GSS6450 Multi-frequency Record & Playback System

The world's first highly portable high bit depth RF record & playback system

Datasheet with Product Specification

Spirent **GSS6450 Multi-frequency Record & Playback System**

Purpose of this document

This datasheet describes the operation and performance of Spirent's GSS6450 GNSS Record\Playback & Playback only systems and is intended to assist potential users in making a purchase decision. This document forms part of the contract of sale, but is subject to change.

A detailed user manual is supplied with the unit to guide the user in its operation.

NOTE: The GSS6450 is a modular platform and can be purchased with various options. Unless otherwise indicated this document refers to all options. Where information is included which refers to only one option this will be clearly indicated in the text or in the paragraph heading. For further information about options please refer to the performance specification tables provided.

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Key Features

The GSS6450 RF Record Playback System (RPS) from Spirent provides a simple and efficient way to capture real world GNSS, Cellular and Wireless signals and replay them in the laboratory. The GSS6450 takes RF recording and playback systems to a whole new level of performance and flexibility, while being housed in a small, battery powered, and portable case. The GSS6450 can record any GNSS signals currently available with bit depths up to 16 bits 'I' & 16 bits 'Q' and bandwidths of up to 80 MHz. The flexible product structure allows the system capability to grow with your testing needs. At the same time the GSS6450 RF RPS can record wireless and cellular data, with up to 80MHz bandwidth and up to 16 bits 'I' and 'Q' data. A total of four channels are available.

- **RF1 GNSS**
  - Multiple Constellations and Frequencies*
    - GPS, GLONASS, Galileo, BeiDou, QZSS
    - L1, L2, L5, B3
  - Bandwidth (10, 30, 50, 60 or 80 MHz, depending on configuration)
  - Up to 4 bands can be recorded
- **RF2 Cellular**
  - Operates between 690 MHz and 2400 MHz
  - Up to 4 bands can be recorded
  - Preset frequency options plus user defined centre frequency and bandwidth options of 10, 30, 50, 60 or 80 MHz.
- **RF3 Wideband**
  - Operates between 100-6000MHz
  - A Single maximum 80MHz band on the RF3 port can be recorded/played back
    - Can be set to 10, 30, 50, 60 or 80 MHz
  - Preset frequency options plus user defined centre frequency.
- **System**
  - Bit depth (I&Q – 2, 4, 8 or 16 bits) *
  - Disk space – 2 TB internal, (1, 2, 4 or 7.5 TB removable external drive also available for purchase).
  - Control from front panel Touch Screen, over WiFi, WebServer or scripts
  - Highly Portable, complete with shoulder strap
  - Fully integrated, no PC or external drives required
  - Embedded Spectrum Analysis software
  - OCXO used on record and playback for high frequency stability
  - Record & playback of up to 4 video streams using webcams
  - USB 3.0 supported. Allows data transfer to or from an external hard drive
  - In-built GNSS receiver (L1-GPS, GLONASS, Galileo, BeiDou), can record NMEA data
- **Recorder**
  - Record any 4 (depending on configuration) signals simultaneously
  - Record 2 bit signals for playback on a GSS6425

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- Internal battery (record time up to 1.5 hours) and vehicle DC power adapter
- Single touch record
- Synchronous and asynchronous storage of external data, without losing channels or compromising bit depth
- Event markers

❖ **Playback Functionality**

- Attenuation across all channels or control per channel
- Browser control over network
- Batch file playback
- Configure files to play
- File start and stop times
- Start at any point in a file, to a resolution of 1 microsecond
- Scripts allow inclusion in automatic test routines
- GSS6425 Compatibility mode to play back 2 bit files recorded on a GSS6425
- Output of raw I/Q data on Aux port (Two most significant bits of each channel).

❖ **CANbus**

- Two in built High Speed CAN interfaces which allow CAN bus data to be recorded as synchronous data without the need for an external interface unit.
    - **The CAN interface is a passive device which records the signal levels seen on the CAN bus. It does not provide bus acknowledgements etc. When replaying CAN Data onto a CAN bus with other transmitting nodes, the GSS6450 will transmit data even if another node is already transmitting causing corruption of data on the CAN bus. It is not recommended to replay CAN data onto a vehicle or any other CAN Bus in a safety critical application.**

- With the (optional) PCAN Router FD two CAN FD or High Speed CAN busses can be recorded, and played back, synchronously with the RF data.
    - Input or output CAN messages can be filtered.

About the GSS6450 Record & Playback System (RPS)

What the GSS6450 does

With the Spirent GSS6450 RPS, it's simple and quick to capture GNSS & other RF signals as they are received for subsequent use in a laboratory test environment.

The GSS6450 RPS digitises and stores the RF signals from the real RF environment. These recordings are then made available for subsequent playback, faithfully reproducing propagation effects such as multipath, fading, obscuration and interference to allow testing of GNSS chipsets, receivers and systems under realistic conditions. You save project, travel and engineering costs while improving product performance, quality and time to market.

The flexibility of the GSS6450 to record multiple frequency bands concurrently means the RPS can be used to test multi-GNSS chipsets and devices in wireless, cellular, automotive, navigation, aerospace, and defence and survey applications. The user can select different bit depths depending on their application and storage requirements.

The GSS6450 RF RPS includes three RF I/O ports. RF1 has optimised filtering for the recording and playback of GNSS signals, while RF2 and RF3 offer wider bandwidth to cover Cellular and Wideband signals respectively.

For interference and jamming testing in-built Spectrum Analysis software is available.

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What GNSS signals are supported on RF1?

The GSS6450 Multi Constellation RPS can record and play back up to four GNSS frequency bands as described in Table 3 and within the throughput capacity limits in Table 6. Throughput capacity is a function of the bandwidth selected and the bit depth. Each band may contain several GNSS signals. For example, if the frequency you select is 1176.45 MHz the RPS will automatically record both the GPS L5 and Galileo E5a GNSS signals. You can select frequencies using the front panel Touch Screen or WebServer.

Figure 1 shows the frequencies and constellations the RPS supports, with the red boxes representing the GSS6450 internal filters. You can record and playback any frequency and signal shown within the red boxes.

- GPS\SBAS, GLONASS, Galileo, BeiDou and regional signals
  - GPS L1 (C\A, L1c, P(Y) and M)
  - GPS L2c, P(Y) and M,
  - GPS L5 signals
  - GLONASS L1 (C/A, P), L2 C/A,P, L3
  - Galileo E1(B and C), E5a, E5b E5ab, E6 (authorised users only)
  - BeiDou B1, B2, B3
  - QZSS L1 (C/A, SAIF, L1c), L2c, L5, L6
  - SBAS L1, L5 (WAAS, EGNOS, MSAS, GAGAN)
  - IRNSS L5
- Nominal Bandwidths
  - 80 MHz (Wide)
  - 60 MHz (Wide)
  - 50 MHz (Wide)
  - 30 MHz (Medium)
  - 10 MHz (Narrow) for L1/E1/B1 civil signals
- Bit Depth (I and Q)
  - 2 bits
  - 4 bits
  - 8 bits
  - 16 bits

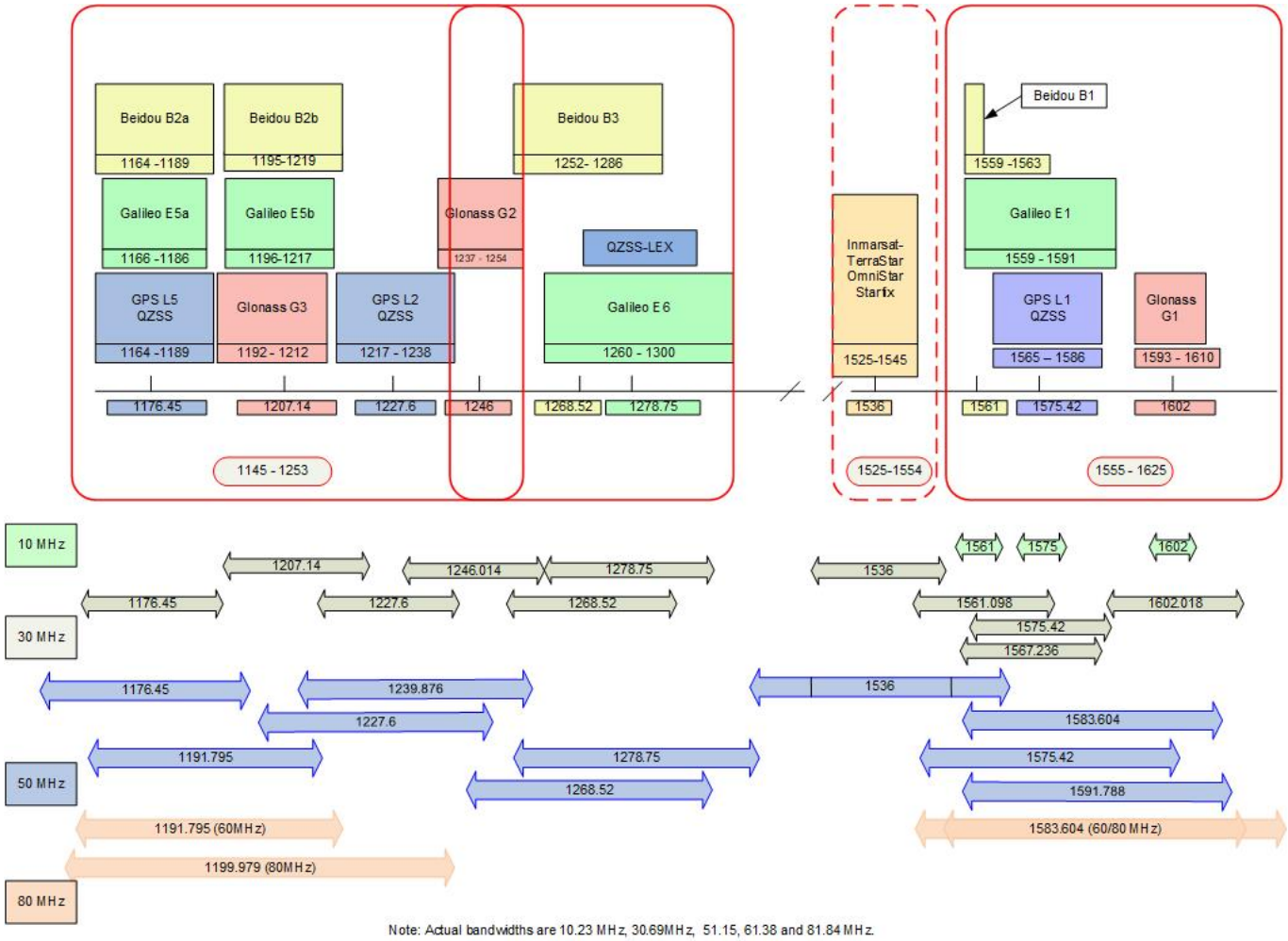

Figure 1 Supported GNSS Bands

If you use satellite-based corrections distributed using Inmarsat around the 1542 MHz frequency band, your GSS6450 can also record these corrections (available as an option, replacing Beidou B3 and Galileo E6).

The RF1 antenna port can provide power to the antenna at either 3.3V or 5V.

GSS6425 Compatibility Mode

The GSS6450 can play back any GSS6425 recordings, once they are uploaded to the GSS6450, or you can record data for playing back on a GSS6425 on a GSS6450. This is provided that the same signals are enabled on both units. Note that the format of the video files on the GSS6450 and GSS6425 are different and so video files are not transferrable.

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Recording Cellular Frequencies on RF2

RF2 has a frequency input range of 690 – 2400 MHz. It allows the recording of up to four signals, just like RF1. There are several pre-set frequencies available such as:

- LTE band 4 centred on 2132.955, 60 MHz bandwidth
- LTE band 12 centred on 734.514 MHz, 60MHz bandwidth
- LTE band 17 centred on 2132.955 MHz, 30MHz bandwidth
- LTE band 30 centred on 2354.946 MHz, 10 MHz bandwidth

It is also possible to set user defined centre frequencies, by simply typing in the centre frequency required, and then nominating the required bandwidth and bit depth.

The user can choose bit depths of 2, 4, 8 or 16 bits, and bandwidths of 10, 30, 50, 60 or 80 MHz as required.

As the RF2 band also covers GNSS frequencies it is possible to record GNSS frequencies using RF2 however the GNSS frequencies on RF2 will ONLY be available if they have been purchased on RF1.

The RF2 antenna port does not provide power to the antenna.

For RF2, an IQ calibration at selected frequencies is required for accurate operation.

For users who wish to record a subset of the pre-set LTE frequencies it is possible to use a narrower bandwidth and specify a particular channel offset from the start of the band.

Recording Wideband Frequencies on RF3

RF3 has a frequency input range of 100 – 6000 MHz. RF3 only allows the recording of any signals within a single 80MHz (or less) bandwidth. There are several pre-set frequencies available such as:

- Wi-Fi 5GHz Ch 36-48 centred on 5210.139 GHz, 80MHz bandwidth
- Wi-Fi 5GHz Ch 149-161centred on 5774.835 GHz, 80MHz bandwidth
- Wi-Fi 2.4 GHz centred on 2440.878 GHz, 80MHz bandwidth
- IRNSS S Band centred on 2491.005 can be recorded at 50MHz or 30 MHz bandwidth.

It is also possible to set user defined centre frequencies, by simply typing in the centre frequency required, bit depth and bandwidth (10, 30, 50, 60 or 80 MHz). As the RF3 band also covers GNSS frequencies it is possible to record GNSS frequencies using RF3 however the GNSS frequencies on RF3 will ONLY be available if they have been purchased on RF1.

For RF3, an IQ calibration at selected frequencies is required for accurate operation.

Note: with RF3 the user cannot record with centre frequencies selected inside the following bands due to the internal architecture of the system. If one of these bands is entered by the user the user will be warned by the Touch Screen or WebServer, and a recommendation will be given for a new centre frequency outside the barred list.

	Barred Centre frequencies (MHz)	Mitigation
1	988 - 1006	Record on RF2 or change centre frequency to be outside the range, but with sufficient bandwidth to cover the range
2	1159 - 1168	Record on RF2 or change centre frequency to be outside the range, but with sufficient bandwidth to cover the range
3	1193 - 1199	Record on RF2 or change centre frequency to be outside the range, but with sufficient bandwidth to cover the range
4	1491- 1500	Record on RF2 or change centre frequency to be outside the range, but with sufficient bandwidth to cover the range
5	1545- 1558	Record on RF2 or change centre frequency to be outside the range, but with sufficient bandwidth to cover the range
6	1975- 2014	Record on RF2 or change centre frequency to be outside the range, but with sufficient bandwidth to cover the range

Table 1 Barred Centre frequencies on RF3

The user can choose bit depths of 2, 4, 8 or 16 bits. RF2 and RF3 antenna port does not provide power to the antenna.

Channel Architecture

The GSS6450 can record up to four signals. It does this by recording and playing back two signals on each of two channels (A and B) as per the following diagram.

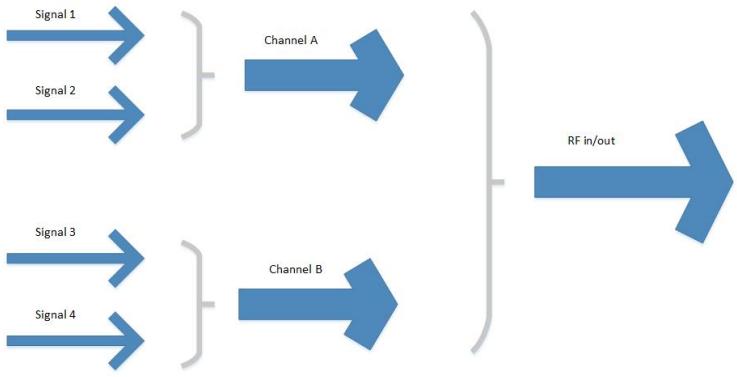

Figure 2 Channel Architecture

Signals on the same Channel must have the same bandwidth and number of bits set (e.g. 30MHz, 8 bits).

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Channel A and B must have the same Bandwidth set (e.g. 50MHz) but different bit depths can be set on each Channel (e.g. Channel A may have 8 bits set while Channel B could have 2 bits). The more bits set improves the dynamic range of the signals, but reduces the recording time. This may be particularly important when recording Cellular signals, needing a high dynamic range (8 bits), but the GNSS signals could be recorded at 4 bits.

There is one special case where different bandwidths can be selected on the different channels. This is the case of recording 60 MHz on one Channel and 30 MHz on the other Channel.

What's in the box?

- GSS6450 Record and Playback System
- Appropriate antenna[1] with 3 metre cable
- External Power supply with mains cable
- 12 Volt vehicle power adapter
- CD with operating manual loaded
- Ethernet cable
- DC block
- Shoulder strap
- Lens cloth
- Quick Start Guide
- Carry case
- USB 3.0 cable for connection of removable drive to PC
- An optional USB Wi-Fi dongle is available to control the GSS6450

Why you might need the GSS6450?

The GSS6450 Record and Playback System reduces your field-trial and travel costs substantially by allowing you to record real-life GNSS, WiFi and Cellular signals (including real world fades, multipath and in-band interference) onto the internal SSD of the RPS.

Once you have recorded this data you can repeatedly play it back into your system under test in the comfort of your own lab, without the need to return to the field, saving you time and money.

Typical Applications include:

- Software and Hardware Testing
  - Repeatability tests
  - Manufacturing test
  - Performance analysis
  - System trials
- Algorithm studies

[1] For most users, Spirent recommends using the supplied antenna. For other applications, Spirent advises using active antennas compatible with 3.3 V or 5 V input voltage, with a maximum 100 mA current.

- Sensor integration
- Position
- Multipath
- Sensitivity

- Interference Monitoring and jamming

- Application Sectors:

  - GNSS chip and board design
  - Cellular manufacturers
  - Chipset manufacturers
  - Aerospace and Defence
  - Survey
  - Research
  - GNSS Product Manufacturers

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How it works

The GSS6450 RPS employs a low noise amplifier for optimum overall system noise performance prior to down-converting to IF for digitising. An AGC circuit caters for a wide range of active or passive antenna gains. Standard antennas with gains of up to 27 dB and 3.3 or 5 Volt nominal DC power can be used directly on RF1. RF2 and RF3 do not supply an antenna voltage. The AGC values are written to a file during recording.

The digitised IF is stored on an internal 2 TB SSD giving up to 50 hours[2] of record time. Along with the data file containing the digitised signals, an accompanying information file is automatically generated containing details such as record time and date. You can add further data to this file for record keeping purposes. The internal hard disk contains the Linux file system together with the applications and all user data. You have more than 900 GB available to store signal data. You can plug a second removable SATA drive into the front panel SATA port. This second drive is a bare drive without any housing, plugging directly into the SATA port.

The GSS6450 incorporates a 1.5 GHz quad core AMD-G Series processor with 8 GB RAM, which runs the Linux Mint operating system. You can add your own applications and scripts to this his PC; simply add a display and keyboard (not supplied) to see the Linux Desktop. A WebServer is also available for control of the GSS6450 via a network, optional WiFi adapter or using a web browser of the Desktop.

Several sampling options are available. 2 or 4 bit sampling is suitable for commercial applications testing while keeping data storage levels down; the full 16 bit sampling provides a much larger dynamic range for interference and jamming testing scenarios.

You can record serial data streams (such as 1PPS timing signals and dead-reckoning sensor data) synchronously with the raw GNSS signal. The data is stored in the SAME file as the raw GNSS signal, so playing back the GNSS signal file synchronously plays back the data. You cannot separately download the stored data. You can record two Synchronous Inputs per frequency recorded, up to a maximum of eight synchronous inputs.

During any recording session you can log data on the Serial COM 1 port to a file. The RPS stores these files separately from the GNSS signal data, and you can separately view, download or edit them. You can add a timestamp to the serial data. NMEA data from the internal GNSS receiver can also be stored to a file during record or playback.

You can record or playback Video files through the attachment of a Webcam to any of the four USB ports. Therefore up to four video streams can be stored at any time. Video files, although stored separately from the main GNSS data file, will play back within 0.5 seconds of the GNSS data, with a potential drift rate of 0.25 seconds per hour.

On playback the IF signal is recreated and then up-converted to RF at the relevant RF frequency using the same built-in oven stabilised local oscillator (OCXO) as used to record the data for minimum phase noise. The RF output can use the AGC files recorded to adjust the output RF signal level to have the same power level seen during the recording. A control allows the recorded AGC file to be ignored and sets the output to a nominal level. The output level can also be increased by +0, +10 or +20dB. It is also possible to fix the input gain (per RF input) for amplitude varying or intermittent signals such as WiFi.

When fixed input gain is used, the dynamic range is reduced.

A stepped attenuator provides attenuation across all channels in 1 dB steps up to a maximum of 20 dB. You can add an additional 20 dB attenuation, in 1.0 dB steps on a per channel basis, allowing you to vary the replayed signal levels with respect to each other, or balance the C/No values as reported on an attached GNSS receiver. You can turn on, or off, individual signal channels using the WebServer.

You can also configure the RF1 output as standard, or high-level, using a switchable 30 dB attenuator. The high-level setting (attenuator disabled) is nominally 30 dB higher than when set as normal output (attenuator enabled).

Typically, the GSS6450 RPS plays back recorded GNSS signals within 1 to 2 dB of the original signal levels as seen on an attached GNSS receiver.

The GSS6450 includes an internal, L1 only, GNSS receiver that allows you to view the satellites tracked during recording or playback. The internal receiver shows GPS and Galileo signals with either GLONASSS or BeiDou. The front panel display and WebServer let you view C/No levels and position of the GSS6450.

[2] Refer to Table 4 Estimated Recording Times PER Terabyte for more details

You can synchronously start recording or playback of the GSS6450 on receipt of a pulse at the AUX port. This is useful for synchronising record/playback with other systems.

The GSS6450 is available in a Replay only configuration; for which the performance is identical to the GSS6450 RPS, except the record functionality is absent.

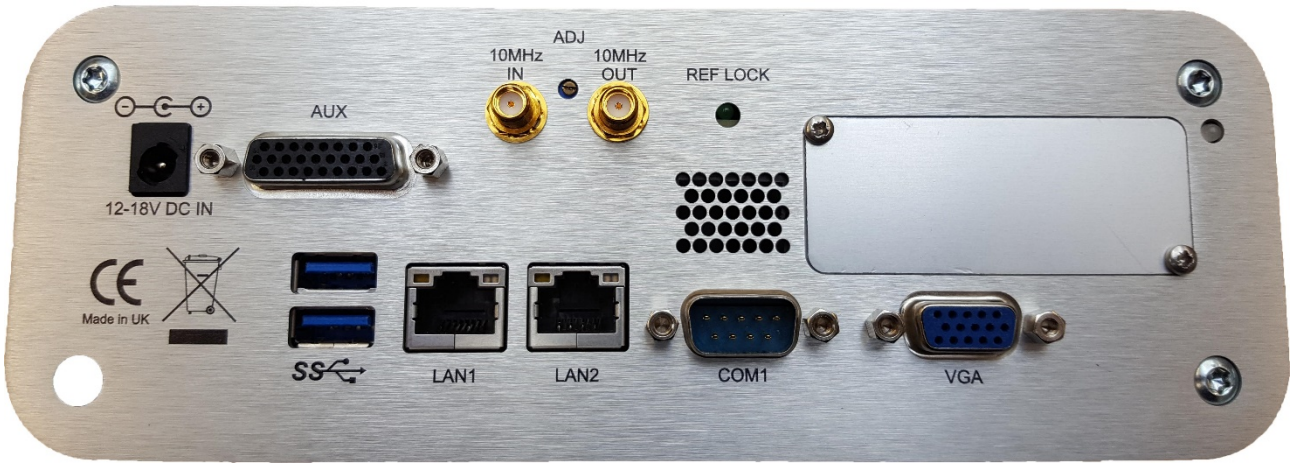

Figure 3 GSS6450 RPS Rear Panel

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Product Variants

GSS6450 is a flexible test platform, comprising of hardware and software components. You can add capabilities to the system by adding various options, see Table 2.

For any standard system, it is **mandatory** to have a hardware chassis (A, B, C or D) with a GNSS Constellation Band option (E to J), or enabling RF2 (Wireless) (S) or RF3 (Wideband) (T). The Base system is pre-configured with 10 MHz bandwidth; 2 TB SSD (internal) and 4 bits quantization. For bit depths of 8 or 16 bits choose the appropriate Bit Depth Option (N, or O). For Constellation Bands requiring 30 MHz bandwidth (H, I, J, L and M) you must purchase the 30 MHz option (P) or the 30/50 MHz option (Q), or the 30/50/60/80 MHz option (R).

It is likely (but not mandatory) that if the RF2 or RF3 are enabled then wider bit depth options (N or O) will be required. Similarly greater bandwidth is likely to be needed, options Q or R. It is expected that the 80MHz bandwidth setting will be required for recording Cellular or Wideband data on RF2 or RF3. When this is purchased it is also possible to record some GNSS signals at 60MHz (see note 8 below table).

Table 2 GSS6450 Hardware & Software Options

Product Elements	Options	With 10 MHz Bandwidth	With 30 MHz Bandwidth option	With 30 /50 MHz Bandwidth option
Hardware Chassis \ Type **(Base system)**	A. Record & playback (std) B. Replay ONLY (std) C. Record & playback (Inmarsat) D. Replay ONLY (Inmarsat)			
	Constellations	**10 MHz**	**30 MHz**	**30/50 MHz**
GNSS Constellation Band (centre frequency MHz) *(option)* *Table 3 shows a complete list of constellations that can be recorded at selected centre frequency and bandwidth*	E. GPS, GAL, BEI L1	1561.098 1575.42	NA	NA
	F. GPS, GAL, GLO L1	1575.42 1602.018	NA	NA
	G. GPS, GAL, GLO, BEI L1	1561.098 1575.42 1602.018	1567.236 1561.098 1575.42 1602.018	1575.42 1583.604 1591.788

Product Elements	Options	With 10 MHz Bandwidth	With 30 MHz Bandwidth option	With 30 /50 MHz Bandwidth option
	H. GPS L1, L2	1575.42	1575.42 1227.60	1575.42 1227.6
	I. GPS L1, L5	1575.42	1176.45 1575.42	1176.45 1575.42
	J. GNSS L1, L2, L5, B3	1561.098 1575.42 1602.018	1176.45 1207.14 1227.60 1246.014 1268.52 1561.098 1567.236 1575.42 1602.018	1176.45 1191.795 1239.876 1268.52 1575.42 1583.604 1591.788
	K. GNSS L1, L2, L5, B3, E6	Please contact Spirent for more information.		
	L. Inmarsat based augmentations		1536.00 MHz	1536.00 MHz
	M. QZSS L6		1278.75	
Bit Depth (I\Q Quantization) *(option)*	N. 8 bits O. 8 and 16 bits			
Bandwidth *(option)*	P. 30 MHz Q. 30 and 50 MHz R. 30,50,60 and 80MHz			
RF2	S. Enable RF2	690-2400MHz GNSS frequencies only available if purchased above IQ calibration at specific frequencies is required for accurate operation.		

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Product Elements	Options	With 10 MHz Bandwidth	With 30 MHz Bandwidth option	With 30 /50 MHz Bandwidth option
RF3	T. Enable RF3	100 – 6000 MHz Notes: 1.Limited to 80MHz bandwidth total 2.GNSS frequencies only available if purchased above, 3. IQ calibration at specific frequencies is required for accurate operation. 4. **Cannot** set centre frequencies in the following ranges 988.0 - 1006.6 MHz 1159.0 - 1168.0 MHz 1193.0 - 1199.0 MHz 1491.0 - 1500.0 MHz 1545.0 - 1558.0 MHz 1975.0 - 2014.0 MHz		

Notes

1. Constellation band options E and F can record at 10 MHz only
2. With constellation band options E, F, H and I, you can simultaneously record and playback up to two RF centre frequencies. With options G, J, K and L you can record and playback up to four RF centre frequencies
3. You need 30 MHz (or 30 and 50 MHz) bandwidth options for constellation band options H, I, J, L and M, although you can choose 10 MHz bandwidths on the indicated signals. Please contact Spirent for any other configurations required, including recording Galileo E6
4. For complete flexibility (in most cases) you can upgrade the GSS6450 using a software key, you do not need to return your GSS6450 to Spirent for upgrades.
5. Overall product configurations and recording options are subject to the throughput constraints detailed in Table 6.
6. If you want to record Inmarsat based augmentation systems (Starfire, Terrastar and so on) you need Base Chassis C or D. You must also purchase the ‘Inmarsat based augmentations’ Option L, and the 30 bandwidth option P, or the 30/50 MHz bandwidth option Q. You cannot use these systems to record BeiDou B3, QZSS L6, or Galileo E6 signals on RF1.
7. If option R (30,50,60,80 MHz bandwidth is purchased) then it is available on RF1, RF2 and RF3 (if these port options have been purchased). Two 60 or 80MHz bandwidth GNSS frequencies become available with this option. They are centred on L1 at 1583.604 MHz and L5 at 1191.795 MHz for 60MHz or L1 at 1583.604 MHz and L2-L5 at 1199.979 MHz for 80MHz.

Example product variant:

To order an RPS GSS6450 system that can record GPS L1, GLONASS L1 RF signals with 10 and 30 MHz bandwidth, and 4 bit quantization, you will need to order a system as follows:

- Option A: Record and playback hardware
- Option G: GPS L1 and GLONASS L1 constellation license
- Option P: 30MHz bandwidth

Table 3 GNSS Frequencies and Constellations Supported on RF1

Item	Centre Frequency, MHz	Constellations Supported	Bandwidth, MHz
1	1176.45	GPS L5 Galileo E5a QZSS L5 SBAS L5	30 or 50
2	1227.6	GPS L2 (L2c, P(Y) and M) QZSS L2c ** Note: the 50MHz setting does not cover GLONASS L2	30, 50
3	1246.014	GLONASS L2 (C/A and P)	30
4	1583.604	GPS L1 (C/A, P(Y), L1c and M) Galileo E1 (B and C, with CBOC) QZSS L1 (C/A, SAIF, L1c with TMBOC) SBAS L1 (WAAS, EGNOS, MSAS, GAGAN) GLONASS L1 (C/A and P)** BeiDou B1 ** Note: you may notice up to 2 dB signal degradation on the upper channels of the L1 GLONASS signal with the 50MHz setting	50, 60 or 80
5	1591.788	GPS L1 (C/A, P(Y), L1c and M) Galileo E1 (B and C, with CBOC)** QZSS L1 (C/A, SAIF, L1c with TMBOC) SBAS L1 (WAAS, EGNOS, MSAS, GAGAN) GLONASS L1 (C/A and P) ** Note: you may notice up to 2 dB signal degradation on the E1 Galileo signal	50
6	1239.876	GPS L2 (L2c, P(Y) and M) QZSS L2c GLONASS L2 (C/A and P)	50

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Item	Centre Frequency, MHz	Constellations Supported	Bandwidth, MHz
7	1561.098	BeiDou B1	10 or 30
8	1575.42	GPS L1 (C/A, L1c – BOC(1,1) only) Galileo E1 (B and C, BOC(1,1) only) QZSS L1 (C/A, SAIF, L1c – BOC(1,1) only) SBAS L1 (WAAS, EGNOS, MSAS, GAGAN)	10
		GPS L1 (C/A, P(Y), L1c and M) Galileo E1 (B and C, with CBOC) QZSS L1 (C/A, SAIF, L1c with TMBOC) SBAS L1 (WAAS, EGNOS, MSAS, GAGAN)	30
		GPS L1 (C/A, P(Y), L1c and M) Galileo E1 (B and C, with CBOC) QZSS L1 (C/A, SAIF, L1c with TMBOC) SBAS L1 (WAAS, EGNOS, MSAS, GAGAN) BeiDou B1	50
9	1602.018	GLONASS L1 (C/A)	10
		GLONASS L1 (C/A and P)	30
10	1207.14	BeiDou B2b Galileo E5b GLONASS L3	30
11	1567.236	GPS L1 (C/A, L1c) BeiDou B1 Galileo E1 (B and C, with CBOC) QZSS L1 (C/A, SAIF, L1c – BOC(1,1) only) SBAS L1 (WAAS, EGNOS, MSAS, GAGAN)	30
12	1268.52	BeiDou B3	30 or 50

Item	Centre Frequency, MHz	Constellations Supported	Bandwidth, MHz
13	1191.795	BeiDou B2 Galileo E5 (E5a +E5b) GLONASS L3 GPS L5 QZSS L5 SBAS L5 GPS L2 (80MHz only) ** Note: at 50 MHz this setting is optimised for Galileo E5ab, there may be minor degradation on the other signals. With the 80MHz setting the centre frequency is moved to 1199.979 MHz to capture GPS L2	50, 60 or 80
14	1536.0	Inmarsat based SBAS (such as Omnistar, Terrastar and Starfire)** **Notes: 1) the 50MHz setting is present to facilitate the recording of Inmarsat signals along with other signals at 50MHz. However the recording is actually limited by the filter which has a bandwidth of 35MHz. This is to ensure there is no overlap into the Beidou band. 2) If purchased it is then not possible to record Beidou B3, QZSS L6 or Galileo E6 on RF1.	30 or 50
15	1278.75	QZSS L6	30

IRNSS S Band centred on 2491.005MHz can be recorded at 50MHz or 30 MHz bandwidth on RF3.

Spirent **GSS6450 Multi-frequency Record & Playback System**

Operation Overview

The GSS6450 is extremely flexible in operation and can be operated:

- From the front panel Touch Screen
- Using a local monitor, keyboard and mouse
- Via the built-in WebServer using a suitable web browser
- Remotely using VNC
- Using shell scripts
- Wirelessly from a PC, Tablet or Smartphone, or via USB tethering

This flexibility caters for a range of situations from simple one-touch record operation for collecting field data to manufacturing operations where multiple GSS6450s can be monitored and controlled from a single PC over a standard Ethernet network.

Front Panel Operation

You can control most of the GSS6450 functions using the front panel touchscreen LCD display:

- 2.4" LCD-TFT display graphics
- 240 x 320 VGA resolution, RGB touch screen

Figure 4 GSS6450 RPS Main Screen

The following operations are available from the front panel:

- Start and stop playing and recording of files
- File management actions, such as deleting files or monitoring disk usage
- Ability to control location of recording and transfer of data
- Choose number of frequencies to record on RF1, RF2 or RF3
- Use of a configuration file
- Adjusting settings, such as the attenuator
- Monitoring status, such as system status, battery level, IP address and software version

- Controlling asynchronous logging on each channel or synchronous logging
- Changing frequencies to record
- Powering and shutting down the system
- Choosing antenna voltage (3.3 Volts, 5 Volts or off) on RF1
- View the GPS/Galileo/GLONASS/BeiDou status of the internal receiver
- Single press “instant” record by holding down the “Start Record”

Front panel icons are multicolour, indicating:

- Power/ Battery status
- Record and antenna status
- Playback and attenuation status

WebServer operation

When the GSS6450 is connected to a network the dynamically assigned IP address can be viewed on the front panel display by navigating to the appropriate status screen using the front panel scroll keys.

Then, using any suitable browser, you can navigate to the home page at the given IP address. The GSS6450 top level menus are then available on the Home page. Clicking on the appropriate headings brings up the sub-pages that allow you to control and configure the GSS6450.

You can also attach a display, keyboard and mouse to access the WebServer. With the optional Wi-Fi dongle you can control the GSS6450 from any Wi-Fi enabled platform, such as a PDA or tablet.

The WebServer lets you perform a full range of operations, including configuring the GSS6450, managing files, transferring files between internal and external SSDs, controlling record and playback, adjusting attenuation settings, or changing the local time.

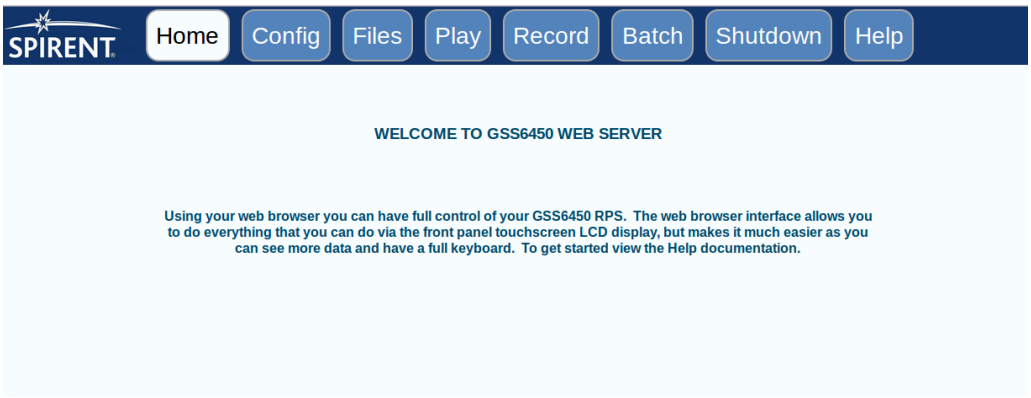

Figure 5 Built-in Web-Server Main Menu Page

Additional features available through the WebServer include switching on or off a particular signal during playback, playing back part way into a file, or setting up a Batch replay mode. Batch replay mode allows the setting up of a number of files to playback, and for each file the user can choose the number of repetitions, alter the attenuation, or start or stop time within the file.

Spirent **GSS6450 Multi-frequency Record & Playback System**

Sample WebServer screen shots:

Figure 6 Sample WebServer Screen shots

Spectrum Analysis Software

The Spectrum Analysis software built in to the GSS6450 allows the user to see the real time spectrum of the signals either during record or playback. The user can switch between the different signals being recorded or played back.

Live Test Mode:

In this mode no signals are recorded, and the RF Spectrum of the Live sky is given. The resolution is automatically set to the highest bit depth based on the bandwidth, and the RF spectrum displayed is the same as that set on the Record page.

Spectrum Analysis Mode:

In this mode the signals are recorded onto the drives at the same time as showing the Spectrum of the recorded signals. The bit depth and signals are as set on the Record page. When operating a throughput of 160MBps is the maximum allowable rate per channel.

During playback the display is dictated by the bandwidth and bit depth at which the signals were recorded.

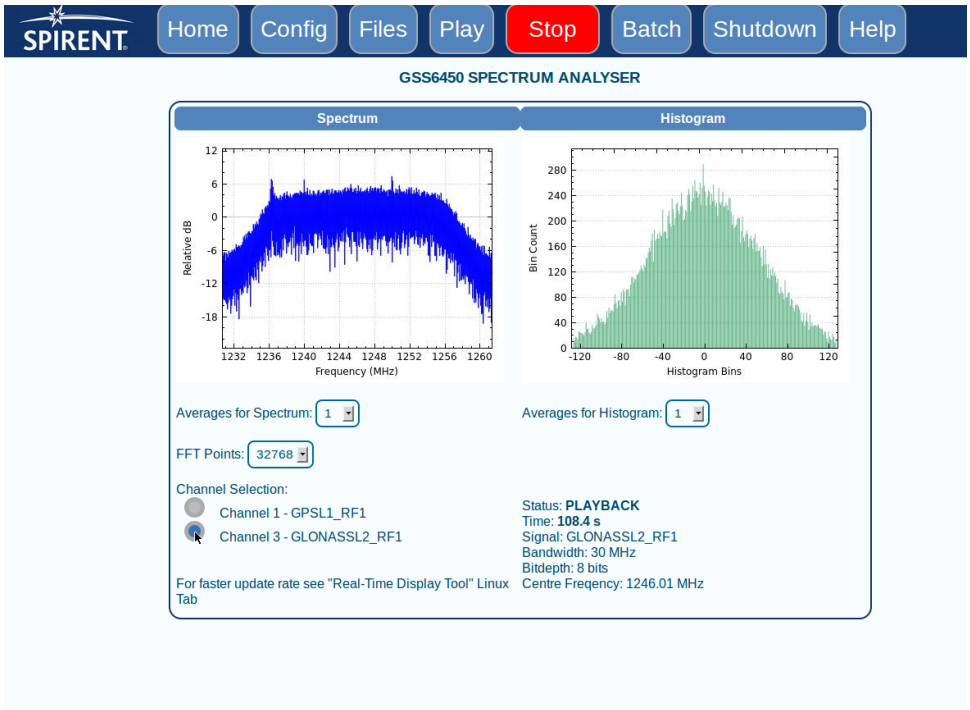

Figure 7 Spectrum Analysis

The Spectrum Analysis software is available through the WebServer at a refresh rate of 1 frame every 2 seconds. The Spectrum Analysis Real-Time display tool is available from the Linux Desktop which gives a faster update rate and provides additional tools such as taking a snapshot of the spectrum.

Spirent **GSS6450 Multi-frequency Record & Playback System**

Remote Operation

You can manage the GSS6450 RPS over a network using its internal VNC server, rather than connecting an external monitor, keyboard and mouse. VNC is a powerful, easy to use and free software application that uses a network (or internet) connection to display the screen of one computer on a second, remote computer.

The VNC application lets you use the mouse and keyboard of the remote computer to control the in-built Linux PC of the GSS6450, giving you the flexibility to control the GSS6450 RPS from a remote location.

To use the VNC connection you need to install a suitable VNC viewer on the remote computer. The VNC access allows you to manage your GSS6450 as local user, such as performing software updates, manage files, add users and so on.

You can also control the GSS6450 using HTTP POST and HTTP GET commands.

Data management

Table 4 shows estimated recording times.

Table 4 Estimated Recording Times PER Terabyte

Number of Frequencies recorded (4 bit)		Available Recording time* (hours)			
	10 MHz	30 MHz	50 MHz	60 MHz	80MHz
1	25	8	5	4	3.4
2	12.5	4	2.5	2	1.7
3	8.4	2.66	1.66	n/a	n/a
4	4.2	2	1.25	n/a	n/a
Number of Frequencies recorded (8 bit)		**Available Recording time* (hours)**			
	10 MHz	**30 MHz**	**50 MHz**		**80MHz**
1	12.5	4	2.5	2	1.56
2	6.25	2	1.25	1	n/a
3	4.17	1.33	0.83	n/a	n/a
4	2.1	1	n/a	n/a	n/a
Number of Frequencies recorded (16 bit)		**Available Recording time* (hours)**			
	10 MHz	**30 MHz**	**50 MHz**		**80MHz**
1	6.25	2	1.25	1	n/a
2	3.1	1	n/a	n/a	n/a
3	2.08	n/a	n/a	n/a	n/a
4	1	n/a	n/a	n/a	n/a

As standard the GSS6450 is supplied with 1 x 2TB internal SSD drive. Removable external SSD of 1, 2, 4 or 7.5 could be purchased. Backup drives of 8 or 12 TB can be supplied, connected by USB3. These drives can transfer data to/from the Internal or Removable drive but should not be written to in real time for record or playback. 8TB or 15TB RAID drives are available, also connected by USB3.These can be used for record/playback or data storage.

Spirent supplies each GSS6450 with its own FTP Server and Client. This allows fast transfer of data to a network or between units.

Configuration Files allow you to quickly load settings into the GSS6450. Example settings include:

- Attenuation Offset
- Attenuation Table (slope of the attenuation curve)

Spirent **GSS6450 Multi-frequency Record & Playback System**

- Synchronous data recording using 0 bits (off), 1 or 2 bit stream recording
- Asynchronous Serial Port Communications Settings (baud), and assumes n,8,1
- Time stamp on/off for Asynchronous recording
- Set Antenna voltage
- Internal GNSS on/off, recording of NMEA data
- Use of AGC files on playback
- Output level of signal
- Input gain

Batch mode allows a number of files to be played back in sequence, you can control:

- Files to play, and number of iterations
- File start/stop times
- Common Attenuation used in each playback
- Repeat in a continuous loop

A ‘Trigger’ feature lets the GSS6450 start recording or playing back based on an external pulse. You can use two GSS6450 connected in Master/Slave mode, which lets you record more signals. The synchronisation between two GSS6450 is better than 5 nanoseconds.

Data Recording File Formats

Table 5 Data Recording File Formats Supported by the GSS6450

Data Type	Description	File Extension
GNSS Signals (GSS6450)	GSS6450 stored GNSS data	.A.gns .B.gns
GNSS Signals (GSS6425)	Compatibility mode for playback of GSS6425 files	.gns
Serial Data	Data presented on the COM 1 port	.com1
Video Capture	Webcam video sources (0 to 3) captured in compressed MPG file format	.mpg
Scenario file	Information about the recording	.scn
AGC file	Stores the AGC levels detected during recording	.agc
NMEA	Store the NMEA data from the internal receiver during recording	.nmea
NMEA	Store the NMEA data from the internal receiver during playback	.nmeaplay

Spirent will supply the format of the digitised data on request for direct access or decoding of the data.

Calibration Requirements

Spirent recommends you calibrate the OCXO annually by comparison to a known, accurate 10 MHz source (GPS or atomic clock derived). The calibration potentiometer is accessible on the rear panel without opening the GSS6450.

Spirent **GSS6450 Multi-frequency Record & Playback System**

Performance Specifications

Table 6 gives an example of the allowed combinations of channel, bandwidth and bit depths that ensure you do not exceed data throughput requirements.

Table 6 Throughput Limitations

No of Channels	No of Bits per Sample	10	30	50	60	80
1	2	Y	Y	Y	Y	Y
	4	Y	Y	Y	Y	Y
	8	Y	Y	Y	Y	Y
	16	Y	Y	Y	N	N
2	2	Y	Y	Y	Y	Y
	4	Y	Y	Y	Y	Y
	8	Y	Y	Y	Y	N
	16	Y	Y	N	N	N
3	2	Y	Y	Y	n/a	n/a
	4	Y	Y	Y	n/a	n/a
	8	Y	Y	Y	n/a	n/a
	16	Y	N	N	n/a	n/a
4	2	Y	Y	Y	n/a	n/a
	4	Y	Y	Y	n/a	n/a
	8	Y	Y	N	n/a	n/a
	16	Y	N	N	n/a	n/a

Y: configuration allowed

N: configuration not allowed

n/a: configuration not available

The GSS6450 can record up to four signals, two on Channel A and two on Channel B. Each channel has a maximum throughput of 200MBps, and there is a combined throughput limit of 300MBps.

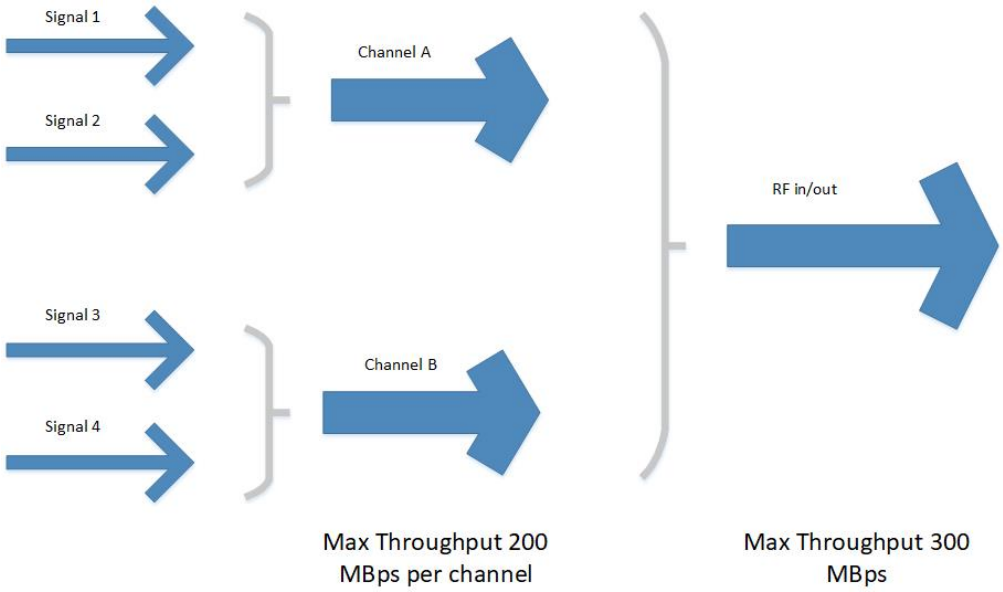

Figure 8 Throughput

The throughput for an individual signal is given by the formula:

Throughput (MBps) = Bit Depth x Bandwidth / 4

Example: Can you record 3 channels at 50 MHz and 8 bits?

Throughput per signal = 8 x 50 / 4 = 100 MBps

Put two signals on Channel A = 200MBps and one on Channel B = 100MBps.

Total throughput is 300 MBps. This is an allowable combination.

On any one channel the signals must have the same bandwidth and bit depth. However, Channel A and Channel B can always have different bit depths, and there are some combinations of different bandwidths that are allowed. In these cases, the formula above should be used to ensure that the required combinations can be set without breaking the throughput limits. The throughput values are automatically calculated in the GSS6450 and the user is warned if the limits are exceeded.

Spirent **GSS6450 Multi-frequency Record & Playback System**

Table 7 General Specifications

Feature		Item	Specification	Note
RF1	Frequency bands	GNSS RF in and Out	1161-1260 MHz 1260 – 1300 MHz* 1550-1610 MHz 1521-1551 MHz* **B3, E6 as standard, Inmarsat SBAS alternative option*	GNSS, up to four frequencies
	Bandwidth	Bandwidth 3 dB points	10.23, 30.69, 51.15, 61.38, 81.84 MHz	Same as sampling rate
	Noise Figure	System noise figure	< 3 dB	Measured at RF in
	Quantisation		2, 4, 8,16 bits	Number of bits of both I and Q
	Sample Freq		10.23, 30.69, 51.15, 61.38, 81.84 MHz	
	RF output	Additive phase noise	Better than -45 dBC @ 1 kHz	
	I/F	Record/replay storage	baseband	2, 4, 8 or 16 bit I and Q samples stored
RF2	Frequency bands	Cellular RF in and Out	690 – 2400 MHz	Up to four frequencies IQ calibration at specific frequencies is required for accurate operation.
	Bandwidth	Bandwidth 3 dB points	10.23, 30.69, 51.15, 61.38, 81.84 MHz	Same as sampling rate
	Noise Figure	System noise figure	< 3 dB	Measured at RF in
	Quantisation		2, 4, 8,16 bits	Number of bits of both I and Q
	Sample Freq		10.23, 30.69, 51.15, 61.38, 81.84 MHz	
	RF output	Additive phase noise	Better than -45 dBC @ 1 kHz	
	I/F	Record/replay storage	baseband	2, 4, 8 or 16 bit I and Q samples stored

Feature		Item	Specification	Note
RF3	Frequency bands	Wireless RF in and Out	87 – 6000 MHz	Single band up to 80MHz bandwidth IQ calibration at specific frequencies is required for accurate operation.
	Barred centre frequencies		988.0 - 1006.6 MHz 1159.0 - 1168.0 MHz 1193.0 - 1199.0 MHz 1491.0 - 1500.0 MHz 1545.0 - 1558.0 MHz 1975.0 - 2014.0 MHz	These centre frequencies cannot be set – either use RF2 or a centre frequency outside the band
	Bandwidth	Bandwidth 3 dB points	10.23, 30.69, 51.15, 61.38, 81.84 MHz	Same as sampling rate
	Noise Figure	System noise figure	< 3 dB	Measured at RF in
	Quantisation		2, 4, 8,16 bits	Number of bits of both I and Q
	Sample Freq		10.23, 30.69, 51.15, 61.38, 81.84 MHz	
	RF output	Additive phase noise	Better than -45 dBC @ 1 kHz	
	I/F	Record/replay storage	baseband	2, 4, 8 or 16 bit I and Q samples stored
Storage capacity		Internal SSD	2 TB	See Table 4
Attenuator		Internal stepped attenuator[3]	20 dB in 1 dB steps, all channels plus 20 dB in 1 dB steps, per channel Ability to switch off a complete channel	Note: for frequencies above 2.4GHz the attenuation becomes non-linear

[3] You can use attenuation to recreate real-world effects, such as degradation of signals when using poorly designed antenna or obscured signals. The GSS6450 provides a simple way of attenuating signals and provides for overall or individual channel adjustment. However, the C/No ratios that an attached GNSS receiver reports may not change dB for dB with the input attenuation because of the way the GNSS receiver calculates its C/No ratio and adjusts its AGC. In wider bandwidth recordings it is possible that not all signals will decrease at exactly the same rate. For a given GNSS receiver, however, the results using the in-built attenuator will be repeatable. Spirent recommends using a simulator for high accuracy sensitivity testing.

Spirent **GSS6450 Multi-frequency Record & Playback System**

Feature	Item	Specification	Note
Asynchronous recording	External data recording on Serial Port	4800 to 115200 baud	Stored in editable log file. NMEA data from the internal GNSS receiver can be stored.
Synchronous recording	Eight channels of external data i/o on Aux port	Max recommended bit rate 300 kbps @ 10.23 MHz 900 kbps @ 30.69 MHz 1500 kbps@ 51.15 MHz 1800 kbps@ 61.38 MHz 2400kbps @ 81.84 MHz	Data not editable Sampled at 1/8th of the main sampling rate.
Built-in controller and WebServer	Operating System	Linux Kernel 4.8 or later	
Power	Internal Battery	90 Wh, 1.5 hr record or playback time[4]	
	External Power	12 to 18 V DC 3.9A	Rear panel 2.1mm socket
	PSU supplied	Input: 90 to 260 V AC	
		Output: 18 V DC	2.1mm DC jack
	Vehicle cigarette lighter adapter supplied	Cigarette lighter plug to locking 2.1 mm jack	
Warm up period	10 minutes before recording or playback		
OCXO	< +/- 1 x 10^{-11} over 1 sec < +/- 1 x 10^{-8}	Short term stability Temperature stability	

[4] 1.5 hours when operating at ambient temperatures in the range 0 to 30°C.
For ambient temperatures between 30 and 40°C, battery life may be reduced.

Feature	Item	Specification	Note
AGC	Min input power level -130 dBm Max input power level -40 dBm	AGC presents optimum levels at the ADC for a Gaussian distribution over 90 dB input signal level range. Each signal has independent AGC control up to 50 dB. There is also an option to set a fixed gain for each RF input. On playback two settings are available 1) Standard Level Setting The Output Gain level on playback is fixed at a nominal setting and does not vary. 2) Absolute Level Setting The AGC levels stored during recording are used to replay at the same power levels as recorded.	
Fixed Input Gain (for 8 and 16 bit recordings only)	Available separately on RF1, RF2, RF3	Auto Manual Low Gain Medium Gain High Gain	Use AGC For signals in range: -80dBm to -30dBm -100dBm to -40dBm -120dBm to -55dBm
Output Gain	Across all channels	0dB 10dB 20dB (default)	Output gain can be set before or during playback. Intended for use with GNSS signals on RF1.
Dynamic Range	Based on an in-band CW jammer	Dynamic Range 4 bits 21 dB 8 bits 45 dB 16 bits 80 dB	
Playback Offset		Can set the playback offset to 1microsecond	
Master/Slave time alignment		10MHz: Time alignment up to 100ns. 30/ 50/ 60/ 80MHz: Typical: <5ns, max 9ns	

Spirent **GSS6450 Multi-frequency Record & Playback System**

Table 8 Connectivity

Category	Item	Specification	Note
Input	RF1 GNSS (input/Output)	Front panel SMA	3.3 Volts nominal to power antenna 5 Volts as an option (user selectable) Limited to 100 mA by self-healing fuse
	RF2 Wireless (input/Output)	Front panel SMA	No power supplied
	RF3 Wideband (input/Output)	Front panel SMA	No power supplied
	Power	2.1 mm locking socket	12 to 18 Volts DC
	10 MHz reference	Rear panel SMA	-15 dBm into 50 Ohm
	Video	Webcam	USB port Maximum four webcams (two front, two rear), depends on data storage rates
	Synchronous data	Aux Port	Two data channels, up to a maximum of eight, recorded per frequency logged
	Trigger	Aux Port	Three pins on port to synchronise two GSS6450, or with an external system
Output	RF1-3	Front panel SMA (as above)	Use DC block supplied for any receiver supplying > 5 Volts
	10 MHz reference	Rear panel SMA	50 Ohm, -3 dB nominal Output during record or replay
	RF out High level RF1-3	-53 dBm nominal at 50 Ohms, measured at 30 kHz bandwidth	Combined with the standard RF output, 30 dB attenuation normally applied.
	Video	15 Way D	VGA

Category	Item	Specification	Note
	Time Pulse	Aux Port 3.3V Active High	Configurable to 1s, 10s and 1 minute
	Synchronous data	Aux Port	Two data channels, up to a maximum of eight, recorded per frequency logged
	Aux Port	26 Way High Density D	Includes 5 Volt, 200 mA maximum, Output to power external modules
	I/Q data	Aux Port	Allows output of raw I/Q data on the AUX port during playback. *Note: the two most significant bits of the I/Q data are brought out, independent of the number of bits recorded.*
	10/100/1000 Ethernet	2 x RJ45	LAN 1 network LAN 2 PC
	2 x USB 2.0 2 x USB 3.0	USB 2 Type A (female) USB 3 Type A (female)	Front panel Rear panel
I/O	Serial (UART) x 1	9-way D (male)	
Interface / Control	Keyboard	USB	
	Removable SSD	SATA	
	VGA Monitor	1x 15-way D (female)	

Spirent **GSS6450 Multi-frequency Record & Playback System**

Table 9 Control Interfaces

Category	Item	Specification	Note
Local - Front Panel	Display	240 x 320 pixel resolution, RGB 65K true to life colours, TFT screen with Integrated 4-Wire Resistive Touch Panel.	Graphical.
	Keypad	Touchscreen LCD	
	Power	Front panel On/Off switch	
	Status indicators	LCD icons	
	Mouse	USB	
Remote	WebServer	Dynamic i/p address	Requires web-browser, or HTTP POST commands
	VNC	VNC server built-in	Requires VNC viewer
	Scripts	Linux shell scripts	

Physical and Environmental

Table 10 Physical and Environmental

Parameter	Value	Units	Notes
Size	216 x 200 x76 8.5 x 7.9 x 3.0	mm inch	Excludes feet
Weight	2.2 4.85	kg lbs	
Operating Temperature	0 to + 40 32 to 104	Degrees C Degrees F	
Operating Humidity	40 to 90	% RH	Non-condensing
Storage	-40 to +60 -40 to 140	Degrees C Degrees F	
Storage Humidity	20 to 90	% RH	Non-condensing

Safety and EMC Conformity

The GSS6450 complies with the following harmonised standards:

- EN 61010-3-2:2014
- EN 61326-2:2013 using the common technical requirements of EN 61326-1:2013
- EN 301489-3: V1.6.1, using the common technical requirements of EN301489-1: V1.9.2
- EN 61000-3-2:2014 and EN61000-3-3:2013
- FCC CFR 47 Parts 15.107 and 15.109 and ICES-003 Issue 6
- EN 303 413

Spirent **GSS6450 Multi-frequency Record & Playback System**

System Variants and Options

Component	Option identifier (see Table 2)	Part number	Description	What's included?
Hardware Chassis **(base system)**	A	6450-1010	GSS6450 Record and Playback (Standard)	Hardware chassis with ability to record & replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, 4 bits record or playback.
	B	6450-1011	GSS6450 Replay only (Standard)	Hardware chassis with ability to ONLY replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, 4 bits playback.
	C	6450-1012	GSS6450 Record and Playback (Inmarsat)	Hardware chassis with ability to record & replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, 4 bits record or playback.
	D	6450-1013	GSS6450 Replay only (Inmarsat)	Hardware chassis with ability to ONLY replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth,4 bits playback.
	U	6450-1014	GSS6450 Record and Playback 2-bit (Standard)	Entry Level hardware chassis with ability to record & replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, 2 bits record or playback.
	V	6450-1015	GSS6450 Record and Playback 2-bit (Inmarsat)	Entry Level hardware chassis with ability to record & replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, 2 bits record or playback.
GNSS Constellation Band	E	6450-3000	GPS, GAL, BEI L1	Constellation license
	F	6450-3001	GPS, GAL, GLO L1	Constellation license
	G	6450-3002	GPS, GAL, GLO, BEI L1	Constellation license
	H	6450-3003	GPS L1, L2	Constellation license
	I	6450-3004	GPS L1, L5	Constellation license
	J	6450-3005	GNSS L1, L2, L5, B3	Constellation license

Component	Option identifier (see Table 2)	Part number	Description	What's included?
	K	6450-3006-R	GNSS L1, L2, L5, B3 including E6	Constellation License (restricted)
	L	6450-3007	Inmarsat based augmentations, such as Omnistar and Starfire	Constellation license (needs base chassis C or D, and bandwidth option O or P)
	M	6450-3008	QZSS L6	Constellation License
	W	6450-7000	GNSS L1 L2 L5 50 MHz BW	Constellation License Bundle for 2-bit HW only
Bit Depth (I\Q Quantization)	N	6450-3021	8 bit	Additional support for 8 bits bit depth.
	O	6450-3022	8 bits and 16 bits	Additional support for 8 and 16 bits bit depth.
Bandwidth	P	6450-3030	30 MHz	Additional support for 30 MHz bandwidth.
	Q	6450-3031	30 and 50 MHz	Additional support for 30 and 50 MHz bandwidth.
	R	6450-3032	30,50,60 and 80 MHz	Additional support for 30, 50, 60 and 80 MHz bandwidth.
Enable RF2	S	6450-3040	Enables operation of RF 2	
Enable RF3	T	6450-3041	Enables operation of RF3	

Contact Spirent for details on upgrades from one standard configuration to another standard configuration.

For non-standard configurations please contact Spirent.

Spirent **GSS6450 Multi-frequency Record & Playback System**

Deliverables

Table 11 Deliverable Items

Item No.	Quantity	Component	Comment
1	1	GSS6450 RPS main unit	
2	1	Power Supply	PSU,Desk Top,18 V, 3.9 A, 90 W
3	1	Power Supply cable	UK, USA or EU versions
4	1	Active GNSS antenna	L1 only
5	1	Cigarette lighter adaptor	With 2.1 mm jack plug
6	1	Manual	Supplied on the CD
7	1	DC Block	
8	1	Ethernet cable (straight)	
9	1	Carry case	
10	1	Shoulder strap	
11	1	Lens cloth & Stylus	
12	1	Quick start guide	
13	1	USB 3.0 to SATA 2.5" HDD adapter cable	

Table 12 Accessories

Accessory Description	System order code
Accessory kit (3 cameras, IPAD, Wi-Fi adapter)	1000-8000
External 8TB Backup drive[5]	1000-8001
External 12TB Backup drive[5]	1000-8015
Removable external 1TB SSD drive	1000-8003
Removable external 2TB SSD drive	1000-8002
Removable external 4TB SSD drive	1000-8012
Removable external 7.5TB SSD drive	1000-8016
RAID 8TB (2 x 4TB SSD)	1000-8013
RAID 15TB (2 x 7.5TB SSD)	1000-8014
Desktop RAID 80TB[6]	1000-8017
Multi-Frequency Antenna – L1, L2, L5 and B3	6450-6001
Spare battery pack	1000-8004
USB Wi-Fi / Wireless Network Micro Adapter	1000-8005
Remove internal SSD (at time of system purchase) and supply 2 x 2 TB removable bootable SSDs	6450-9002
Alignment Certificate and Test Report	6450-9003
Battery Accessory Kit (excludes battery) - External charger, mains power cable - Power Cable for connection to the 6450 - Holding strap	1000-8007
Master/ Slave Cable set	1000-8006
PCAN Router FD	6450-6008
PCAN Router Interface Cable for High Speed USB2.0	6450-6009
PCAN Router Bus Converter High Speed to Single Wire	6450-6010

[5] The primary function of this option is to store the data recorded from the GSS6450. Data throughput may not be fast enough for direct playback or recording.
[6] Mains powered only

Spirent **GSS6450 Multi-frequency Record & Playback System**

PCAN Router Bus Converter High Speed to Loe Speed	6450-6011
PCAN Router Interface Cable for GSS6450	6450-6012

The Battery Accessory Kit allows a GSS6450 battery to be charged external to the GSS6450 itself. The battery can also be used directly through a power cable to the GSS6450 in order to double the battery life.

* The primary function of this option is to store the data recorded from the GSS6450. Data throughput may not be fast enough for direct playback or recording.

Glossary of Terms

1PPS	One Pulse-Per-Second
ADC	Analogue to Digital Converter
AGC	Automatic Gain Control
Aux	Auxiliary
BeiDou	Chinese GNSS System
C/No	Carrier to Noise Density Ratio
EMC	Electromagnetic Compatibility
FTP	File Transfer Protocol
GALILEO	EU GNSS System
GLONASS	GLObal NAvigation Satellite System (Russian Federation)
GNSS	Global Navigation Satellite System (Galileo + GPS + SBAS + GLONASS + IRNSS + BeiDou)
GPS	Global Positioning System US GNSS system
IRNSS	Indian Regional Navigation Satellite System
OCXO	Over Controlled Crystal Oscillator
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
RPS	Record and Playback System
SBAS	Space-Based Augmentation System (such as WAAS, EGNOS, MSAS)
SSD	Solid State Desk
VNC	Virtual Network Computing

Referenced Documents

a) DGP01444AAA GSS6450 RPS Manual [latest issue]

Spirent **GSS6450 Multi-frequency Record & Playback System**

For more information

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