

## LabSat 3 Wideband User Guide

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## 01 - LabSat3W Introduction

LabSat 3 Wideband is an RF signal record and replay system with 3 independently tuneable wideband channels. This allows capture and replay of most GNSS signals and even a few non-GNSS signals. The three RF channels all share a common sample rate which can be adjusted from 10 - 60 MHz.

Quantisation of I and Q signals is selectable from 1, 2 or 3 bits per signal. Depending on the combination of channel bandwidth and quantisation, LabSat 3 Wideband will adjust the number of available RF channels to keep the record data bandwidth within a rate that ensures continuous file transfer.

Because wideband recording allows capture of multiple GNSS frequencies within each RF channel, the procedure for configuring LabSat 3 Wideband involves selecting the frequency bands most suitable for capture of the required GNSS signals. LabSat helps by displaying only the frequencies for GNSS bands appropriate for the selected bandwidth.

Despite its simplicity, LabSat 3 Wideband supports a number of powerful features for use in industries such as automotive, sports and aerospace including three RF channels for multiple constellation testing, dual CAN Bus recording, inertial sensor logging and battery powered operation.



### Additional features:-

- Available for all global navigation satellite systems (GNSS). i.e GPS, GLONASS, BeiDou & Galileo.
- Additional systems include QZSS, IRNSS, SBAS and Commercial differential services.
- Simple to use one touch recording.
- Record or replay using internal SSD.
- RS232, Digital & Dual CAN interface.
- Remote control over Ethernet.
- External 10 MHz Reference input.
- Selectable TCXO/OCXO.
- OEM version available for system integrators
- Digital input for event marking or 1PPS recording.
- Adjustable attenuation (+20 to -69 dB).
- On-board GNSS receiver for monitoring RF during record and replay (L1 only).

### Product description:-

Version	Description
RLLS03W-RP	Three channel record & replay system with CAN Bus / RS232 / Digital IO
RLLS03W-P	Three channel replay only system with CAN Bus / RS232 / Digital IO

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## How does it work?

GNSS stands for Global Navigation Satellite Systems and is a general term that covers satellite positioning constellations belonging to different countries around the world. These include, among others, the United States 'GPS', the Russian 'GLONASS' and the Chinese 'BeiDou' systems. LabSat 3 Wideband is capable of recording and replaying the raw radio signals that are transmitted by the various constellations of satellites. LabSat receives the signal from an antenna just like a standard GNSS receiver but instead of processing each of the received signals to calculate a position fix, LabSat 3 Wideband samples and stores the antenna signal at very high speed.

When recorded RF signal is replayed by LabSat 3 Wideband into a standard GNSS receiver, such as a portable navigation system, the receiver will accept the signal as live, including all the velocity, delays and multipath effects.

This makes LabSat 3 Wideband invaluable for recording dynamic scenarios such as driving through a city in a vehicle.



[https://en.racelogic.support/Product\\_Info/LabSat\\_3\\_Wideband/LabSat\\_3\\_Wideband\\_User\\_Guide/01\\_-\\_LabSat3W\\_Introduction](https://en.racelogic.support/Product_Info/LabSat_3_Wideband/LabSat_3_Wideband_User_Guide/01_-_LabSat3W_Introduction)

The benefits of using a recorded test signal are consistency and reliability. For example, if testing of a product involves going for a drive each time the receiver firmware is updated, the satellite positions and atmospheric conditions will all be different for every drive. If the drive is recorded once with LabSat 3 Wideband, the recorded signal can be replayed over and over on the bench saving hours of drive time and with the knowledge that conditions will be the same for each reply.

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## Registration

Racelogic recommend that all LabSat devices are registered immediately on receipt. Please go to [www.labsat.co.uk/register](http://www.labsat.co.uk/register) and fill in all the details requested. If you register your LabSat within its first year warranty, you will automatically receive an additional year's warranty.

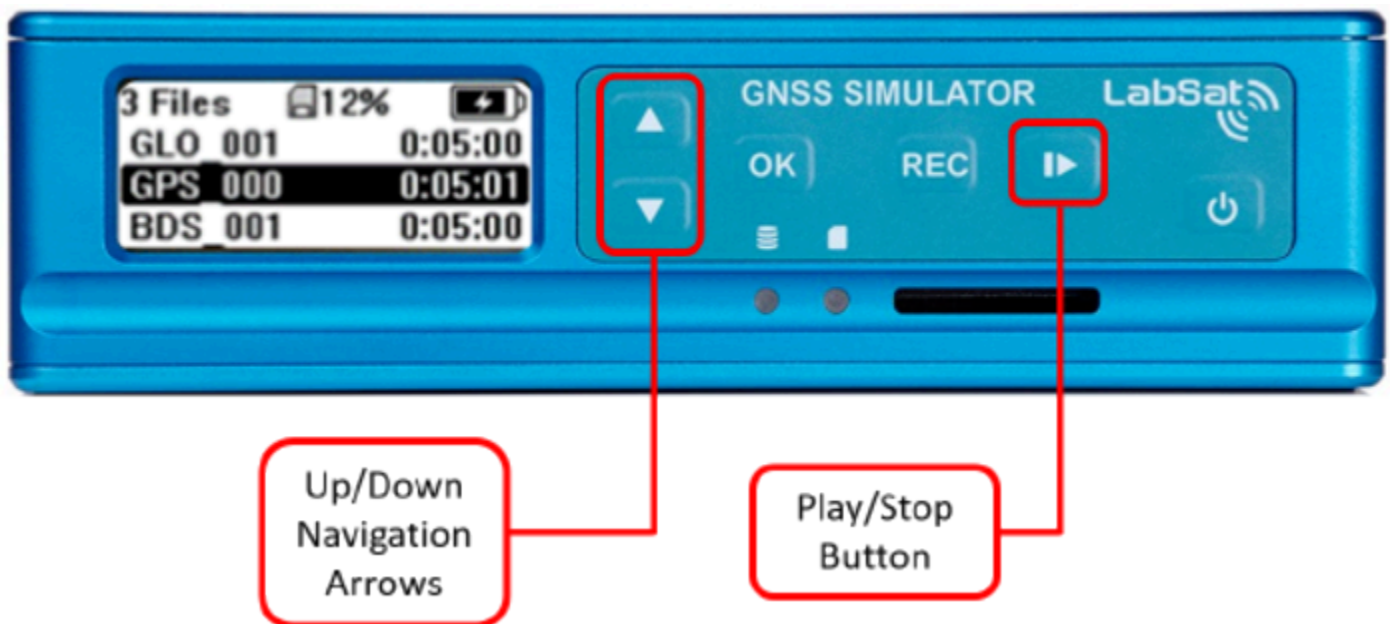
Registering your LabSat will enable you to easily communicate with our support team. Any firmware / software updates will be available on the LabSat website. Updates are more robust and easier to use, and later firmware releases offer bug fixes as well as added features and improvements to the original specification of the product. Your details will be available to our Support Team, in case you need any assistance in the future.

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## Replay Example

Example of Replay using the internal SSD with preloaded scenario.

Briefly press the power button to power up LabSat 3 Wideband. Connect from the RF output on the rear of LabSat 3 Wideband to your GPS system antenna input. Use the **'UP/DOWN'** arrows to select a file. Press the **'PLAY'** button to start replay.





LabSat 3 Wideband contains an on board GNSS receiver that allows monitoring of the RF signals during record or replay. To show a live histogram of satellite signal levels detected by the on board receiver, press the '**OK**' button during replay. Press the '**OK**' button again to return to the replay status display. During replay, pressing the '**PLAY**' button will halt replay and return to the file list.



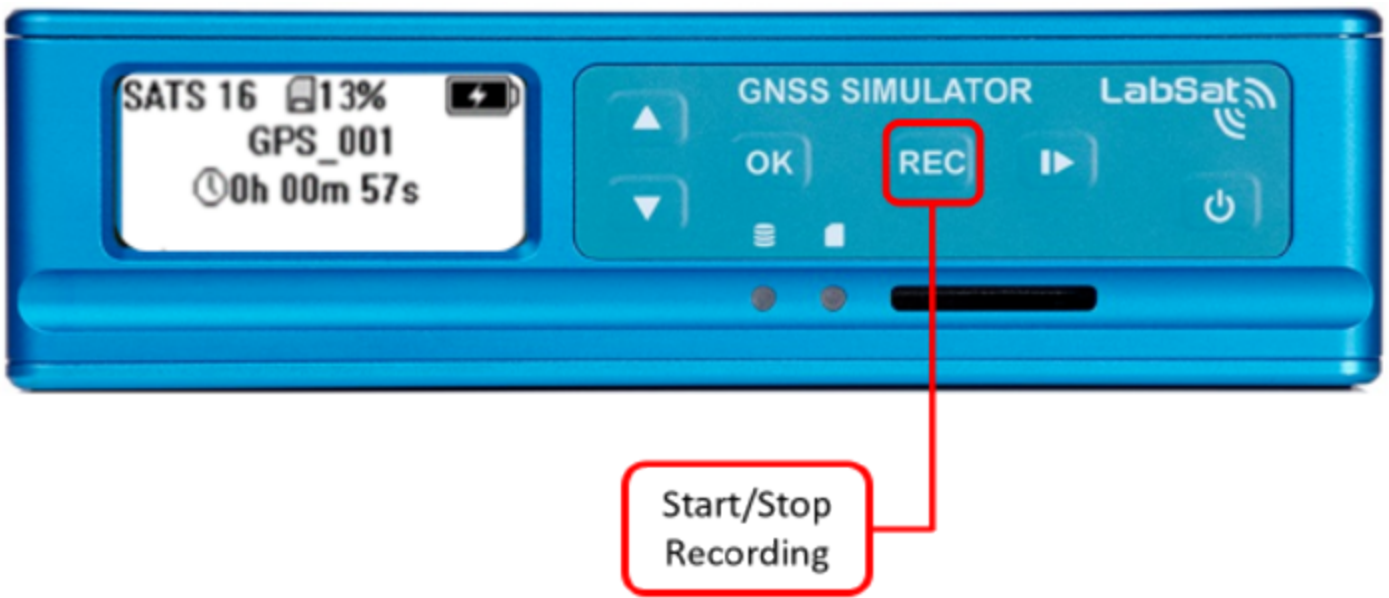
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## Record Example

Example of Recording your own file to the internal SSD card.

To record a new file, connect the LabSat 3 Wideband antenna to the RF input on the rear of the LabSat. Ensure that the antenna has a clear view of the sky, press the '**REC**' button to start recording. Press the '**REC**' button again to stop recording. While recording, if the SSD becomes full, recording will stop automatically. During recording, pressing the '**OK**' button will switch the display to show a live histogram view of the satellite levels being received by the on-board GNSS monitor. Pressing the '**OK**' button again will return to the record status display.





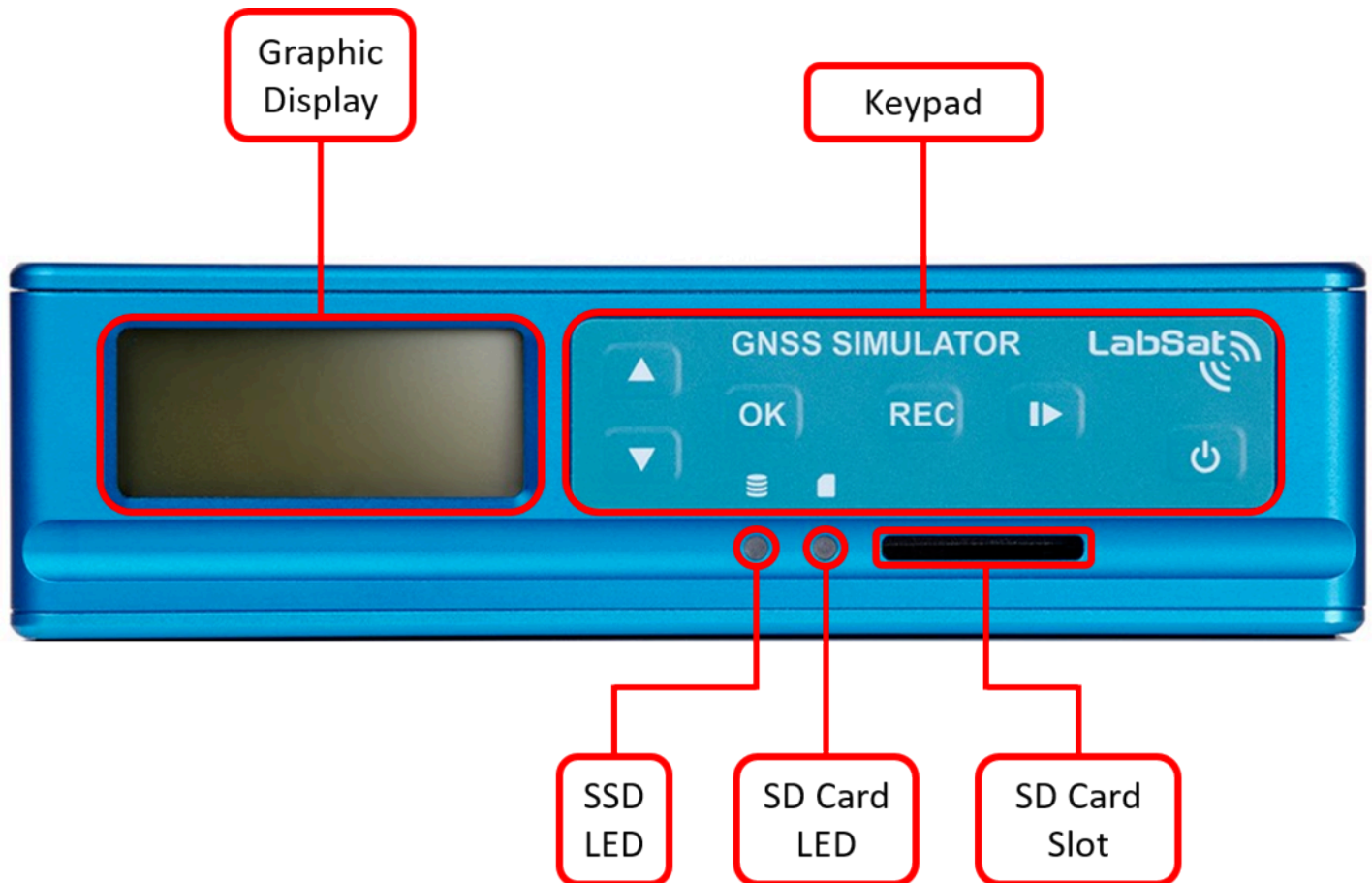
During recording, while using battery power, the GNSS monitor display will automatically revert to the record display after a short period to conserve battery power. This power save feature can be switched off but it is recommended to be left active for maximum battery life.



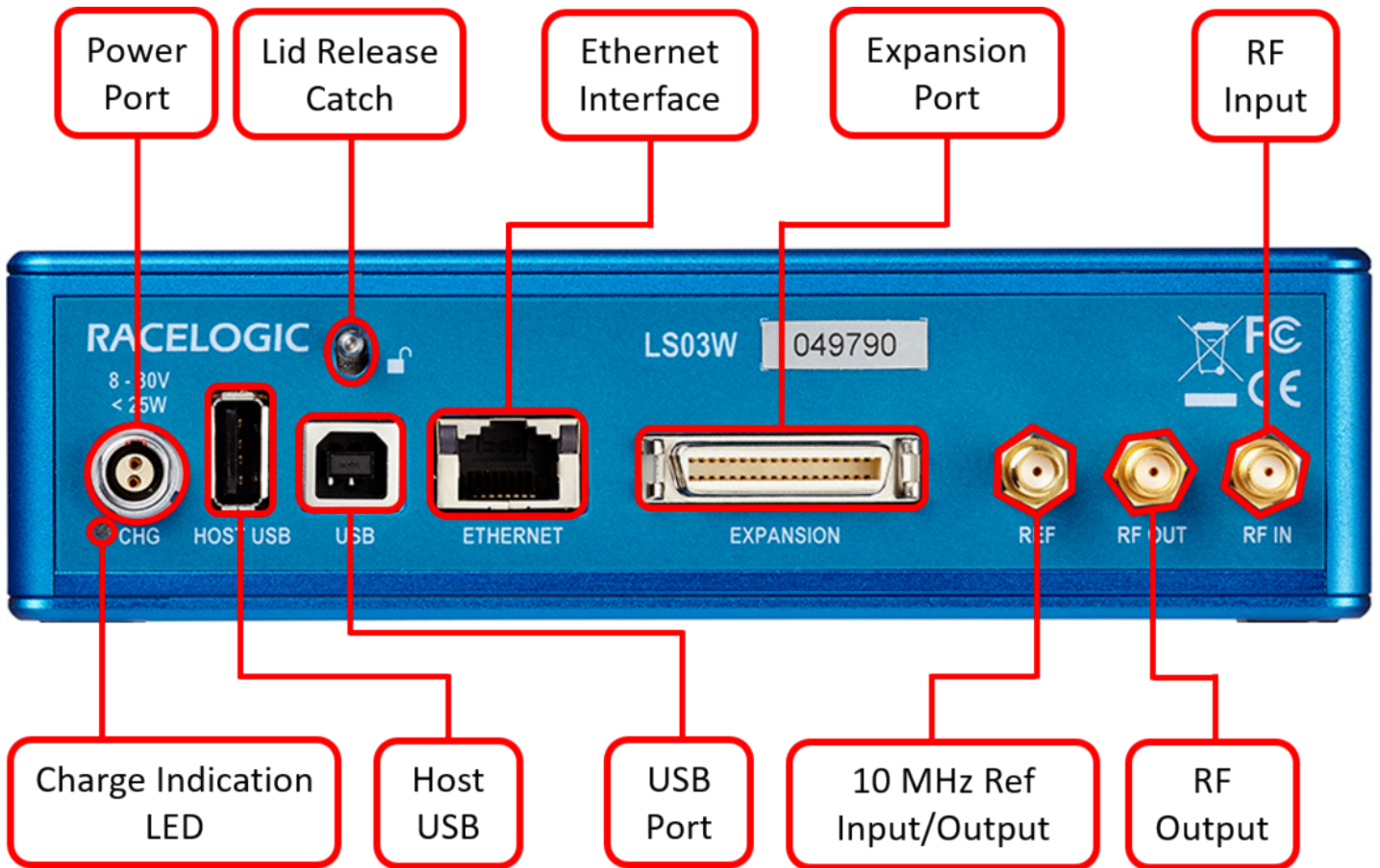
## 02 - LabSat3W Components

LabSat 3 Wideband has been designed to be portable and simple to use allowing virtually anyone to gather field test signals without in depth training. Recording GNSS signals is as simple as positioning the antenna and pressing one button. The sunlight-readable graphic display gives instant feedback of record status and can show live histogram data to verify satellites in view during recording. Back at the Lab, recorded signals can be replayed at the push of a button for repeatable, reliable testing.

### LabSat 3 Wideband Front



## LabSat 3 Wideband Rear



<b>Name</b>	<b>Type</b>	<b>Description</b>
PWR	2 pin LEMO	8 - 30 V DC Power Supply input
HOST USB	USB 'A'	Connection of USB Storage devices and WiFi Dongle
USB	USB 'B'	NMEA data output
ETHERNET	RJ45	Remote access and control
EXPANSION	36 Way MDR	1PPS, Digital I/O, CAN, RS232
REF	SMA	10 MHz Reference Clock Input/Output
RF OUT	SMA	Output RF signal
RF IN	SMA	Input RF signal (RP variants only)



## 03 - LabSat3 Wideband Media

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### File Formats

LabSat 3 Wideband uses a Linux EXT4 formatted drive for data storage. Recorded data consists of two separate files with the same name but with different extensions. The RF signal data is stored with the extension '.LS3W' and is a raw binary file. The configuration used to record and replay the RF data is stored in the '.ini' file. When copying files to or from the Labsat 3 Wideband SSD, both the '.LS3W' and '.ini' files must be copied together.

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### SD Card

The 4 GB SD card included with the LabSat 3 Wideband system is used for firmware upgrades and includes the following:

- SatGen simulation software video
- LabSat 3 Wideband demonstration files description
- Quick Start pdf

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### Solid State Drive (SSD)

#### Supported Media

The LabSat 3 Wideband currently supports a range of SSD's with various capacities. The following SSD's are compatible for use with LabSat 3 Wideband:

- Samsung QVO 870 1TB
- Samsung EVO 850, 860 & 870 1TB
- Samsung EVO 850, 860 & 870 2TB
- Samsung EVO 850, 860 & 870 4TB
- Samsung 7.68TB (MZ7LH7T6HMLA-00005)

#### Supplied 1 TB SSD

The LabSat 3 Wideband 1 TB SSD includes the following:

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[https://en.racelogic.support//Product\\_Info/LabSat\\_3\\_Wideband/LabSat\\_3\\_Wideband\\_User\\_Guide/03\\_-\\_LabSat3\\_Wideband\\_Media](https://en.racelogic.support//Product_Info/LabSat_3_Wideband/LabSat_3_Wideband_User_Guide/03_-_LabSat3_Wideband_Media)

- LabSat 3 Wideband sample files:
  - 1 x UK dynamic file - 20 mins
  - 3 x UK static files - 20 mins each
  - 1 x Korea static file - 20 mins
  - 1 x India static file - 20 mins

## SSD Access

The Solid State Drive is removable. To gain access to the LabSat 3 Wideband internal SSD the systems lid must be removed. To remove the systems lid, the locking pin at the rear must be depressed while the lid is push back towards the catch. The SSD can then be removed by gently lifting the attached tag.

**The system must be powered down while the SSD is being removed or reinserted.**

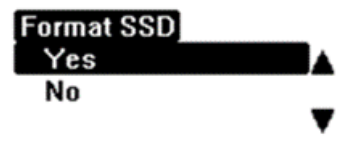
The system lid can be reattached by positioning the locating lugs with the mounting holes and the LabSat logo facing forward. The lid will automatically lock by pressing down and sliding forward.

*Note: Due to the high sustained data rates required for wideband recording, not all SSD devices are compatible with LabSat 3 Wideband. Only drives supplied by Racelogic are supported.*

## SSD Format

To format an SSD with LabSat 3 Wideband, the user should select the following options:

**MENU > File > Format SDD > Yes**, as shown below.



*Note: Firmware version 1.0.414 and higher support formatting SSDs from other settings to Linux EXT4.*





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## File Transfer

### Network Security

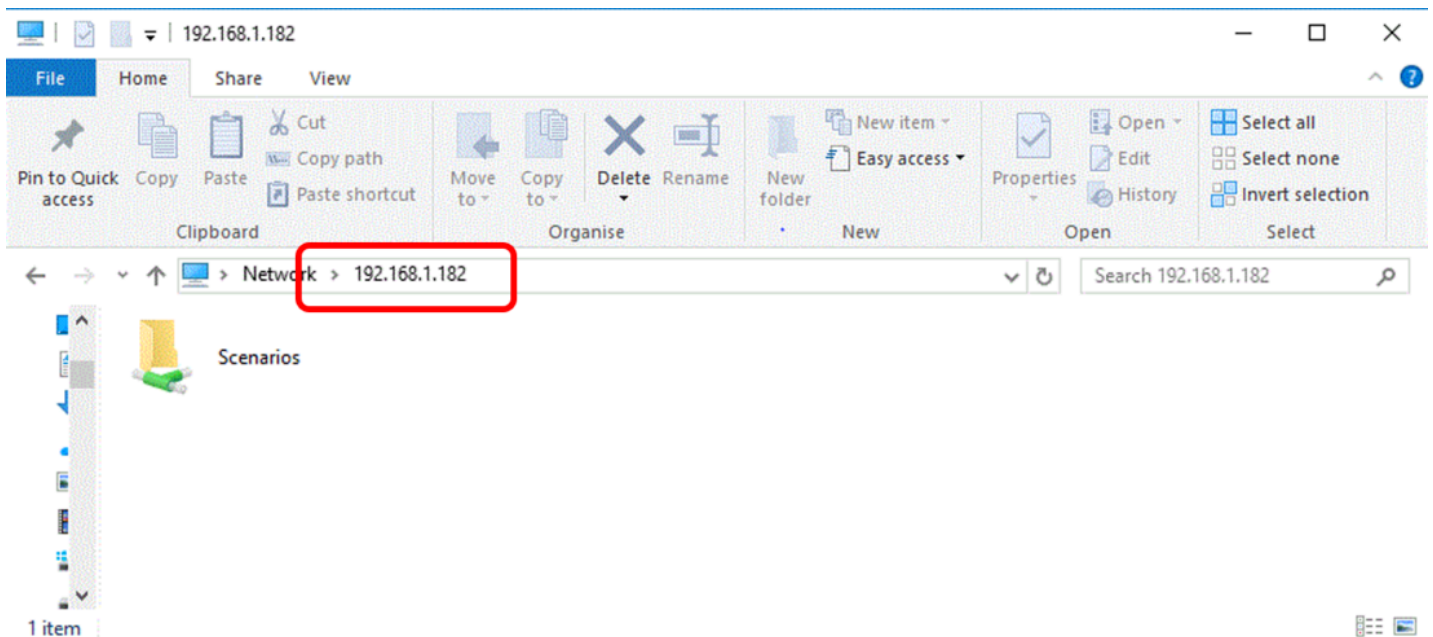
You can enable/disable Network Security in the LabSat 3 Wideband 'LAN' menu (**menu > setup > LAN**). When network security is enabled, you will be prompted to enter a username and password to gain access to the 'Scenarios' folder in Windows file explorer.

The username is generic for all LabSat units, however, the password is unit-specific. The password will always use the prefix 'labsat\_', and will be followed by the unit's serial number (without the leading zero) creating the following format: 'labsat\_xxxxx'.

*Note: If you are using a Windows-based PC, you will need to put a \ before the username (\labsat).*

### Ethernet Transfer

To connect LabSat 3 Wideband to a PC, connect an Ethernet cable between the system and the PC. Ensure that a static IP address or DHCP is set within the LAN menu, enter the 'About' menu to view the allocated IP address. Open a file explorer window on the PC and enter \\ followed by the IP address. See the example below.



### USB and SD Media Transfer

Files can also be copied from the LabSat 3 Wideband internal SSD via SD or USB media. The user can do this by following the steps below.

1. Connect/insert SD or USB media



[https://en.racelogic.support/Product\\_Info/LabSat\\_3\\_Wideband/LabSat\\_3\\_Wideband\\_User\\_Guide/03\\_-\\_LabSat3\\_Wideband\\_Media](https://en.racelogic.support/Product_Info/LabSat_3_Wideband/LabSat_3_Wideband_User_Guide/03_-_LabSat3_Wideband_Media)

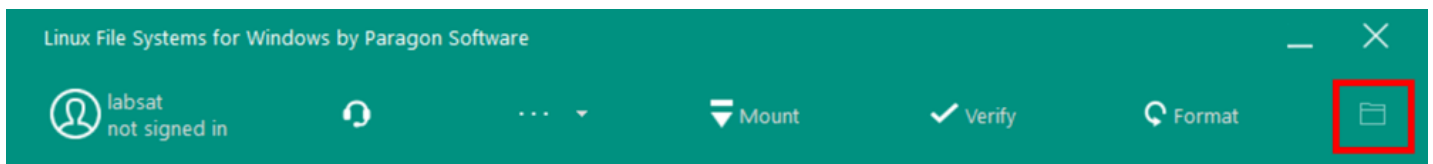
2. Highlight the file requiring transfer
3. Press 'OK' and then 'OK' again to enter the 'File' menu
4. Select 'Copy' and choose the media location

*Note: Any SD card used for a file transfer must be in exFAT format. USB media being connected can be in any Linux format that supports files larger than 4GB, alternatively, exFAT formatting can also be used.*

## Paragon Software Transfer

Linux File Systems for Windows by Paragon is a unique software tool which gives you full access to Linux volumes within Windows. By removing the LabSat 3 Wideband SSD and connecting it to the PC using the supplied USB to SATA cable, you can instantly work with the Linux partition.

Once the SSD is connected to the PC via the supplied USB to SATA cable it should automatically display within Paragon software (this may take up to 30 seconds). When the SSD has been mounted by the Paragon software it is possible to view and manage the files on the SSD with Windows File Explorer by selecting the folder icon in the top right of the paragon software window.



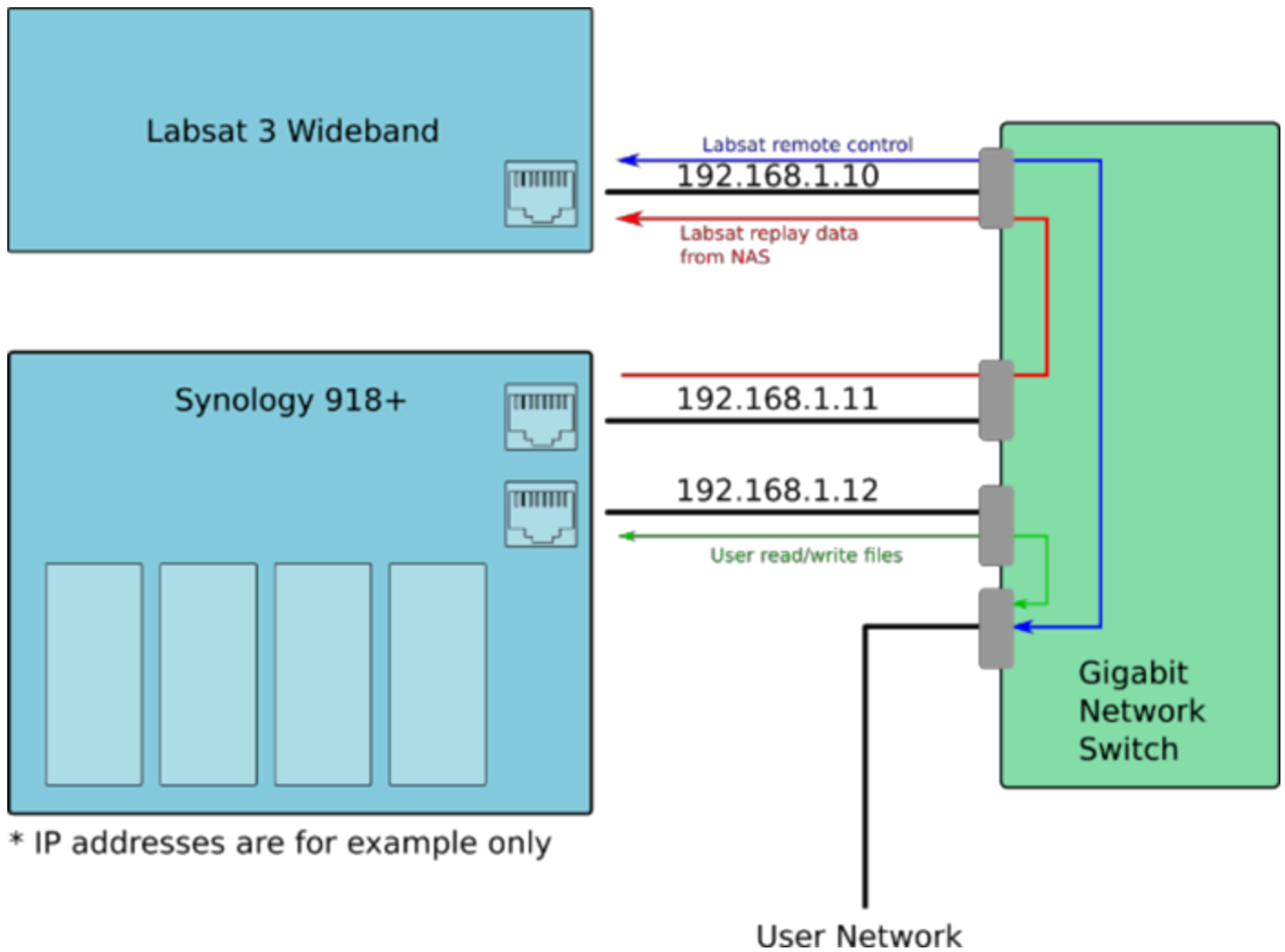
## 04 - LabSat3W Synology Configuration

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### Hardware Connection

LabSat 3 Wideband is connected to the Synology NAS through a Gigabit network switch. This ensures that maximum bandwidth is available between the LabSat and the Synology NAS while also allowing control of LabSat via LAN. The secondary LAN port on the Synology NAS provides a data path to the rest of the user network allowing files to be copied to and from the NAS.





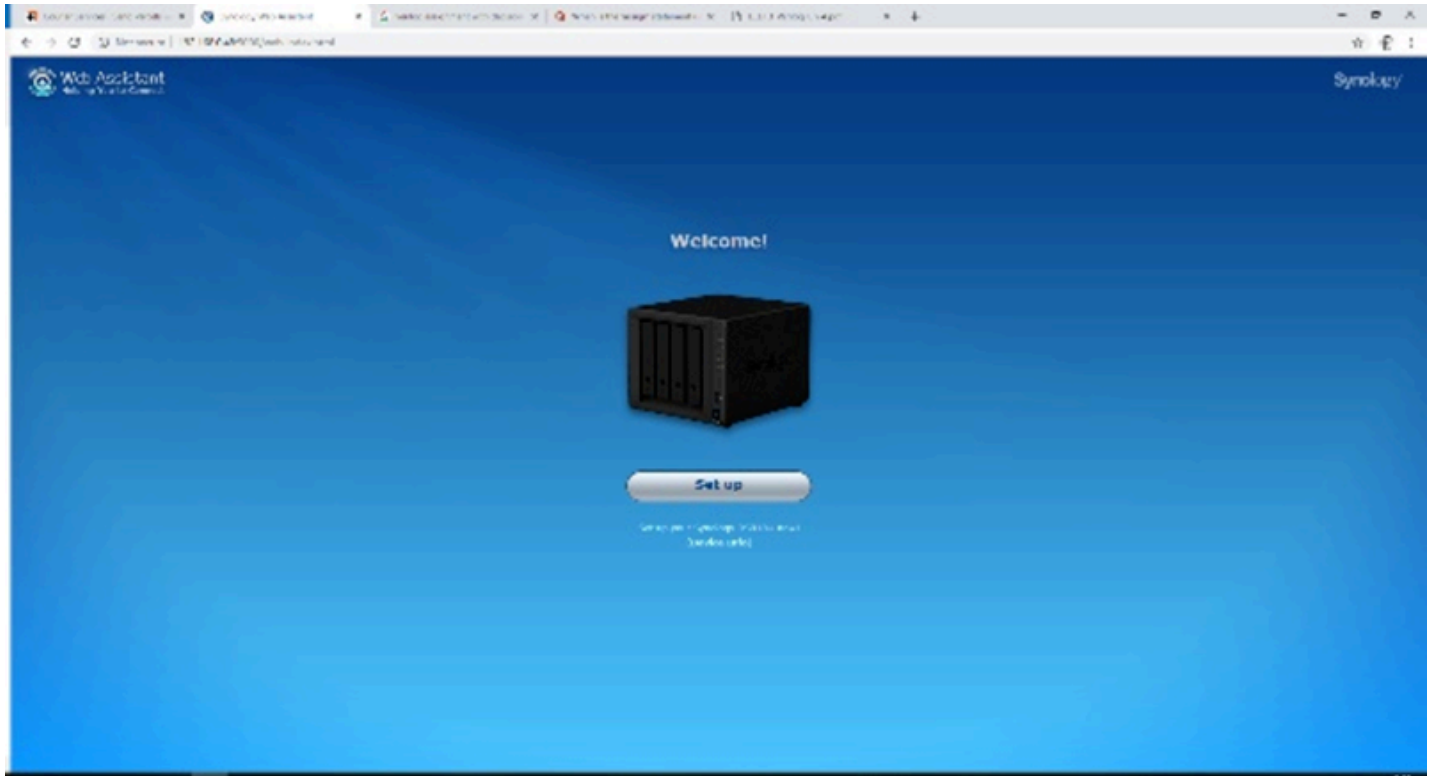
## Initial Setup

Synology 918+ 4-Bay NAS with DSM 6.2 - 4x new installed Western Digital 10 TB WD Red drives (WD100EFAX).

1. After installing new Hard drives, connect to the website <http://find.synology.com/> to locate the NAS on the network. This page will search for Synology drives on your network and display them. Select the correct device and press **'Connect'**.



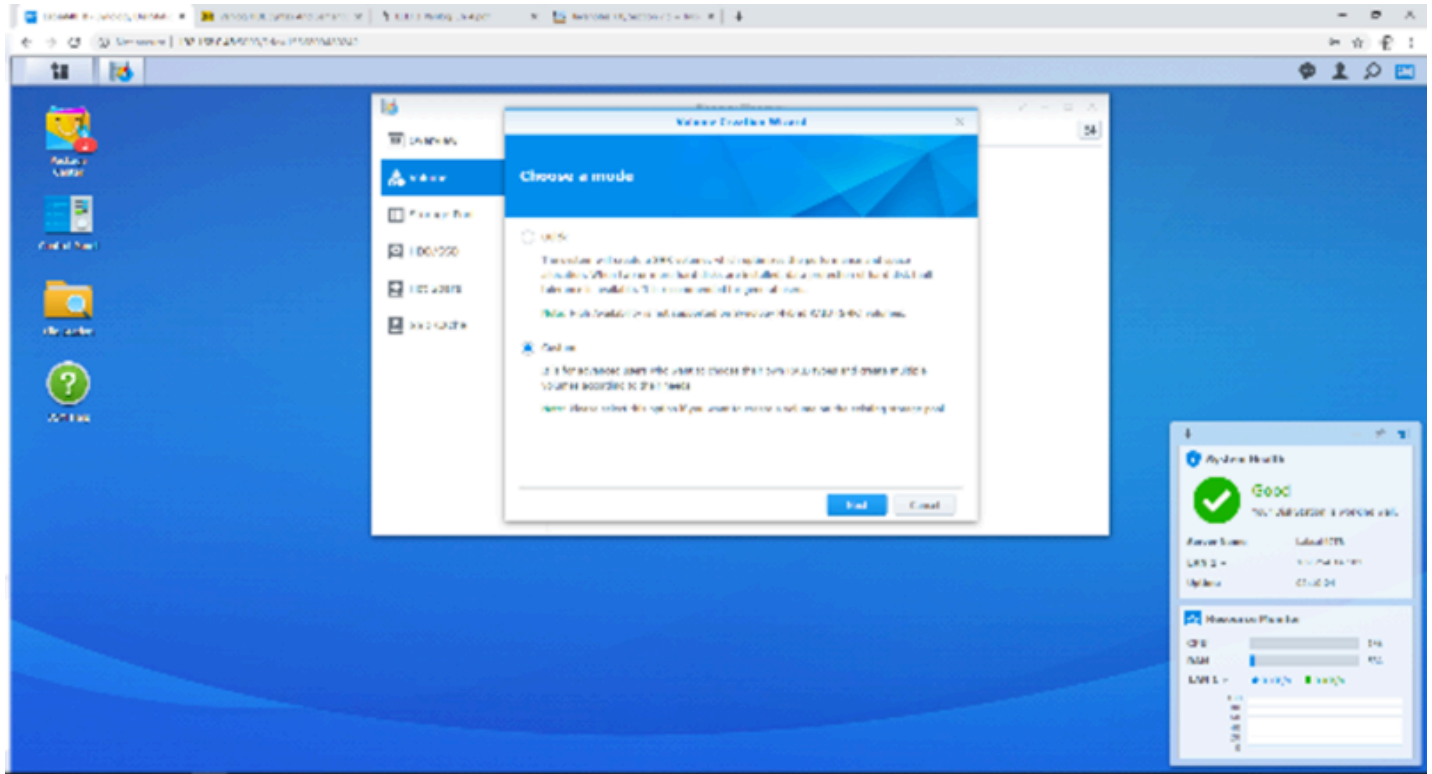
2. Once connected, a picture of the NAS should appear. Press **'Set up'**.



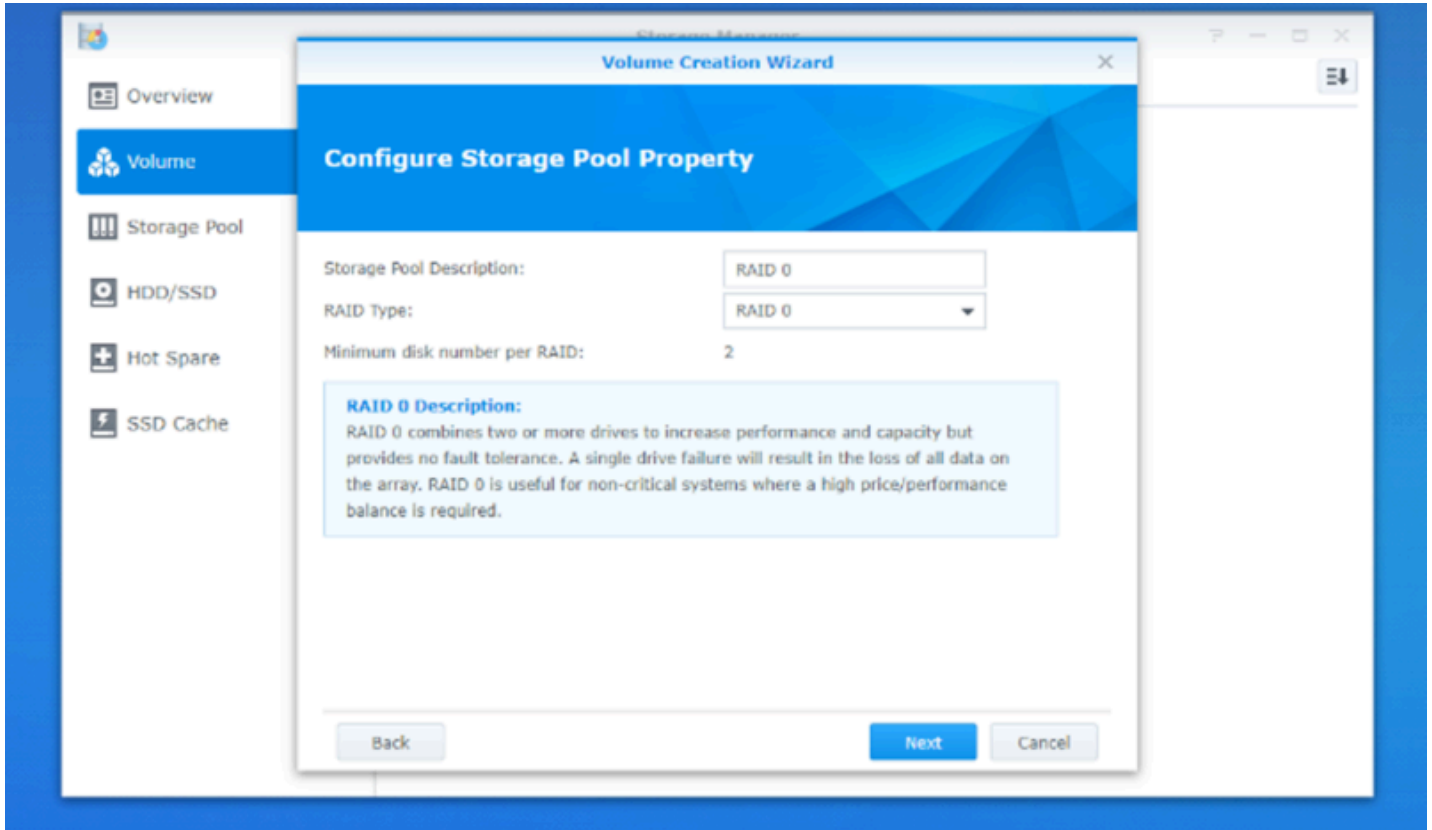
3. If prompted to install the latest DiskStation Manager software click **'Install Now'**. This will ensure that the NAS is up to date.
4. Next, set up a server name along with a username and password. In this example, we use 'Labsat40TB' for the server name, 'labsat' for the username and 'racelogic' for the password. Once done, click **'Next'**.
5. On the DSM update page, click **'Notify me of DSM updates and let me install them manually'**. Click **'Next'**.
6. For our example setup, On the **'Set up QuickConnect'** page, click **'Skip this step'**.
7. The Synology should now show its windows style web interface. At this point, the Synology has 4 disks install but doesn't know what format to use or which RAID mode to use. There are several different RAID modes that give different benefits such as maximum performance or maximum redundancy. In this example we will use RAID 0 which configures the disks for maximum performance.
8. Open the **'Storage Manager'** application and with **'Volume'** highlighted, click **'Create'**.
9. Select **'Custom'**, then click **'Next'**.



10. Select **Better performance** for the storage pool type, then click **Next**.



11. For 'Raid Type' select RAID 0. This does not have fault tolerance but does provide good performance. Click 'Next'.

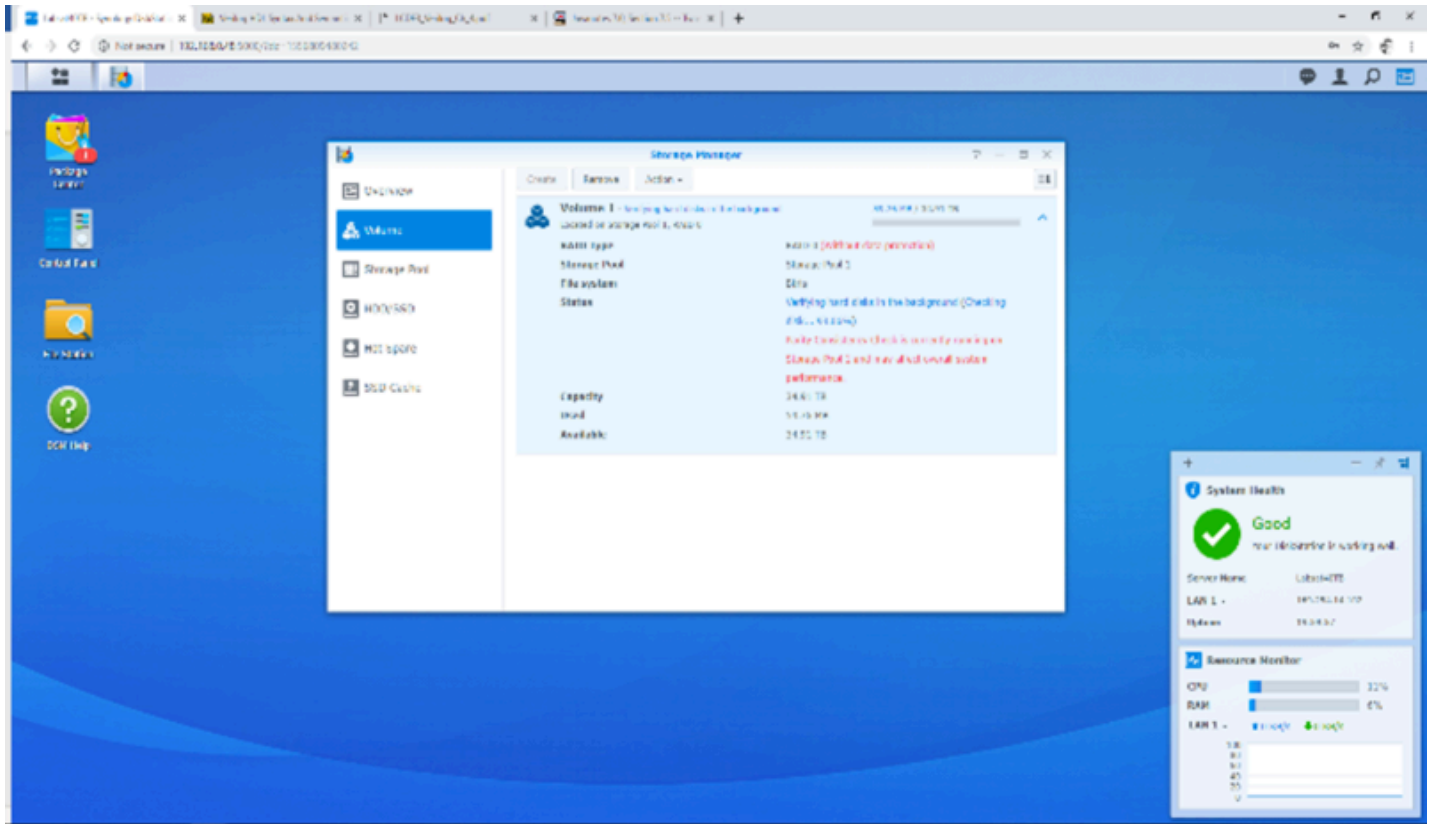


12. Make sure all disks are selected. Click 'Next' then 'OK' to confirm that all data on the disks will be erased.





13. The Synology will now format and check the disks. This process is very slow and depending on disk size, can take a day to complete.



14. Click on 'File Station' then 'create' and 'create new shared folder'.



15. Set up a network share name and description. Click **'Next'**.

Shared Folder Creation Wizard

### Set up basic information

Name: LabsatNAS

Description: Labsat NAS storage

Location: Volume 1 (Available: 34.91 TB) - btrfs

Hide this shared folder in "My Network Places"

Hide sub-folders and files from users without permissions

Enable Recycle Bin

Restrict access to administrators only

Note: [How to set up a Recycle Bin emptying schedule](#)

Next Cancel

External Access

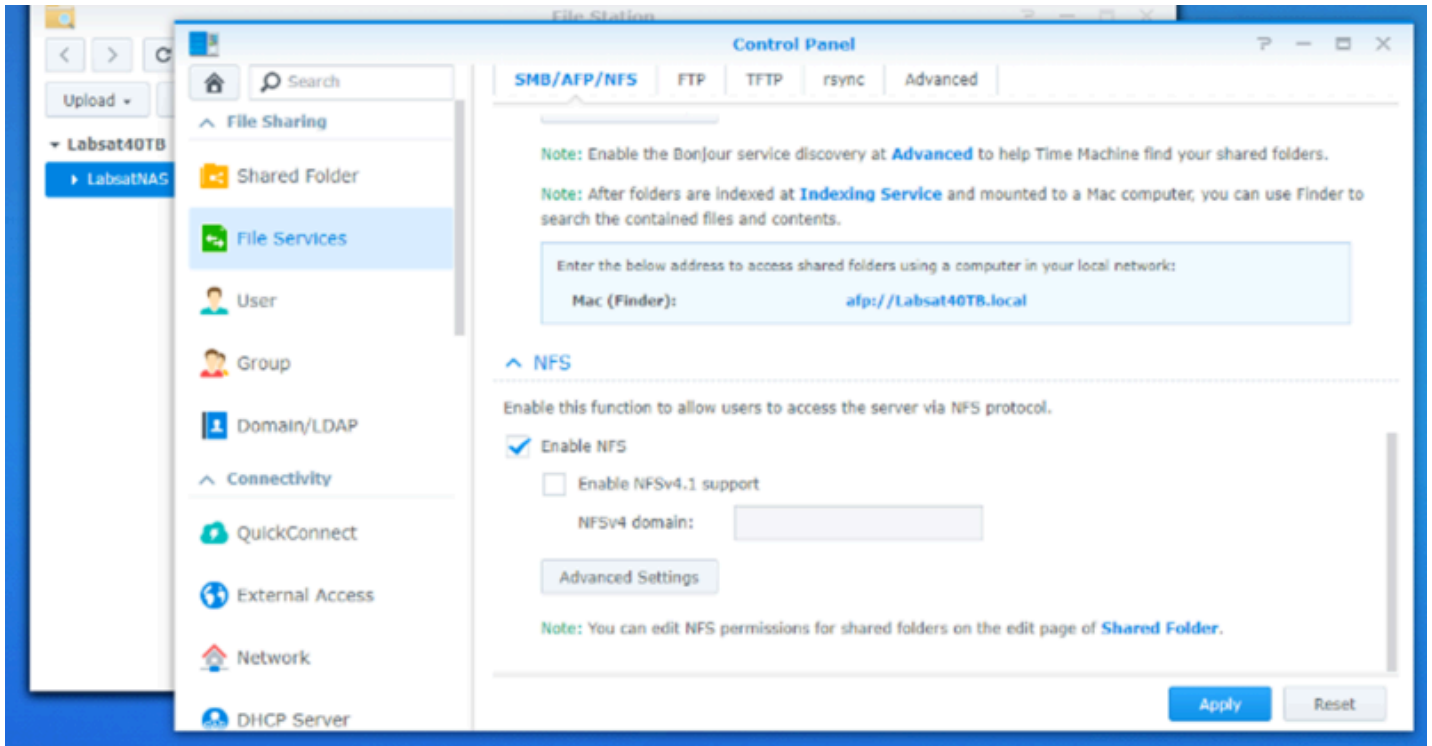
16. In this example we will not use encryption. Click **'Next'**.

17. Click **'Next'** on advanced setting page for default selection.

18. Click **'Apply'** to confirm creation.



19. Click **OK** on shared folder page to accept default permissions.
20. With the share setup, it is necessary to enable NFS. To do this, select, **Control Panel** then **File Services**. Scroll to the bottom of the page and tick the **Enable NFS** box then **Apply**.



21. Go to **Control Panel** then **File Services** and select **Advanced settings**. Select SMB3 for maximum SMB protocol & SMB1 for minimum SMB protocol, then apply.



**Control Panel**

SMB/AFP/NFS | FTP | TFTP | rsync | Advanced

^ SMB

Enable SMB service

Workgroup:

Disallow access to Previous Versions

Enable Transfer Log

**Advanced Settings**

**Note:** You can enable Recycle Bin on the edit page of **Shared Folder**.

**Note:** After folders are indexed at **Indexing Service** and mounted to a Mac computer, you can use Finder to search the contained files and contents.

Enter the below address to access shared folders using a computer in your local network:

PC (Windows Explorer):	<code>\\Labsat40TB</code>
Mac (Finder):	<code>smb://Labsat40TB</code>

^ AFP

Enable AFP service

Enable transfer log



**Advanced Settings**

WINS server:

Maximum SMB protocol:

Minimum SMB protocol:

SMB range: SMB1,SMB2,SMB2 and Large MTU,SMB3

Transport encryption mode:

Enable Opportunistic Locking

Enable SMB2 lease

Enable Local Master Browser

Enable DirSort VFS module

This option sorts directory items alphabetically before sending them to clients.

Veto files

Veto criteria:

Allow symbolic links within shared folders

Allow symbolic links across shared folders

*Note: The latest Synology DSM sets the minimum SMB protocol to 2.0 and max to 3.0. This stops LabSat 3 Wideband from mounting as it uses SMB 1.0. Therefore it is necessary to configure Synology for minimum SMB version of 1.0 (SMB1).*



## 05 - LabSat3W Synology Functionality

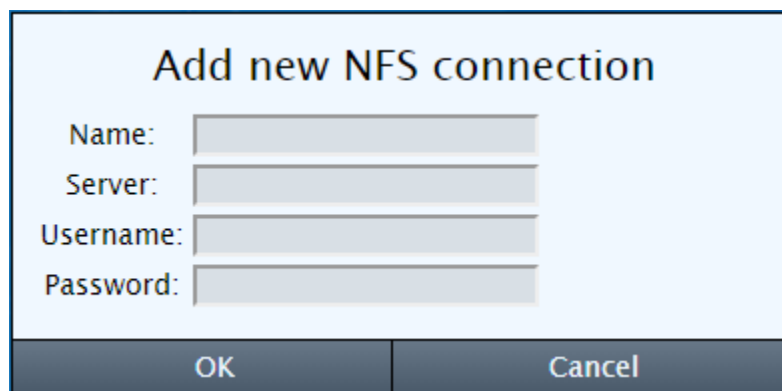
To facilitate the ability to replay a GNSS scenario and to load the file store at the same time. We have developed this capability on a Synology NAS with 40 TB data store. Designed for the Synology 918+ 4bay NAS using 4 Western Digital 10 TB WD Red drives (WD100EFAX).

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### Connecting to Synology

Once the Synology NAS has been [Configured](#), it is possible to connect to the shared folder with a LabSat 3 Wideband. To add an NFS (Network Filing System) mount, use the following procedure on the LabSat 3 Wideband web server interface.

1. Select '**SYSTEM SETUP**' within the navigation menu. Then click on the '**Add new**' button within the '**NFS Mounts**' section.
2. A pop-up box will appear to input the connection details.



**Add new NFS connection**

Name:

Server:

Username:

Password:

OK Cancel

- **Name:** Give a meaningful name for the connection. For example, **MyNAS**.

*Note: Spaces cannot be used!*

- **Server:** Enter the IP address of the Synology and the network share name.

On step 15 of the '[Synology Configuration](#)' page, 'set up basic information' we chose a share name of



'LabsatNAS'. For example, in the server section we would enter '192.168.0.48/LabsatNAS'.

*Note: The IP address will change depending on network settings.*

- **Username:** Enter the username that was setup on step 4 of the '[Synology Configuration](#)' page 'labsat'.
- **Password:** Enter the password that was setup on step 4 of the '[Synology Configuration](#)' page 'racellogic'.
- Click '**OK**' to save the settings.

With the new mount configured, it should be possible to tick the '**Connected**' box in the **NFS mounts** section to allow the LabSat 3 Wideband to connect to the network share.

The screenshot shows the DSM interface for LabSat 3 Wideband. At the top left, it says "and SN: 565656". The main area is titled "LABSAT 3 WID". There are three main sections:











- NFS MOUNTS:** A table with columns: Name, Server, Username, Connected, Edit, Delete. One entry is visible: "MyNAS 192.168.0.48/LabsatNAS labsat" with the "Connected" checkbox checked. There are "Edit" and "Delete" buttons for this entry, and an "Add new" button below the table.
- WIRED NETWORK OPTIONS:** A section with a checked "Enable DHCP" checkbox. Below it are input fields for "IP address" (192.168.0.74), "Subnet mask" (255.255.254.0), and "Default gateway" (192.168.1.254). A "Refresh" button is at the bottom.
- SYSTEM OPTIONS:** A section with two unchecked checkboxes: "Enable sounds on key press" and "Enable power save".















## Replaying from Synology



The Synology NAS provides 40 TB of storage for LabSat 3 Wideband scenarios. The storage can be accessed via the LabSat 3 Wideband allowing for direct scenario replay from the Synology NAS.



Bandwidth (MHz)	Quantisation	Channels	
10	1	1	
		2	
		3	
	2	1	
		2	
		3	
	3	1	
		2	
		3	
30	1	1	



Bandwidth (MHz)	Quantisation	Channels	
		2	
		3	
		1	
	2	2	
		3	
		1	
	3	2	
	56	1	1
2			
3			
2		1	
		2	



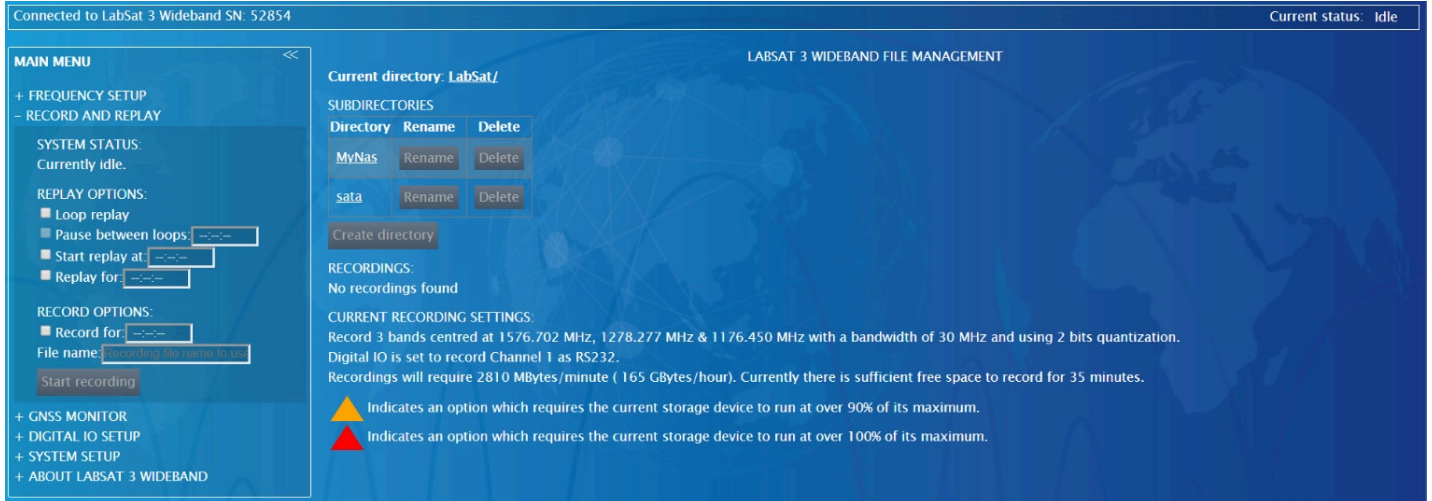
Bandwidth (MHz)	Quantisation	Channels	
	3	1	
		2	

	Indicates an option which requires the current storage device to run comfortably within its operating limits.
	Indicates an option which requires the current storage device to run at over 90% of its maximum.

**This is based on GNSS only scenarios – capability may change if external data is included!**

Once connected to the Synology NAS the scenario storage can be accessed directly from the LabSat 3 Wideband via the Web Server. Select 'Record and Replay' from the navigation menu, this will then display the currently mounted medias content.

To view which media is mounted, click the 'LabSat' heading within 'Current Directory' file path at the top of the 'Record and Replay' page. This will display the currently available media locations.



Connected to LabSat 3 Wideband SN: 52854 Current status: Idle

**LABSAT 3 WIDEBAND FILE MANAGEMENT**

Current directory: LabSat/



SUBDIRECTORIES

Directory	Rename	Delete
MyNas	Rename	Delete
Sata	Rename	Delete

Create directory

RECORDINGS:  
No recordings found

CURRENT RECORDING SETTINGS:  
Record 3 bands centred at 1576.702 MHz, 1278.277 MHz & 1176.450 MHz with a bandwidth of 30 MHz and using 2 bits quantization.  
Digital IO is set to record Channel 1 as RS232.  
Recordings will require 2810 MBytes/minute ( 165 GBytes/hour). Currently there is sufficient free space to record for 35 minutes.










 Indicates an option which requires the current storage device to run at over 90% of its maximum.  
 Indicates an option which requires the current storage device to run at over 100% of its maximum.



To view and replay scenarios stored on the Synology NAS, select the NAS in the directory table (e.g 'MyNAS') and the page will repopulate with the file structure.

## Recording to Synology



Recording directly to the Synology NAS has limited capability, we recommend using the internal Samsung SSD for direct recording.




Bandwidth (MHz)	Quantisation	Channels	
10	1	1	
		2	
		3	
	2	1	
		2	
		3	
	3	1	
		2	
		3	



Bandwidth (MHz)	Quantisation	Channels	
30	1	1	
		2	
		3	
	2	1	
		2	
		3	
	3	1	
		2	
	56	1	1
2			
3			
2		1	



Bandwidth (MHz)	Quantisation	Channels	
		2	
	3	1	

	Indicates an option which requires the current storage device to run comfortably within its operating limits.
	Indicates an option which requires the current storage device to run at over 90% of its maximum.
	Indicates an option which requires the current storage device to run at over 100% of its maximum.

**This is based on GNSS only scenarios – capability may change if external data is included!**

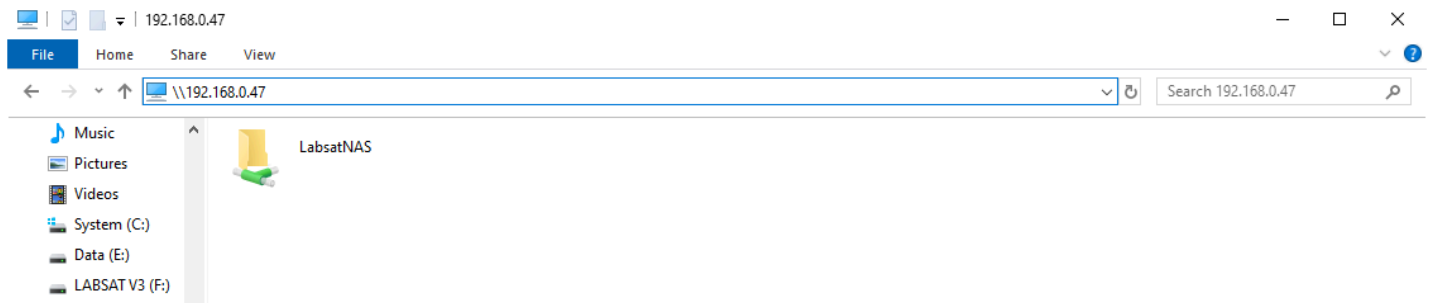


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## Data Transfer with Synology

For fast transfer to and from the Synology NAS we recommend attaching a USB 3.0 SSD caddy. The SSD can be removed from the LabSat 3 Wideband, inserted into the SSD caddy and attached to the NAS for fast file transfer.

The Synology NAS storage can be accessed via two different methods when transferring data, either via the Synology web interface or via the Windows File Explorer. To access the Synology web interface, enter the Synology NAS IP address into an internet browser. To view the Synology NAS storage in Windows File Explorer, enter \\ followed by the Synology NAS IP address.





## 06 - LabSat3W Menu layout

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### Main 'File Display' screen button functions



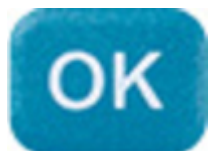
Move up/Down through list of files or menu options.



Begin replay of the currently highlighted file.



Start recording to a new file using the current settings.  
File number will be incremented.



Press OK to select option.





Press for 3 seconds to power down LabSat.



---

## Top Level Menu Functions

### File

- **Info** – Display file info for selected file.
- **Protect** – Write protect current file to avoid accidental deletion.
- **Copy** – Copy selected file to SD/USB media.
- **Delete** – Delete selected file, Yes/No.
- **Format** – Erase and Format internal SSD, Yes/No.

### Constellation

Allows configuration of recorded frequency bands. Within the constellation options are signal bit-depth (quantisation) and bandwidth settings. Depending on the combination of bit depth and bandwidth, the number of configurable RF channels will be automatically adjusted to maintain the maximum available disk (SSD) bandwidth.

- **Quan/Bandwidth** – Adjust both quantisation (bit depth) and recorded signal bandwidth. Changing bandwidth will clear the RF channel settings requiring new RF channel selection by the user.
- **RF Channel 1/2/3** – Configure the centre frequency for each available RF channel. Only frequencies containing valid GNSS signals for the selected bandwidth will be shown. In addition to this, once a frequency has been selected on one channel, the same frequency cannot be used on another channel.
- **Load Custom Profile** – Allows the user to select a profile that has been previous saved via the Web Server.

### Play Options

Allows control over how LabSat will replay a file.

- **Loop** – Selected file will replay continuously.
  - **Pause** – Define a pause duration between loops.
- **From** – Specify a time in the scenario to replay from.
- **For** – Specify how long the scenario will replay for.

### Record Options

Allows control over how LabSat will record a file.

- **For** – Specify how long the LabSat will record for.



## Setup

Most user configurable device settings are accessed from the SETUP menu.

- **CLK REF**
  - **OCXO** – Configure clock to OCXO (Oven Controlled Oscillator).
  - **TCXO** – Configure clock to TCXO (Temperature Controlled Oscillator).
  - **External 10 MHz** – Configure clock to 10 MHz external signal.
  - **REF OUT** – Output a 10 MHz reference signal for use by other systems (available when OCXO or TCXO is selected).
- **Digital**
  - **CH1 to CH4**
    - **CAN1** – Record CAN Bus channel 1.
    - **CAN2** – Record CAN Bus channel 2.
    - **1PPS** – Record 1PPS signal from internal GNSS monitor (disable power save).
    - **RS232** – Record RS232 signal.
    - **DIGI 1** – Record state of DIGI 1 input.
    - **DIGI 2** – Record state of DIGI 2 input.
  - **Ext Sync** – When enabled allows the user to synchronize record or replay using a switch on the DIGI2 expansion pin.
- **CAN**
  - **Log File** – When selected the CAN data will be logged into a separate .txt file.
  - **Replay Log File** – When selected if a .txt file is available for the scenario it will be replayed.
  - **CAN1** – Set the desired baud rate.
  - **CAN2** – Set the desired baud rate.
  - **Silent Record** – Determines whether or not the LabSat sends an acknowledge pulse during recording (both channels).
- **RS232**
  - **Log File** – When selected the serial data will be logged into a separate .ser file.
  - **Replay Log File** – When selected if a .ser file is available for the scenario it will be replayed.
  - **Port Settings**
    - **Baud** – Set the desired baud rate.
    - **Databits** – Set the desired databit.
    - **Stopbits** – Set the desired stopbit.
    - **Parity** – Set the desired parity.
- **LAN**
  - **Static IP** – Enable/Disable Static IP.
  - **IP** – Set the IP address assigned to LabSat 3 Wideband (available when Static IP is selected).
  - **Mask** – Set the Subnet mask assigned to LabSat 3 (available when Static IP is selected).



- **GW** – Set the default gateway for the network (available when Static IP is selected).
- **Display** – Adjust display contrast and backlight brightness.
- **Power Save** – When selected, will power down display backlight and internal monitor during recording.
- **Disable Beep** – When selected the keypad sound will be disabled.
- **Time** – Configure internal clock using UTC time from internal GNSS monitor or set manually.
- **Export Config** – A settings.txt file containing the LabSat's current settings will be placed in the root of the SSD.

**About** – Contains information specific to the LabSat, e.g. serial number and firmware version.

**Exit** – Return to file list.



## 07 - LabSat3W Record and Replay Operations in Detail

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### Replay operation

LabSat 3 Wideband uses SSD memory for storage and playback of GNSS data.

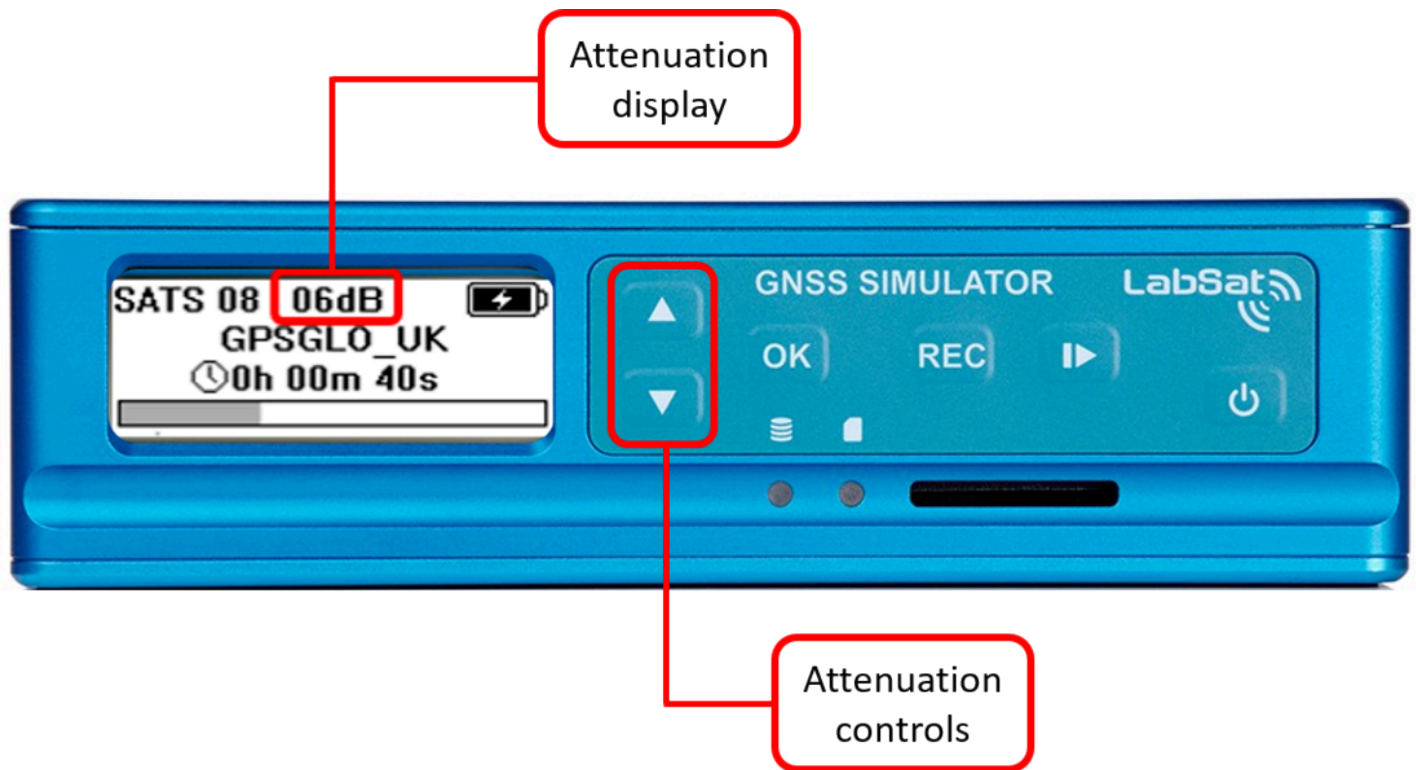
The 1 TB Solid State Drive (SSD) supplied contains a selection of pre-recorded scenarios. These scenarios can easily be deleted if extra space is required.

The RF OUT connector is a 50  $\Omega$  output which can be connected directly to the antenna input of the GNSS receiver being tested. The RF OUT connector is internally DC blocked with a 470  $\Omega$  DC load to protect the RF output stage but does provide a small resistive load to mimic an antenna load. When a file is selected for replay, the LabSat will configure constellation frequencies and digital channels automatically before starting replay.

During replay, pressing '**OK**' will show a live histogram of satellite levels detected by the internal GNSS receiver. The internal receiver currently supports GPS, GLONASS, BeiDou & Galileo constellations. When the satellite levels are displayed, the '**UP/DOWN**' keys switch between the constellation groups. Please note that when switching between modes, the internal receiver will take some time to re-acquire satellite signal levels. In the case of GLONASS signals for example, it may take over a minute to show the satellite signal information.

LabSat 3 Wideband features 90 dB of attenuation control over the nominal signal output. This is adjustable in 1 dB steps. During replay, Pressing the '**DOWN**' arrow will increase attenuation resulting in a lowering of the RF power output. This reduction of output power is indicated by the negative dB value. Pressing the '**UP**' arrow will decrease attenuation resulting in a high RF output level.





---

## Record operation

LabSat 3 Wideband uses an internal SSD (**S**olid **S**tate **D**rive) memory for storage and playback of GNSS data. This is formatted in an EXT4 linux format.

LabSat 3 Wideband is supplied with a magnetic mounting GNSS antenna. The antenna is an active device with approximately 28 dB of gain. The LabSat provides a 3.3 V DC bias for antenna power on the centre pin of the RF IN connector. It is also possible to use third party antennas providing they are compatible with the 3.3 V bias.

If connecting LabSat to an antenna which requires a higher bias voltage (e.g. 12 V), the antenna bias must be supplied by the user and an appropriate DC block (such as DCB from <https://www.gpsnetworking.com/product-categories/attenuators-dc-blocks>) must be inserted at the LabSat 3 Wideband RF IN connector to avoid damage to the LabSat. A Bias-T could also be used which would allow you to both inject the 12 V for the antenna and block it from the LabSat in one part.



There are a number of GNSS systems currently in operation or in a test phase. LabSat 3 Wideband provides preselected frequencies to cover various GNSS signal recording requirements. The frequencies listed and the number of available channels depend on the required signal resolution and bandwidth. For example, it is possible to record 3 separate RF channels of 56 MHz each using 1 bit quantisation but if 3 bit quantisation is required at 56 MHz bandwidth, only one RF channel will be available. Steps to configure Labsat 3 Wideband are as follows.

- Quantization selection of 1, 2 or 3 bit. 1 bit means 1 bit I & 1bit Q, which can be described as 2 bit.
- Bandwidth selection of 10, 30 or 56 MHz.
- Channel frequency allocation. Frequencies available depend on bandwidth selected.

The table below describes the selection of quantization, bandwidth and channel frequency allocation:

<b>Set</b>	<b>Frequency (MHz)</b>	<b>10 MHz Bandwidth 10.23 MSPS</b>	<b>30 MHz Bandwidth 30.69 MSPS</b>	<b>56 MHz Bandwidth 58 MSPS</b>
<b>1</b>	1602	GLONASS L1 CA	GLONASS L1 CA, P	-
<b>2</b>	1580	-	-	GPS L1 CA P(Y), L1c, M  Galileo E1 B,C CBOC  QZSS L1 CA, L1c TMBOC  WAAS, EGNOS, MSAS, GAGAN, SAIF  GLONASS L1 CA, P  B1
<b>3</b>	1575.42	GPS L1 CA, L1c BOC(1,1)	GPS L1 CA P(Y), L1c, M	GPS L1 CA P(Y), L1c, M





<b>Set</b>	<b>Frequency (MHz)</b>	<b>10 MHz Bandwidth 10.23 MSPS</b>	<b>30 MHz Bandwidth 30.69 MSPS</b>	<b>56 MHz Bandwidth 58 MSPS</b>
		Galileo E1 B,C BOC (1,1) QZSS L1 CA, L1c BOC(1,1) WAAS, EGNOS, MSAS, GAGAN, SAIF	Galileo E1 B,C CBOC QZSS L1 CA, L1c TBOC WAAS, EGNOS, MSAS, GAGAN, SAIF	Galileo E1 B,C CBOC QZSS L1 CA, L1c TBOC WAAS, EGNOS, MSAS, GAGAN, SAIF
<b>4</b>	1567.236	-	GPS L1 CA, L1c BOC(1,1) Galileo E1 B,C BOC (1,1) Beidou B1 QZSS L1 CA, L1c BOC(1,1) WAAS, EGNOS, MSAS, GAGAN, SAIF	-
<b>5</b>	1561.098	Beidou B1	Beidou B1	-
<b>6</b>	1542	OmniSTAR, TerraStar, StarFire	OmniSTAR, TerraStar, StarFire	-
<b>7</b>	1278.75	-	-	Galileo E6 A,B Beidou B3
<b>8</b>	1268.52	-	Beidou B3	-
<b>9</b>	1246	-	GLONASS L2 CA, P	-



<b>Set</b>	<b>Frequency (MHz)</b>	<b>10 MHz Bandwidth 10.23 MSPS</b>	<b>30 MHz Bandwidth 30.69 MSPS</b>	<b>56 MHz Bandwidth 58 MSPS</b>
<b>10</b>	1233.738	-	-	GPS L2 L2c, P(Y), M  QZSS L2c  GLONASS L2 CA, P
<b>11</b>	1227.6	GPS L2 L2c	GPS L2 L2c, P(Y), M  QZSS L2c	GPS L2 L2c, P(Y), M  QZSS L2c
<b>12</b>	1207.14	-	Beidou B2  Galileo E5b  GLONASS L3	-
<b>13</b>	1176.45	-	GPS L5  Galileo E5a  QZSS L5  IRNSS L5  SBAS L5	-
<b>14</b>	1191.795	-	-	Galileo E5A/B  GPS L5  Beidou B2  IRNSS



*Note: The user has the ability to create frequency sets of their own and load via the SD card. Sets appear in Constellation menu.*

Recording of the desired signals are configured in the '**CONSTELLATION**' menu. In this menu, the sequence described above allows the user to configure a wide range of signal in the upper and lower L-band.

Once the constellations are configured, exit the menu and press the '**REC**' button to begin recording. A new file will be created each time recording starts. The file name used corresponds to the constellations selected. For example, the file created will be File\_nnn where nnn is a number that increments with each new recording. Details of the LS3W file format are available on request from Racelogic.

During recording, pressing the '**OK**' button will switch the display to show satellite levels for either GPS, GLONASS, BeiDou & Galileo satellites (dependent on the system configuration). In this display mode, the '**UP/DOWN**' arrow keys will toggle between constellations.

To maximise battery life during recording, LabSat 3 Wideband has a power save mode which is enabled by default in the setup menu. Power save mode recognizes when running from battery power and will dim the display backlight and power-down the internal monitor after 30 seconds of user inactivity.

If recording from passive antennas, enabling the power-save mode will also provide the highest possible sensitivity by ensuring that unused modules within LabSat 3 Wideband are switched off.



## 08 - LabSat3W GNSS Monitor

LabSat 3 Wideband features a multi constellation GNSS receiver which can be used to monitor L1 band GNSS signals in either the incoming RF signal during recording or the outgoing RF signal during replay. The USB device connector on the rear of LabSat 3 Wideband functions as a virtual serial connection and will output NMEA data from the GNSS monitor at 115,200 baud when record or replay is active.

In addition to this, pressing the '**OK**' button during record or replay will switch the display to show satellite tracking levels for GPS L1, GLONASS L1, Beidou B1 and Galileo E1 satellites. Pressing the up or down arrows in this display will swap between constellations. It is important to note that when switching between constellations on the LCD display, the configuration of the GNSS monitor, and therefore the NMEA data content, will change.

The primary aim of the GNSS monitor during recording is to give indication that an L1 band GNSS antenna is connected and working. It is important to understand that the monitor is listening directly to the RF input and so the presence of valid satellites indicated by the monitor does not have any link with the user configured constellation frequencies being recorded. Therefore it is up to the user to check that these are correctly configured. If the antenna used does not support L1 GNSS signals, then the GNSS monitor will not show any satellite tracking information.

During replay, the GNSS monitor will listen into the RF output signal. If the replayed signal contains valid L1 GNSS signals then these will be reported by the monitor.



## 09 - LabSat3W SSD File Layout

LabSat 3 Wideband records data files on the internal SSD. With LabSat 3 Wideband connected to a LAN via the Ethernet link, it is possible to use a computer on the same network to manage the files stored on the SSD. Files can be renamed and folders created as necessary. If renaming files, make sure that the '.LS3W' and '.ini' files are given the same name but do not change the '.LS3W' or '.ini' filename extensions. Previously recorded files can be rearranged into a folder structure.

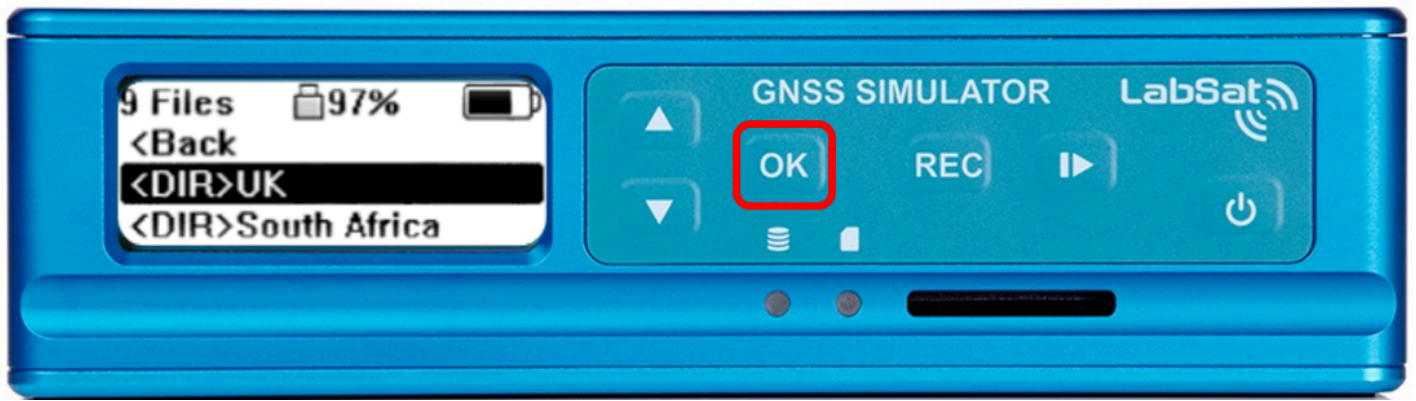
The example below shows the folder layout on a LabSat 3 Wideband SSD. The LabSat internal SSD can use multiple folders. When folders are detected, LabSat 3 Wideband will display them in a similar fashion to a PC using the DIR indicator.

When recording to the SSD, LabSat will save scenario files to the first folder in the directory (root directory) unless an alternative location is defined.



<DIR> indicates a folder and not a scenario. Pressing 'OK' will navigate to the next stage of the scenario directory.





Continue to navigate using 'OK' until <DIR> is no longer shown, this indicates the file is a scenario not a directory.



Pressing play will start the individual scenario replay.

---

## Export Config

When 'Export Config' is selected (Menu > Setup > Export Config) a file called settings.txt will be placed in the root directory of the LabSat 3 Wideband internal SSD. The settings.txt file contains details of the LabSat's current configuration, an example of this file can be seen below.



[INFO]

TYPE=LS3W 52854  
DATE 09/05/2018  
TIME 14:34  
REC\_PROFILE=L1\_56M\_3Bit

[CONS]

CH1=1575.420 MHz  
CH2=1227.600 MHz  
CH3=1176.450 MHz  
BW=30 MHz  
Quan=2 bit

[DIGITAL]

DIG\_CHN1=NONE  
DIG\_CHN2=NONE  
DIG\_CHN3=NONE  
DIG\_CHN4=NONE

[PLAY]

LOOP=N  
PAUSE=00:00:00  
FROM=00:00:00  
FOR=00:00:00

[RECORD]

FOR=00:00:00

[MISC]

POW\_SAVE=N  
EXT\_SYNC=N  
DONT\_BEEP=Y  
GPS\_TIME=Y  
MANUAL\_TIME=N  
CLKREF=OCXO  
REF\_OUT=N  
STATIC\_IP=N  
BRIGHTNESS=100  
CONTRAST=100

[CAN]

LOG\_CAN=N  
LOG\_CAN\_REPLAY=N

[SERIAL]

LOG\_SERIAL=N  
LOG\_SERIAL\_REPLAY=N



## 10 - LabSat3W Battery

---

### Battery operation and charging

LabSat 3 Wideband is shipped with a rechargeable, lithium-ion Smart battery pack (Inspired Energy NB2037HD34). It is UN38.3 (transportation) certified and CE, FCC and REACH/RoHS compliant. Each pack gives up to 2 hours of record time. When LabSat 3 Wideband is powered externally, it will charge the internal battery pack if fitted, and seamlessly switch over to battery operation when external power is removed.

To install the LabSat 3 Wideband battery, depress the lid release lever on the unit rear panel, slide off the unit lid and insert the battery into the battery slot so that its connector mates with the battery connector inside the unit. To remove the battery, lift it out using the plastic tab attached to the battery pack.

If LabSat 3 Wideband is switched off while charging from an external supply, it will continue to charge until the battery reaches full capacity. Charging is indicated by the illumination of the blue LED next to the DC CHG input on the rear panel. When charging has finished, the blue LED will go out. Never leave a system unattended during charging or discharging of the battery pack.

When operating from battery power, the battery charge status will be shown in the top-right section of the display -



If external power is connected and the battery is being charged, a power symbol will be shown over the battery symbol -





The discharge temperature range for the battery is -20°C to +60°C. Therefore, if the LabSat is operating from battery power, it will power-down if the temperature falls outside this range.

The charge temperature range of the battery pack is 0 - 45°C. Outside this temperature range, the LabSat will switch off charging of the internal battery but will continue to operate from the external power supply.

### **Warning - Li-Polymer Battery Pack - Risk of fire or explosion.**

**Do not incinerate, disassemble, short terminals, expose to temperature above 140°F/60°C.**

**Do not charge battery unattended, expose of batteries in fire or disassemble the batteries.**

---

## Battery fitting, removal and handling

- Replace battery with Racelogic, Part No. RLACS229 **only**. Use of another battery may present a **risk of fire, explosion or other malfunction**.
- **Caution:** The battery used in this device may present a **fire or chemical burn hazard** if mistreated. **Do not disassemble or heat above 80°C (176°F) or incinerate.**
- To remove or change the battery, disconnect from mains power. Remove the unit lid, lift out the old battery and replace ensuring that the connectors on the replacement battery align with the connectors inside the unit. Please dispose of old or used batteries promptly in accordance with local regulations. Keep away from children.
- The battery should be fully charged when stored. If a battery is left depleted for a prolonged period then it is likely that the performance of the battery will degrade and may be unusable.
- **Do NOT** immerse the battery pack in water.
- **Never** incinerate nor dispose of cells in a fire.
- **Never** short circuit the battery pack. It will generate very high currents resulting in overheating of the cells, which may cause electrolyte leakage, gassing or fire.
- **Never** disassemble the cells. Disassembling cells may cause an internal short circuit in the cell, which could further result in **gassing, fire, or other problems**.
- If for any reason the battery pack becomes damaged it is possible that it may leak electrolyte. The electrolyte is harmful to the human body. If the electrolyte comes into contact with the skin, eyes or others parts of body, the electrolyte shall **be flushed immediately with fresh water. Seek immediate medical advice from a physician.**
- Cells may be damaged during shipping by shocks, or other causes. If any abnormal features of the cells are found such as: damage to a plastic envelope of the cell, deformation of the cell container, smell of electrolyte, an



electrolyte leakage, or other abnormalities, the cells **should not be used**. Cells with a smell of electrolyte or leakage should be kept away from fire to avoid **ignition**.



## 11 - LabSat3W External Reference Clock Input

LabSat 3 Wideband features an external reference input for synchronization to a 10 MHz clock. To use this feature, connect a 10 MHz reference signal with minimum +3 dB level to the REF IN SMA connector and ensure that the **'External 10MHz'** reference clock option is ticked in **Menu > Setup > CLK REF > External 10 MHz**.

When Labsat is operating from the internal TCXO or OCXO, the REF connector can be configured to output a 10 MHz reference for use by other equipment. This is enabled by ticking the **REF OUT** menu option which is visible only when internal TCXO or OCXO is enabled.



## 12 - LabSat3W Digital Channels

There are 4 channels available for external digital data capture LabSat 3 Wideband. Recorded digital channel data is synchronized to each sample of recorded RF data; the maximum input frequency for each channel is 1 MHz.

The Digital menu allows CH1, CH2, CH3 & CH4 to be configured to record any of the following parameters:-

Function	Description
<b>1PPS</b>	This is the 1 Pulse Per Second output from the internal GNSS monitor and will become active once the internal GNSS monitor has a position fix. Note, that if using battery power with the power save option enabled, the GNSS monitor will power-down after approx 30 seconds into the recording and therefore not be present in the recorded data. During replay, the recorded 1PPS signal will be output on pin 2 (DIGO) of the expansion connector.
<b>CAN</b>	CAN 1 and CAN 2 on the expansion connector (RLACS202) will be recorded on channel 1 & 2 of the LabSat 3 Wideband. See section CAN BUS for more details.
<b>RS232</b>	This will record an RS232 level signal input on pin 18 of the expansion connector. During replay, pin 17 of the expansion connector will output the recorded data at RS232 level. Because the RS232 signal is digitized directly, it is not necessary to configure baud rate.
<b>DIGI1</b>	Will record the digital state of pin 3 of the expansion connector. During replay, the signal will be re-created on pin 2 (DIGO) of the expansion connector. See section EXPANSION CONNECTOR for more details.
<b>DIGI2</b>	Will record the digital state of pin 8 of the expansion connector. During replay, the signal will be re-created on pin 6 (DIGO 2) of the expansion connector. See section EXPANSION CONNECTOR for more details.



## 13 - LabSat3W CAN Bus

LabSat 3 Wideband is capable of listening to, and recording data from, two separate CAN networks. Dual channel CAN Bus data recording with LabSat 3 Wideband can be achieved in two ways. Depending on the mode selected, the CAN signal will be either digitized and re-created on a raw bit level or decoded and recorded in a time-stamped text file. The CAN mode operation is selected under the menu option 'CAN' in the SETUP section. When 'digitized' mode is selected, the channel is configured in the 'Digital' menu.

---

### DIGITIZE mode

The 'Digitize' mode records CAN data by listening to the bus and sampling the rising and falling edges of the raw signal. Timing codes are inserted into the recorded GPS data so that when the file is replayed LabSat re-creates the digitized CAN signal exactly as it appeared during recording. This mode can therefore be used to capture data along with bus-errors or data-collisions and is synchronised to the RF signal to within approximately 60 nanoseconds. One advantage of this mode is that there is no-need to configure CAN baud rate. During replay, the CAN data can be viewed with a CAN Bus analyser tool such as Vehicle-SPY or CANalyzer.

When using the digitize method the CAN data is replayed exactly as recorded, there will be no arbitration with other systems during replay. Therefore, if the CAN data is replayed into a system which is transmitting its own CAN data, LabSat will 'speak' over the top of the other CAN data. This may cause corruption of some data frames.

---

### LOG FILE mode

Selecting the 'LOG FILE' mode of CAN recording enables data to be recorded in an easy to read text log file as shown below.



```

Labsat3 SN:00323502
DATE:12/06/2014
TIME:13:07
CAN1: 500.00K
CAN2: 500.00K
GNSS: GPS, GLO
CHAN, TIME, ID, DLC, DATA
2      0.060      360  8 0B 70 C8 35 44 60 80 A3
1      0.060      420  8 7B 46 02 84 01 00 3E 1D
2      0.062      620  8 0D 24 02 1B 81 7E 37 02
1      0.063      428  7 00 8E 00 00 37 00 20
2      0.064      200  7 01 F5 01 E2 02 00 00

```

The log file contains a short header detailing the LabSat serial number, time, date CAN Bus baud settings and GNSS settings. Each line of CAN data recorded contains the following space-delimited information:-

1. CHAN - CAN Channel that the data was received on 1 or 2.
2. TIME - Timestamp to 1 ms resolution.
3. ID - Identifier, 'x' suffix is shown for extended CAN IDs.
4. DLC - Data length code DLC, this shows the number of data bytes within the CAN frame.
5. DATA - Data section, up to 8 bytes of data as indicated by the DLC.

At the end of the log file there will be a summary of the number of CAN messages received on each channel during the recording.

The log file is recorded in the same folder as the RF data and has a .TXT file extension.

During recording, the CAN controller listens to the CAN bus and stores incoming data. LabSat 3 Wideband will transmit acknowledge pulses on the bus in response to correctly received data unless the 'Silent Record' option is ticked. The ability to transmit acknowledge pulses in 'LOG FILE' mode means that it is possible to record data directly from inertial sensors or other devices with a CAN bus output.

During the replay of data recorded in the 'LOG FILE' mode, LabSat scans through the log file, sending the CAN data at the time intervals indicated by the time-stamp. Because CAN data is transmitted using an active CAN Bus controller,



LabSat will arbitrate by listening to the current bus state and only transmitting the data between other messages that may be sent from other nodes.

---

## Filtering CAN frames

Filtering of selected CAN frames in the LOG FILE mode can be achieved by creating a file called CANFILTER.TXT in the root directory of the current SD/SSD. An example of the CANFILTER.TXT file is shown below.

```
1 0x3F1 0x7FF
1 0x7E8 0x7FF
2 0x10751023x 0x1FFFFFFF
1 0x10751023x 0x1FFFFFFF

-- End of configuration file
```

The format for the filter file is:-

<CHANNEL><IDENTIFIER><MASK>, for example 1 0x3F1 0x7FF means that channel 1 will allow recording of identifier 0x3F1. The mask value of 0x7FF is a bit-wise mask that is used by the CAN controller to allow a single identifier of a range of identifiers to be recorded. If the mask value was set to 0x7F0, then identifiers from 0x3F0 to 0x3FF would be recorded, not just 0x3F1. Up to 16 identifiers can be defined for each CAN channel.

Please Note: The filter will remain until the CANFILTER.TXT file on the SD card or SSD is manually removed.



## Warning

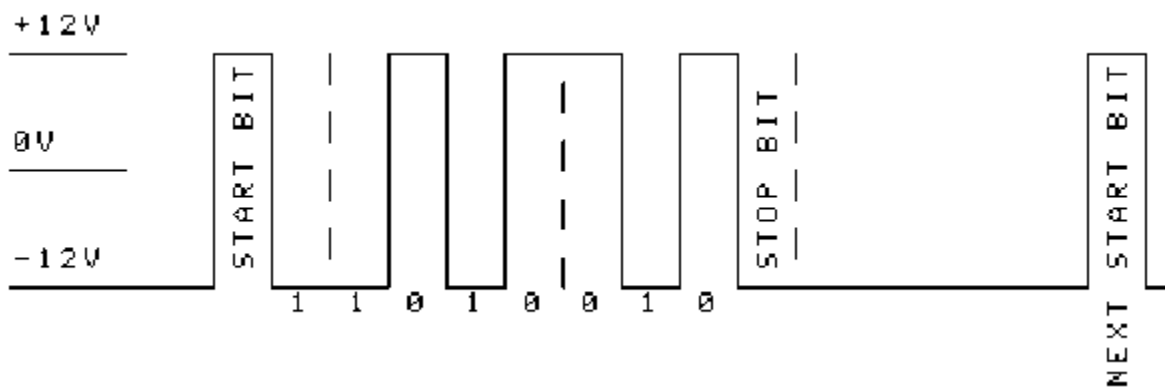
The LabSat 3 Wideband CAN Bus interface may corrupt existing CAN Bus signals when used incorrectly. It is up to the user to ensure that the LabSat and interface are configured correctly and that they are used in a safe environment where corruption of CAN Bus signals cannot cause injury or harm. Racelogic accepts no responsibility for loss, damage or injury caused by the use of LabSat or the CAN Bus interface.





## 14 - LabSat3W RS232

LabSat 3 Wideband can record and replay RS232 data in addition to GNSS signal data. There are two methods that can be used to record RS232; the first way is digitised mode where LabSat samples the raw logic level transitions of the RS232 data and then reconstructs the signal during replay; the second method is the LOG FILE mode. In this mode, LabSat receives each RS232 data byte and stores the data in a readable text file.



In either mode, the RS232 signal is converted from the normal signal levels of approximately  $\pm 12$  V down to 3 V logic levels to match the internal logic of LabSat.

### Digitised

In digitised mode, the data level is sampled and stored in synchronisation with the recorded GNSS data. When replayed, the levels are recreated and output via a voltage level shifter to the RS232 output of LabSat. This method has the benefit that it is not necessary to configure baud rate. It is also suitable for capturing binary data that does not use the ASCII format.

### Log File

Log File mode is suitable for recorded ASCII text based message data. As data is received, a new timestamped line is created in a log file which has the same name as the GNSS signal data but a 'SER' extension. Each byte of incoming data is added to the line until LabSat recognises a carriage return [CR] or a line feed [LF] character. On receiving a CR, LF or both characters together, a newline is started in the text file with a new timestamp for the next received character.



ASCII	Hex	Dec	Use
<CR>	0x0d	13	Carriage return
<LF>	0x0a	16	Line feed, end delimiter

An example of an ASCII formatted message would be NMEA data from a GNSS module such as this:

**\$GPGGA,123519,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,\*47**

Because Log File data is received and processed by LabSat, the correct data or baud rate must be configured using the LCD interface or web interface. The standard rate for NMEA is 4800 bit/s but it is not uncommon for systems to use other rates such as 9600 or 115,200 bit/s per second.

An example of the log file is shown below:

```

RLLS03W-RP 46966
DATE 09/05/2018
TIME 14:26
baud=9600, data_bits=8, stop_bits=1, parity=none, flow_control=false
[TIME]characters
[00000.303035]$GNGGA,142624.000,5159.3737,N,00059.4843,W,1,17,0.63,104.0,M,47.3,M,,*6E
[00000.381021]$GPGSA,A,3,31,25,14,26,02,23,29,21,16,05,,1.04,0.63,0.83*04
[00000.446229]$GLGSA,A,3,85,77,68,86,76,75,87,,,,,1.04,0.63,0.83*14
[00000.505305]$GNRMC,142624.000,A,5159.3737,N,00059.4843,W,0.00,138.31,090518,,A*67
[00000.581050]$GNVTG,138.31,T,,M,0.00,N,0.00,K,A*2B
[00001.311372]$GNGGA,142625.000,5159.3737,N,00059.4843,W,1,17,0.63,104.0,M,47.3,M,,*6F
[00001.389135]$GPGSA,A,3,31,25,14,26,02,23,29,21,16,05,,1.04,0.63,0.83*04
[00001.454471]$GLGSA,A,3,85,77,68,86,76,75,87,,,,,1.04,0.63,0.83*14

```

The first section of the log file contains details such as LabSat serial number, date and time of recording and the baud rate settings. After the [TIME] and character heading, the received data appears along with the timestamp of the start of each line. When a recording with logged RS232 data is replayed, LabSat uses the timestamp in the file to replay each line at the corresponding time. It is important to note that there will be some variation of data output timing when compared to the record timing.

A feature of the log file mode is that once, created, the log file can be modified using a text editor application such as Notepad to change the replayed output.



The differences between digitised and log file modes are shown below. However, it is possible to record to log file and digitise simultaneously and then choose whether to replay digitised or logged data.

	<b>Digitized Mode</b>	<b>Log File Mode</b>
<b>Strengths</b>	<ul style="list-style-type: none"> <li>• No need to configure baud rate</li> <li>• Very accurate timing</li> <li>• Handles binary data</li> </ul>	<ul style="list-style-type: none"> <li>• Produces readable text file with timestamping</li> <li>• Files can be modified to produce test conditions</li> </ul>
<b>Weaknesses</b>	<ul style="list-style-type: none"> <li>• No readable log file</li> </ul>	<ul style="list-style-type: none"> <li>• Does not support binary message data</li> <li>• Original message timing is not perfectly reproduced</li> </ul>



## 15 - LabSat3W Digital In / Out

For recording events from an external source such as an event logging switch, LabSat 3 Wideband is equipped with two digital inputs (DIGI 1 and DIGI 2) and two digital outputs (DIGO 1 and DIGO 2) which can be found on the expansion connector at the rear of the device.

Digital inputs are pulled up internally to 5 V. The input will accept signals up to 12 V DC. Switching threshold for the digital inputs is 2.5 V. Digital out is a 5 V level output.

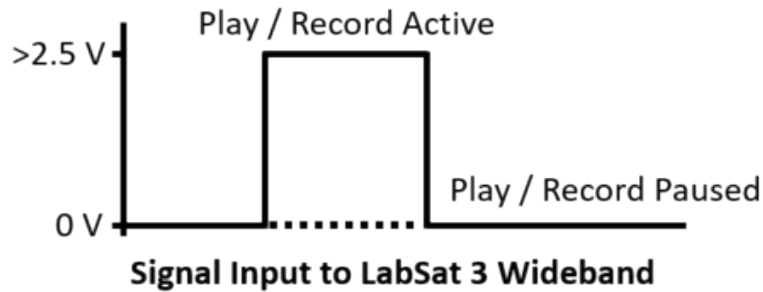
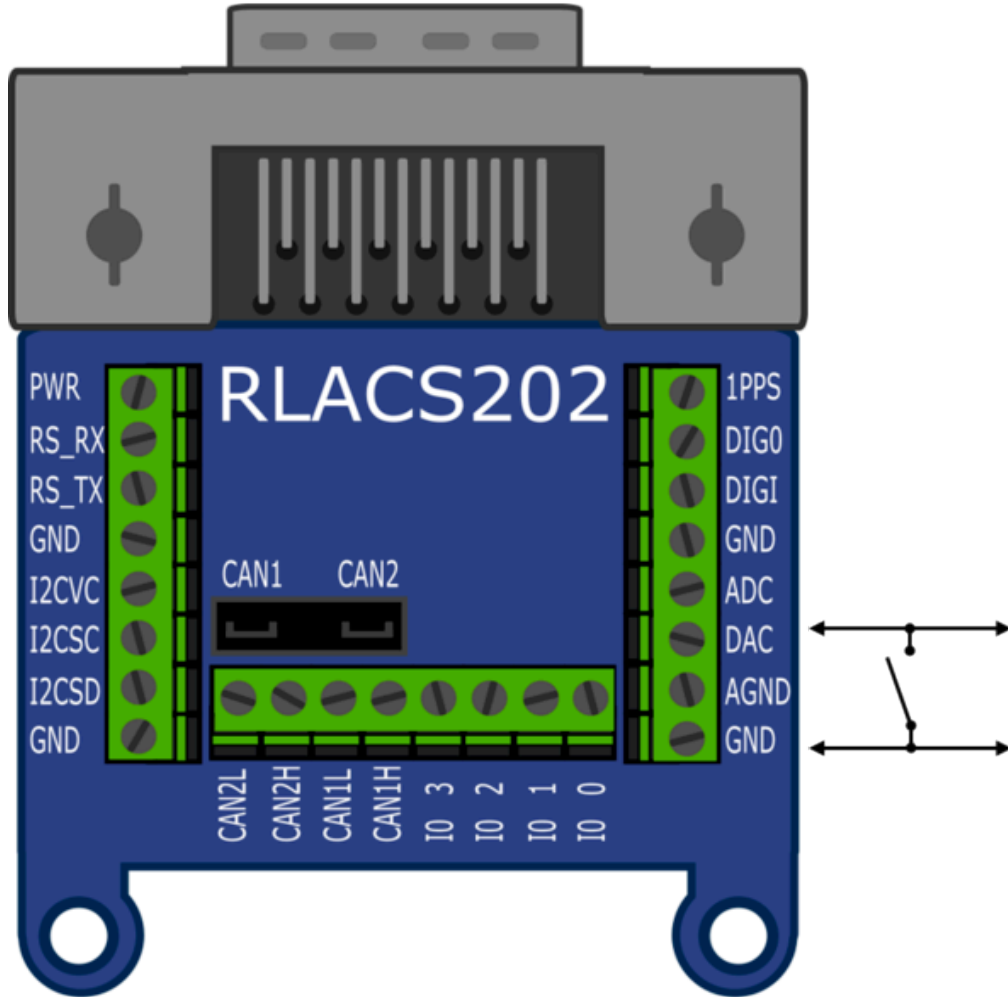
To enable the digital input for recording, go to **Menu > Setup > Digital**, select one of the four channels and then enable the tick against DIGI 1 or DIGI 2 in the signal list. Then, during recording, LabSat 3 Wideband will record the state of DIGI 1 or DIGI 2 (pin3 or pin 8 of the expansion connector). During replay, the relevant DIGO pin will output the recorded DIGI signal states.





## 16 - LabSat3W External Synchronisation

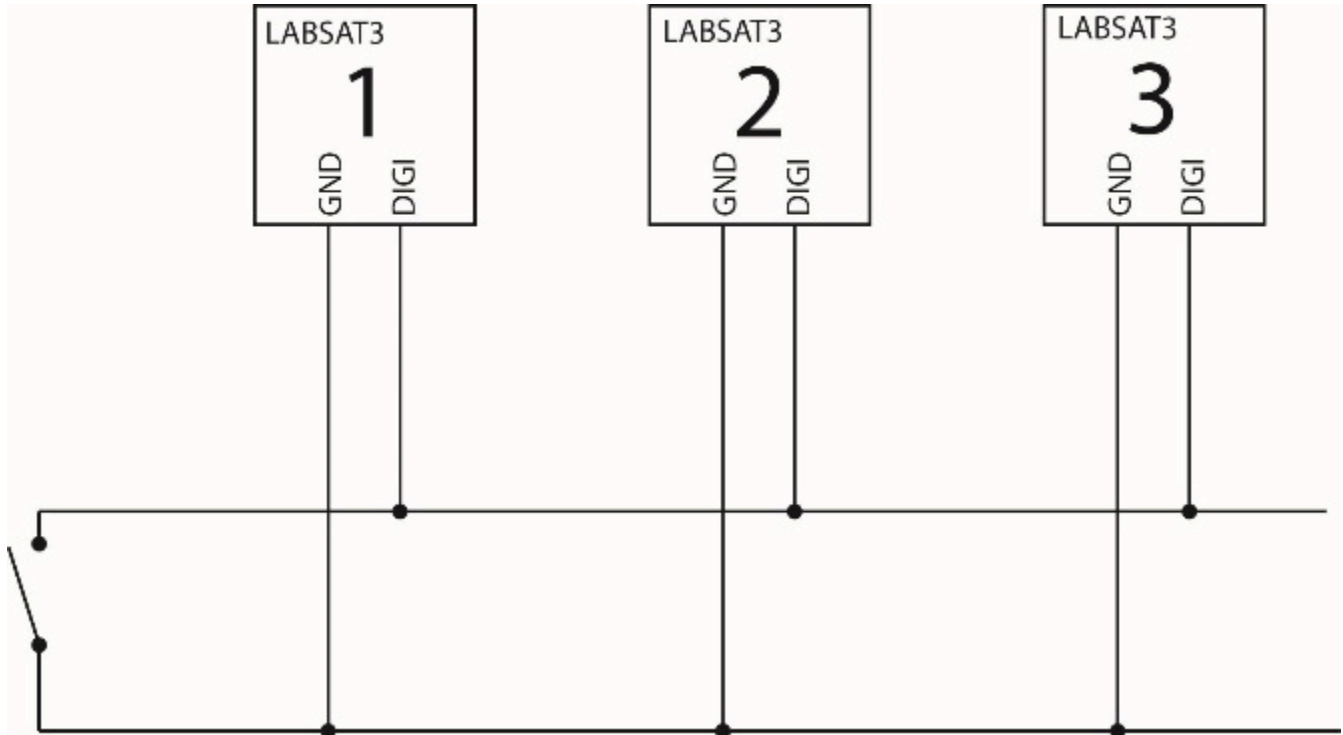




When 'Ext Sync' is enabled within the LabSat 3 Wideband menu, the DIGI2 pin on the expansion connector can be used to pause record or replay allowing synchronisation of multiple LabSats or simply a remote trigger to record/replay.

This is achieved when a low voltage (0 V) is applied, the DIGI pin is internally pulled up to approximately 5 V, so it is possible to pause the record or replay activity simply by connecting the DIGI input to GND via a switch.

Synchronising multiple LabSat 3 Wideband systems to record at the same time is possible by setting DIGI low (closed switch between DIGI2 and GRND), then pressing the record button on each LabSat and bringing DIGI2 high (open switch) to start data transfer. Synchronised replay can be achieved using the same method.



*Note: The DIGI2 pin (DAC pin on RLACS202) will only operate as a PAUSE function when DIGI2 is not configured in any of the digital channels.*





## 17 - LabSat3W WiFi Dongle

The LabSat 3 Wideband Web Server can be accessed on mobile devices such as smartphones or tablets to allow the user to configure and monitor the LabSat, connection is made possible using a WiFi dongle. The USB WiFi dongle must use a RT5370 chipset.

This feature will allow for remote control of the system and will be particularly useful in the field. For example, the LabSat 3 Wideband can be controlled from the front of a vehicle, monitoring the performance in real-time.

The WiFi Dongle should be connected to the Host USB port on the LabSat rear panel. Once connected a hotspot will be created using the LabSat host name, the host name will be '**labsatv3w\_XXXXXXXX**', where XXXXXXXX is replaced with the LabSat serial number (the serial number must be entered in an 8 digit format, leading zeros should be used). Connection can also be made by entering '<http://10.0.0.3>' in the web browser address bar.

When selecting the hotspot on a mobile device, a password will be requested prior to connection, the password for all LabSat hotspots is '**secret1234**'. Please note that the password is case sensitive and should be entered all lowercase.

*Note: If WiFi and Ethernet connection are used at the same time, there may be a 'disconnected' status displayed on the web server. This is due to limitations of handling data from two interfaces.*



## 18 - LabSat3W Remote Control

To enable LabSat 3 and LabSat 3 Wideband to be used for applications that require automated or remote control functionality, an application programme interface (API) is available together with a manual for communication via Telnet over IP.

- The LabSat 3 and LabSat 3 Wideband API is a Microsoft .NET API to allow functions of a LabSat 3 or LabSat 3 Wideband connected via LAN to be accessed programmatically.
- LabSat 3 and LabSat 3 Wideband are equipped with an Ethernet interface to allow remote control over a Local Area Network (LAN). Remote control is accomplished using simple text based commands through the Telnet protocol.

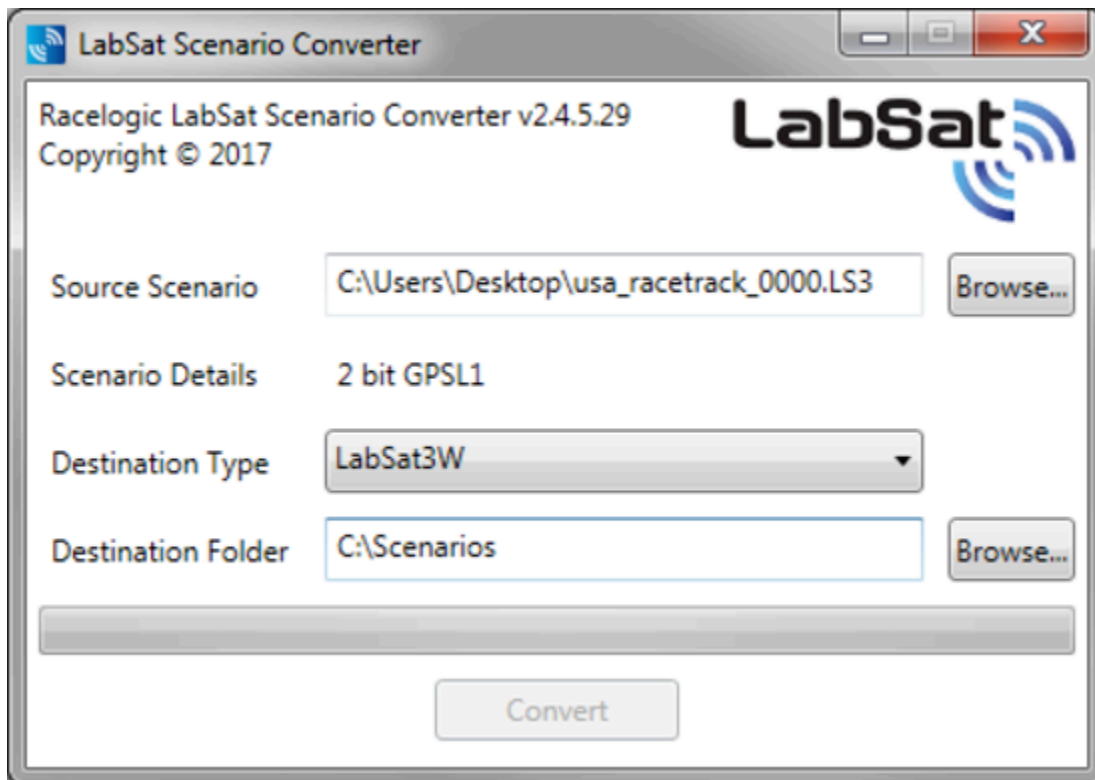
Please contact your local LabSat distributor or [raise a support ticket](#) for the LabSat remote control information pack.



## 19 - LabSat3W Converting LabSat Scenarios

LabSat uses a binary Intermediate Frequency to down convert GPS RF data into a binary file, whereas LabSat 2, 3 and 3 Wideband store GNSS RF data as an I & Q binary file. This means that existing LabSat scenarios cannot be run natively on a LabSat 2, 3 and 3 Wideband or vice versa. The LabSat scenario converter software is available on the [LabSat Website](#), it will convert LabSat, LabSat 2 and LabSat 3 files to each other's format and those three formats to LabSat 3 Wideband. This conversion utility will allow LabSat users to perform a one-time conversion of files (Please note that it's only possible to convert GNSS data files. Files that contain external data such as CAN bus or serial data cannot be converted).

The operation of the conversion utility is detailed below:-



Load the file to be converted into the '**Source Scenario**' section using the '**Browse**' button or manually type the file location. When the file is loaded the scenario information will be displayed in the '**Scenario Details**' section.

The software will automatically detect the file extension of the source scenario so the '**DestinationType**' will only display the alternate LabSat variants. Select one of the remaining LabSat variants to convert the file to.

Choose a suitable file location for the converted scenario by using the '**Browse**' button or manually type the desired location into the '**Destination Scenario**' box.

LabSat 3 file format requires a folder for the data files. So when converting LabSat 3 (\*.ls3) to LabSat 2 (\*.ls2) or LabSat (\*.bin) formats, please select the first file within the LabSat 3 scenario folder for conversion. The software will automatically convert all the files in the folder.

This software does not support conversion of LabSat 3 Wideband files to any other format.

**Note:** When moving LabSat 3 scenarios between media, the entire scenario folder must be moved not just the individual files, no other files can be stored in the scenario folder. LabSat 3 Wideband scenarios comprise of two files, .ini & .ls3w, both of these files need to remain together when moving files.



## 20 - LabSat3W SatGen Software

Below is a short Video introducing the capabilities of SatGen software.

Media, iframe, embed and object tags are not supported inside of a PDF.

SatGen software is a powerful tool for defining and creating RF playback scenario files for use with the LabSat Simulator. For many applications, LabSat 3 Wideband can record and playback real world, live sky data, but there may be times when you need a more controlled, user definable signal. When this is the case, SatGen provides all of the tools necessary to create a predictable, stable and accurate RF output from LabSat. SatGen has the distinct advantage of allowing for the creation of scenarios with any dynamics, location, date or time.



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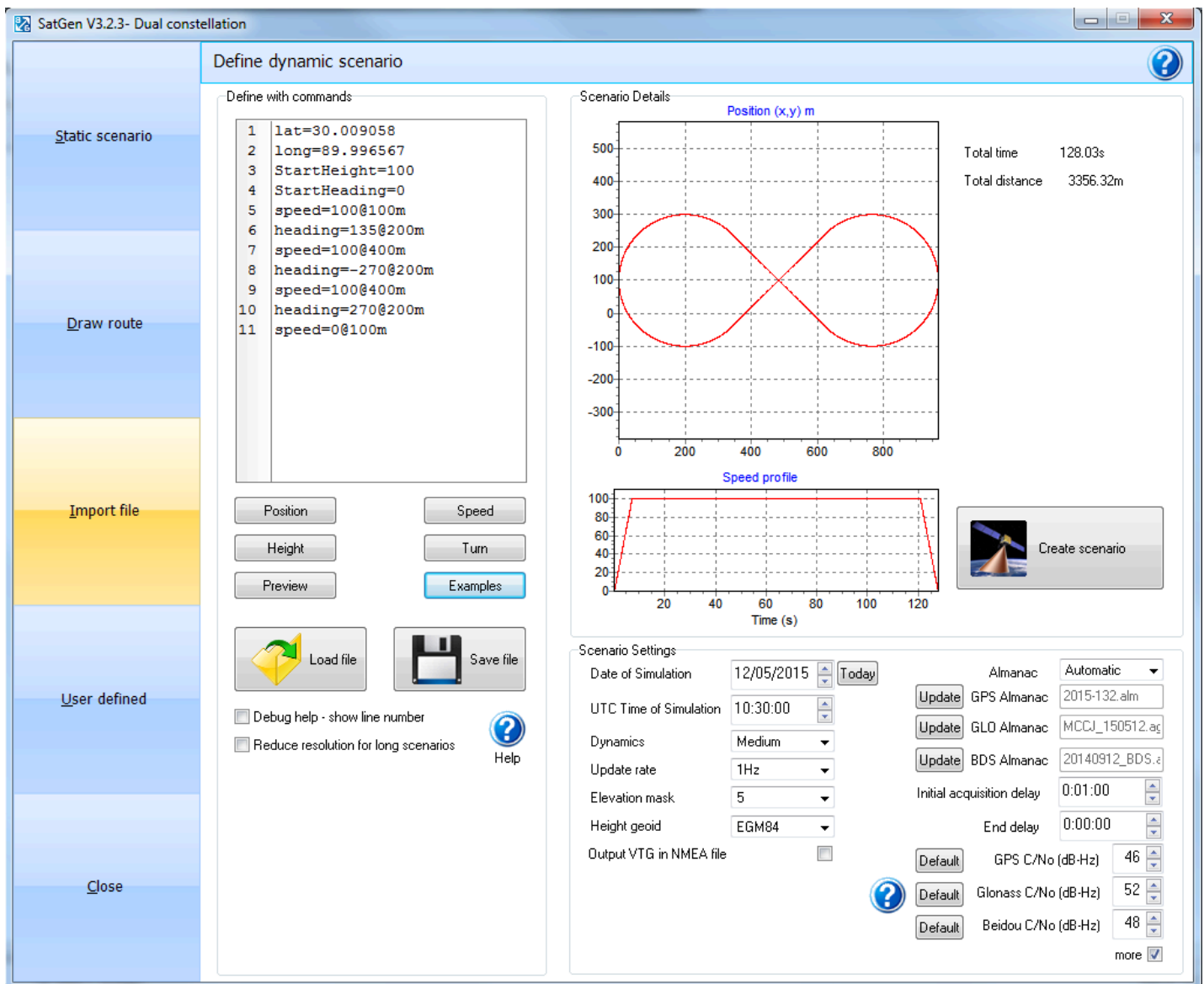
## Why use SatGen software?

You might be based in Europe, but your GPS devices will be deployed throughout the world. With SatGen you can create a test scenario based on a user-generated trajectory file for virtually any location, including hostile areas for which live-sky field testing might be impossible. This allows you to verify that your GPS equipment design performs as required, in a variety of locations that may be geographically remote from your facility. It also means the same scenario can be replayed repeatedly to see how the device under test (DUT) performs.

Of course, LabSat 3 Wideband can record and replay live data, but creating an artificial scenario allows you to precisely control the data content, and create a 'gold standard' file for carrying out true comparisons between receivers. From your bench you can try different acceleration levels, crossing different time zones, the equator, leap second roll-overs and many hard to replicate tests.

Artificial scenario files can easily be created from a static position, draw a route, import a file (NMEA, Google.kml, and VBOX.vbo) and user defined instructions with inclusive pre-defined examples.





There are five variants of SatGen Simulation Software available to suit a range of testing requirements. These are:

### RLSSGSW03-1 SatGen v3 Single Constellation

Create single constellation scenario files for GPS L1, Galileo E1, GLONASS L1 or BeiDou B1.

### RLSSGSW03-2 SatGen v3 Dual Constellation

Create single or dual constellation scenario files for GPS L1, Galileo E1, GLONASS L1 or BeiDou B1.



### **RLLSSGSW03-3 SatGen v3 Triple Constellation**

Create single, dual or triple constellation scenario files for GPS L1, Galileo E1, GLONASS L1 or BeiDou B1.

### **RLLSSGSWRT-2 SatGen v3 Dual Constellation Real Time**

Create single or dual constellation signals streamed to a LabSat Real Time for GPS L1, Galileo E1, GLONASS L1 or BeiDou B1.

(This software variant will only function for Real Time with a LabSat Real Time unit).

### **RLLSSGSW03-W SatGen v3 Wideband**

Create any single, dual or triple constellation scenario file (L1 only) or combinations of GPS L1C/A, L1P, L1M, L2C, L2P, L2M, L5, Galileo E1, E5a, E5b, E6 B/C, GLONASS L1OF, L2OF, BeiDou B1I, B2I, B3I, NAVIC L5 SPS, S SPS.

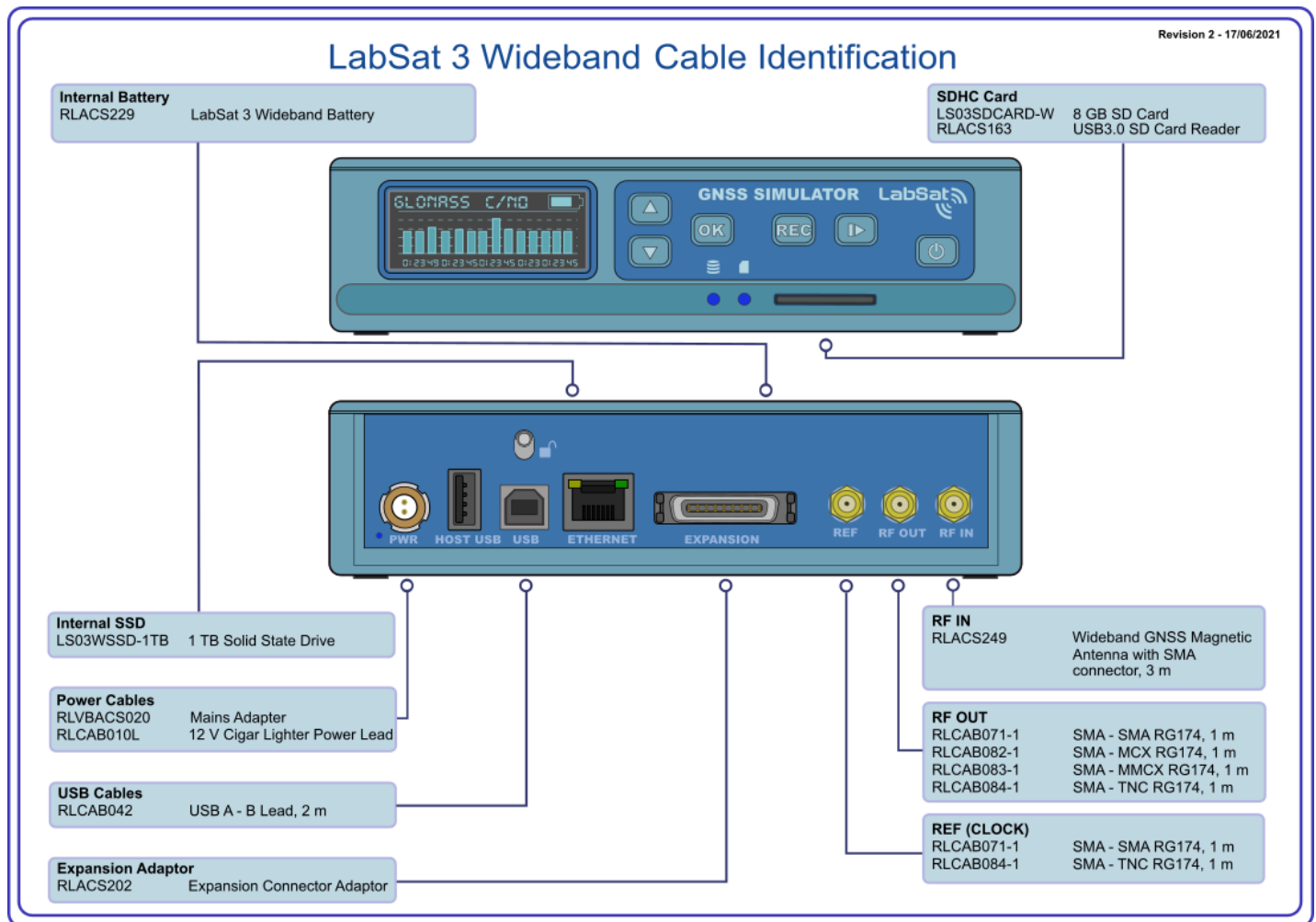
SatGen simulation software can create scenario files for LabSat 1, LabSat 2, LabSat 3 and LabSat 3 Wideband or generate a live signal stream to a LabSat RT (Real Time). Scenarios can be created for static or dynamic trajectories, the date, time and duration of simulation are user configurable.



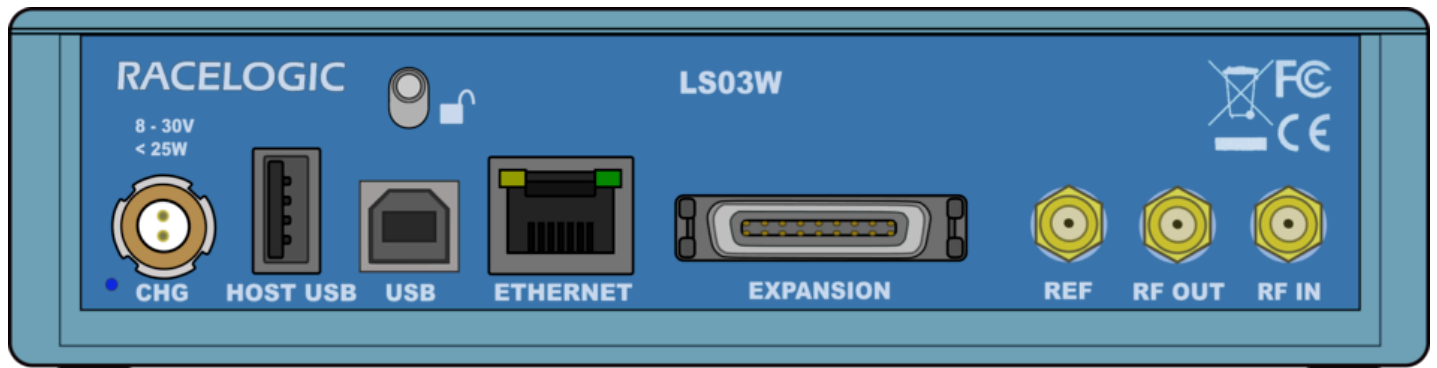


## LabSat3W - Cable Identification

[Click here](#) for a printable PDF.



## LabSat3W - PIN OUTS



Rear View of LabSat 3 Wideband

### Connector 1 - POWER (Lemo 2 PIN)



PIN	I/O	Function	Range
1	I	Power+	8 - 30 V
2	I	Ground	0 V



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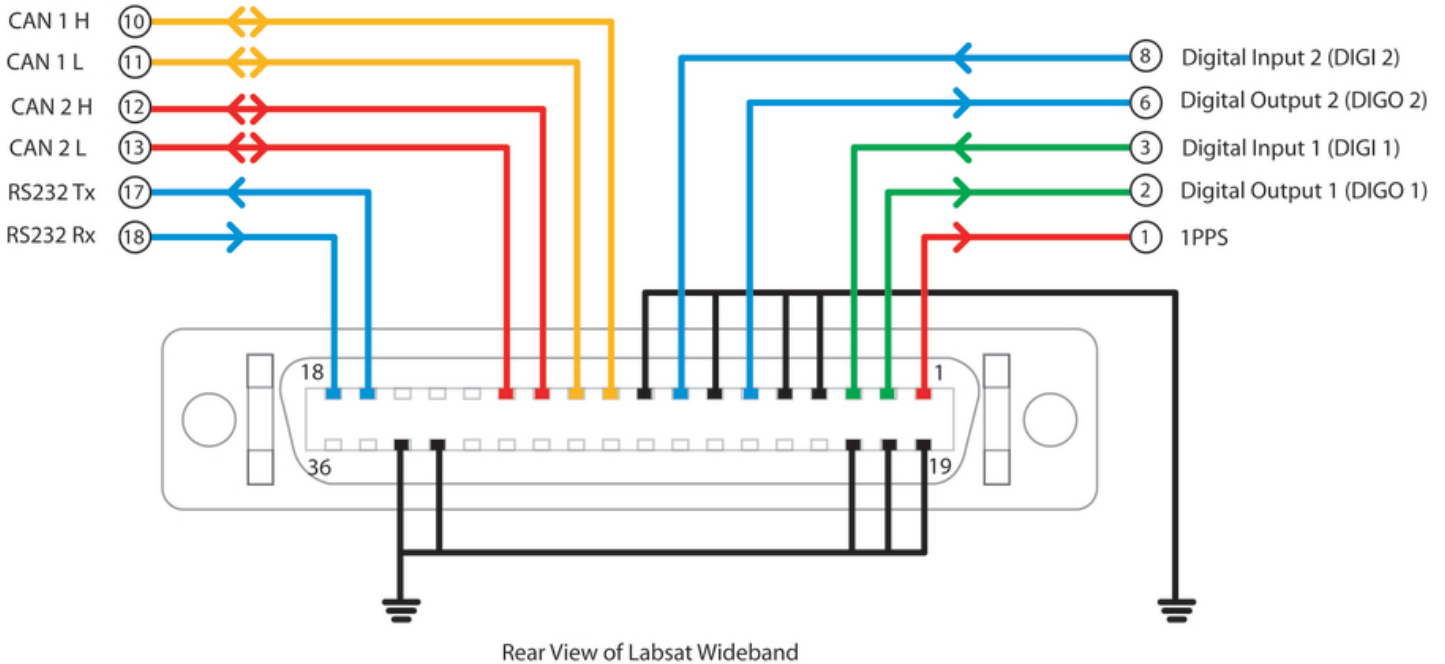
## SMA Connectors - RF OUT, RF IN and REF



<b>PIN</b>	<b>Name</b>	<b>Function</b>	<b>Range</b>
Center	RF IN	RF Signal Input DC bias for active antenna	Bias output 2.8 - 3 V
	RF OUT	RF Signal Output DC Blocked	
	REF	10 MHz Reference Clock Input/Output	
Chassis	-	Ground	



## Expansion port 36 way MDR type connector



The 'EXPANSION' connector on the rear of LabSat 3 Wideband gives access to a number of signals including CAN Bus, RS232, 1PPS and Digital input/output. Accessory RLACS202 is used to provide user signal access for integration into the users test system. Pin functions are as follows:-

Number	Name	I/O	Function
1	1PPS	O	Signal from Internal GNSS monitor. Becomes active when monitor is locked. 5 V Level. 25 mA
2	DIGO 1	O	User digital output. 5 V Level. 25 mA max
3	DIGI 1	I	User digital input. Up to 12 V input level. Detection threshold=2.5 V
4	-	-	-



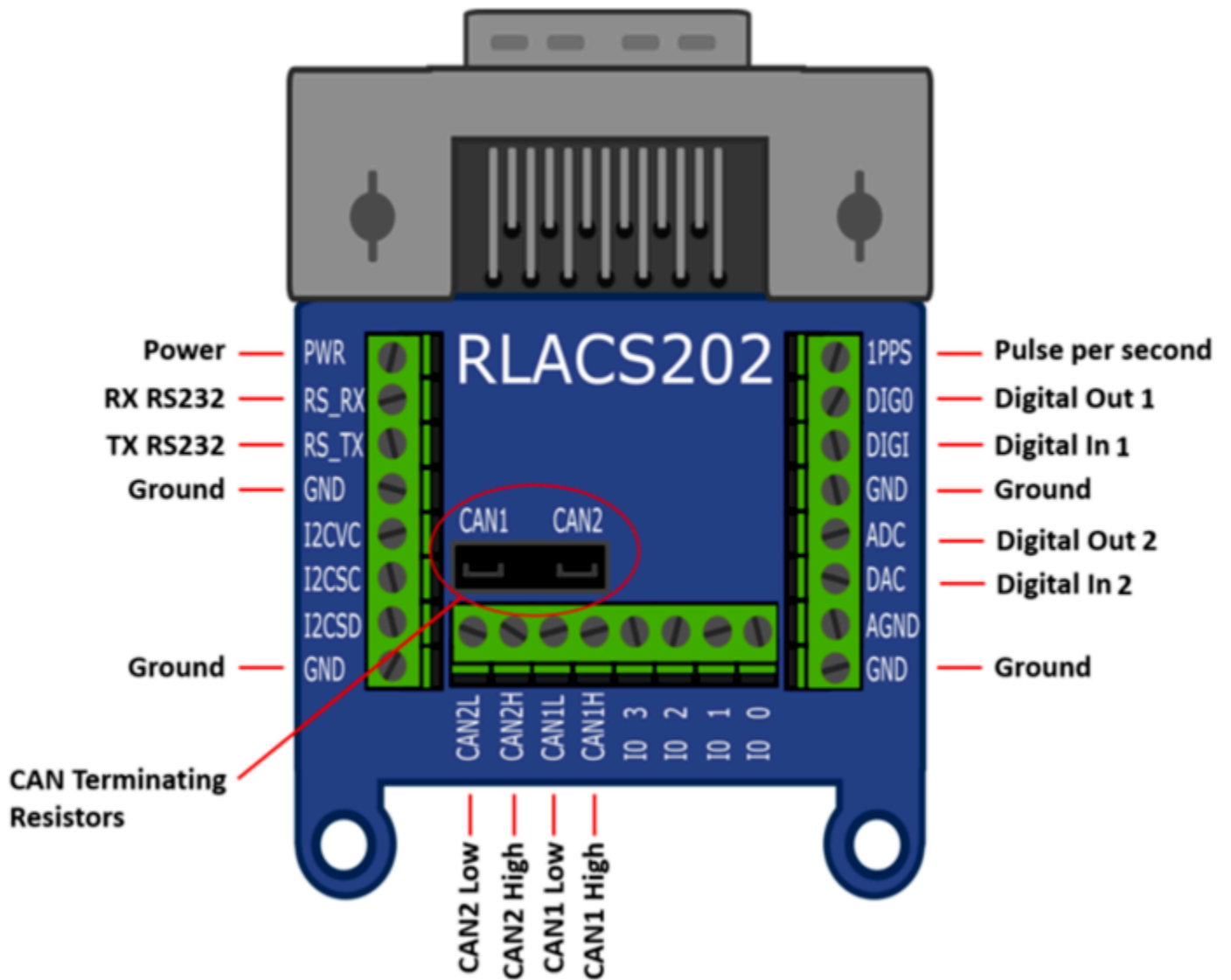
Number	Name	I/O	Function
5	-	-	-
6	DIGO 2	O	User digital output. 5 V Level. 25 mA max
7	-	-	-
8	DIGI 2	I	User digital input. Up to 12 V input level. Detection threshold=2.5 V
9	-	-	-
10	CAN 1 H	I/O	CAN Bus High Channel 1 – Standard ISO 11898 voltage signal levels for CAN
11	CAN 1 L	I/O	CAN Bus Low Channel 1 – Standard ISO 11898 voltage signal levels for CAN
12	CAN 2 H	I/O	CAN Bus High Channel 2 – Standard ISO 11898 voltage signal levels for CAN
13	CAN 2 L	I/O	CAN Bus Low Channel 2 – Standard ISO 11898 voltage signal levels for CAN
14	I2C SDA	I/O	I2C Bus Data – Reserved for future use
15	I2C SCL	I/O	I2C Bus Data – Reserved for future use
16	I2C VCC	I/O	I2C Bus Data – Reserved for future use
17	RS232 Tx	O	RS232 data output. NMEA Data from GNSS monitor or User RS232 data if enabled. Standard RS232 Level



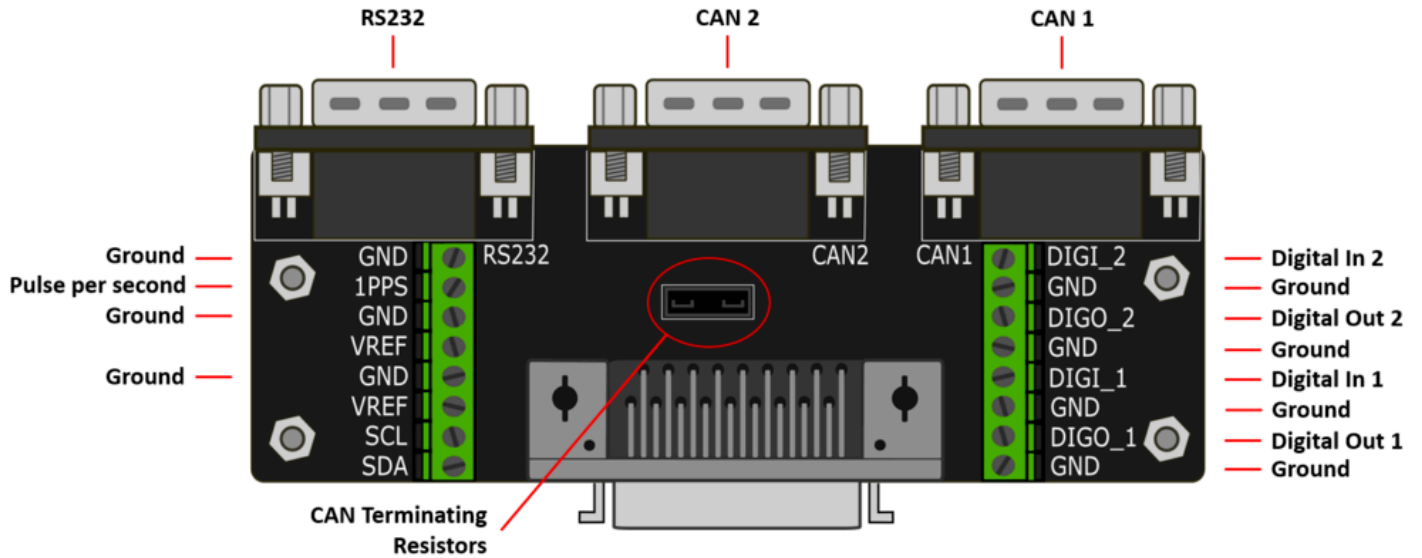
Number	Name	I/O	Function
18	RS232 Rx	I	User RS232 data which is recorded if RS232 is enabled in Digital configuration menu. Standard RS232 Level
19	Ground	O	Ground Connection
20	Ground	O	Ground Connection
21	Ground	O	Ground Connection
22	-	-	-
23	-	-	-
24	-	-	-
25	-	-	-
26	-	-	-
27	-	-	-
28	IO_0	I/O	Reserved
29	IO_1	I/O	Reserved
30	IO_2	I/O	Reserved
31	IO_3	I/O	Reserved
32	-	-	-
33	Ground	O	Ground Connection
34	Ground	O	Ground Connection
35	Power	O	Connected to input power – Max 250 mA
36	Power	O	Connected to input power – Max 250 mA



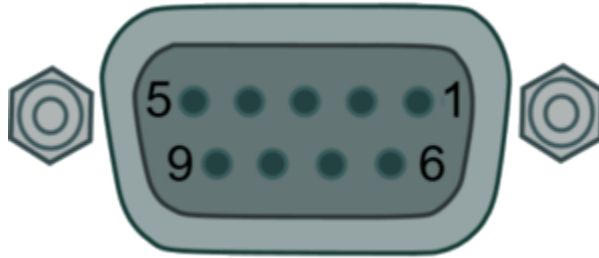
## Expansion Connector



## Locking Expansion Connector (RLACS261)



### Connector 1 - RS232 (9 PIN SUB-D)



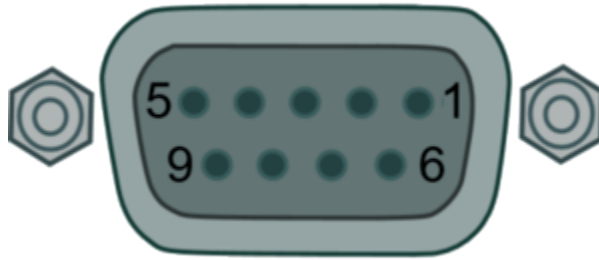
PIN	I/O	Function	Range
2	O	Tx	RS232 data output. NMEA Data from GNSS monitor or User RS232 data if enabled. Standard RS232 Level
3	I	Rx	User RS232 data which is recorded if RS232 is enabled in Digital configuration menu. Standard RS232 Level
5	O	Ground	-



[https://en.racelogic.support/Product\\_Info/LabSat\\_3\\_Wideband/LabSat\\_3\\_Wideband\\_User\\_Guide/21\\_-\\_LabSat3W\\_Technical\\_Properties/LabSat3W\\_-\\_PIN\\_OUTS](https://en.racelogic.support/Product_Info/LabSat_3_Wideband/LabSat_3_Wideband_User_Guide/21_-_LabSat3W_Technical_Properties/LabSat3W_-_PIN_OUTS)



## Connectors 2 / 3 - CAN 1 / CAN 2 (9 PIN SUB-D)



PIN	I/O	Function	Range
2	I/O	CAN Low	CAN Bus Low Channel 1/ 2 – Standard ISO 11898 voltage signal levels for CAN
7	I/O	CAN High	CAN Bus High Channel 1/ 2 – Standard ISO 11898 voltage signal levels for CAN



## LabSat3W - Replacement Parts and Optional Accessories

### LabSat 3 Wideband Standard Inventory

Description	Product Code
LabSat 3 Wideband unit	LS03W-V2
LabSat 3 carry case	RLACS197
Mains Power supply - Lemo 2 way plug	RLVBACS020
8 GB SD Card	LS03SDCARD-W
2 way Lemo to 12 V cigar lighter lead, 2 m	RLCAB010LE
Wideband GNSS Magnetic Antenna with SMA connector, 3 m	RLACS249
SMA-SMA cable, 1 m	RLCAB071-1
SMA plug to MCX plug cable, 1 m	RLCAB082-1
SMA plug to MMCX plug cable, 1 m	RLCAB083-1
SMA plug to TNC plug cable, 1 m	RLCAB084-1
USB 3.0 to SATA adaptor cable	RLACS289
LabSat 3 Wideband battery	RLACS229
LabSat 3 Wideband expansion connector adapter (includes screwdriver)	RLACS202
LabSat 3 Wideband cable identification sheet	LS03W-CABIDEN
LabSat 3 Wideband quick start guide	LS03WGUIDE



Description	Product Code
Licence for Linux File Systems for Windows by Paragon Software	n/a

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## Optional accessories

Description	Product Code
Locking Expansion Connector	RLACS261
LabSat 3 Wideband 1 TB SSD	LS03WSSD-1TB
LabSat 3 Dipole Antenna	RLACS219
USB 3.0 dual slot card reader	RLACS163

Please contact your local distributor or Racelogic for pricing and availability.



## LabSat3W - Technical Specification

### LabSat 3 Wideband Technical Specification

<b>Constellation</b>	GPS: L1, L2, L5; Galileo: E1, E5a/b, E6; GLONASS: L1, L2, L3; BeiDou: B1, B2, B3; QZSS: L1, L2, L5; NavIC L5 & S-Band; In Band SBAS, user defined frequency bands like Iridium & SiriusXM radio
<b>Nominal Output Signal Level</b>	-73 dBm/MHz @ 0 dB  Variable attenuator provides between +20 dB and -69 dB of adjustment during replay
<b>RF Channels</b>	3
<b>RF Channel 1 Centre Frequency</b>	Selectable
<b>RF Channel 2 Centre Frequency</b>	Selectable
<b>RF Channel 3 Centre Frequency</b>	Selectable
<b>Number of Satellites Observed</b>	All in view
<b>Sampling frequency</b>	10.23 MHz, 30.69 MHz, 58 MHz
<b>Bandwidth</b>	10 MHz, 30 MHz, 56 MHz
<b>Quantisation</b>	1, 2 or 3 bit (I & Q)
<b>Data Format</b>	I & Q
<b>User Control</b>	6 Button Membrane Keypad



<b>Display</b>	Backlit LCD Dotmatrix				
<b>Additional Logging</b>	2 x CAN channels, 2 x Digital channels, 1 x RS232 channel				
<b>Removable Battery Pack</b>	Yes				
<b>Media Storage Included</b>	1 TB SDD and 8 GB SD Card (SD card for firmware upgrade only)				
<b>Active Antenna Voltage Supply</b>	2.8 - 4.6 V DC				
<b>Reference Oscillator</b>	<table style="width: 100%; border: none;"> <thead> <tr> <th style="text-align: center; border: none;">TCXO</th> <th style="text-align: center; border: none;">OCXO</th> </tr> </thead> <tbody> <tr> <td style="border: none;"> <ul style="list-style-type: none"> <li>• Temperature Stability <math>\pm 0.05</math> ppm</li> <li>• Frequency Stability <math>\pm 1</math> ppm over first year</li> </ul> </td> <td style="border: none;"> <ul style="list-style-type: none"> <li>• Temperature Stability <math>\pm 0.05</math> ppm</li> <li>• Frequency Stability <math>\pm 0.3</math> ppm over first year</li> </ul> </td> </tr> </tbody> </table>	TCXO	OCXO	<ul style="list-style-type: none"> <li>• Temperature Stability <math>\pm 0.05</math> ppm</li> <li>• Frequency Stability <math>\pm 1</math> ppm over first year</li> </ul>	<ul style="list-style-type: none"> <li>• Temperature Stability <math>\pm 0.05</math> ppm</li> <li>• Frequency Stability <math>\pm 0.3</math> ppm over first year</li> </ul>
TCXO	OCXO				
<ul style="list-style-type: none"> <li>• Temperature Stability <math>\pm 0.05</math> ppm</li> <li>• Frequency Stability <math>\pm 1</math> ppm over first year</li> </ul>	<ul style="list-style-type: none"> <li>• Temperature Stability <math>\pm 0.05</math> ppm</li> <li>• Frequency Stability <math>\pm 0.3</math> ppm over first year</li> </ul>				
<b>Operating Voltage</b>	8 - 30 V DC				
<b>Size</b>	167 mm x 128 mm x 46 mm				
<b>Weight</b>	1.2 kg				
<b>Operating Temperature</b>	0°C to +60°C Note: Battery will not charge below 0°C or above +45°C (charger shuts down outside this range). Unit will shut down outside operating temperature range.				
<b>Storage Temperature</b>	-20°C to +60°C Note: Battery will discharge whilst in storage and discharge rate will increase at higher storage temperatures.				

## LabSat 3 Wideband Dimensions

The LabSat 3 Wideband dimensions (mm):



[https://en.racelogic.support/Product\\_Info/LabSat\\_3\\_Wideband/LabSat\\_3\\_Wideband\\_User\\_Guide/21\\_-\\_LabSat3W\\_Technical\\_Properties/LabSat3W\\_-\\_Technical\\_Specification](https://en.racelogic.support/Product_Info/LabSat_3_Wideband/LabSat_3_Wideband_User_Guide/21_-_LabSat3W_Technical_Properties/LabSat3W_-_Technical_Specification)

