GSS6450 Multi-frequency Record & Playback System

The world’s first highly portable high dynamic range RF record & playback system
Purpose of this Document

This datasheet describes the functionality of the Spirent GSS6450 Multi-Frequency, Multi-GNSS Record/Playback & Playback only systems, which sets a new standard of excellence in GNSS RF record and playback for R&D and performance test. This datasheet also provides technical data and configuration information. The GSS6450 is a modular platform and can be purchased with various options. Please speak to your Spirent Sales representative before ordering to ensure your specific needs are met.
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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 dynamic range up to 80dB, high bit depths both ‘I’ & ‘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 at high bit depth and 80dB of dynamic range. 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 470-6000MHz
- 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
- Dynamic Range (Standard 44dB, Advanced 56dB or High Dynamic Range 80dB)
- 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 signals for playback on a GSS6425
- Internal battery (record time up to 1.5 hours) and vehicle DC power adapter
- Single touch record
- Support for parallel synchronous and asynchronous storage of external data
- Event markers
Playback Functionality

- Common 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 files recorded on a GSS6425
- Output of raw I/Q data on Aux port (Two most significant bits of each channel).

CAN bus

- 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 dynamic ranges 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.

Dynamic Range

The dynamic range of the GSS6450 is stated to be the unit’s ability to differentiate between the lowest amplitude signal and highest amplitude signal recorded / played back. For example, being in the noise floor a single GNSS signal does not necessarily need a wide dynamic for high fidelity recording and playback. However, this is not the case if the GNSS signal is accompanied by a 40dB interference signal above the GNSS signal. To representatively record and playback this GNSS plus 40dB interference signal combination, the record / playback solution must have a dynamic range larger than this. If this is not the case, the signal will not be captured and replayed properly. The signal will become distorted in amplitude and phase as it becomes compressed and hence impact the test credibility.

The GSS6450 offers three dynamic range options Standard (44dB), Advanced (56dB) and High Dynamic Range (80dB). Please ensure that the dynamic range option selected is sufficient for the range of signals required to be captured and played back.

Definition of Dynamic Range;

I. The AGC Range is the acceptable range of time-varying total input power – used to increase the range of possible input powers
II. The Signal Dynamic Range is the ratio of the quietest to loudest simultaneous recorded signals
III. The Recording Dynamic Range is a combination of the AGC range and the Signal Dynamic Range

![Figure 1 Dynamic Range](image-url)
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 dynamic range. 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 2** 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\sSBAS, 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

- Dynamic Range
  - Standard 44dB
  - Advanced 56dB
  - High 80dB
Figure 2 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.

**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 dynamic ranges.

The user can choose a dynamic range of 44, 56 or 80dB, 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 frequency offset from the start of the band.

**Recording Wideband Frequencies on RF3**

RF3 has a frequency input range of 470 – 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 bandwidth.

It is also possible to set user defined centre frequencies, by simply typing in the centre frequency required, dynamic range 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.

RF3 can be used to capture Wi-Fi at 2.4 GHz and 5 GHz, for use cases where Wi-Fi capture is required, please contact us to discuss your requirements and for guidance on how to get the best Wi-Fi capture from your GSS6450.

**Note:** In cases where there are many Wi-Fi access points or where there are both near and far Wi-Fi access points, the GSS6450 should not be used.

**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.

<table>
<thead>
<tr>
<th>Table 1 Barred Centre frequencies on RF3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Barred Centre frequencies (MHz)</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

The user can choose a dynamic range of 44, 56 or 80dB. RF2 and RF3 antenna ports do not provide power to the antenna.

**Channel Architecture**

The GSS6450 can record up to four signals. It does this by recording and playing back up to two signals on each of the two channels (A and B) as per the following diagram.
Signals on the same Channel must have the same bandwidth and dynamic range (e.g. 30MHz, HDR).

Channel A and B must have the same Bandwidth set (e.g. 50MHz) but different dynamic ranges can be set on each Channel (e.g. Channel A may have High dynamic range set while Channel B could have Standard dynamic range set). The higher dynamic range selected for the signals reduces the recording time. This may be particularly important when recording Cellular signals, needing a high dynamic range (80dB), but the GNSS signals could be recorded at with advanced dynamic range (56dB).

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. Some limited combinations of other rates are also possible.

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

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\(^1\) 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.
Algorithm studies
- 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

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 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. Standard 44dB or Advanced 56dB dynamic range sampling is suitable for commercial applications testing while keeping data storage levels down; the full High dynamic range 80dB sampling provides the capability 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

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

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.
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 system, it is mandatory to have a hardware chassis (A, B, C, D, E or F) with a GNSS Constellation Band option (G to O), or enabling RF2 (Wireless) (T) or RF3 (Wideband) (U). The Base system is pre-configured with 10 MHz bandwidth; 2 TB SSD (internal) and 56dB dynamic range. For dynamic range of 80dB choose the appropriate dynamic range option (P). For a dynamic range of 44dB choose HW options E or F, this system is pre-configured with 10 MHz bandwidth and 2 TB internal SSD. For Constellation Bands requiring 30 MHz bandwidth (J, K, L, N and O) you must purchase the 30 MHz option (Q) or the 30/50 MHz option (R), or the 30/50/60/80 MHz option (S).

It is likely (but not mandatory) that if the RF2 or RF3 are enabled then a wider dynamic range option (P) will be required. Similarly, greater bandwidth is likely to be needed, options R or S. 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

<table>
<thead>
<tr>
<th>Product Elements</th>
<th>Options</th>
<th>With 10 MHz Bandwidth</th>
<th>With 30 MHz Bandwidth option</th>
<th>With 30 /50 MHz Bandwidth option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware Chassis \ Type (Base system)</td>
<td>A. Record &amp; playback (Advanced)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Replay ONLY (Advanced)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Record &amp; playback (Advanced, Inmarsat)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Replay ONLY (Advanced, Inmarsat)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Record &amp; playback (Standard)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F. Record &amp; playback (Standard, Inmarsat)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3

<table>
<thead>
<tr>
<th>Constellations</th>
<th>10 MHz</th>
<th>30 MHz</th>
<th>30/50 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>G. GPS, GAL, BEI L1</td>
<td>1561.098</td>
<td>1575.42</td>
<td></td>
</tr>
<tr>
<td>H. GPS, GAL, GLO L1</td>
<td>1575.42</td>
<td>1602.018</td>
<td></td>
</tr>
<tr>
<td>I. GPS, GAL, GLO, BEI L1</td>
<td>1561.098</td>
<td>1575.42</td>
<td>1567.236</td>
</tr>
<tr>
<td>J. GPS L1, L2</td>
<td>1575.42</td>
<td>1227.60</td>
<td>1575.42</td>
</tr>
<tr>
<td>K. GPS L1, L5</td>
<td>1575.42</td>
<td>1176.45</td>
<td>1575.42</td>
</tr>
<tr>
<td>L. GNSS L1, L2, L5, B3</td>
<td>1561.098</td>
<td>1575.42</td>
<td>1176.45</td>
</tr>
</tbody>
</table>

Table 3 shows a complete list of constellations that can be recorded at selected centre frequency and bandwidth.
<table>
<thead>
<tr>
<th>Product Elements</th>
<th>Options</th>
<th>With 10 MHz Bandwidth</th>
<th>With 30 MHz Bandwidth option</th>
<th>With 30 /50 MHz Bandwidth option</th>
</tr>
</thead>
<tbody>
<tr>
<td>M. GNSS L1, L2, L5, B3, E6</td>
<td>Please contact Spirent for more information.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N. Inmarsat based augmentations</td>
<td>1536.00</td>
<td>1536.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O. QZSS L6</td>
<td>1278.75</td>
<td>1278.75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dynamic Range (option)**

<table>
<thead>
<tr>
<th>Bandwidth (option)</th>
<th>P. High dynamic range 80dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. 30 MHz</td>
<td>690-2400MHz</td>
</tr>
<tr>
<td>R. 30 and 50 MHz</td>
<td></td>
</tr>
<tr>
<td>S. 30,50,60 and 80MHz</td>
<td></td>
</tr>
</tbody>
</table>

**RF2**

<table>
<thead>
<tr>
<th>T. Enable RF2</th>
</tr>
</thead>
</table>

**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
- 1290.0 - 1370.0 MHz
- 1491.0 - 1500.0 MHz
- 1545.0 - 1558.0 MHz
- 1975.0 - 2014.0 MHz

**RF3**

<table>
<thead>
<tr>
<th>U. Enable RF3</th>
<th>470 – 6000 MHz</th>
</tr>
</thead>
</table>

**Notes:**

1. Constellation band options G and H can record at 10 MHz only
2. With constellation band options G, H, J and K, you can simultaneously record and playback up to two RF centre frequencies. With options I, L, M and N 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 J, K, L, N and O, 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, D or F. You must also purchase the ‘Inmarsat based augmentations’ Option N, and the 30MHz bandwidth option Q, or the 30/50 MHz bandwidth option R. You cannot use these systems to record BeiDou B3, QZSS L6, or Galileo E6 signals on RF1.
7. If option S (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 Advanced 56dB dynamic range, you will need to order a system as follows:

- Option A: Record and playback hardware (Advanced)
Option I: GPS L1 and GLONASS L1 constellation license
Option Q: 30MHz bandwidth

<table>
<thead>
<tr>
<th>Item</th>
<th>Centre Frequency, MHz</th>
<th>Constellations Supported</th>
<th>Bandwidth, MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1176.45</td>
<td>GPS L5, Galileo E5a, QZSS L5, SBAS L5</td>
<td>30 or 50</td>
</tr>
<tr>
<td>2</td>
<td>1227.6</td>
<td>GPS L2 (L2c, P(Y) and M), QZSS L2c</td>
<td>30, 50</td>
</tr>
<tr>
<td></td>
<td>** Note: the 50MHz setting does not cover GLONASS L2**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1246.014</td>
<td>GLONASS L2 (C/A and P)</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>1583.604</td>
<td>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</td>
<td>50, 60 or 80</td>
</tr>
<tr>
<td></td>
<td>** Note: you may notice up to 2 dB signal degradation on the upper channels of the L1 GLONASS signal with the 50MHz setting **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1591.788</td>
<td>GPS L1 (C/A, P(Y), L1c and M), Galileo E1 (B and C, with CBOC)<strong>, QZSS L1 (C/A, SAIF, L1c with TMBOC), SBAS L1 (WAAS, EGNOS, MSAS, GAGAN), GLONASS L1 (C/A and P)</strong>, BeiDou B1</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>** Note: you may notice up to 2 dB signal degradation on the E1 Galileo signal **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1239.876</td>
<td>GPS L2 (L2c, P(Y) and M), QZSS L2c, GLONASS L2 (C/A and P)</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>1561.098</td>
<td>BeiDou B1</td>
<td>10 or 30</td>
</tr>
<tr>
<td>8</td>
<td>1575.42</td>
<td>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), 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)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>** Note: you may notice up to 2 dB signal degradation on the upper channels of the L1 GLONASS signal with the 50MHz setting **</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>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</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>** Note: you may notice up to 2 dB signal degradation on the upper channels of the L1 GLONASS signal with the 50MHz setting **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1602.018</td>
<td>GLONASS L1 (C/A)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>GLONASS L1 (C/A and P)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Centre Frequency, MHz</td>
<td>Constellations Supported</td>
<td>Bandwidth, MHz</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------</td>
<td>--------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>10</td>
<td>1207.14</td>
<td>BeiDou B2b, Galileo E5b, GLONASS L3</td>
<td>30</td>
</tr>
<tr>
<td>11</td>
<td>1567.236</td>
<td>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)</td>
<td>30</td>
</tr>
<tr>
<td>12</td>
<td>1268.52</td>
<td>BeiDou B3</td>
<td>30 or 50</td>
</tr>
<tr>
<td>13</td>
<td>1191.795</td>
<td>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</td>
<td>50, 60 or 80</td>
</tr>
<tr>
<td>14</td>
<td>1536.0</td>
<td>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.</td>
<td>30 or 50</td>
</tr>
<tr>
<td>15</td>
<td>1278.75</td>
<td>QZSS L6</td>
<td>30 or 50</td>
</tr>
</tbody>
</table>

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

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.

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.
Sample WebServer screen shots:

![Sample WebServer Screen shots](image)

**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 dynamic range 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 dynamic range 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 dynamic range at which the signals were recorded.
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.

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>
<thead>
<tr>
<th>Number of Frequencies recorded (Standard dynamic range)</th>
<th>Available Recording time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 MHz</td>
</tr>
<tr>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>12.5</td>
</tr>
<tr>
<td>4</td>
<td>8.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Frequencies recorded (Advanced dynamic range)</th>
<th>Available Recording time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 MHz</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>12.5</td>
</tr>
<tr>
<td>3</td>
<td>8.4</td>
</tr>
<tr>
<td>4</td>
<td>4.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Frequencies recorded (High dynamic range)</th>
<th>Available Recording time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 MHz</td>
</tr>
<tr>
<td>1</td>
<td>12.5</td>
</tr>
<tr>
<td>2</td>
<td>6.25</td>
</tr>
<tr>
<td>3</td>
<td>4.17</td>
</tr>
<tr>
<td>4</td>
<td>2.1</td>
</tr>
</tbody>
</table>

As standard the GSS6450 is supplied with a 2TB internal SSD drive. Removable external SSD of 1, 2, 4 or 7.5TB could be purchased. 8TB, 15TB or 80TB 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)
- 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>
<thead>
<tr>
<th>Data Type</th>
<th>Description</th>
<th>File Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNSS Signals</td>
<td>GSS6450 stored GNSS data</td>
<td>.A.gns</td>
</tr>
<tr>
<td>(GSS6450)</td>
<td></td>
<td>.B.gns</td>
</tr>
<tr>
<td>GNSS Signals</td>
<td>Compatibility mode for playback of GSS6425 files</td>
<td>.gns</td>
</tr>
<tr>
<td>(GSS6425)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serial Data</td>
<td>Data presented on the COM 1 port</td>
<td>.com1</td>
</tr>
<tr>
<td>Video Capture</td>
<td>Webcam video sources (0 to 3) captured in compressed MPG file format</td>
<td>.mpg</td>
</tr>
<tr>
<td>Scenario file</td>
<td>Information about the recording</td>
<td>.scn</td>
</tr>
<tr>
<td>AGC file</td>
<td>Stores the AGC levels detected during recording</td>
<td>.agc</td>
</tr>
<tr>
<td>NMEA</td>
<td>Store the NMEA data from the internal receiver during recording</td>
<td>.nmea</td>
</tr>
<tr>
<td>NMEA</td>
<td>Store the NMEA data from the internal receiver during playback</td>
<td>.nmeaplay</td>
</tr>
</tbody>
</table>

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

### Calibration Requirements

The GSS6450 is calibrated to the ISO/IEC 17025 standard at the time of purchase, this accredited calibration comes with a default 12-month calibration period. Annual re-calibration must be carried out at a Spirent facility or accredited laboratory to maintain this accreditation.

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.

*For more information on Spirent’s calibration service, customers may refer to MS3089: Spirent Support Service for Positioning Technology Products, Customers who require more information on how to renew the annual accredited calibration, may contact their local Spirent representative.*

![Warning](https://via.placeholder.com/150)

**Warning:** Altering the 10 MHz adjustment outside of a spirent-authorised ISO/IEC17025 accredited laboratory will invalidate the accredited calibration, if you have one. Please contact Spirent support if you want to maintain or renew your accredited calibration.
Performance Specifications

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

<table>
<thead>
<tr>
<th>No of Channels</th>
<th>Dynamic Range</th>
<th>10</th>
<th>30</th>
<th>50</th>
<th>60</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Standard</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>2</td>
<td>Standard</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>3</td>
<td>Standard</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>4</td>
<td>Standard</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

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. When configuring the channels in the GSS6450, the front panel screen or the web server automatical calculates and ensures you cannot select and invalid combination.
On any one channel the signals must have the same bandwidth and dynamic range. However, Channel A and Channel B can always have different dynamic ranges, 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.
### Table 7 General Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Item</th>
<th>Specification</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF1</td>
<td>Frequency bands</td>
<td>GNSS RF in and Out</td>
<td>GNSS, up to four frequencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1161-1260 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1260 – 1300 MHz*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1550-1610 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1521-1551 MHz*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*B3, E6 as standard, Inmarsat SBAS alternative option</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bandwidth 3 dB points</td>
<td>10.23, 30.69, 51.15, 61.38, 81.84 (@92.07 Msps) MHz</td>
<td>Anti alias rejection from adjacent signals approx. 15dB</td>
</tr>
<tr>
<td></td>
<td>Noise Figure</td>
<td>System noise figure</td>
<td>&lt; 3 dB</td>
</tr>
<tr>
<td></td>
<td>Sample Freq</td>
<td>10.23, 30.69, 51.15, 61.38, 81.84, 92.07 Msps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RF output</td>
<td>Additive phase noise</td>
<td>Better than -45 dBC @ 1 kHz</td>
</tr>
<tr>
<td>RF2</td>
<td>Frequency bands</td>
<td>Cellular RF in and Out</td>
<td>Up to four frequencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>690 – 2400 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bandwidth 3 dB points</td>
<td>10.23, 30.69, 51.15, 61.38, 81.84 (@92.07 Msps) MHz</td>
<td>Anti alias rejection from adjacent signals approx. 15dB</td>
</tr>
<tr>
<td></td>
<td>Noise Figure</td>
<td>System noise figure</td>
<td>&lt; 3 dB</td>
</tr>
<tr>
<td></td>
<td>Sample Freq</td>
<td>10.23, 30.69, 51.15, 61.38, 81.84 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RF output</td>
<td>Additive phase noise</td>
<td>Better than -45 dBC @ 1 kHz</td>
</tr>
<tr>
<td>RF3</td>
<td>Frequency bands</td>
<td>Wireless RF in and Out</td>
<td>Single band up to 80MHz bandwidth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>470 – 6000 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Barred centre frequencies</td>
<td>988.0 - 1006.6 MHz</td>
<td>These centre frequencies cannot be set – either use RF2 or a centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1159.0 - 1168.0 MHz</td>
<td>frequency outside the band</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1193.0 - 1199.0 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1491.0 - 1500.0 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1545.0 - 1558.0 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1975.0 - 2014.0 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bandwidth 3 dB points</td>
<td>10.23, 30.69, 51.15, 61.38, 81.84 (@92.07 Msps) MHz</td>
<td>Anti alias rejection from adjacent signals approx. 15dB</td>
</tr>
<tr>
<td></td>
<td>Noise Figure</td>
<td>System noise figure</td>
<td>&lt; 3 dB</td>
</tr>
<tr>
<td></td>
<td>Sample Freq</td>
<td>10.23, 30.69, 51.15, 61.38, 81.84 MHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RF output</td>
<td>Additive phase noise</td>
<td>Better than -45 dBC @ 1 kHz</td>
</tr>
<tr>
<td>Storage capacity</td>
<td>Internal SSD</td>
<td>2 TB</td>
<td>See Table 4</td>
</tr>
</tbody>
</table>

3 Bandwidth is defined as the 3dB point +/- 1dB passband ripple
4 Bandwidth is defined as the 3dB point +/- 1dB passband ripple
5 Bandwidth is defined as the 3dB point +/- 1dB passband ripple
<table>
<thead>
<tr>
<th>Feature</th>
<th>Item</th>
<th>Specification</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attenuator</td>
<td>Internal stepped attenuator&lt;sup&gt;6&lt;/sup&gt;</td>
<td>20 dB in 1 dB steps, all channels plus 20 dB in 1 dB steps, per channel Ability to switch off a complete channel</td>
<td>Note: for frequencies above 2.4GHz the attenuation becomes non-linear</td>
</tr>
<tr>
<td>Asynchronous recording</td>
<td>External data recording on Serial Port</td>
<td>4800 to 115200 baud</td>
<td>Stored in editable log file. NMEA data from the internal GNSS receiver can be stored.</td>
</tr>
</tbody>
</table>
| 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 4.19 |                                                                                           |
| Power                        | Internal Battery                          | 90 Wh, 1.5 hr record or playback time<sup>7</sup>                           | Rear panel 2.1mm socket  
Input: 90 to 260 V AC  
Output: 18 V DC  
2.1mm DC jack | Cigarette lighter plug to locking 2.1mm jack |
| Power                        | External Power                            | 12 to 18 V DC  
3.9A                                                                                       |                                                                                           |
| Power                        | PSU supplied                              | Input: 90 to 260 V AC  
Output: 18 V DC  
2.1mm DC jack                                                                                       |                                                                                           |
| Warm up period               | 10 minutes before recording or playback   |                                                                                |                                                                                           |
| OCXO                         | < +/- 1 x 10<sup>-11</sup> over 1 sec    | Short term stability  
Temperature stability                                                                 |                                                                                           |
| AGC<sup>8</sup>             | Input Power Level Min Max                 | 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.  
Measured at L1 frequency. |                                                                                           |

<sup>6</sup> 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.

<sup>7</sup> 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.

<sup>8</sup> Measured at L1 frequency
<table>
<thead>
<tr>
<th>Feature</th>
<th>Item</th>
<th>Specification</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Input Gain (^9) (for high dynamic range recordings only)</td>
<td>Available separately on RF1, RF2, RF3</td>
<td>Auto</td>
<td>Use AGC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manual</td>
<td>For signals in range:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low Gain</td>
<td>RF1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-80dBm to -30dBm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium Gain</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>High Gain</td>
<td></td>
</tr>
<tr>
<td>Output Gain</td>
<td>Across all channels</td>
<td>0dB</td>
<td>0dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10dB</td>
<td>10dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20dB (default)</td>
<td>20dB (default)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Output gain can be set before or during playback. Intended for use with GNSS signals on RF1.</td>
<td></td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>Based on an in-band CW jammer</td>
<td>Dynamic Range</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standard 44 dB</td>
<td>Advanced 56 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High 80 dB</td>
<td></td>
</tr>
<tr>
<td>Playback Offset</td>
<td>Can set the playback offset to 1microsecond</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master/Slave time alignment</td>
<td>10MHz: Time alignment up to 100ns.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30/ 50/ 60/ 80MHz: Typical: &lt;5ns, max 9ns</td>
<td></td>
</tr>
</tbody>
</table>

\(^9\) Measured at L1 frequency
<table>
<thead>
<tr>
<th>Category</th>
<th>Item</th>
<th>Specification</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>RF1 GNSS (input/Output)</td>
<td>Front panel SMA</td>
<td>3.3 Volts nominal to power antenna</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 Volts as an option (user selectable)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Limited to 100 mA by self-healing fuse</td>
</tr>
<tr>
<td></td>
<td>RF2 Wireless (input/Output)</td>
<td>Front panel SMA</td>
<td>No power supplied</td>
</tr>
<tr>
<td></td>
<td>RF3 Wideband (input/Output)</td>
<td>Front panel SMA</td>
<td>No power supplied</td>
</tr>
<tr>
<td></td>
<td>Power</td>
<td>2.1 mm locking socket</td>
<td>12 to 18 Volts DC</td>
</tr>
<tr>
<td></td>
<td>10 MHz reference</td>
<td>Rear panel SMA</td>
<td>-15 dBm into 50 Ohm</td>
</tr>
<tr>
<td></td>
<td>Video</td>
<td>Webcam</td>
<td>USB port</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maximum four webcams (two front, two rear), depends on data storage</td>
</tr>
<tr>
<td></td>
<td>Synchronous data</td>
<td>Aux Port</td>
<td>Two data channels, up to a maximum of eight, recorded per frequency</td>
</tr>
<tr>
<td></td>
<td>Trigger</td>
<td>Aux Port</td>
<td>Three pins on port to synchronise two GSS6450, or with an external</td>
</tr>
<tr>
<td>Output</td>
<td>RF1-3</td>
<td>Front panel SMA (as</td>
<td>Use DC block supplied for any receiver supplying &gt; 5 Volts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>above)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 MHz reference</td>
<td>Rear panel SMA</td>
<td>50 Ohm, -3 dB nominal</td>
</tr>
<tr>
<td></td>
<td>RF out High level RF1-3</td>
<td>-53 dBm nominal at</td>
<td>Combined with the standard RF output, 30 dB attenuation normally</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 Ohms, measured at</td>
<td>applied.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 kHz bandwidth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Video</td>
<td>15 Way D</td>
<td>VGA</td>
</tr>
<tr>
<td></td>
<td>Time Pulse</td>
<td>Aux Port</td>
<td>Configurable to 1s, 10s and 1 minute</td>
</tr>
<tr>
<td></td>
<td>Synchronous data</td>
<td>Aux Port</td>
<td>Two data channels, up to a maximum of eight, recorded per frequency</td>
</tr>
<tr>
<td></td>
<td>Aux Port</td>
<td>26 Way High Density D</td>
<td>Includes 5 Volt, 200 mA maximum, Output to power external modules</td>
</tr>
<tr>
<td></td>
<td>I/Q data</td>
<td>Aux Port</td>
<td>Allows output of raw I/Q data on the AUX port during playback. Note:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the two most significant bits of the I/Q data are brought out,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>independent of the number of bits recorded.</td>
</tr>
<tr>
<td></td>
<td>10/100/1000 Ethernet</td>
<td>2 x RJ45</td>
<td>LAN 1 network</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LAN 2 PC</td>
</tr>
<tr>
<td></td>
<td>2 x USB 2.0</td>
<td>USB 2 Type A (female)</td>
<td>Front panel</td>
</tr>
<tr>
<td></td>
<td>2 x USB 3.0</td>
<td>USB 3 Type A (female)</td>
<td>Rear panel</td>
</tr>
<tr>
<td>I/O</td>
<td>Serial (UART) x 1</td>
<td>9-way D (male)</td>
<td></td>
</tr>
<tr>
<td>Interface / Control</td>
<td>Keyboard</td>
<td>USB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Removable SSD</td>
<td>SATA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VGA Monitor</td>
<td>1x 15-way D (female)</td>
<td></td>
</tr>
</tbody>
</table>
## Table 9 Control Interfaces

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

Table 10 Physical and Environmental

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>216 x 200 x 76</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8.5 x 7.9 x 3.0</td>
<td>inch</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Excludes feet</td>
</tr>
<tr>
<td>Weight</td>
<td>2.2</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.85</td>
<td>lbs</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>0 to + 40</td>
<td>Degrees C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32 to 104</td>
<td>Degrees F</td>
<td></td>
</tr>
<tr>
<td>Operating Humidity</td>
<td>40 to 90</td>
<td>% RH</td>
<td>Non-condensing</td>
</tr>
<tr>
<td>Storage</td>
<td>-40 to +60</td>
<td>Degrees C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-40 to 140</td>
<td>Degrees F</td>
<td></td>
</tr>
<tr>
<td>Storage Humidity</td>
<td>20 to 90</td>
<td>% RH</td>
<td>Non-condensing</td>
</tr>
</tbody>
</table>

## 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
## System Variants and Options

<table>
<thead>
<tr>
<th>Component</th>
<th>Option identifier (see Table 2)</th>
<th>Description</th>
<th>What’s included?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware Chassis (base system)</td>
<td>A</td>
<td>GSS6450 Record and Playback Advanced 56dB dynamic range</td>
<td>Hardware chassis with ability to record &amp; replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, Advanced 56dB dynamic range record or playback.</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>GSS6450 Replay only Advanced 56dB dynamic range</td>
<td>Hardware chassis with ability to ONLY replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, Advanced 56dB dynamic range playback.</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>GSS6450 Record and Playback Advanced 56dB dynamic range (Inmarsat)</td>
<td>Hardware chassis with ability to record &amp; replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, Advanced 56dB dynamic range record or playback.</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>GSS6450 Replay only Advanced 56dB dynamic range (Inmarsat)</td>
<td>Hardware chassis with ability to ONLY replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, Advanced 56dB dynamic range playback.</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>GSS6450 Record and Playback Standard 44dB dynamic range</td>
<td>Hardware chassis with ability to record &amp; replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, Standard 44dB dynamic range record or playback.</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>GSS6450 Record and Playback Standard 44dB dynamic range (Inmarsat)</td>
<td>Hardware chassis with ability to record &amp; replay RF GNSS signals. SSD (1 x 2 TB internal), 10 MHz Bandwidth, Standard 44dB dynamic range record or playback.</td>
</tr>
<tr>
<td>GNSS Constellation Band</td>
<td>G</td>
<td>GPS, GAL, BEI L1</td>
<td>Constellation license</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>GPS, GAL, GLO L1</td>
<td>Constellation license</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>GPS, GAL, GLO, BEI L1</td>
<td>Constellation license</td>
</tr>
<tr>
<td></td>
<td>J</td>
<td>GPS L1, L2</td>
<td>Constellation license</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>GPS L1, L5</td>
<td>Constellation license</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>GNSS L1, L2, L5, B3</td>
<td>Constellation license</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>GNSS L1, L2, L5, B3 including E6</td>
<td>Constellation License</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Inmarsat based augmentations, such as Omnistar and Starfire</td>
<td>Constellation license (needs base chassis C or D, and bandwidth option Q or R)</td>
</tr>
<tr>
<td></td>
<td>O</td>
<td>QZSS L6</td>
<td>Constellation License</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>GNSS L1 L2 L5 50 MHz BW</td>
<td>Constellation license Bundle for Standard 44dB dynamic range HW only</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>P</td>
<td>80dB High dynamic range</td>
<td>Additional support for 80dB High dynamic range</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Q</td>
<td>30 MHz</td>
<td>Additional support for 30 MHz bandwidth.</td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>30 and 50 MHz</td>
<td>Additional support for 30 and 50 MHz bandwidth.</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>30, 50, 60 and 80 MHz</td>
<td>Additional support for 30, 50, 60 and 80 MHz bandwidth.</td>
</tr>
<tr>
<td>Enable RF2</td>
<td>T</td>
<td>Enables operation of RF 2</td>
<td></td>
</tr>
<tr>
<td>Enable RF3</td>
<td>U</td>
<td>Enables operation of RF3</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----</td>
<td>--------------------------</td>
<td></td>
</tr>
</tbody>
</table>

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

For non-standard configurations please contact Spirent.
Deliverables

Table 12 Deliverable Items

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

Table 13 Accessories

Accessory Description

- Accessory kit (3 cameras, IPAD, Wi-Fi adapter)
- Removable external 1TB SSD drive
- Removable external 2TB SSD drive
- Removable external 4TB SSD drive
- Removable external 7.5TB SSD drive
- RAID 8TB (2 x 4TB SSD)
- RAID 15TB (2 x 7.5TB SSD)
- Multi-Frequency Antenna – L1, L2, L5 and B3
- Spare battery pack
- USB Wi-Fi / Wireless Network Micro Adapter
- Remove internal SSD (at time of system purchase) and supply 2 x 2 TB removable bootable SSDs
- Alignment Certificate and Test Report
- External battery charger
- Master/ Slave Cable set
- PCAN Router FD
- PCAN Router Interface Cable for High Speed USB2.0
### Accessory Description

<table>
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<th>Description</th>
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<td>PCAN Router Bus Converter High Speed to Single Wire</td>
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<td>PCAN Router Interface Cable for GSS6450</td>
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The External battery charger allows a GSS6450 battery to be charged external to the GSS6450 itself. For further information and guidance on external power supply usage, please refer to DCS0091A – GSS6450 External Power Supply Usage.
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 | Oven 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

- DGP01444AAA GSS6450 RPS Manual [latest issue]
- DCS0091A GSS6450 External Power Supply Usage
For more information

For more information on any aspect of performance evaluation of positioning, navigation & timing systems, please contact your Spirent representative or Spirent directly:

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About Spirent Positioning Technology

Spirent enables innovation and development in the GNSS (global navigation satellite system) and additional PNT (positioning, navigation and timing) technologies that are increasingly influencing our lives.

Our clients promise superior performance to their customers. By providing comprehensive and tailored test solutions, Spirent assures that our clients fulfill that promise.

Why Spirent?

Over five decades Spirent has brought unrivalled power, control and precision to positioning, navigation and timing technology. Spirent is trusted by the leading developers across all segments to consult and deliver on innovative solutions, using the highest quality dedicated hardware and the most flexible and intuitive software on the market.

Spirent delivers:

• Ground-breaking features proven to perform
• Flexible and customisable systems for future-proofed test capabilities
• World-leading innovation, redefining industry expectations
• First-to-market with new signals and ICDs
• Signals built from first principles — giving the reliable and precise truth data you need
• Unrivalled investment in customer-focused R&D
• A global customer support network with established experts

ISO/IEC 17025
The GSS6450 is calibrated to the ISO 17025 standard at the time of delivery.

About Spirent Communications

Spirent Communications (LSE: SPT) is a global leader with deep expertise and decades of experience in testing, assurance, analytics and security, serving developers, service providers, and enterprise networks. We help bring clarity to increasingly complex technological and business challenges. Spirent’s customers have made a promise to their customers to deliver superior performance. Spirent assures that those promises are fulfilled. For more information visit: www.spirent.com

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