross correlation) have had assigned to them PRN numbers. To select one of these codes it is easier to use the SVID command.

The message format is:

SG2D <g2delay>

Where

<g2delay> Integer in the range 0 to 1023

5.1.31 SIGT

Signal Type

This command defines the required signal type, SBAS or GPS. This setting determines the form of the Navigation data message transmitted.

The message format is:

SIGT GPS | SBAS

5.1.32 SNUM ?

Query the Device Serial Number

Commands the device to return its serial number.

The message format is:

SNUM ?

Response

An ASCII string of the form 0999.

5.1.33 STAT

Query Status Flags

Commands the device to return the content of the Serial Poll Status Register in an ASCII string as two hexadecimal digits together with the name of the operating state. The status register may also be read by a Serial Poll, see section 5.3 for the definition of the status bits.

The message format is:

STAT ?

Response:

STAT <hexbyte> <state>

Where:

<hexbyte>	is a representation of the 8 bits of the status byte using hexadecimal digits.
<state>	An ASCII string which may one of: HALTED or ARMED or RUNNING

5.1.34 SVID

Select PRN by SVID

Commands the device to generate the PRN sequence for the specified Satellite ID number as specified in ICD-GPS-200 (GPS) or RTCA-DO229 (SBAS).

The message format is:

SVID <gps prn> | <sbas prn>

Where

<gps prn>	Integer in the range: 1 to 37
<sbas prn>	Integer in the range: 120 to 138

5.1.35 TIOP

Select 1PPS Output Signal

Selects the format of the signal generated on the rear panel "1 PPS out" connector.

The message format is:

TIOP <code>

Where

<code> HIGH – The output is always high

LOW – The output is always low

1PPS – The output is always 1 PPS

GATED – The output is 1 PPS only whilst the simulation is running

RISE – The output is a rising edge as the simulation starts, returning low when the simulation halts

5.1.36 TIOP ?

QUERY 1PPS Output Signal

Commands the unit to return an ASCII string describing the current TIOP setting.

The message format is:

TIOP ?

Example Response:

TIOP 1PPS

5.1.37 TRIG

Select External Trigger

Select Trigger mode. The selection determines how the device will commence a simulation when the RUNS command is applied.

TRIG 0 is the default mode, the device defaults to this for each run, thus the TRIG command is optional if the external trigger is not used. If an Ext Trigger pulse is not applied, send the HALT command to return to the Halted state. Returning to the Halted state resets the Trig mode to 0 (disabled).

The message format is:

TRIG <code>

Where:

<code>	0	Start on next 1PPS event (rising edge) without external trigger
	1	Start immediately on a rising edge on the External Trigger input
	2	Start at the next 1PPS event following a rising edge on the External Trigger input

5.1.38 VCTY

Set Doppler Velocity

Commands the device to simulate the specified Doppler velocity settings. If the required Doppler is specified by a single unqualified value then this is applied as both code and carrier Doppler Velocity. Different Doppler settings for code and carrier may be specified if required.

The difference between the CODE and CARR Doppler values will be limited to a maximum of +/- 1000.00 m/s.

The message format is:

VCTY <Doppler> | CODE <Doppler> CARR <Doppler>

Where

<Doppler> Floating point number in the range: -15000.00 to + 15000.00 m/s

A positive Doppler figure yields a decrease in the code/Carrier frequency. Both values may be entered to a maximum resolution of 0.01m/s.

The CARR <Doppler> value is constrained to be the CODE <Doppler> value +/- 1000.00 m/s.

5.1.39 WEEK

Select GPS Week Number

Commands the device to commence the next simulation run with the Navigation Message set to simulate signals for the week number specified.

The message format is:

WEEK <GPS week number>

Where

<GPS week number> Integer number in the range 0 to 1023

5.1.40 WRTE

Select SBAS DATA Rate

This command selects the data rate for the SBAS message. Default 250 symbols per second. (This does not have any affect on the GPS data message rate).

The message format is:

WRTE <sbas rate>

Where:

<sbas rate>	Integer from the set: 50 | 100 | 125 | 250

5.1.41 ZCNT

Specify the Starting Time

The command sets the Z Count value that will be inserted in the first frame of the Navigation Data Message at the start of the next simulation run. The value should be supplied as a multiple of four and other values will be truncated to a multiple of four.

The message format is:

ZCNT <GPS time into week>

Where

<GPS time into week>	Integer in the range: 0 to 403199

The Z Count unit is a period of 1.5 seconds, so that four Z Count units is a period of six seconds.

5.2 COMMAND AVAILABILITY BY MODE

Some simulation information must be defined before the simulation is armed and run. Thus some commands are only available in certain modes. This is summarised in Table 1, overpage. The Controller application can determine the device's operating state via a Serial Poll. The device will regard a command received in a wrong state as an error. The Command will not be executed and an error flag will be set that can be interrogated by a Serial Poll.

IDLE	ARMED	RUNNING
*IDN? ARMS AUXP BITE COSW EREF EREF ? GPIB IDEN IPRG LEVL LEVL ? MODE MODE? NDSW NSAV NSAV ? NSEL PFIL PROS PRTY RSET SERR ? SG2D SIGT SNUM ? STAT ? SVID TIOP TIOP ? TRIG VCTY WEEK WRTE ZCNT	*IDN? BITE COSW EREF ? HALT IDEN LEVL LEVL ? NDSW PFIL PROS PRTY RSET RUNS SERR ? SNUM ? STAT ? TIOP ? VCTY	*IDN? BITE COSW EREF ? HALT IDEN LEVL LEVL ? NDSW PFIL PROF PROS PRTY RSET SERR ? SNUM ? STAT ? TIOP ? VCTY

Table 1 Commands by Mode

5.3 SERIAL POLL – STATUS BITS

The device status is signalled by setting bits in the GPIB Serial Poll Status Byte Register. The Controller may read this using a Serial Poll command.

Bits 0 & 1 signal the four operating states of the device:

Bit [1:0]	
00	Halted (Idle)
11	Armed (Ready to Run)
10	Running

Bit 2 is a Poll Validity flag. The error flag (bit 7) is undefined whilst the Poll Validity flag is reset.

Bit 7 is a Command Error flag. This is set when an erroneous command is decoded. Once set, the bit state is maintained and the front panel health light flashes until a SERR ? is performed to reset the error condition. Note: the BITE query gives additional information on the command or parameter error, which caused the error condition.

5.4 EXAMPLE COMMAND SEQUENCES

5.4.1 EXAMPLE GPS SIMULATIONS

Step 1 – Basic Initialisation

RSET	;Reset Unit (may be omitted if conditions from previous run to be used)
Serial Poll	;Note - Confirm Validity Bit Set
On Not Error	;Check for Error on each command
	;Omitted hereafter for brevity only

Step 2 – Set Initial Conditions

WEEK 987	;If HALT used, reverts to this at end of run
ZCNT 1236	;Note – Multiple of 4. Reverts on HALT
SVID 12	;PRN for GPS Satellite 12. Remains set on HALT
LEVL 12.5	;RF Output level. HALT keeps setting at end of run

VCTY 0.0 ;No Doppler on Code or Carrier. HALT keeps setting at end of run

Step 3 – ARM Simulation

ARMS ;Align RF and set Ready to Run

Serial Poll ;Wait until Ready to Run Flags set

On Ready to Run ;When Bit 0 = 1 and Bit 1 = 1

Step 4 – Start Simulation

RUNS ;Starts on next internal 1PPS pulse

Step 5 – Vary Level and Doppler as desired

LEVL –15.0

VCTY CODE 500.3 CARR 501.3

;500.3m/s with 1m/s carrier offset

;simulating changing atmospheric delay

Step 7 – Revert to Idle when finished

HALT

5.4.2 EXAMPLE WITH EXTERNAL TRIGGER

Step 1 – Basic Initialisation

RSET	;Reset Simulation
Serial Poll	;Note - Confirm Validity Bit Set
On Not Error	;Check for Error on each command
	;Omitted hereafter for brevity only
TRIG 1	;Start immediately on External Trigger

Step 2 – Set Initial Conditions

;or Use Defaults

Step 3 – ARM / RUN Simulation

ARMS	;Prepare to run
Serial Poll	;Wait until Ready to Run Flags set
On Ready to Run	;When Bit 0 = 1 and Bit 1 = 1
RUNS	;Set to RUN mode.
	Front Panel 'Active' LED will be seen to flash. Trigger may now be applied
Serial Poll	;Check Simulation is Running
On Running	;When Bit 0 = 0 and Bit 1 = 1

Step 4 – Vary Level and Doppler as desired

LEVL 20.0

VCTY 10.23

Step 5 – Invoke a Doppler Pulse if desired

VCTY –500.00	;Set Base Doppler Velocity
PFIL PROF2	;Select Standard Profile No. 2
PROF 1	;Start Velocity Profile Sequence

	;The Sequence repeats indefinitely
PROF 0	;Stop the sequence

Step 7 – Revert to Idle when finished

HALT

5.4.3 EXAMPLE WITH EXTERNAL SIGNALS

Step 1 – Basic Initialisation

Serial Poll	;Read the Status Bits
On Not Idle	;Either Bit 0 or Bit 1 set
HALT	;Force Simulation to Idle mode
RSET	;Reset Simulation
SIGT	;Select GPS Mode
Serial Poll	;Note - Confirm Validity Bit Set
On Not Error	;Check for Error on each command
	;Omitted hereafter for brevity only
EREF 10MHZ	;Seek Lock to External Reference
EREF ?	;Query after 30 seconds
On Lock	;Response = EREF 10MHz
	;Response = EREF INTERNAL if
	;lock not achieved
TRIG 1	;Start on External Trigger

Step 2 – Set Initial Conditions

;or Use Defaults

Step 3 – ARM /RUN Simulation

ARMS	;Prepare to run
Serial Poll	;Wait until Ready to Run Flags set
On Ready to Run	;When Bit 0 = 1 and Bit 1 = 1
RUNS	;Set to RUN mode.

Front Panel 'Active LED will be seen to flash. Trigger may now be applied

Serial Poll	;Check Simulation is Running
On Running	;When Bit 0 = 0 and Bit 1 = 1

Step 4 – Vary Level and Doppler as desired

LEVL 20.0

VCTY 10.23

Step 5 – Revert to Idle when finished

6 HARDWARE CALIBRATION AND CONFIGURATION

6.1 CALIBRATION

The GSS6100 employs a digital architecture to produce accurate and stable signals. As such it requires little calibration.

There are just two user adjustments: Frequency and Power.

These are both simple potentiometer adjustments. Test equipment requirements are a suitable frequency counter with a stable reference and an RF power meter respectively.

It is recommended that these calibrations be performed yearly.

6.1.1 REFERENCE FREQUENCY CALIBRATION

This requires a frequency counter capable of measuring 10.00 MHz with at least 10 digits of accuracy, for example an HP53131A. The frequency counter should be locked to a frequency standard accurate to $< \pm 1 \times 10^{-9}$, for example an HP5065A Rubidium standard. It is permissible to use a less accurate standard if the user is prepared to accept lower frequency accuracy for the simulator.

- Turn on the GSS6100 and allow 30 minutes for the internal oscillator to stabilise.
- Attach the frequency counter to the 10MHz OUT BNC connector on the rear panel.
- Remove ‘Calibration Void if Broken’ label covering from the 10MHz Ref Cal adjustment port.
- Use the frequency adjustment potentiometer to achieve a frequency reading of 10MHz ± 0.02Hz.
- Re-cover 10MHz Ref Cal port with appropriate calibration label.
- This concludes the reference frequency calibration

6.1.2 POWER LEVEL CALIBRATION

This requires an RF power meter capable of measuring a frequency of 1.57542 GHz and power levels between –50dBm and –60dBm, for example an HP E4418B. Ensure that the power meter is calibrated according to the manufacturer's instructions, including any adjustments for sensor calibration factor and frequency.

- Turn on the GSS6100.
- Attach the RF power meter to the 'N type' MON/CAL port connector on the rear panel of the unit
- Allow 15 minutes for the GSS6100 to stabilise.
- Remove 'Calibration Void if Broken' label covering from the IF Level Cal adjustment port.
- From the SimCHAN Menu Bar select Options->Power Calibration and follow the on-screen prompts. The software will set up a calibration signal on the rear panel MON/CAL output and calculate and display the power level required on the power meter. Adjust the potentiometer to obtain this value ±0.05dB.

This concludes the Power Level Calibration.

6.2 BITE REPORTING

BITE messages are displayed in the **message** window, see Appendix F. Message types "info", "fatal" and "warning" contain information for SPIRENT use only.

Note: Fatal messages will produce a pop up warning box and terminate a simulation if running.

Message type "hardware", contains BITE information generated by the GSS6100 hardware. All hardware messages except for the following will require the user to contact SPIRENT.

Displayed string	User action
RF-Reference oscillator out-of-lock	Check the external reference is connected and the "hardware settings" options are correctly set.
USB-Error	Check USB connection.

6.3 UPGRADING THE FIRMWARE USING THE FLASH MEMORY LOADER

The GSS6100 internal firmware may be upgraded in the field. SPIRENT may make upgrades available from time to time to customers under Warranty or a Support agreement. Upgrades will be made available via suitable media or from an FTP site.

The GSS6100 Flash memory device is capable of holding multiple application images. A default image is loaded during manufacture and never overwritten. Further images may be stored at different re-programmable memory locations.

The boot code will always check for a new image and run it if found. If no new image is found the default image will be run.

The firmware may be upgraded in the field over the USB interface using a utility supplied by SPIRENT.

This utility is accessed from the Windows Start menu:

Start->Programs->GSS->Flash_Loader.

Note: This utility must not be run at the same time as SimCHAN

Before running this utility ensure the GSS6100 hardware is connected and powered on.

A file selection window is displayed. Select the upgrade file supplied by SPIRENT and then click **Load**. A message will be displayed when the upgrade has been downloaded.

Exit the application. Power to the GSS6100 must be now be cycled. When the GSS6100 powers up again, the upgrade is complete.

The current firmware issue may be checked using the

Options->Hardware Settings menu item on the GSS6100 software, see section 4.5.

7 CONTACTING SPIRENT

The staff at Spirent Customer Support can be contacted by E Mail, Fax or Telephone during normal office hours, both in the United Kingdom and the USA. The Customer Support contact details are overleaf.

Spirent provide Technical Support for questions about any aspect of the product, be it hardware, software or general information. The Technical Support Service is available to all customers under Warranty or who have a maintenance agreement. It is also available to those customers who do not have a maintenance agreement, however Spirent are not obliged to provide answers/solutions to these customers.

Spirent will endeavour to respond/initiate an investigation where necessary, to any query normally within one working day.

Spirent should be informed when any unexpected, unusual or unacceptable behaviour is exhibited by the simulation system. This includes faults in the software, hardware, or the documentation.

If in the unlikely event of a fault occurring, Spirent have a fault reporting system, designed to ensure a swift return to normal operation. Once Spirent are informed, a System Incident Report (SIR), is raised by the Customer Support staff, and an investigation initiated. In addition an SIR may be used to identify proposed system enhancements.

The Customer Support Engineer will allocate an SIR number, notify the originator of receipt. Once an SIR has been issued, please ensure it is used in any correspondence relating to that particular incident. If responses from Spirent do not contain an SIR reference number, please insist that one is given to you.

It would greatly assist Customer Support if, when contacting Spirent about any matter, the following information is provided by the customer: A contact name; E mail address; telephone or fax number; software version number; signal generator type and hardware serial number (located on rear panel); and as comprehensive a description of the incident as possible using continuation sheets if required.

This will enable swift processing of the enquiry and therefore improve the service to you the customer.

Spirent Customer Support can be contacted via the following:

United States/Canada (All Customers)

Spirent Federal Systems Inc.

Customer Support Center

1331 Airport Freeway, Suite 304

Euless

TX 76040

USA

Contact Ed Schwanke:

Tel: 817 508 6095

Fax 817 508 6096

E-mail: edward.schwanke@spirentfederal.com

All other Regions and Customers

Spirent Communications (SW) Ltd

Aspen Way

Paignton

Devon

TQ4 7QR

United Kingdom

Contact Customer Support:

Tel: + 44 1803 546333

Fax: + 44 1803 546301

E-mail: help@spirentcom.com

Access to the Spirent FAQ and document databases is via the Support web site. This site also gives customers access to the complete Customer Support database system.

The support web-site can be accessed via the Support links on our web-site at http://www.positioningtechnology.co.uk

A GLOSSARY

ATE	Automatic Test Equipment
BPSK	Binary Phase Shift Keying
C/A	Coarse Acquisition
CAL	Calibration
FEC	Forward Error Correction
GND	Ground / Earth Connection
GPS	Global Positioning System
GPIB	General Purpose Interface Bus
HOW	Handover Word
IODP	Issue of Data PRN
ISCN	Intentional Satellite Clock Noise
LSB	Least Significant Bit
MSB	Most Significant Bit
OCXO	Oven Controlled Crystal Oscillator
PRN	Pseudo Random Number
rads	Radians
RAM	Random Access Memory
RF	Radio Frequency
RMS	Root Mean Square
SBAS	Satellite Based Augmentation System
SV ID	Satellite Vehicle Identity
TLM	Telemetry Word
TOW	Time of Week
UDREI	User Differential Error Indicator
UTC	Universal Co-ordinated Time
WAAS	Wide Area Augmentation System

B CONNECTING A GPS RECEIVER

This Appendix has been included to offer the user, new to both GPS Simulators and/or Receivers, basic guidance on how to set up and track GPS signals.

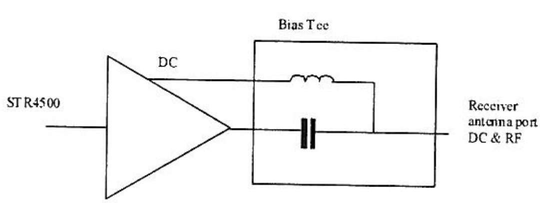
The signal input on a GPS receiver typically falls into one of three types.

1. An input socket for a passive antenna.
2. An input socket for an active antenna/pre-amplifier combination.
3. A built in antenna only with no input connector (some handheld receivers).

Determine which category your receiver fits and proceed as follows:

Type 1) Connect the receiver directly to the front panel RF OUTPUT connector using a suitable cable.

Type 2) Use an AC coupled amplifier with equivalent gain and noise figure to that used by the active antenna. This amplifier can be powered either from an external power supply or from the receiver supply intended for the active antenna. A bias tee/DC block may be required as shown below.

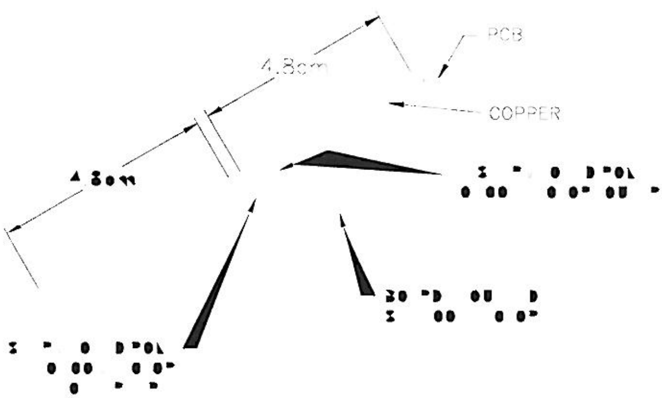


If this is not available an alternative is to use the high power MON CAL port at the rear of the signal generator. As the signal is approximately 60dB larger than the front panel signal, attenuation may need to be added.

As the noise floor for both the front and rear panel outputs is governed by the thermal noise of a coaxial attenuator the S/N ratio for the rear panel is artificially high. For this reason the above arrangement may not yield an identical receiver performance.

It is strongly recommended that a DC block is inserted between the receiver input and any external attenuation as a safety measure.

Type 3) In this case an option is to make or purchase an antenna, for example a simple dipole, which is attached to the GSS6100 RF output. The antenna is held in close proximity to the receiver. Due to the unknown coupling of this arrangement it may be necessary to either use an external amplifier on the GSS6100 front panel output, or to use the rear panel MON/CAL high level output to provide sufficient signal level. If you wish to construct a suitable dipole, then for the GPS L1 frequency of 1575.42MHz each arm should be approximately 4.8 cm long. A design for a simple dipole follows:



Note that in this mode you are radiating a GPS signal (although at a low level) which could conceivably interfere with local GPS users. At the same time your receiver is susceptible to signals from real GPS satellites. This set-up should therefore only be used in an RF screened environment!

C SIGNAL GENERATOR CONNECTIVITY[8]

PORT	IN/OUT	TYPE	CHARACTERISTICS
Primary RF	OUT	COAXIAL Type 'N' Female	Provides the primary RF GPS signal output at specified levels. 50 ohm. VSWR <1.2:1 (in band). DC isolated.[9]
MON/CAL Output	OUT	COAXIAL Type 'SMA' Female	Provides a high level output suitable for calibration with a power meter. 50 ohm. VSWR <1.2:1 @ L1. DC isolated.[9]
TRIG	IN	COAXIAL BNC Socket	External Trigger input, allows external control of simulation start time. Supplied signal to have a pulse width ≥120nsecs. (See section 4.6). TTL compatible levels. 50 ohm
External Reference	IN	COAXIAL BNC Socket	Allows the GSS6100 to be locked to an external reference. 5 or 10MHz: sine or square wave, -5 to +10 dBm 1MHz square wave, 0 to +10 dBm 50 ohm, Required accuracy <0.1 ppm.
10MHz OUT Internal Ref Oscillator	OUT	COAXIAL BNC Socket	10MHz Sine 0 dBm nominal 50 ohm
IEEE-488	IN/OUT	IEEE-488 connector	Host interface. IEEE-488 (GPIB) compatible.
RS232	IN/OUT	9-way 'D' socket Rear Panel	Alternative control Interface
USB	IN/OUT	USB connector	Host interface with PC. Universal Serial Bus, bi-directional.

[8] This table is included for reference only, MS3037 - GSS6100 Product Specification should be used as the definitive document.
[9] DC isolation can withstand a maximum DC level of ±100V and reverse RF levels to a maximum of 1W.

PORT	IN/OUT	TYPE	CHARACTERISTICS
TRIGGER	IN	COAXIAL BNC Socket	A trigger input to allow an external signal to start the simulation. TTL level compatible 50 ohm
Aux Output	IN/OUT	25 way D type	Pin No. Signal Name 1 1PPS IN[10] * 2 1PPS OUT[11] * 3 Reserved 4 Reserved 5 Reserved 6 Reserved 7 Reserved 8 C/A CLOCK* 9 CODE 1PPS* 10 C/A EPOCH* 11 NAV DATA* 12 C/A CODE* 13 NC 14 GND FOR 1PPS IN 15 GND FOR 1PPS OUT 16 NC 17 GND 18 GND 19 NC 20 NC 21 GND FOR C/A CLOCK 22 GND FOR CODE 1PPS 23 GND FOR C/A EPOCH 24 GND FOR NAV DATA 25 GND FOR C/A CODE **Notes:** Input signals marked * are 50 ohm terminated, Output signals marked * are 50 ohm drive capable.
110/240V ac	IN	Industry Standard IEC	Auto-switching. No voltage selection required.

[10] In combination with the External Reference input, can be used to synchronise the simulator to an external system, (See section 4.6). TTL level compatible.

[11] TTL level compatible, nominal pulse width 100ms

D SIGNAL CAPABILITY[12]

PARAMETER	COMMENT	VALUE	UNITS
Number of GPS signal sources	L1	1	channel
In-band spectral purity (1575.42 ± 20)MHz	Referred to unmodulated carrier level at RF output, whichever value is greater	≤ -30 ≤ -160	dBc dBm
Harmonics of L1	Referred to unmodulated carrier	≤-35	dBc
Close to Carrier unmodulated phase noise (Single Sideband)	Integrated between 10Hz and 10kHz	≤ 0.02 RMS max	Rad
Nominal signal level[13]	Main RF port CAL port (approximate)	-130 -70	dBm dBm
Signal level control	Dynamic range relative to nominal level.	+20, -20 0.1	dB dB
Signal Dynamics	Maximum Relative Velocity	±15,000	m/s
	Maximum Relative Acceleration	±450	m/s^2
	Maximum Relative Jerk	±500	m/s^3
	Maximum Angular rate (1.5m lever arm)	2π	rad/s
Nominal carrier frequency	L1 (GPS/SBAS)	1575.42	MHz
Modulation	C/A code ranging (PRNs 0-1023) GPS Data Bit Rate	1.023 50	Mcps Bps
Channel Hardware Update Rate		100	Hz
1PPS Out to RF Delay	Nominal delay zero	±5 (1σ) RSS	nsecs

[12] This table is included for reference only, MS3037 - GSS6100 Product Specification should be used as the definitive document.

[13] The GSS6100 provides both the normal front-panel RF output port (RF OUT) for testing, and a high-level, rear-panel output port (CAL OUT) to allow calibration. Both ports are isolated to dc voltages. Nominal corresponds to the 0dB setting of the SimCHAN Power Slider control.

E ENVIRONMENTAL

Dimensions, nominal	449mm x 386mm x 89mm (W x D x H) (17.75inch x 15.25inch x 3.5inch)
Weight Signal Generator (approx)	5kg (11lb)
Temperature Operating Temperature Humidity Storage Temperature Humidity	+10 to + 40°C (50 to 104°F) 40 to 90% RH (non-condensing) -40 to + 60°C (-90 to 140°F) 20 to 90% RH (non-condensing)
Electrical Voltage (a.c.) Power Consumption Frequency	100 to 120V, 206 to 264V ac (auto sensed) <70W 48 to 62 Hz

F GSS6100 BITE RESPONSE MESSAGE

This message returns the current BITE status. This is a verbose; multi-line null terminated string. The first line starts with the message identifier "BITE". This identifier is followed by an ASCII encoded hexadecimal value indicating hardware BITE errors. For any bit set a verbose string is displayed giving the bit number and error message shown in the Table 2, overpage.

The return format is:
BITE 00000010
4 - FPGA_TIMER – Invalid number of ms in second

Table 2 Bit Interpretation of Hardware BITE Response

Bit	String	Description
0	MBRD - Wrong issue	An invalid Motherboard issue was detected
1	Not Used	
2	VPROF - VPROF buffer underrun	The GSS6100 ran out of velocity profile data.
3	EEPROM - Attempt to write to locked EEPROM	The EEPROM low-level driver attempted to write to the EEPROM when it was locked.
4	FPGA_TIMER – Invalid number of ms in second	An invalid number of 1 ms pulses was detected in 1 second.
5	USB – Receive buffer overflow	To much data was received via the USB to fit into one buffer descriptor.
6	USB – No more receive buffer descriptors available	The USB receiver ran out of buffer descriptors to store incoming data.
7	USB – Transmit buffer overflow	An attempt was made to write too much data to a USB transmit buffer descriptor.
8	USB – No more transmit buffer descriptors available	The USB receiver ran out of buffer descriptors to store outgoing data.
9	USB – Error 1: EP0 has stalled	A stall was detected on EP0
10	USB – Error 2: Program fault.	A fault occurred in the USB algorithm.
11	USB – Error 3: Suspend request(?)	A suspend request was detected
12	USB – Error 4: Unexpected interrupt	An unexpected USB interrupt was detected.
13	RF – Reference oscillator out-of-lock	The reference oscillator is out-of-lock
14	RF - LO1 out-of-lock	Local oscillator 1 is out-of-lock
15	RF - LO2 out-of-lock	Local oscillator 2 is out-of-lock

Bit	String	Description
16	DSP – NAVD underrun	A DSP ran out of NAV data
17	EEPROM - Load error	There was an error reading from the EEPROM
18	EEPROM - Save error	There was an error writing to the EEPROM
19	EEPROM - Invalid contents	The firmware detected invalid EEPROM contents
20	TIMER - Timer FPGA load error	The firmware was unable to load the Timer FPGA correctly.
21	DSP – DSP FPGA load error	The firmware was unable to load the DSP FPGA correctly.
22	Motherboard – Wrong EPLD version	An invalid Motherboard EPLD version was detected.
23	DSP board - Wrong EPLD version	An invalid DSP board EPLD version was detected.
24	MOD – DSP PLL out-of-lock	The Modulator DSP PLL is out of lock
25	MOD – DSP PLL Loss of input clock	The Modulator DSP PLL has no clock input.
26	MOD – DSP PLL Loss of clock output	The Modulator DSP PLL has no clock output.
27	DSP – Wrong issue	An invalid DSP issue was detected
28	DSP – Overtemp	The DSP has reported an over-temperature problem and shutdown.
29	EREF – External reference present state changed during run	The state of the external reference changed during the run.
30	NAVD – End of SBAS correction data	The SBAS correction data has been exhausted.

G STANDARD GPS NAVIGATION MESSAGE

G.1 INTRODUCTION

The following description details the default GPS navigation message supplied with the GSS6100.

The navigation message is constructed from 25 frames of data and has a total duration of 12.5 minutes. Each frame is made up of 5 subframes, which in turn consist of ten, thirty bit words.

For words of 3 through 10 of each subframe, it is possible to generate a representative navigation data model using stored data. The parity bits of these words may also be selected to be valid or invalid.

The format of the telemetry and handover words (words 1 and 2) does not change, and the parity bits for these words are always valid.

Parity bits are calculated to NATO STANAG 4294 draft issue 1 - equivalent to ICD_GPS_200. Where shown the parity bits are always the transmitted parity bits. The other data bits (1-24) are source data bits and as such may be inverted before transmission, dependant on the calculated parity bit 30 (transmitted) of the previous word. The source data bits of the words 1 and 3 of every subframe are never inverted before transmission because bit 30 of the previous word is always zero for these words. The data/parity bits marked '*' may vary from frame to frame, and are calculated before transmission.

Time of Week and GPS Week are encoded into the transmitted message whilst the simulation is running. Week number rollovers are supported, but not ephemeris cut-overs.

Satellite health data within the navigation message is automatically calculated to reflect the selected PRN Number.

G.1.1 TELEMETRY (TLM) WORD – ALL SUBRAMES

This is the first word in every subframe.

Bits	Contents
1 – 8 **(1000 1011)**	preamble
9 – 22 **(1010 1010 1010 10)**	alternating ones and zeros
23 – 24 **(11)**	reserved bits
25 – 30 **(calculated = 01 1001)**	parity

G.1.2 HANDOVER WORD (HOW) – ALL SUBFRAMES

This is the second word in every subframe.

The data/parity bits in this word marked '*' will vary from frame to frame, according to the time of week and subframe ID at the time of transmission.

Bits	Contents
1 – 17 **(calculated = **** **** **** *)**	17 MSB's of the TOW count
18 **(0)**	momentum/alert flag
19 **(0)**	synchronisation/anti-spoof flag
20 – 22 **(calculated = 001, 010, 011, 100, or 101)**	subframe ID
23 – 24 **(calculated =**)**	solved to ensure parity bits 29/30 zero
25 – 30parity **(calculated =** **00)**	

G.1.3 SUBFRAMES 1 THROUGH 3

G.1.3.1 Subframe 1 Word 3

Bits	Contents
1 – 10 **(calculated = **** **** *)**	week number, from main window
11 - 12 **(01 for P code)**	Set according to normal code on L2
13 - 16 **(0010)**	SV accuracy
17 – 22 **(0000 00)**	SV health
23 – 24 **(00)**	issue of data clock IODC (2 MSB's)
25 – 30 **(calculated =** *******)**	parity

G.1.3.2 Subframe 1 Word 4

Bits	Contents
1 **(1)**	data for L2 P code flag
2 – 24 **(010 1010 1010 1010 1010 1010)**	alternating ones and zeros
13 - 16 **(0010)**	SV accuracy
25 – 30 **(calculated =** *******)**	parity

A.1.1.1 Subframe 1 Word 5

Bits	Contents
1 - 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated =** *******)**	parity

G.1.3.3 Subframe 1 Word 6

Bits	Contents
1 - 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated =** ** ******)**	parity

G.1.3.4 Subframe 1 Word 7

Bits	Contents
1 – 16 **(1010 1010 1010 1010)**	alternating ones and zeros
17 – 24 1.863 ns ($4x2^{-31}$ s) **(0000 0100)**	Estimated group delay t_{GD}:
25 – 30 **(calculated =** ** ******)**	parity

G.1.3.5 Subframe 1 Word 8

Bits	Contents
1 – 8 issue 5 **(1010 0101)**	issue of data clock IODC (8 LSB's) :
9 – 24 **(0000 0001 1100 0010)**	reference time clock t_{OC}:2 hours into week ($450x2^{4}$ s)
25 – 30 **(calculated =** ** ******)**	parity

G.1.3.6 Subframe 1 Word 9

Bits	Contents
1–8 **(0000 0110)**	clock correction coefficient $_{f2}$:166.5x10^{-18}s/s^{2}**(6x2-55 s/s2)**
9–24 **(0000 0000 0000 0111)**	clock correction coefficient $_{f1}$:795.8x10^{-15}s/s ($7x2^{-43}$ s/s)
25–30 **(calculated =** ** ******)**	parity

G.1.3.7 Subframe 1 Word 10

Bits	Contents
1 – 22	clock correction coefficient a_{f0} : 3.726×10^{-9}s (8×2^{-31}s)
(0000 0000 0000 0000 0010 00)	
23 – 24	solved to ensure parity bits 29/30 zero
(calculated = **)	
25 – 30	parity
(calculated = ****)**	

G.1.3.8 Subframe 2 Word 3

Bits	Contents
1 – 8	issue of data ephemeris IODE : issue 5
(0000 0101)	
9 – 24	C_{rs} : 281.25×10^{-3} m (9×2^{-5}m)
(0000 0000 0000 1001)	
25 – 30	parity
(calculated = ****)**	

G.1.3.9 Subframe 2 Word 4

Bits	Contents
1 – 16	mean motion difference from computed value delta-n: 1.137×10^{-12} semicircles/s(10×2^{-43} semicircles/s)
(0000 0000 0000 1010)	
17 – 24	mean anomaly at reference time M_0(10×2^{-43} semicircles) (8 MSB's) : 5.1223×10^{-9} semicircles
(0000 0000)	
25 – 30	parity
(calculated = ****)**	

G.1.3.10 Subframe 2 Word 5

Bits	Contents
1 – 24 **(0000 0000 0000 0000 0000 1011)**	mean anomaly at reference time M_9(24 LSB's) : 5.1223×10^{-9} semicircles(11×2^{-31} semicircles)
25 – 30 **(calculated =** ** ****)**	parity

G.1.3.11 Subframe 2 Word 6

Bits	Contents
1 – 16 **(0000 0000 0000 1100)**	C_{uc} : 22.3517×10^{-9} rads (12×2^{-29} rads)
17 – 24 **(0000 0000)**	eccentricity e (8 MSB's) : 1.5134×10^{-9}(13×2^{-33})
25 –30 **(calculated =** ** ****)**	parity

G.1.3.12 Subframe 2 Word 7

Bits	Contents
1 – 24 **(0000 0000 0000 0000 0000 1101)**	eccentricity e (24 LSB's) : 1.5134×10^{-9}rads (13×2^{-33} rads)
25 – 30 **(calculated =** ** ****)**	parity

G.1.3.13 Subframe 2 Word 8

Bits	Contents
1 – 16 **(0000 0000 0000 1110)**	C_{us} : 26.077x10^{-9} rads (14x2^{-29} rads)
17 – 24 **(1010 0001)**	square root of semimajor axis $\sqrt{A}$ (8 MSB's) : 5153.7 $m^{1/2}$ (2702023066x2^{-19} $m^{1/2}$)
25 –30 **(calculated =** ** ****)**	parity

G.1.3.14 Subframe 2 Word 9

Bits	Contents
1 – 24 **(0000 1101 1001 1001 1001 1010)**	square root of semimajor axis $\sqrt{A}$ (24 LSB's) : 5153.7 $m^{1/2}$(2702023066x2^{-19} $m^{1/2}$)
25 – 30 **(calculated =** ** ****)**	parity

G.1.3.15 Subframe 2 Word 10

Bits	Contents
1–16 **(0000 0001 1100 0010)**	reference time ephermerist$_{oe}$:2 hours into week(450x2^4 s)
17 **(1)**	fit interval flag:6 hours
18–22 **(010 10)**	alternating ones and zeros
23–24 **(calculated =**)**	solved to ensure parity bits 29/30 zero
25–30 **(calculated =** ** 00)**	parity

G.1.3.16 Subframe 3 Word 3

Bits	Contents
1 – 16	C_{ic} : 27.94x10^{-9} rads (15x2^{-19} rads)
(0000 0000 0000 1111)	
17 – 24	right ascension at reference timeΩ_o (8 MSB's) : 7.4506x10^{-9}semicircles (16x2^{-31} semicircles)
(0000 0000)	
25 – 30	parity
(calculated = ** ****)	

G.1.3.17 Subframe 3 Word 4

Bits	Contents
1 – 24	right ascension at reference timeΩ_o (24 LSB's) : 7.4506x10^{-9}semicircles (16x2^{-31} semicircles)
(0000 0000 0001 0000)	
25 - 30	parity
(calculated = ** ****)	

G.1.3.18 Subframe 3 Word 5

Bits	Contents
1 – 16	C_{is} : 31.665x10^{-9} rads (17x2^{-29} rads)
(0000 0000 0001 0001)	
17 – 24	inclination angle at reference time i_o(8 MSB's) : 0.3 semicircles(644245944x2^{-31} semicircles)
(0010 0110)	
25 – 30	parity
(calculated = ** ****)	

G.1.3.19 Subframe 3 Word 6

Bits	Contents
1 – 24 **(0110 0110 0110 1001 1011 1000)**	inclination angle at reference time i_o(24 LSB's) :0.3 semicircles(644245944x2^{-31} semicircles)
25 – 30 **(calculated =** ** ****)	parity

G.1.3.20 Subframe 3 Word 7

Bits	Contents
1 – 16 **(0000 0000 0001 0010)**	C_{rc} : 562.5x10^{-3} m (18x2^{-5} m)
17 – 24 **(0100 0000)**	argument of perigee ω (8 MSB's) :0.5 semicircles (230x2^{-31} semicircles)
25 – 30 **(calculated =** ** ****)	parity

G.1.3.21 Subframe 3 Word 8

Bits	Contents
1 – 24 **(0000 0000 0000 0000 0000 0000)**	argument of perigee ω (24 LSB's) :0.5 semicircles (230x2^{-31} semicircles)
25 – 30 **(calculated =** ** ****)	parity

G.1.3.22 Subframe 3 Word 9

Bits	Contents
1 – 24 **(0000 0000 0000 0000 0001 0011)**	rate of right ascension Ω_{DOT} :2.16x10^{-12}semicircles/s (19x2^{-43} semicircles/s)
25 – 30 **(calculated =** ** ****)	parity

G.1.3.23 Subframe 3 Word 10

Bits	Contents
1 – 8 **(0000 0101)**	issue of data ephemeris IODE : issue 5
9 – 22 **(0000 0000 0101 00)**	rate of inclination angle IDOT :2.2737×10^{-12} semicircles/s (20×2^{-43} semicircles/s)
23 – 24 (calculated =**)	solved to ensure parity bits 29/30 zero
25 - 30 **(calculated =** **00)**	parity

G.1.4 SUBFRAMES 4 AND 5

Both subframes 4 and 5 are sub-commutated 25 times each; the 25 versions of these subframes are referred to as pages 1 through 25 of each subframe; and each of these pages has a page ID number associated with it. A brief summary of the various data contained in each page of subframes 4 and 5 follows:

G.1.4.1 Subframe 4

1. Pages 1, 6, 11, 16, and 21:reserved. (page ID 57)
2. Pages 2, 3, 4, 5, 7, 8, 9, and 10:Almanac data for satellites 25 through 32, respectively. (page ID's 25 through 32 respectively)
3. Pages 12 and 24:reserved. (page ID 62)
4. Pages 19, 20, 22, and 23:reserved. (page ID's 58 through 61 respectively)
5. Pages 13, 14 and 15:spares. (page ID's 52, 53, and 54)
6. Page 17: Special messages. (page ID 55)
7. Page 18:Ionospheric and UTC data. (page ID 56)
8. Page 25:A-S flags and satellite configurations for 32 satellites plus satellite health for satellites 25 through 32 (page ID 63)

G.1.4.2 Subframe 5

1. Pages 1 through 24:almanac data for satellites 1 through 24, respectively. (page ID's 1 through 24 respectively)
2. Page 25:satellite health for satellites 1 through 24. (page ID 51)

For further details refer to the description given for each of the page ID's.

G.1.5 PAGE ID'S 1 THROUGH 32

These pages contain almanac data and a health word for the 32 satellites. All the almanacs are identical, but the health word is all ok for the simulated satellite and all bad for the other 31 satellites. Page ID's 1 through 24 are transmitted on pages 1 through 24 of subframe 5; and page ID's 25 through 32 are transmitted on pages 2 through 5 and 7 through 10 of subframe 4.

G.1.5.1 Page ID's 1 through 32 – Word 3

Bits	Contents
1 – 2 **(01)**	data ID : data ID two
3 – 8 **(calculated = 00 0001 to 10 0000)**	Page (SV) ID : 1 to 32
9 – 24 **(0000 0000 0000 0000)**	eccentricity e : $1.5134\text{x}10^{-9}$ (rounded to $0\text{x}2^{-19}$)
25 – 30 **(calculated =** ** ****)	parity

G.1.5.2 Page ID's 1 through 32 – Word 4

Bits	Contents
1 – 8 **(0000 0010)**	almanac reference time t_{oa} :8192 seconds ($2\text{x}2^{12}$ seconds)
9 – 24 **(0000 0000 0000 0000)**	relative inclination angle δI : 0
25 – 30 **(calculated =** ** ****)	parity

G.1.5.3 Page ID's 1 through 32 – Word 5

Bits	Contents
1 – 16	rate of right ascension Ω_{DOT} : 2.16x10^{-12} semicircles/s (1x2^{-38} semicircles/s)
(0000 0000 0000 0001)	
17 – 19	SV health : all data OK if the page ID is the same as the simulated SV and all data bad otherwise.
(000) or (111)	
20 – 24	SV health : all signals OK if data OK if the page ID is the same as the simulated SV ID; and all data bad otherwise.
(0 0000) or (1 1111)	
25 – 30	parity
(calculated = ** ****)	

G.1.5.4 Page ID's 1 through 32 – Word 6

Bits	Contents
1 – 24	square root of semimajor axis $\sqrt{A}$: 5153.7 m^{½} (10554778x2^{-11} m$^{1/2}$)
(1010 0001 0000 1101 1001 1010)	
25 – 30	parity
(calculated = ** ****)	

G.1.5.5 Page ID's 1 through 32 – Word 7

Bits	Contents
1 – 24	right ascension at reference time Ω_o : 7.4506x10^{-9} semicircles (0x2^{-23} semicircles)
(0000 0000 0000 0000 0000 0000)	
25 – 30 parity	
(calculated = ** ****)	

G.1.5.6 Page ID's 1 through 32 – Word 8

Bits	Contents
1 – 24 **(0100 0000 0000 0000 0000 0000)**	argument of perigee ω :0.5 semicircles (222x2^{-23} semicircles)
25 – 30 **(calculated =** ** ****)	parity

G.1.5.7 Page ID's 1 through 32 – Word 9

Bits	Contents
1 – 24 **(0000 0101 1110 0101 0001 1110)**	mean anomaly at reference time M_o : 46.0546x10^{-3} semicircles (386334x2^{-23} semicircles)
25 – 30 **(calculated =** ** ****)	parity

G.1.5.8 Page ID's 1 through 32 – Word 10

Bits	Contents
1 – 8 **(0000 0000)**	clock correction coefficient a_{f0} 8 MSB's :3.726x10^{-9} s (rounded to 0x2^{-20} s)
9 – 19 **(0000 0000 00)**	clock correction coefficient a_{f1} :795.8x10^{-15} s^{-1} (rounded to 0x2^{-38} s^{-1})
20 – 22 **(00 0)**	clock correction coefficient a_{f0} 3 LSB's :3.726x10^{-9} s (rounded to 0x2^{-20} s)
23 – 24 **(calculated =**)	solved to ensure parity bits 29/30 zero
25 – 30 **(calculated =** ** ****)	parity

G.1.6 PAGE ID 51

This page contains health words for satellites 1 through 24. The health word for the simulated satellite is all ok, and the health words for all of the other satellites is all bad. Page ID 51 is transmitted on page 25 of subframe 5.

G.1.6.1 Page ID 51 – Word 3

Bits	Contents
1 – 2 **(01)**	data ID : data ID two
3 – 8 **(11 0011)**	Page ID : 51
9 – 16 **(0000 0010)**	almanac reference time t_{oa} :8192 seconds ($2x12^{-12}$ seconds)
17 – 24 **(0000 0001)**	almanac reference week WN_a : second week
25 – 30 **(calculated =** ** **** **)**	parity

G.1.6.2 Page ID 51 – Word 4

Bits	Contents
1 – 6 **(0000 00 or 1111 11)**	Satellite health for SV 1 :All zeros if SV ID is 1, all ones otherwise
7 – 12 **(0000 00 or 1111 11)**	Satellite health for SV 2 : All zeros if SV ID is 2, all ones otherwise
13 – 18 **(0000 00 or 1111 11)**	Satellite health for SV 3 : All zeros if SV ID is 3, all ones otherwise
19 – 24 **(0000 00 or 1111 11)**	Satellite health for SV 4: All zeros if SV ID is 4, all ones otherwise
25 – 30 **(calculated =** ** **** **)**	parity

G.1.6.3 Page ID 51 – Word 5

Bits	Contents
1 – 6 (**0000 00 or 1111 11**)	Satellite health for SV 5 : All zeros if SV is 5, all ones otherwise
7 – 12 (**0000 00 or 1111 11**)	Satellite health for SV 6 : All zeros if SV ID is 6, all ones otherwise
13–18 (**0000 00 or 1111 11**)	Satellite health for SV 7 : All zeros if SV ID is 7, all ones otherwise
19–24 (**0000 00 or 1111 11**)	Satellite health for SV 8:All zeros if SV ID is 8, all ones otherwise
25–30 (**calculated =** ** ****)	parity

G.1.6.4 Page ID 51 – Word 6

Bits	Contents
1 – 6 (**0000 00 or 1111 11**)	Satellite health for SV 9 : All zeros if SV ID is 9, all ones otherwise
7 – 12 (**0000 00 or 1111 11**)	Satellite health for SV 10 : All zeros if SV ID is 10, all ones otherwise
13 – 18 (**0000 00 or 1111 11**)	Satellite health for SV 11 : All zeros if SV ID is 11, all ones otherwise
19 – 24 (**0000 00 or 1111 11**)	Satellite health for SV 12:All zeros if SV ID is 12, all ones otherwise
25 – 30 (**calculated =** ** ****)	parity

G.1.6.5 Page ID 51 – Word 7

Bits	Contents
1 – 6 **(0000 00 or 1111 11)**	Satellite health for SV 13 :All zeros if SV ID is 13, all ones otherwise
7 – 12 **(0000 00 or 1111 11)**	Satellite health for SV 14 :All zeros if SV ID is 14, all ones otherwise
13 – 18 **(0000 00 or 1111 11)**	Satellite health for SV 15 : All zeros if SV ID is 15, all ones otherwise
19 – 24 **(0000 00 or 1111 11)**	Satellite health for SV 16: All zeros if SV ID is 16, all ones otherwise
25 – 30 **(calculated =** ** ****)	parity

G.1.6.6 Page ID 51 – Word 8

Bits	Contents
1 – 6 **(0000 00 or 1111 11)**	Satellite health for SV 17:All zeros if SV ID is 17, all ones otherwise
7 – 12 **(0000 00 or 1111 11)**	Satellite health for SV 18 : All zeros if SV ID is 18, all ones otherwise
13 – 18 **(0000 00 or 1111 11)**	Satellite health for SV 19 : All zeros if SV ID is 19, all ones otherwise
19 – 24 **(0000 00 or 1111 11)**	Satellite health for SV 20: All zeros if SV ID is 20, all ones otherwise
25 – 30 **(calculated =** ** ****)	parity

G.1.6.7 Page ID 51 – Word 9

Bits	Contents
1 – 6 **(0000 00 or 1111 11)**	Satellite health for SV 21 : All zeros if SV ID is 21, all ones otherwise
7 – 12 **(0000 00 or 1111 11)**	Satellite health for SV 22 : All zeros if SV ID is 22, all ones otherwise
13 – 18 **(0000 00 or 1111 11)**	Satellite health for SV 23 : All zeros if SV ID is 23, all ones otherwise
19 – 24 **(0000 00 or 1111 11)**	Satellite health for SV 24: All zeros if SV ID is 24, all ones otherwise
25 – 30 **(calculated =** ** ****)**	parity

G.1.6.8 Page ID 51 – Word 10

Bits	Contents
1 – 22 **(1010 1010 1010 1010 1010 10)**	alternating ones and zeros
23 – 24 **(calculated = **)**	Solved to ensure parity bits 29/30 zero
25 – 30 **(calculated =** ** **00)**	parity

G.1.7 PAGE ID'S 52 THROUGH 54

These pages are spare and contain alternating ones and zeros. Page ID's 52 through 54 are transmitted on pages 13 through 15 of subframe 4.

G.1.7.1 Page ID's 52 through 54 – Word 3

Bits	Contents
1 – 2 **(01)**	data ID : date ID two
3 – 8 **(11 0100) or (11 0101) or (11 0110)**	Page ID : 52,53, or 54
9 – 24 **(1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated =** ** ****)	parity

G.1.7.2 Page ID's 52 through 54 – Word 4

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated =** ** ****)	parity

G.1.7.3 Page ID's 52 through 54 – Word 5

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated =** ** ****)	parity

G.1.7.4 Page ID's 52 through 54 – Word 6

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated =** ** ****)	parity

G.1.7.5 Page ID's 52 through 54 – Word 7

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated =** ** ****)**	parity

G.1.7.6 Page ID's 52 through 54 – Word 8

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated =** ** ****)**	parity

G.1.7.7 Page ID's 52 through 54 – Word 9

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated =** ** ****)**	parity

G.1.7.8 Page ID's 52 through 54 – Word 10

Bits	Contents
1 – 22 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
23 – 24 **(calculated =** ** ****)**	solved to ensure parity bits 29/30 zero
25 – 30 **(calculated =** ** **00)**	parity

G.1.8 PAGE ID 55

This page is reserved for special messages and contains the message 'STC GPS SIMULATOR'. Page ID 55 is transmitted on page 17 of subframe 4.

G.1.8.1 Page ID's 55 – Word 3

Bits	Contents
1 – 2 **(01)**	data ID : data ID two
3 – 8 **(11 0111)**	Page ID : 55
9 – 24 **(0101 0011 0101 0100)**	ASCII message data : 'ST'
25 – 30 **(calculated = ** ****)**	parity

G.1.8.2 Page ID's 55 – Word 4

Bits	Contents
1 – 24 **(0100 0011 0010 0000 0010 0000)**	ASCII message data :'C'
25 – 30 **(calculated = ** ****)**	Parity

G.1.8.3 Page ID's 55 – Word 5

Bits	Contents
1 – 24 **(0100 0111 0101 0000 0101 0011)**	ASCII message data : 'GPS'
25 – 30 **(calculated = ** ****)**	Parity

G.1.8.4 Page ID's 55 – Word 6

Bits	Contents
1 – 24 **(0010 0000 0010 0000 0101 0011)**	ASCII message data : 'S'
25 – 30 **(calculated = ** ****)**	Parity

G.1.8.5 Page ID's 55 – Word 7

Bits	Contents
1 – 24	ASCII message data : 'IMU'
(0100 1001 0100 1101 0101 0101)	
25 – 30	Parity
(calculated = ** **)**	

G.1.8.6 Page ID's 55 – Word 8

Bits	Contents
1 – 24	ASCII message data : 'LAT'
(0100 1100 0100 0001 0101 0100)	
25 – 30	Parity
(calculated = ** **)**	

G.1.8.7 Page ID's 55 – Word 9

Bits	Contents
1 – 24	ASCII message data : 'OR'
(0100 1111 0101 0010 0010 0000)	
25 – 30	Parity
(calculated = ** **)**	

G.1.8.8 Page ID's 55 – Word 10

Bits	Contents
1 – 16	ASCII message data : ' '
(0010 0000 0010 0000)	
17 – 22	alternating ones and zeros
(1010 10)	
23 – 24	solved to ensure parity bits 29/30 zero
(calculated = **)	
25 – 30	parity
(calculated = ** **00)	

G.1.9 PAGE ID 56

This page contains ionospheric and UTC data. Page ID 56 is transmitted on page 18 of subframe 4.

G.1.9.1 Page ID 56 – Word 3

Bits	Contents
1 – 2 **(01)**	data ID : data ID two
3 – 8 **(11 1000)**	Page ID : 56
9 – 16 **(0000 1000**	α_0 : 7.45×10^{-9} seconds (8×2^{-30} seconds)
17 – 24 **(1111 1111)**	α_1 : -7.45×10^{-9} s/semicircle (-1×2^{-27} s/semicircle)
25 – 30 **(calculated = ** ****)**	parity

G.1.9.2 Page ID 56 – Word 4

Bits	Contents
1 – 8 **(1111 1111)**	α_2 : -5.96×10^{-8} s/semicircle^2 (-1×2^{-24} s/semicircle^2)
9 – 16 **(0000 0001)**	α_3 : 5.96×10^{-8} s/semicircle^3 (1×2^{-24} s/semicircle^3)
17 – 24 **(0010 1011)**	β_0 : 88064 seconds (43×2^{11} seconds)
25 – 30 **(calculated = ** ****)**	parity

G.1.9.3 Page ID 56 – Word 5

Bits	Contents
1 – 8 **(1111 1110)**	β_1 : -32768 s/semicircle ($-2x2^{14}$ s/semicircle)
9 – 16 **(1111 1101)**	β_2 : -196608 s/semicircle^2($-3x2^{16}$ s/semicircle^2)
17 – 24 **(0000 1011)**	β_3 : 196608 s/semicircle^3($3x2^{16}$ s/semicircle^3)
25 – 30 **(calculated = ** ****)**	parity

G.1.9.4 Page ID 56 – Word 6

Bits	Contents
1 – 24 **(1111 1111 1111 1111 1111 1011)**	A_1 : $-4.4x10^{-15}$ s/s ($-5x2^{-50}$ s/s)
25 – 30 **(calculated = ** ****)**	parity

G.1.9.5 Page ID 56 – Word 7

Bits	Contents
1 – 24 **(0000 0000 0000 0000 0000 0000)**	A_0 : (24 MSB's) : $3.7x10^{-9}$ seconds ($4x2^{-30}$ seconds)
25 – 30 **(calculated = ** ****)**	parity

G.1.9.6 Page ID 56 – Word 8

Bits	Contents
1 – 8 **(0000 0100)**	A_0 : (8 LSB's) : $3.7x10^{-9}$ seconds ($4x2^{-30}$ seconds)
9 – 16 **(0000 0010)**	reference time for UTC data t_{ot} : 8192 seconds ($2x2^{12}$seconds)
17 – 24 **(0000 0001)**	reference week number for UTC data WN_t : week 2
25 – 30 **(calculated = ** ****)**	parity

G.1.9.7 Page ID 56 – Word 9

Bits	Contents
1 – 8 **(0000 0000)**	delta time due to leap seconds, Δt_{LS} : 0
9 – 16 **(0000 0000)**	reference week number for future leap seconds WN_{LSF} : week
17 – 24 **(0000 0001)**	day number DN : day 1
25 – 30 **(calculated = ** ****)**	parity

G.1.9.8 Page ID 56 – Word 10

Bits	Contents
1–8 **(0000 0000)**	delta time due to future leap seconds, Δt_{LSF} : 0
9–22 **(1010 1010 1010 10)**	alternating ones and zeros
23–24 **(calculated = **)**	solved to ensure parity bits 29/30 zero
25–30 **(calculated = ** **00)**	parity

G.1.10 PAGE ID 57

This page is reserved and contains alternating ones and zeros. Page ID 57 is transmitted on pages 1, 6, 11, 16, and 21 of subframe 4.

G.1.10.1 Page ID 57 – Word 3

Bits	Contents
1 – 2 **(01)**	data ID : data ID two
3 – 8 **(11 1001)**	Page ID : 57
9 – 24 **(1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.10.2 Page ID 57 – Word 4

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.10.3 Page ID 57 – Word 5

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.10.4 Page ID 57 – Word 6

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.10.5 Page ID 57 – Word 7

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.10.6 Page ID 57 – Word 8

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 (calculated = ** ****)	parity

G.1.10.7 Page ID 57 – Word 9

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.10.8 Page ID 57 – Word 10

Bits	Contents
1 – 22 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
23 –24 **(calculated = **)**	solved to ensure parity bits 29/30 zero
25 – 30 **(calculated = ** **00)**	parity

G.1.11 PAGE ID'S 58 THROUGH 62

These pages are reserved and contain alternating ones and zeros. Page ID's 58 through 61 are transmitted on pages 19, 20, 22 and 23 of subframe 4 respectively. Page ID 62 is transmitted on pages 12 and 24 of subframe 4.

G.1.11.1 Page ID's 58 through 62 - Word 3

Bits	Contents
1 – 2 **(01)**	data ID : data ID two
3 – 8 **(11 1010 to 11 1110)**	Page ID : 58 to 62
9 – 24 **(1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.11.2 Page ID's 58 through 62 - Word 4

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.11.3 Page ID's 58 through 62 - Word 5

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.11.4 Page ID's 58 through 62 - Word 6

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.11.5 Page ID's 58 through 62 - Word 7

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.11.6 Page ID's 58 through 62 - Word 8

Bits	Contents
1 – 24 **(1010 1010 1010 1010 1010 1010)**	alternating ones and zeros
25 – 30 **(calculated = ** ****)**	parity

G.1.11.7 Page ID's 58 through 62 - Word 9

Bits	Contents
1 – 24	alternating ones and zeros
(1010 1010 1010 1010 1010 1010)	
25 – 30	parity
(calculated = ** **)**	

G.1.11.8 Page ID's 58 through 62 - Word 10

Bits	Contents
1 – 22	alternating ones and zeros
(1010 1010 1010 1010 1010 10)	
23 –24	solved to ensure parity bits 29/30 zero
(calculated = **)	
25 – 30	parity
(calculated = ** **00)	

G.1.12 PAGE ID 63

This page contains A-S flags and satellite configuration data for all 32 satellites, plus health words for satellites 25 through 32. The health word for the simulated satellite is all ok, and the health words for all of the other satellites is all bad. Page ID 63 are transmitted on page 25 of subframe 4.

G.1.12.1 Page ID 63 – Word 3

Bits	Contents
1 – 2	data ID : data ID two
(01)	
3 – 8	Page ID : 63
(11 1111)	
9 – 24	Anti-Spoof (A-S) flags and satellite configurations (satellites 1 to 4). All Block II satellites with A-S off
(0010 0010 0010 0010)	
25 – 30	parity
(calculated = ** **)**	

G.1.12.2 Page ID 63 – Word 4

Bits	Contents
1 – 24 (0010 0010 0010 0010 0010 0010)	Anti Spoof (A-S) flags and satellite configurations (satellites 5 to 10). All Block II satellites with A-S off
25 – 30 (calculated = ** ****)	parity

G.1.12.3 Page ID 63 – Word 5

Bits	Contents
1 – 24 (0010 0010 0010 0010 0010 0010)	Anti Spoof (A-S) flags and satellite configurations (satellites 11 to16). All Block II satellites with A-S off
25 – 30 (calculated = ** ****)	parity

G.1.12.4 Page ID 63 – Word 6

Bits	Contents
1 – 24 (0010 0010 0010 0010 0010 0010)	Anti Spoof (A-S) flags and satellite configurations (satellites 17 to 22). All Block II satellites with A-S off
25–30 (calculated = ** ****)	parity

G.1.12.5 Page ID 63 – Word 7

Bits	Contents
1 – 24 (0010 0010 0010 0010 0010 0010)	Anti Spoof (A-S) flags and satellite configurations (satellites 23 to 28). All Block II satellites with A-S off
25 – 30 (calculated = ** ****)	parity

G.1.12.6 Page ID 63 – Word 8

Bits	Contents
1 – 16 **(0010 0010 0010 0010)**	Anti Spoof (A-S) flags and satellite configurations (satellites 29 to 32). All Block II satellites with A-S off
17 – 18 **(10)**	alternating ones and zeros
19 – 24 **(0000 00 or 1111 11)**	Satellite health for SV 25:All zeros is SV ID is 25, all ones otherwise
25 – 30 **(calculated = ** ****)**	parity

G.1.12.7 Page ID 63 – Word 9

Bits	Contents
1 – 6 **(0000 00 or 1111 11)**	Satellite health for SV 26: All zeros if SV ID is 26, all ones otherwise
7 – 12 **(0000 00 or 1111 11)**	Satellite health for SV 27: All zeros if SV ID is 27, all ones otherwise
13 – 18 **(0000 00 or 1111 11)**	Satellite health for SV 28: All zeros is SV ID is 28, all ones otherwise
19 – 24 **(0000 00 or 1111 11)**	Satellite health for SV 29: All zeros is SV ID is 29, all ones otherwise
25 – 30 **(calculated = ** ****)**	parity

G.1.12.8 Page ID 63 – Word 10

Bits	Contents
1 – 6 **(0000 00 or 1111 11)**	Satellite health for SV 30: All zeros if SV ID is 30, all ones otherwise
7 – 12 **(0000 00 or 1111 11)**	Satellite health for SV 31: All zeros if SV ID is 31, all ones otherwise
13 – 18 **(0000 00 or 1111 11)**	Satellite health for SV 32: All zeros is SV ID is 32, all ones otherwise
19 – 22 **(10 10)**	alternating ones and zeros
23 – 24 **(calculated = **)**	solved to ensure parity bits 29/30 zero
25 – 30 **(calculated = ** **0)**	parity

H USER DEFINABLE NAVIGATION DATA

H.1 INTRODUCTION

The GSS6100 has a facility to enable the user to completely define the contents of the GPS Navigation Data Message.

The data message contents are held within an editable ASCII File (template file). The default Navigation message is described in Appendix G.

The following pages detail the message file format.

H.2 FORMAT OF FILE

H.2.1 GENERAL

The file is ASCII text only. Any normal text editor (e.g. Windows Notepad) may be used for creating or modifying files.

Comments are allowed and are denoted by an exclamation mark (!) in the first column.

The length of any line must not exceed 24 characters. The total number of lines in the file must not exceed 549.

The TOW and week number fields in the nav message are overridden by the menu screen or defined ATE values.

Subframe ID (word2) is not user definable.

The almanac health fields for the SIMULATED SVID are always set healthy in page ID 51 or 63, as appropriate.

H.2.2 DATA FIELDS

The data is organised by word and subframe. The ordering of the data is as follows:
Word 1 for all subframes
Word 2 for all subframes
Words 3 through 10 for subframes 1 through 3
Words 3 through 10 for page Ids 1 through 32,51 through 63

Page ID's are defined in STANAG 4294. They specify the contents of subframes 4 and 5. Page ID 57 is used 4 times, 62 used twice.

A comment is included after each line of data defining the word number.

A typical line is as follows

8BAAAB tttttt wd 1

The first 6 characters represent the 24-bit word data in hexadecimal format.

8	B	A	A	A	B
1000	1011	1010	1010	1010	1011

The bit order is leftmost transmitted first.

The next six characters are reserved for future implementation of parity adjustment. In this release these characters should remain tttttt. In future releases t will represent the parity bit as calculated, f as the inverse of calculated. 0 as forced to zero, and 1 as forced to one.

The next character is a space delimiter.

The remaining characters are comment, in this case showing word 1 for all subframes (the telemetry word).

H.2.2.1 Example Nav Data Template

```
!no.lines in file <550
!line length <25 chars
!
!bit 1 on left
!bit 24 on right
!wds 1&2 every sframe
8BAAAB tttttt wd1
```

```
000000 tttttt wd2
!
!subframes 1 to 3
!
!subframe1
002200 tttttt wd3
AAAAAA tttttt wd4
AAAAAA tttttt wd5
AAAAAA tttttt wd6
AAAA04 tttttt wd7
0501C2 tttttt wd8
060007 tttttt wd9
000020 tttttt wd10
!
!subframe2
!
050009 tttttt wd3
000A00 tttttt wd4
00000B tttttt wd5
000C00 tttttt wd6
00000D tttttt wd7
000EA1 tttttt wd8
0D999A tttttt wd9
01C2A8 tttttt wd10
!
!subframe3
!
000F00 tttttt wd3
000010 tttttt wd4
001126 tttttt wd5
6669B8 tttttt wd6
001240 tttttt wd7
000000 tttttt wd8
000013 tttttt wd9
050050 tttttt wd10
!
!subframes 4 & 5
!pages 1 to 25
!
!page id1
!
410000 tttttt wd3
020000 tttttt wd4
0001FF tttttt wd5
```

```
A10D9A tttttt wd6
000000 tttttt wd7
400000 tttttt wd8
05E51E tttttt wd9
000000 tttttt wd10
!
!page id2
!
420000 tttttt wd3
020000 tttttt wd4
0001FF tttttt wd5
A10D9A tttttt wd6
000000 tttttt wd7
400000 tttttt wd8
05E51E tttttt wd9
000000 tttttt wd10
!
! <page id's 3 to 32 and page id's 51 to 63
removed for brevity>
!
```

I SBAS CORRECTION DATA FILES

I.1 CREATING AND EDITING A SBAS CORRECTION DATA FILE

When in SBAS mode the GSS6100 produces a SBAS correction data message from the user supplied *.WAS ASCII file. The default correction data file is WAAS_DEF.WAS. The file appropriate to WAAS change note 3 is SBAS_CN3.WAS

Raw SBAS correction data has the following basic format:

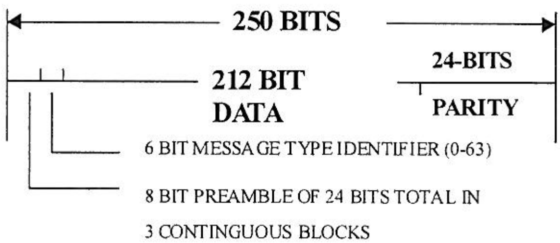


Figure 27 Raw SBAS Correction Data Diagram

As can be seen from the diagram above the message can be split into two main segments, data and parity.

Each line of data in the *.WAS file corresponds to 1 second of data (assuming a data rate of 500 symbols/sec). The 226 data bits are encoded into 57 hex characters, see below:

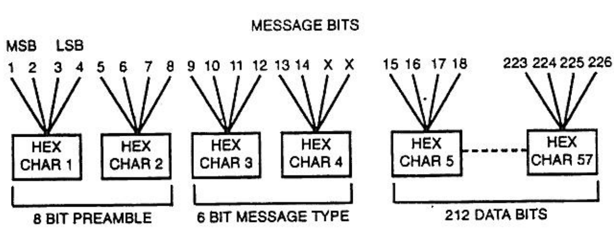


Figure 28 SBAS Message Structure

Note1: The 2 LSB's of hex character 4 in each data line are discarded
Note 2: Data bit 1 is transmitted first.

I.1.1 EXAMPLE

First 6 characters of a line of data are : A C F C B 6

Bit No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	X	X	15	16	17	18	19	20	21	22
Data	1	0	1	0	1	1	0	0	1	1	1	1	1	1	0	0	1	0	1	1	0	1	1	0

To complete the full 250 bit data message 24 Cyclic Redundancy Check (CRC) parity bits must be appended to the 226 data bits. The calculation of these parity bits is controlled by the GSS6100 software and no user intervention is required. All 24 parity bits can be complemented by selecting message parity FALSE from within the standalone simulation software or by calling the 'C' ATE Library function W32_message_parity (FALSE) function.

Once the complete 250 bit message has been created it is encoded by a ½ rate convolutional Forward Error Correction (FEC) process. The FEC data is produced, in software, by contiguously feeding the data bits through a constrained length 7 Veterbi encoder. This action converts each data bit into two data symbols. This process, like the parity calculations, is invisible to the user.

I.1.2 DEFAULT *.WAS FILE, WAAS_DEF.WAS

The supplied default correction message gives examples of some of the available messages types. This default message does not constitute an actual usable correction message but does enable the user to compare their receivers decoded correction data against know input values.

I.1.2.1 The Preamble

The preamble consists of a 24 bit word, 01010011 10011010 11000110. This word is divided into three bytes, and is broadcast contiguously 1 byte a second. The full preamble word repeats every 3 seconds. The preamble bytes are stored in bits 1 to 8 of the message.

Second	Preamble Byte	*.WAS data Chars 1 & 2
1	01010011	5 3
2	10011010	9 A
3	11000110	C 6

I.1.2.2 Message Type Identifier

The correction message has been subdivided into 64 distinct message types. The message type identifier, bits 9 to 14 state which message type is to be broadcast.

Message Type	Message Type Bits	*.WAS data Chars 3 & 4
1	000001	0 4
7	000111	1 C
17	010001	4 4

Note: Remember that the 2 LSB's in hex character 4 in the *.WAS file are DON'T CARE. It is suggested, as in the case of the examples shown, that the user sets both of these bits to zero.

Tabulated below is a complete list of available message types and their contents.

Type	Contents
0	Do not use this GEO for anything (for SBAS testing only)
1	PRN Mask assignments, set up to 51 of 210 bits
2 to 5	Fast corrections
6	Integrity information
7	Fast correction degradation factor
8	Reserved for future messages
9	GEO navigation message (X,Y,Z, time etc.)
10	Degradation Parameters
11	Reserved for future messages
12	SBAS Network Time/UTC offset parameters
13-16	Reserved for future messages
17	GEO satellite almanacs
18	Ionospheric grid point masks
19 – 23	Reserved for future messages
24	Mixed fast corrections/long term satellite error corrections
25	Long term satellite error corrections
26	Ionospheric delay corrections
27	SBAS service message
28-61	Reserved for future messages
62	Internal Test Message
63	Null message

The format of the SBAS messages is as defined in RTCA/DO-229A. The following information describes how the content of these messages is determined during a simulation.

1.1.2.3 Example of Message Type 0: Test Message

This message may be generated under the following conditions:

1. This message type is enabled. In this case the message is output at the specified interval.
2. This message type is disabled, but a satellite off period is specified with the Satellite off mode selected as "O/P Test Message". In this case this message is transmitted continuously during the off period.

The content of the 212 bit data field is always set to alternating 1's and 0's. An example to illustrate 212 bit data block and its hexadecimal equivalent is shown below:

```
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010
Hex:
AA AA AA AA AA AA AA AA AA AA AA AA AA
AA AA AA AA AA AA AA AA AA AA AA AA AA A
```

I.1.2.4 Example of Message Type 1: PRN Mask

The PRN mask appears early in the message and determines which PRN (satellite) the following correction data is to apply to. The data block for each message type is 212 bits long. With message type 1, each bit of the first 210 bits corresponds to its equivalent PRN number i.e. bit 7 is PRN 7. A maximum of 51 bits of the 210 can be set. The last 2 data bits 211 and 212 determine an Issue of Data PRN (IODP), these 2 bits are set to three throughout the default message.

In the example below 8 satellites are to be considered, PRN 2, 7, 10, 15, 22, 25, 32 and 120.

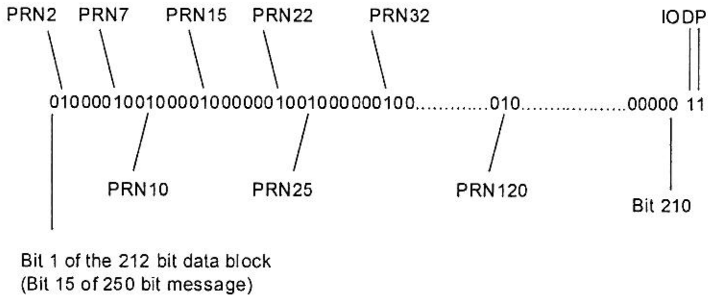


Figure 29 Bit Sequence Message Type 1

*.WAS data line for the 212 bit data block of message type 1 is:

```
Hex:
42 42 04 81 00 00 00 00 00 00 00 00 00
00 01 00 00 00 00 00 00 00 00 00 00 00 3
```

I.1.2.5 Examples of Message Type 2: Fast Corrections

This message contains clock correction data for all satellites referenced in the PRN mask. The correction values are determined from the ISCN (Intentional Satellite Clock Noise) model, which may be enabled and specified for individual GPS satellites via the GPS Constellation File. If no error is applied to the correction data then this will accurately reflect the actual clock error being applied. It is however possible to add an element of error to the correction data. SBAS satellites are included in this message, but no clock error is currently generated for these. The time of applicability of the data is the time of message transmission.

Satellites which are not visible from any of the specified monitoring points are flagged as "Not Monitored" (UDREI = 14). If the clock error exceeds the allowed range then a UDREI of 15 is assigned ("Do Not Use"). An SBAS satellite, which is in test mode is set to "Do Not Use".

This message holds data for up to 13 satellites. Message type 2 will normally be generated at the specified rate, and types 3, 4, 5 are viewed as continuations of this message as required, which depends on the amount of correction data to be broadcast, i.e. the number of satellites in the PRN mask. If the last of these messages contains data for fewer than 7 satellites then this may be replaced by a mixed message (type 24), when this is enabled.

The IODP value (bits 3-4) will correspond to that used in the preceding PRN mask message, i.e. 3.

The IODF values (bits 1-2) increment for each new transmission, i.e. they cycle between 0 and 2 and will be initialised with 1.

Fast Correction Data (PRC_f): As only 8 of the possible 13 available fast correction slots have been used, the remaining empty slots have been filled with 0's for the fast correction data and 15 (Do Not Use) for the UDREI part of the data.

Fast Correction Data (PRC_f): (13 x 12 Bits, = bits 5 to 160)

The PRC_f data is measured in metres with a range of –256.000 to 255.875 and a resolution of 0.125 metres.

In this example the monitored satellites will have the following PRC_f values.

PRN 2:	10m	(000001010000)
PRN 7:	-2m	(111111110000)
PRN 10:	50m	(000110010000)
PRN 15:	4m	(000000100000)
PRN 22:	0.125m	(000000000001)
PRN 25:	-1m	(111111111000)
PRN 32:	1m	(000000001000)
PRN 120:	0m	(000000000000)

I.1.2.6 User Differential Range Error Indicator (UDREI): (13 x 4 Bits, = bits 161 to 212)

The UDRE indicator, as can be seen from the table below, gives the user an indication of the range error the user can expect from the fast and slow error corrections that are being broadcast.

$UDREI_i$	$UDREI_i$ (99.9%) – Metres
0	0.75
1	1.0
2	1.25
3	1.75
4	2.25
5	3.0
6	3.75
7	4.5
8	5.25
9	6.0
10	7.5
11	15.0
12	50.0
13	150.0
14	Not Monitored
15	Do Not Use

In this example our monitored satellites will have the following UDREI values.

PRN 2:	1.25m	(0010)
PRN 7:	1.0m	(0001)
PRN 10:	3.75m	(0110)
PRN 15:	6.0m	(1001)
PRN 22:	0.75m	(0000)
PRN 25:	1.0m	(0001)
PRN 32:	150m	(1101)
PRN 120:	Not Monitored	(1110)

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

```
0111 0000 0101 0000 1111 1111 0000 0001 1001 0000 0000
0010 0000 0000 0000 0001 1111 1111 1000 0000 0000 1000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0010 0001 0110 1001
0000 0001 1101 1110 1111 1111 1111 1111 1111
Hex:
70 50 FF 01 90 02 00 01 FF 80 08 00 00
00 00 00 00 00 00 00 21 69 01 DE FF FF F
```

I.1.2.7 Message Type 6: Integrity Information

This message repeats the integrity information (UDREIs) broadcast by a preceding fast corrections message. The $IODF_n$ values are set to 3 at all times (for n = 2 - 5). Note that this message will not be broadcast if its nominal transmission time corresponds with that for a fast correction message sequence. Thus if both fast corrections and integrity information update periods are set to 6 seconds, no separate integrity data messages will be generated.

$IODF_n$ occupies bits 1-8 of the 212 bit message. The remaining 204 bits is divided into 51 slots of 4 bit UDREI's, one for each satellite in the mask.

Parameter	No. of Bits
$IODF_2$	2
$IODF_3$	2
$IODF_4$	2
$IODF_5$	2
UDREI	4 (for each of 51 satellites)

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

```
1111 1111 0010 0001 0110 1001 0000 0001 1101 1110 1111
1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111
1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111
1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111
1111 1111 1111 1111 1111 1111 1111 1111 1111
Hex:
FF 21 69 01 DE FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF F
```

I.1.2.8 Message Type 7: Degradation Factor

This message contains degradation factors, which allow the user to compensate the UDRE data for data latency.

Ai_i	a_i – mm/s^2
0	0.00
1	0.05
2	0.09
3	0.12
4	0.15
5	0.20
6	0.30
7	0.45
8	0.60
9	0.90
10	1.50
11	2.10
12	2.70
13	3.30
14	4.60
15	5.80

Parameter	**No. of Bits**
System latency (t_{lat})	4
IODP	2
Spare	2
ai_i (Indicator)	4 (for each of 51 satellites)

IODP = 3
System Latency = 0

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

```
0000 1100 0000 0000 0000 0101 0101 0000 0101 0101 0101
0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101
0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101
0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101
0101 0101 0101 0101 0101 0101 0101 0101 0101
Hex:
```

OC 00 05 50 55 55 55 55 55 55 55 55 55
55 55 55 55 55 55 55 55 55 55 55 55 55 5

I.1.2.9 Message Type 9: GEO Navigation

This message contains information, which defines the motion of the transmitting GEO satellite at a specific time (Toa). The GEO motion parameters at this time are extrapolated from the initialisation data entered by the user. The content of this message is updated at a fixed interval of ten times the message transmission interval, and the Issue of Data is incremented at this time. The Toa value (time of day) is set to be at the mean point between updates (truncated to a 16 second epoch). The clock parameters a_{Gf0}, a_{Gf1} are also updated to this time. The accuracy is set to the user-defined URA value.

Parameter	No. of Bits	Value
Issue of Data	8	3
t_0	13	43248 seconds
Accuracy	4	0
X_G (ECEF)	30	42164174 metres
Y_G (ECEF)	30	0 metres
Z_G (ECEF)	25	0 metres
X_G (Rate-of-Change)	17	0 m/s
Y_G (Rate-of-Change)	17	0 m/s
Z_G (Rate-of-Change)	18	0 m/s
X_G Acceleration	10	0 m/s^2
Y_G Acceleration	10	0 m/s^2
Z_G Acceleration	10	0 m/s^2
a_{Gf0}	12	0 seconds
a_{Gf1}	8	0seconds/sec

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

```
0000 0011 0101 0100 0111 1000 0011 1110 1101 0100 0101
1011 0001 1110 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000
Hex:
03 54 78 3E D4 5B 1E 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 0
```

I.1.2.10 Message Type 10: Degradation Parameters

This information is used to model the degradation of the fast, long term, and ionospheric correction data as defined in RTCA/DO-229A (para.A.4.5). The same user specified values are used throughout for all SBAS satellites.

Parameter	No. of Bits	Value
B_{rrc}	10	0
C_{ltc_lsb}	10	0
C_{ltc_v1}	10	0
I_{ltc_v1}	9	60
C_{ltc_v0}	10	0
I_{ltc_v0}	9	60
C_{geo_lsb}	10	0
C_{geo_v}	10	0
I_{geo}	9	60
C_{er}	6	0
C_{iono_step}	10	0
I_{iono}	9	120
$C_{iono\ ramp}$	10	0
RSS_{UDRE}	1	0
RSS_{iono}	1	0
Spare	88	

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

```
0000 0000 0000 0000 0000 0000 0000 0000 0111 1000 0000
0000 0000 1111 0000 0000 0000 0000 0000 0000 0000 0111
1000 0000 0000 0000 0000 0111 1000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000
Hex:
00 00 00 00 78 00 0F 00 00 00 78 00 00
78 00 00 00 00 00 00 00 00 00 00 00 00 0
```

I.1.2.11 Message Type 12: SBAS Network Time

This contains parameters, which relate SBAS network time to UTC time. The number of leap seconds will be as specified in the GPS constellation file. The UTC identifier is as defined in the SBAS Signal Control Data screen.

Parameter	**No. of Bits**	**Value**
A_{1WNT}	24	0
A_{0WNT}	32	0
C_{ltc_v1}	8	0
t_{0t}	8	116
WN_t	8	61
WN_{LSF} 8	61	
DN	8	1
Δt_{LSF}	8	0
UTC Standard Identifier	3	0
GPS Time-of-Week	20	475231 seconds TOW
GPS Week Number	10	829
Glonass Indicator	1	0
Glonass time offset	74	- reserved

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

```
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0111 0100 0011 1101 0000 0000 0011 1101
0000 0001 0000 0000 0000 1110 1000 0000 1011 1111 1001
1110 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010
Hex:
00 00 00 00 00 00 00 74 3D 00 3D 01 00
0E 80 BF 9E AA AA AA AA AA AA AA AA AA A
```

I.1.2.12 Message Type 18: Ionospheric Grid Mask

There are nine grid mask bands (0 to 8) each defining the status of 201 grid points (200 for band 8), so nine messages would be required to transmit all of this data. The user may however restrict the number of bands broadcast from each GEO satellite to a more sensible level, and the bands nearest to the GEO position are then used. The user may also define which latitude and longitude grid points are valid globally, and this determines which points are used within each band. The set of valid iono grid points does not change unless an IODI update time is specified for an SBAS satellite. In this case a second set of user defined iono grid points is applied (for this satellite), and IODI is also incremented.

Parameter	No. of Bits
Number of Bands being broadcast	4
Band Number	4
Issue of Data – IODI	2
IGP Mask	201
Spare	1

Number of Bands being broadcast = 3

Band Number = 1
Issue of Data – IODI = 0

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

```
0011 0001 0000 1111 1111 0000 0000 0111 1111 1000 0100
0100 0000 0100 0100 0001 1111 1100 0000 0001 1111 1100
0001 0000 0000 0000 0001 0000 1111 1111 1000 0000 1111
1111 1000 0100 0000 0000 0000 0100 0001 1111 1100 0000
0001 1111 1100 0001 0001 0000 0001 0001 0000
Hex:
31 0F F0 07 F8 44 04 41 FC 01 FC 10 00
10 FF 80 FF 84 00 04 1F C0 1F C1 10 11 0
```

Band Number = 2
Issue of Data – IODI = 0

```
0011 0010 0001 1111 1110 0000 0000 1111 1111 0000 1000
1001 0000 0000 1000 0011 1111 1100 0000 0111 1111 1000
0001 0000 0000 0000 0001 0000 1111 1111 0000 0000 0111
1111 1000 0100 0100 0000 0100 0100 0001 1111 1100 0000
0001 1111 1100 0001 0000 0000 0000 0001 0000
Hex:
32 1F E0 0F F0 89 00 83 FC 07 F8 10 00
10 FF 00 7F 84 40 44 1F C0 1F C1 00 01 0
```

Band Number = 3
Issue of Data – IODI = 0

```
0011 0011 0001 1111 1111 0000 0001 1111 1111 0000 1000
0000 0000 0000 1000 0001 1111 1100 0000 0001 1111 1100
0001 0001 0000 0001 0001 0000 1111 1111 0000 0000 0111
1111 1000 0100 0000 0000 0000 0100 0001 1111 1110 0000
0011 1111 1100 0001 0000 0000 0000 0001 0000
Hex:
33 1F F0 1F F0 80 00 81 FC 01 FC 11 01
10 FF 00 7F 84 00 04 1F E0 3F C1 00 01 0
```

I.1.2.13 Message Type 25: Long Term Satellite Error Corrections

The long-term corrections message contains data to compensate for errors in satellite position and velocity (if significant), and also clock noise. As the name implies, these are effects which are expected to change slowly with time. Motion errors will apply to a GPS satellite if track errors are specified for this satellite in the GPS constellation file. Similarly clock error will apply if non-zero values are specified for the clock error terms (Δaf0, Δaf1, Δaf2) in the same file. The error correction values are calculated on every 16 second epoch, and the time of applicability is set to be at least 60 seconds after the nominal message transmission time.

There are two formats for this message type, with or without velocity corrections, i.e. velocity codes 1 and 0 respectively. Unless either clock rate or velocity component corrections are greater than their respective resolutions in the code 1 message type then the code 0 message type is used. This message type can contain correction data for two satellites with velocity code 1, 4 satellites with velocity code 0, or 3 satellites with a combination of these. The IODP will correspond with that broadcast in the preceding PRN mask message, but could lag when a change in PRN mask interrupts a long-term message sequence. The Issue of Data (IOD) will normally correspond to the current IODE value for the GPS ephemeris data, but change in this value on a GPS cutover/upload will be delayed for two minutes.

No long term correction data is broadcast for the SBAS satellites themselves.

The purpose of message type 25 is to broadcast long term satellite error correction data. These long term errors are derived from slowly varying satellite ephemeris and clock error data.

The 212 bit data block can be divided up so as to detail long term correction data for either 2, 3 or 4 satellites. For the SBAS_CN3.WAS file PRNS 2 and 7, 10 and 22, and 10, 15 and 29 have been grouped together to produce 3 different message type 25 examples.

Example 1: PRNS 2 AND 7

Parameter	Value	No. Bits	Bit Positions	Binary data
Velocity Code	1	1	15	1
PRN Mask No. (PRN 2)	1	6	16..21	000001
Issue of Data	2	8	22..29	00000010
δx (ECEF)	0.5 metres	11[1]	30..40	00000000100
δy (ECEF)	17.125 metres	11[1]	41..51	00010001001
δz (ECEF)	2.125 metres	11[1]	52..62	00000010001
δa_{f0}	0.0s	11[1]	63..73	00000000000
δx rate-of-change (ECEF)	0.00048828125 m/s	8[1]	74..81	00000001
δy rate-of-change (ECEF)	0 m/s	8[1]	82..89	00000000
δz rate-of-change (ECEF)	-0.00146484375 m/s	8[1]	90..97	11111101
δa_{f1}	0.0 seconds/sec	8[1]	98..105	00000000
Time-of-Day Applicability	704 seconds	13	106..118	0000000101100
IODP	3	2	119..120	11

[1] Denotes a 2's complement number

Parameter	Value	No. Bits	Bit Positions	Binary data
Velocity Code	1	1	121	1
PRN Mask No. (PRN 7)	2	6	122..127	000010
Issue of Data	2	8	128..135	00000010
δx (ECEF)	4.5 metres	11[1]	136..146	00000100100
δy (ECEF)	4.5 metres	11[1]	147..157	00000100100
δz (ECEF)	-16 metres	11[1]	158..168	11110000000
δa_{f0}	0.0s	11[1]	169..179	00000000000
δx rate-of-change (ECEF)	0.00244140625 m/s	8[1]	180..187	00000101
δy rate-of-change (ECEF)	0.0 m/s	8[1]	188..195	00000010
δz rate-of-change (ECEF)	0.00048828125 m/s	8[1]	196..203	00000001
δa_{f1}	0.0 seconds/sec	8[1]	204..211	00000000
Time-of-Day Applicability	704 seconds	13	212..224	0000000101100
IODP	3	2	225..226	11

[1] Denotes a 2's complement number

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

1st 106 bits.

```
1000 0010 0000 0100 0000 0001 0000 0100 0100 1000 0001
0001 0000 0000 0000 0000 0010 0000 0001 1111 1010 0000
0000 0000 0010 1100 11
```

2nd 106 bits.

```
  10 0001 0000 0001 0000 0010 0100 0000 0100 1001 1110
0000 0000 0000 0000 0000 0010 1000 0000 0000 0000 1000
0000 0000 0000 1011 0011
```

```
Hex:
82 04 01 04 48 11 00 00 20 1F A0 00 2C
E1 01 02 40 49 E0 00 00 28 00 08 00 0B 3
```

Example 2: PRNS 10 AND 22

Parameter	Value	No. Bits	Bit Positions	Binary data
Velocity Code	1	1	15	1
PRN Mask No (PRN 10)	3	6	16..21	000011
Issue of Data	2	8	22..29	00000010
δx (ECEF)	-1 metre	11[1]	30..40	11111111000
δy (ECEF)	12.625 metres	11[1]	41..51	00001100101
δz (ECEF)	-11.625 metres	11[1]	52..62	11110100011
δa_{f0}	0.0s	11[1]	63..73	00000000000
δx rate-of-change (ECEF)	0.00048828125 m/s	8[1]	74..81	00000001
δy rate-of-change (ECEF)	0.001953125 m/s	8[1]	82..89	00000100
δz rate-of-change (ECEF)	0.001953125 m/s	8[1]	90..97	00000100
δa_{f1}	0.0 seconds/sec	8[1]	98..105	00000000
Time-of-Day Applicability	704 seconds	13	106..118	0000000101100
IODP	3	2	119..120	11

[1] Denotes a 2's complement number

Parameter	Value	No. Bits	Bit Positions	Binary data
Velocity Code	1	1	121	1
PRN Mask No (PRN 22)	5	6	122..127	000101
Issue of Data	2	8	128..135	00000010
δx (ECEF)	13.375 metres	11[1]	136..146	00001101011
δy (ECEF)	-1.875 metres	11[1]	147..157	11111110001
δz (ECEF)	10.75 metres	11[1]	158..168	00001010110
δa_{f0}	0.0s	11[1]	169..179	00000000000
δx rate-of-change (ECEF)	0.00048828125 m/s	8[1]	180..187	00000001
δy rate-of-change (ECEF)	0.0009765625 m/s	8[1]	188..195	00000010
δz rate-of-change (ECEF)	0.0 m/s	8[1]	196..203	00000000
δa_{f1}	0.0 seconds /sec	8[1]	204..211	00000000
Time-of-Day Applicability	704 seconds	13	212..224	0000000101100
IODP	3	2	225..226	11

[1] Denotes a 2's complement number

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

1st 106 bits.

```
1000 0110 0000 0101 1111 1110 0000 0011 0010 1111 1010
0011 0000 0000 0000 0000 0010 0000 1000 0000 1000 0000
0000 0000 0010 1100 11
```

2nd 106 bits.

```
  10 0010 1000 0001 0000 0110 1011 1111 1110 0010 0001
0101 1000 0000 0000 0000 0000 1000 0001 0000 0000 0000
0000 0000 0000 1011 0011
```

```
Hex:
86 05 fe 03 2f a3 00 00 20 80 80 00 2c
e2 81 06 bf e2 15 80 00 08 10 00 00 0b 3
```

Example 3: PRNS 10, 2 and 7

Parameter	Value	No. Bits	Bit Positions	Binary data
Velocity Code	1	1	15	1
PRN Mask No. (PRN 10)	3	6	16..21	000011
Issue of Data	2	8	22..29	00000010
δx (ECEF)	-1 metre	11[1]	30..40	11111111000
δy (ECEF)	12.625 metres	11[1]	41..51	00001100101
δz (ECEF)	-11.625 metres	11[1]	52..62	11110100011
δa_{f0}	0.0s	11[1]	63..73	00000000000
δx rate-of-change (ECEF)	0.00048828125 m/s	8[1]	74..81	00000010
δy rate-of-change (ECEF)	0.001953125 m/s	8[1]	82..89	00000100
δz rate-of-change (ECEF)	0.001953125 m/s	8[1]	90..97	00000100
δa_{f1}	0.0 seconds/sec	8[1]	98..105	00000000
Time-of-Day Applicability	704 seconds	13	106..118	0000000101100
IODP	3	2	119..120	11

[1] Denotes a 2's complement number

Parameter	Value	No. Bits	Bit Positions	Binary data
Velocity Code	0	1	121	0
PRN Mask No. (PRN 2)	1	6	122..127	000001
Issue of Data	2	8	128..135	00000010
δx (ECEF)	0.5 metres	9[1]	136..144	000000100
δy (ECEF)	17.125 metres	9[1]	145..153	010001001
δz (ECEF)	2 metres	9[1]	154..162	000010001
δa_{f0}	0.0s	10[1]	163..172	0000000000
PRN Mask No. (PRN 7)	2	6	173..178	000010
Issue of data	2	8	179..186	00000010
δx (ECEF)	4.625 metres	9[1]	187..195	000100100
δy (ECEF)	4.5 metres	9[1]	196..204	000100100
δz (ECEF)	-16 metres	9[1]	205..213	110000000
δa_{f0}	0.0 s	10[1]	214..223	0000000000
IODP	3	2	224..225	11
Spare	0	1	226	0

[1] Denotes a 2's complement number

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

1st 106 bits.

```
1000 0110 0000 0101 1111 1110 0000 0011 0010 1111 1010
0011 0000 0000 0000 0000 0100 0000 1000 0000 1000 0000
0000 0000 0010 1100 11
```

2nd 106 bits.

```
  00 0000 1000 0001 0000 0001 0001 0001 0010 0001 0001
0000 0000 0000 0010 0000 0010 0001 0010 0000 1001 0011
0000 0000 0000 0000 0110
```

```
Hex:
86 05 FE 03 2F A3 00 00 20 80 80 00 2C
C0 81 01 11 21 10 00 20 21 20 93 00 00 6
```

I.1.2.14 Example of Message Type 24: Mixed Fast and Long Term Satellite Error Corrections

The mixed corrections message contains fast and long term correction data. This is only used (if enabled) when a currently scheduled fast correction message is less than half full, and a sequence of long term messages is in progress or pending. The second half of the message then has long term data added. This message does not have an associated message output interval as it is subservient to the fast corrections message.

This message types combines both fast and slow correction data. Fast correction data can be broadcast for up to 6 satellites in addition to long term data for up to 2 satellites.

The example below has fast correction data for PRNS 2, 7, 10, 15, 22, and 120 and long term data for satellites 2 and 7.

Parameter	Value	No. Bits	Bit Positions	Binary data
PRN 2 PRC_f	10 metres	12	15..26	000001010000
PRN 7 PRC_f	-2 metres	12	27..38	111111110000
PRN 10 PRC_f	50 metres	12	39..50	000110010000
PRN 15 PRC_f	4 metres	12	51..62	000000100000
PRN 22 PRC_f	0.125 metres	12	63..74	000000000001
PRN 120 PRC_f	0.0 metres	12	75..86	000000000000
PRN 2 UDREI	1.25 metres	4	87..90	0010
PRN 7 UDREI	1.0 metres	4	91..94	0001
PRN 10 UDREI	3.75 metres	4	95..98	0110
PRN 15 UDREI	6.0 metres	4	99..102	1001
PRN 22 UDREI	0.75 metres	4	103..106	0000
PRN 120 UDREI	0.75 metres	4	107..110	0000
IODP	3	2	111..112	11
Block ID	0	2	113..114	00
IODF	1	2	115..116	01
Spare	-------	4	117..120	0000

Parameter	Value	No. Bits	Bit Positions	Binary data
Velocity Code	0	1	121	0
PRN Mask No. (PRN 2)	1	6	122..127	000001
Issue of Data	2	8	128..135	00000010
δx (ECEF)	0.5 metres	9[1]	136..144	000000100
δy (ECEF)	17.125 metres	9[1]	145..153	010001001
δz (ECEF)	2 metres	9[1]	154..162	000010000
δa_{f0}	0.0s	10[1]	163..172	0000000000
PRN Mask No. (PRN 7)	2	6	173..178	000010
Issue of data	2	8	179..186	00000010
δx (ECEF)	4.625 metres	9[1]	187..195	000100101
δy (ECEF)	4.5 metres	9[1]	196..204	000100100
δz (ECEF)	-16 metres	9[1]	205..213	110000000
δa_{f0}	0.0 s	10[1]	214..223	0000000000
IODP	3	2	224..225	11
Spare	0	1	226	0

[1] Denotes a 2's complement number

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

1st 106 Bits

```
0000 0101 0000 1111 1111 0000 0001 1001 0000 0000 0010
0000 0000 0000 0001 0000 0000 0000 0010 0001 0110 1001
0000 0000 1100 0100 00
```

2nd 106 Bits

```
  00 0000 1000 0001 0000 0001 0001 0001 0010 0001 0000
0000 0000 0000 0010 0000 0010 0001 0010 1000 1001 0011
0000 0000 0000 0000 0110
```

```
Hex:
05 0F F0 19 00 20 00 10 00 21 69 00 C8
00 81 01 11 21 00 00 20 21 28 93 00 00 6
```

I.1.2.15 Example of Message Type 17: GEO Almanacs

This message contains almanac data for up to 3 GEO satellites. All SBAS satellites enabled in the SBAS constellation file are included. If there are more than three of these, then this requires more than one message of this type to transmit the full set of almanac data.

The almanac data is currently revised at a fixed interval of one hour (at hourly epochs in GPS time). The Data ID is set to zero, and the health/status bits will normally all be "On". An exception to this is when a particular satellite has reached a "switched off" period, and the user has specified one of the options to amend the health bits during this time. The Service Provider ID is selected by the user.

In this example 1 GEO is assumed with a PRN of 120. It is positioned directly over the equator with a longitude of 80° WEST. The distance from the satellite to the centre of the earth is assumed to be 42.164174*10^6 metres. The 2 bits of data ID are both set to 0 and the satellite is assumed healthy with all 8 health and status bits set to 0 also. This message type is divided into 3, 67 bit segments with each segment describing almanac data for 1 GEO satellite. The remaining 11 bits of the message detail the Time Of Day in seconds. Unused GEO almanac segments are prescribed a PRN value of 0 and all remaining segment bits are set to alternate 1's and 0's.

Parameter	Value	No. Bits	Bit Positions	Binary data
Data ID	0	2	15..16	00
1) PRN number	120	8	17..24	01111000
Health	Good	8	25..32	00000000
X_G (ECEF)	7.32134535*10^6	15[1]	33..47	000101100000000
Y_G (ECEF)	-41.5236736*10^6	15[1]	48..62	100000110011110
Z_G (ECEF)	0 metres	9[1]	63..71	000000000
X_G^{dt} (ECEF)	0 metres/sec	3[1]	72..74	000
Y_G^{dt} (ECEF)	0 metres/sec	3[1]	75..77	000
Z_G^{dt} (ECEF)	0 metres/sec	4[1]	78..81	0000
Data ID	0	2	82..83	00
2) PRN number	0	8	84..91	00000000
NOT used	Alternate 1's & 0's	57	92..148	1010..1010
Data ID	0	2	149..150	00
3) PRN number	0	8	151..158	00000000
Not used	Alternative 1's & 0's	57	159..215	1010..1010
TOD (time of day)	640 seconds	11	216..226	00000001010

[1] Denotes a 2's complement number

The complete contiguous 212 bit data block and its hexadecimal equivalent is shown below:

```
0001 1110 0000 0000 0000 0101 1000 0000 0100 0001 1001
1110 0000 0000 0000 0000 0000 0000 0000 0101 0101 0101
0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101
0100 0000 0000 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1000 0000 1010
Hex:
1E 00 05 80 41 9E 00 00 00 05 55 55 55
55 55 55 54 00 AA AA AA AA AA AA AA 80 A
```

I.1.2.16 Example of Message Type 26: Ionospheric Delay Corrections

This message contains data for ionospheric delay corrections, for the relevant ionospheric mask bands and enabled grid points (IGPs) in these bands. The data for the vertical ionospheric corrections (15 per message) is determined using the GPS ionospheric parameters defined in the GPS constellation file, and the ionospheric correction model defined in STANAG

4294/ICD-GPS-200C. If the calculated ionospheric delay is greater than the available field range then the value will be set to the maximum (63.875m – Don't Use).

This message also contains error estimates (GIVEI) for each IGP. These are determined from a global grid of user defined values. The GIVEI value, which relates to a given IGP, is taken as the value for the grid cell, which contains the IGP.

Normally the broadcast ionospheric correction data will accurately reflect the idealised model, but it is possible to add errors to this information. The offsets are related to the error associated with the applicable GIVEI and a user entered error factor.

The IODI value in this message will normally correspond with that in the preceding ionospheric grid message (transitory exceptions may occur if IODI changes).

Notes:

1. As correction data is always available for all enabled IGPs, the "Not Monitored" condition (GIVEI = 15) will never be applicable in this implementation.
2. As each message only contains data for 15 grid points, the number of bands and enabled grid points should be kept to a reasonable level to prevent overloading of the message scheduling.

Parameter	**No. Bits**	**Bit Positions**
Band Number	4	15..18
Block ID	4	19..22
For each of 15 Grid Points	13	
IGP Vertical Delay Estimate	9	23..
Grid Ionospheric Vertical Error Indicator (GIVEI)	4	..217
IODI	2	218..219
Spare	7	220..226

An example to illustrate 212 bit data block and its hexadecimal equivalent is shown below:

```
0001 0000 0000 0101 1111 1000 0011 1011 1100 0010 0001
1110 0001 0010 1111 0000 1010 0111 1000 0101 1011 1100
0011 0001 1110 0001 1010 1111 0001 0001 0111 1000 1000
0111 1100 0100 0001 1110 0001 1101 1111 0000 1101 0111
1000 0101 1111 1100 0010 0111 1111 1101 0101
Hex:
10 05 F8 3B C2 1E 12 F0 A7 85 BC 31 E1
AF 11 78 87 C4 1E 1D F0 D7 85 FC 27 FD 5
```

I.1.2.17 Example of Message Type 27: WAAS Service Message

The SBAS constellation file allows up to 8 different regions to be defined, together with their associated service indicator. If more than 7 regions are defined then more than one service message is required to transmit all the information. If no service message is required then a warning message is displayed on starting the run, and this message is then disabled for the remainder of the run.

Parameter	No. Bits	Bit Positions
For each of 7 Regions	28	
Region Latitude	10	15..
Region Longitude	11	..
Region Radius Indicator	3	..
WAAS Service Indication/UDRE Increment Indicator	4	..210
Number of Service Messages	4	211..214
Issue of Data – IODS	3	215..217
Spare	9	218..226

An example to illustrate 212 bit data block and its hexadecimal equivalent is shown below:

```
0011 0100 0010 1111 1100 0010 0010 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0001 0010 0000 0000
Hex:
34 2F C2 20 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 01 20 0
```

I.1.2.18 Example of Message Type 62: Internal Test Message

The internal test message contains no usable data but is set to alternating 1's and 0's.

An example to illustrate 212 bit data block and its hexadecimal equivalent is shown below:

```
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010
Hex:
AA AA AA AA AA AA AA AA AA AA AA AA AA
AA AA AA AA AA AA AA AA AA AA AA AA AA A
```

I.1.2.19 Example of Message Type 63: Null Message

This is broadcast when no other message type is scheduled.

An example to illustrate 212 bit data block and its hexadecimal equivalent is shown below:

```
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010 1010 1010
1010 1010 1010 1010 1010 1010 1010 1010 1010
Hex:
AA AA AA AA AA AA AA AA AA AA AA AA AA
AA AA AA AA AA AA AA AA AA AA AA AA AA A
```

I.1.3 POSSIBLE *.WAS DATA ERRORS

When a *.WAS file is requested the software performs a number of simple test to ensure the data is valid.

- It checks each line in the file to ensure all data characters are valid hexadecimal figures.
- It checks that each data line has a minimum of 57 characters.
- It checks that each data line does not exceed 100 characters.

Note: In SBAS standalone mode the user is warned when the correction message is completely exhausted.

The simulation will continue to RUN after the correction message has finished.

I.1.3.1 Segment of Example Correction Data File SBAS_CN3.WAS

Note: Lines beginning with an '!' denote a comment and are ignored by SimCHAN.

```
! GSS6100 WAAS  correction message (Change Note 3
!filename: SBAS_CN3.WAS
! PRN mask, message type 1,for satellites 2, 7, 10, 15,
22, 25, 32 and 120
! Time 0 Message type 2 - fast corrections
53087000000000000000000000000000000000000000adaecda0fffff

! Time 1 Message type 1 - PRN Mask Transition
9a044242048100000000000000000000010000000000000000000000003
```

```
! Time 2 Message type 9 - GEO Navigation Message
c6240301580ae904e3088001a00000000000000000000000000000000

! Time 3 Message type 7 - UDRE degradation factor
531c0c000500055555555555555555555555555555555555555555555

! Time 4 Message type 18 - Ionospheric Grid Point Masks
9a48310ff007f8440441fc01fc100010ff80ff8400041fc01fc110110

! Time 5 Message type 18 - Ionospheric Grid Point Masks
c648321fe00ff0800083fc07f8100010ff007f8440441fc01fc100010

! Time 6 Message type 2 - fast corrections
5308b000000ffb000005000ffc000000000000000000adaecda0fffff
! Time 7 Message type 18 - Ionospheric Grid Point Masks
9a48331ff01ff0800081fc01fc110110ff007f8400041fe03fc100010

! Time 8 Message type 25 - Long Term corrections
c6648204010448110000201fa0002ce101024049e00000280008000b3

! Time 9 Message type 25 - Long Term corrections
53648605fe032fa30000208080002ce28106bfe215800008100000 0b3

! Time 10 Message type 25 - Long Term corrections
9a648c040201077a00007f8000002ce3817bb0b8130007f007f0000b3

! Time 11 Message type 26 - Ionospheric delay corrections
c6681005f83bc21e12f0a785bc31e1af117887c41e1df0d785fc27fd5

! Time 12 Message type 2 - fast corrections
53083000000ff2000003002ffc000000000000000000adaecda0fffff

! Time 13 Message type 26 - Ionospheric delay corrections
9a681105f853c39e22f0e783bc21e12f0a785bc31e1af10f883c3dfd5

! Time 14 Message type 26 - Ionospheric delay corrections
c668120df863c2be11f0a786bc17e0ef08784bc29e15f0bf867c37fd5

! Time 15 Message type 26 - Ionospheric delay corrections
53681310787fc3be1bf0cf85bc27e0ff05f84fc31e0ef087847c27fd5

! Time 16 Message type 26 - Ionospheric delay corrections
9a68140a785bc2fe1cf0df867c2de14f08f837c25e18f0e7857d555d5

! Time 17 Message type 26 - Ionospheric delay corrections
```

```
c6682006783bc1fe10f08f84fc29e15f0cf863c2de14f08f83fc19fd5

! Time 1801010011  Message type 2 - fast corrections
53087000000fe8000003ffeffd000000000000000000adaecda0fffff

! Time 19 Message type 26 - Ionospheric delay corrections
9a682105f843c25e0df06f83bc1fe10f09784fc29e17f0b7857c27fd5

! Time 20 Message type 26 - Ionospheric delay corrections
c6682208f83fc1be0cf077843c19e0cf067837c1be0ef07f843c25fd5

! Time 21 Message type 26 - Ionospheric delay corrections
53682308f843c1de0df067833c17e0cf07f847c1be0b905c82e4173d5

! Time 22 Message type 26 - Ionospheric delay corrections
9a682405c83241b20f907483641920b905c82e41720b95555555555d5

! Time 23 Message type 26 - Ionospheric delay corrections
c6683005c82e41720b905c82e41720b905c83241720b905c82e4173d5

! Time 24 Message type 2 - fast corrections
5308b000000fe2000001ff2ffc000000000000000000adaecda0fffff

! Time 25 Message type 26 - Ionospheric delay corrections
9a683105c82e41720b905c82e41720b305982cc1660b305982cc167d5

! Time 26 Message type 26 - Ionospheric delay corrections
c6683205982cc1660b905982cc1660b305c82e41720b305982cc167d5

! Time 27 Message type 26 - Ionospheric delay corrections
53683305982cc1660b305982cc1660b905c82cc1660b905c82cc167d5

! Time 28 Message type 26 - Ionospheric delay corrections
9a683405982cc1620b105882c41620b305982cc1660b905982cd555d5

! Time 29 Message type 10 - degradation Parameters
c628000000078000f0000007800003c00000000000000000000000000

! Time 30 Message type 2 - fast corrections
53083000000fe5000ffcfe4ff2000000000000000000adaecda0fffff

! Time 31 Message type 27 - SBAS Service Message
9a6c342fc2200000000000000000000000000000000000000001200

! Time 32 Message type 12 - Network Time
c6300000000000000003ff700f7010067ee39fbaaaaaaaaaaaaaaaaaa
```

! Time 33 Message type 17 - GEO Satellitealmanac
53441e000580419e0000000555555555555555400aaaaaaaaaaaaa80a

! Time 34 Message type 63 - Null Message
9afcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 35 Message type 63 - Null Message
c6fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 36 Message type 2 - fast corrections
53087000000fe5000ffafd1fe8000000000000000000adaecda0fffff

! Time 37 Message type 63 - Null Message
9afcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 38 Message type 63 - Null Message
c6fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 39 Message type 63 - Null Message
53fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 40 Message type 63 - Null Message
9afcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 41 Message type 63 - Null Message
c6fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 42 Message type 2 - fast corrections
5308b000000fe7000001fbcfe4000000000000000000adaecda0fffff

! Time 43 Message type 63 - Null Message
9afcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 44 Message type 63 - Null Message
c6fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 45 Message type 63 - Null Message
53fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 46 Message type 63 - Null Message
9Afcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 47 Message type 63 - Null Message
c6fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

```
! Time 48 Message type 2 - fast corrections
53083000000fea00000bfabfe6000000000000000000adaecda0fffff

! Time 49 Message type 63 - Null Message
9afcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 50 Message type 63 - Null Message
c6fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 51 Message type 63 - Null Message
53fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 52 Message type 63 - Null Message
9afcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 53 Message type 63 - Null Message
c6fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 54 Message type 2 - fast corrections
53087000000ff5000017f9bfe6000000000000000000adaecda0fffff

! Time 55 Message type 63 - Null Message
9afcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 56 Message type 63 - Null Message
c6fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 57 Message type 63 - Null Message
53fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 58 Message type 63 - Null Message
9afcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 59 Message type 63 - Null Message
c6fcaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa

! Time 60 Message type 2 - fast corrections
5308b000000002000023f8bfe9000000000000000000adaecda0fffff
```

In the SBAS_CN3.WAS file this 60 second block of data is continuously repeated.

Referenced Documents

RTCA/DO-229A June 8, 1998: Minimum operational performance standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment.

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