Halo Photonics Stream Line Scanning Doppler LiDAR system – v14 Software Guide.

Our modular, autonomous, turn-key, pulsed Doppler LiDAR systems were conceived to meet the need for remote sensing of motion and backscatter in the atmosphere. In this mode of operation, naturally occurring aerosols and clouds act as a distributed target and backscatter the transmitted pulses. The receiver detects the Doppler shift brought about by the motion of the distributed targets and therefore the line-of-sight component of their velocity. The novel optical technology employed and the design approach have led to a new class of eye-safe (Class 1M), high performance LiDAR exhibiting exceptional stability which is compatible with a continuous and unattended mode of operation. Typical applications include boundary layer wind profiling, plume dispersion, analysis of complex flows, cloud studies, cloud base measurements and gust and air quality monitoring.

While every effort has been made to provide accurate and calibrated data products, HALO Photonics does not currently guarantee the calibration of the data in absolute terms.

The system has been designed to be rugged and autonomous. Even so, the end user must respect the fact that the system is a precision optical instrument that must be treated with great care.

The laser emission from the antenna is in the class 1M category. The responsibility for ensuring suitable safety procedures and operating modes lies entirely with the end user. HALO Photonics does not accept any responsibility for issues relating to the field deployment of the equipment and propagation of the beam in the atmosphere.

LASER RADIATION
DO NOT VIEW DIRECTLY
WITH OPTICAL INSTRUMENTS
CLASS 1M LASER PRODUCT

General notes on the LiDAR PC and the use of third party software.

- The LiDAR contains a PC, running Windows XP or 7. It is an embedded, ruggedised unit, which controls the LiDAR and acts as a storage system for the collected data. We would encourage users to treat the PC as a sophisticated embedded controller, and not as a general use PC. For example – the USB ports are for attaching a keyboard and mouse, and not for charging mobile phones.

- Each LiDAR is shipped with a suite of software that has been tested and found to be stable and Halo Photonics can only guarantee trouble free operation of the system's control software and PC as long as no 3rd party software is installed.

- If additional software is needed for security reasons, then it should be fully tested before the LiDAR is left unattended.

- For remote connection to the Internet, we would advise the use of SIM-based modems that simply present RJ45 connectivity to the LiDAR – which means that there is no need for additional software. USB broadband dongles have been known to cause problems both from the software, and because of the amount of power that they draw from the USB port.

- The PC should be allowed to boot straight to the desktop without user intervention. If accounts are set up that require a password to be entered, then the LiDAR won't be able to run any software contained in the Windows startup directory when recovering from a power cut for example.

Windows settings:
Windows auto-updates are disabled.
Windows firewall is on
Windows anti-virus is off
Windows time syncing is disabled
Daylight saving adjustment is disabled
Video resolution is 1280 x 1024

BIOS settings:
The PC is set to come on with power.
The PC will come on at 12:20 PM if it is powered, but is off (after a shutdown for example)

General settings:
IP address for RJ45-X (192.168.0.1) – please do not change this setting.

IP address for RJ45-BB – This can be fixed if needed. The default is auto assign.

General handling notes regarding the LiDAR.

- No part of the LiDAR is to be removed or modified in any way without the written permission of Halo Photonics. The removal or changing in any way of components or software will void the system's warranty.

- If the handles need to be removed, then it is important that they are fully screwed back on before lifting. The long handles screw onto the connector panel end, and the short ones go on the scanner end.

- If the scanner is moved manually whilst the LiDAR is un-powered, or when the motors are disabled (using the scanner utility software), then it must not be rotated at more than 30 degrees per second.

- When adjusting the legs, care must be taken to ensure that the telescopic inner part of the leg does not protrude more than 10cm (4"). If further adjustment is needed, then the opposite leg(s) can be wound in.

- Do not over-tighten the leg clamps. The 3 turned regions of the legs provide a suitable hard stop that will prevent the clamps sliding.

- The system must not be stored or left in conditions where there is a risk that the ambient temperature could fall below -20°C. During cold deployments, the system must be stored at room temperature prior to deployment for at least 10 hours. Power must be maintained at all times during sub-zero deployments.

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1. Controlling the embedded PC. [Back to contents]

There are three methods of controlling the LiDAR.
i. Direct connection using a keyboard, mouse and monitor,
ii. Network connection using a crossover cable into the RJ45-X connector and a controlling PC with appropriate remote access software installed,
iii. Remote access over a LAN by using another PC on the same LAN running the remote access software.

i. Control using a keyboard, mouse and monitor.

The LiDAR has 2 USB ports, and a SVGA connector (via a short interface cable), allowing connection of a keyboard, mouse and monitor. The monitor resolution is set to **1280 x 1024**. A simple USB keyboard without a USB hub is best used, as it will not require any driver installation.

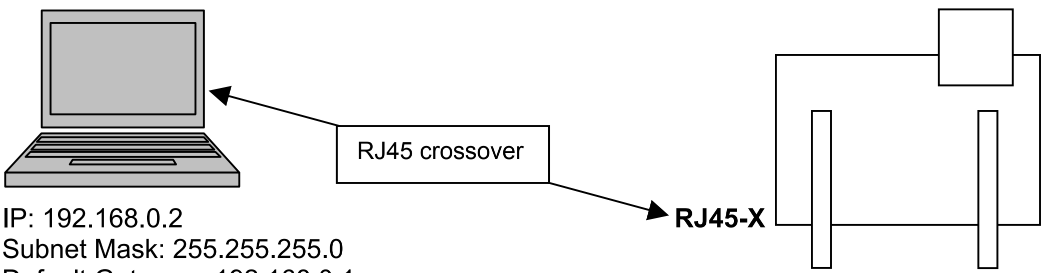
ii. Control using a directly connected PC with crossover cable into the RJ45-X port.

Communication between the LiDAR and an attached (or LAN connected) PC, is achieved by installing and running the **client part** of the remote access software found at this address: http://www.halo-photonics.com/rpcsetup.exe

During installation, you will need to choose to install just the **client** part. It is also possible to run a standalone Java client that will not require installation.

To remotely connect to the LiDAR using a laptop, a **crossover** RJ45 cable is used. Change your laptop (or other device) IP settings as follows:

Network settings (Ip v4) for an attached PC using the crossover Ethernet cable	
IP Address	**192.168.0.2**
Subnet Mask	**255.255.255.0**
Default Gateway	**192.168.0.1**

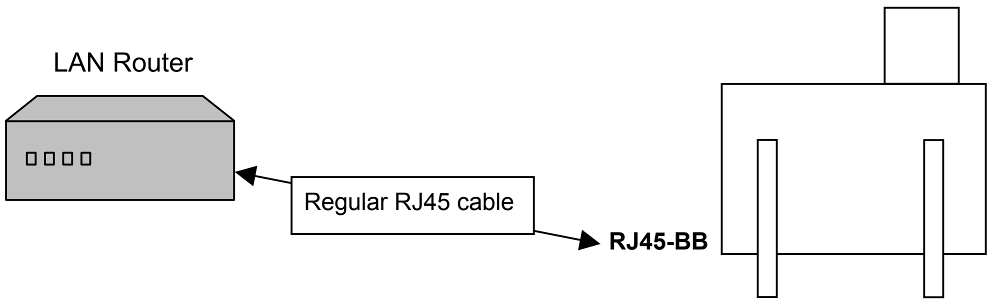


IP: 192.168.0.2
Subnet Mask: 255.255.255.0
Default Gateway: 192.168.0.1

Connect your PC to the LiDAR using the cross-over cable into the RJ45-X port. Wait for both PCs to find the connection (usually 10 seconds or so). Now, go to 'Remote access software' step below.

iii. Control over a LAN.

It is also possible to attach the LiDAR to a LAN using a straight-wired network cable into the RJ45-BB input. The LiDAR is set to acquire an IP address automatically, and the address that is assigned will need to be known in order to use the remote connection software



2. Remote access software. [Back to contents]

After the LiDAR PC has been given time to boot up, run the client remote PC software on the connected PC.The following screen will be displayed:

Use **192.168.0.1** if connected using a crossover cable into RJ45-X.

If you are connecting over a LAN, you will need to enter the IP address that has been **assigned** to the system.

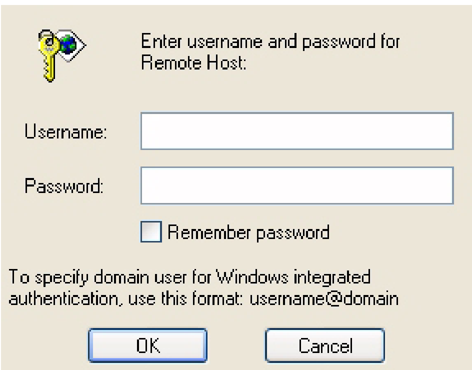
You may also see the computer name if you select the drop down menu. If you can see it, you can select it instead of entering an IP address.

If the connection is made via a crossover cable connected directly to RJ45-X on the LiDAR, then the following Remote computer name is used: **192.168.0.1**

If a LAN is being used, then the IP address that has been assigned to the LiDAR by the router will need to be entered **instead**. It's also possible that the LiDAR will be listed in the drop down menu – if it is, you should be able to use that instead of having to enter an IP address.

If the PC name isn't listed, the address that is assigned to the LiDAR by your dynamic DNS system must be used. To find this, it will be necessary to connect to the LiDAR using method i or ii as above, so that the IP assigned to the LAN connection can be observed. This IP address can then be used to connect to the system.

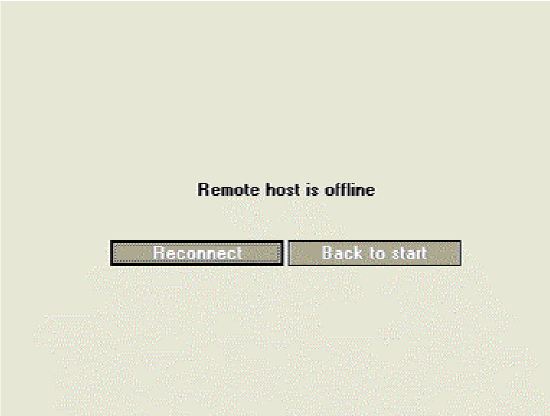
Once the appropriate IP address has been entered as shown above and the connect button clicked, the username and password dialogue box will appear.



Enter the **system serial number** for the **user name**, and the same reversed for the **password**. For example, 0102-03 for the username, and 30-2010 for the password including the **-** character.

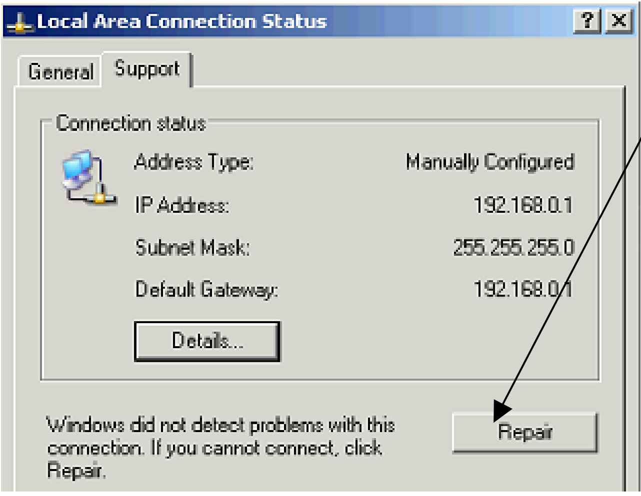
Click the 'Remember password' so that the username and password doesn't have to be entered each time a connection is made, then click OK to connect.

If the remote PC is physically switched off, or is having a problem connecting to the Internet or LAN, then the following message will be displayed after the 'Connect' button is pressed:

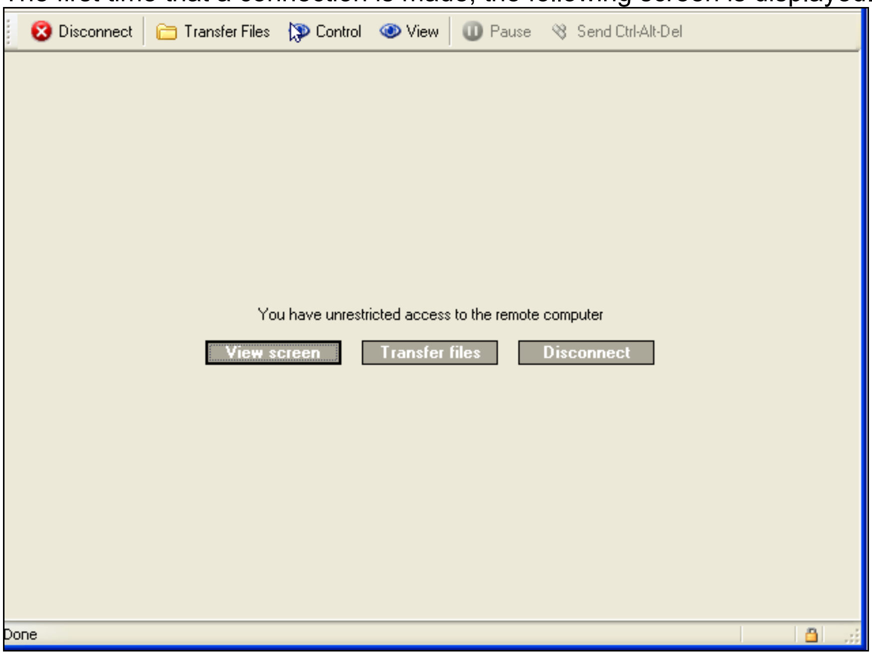


If connection is problematic, check that your attached PC is using the correct network settings and that the correct RJ connection and leads are being used. If the problem persists, follow this procedure:

Choose the network connections, choose the fixed IP connection number (double click), and then choose the support tab. If it's stuck on acquiring address or is having problems, click the 'Repair' button. It should then assign the 192.168.0.2 IP address.



The first time that a connection is made, the following screen is displayed.



Choose the '**View screen**' option to view the desktop display of the LiDAR PC. The software allows for file transfer across the connection, as well as an option to view only.

If the connection configuration and login details are all correct, then the desktop of the LiDAR PC will be displayed.

At the top of the window, there is a 'Disconnect' button, Transfer files, Control and View.

Control allows full control over the PC in every way, while ***View*** just allows viewing with no interaction.

The ***Transfer Files*** button will launch a Windows style drag and drop screen with the remote files on the right, and the local PC on the left. Transfer via this method will be at the connection speed of the LAN. If the LiDAR PC is taking data, then the transfer will be slowed down. **Be careful not to transfer or access any data files that are currently being written to, or sharing violations will occur.**

Control allows full control over the PC in every way, while ***View*** just allows viewing with no interaction.

NB. When viewing a remote desktop, it is easy to get confused with respect to which desktop belongs to each PC. It is recommended to alter the desktop appearance of the attached PC so as to make it sufficiently different to that of the LiDAR PC to minimise the risk of closing down by mistake.

Terminate the software when finished using the ***Disconnect*** button.

3. The desktop. [Back to contents]

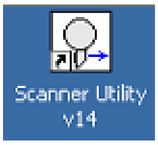
There are 4 software modules related to running the LiDAR:

Shutdown
Scan schedule
Stream Line v14
Scanner Utility

The corresponding icons are shown here (the order and icon may differ from shown):

The Stream Line main control software. Double click the icon to load and run it

The **scan schedule** is used to edit and schedule the scans that the main control software will use when running. This module can be run while the main control software is running.

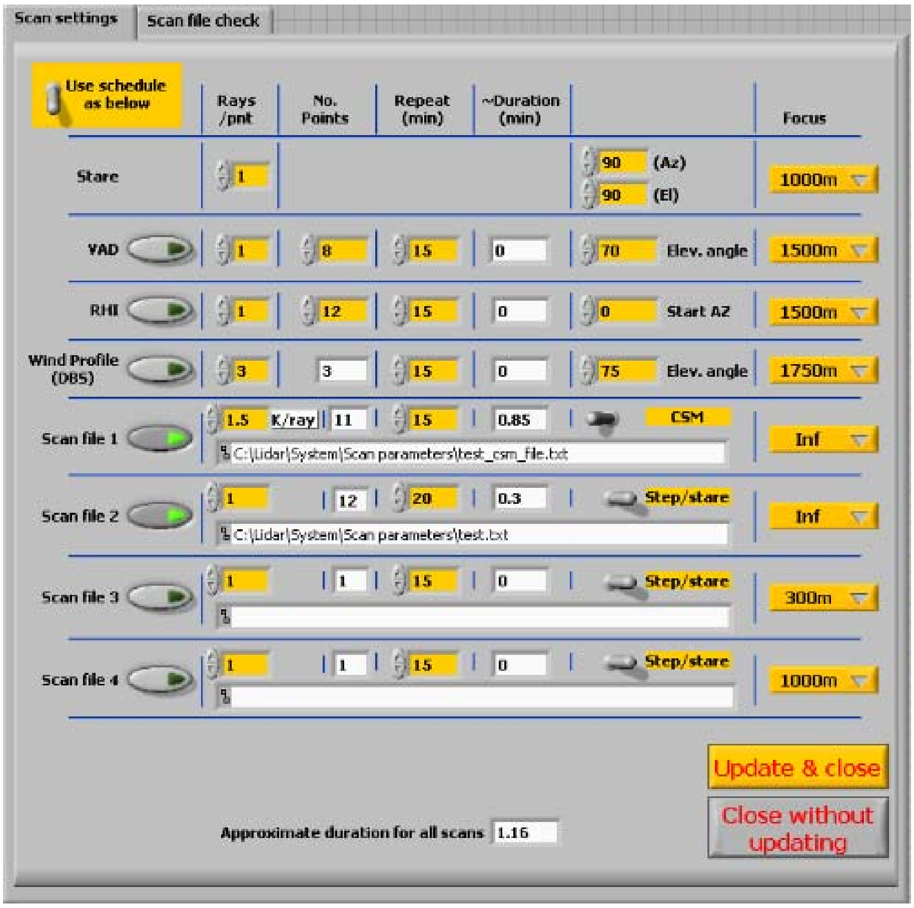


The Scanner utility software can only be used when no other software is running, and must be closed before other software is started. It is used to manually move the scanner, and to disable the motors.

The **Shutdown** module is used to power off the internal components when the LiDAR will be fully powered down prior to moving.

4. Scan Schedule. [Back to contents]

The **scan schedule** module is used to edit and schedule the scans that the main control software will use when running. This module can be run while the main control software is running.



The screenshot shows the front panel of the scan schedule software.

The previously used settings are displayed when this module runs.

The selection buttons on the left are used to enable the various **scan types**. If no scans are selected, the system will run in stare mode by default, using the Az and El co-ordinates as shown.

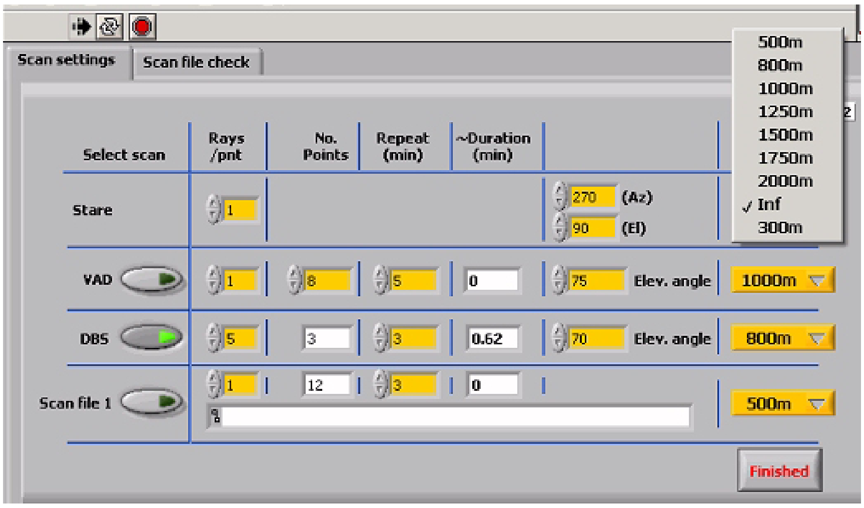
Note that Scan file 1 has been chosen to be a CSM scan type, whilst Scan file 2 is a step/stare scan type.
For these 2 different modes, the **Rays/pnt** field will change meaning. For step/stare mode, it will represent a multiple of the **Averages** number that is selected during the main software setup (1 x 10000 laser shots per ray for example) averaged at each of the scan positions. So a 2 here will mean that 20000 shots are averaged at each scan position. In CSM mode however, Rays/pnt will be labelled as **K/ray**, and will represent the number of individual laser shots (in thousands) that make up a ray – so 8 will be equivalent to 8000 laser shots, 30 will result in 30000 shots being averaged and so on.

The **No. Points** control is used to select the number of individual lines of sights making up the VAD and RHI scan, and they are both step/stare files by default.

The **Duration (min)** gives a rough guide to the time taken to execute each scan, with a total for all selected scans at the bottom of the column. The software will use **2.5 seconds per ray** to calculate all duration calculations (in step/stare mode). This allows for the time taken to move the scanner from point to point to be taken into account. The duration for CSM scans is also predicted using the wait, movement and speed numbers contained in the input scan file.

The **Repeat (min)** number represents the number of minutes between each start time of successive scan executions. The minimum repeat number will be roughly equal to the total duration time for all scans + 2 minutes. The **Approximate duration for all scans** display is re-calculated each time a scan is selected, deselected or changed.

The unlabelled column is used for inputting fixed angles of elevation or azimuth for the pre-defined scan types, or for selecting Step/stare or CSM scan types. **Select the scan type before pressing the selection button for the scan.**



Variable electronic focus

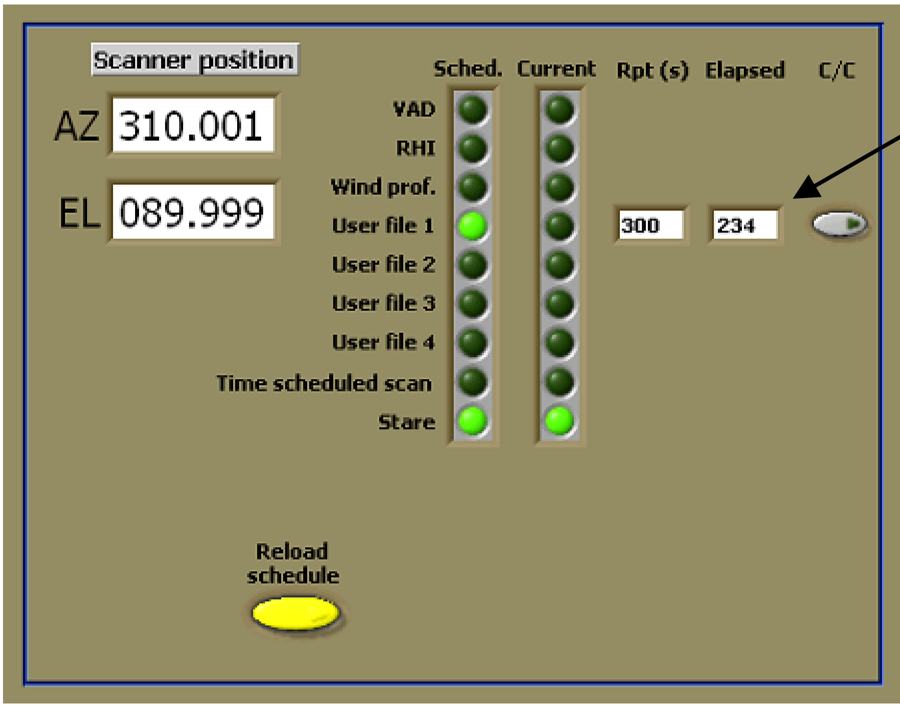
If your system has a variable electronic focus option (not available for XR systems), then it is also possible to choose a focus position for each of the scan types.

More information can be found here - Electronic focus

Close the software using one of the two options at the bottom right.

The **Update & close** button will update the scan parameters and schedule (even if no changes have been made). If the v14 main software module is running, then the **Reload schedule** button will toggle between normal appearance and yellow to indicate that a change has been made to the scan schedule, that has not been read in yet.

The system will not perform any scheduled scans until the **Reload schedule** button has been pressed. Once the button is pressed, all of the **Elapsed** displays will be reset to **0**.



Whilst the Reload button is flashing, any scan that reaches its elapsed scan time will be reset to 0.

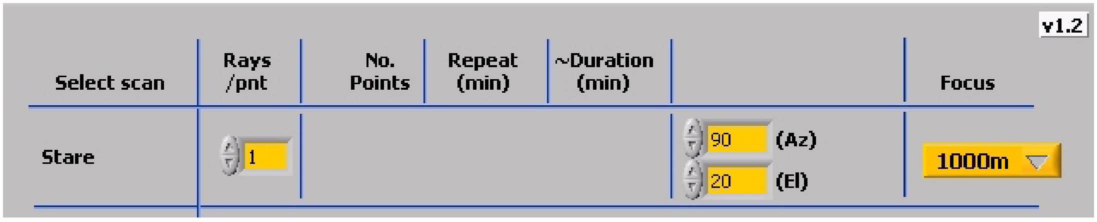
The C/C button will also have no effect until the Reload button is pressed.

The **Close without updating** button can be pressed to close the scan schedule software without making any changes to the scan schedule. Changes that have been made will be lost, and the main v14 software won't need to have the **Reload schedule** button pressed. This can be useful for situations where you want to check the schedule without changing anything.

5. Scan files. [Back to contents]

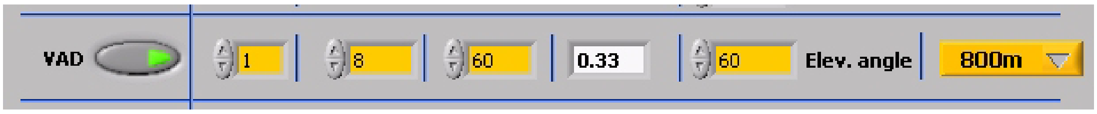
Stare co-ordinates for step/stare scan modes.

The stare co-ordinates are used by default when the LiDAR software is started and when no other scan files are being executed. A suitable staring position can be entered into the Az and El fields. **If a vertical stare is used, then it's best to avoid an azimuth of zero degrees, otherwise the elevation pod will be located directly over the wiping brush.**



If the wiping brush becomes very distorted, it can be reshaped while wet, and dried straight. It can be removed by unscrewing two M3 grub screws that can be accessed from the side of the heat shield.

VAD scans.

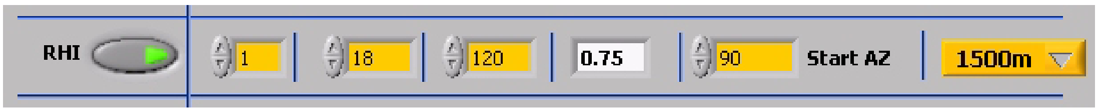


To add a VAD scanning routine to the current schedule, press the **VAD** button. The various options for the VAD scan are selected by altering the editable (yellow) boxes.

If the above settings were used, the scan schedule would be set as follows:

- On main system start up, (for example the time is 09:50) data would be collected with the beam set to the vertical position until 10:50.
- At 10:50, a VAD scan would be performed consisting of 8 rays at 60 degrees elevation from horizontal with 45 degrees in azimuth between them (360 / 8). The first ray would be at 0 degrees in azimuth, the next at 45 degrees and so on.
- After the VAD scan is finished, (the time is now approximately 10:51), the system goes back to staring vertically until ~ 11:50.
- The repetition time is counted from the beginning of a scan file to the next beginning, and not from when a scan finishes. E.g. 10-minute repeats with a scan duration of 2 minutes will produce a scan every 10 minutes – not every 12 minutes.

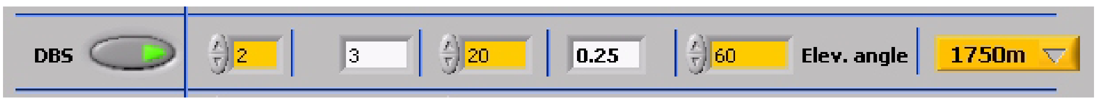
RHI scans.



The input parameters for an RHI scan are similar to those of the VAD type. The starting azimuth will be the bearing of the first point at 0 degrees elevation. For the example above, the scanner will move to 10 degrees elevation for the next point, then to 20 degrees etc. finishing at 180 degrees elevation (or 0 degrees at 270 degrees azimuth equivalent). The RHI always starts and finishes at the horizontal orientation.

The RHI example above will repeat every 2 hours. As the VAD is set to repeat every hour, they will coincide every 3rd hour. In that situation, the VAD scan will execute, immediately followed by the RHI scan. As usual, the system will be orientated in the stare mode when no other scan types are in progress.

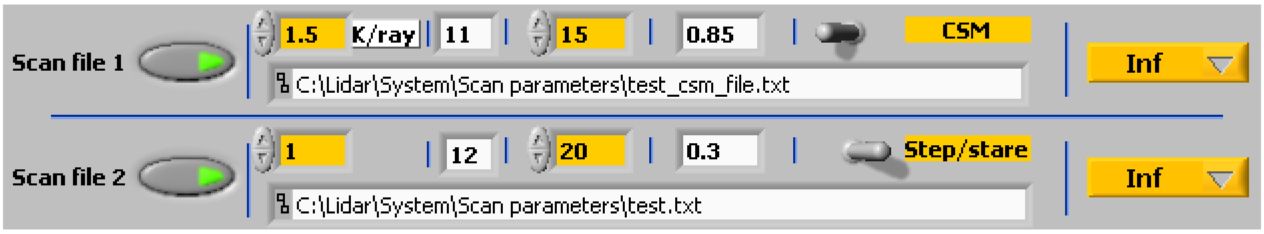
Wind profile – (DBS).



The wind profile pattern uses the same measurement configuration as some RADAR wind profilers, scanning 3 beams, one vertically pointing, one at a set elevation angle to the North, and another towards the East.

The options available for the wind profile scan are to select the number of rays averaged for each position, the repeat time in minutes, the elevation angle (from horizontal) and the focus if enabled.

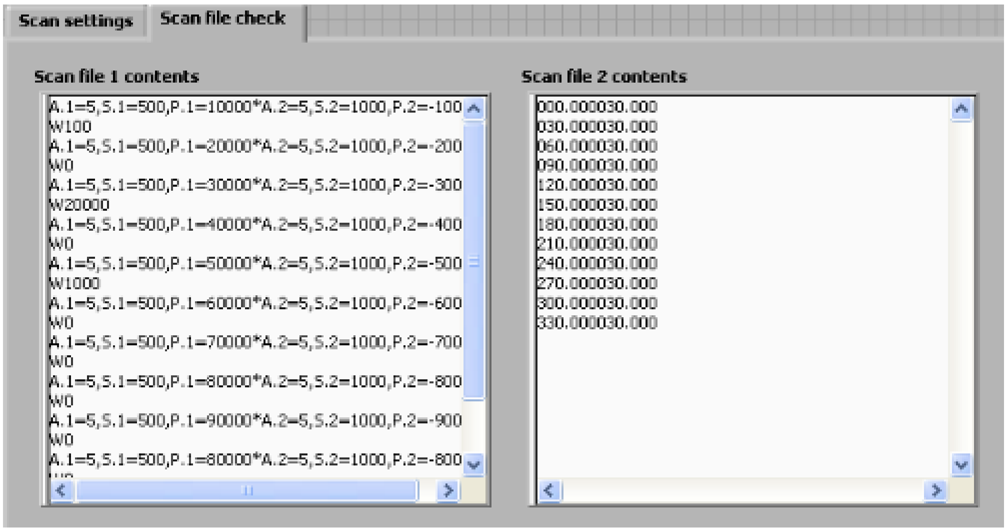
User generated scan files in step/stare mode.



The scan file option is used to input a user generated scan pattern, which can consist of any number of co-ordinate pairs within the 2π steradian field of regard.

Choose the scan type first, **CSM** or **Step/stare** – then press the scan file button to open a file browse window. Choose the appropriate scan file – making sure that it is in the correct format for the type chosen. The approximate scan duration, number of points etc. will be displayed.

The file contents can be checked by selecting the **Scan file check** tab at the top of the panel. The two formats are shown below. Scan file 1 is a CSM type, and Scan file 2 is a Step/stare scan type. Note that it is not possible to edit the scan files on this display. To edit the file, open it into a text editor, and when finished, reload it into the schedule software and ensure that the changes are reflected in the check display.



5.1 Creating a custom scan file for use in step/stare mode. [Back to contents]

When a step/stare scan file executes, the scanner will move to each set of co-ordinates in turn until the end of the file. Motion will be at a fixed speed and acceleration. If a bearing offset has been used, it will be taken into account for the azimuth positions, so 90 degrees in azimuth as chosen in the scan file will always result in the LiDAR pointing to the East – assuming that the system has been aligned to point North when homed.

To create a custom scan file, open a simple text editor such as notepad, and enter pairs of azimuth and elevation co-ordinates. The following format must be used for the co-ordinate pairs:

1st pair (AzimuthElevation) in the form 012.345123.456 – both must be **zero padded** f6.3 format. 2nd pair . last pair

Example file: (3 pairs of co-ordinates)

001.004090.000
295.004-10.000
025.004040.000

Negative numbers can be used for elevation angles, as long as the 3.3 convention remains – as shown in the example file above.

Save the co-ordinate list as a .txt file – it can be named appropriately to describe the scan pattern that it represents. Many files can be produced and saved using this method.

Scan files that have been created in a text editor can be loaded from any location – but it is suggested that step/stare scan files are stored in the C:\Lidar\System\Scan parameters\Step_Stare_Scan_Files directory, and CSM files in the CSM_Scan_Files directory. When the scan schedule software reads custom scan text files for use with the control software, it will add some header lines and save them into the C:\Lidar\System\Scan parameters\ directory. The original files will not be altered in any way.

5.2 Creating a custom scan file for use in CSM mode. [Back to contents]

CSM scanner positioning is performed with reference to the scanner's home position, which is where each motor is at 0 encoder counts.

For each movement, an acceleration (**A**), speed (**S**) and position (**P**) must be specified for each motor. All movements are absolute, and with reference to the home position – and any correction bearing entered or used during set-up will **not** be taken into account. For this reason, it may be easier to always make sure that the system is aligned to north and zero is used for the bearing.

Motor resolution.

Azimuth encoder counts per full rotation = 500000 (1º = 500000/360º = 1388.88 pulses)
Elevation encoder counts per full rotation = 250000 (1º = 250000/360º = 694.44 pulses)

This number will be rounded up or down, as the motors cannot accept fractions of 1 count. 1 count is equal to 0.00072º for the azimuth motor, and 0.0014º for the elevation.

Rounding error for the motors.

The following two examples show the relative rounding error for the azimuth motor. The same effect applies to the elevation motor.

1 degree = 1388.88 rounded to 1389 giving 0.12 pulse counts in rounding error (0.000086º).
2.875 degrees = 2.875 x 1388.88 = 3993.03 rounded to 3993 giving 0.03 pulse counts in rounding error (0.000021º).

Movement commands.

The position (**P**) number is increased for rotations in one direction, and decreased to reverse the direction.

To move the azimuth ccw one complete rotation, 500000 would be sent as a position. To move it back cw again, 0 would be sent. To move it cw 2 full rotations, -1000000 would be sent, to move it ccw 1 rotation, -500000 would be sent (not 500000 – which would be 3 rotations ccw).

Speed (**S**) is defined in 10's of pulses per second. Try a speed of 500 to 1000 to start with, and don't go above 5000. So, one rotation of 500000 pulses at a speed of 5000 will take 10 seconds, ignoring the acceleration time. Because S is defined in units of 10's of pulses per second, the 5000 becomes 50000.
Acceleration (**A**) is defined in 1000's of pulses per second/second. Max = 50.
Wait (**W**) in milliseconds at each of the points. Set this to 0 if no wait is required.

Example CSM mode program:

```
A.1=5,S.1=500,P.1=10000*A.2=5,S.2=1000,P.2=-10000
W100
A.1=5,S.1=500,P.1=20000*A.2=5,S.2=1000,P.2=-20000
W0
A.1=5,S.1=500,P.1=30000*A.2=5,S.2=1000,P.2=-30000
W20000
A.1=5,S.1=500,P.1=40000*A.2=5,S.2=1000,P.2=-40000
W0
A.1=5,S.1=500,P.1=50000*A.2=5,S.2=1000,P.2=-50000
W1000
A.1=5,S.1=500,P.1=60000*A.2=5,S.2=1000,P.2=-60000
W0
A.1=5,S.1=500,P.1=70000*A.2=5,S.2=1000,P.2=-70000
W0
A.1=5,S.1=500,P.1=80000*A.2=5,S.2=1000,P.2=-80000
W0
A.1=5,S.1=500,P.1=90000*A.2=5,S.2=1000,P.2=-90000
W0
A.1=5,S.1=500,P.1=80000*A.2=5,S.2=1000,P.2=-80000
W0
A.1=5,S.1=500,P.1=70000*A.2=5,S.2=1000,P.2=-70000
W200
```

Must end with a 'W' command.

Check that there are no blank lines at the end of the file.

The motor movement definitions follow a pattern of A.1,S.1,P.1 followed by a * delimiter then A.2,S.2,P.2. There is a wait after each position. The last line of the program is the last wait for the last position.

The first line will be the starting position for the scanner, and it will be moved to from whatever position the scanner was in immediately before this scan is started. If the scanner is **more than one full rotation** away from this starting position in azimuth, then the scanner will **home** before moving to the start position. This is necessary because the scanner could be many rotations away from the start point (in terms of encoder counts), and would go round and round in order to reach the first azimuth position.

The first position's speed and acceleration are not used because they are both defined by the software, and are 5000 for speed, and 30 for acceleration (the default for all step/stare motion), so the A and S numbers for the first position are ignored – but they must still be included.

The W100 will be used as the pause at the starting position, and is 0.1 seconds (for this example).

All of the remaining motion and wait commands will be used as specified.

Important notes.

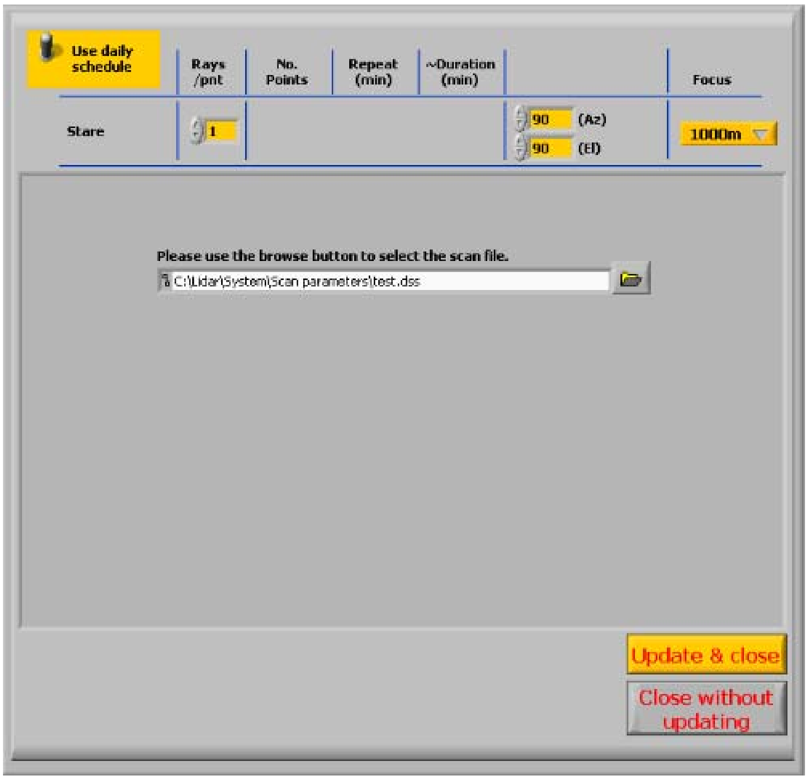
- Motor 1 moves the azimuth, and motor 2 the elevation. The .1 and .2 after each motion parameter indicates whether motor 1 or 2 is being addressed.
- Normal step/stare motion is performed with 5000 for Speed (both motors), and 30 for the azimuth acceleration, and 50 for the elevation acceleration.
- Always use this A.1,S.1,P.1*A.2,S.2,P.2 format with no spaces and no commas in the position numbers.
- Always put a W = command after a position line, even if no wait is needed (W=0).
- Always provide positions for both motors, even if only one motor needs to be moved – i.e. simply repeat the same position command as the last movement for a null movement.
- Use **no more** than **50** for **Acceleration**.
- Use **no more** than **5000** for **Speed**.
- The max pulse count can be +/- 1bn.
- Motors will be started and move at the same time (unless one of them is repeating a previous command), and the scanner will wait for both motors to stop before progressing to the next command.
- There is no maximum number of positions.

If you need some help creating CSM programs – please contact Halo.

5.3 Using the daily scan schedule. [Back to contents]

The daily scan schedule (DSS) offers another way of scheduling scan files. It allows both step/stare and CSM scan files to be scheduled with respect to the time of day. It may be useful to use this mode in situations where it is necessary for the beginning of a scan to coincide with another timed event. The daily scan schedule has no limit to the number of scans that can be scheduled, while the regular scan schedule mode has a limit of 4 user scan files.

When the daily schedule mode is selected, the stare mode is the only other available scan type.



A daily scan schedule file containing all of the scan timings, filenames etc. must be selected.

Press the file browser icon  to choose an appropriate schedule file that has been created in a text editor.

It is advised these files are saved with an easily identifiable file extension (like .dss for example) to avoid confusion with other files. The DSS file can be saved to any location, but it is advised that it be located in the C:\Lidar\System\Scan parameters directory.

Press the **Update and close** button to save the new schedule, or the **Close without updating** button to dismiss changes to the existing schedule.

Example DSS file.

150400	S_Vad_70	1	S	0
151000	S_Vad_60	1	S	0
152000	C_Vad_15	5	C	0
154700	S_Vad_70	1	S	0
155500	C_Vad_25	5	C	0
170100	C_Vad_25	5	C	0
170725	C_Vad_25	5	C	0
172000	C_Vad_25	5	C	0
173000	C_Vad_25	5	C	0
174000	C_Vad_25	5	C	0

Note the use of a **C_** and a **S_** in the filename to help identify CSM and step/stare files. This is recommended because daily scan files are all stored together in the **Daily_Scan_Files** directory.

The file must be a **tab delimited** text file containing the time in **hhmmss**, then the **filename** of the scan (**without** the .txt extension), then the **k/samples** per ray for CSM or **averaging loops** for step/stare files, whether the scan is of step/stare **S** or CSM **C** type, and then the **focus** position. The focus position is not used in XR systems, but the value **must be present** in the daily scan schedule file.

Focus: 0=500m, 1=800m, 2=1000m, 3=1250m, 4=1500m, 5=1750m, 6=2000m, 7=Infinity, 8=300m

The scan files that are referred to in the schedule **must be located** in the C:\Lidar\System\Scan parameters\Daily_Scan_Files directory and have a **.txt** extension.

Example CSM file (C_Vad_15 in the example, and saved as C_Vad_15.txt in the Daily_Scan_Files directory).	Example daily step/stare file (S_Vad_70 in the example).
A.1=10,S.1=1000,P.1=0*A.2=10,S.2=5000,P.2=-694 W100 A.1=10,S.1=2000,P.1=500000*A.2=10,S.2=5000,P.2=-10417 W2000	000.000090.000 000.000070.000 090.000070.000 180.000070.000 270.000070.000

Summary of Scan files formats and locations.

'Daily_Scan_Files' Directory
Scan files for use with the daily scan schedule mode. These files are in the standard CSM and step/stare format:

A.1=10,S.1=1000,P.1=0*A.2=10,S.2=5000,P.2=-694 W100 A.1=10,S.1=2000,P.1=5000*A.2=10,S.2=5000,P.2=-694 W2000	000.000090.000 000.000070.000 090.000070.000 180.000270.000 270.000070.000

'CSM_Scan_Files' Directory
This directory can be used to store CSM files, which are selected as one of four user files in the scan schedule software. It's not essential that they are stored here, but it is important not to mix up step/stare and CSM files.

```
A.1=10,S.1=1000,P.1=0*A.2=10,S.2=5000,P.2=-694
W100
A.1=10,S.1=2000,P.1=500000*A.2=10,S.2=5000,P.2=-694
W2000
```

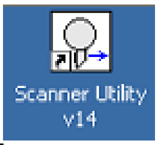
'Step_Stare_Scan_Files' Directory
This directory can be used to store step/stare files, which are selected as one of four user files in the scan schedule software. It's not essential that they are stored here, but it is important not to mix up step/stare and CSM files.

```
000.000090.000
000.000070.000
090.000070.000
180.000270.000
270.000070.000
```

'Feedback_Scan_Files' Directory
This directory contains scan files (with a **.sc4** extension) that are used in an optional feedback mode, where the derived bearing from the last DBS scan is used to select the next User 4 scan file. This mode is not enabled by default, but if you would like more information about it, please let us know.

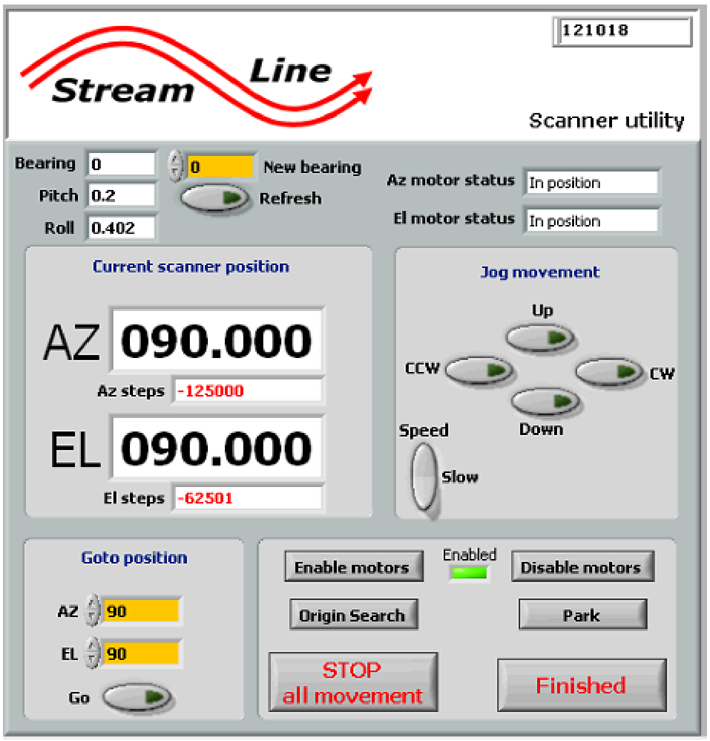
```
1
12
2
000.000030.000
030.000030.000
060.000030.000
090.000030.000
```

6. Scanner utility. [Back to contents]



This module allows the scanner to be moved manually and can be useful in observing scan co-ordinates or motor encoder counts for a user generated scan file. It **cannot** be run or open while the main LiDAR software is running.

This software is not to be used while any other data collection software is running, as both will try to communicate with the scanner simultaneously, which will cause problems.



The **Bearing** display shows the bearing that the LiDAR is currently using for its orientation. If it is incorrect, enter the correct orientation bearing into the yellow **New bearing** box and press **Refresh**.

Note that if a new bearing is entered, the azimuth readout (in degrees) will be updated to reflect the bearing offset, but the **Az steps** display will still show the same before and after. This is because the motor encoder uses absolute positioning with reference to the home position.

The **Pitch** and **Roll** will be displayed, and the legs should be adjusted to achieve as close to 0.00 as possible in both pitch and roll.

The **Current position** is read back from the scanner and displayed at a resolution of 1/1000th of a degree. The readout is updated even when the scan motors are disabled. The encoder step number for each motor is displayed below its current angle in degrees. This can be useful during **CSM** mode programming to check the angle versus encoder step number.

The **Goto** feature is used to give precise positioning of both axes simultaneously – both values will be sent to the scanner each time the **Go** button is pressed. Angle resolutions of up to 1/1000th of a degree can be entered.

The **Jog movement** allows coarse and fine adjustments. **'Up'** relates to the scanner elevation increasing in angle from 0 degrees (horizontal). **'CW'** moves the scanner in increasing angle in a clockwise direction when viewed from above.

Both motors can be **Enabled** and **Disabled** – angle reading will continue while the motors are disabled. This can be useful when moving the scanner round by hand to determine a position manually

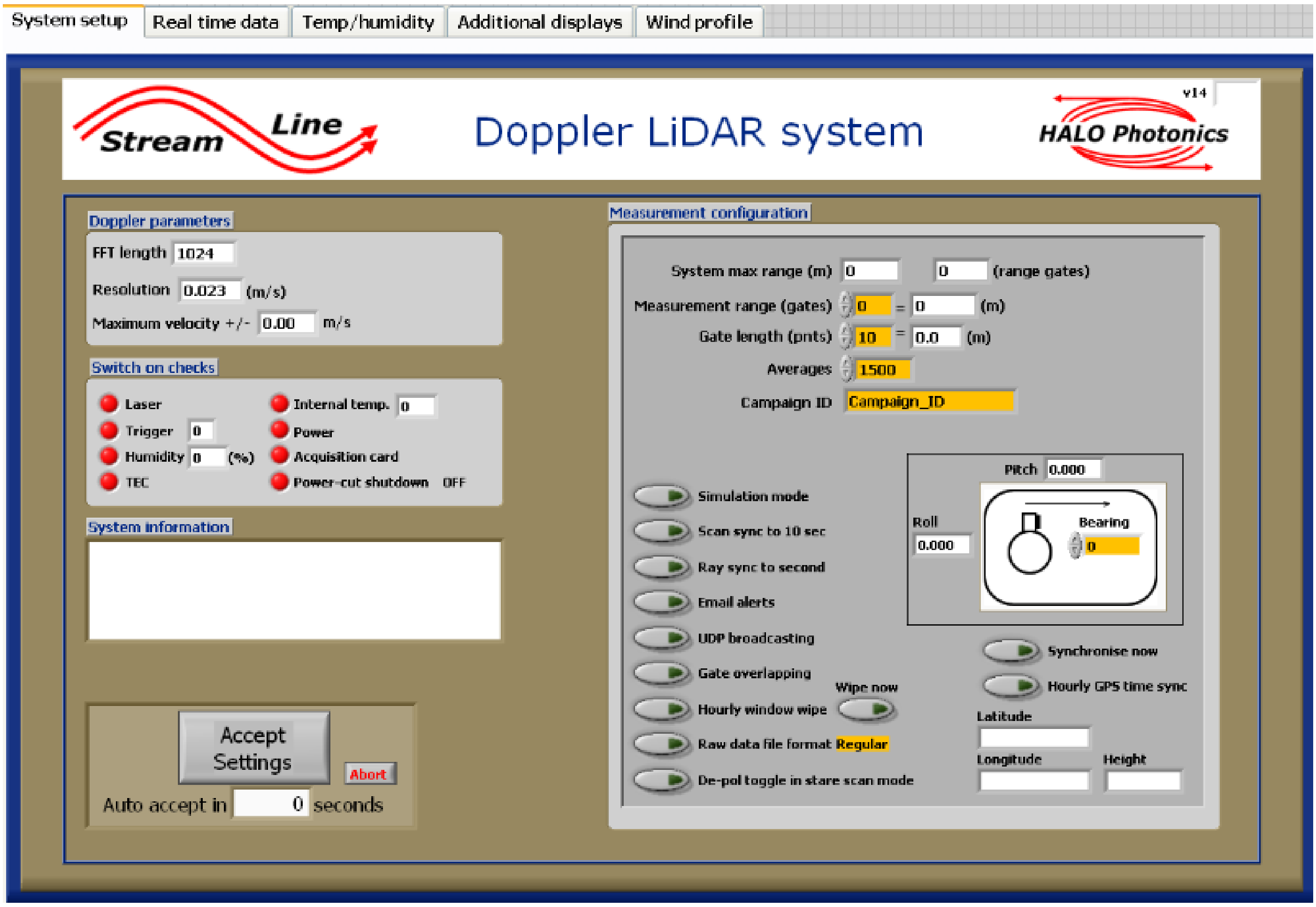
An **Origin search** will place the motor in the home (0,0) position. If the scanner doesn't move, make sure that the motors are enabled.

Parking the scanner places it in a looking down position over its heat shield.

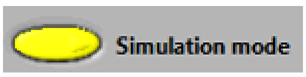
Press the  to stop and close the software.

7. Main control software. [Back to contents]

When the software is loaded the following screen is displayed:



It is possible to run the system with no optical output (for example, if running indoors for a demo) by pressing the **Simulation mode** button during the first 8 seconds of program run time (button flashes yellow). After 8 seconds, the button will disappear.



The **System information** box will display system messages and information.

The **Doppler parameters** are shown for information only. The FFT parameter is set to 1024 by default. This can be changed if needed – but please consult Halo to make sure that the change is necessary.

The **Switch on checks** will commence once the software is started. If the software has been previously stopped, it can be restarted by pressing the run arrow  - top left. The **TEC** status will be displayed if your system has the active or extended temperature option fitted. A scanner check (and re-home) may take place when the software starts.

All the red lights in the **Switch on checks** panel should turn green if the system is ok (and not in Simulation mode). If a failure occurs, then the software may stop and a message should appear in the **System information** box. Allow up to 15 seconds for the tests to complete.

Once the tests are complete, the previous settings will be loaded into all the parameter boxes and there is the option to change them before pressing the **Accept settings** button. The system will auto accept in 6 minutes if the accept button is not pressed. This is a system recovery feature and is to make sure that if the system comes on after power failure, the software progresses past this point. The **Abort** button can be used to stop the software from progressing further.

While the software is taking data, it is possible to navigate to any of the other tab displays. It is not possible however to alter any settings on the 'System setup' screen unless the 'Change LiDAR settings' button is first pressed.

Measurement range - The system's maximum measurement range is displayed in metres and range gates. The max desired measurement range (gate number) is selected by entering it into the yellow box. [Click outside the box, or press Enter to enter the number].
Lowering the maximum measurement range will reduce the processed data file size.

The **Gate length** shown in data points at a sample rate of 50MHz. The default is 10, but this can be increased in 2's. Increasing the gate length will increase the spectral resolution to the detriment of the range resolution.

Choose the number of **Averages** for each ray in step/stare mode. The minimum is 500 and the maximum is 15000. If more averages are required, then a multiplier of the Averages number can be specified in the scan schedule software Rays/pnt control.

The graphic shows the relevant LiDAR alignment for which the **Bearing** input applies. The previous bearing is shown and will be used if not updated. Try to align the LiDAR to face North in the home position if possible, meaning a Bearing of 0 is used.

The **hourly wipe** option will cause the window to be wiped every hour. A window wipe can be initiated at any time (except during CSM mode scans) by pressing the **Wipe now** button.

The **Power-cut shutdown** control system status is shown. The Stream Line LiDAR has a UPS module with the necessary circuitry to enable the shutdown feature, so this should always be displayed and have a green LED illuminated. If it is not shown, it may mean there is a fault with the UPS module.

The **Campaign ID** can be filled in with a short one-line description of the current measurement campaign. Some system data is saved to the campaign log as shown below:

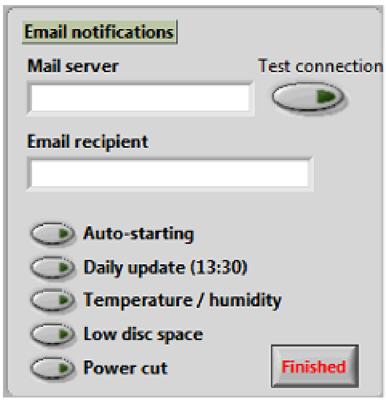
```
********************************
Lat:      52 10' 45.86"N
Long:     2 19' 47.60"W
Height:   00030.5
Bearing:  0.0
Temperature:    24.63
Humidity:       6.00
PIN:      7.90
Roll:     -0.31
Pitch:    -0.10
Started:  02/03/15 16:46:30
********************************
```

Each time the software is started, another set of parameters is saved to the campaign file. If the same campaign ID is used on subsequent software start-ups, another set of parameters will be written to the same campaign file.

The **De-pol** switch (if the optional depolarisation channel is fitted) will cause the de-polarisation toggle to activate when the system is in **stare mode only**. Data from the cross-polarisation will be stored in separate files in the 'cross' directory within the 'proc' and 'raw' data directories.

The **Gate overlapping** button toggles the function that either processes the range gates in an end to end, or in an overlapped by one sample point arrangement. See diagram.

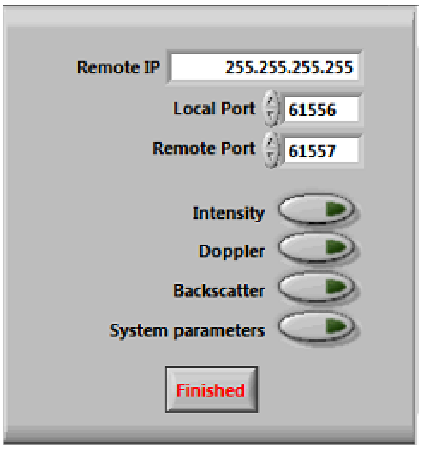
Email alerts can be enabled and individually selected, that will (with an Internet connection, and accessible email server), allow the system to send alert mails. For example, if the system experiences an over temperature state, low disk space, a power cut, auto-starting after a power cut, and also a general daily status. A pop-up window will appear whenever the Email alerts button changes from the OFF position to the ON position during system setup.



The **Mail server** and **Email recipient** can be entered into the relevant boxes. Test the connection to ensure that the software is able to communicate with the email server. Select the required alerts. Press the Finished button to save the settings and close the window.

When **UDP data broadcasting** is enabled, some data fields will be broadcast to a remote IP and Port. A valid LAN or Internet connection is needed for this function, although the loss of connection won't adversely affect the system as the UDP method of broadcasting is insensitive to network problems. For example, the network cable can be removed during broadcasting, and the system will be unaffected.

The following window will be displayed when the button position changes from the OFF position to the ON position during system setup.



Choose an appropriate IP address and port to broadcast the data to, and the fields to be broadcast. Note that raw data is too large to send using UDP, and there could be data loss for processed data taken to long range when gate overlapping is enabled. It will depend to some extent on the speed and quality of the network connection.

Press the **Finished** button to save the settings and close the window.

The UDP data format is described in section 12 - UDP data broadcasting

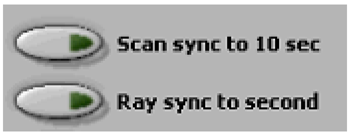
The **Raw data** format can be chosen to be of the legacy format, or AET – which will include the background data (1 ray of 4000 data points for 10kHz systems, and 3200 data points for 15kHz systems) at the beginning of the file, and then the azimuth, elevation and decimal time for each ray.

Gate overlapping is covered in the next section.

Scan and ray synchronisation.

The **Scan sync to 10 sec** forces the start of a scan to coincide with a whole number of tens of seconds (i.e. 00, 10, 20 seconds). This can be useful where more than 1 system are being synchronised – for duel Doppler scans for example.

Ray syncing will mean that each ray's acquisition is started with the changeover of a second, rather than as fast as the software loop iteration will allow.



Care needs to be taken to ensure that the number of averages is selected accordingly. For example, a 15kHz system set to acquire 15000 averages per ray will take slightly longer than 1 second to complete the acquisition, processing and logging. If the ray sync to 1 second was enabled for this example, then one ray would be collected every 2 seconds.

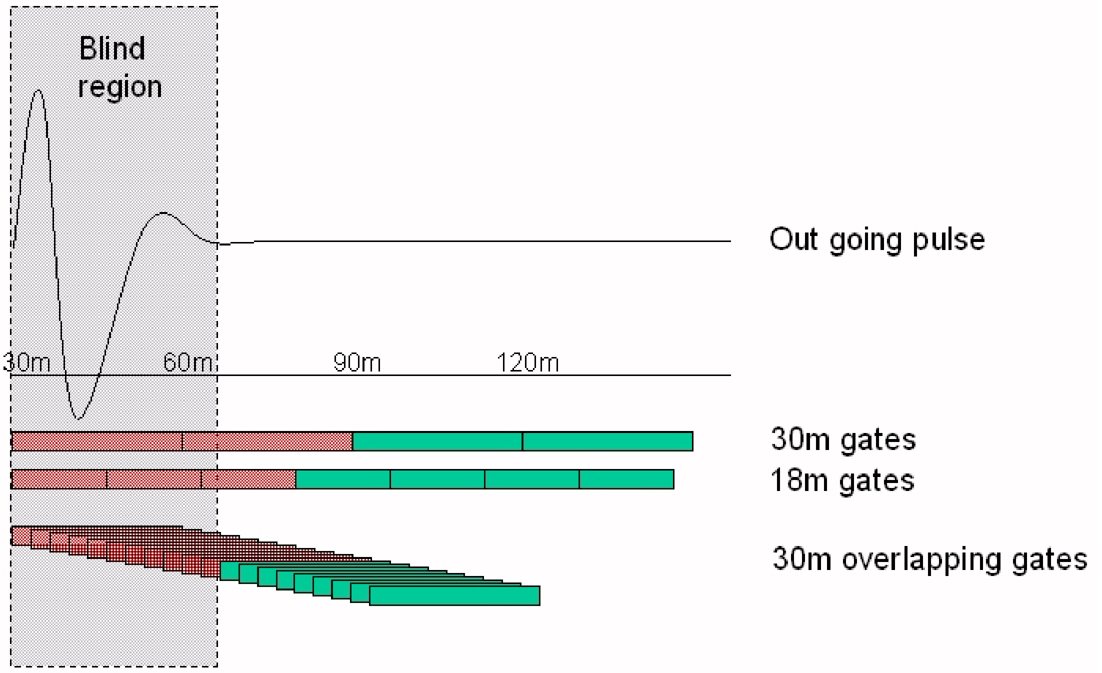
Both sync modes are only activated during **step/stare** mode.

It is important to test the functionality of these various operating modes fully before leaving a system unattended in the field.

After the required settings have been selected, and the **Accept settings** button has been pressed, the settings will be saved and become the new default values that the system will use for the next start up.

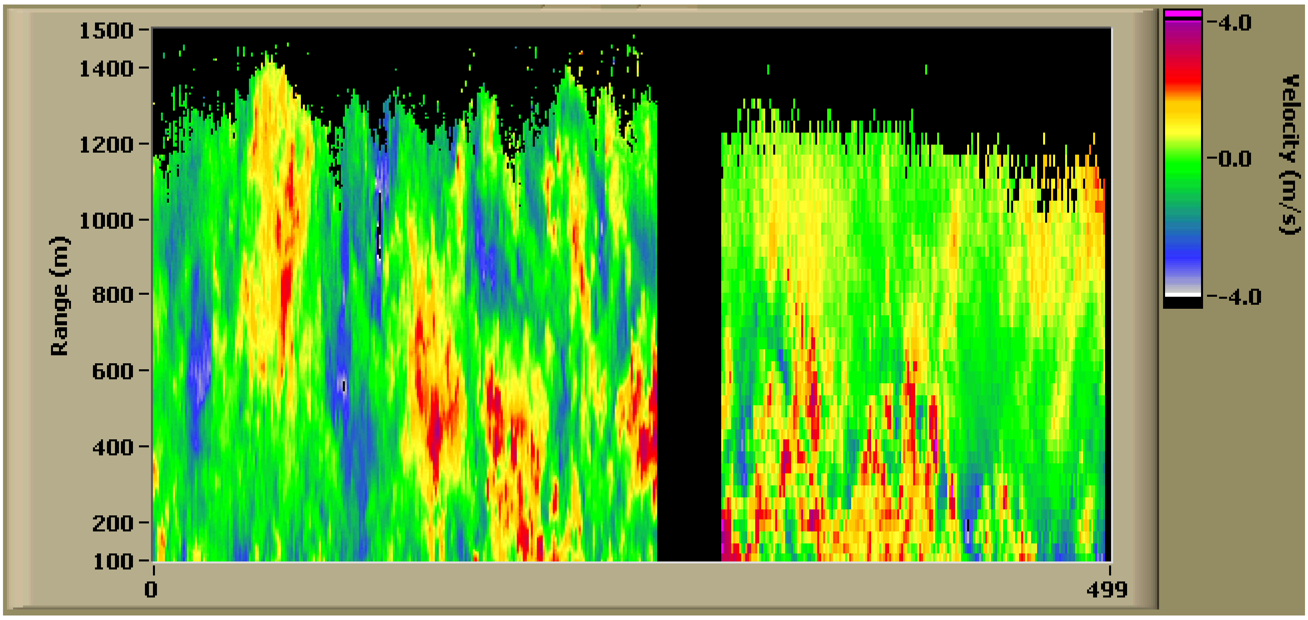
7.1 Gate overlap mode. [Back to contents]

The diagram shows how the contamination from the out-going pulse means that some of the near range-gates are contaminated. (Note that each system has a different minimum range, and the diagram is purely for reference, and not a representation of the actual minimum range of your system.)
If the range gates are set up so that some of this contamination is contained within them, then usually the whole gate is adversely affected (shown as red gates). It can be seen that in overlapped mode, the first 'good' gate happens as soon as possible after the contamination area, and yields a better minimum range than having 30m or 18m set in conventional non-overlapped mode.

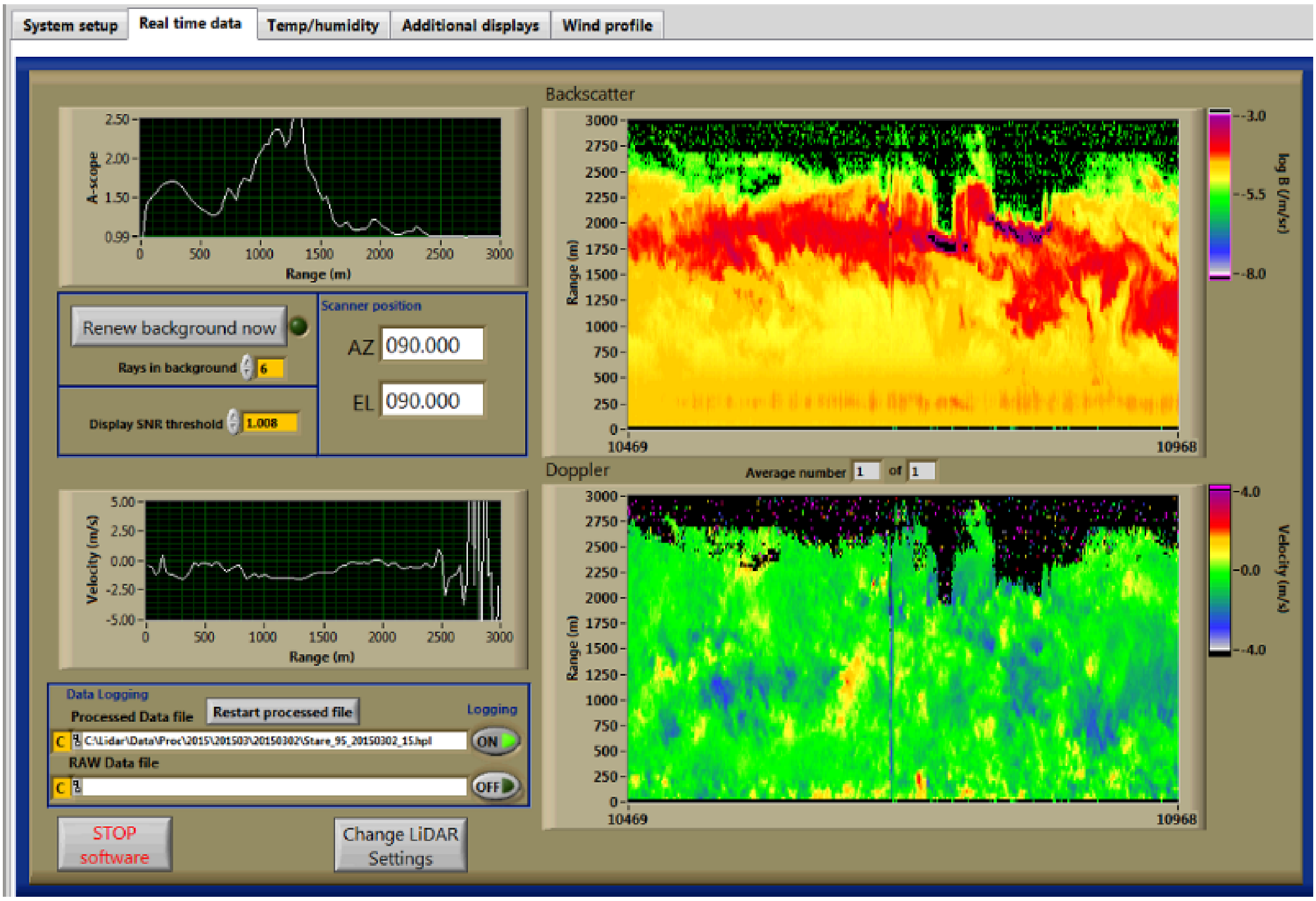


Enabling the overlapping will result in more processed data being saved to the hard drive. With 10 points per gate selected, 10x more processed data will be saved. Raw data is unaffected, and its size will be determined by the prf of each system (10kHz or 15kHz).

The difference between the overlapped (before the break), and non-overlapped is shown below. Overlapping ensures that the minimum range is as low as possible.



7.2 Real time data display. [Back to contents]



The **Scanner position**, the **A-scope** or power versus range and the **Doppler velocity** versus range are displayed on the left. The backscatter and Doppler returns are shown on the right hand waterfall plots, with colourised Z-axes.

The **Data logging** section shows the file names of the current log files for both processed and raw data. The processed logging button is on by default unless manually switched off. The position of the raw data logging button will be stored and used for the next program start. Pressing the **Restart file** button will cause the current **processed** data file to be deleted and restarted. More details about logging to an attached drive are provided in 7.3 Data logging.

The **Background** file is used to remove any (non white) features present in the noise floor. A new file is taken every hour, (unless a scan file is running at the hourly change), at which time the scanner will move to the parked position to ensure that no atmospheric return is present. The number of rays that are averaged for the background can be changed if necessary. The **Renew background** button can be pressed if a bias in the Doppler display is evident.

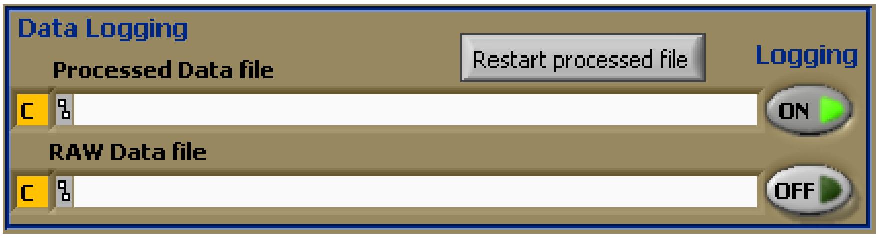
Pressing the **Change LiDAR settings** button will cause the current data taking to pause, while new settings are chosen on the set up screen – in the same way that they were initially chosen on start up.

If more than 2 rays are being averaged at each step/stare point, then this is displayed on the **Average number** display.

Scale settings.
Graph axis ranges can be altered by double clicking the graph x,y and z scale labels and entering new values. Auto scaling may need to be disabled to maintain new axis values. To disable auto scaling, right-click over the relevant scale and deselect the Auto scaling option.

The **Display SNR threshold** can be changed to reduce or increase the amount of noise that is shown on the colour charts. The Doppler chart will only display points where the equivalent A-scope data is equal to, or above the chosen threshold. Choosing a value like 0.9 will ensure that all data are displayed, and something like 1.005 will reduce low signal regions. The chosen setting will not affect the logged data in any way, just the real time display.

7.3 Data logging. [[Back to contents]]



Data logging destination drive.
The destination drive letter can be chosen, either before the logging buttons are pressed, or while data logging is enabled. If a drive letter other than ‘C’ is chosen (in the yellow background control), then the software will check for a valid drive connection and also that there is more than 1GB of storage space available. If either check fails, then the data are logged by default to the C drive. The directory structure described below will be used regardless of which drive letter is selected.

A LAN connected drive, or a directly connected (and externally powered) USB drive can be selected. The drive letter, and the button position will be saved and used at next program start up.

Logging to a drive other than the LiDAR’s C drive will reduce acquisition speed.

Data are logged using the following directory structures:

C:Lidar\Data\Proc\yyyy\yyyymm\yyyymmdd\ - for processed data

C:Lidar\Data\Raw\yyyy\yyyymm\yyyymmdd\ - for raw data

And with the following naming convention:

Stare_ID_yyyymmdd_hh.hpl – for stare files (.raw for raw data files)

If the optional de-polarisation channel is fitted, then the directory structure will be as above with the additional **‘cross’** folder in both the raw and processed directories.

For other scan types, the naming convention is as shown:

VAD_ID_yyyymmdd_hhmmss.hpl (.raw for raw data files)
RHI_ID_yyyymmdd_hhmmss.hpl
Wind_Profile_ID_yyyymmdd_hhmmss.hpl
User**n**_ID_yyyymmdd_hhmmss.hpl (**n** = user file number - 1 to 5)

All data files are appended to, therefore reducing the risk of loss of data due to power failure. **When copying data from the PC, avoid copying the current data files to reduce the risk of file sharing.**

Typical staring data file header and data format:

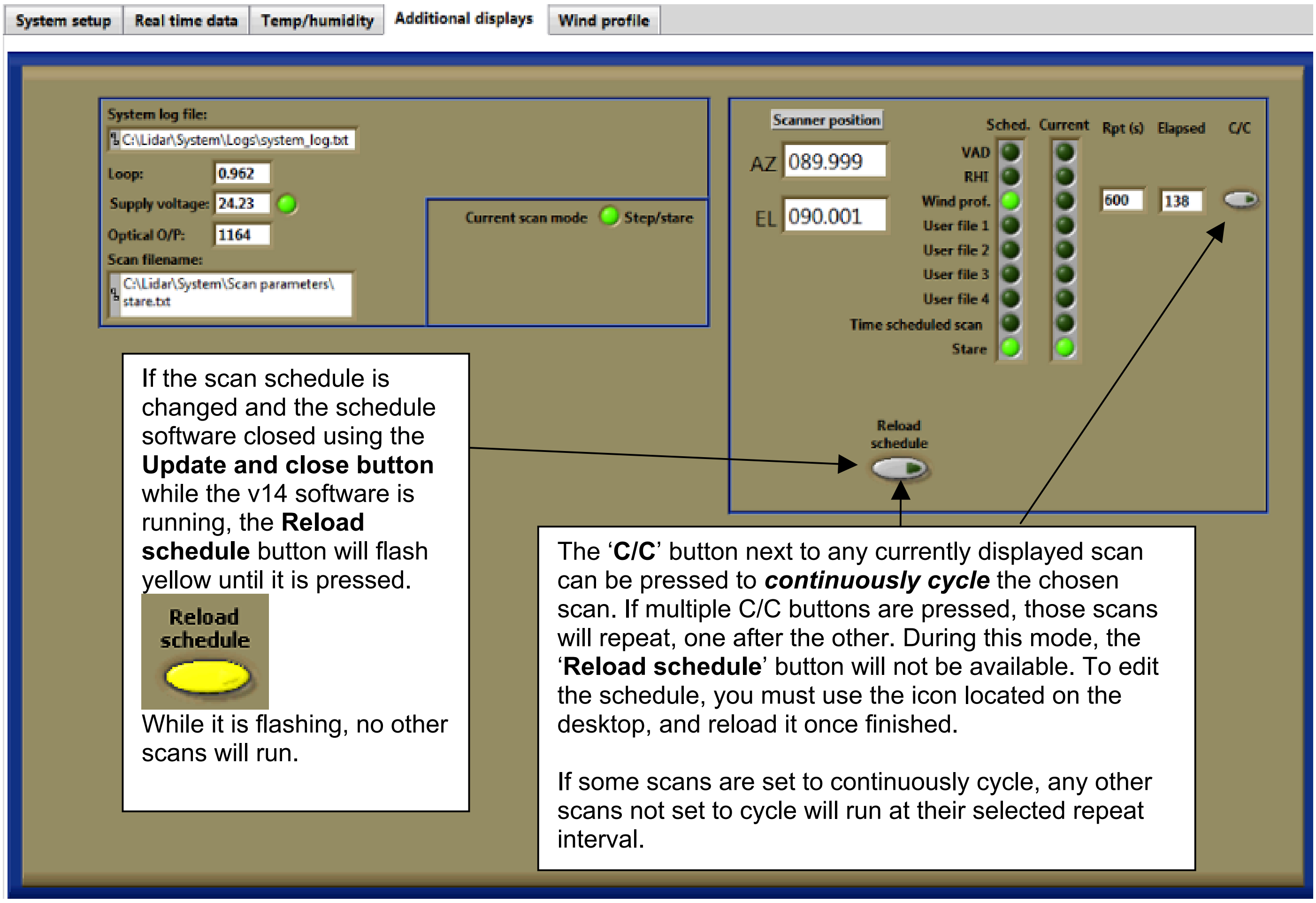
```
Filename:           Stare_84_20140521_12.hpl
System ID:          84
Number of gates: 100
Range gate length (m):      30.0
Gate length (pts): 10
Pulses/ray:         15000
No. of rays in file: 1
Scan type:          Stare - stepped
Focus range:        500
Start time:         20140521 12:48:45.53
Resolution (m/s):  0.0382
Altitude of measurement (center of gate) = (range gate + 0.5) * Gate length
Data line 1: Decimal time (hours)  Azimuth (degrees)  Elevation (degrees) Pitch (degrees) Roll (degrees)
f9.6,1x,f6.2,1x,f6.2
Data line 2: Range Gate  Doppler (m/s)  Intensity (SNR + 1)  Beta (m-1 sr-1)
i3,1x,f6.4,1x,f8.6,1x,e12.6 - repeat for no. gates
****
12.812647  90.00  90.00 -1.12 -0.31
  0 -0.4482 1.011448  6.447228E-7
  1 -0.1425 1.021657  1.221373E-6
  2 0.1633 1.024372  1.377377E-6
  3 1.0042 1.021814  1.236317E-6
  4 -0.1042 1.022668  1.289223E-6
  5 -0.3718 1.026051  1.487940E-6
  6 0.3162 1.027775  1.594230E-6
  7 0.2780 1.032716  1.888359E-6
  8 0.2397 1.029193  1.695600E-6
```

Typical scan file (in CSM mode) data file header and data format:

```
Filename:           User1_84_20140513_000428.hpl
System ID:          84
Number of gates: 70
Range gate length (m):      30.0
Gate length (pts): 10
Pulses/ray:         8000
No. of waypoints in file:      1
Scan type:          User file 1 - csm
Focus range:        500
Start time:         20140513 00:04:37.77
Resolution (m/s):  0.0382
Altitude of measurement (center of gate) = (range gate + 0.5) * Gate length
Data line 1: Decimal time (hours)  Azimuth (degrees)  Elevation (degrees)  Pitch (degrees) Roll (degrees)
f9.6,1x,f6.2,1x,f6.2
Data line 2: Range Gate  Doppler (m/s)  Intensity (SNR + 1)  Beta (m-1 sr-1)
i3,1x,f6.4,1x,f8.6,1x,e12.6 - repeat for no. gates
****
 0.077158   0.00  60.00 -0.10 0.20
  0 -8.7803 0.999039 -5.411876E-8
  1 2.3037 1.003248  1.831475E-7
  2 -3.3530 1.003729  2.107668E-7
  3 1.0424 1.004388  2.486822E-7
  4 9.2598 1.002395  1.362188E-7
  5 -16.8830 1.007852  4.484818E-7
  6 15.6426 1.004045  2.321942E-7
  7 -18.2207 1.001765  1.018705E-7
  8 -0.1807 1.007601  4.415165E-7
```

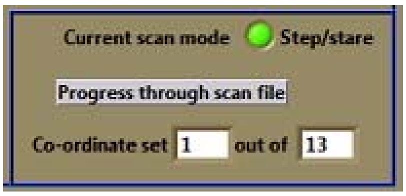
Scan type can be RHI, Stare, VAD, DBS, or User file 1 through 4. Scan type (step/stare or CSM) will also be logged. For CSM data, the number of waypoints in the scan file will be logged, and for step/stare files, the number of rays (i.e. step positions in the scan) will be logged.

7.4 Additional displays tab. [Back to contents]

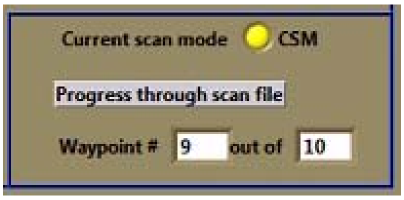


The currently loaded schedule is displayed along with the scan pattern that is currently being performed along with their **repeat time** in seconds and the number of seconds until the next repeat.

Current scan mode displays whether the scan that is active is CSM or step/stare.



When step/stare scans are being performed, the current co-ordinate pair number out of the total in the file will be displayed.

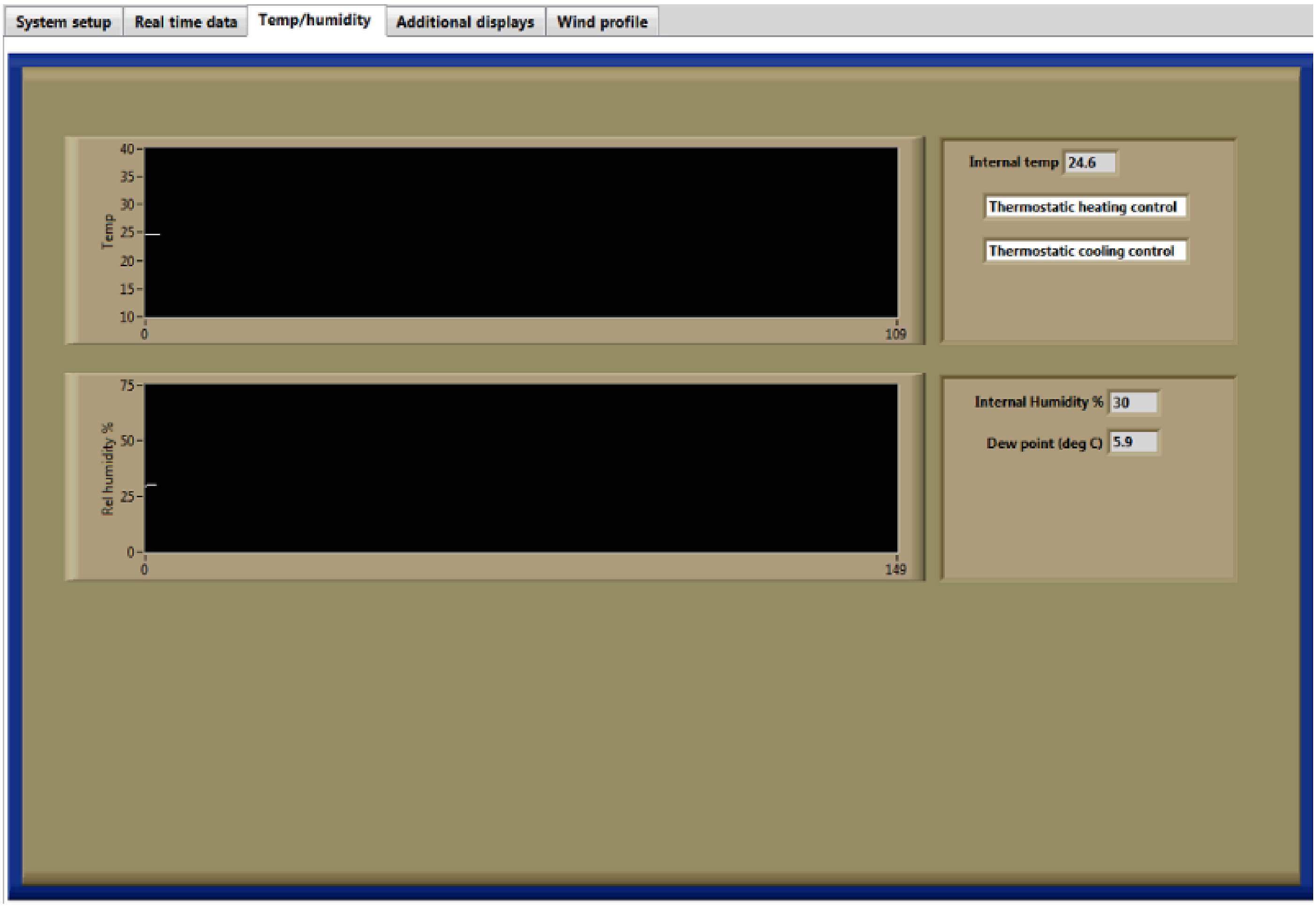


When CSM scans are being executed, the current waypoint number will be displayed along with the total number of waypoints in the scan file.

The **Optical O/P** display will be 0 during simulation mode operation, but should be >0 for normal use. The output will be checked by the software every hour, so if it reads 0 at startup, and the system is not in simulation mode, then it is worth allowing the system to warm up and allowing it to re-check the next hour.
Optical output can sometimes be disabled if the internal temperature of the LiDAR is less than 15ºC at power up. The thermal control system may take some time to bring the temperature to a suitable level, but if the unit has been un-powered in sub-zero temperatures, then it may take many hours to bring the internal temperature up to above 15ºC.

The **Supply voltage** is displayed on this tab and should read 24 +/- 10%. If it is outside of this specification (when fully heating or cooling for example), then the power supply that is feeding the UPS system may need to be adjusted.

7.5 Temp / humidity tab. [Back to contents]



The Temp / humidity tab displays the system humidity and temperature state. The displays are updated every 2 minutes. The system will perform a partial thermal shutdown, and data collection will pause if the internal temperature exceeds a set value – typically 45 degrees.

If the **internal humidity** increases to above 60%, the software will show a warning message. A system purge will be needed if this happens, for which a procedure is available.

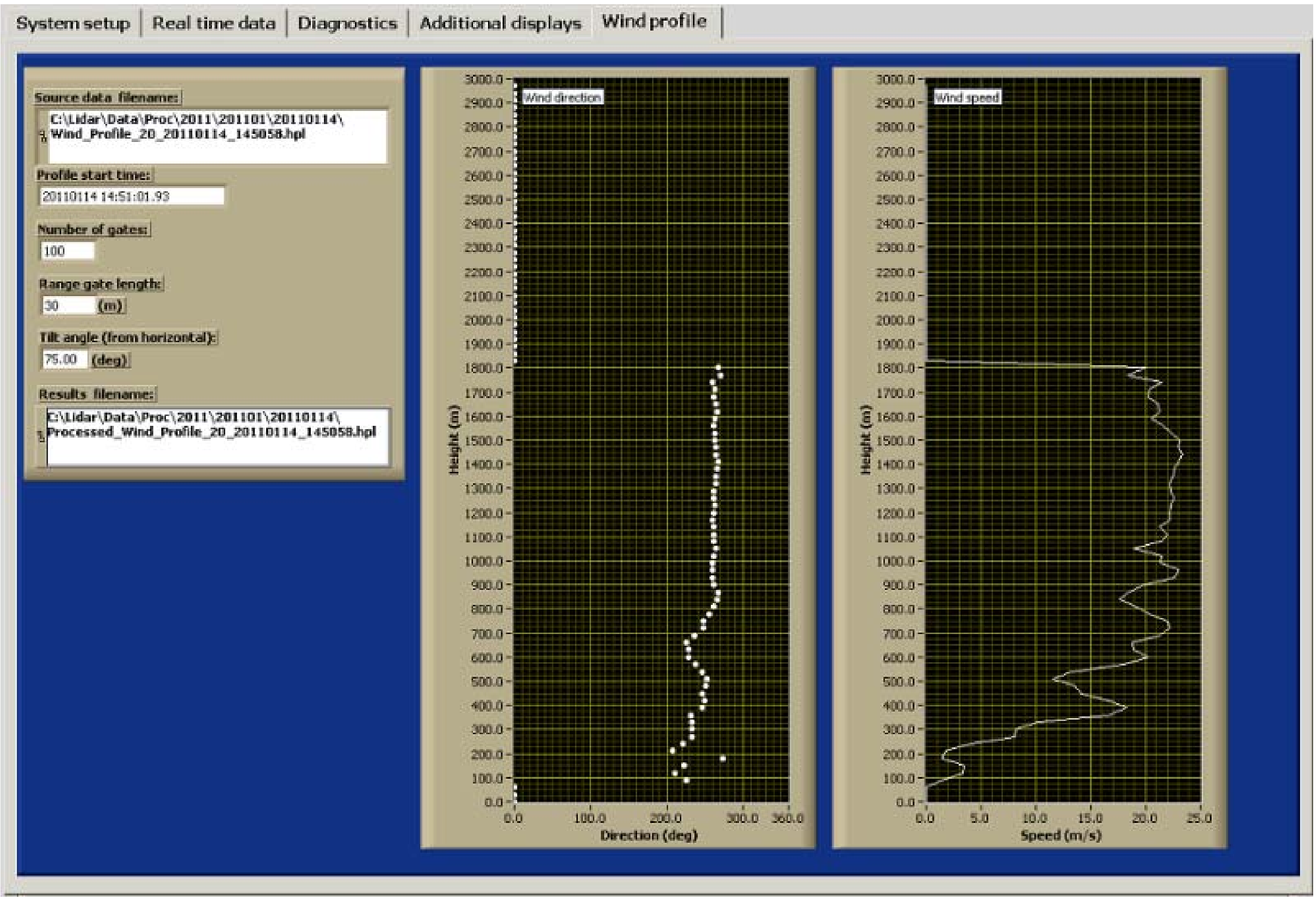
The temperature, humidity, supply voltage, acquisition card temperature, pitch and roll data are logged to a file that is stored in the monthly directory in the processed data directory:

C:\Lidar\Data\Proc\yyyy\yyyymm\system_parameters_SystemID_yyyymm.txt

An example file showing date/time, internal temperature (1 deg C resolution), internal relative humidity, supply voltage, acquisition card temperature (not always used), pitch and roll.

01/05/2014 23:30:16	25.70	51.73	24.60	0	0.10	0.20
01/05/2014 23:55:06	26.72	50.10	24.65	0	0.10	0.20

7.6 Wind profile tab. [Back to contents]



A few seconds after a wind profile measurement has been taken, the data are processed to display a standard direction and speed profile as displayed above. The display is meant to serve as a quick look only, and it is possible to re-process the data from the original line of sight data files. The processed data are saved into the current processed data directory.
File naming convention for processed wind profile data:

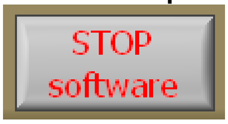
Processed_Wind_Profile_SystemID_yyyymmdd_hhmmss.hpl

Processed files are in the format shown below, with the total number of heights first, then successive data points giving height (AGL), bearing and horizontal wind speed.

```
200
   0   0.00   0.00
  48 229.55  14.40
  96 232.82  11.44
 144 230.20  11.44
 192 228.82  14.02
 240 232.80  14.53
 288 232.61  15.67
 336 239.62  15.62
 384 238.57  16.81
 432 242.97  16.48
 480 242.70  16.04
 528 252.52  16.17
 576 256.44  15.12
 624 255.90  15.76
 672 252.70  15.85
 720 256.04  16.50
 768 258.22  16.67
 816 259.74  17.48
 864 263.04  17.35
 912 264.02  17.31
 960 264.29  18.19
1008 264.68  18.04
1056 265.21  18.32
1104 265.14  18.19
1152 264.95  19.07
```

8. Stopping the Software [Back to contents]

Press the **Stop software** button on the Real time data tab to stop the software and park the scanner.



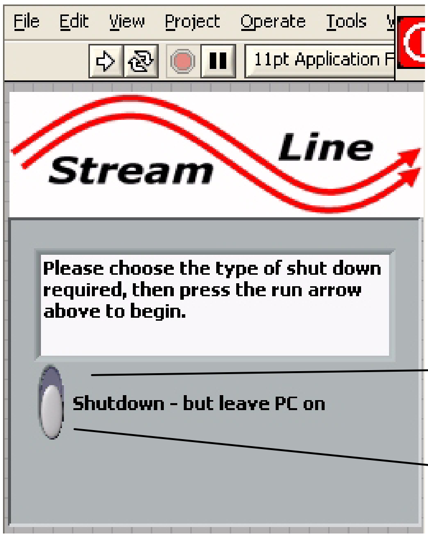
The software will stop, and a message will be displayed stating that the power should be left on for a few minutes to allow the internal fans to remove residual heat from the electronics.

8.1 Shutting down. [Back to contents]

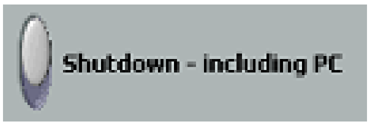
Double click the Shutdown icon to load up the software.

Description:
This module will shut down the internal systems of the LiDAR in a controlled manor, and will also shut down the PC if the option is selected.

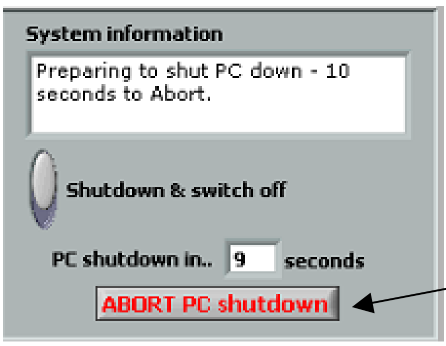
When to use:
Use whenever the system is going to remain in a powered but dormant state (i.e. not collecting data), or if the system is going to be powered down.



Both switch options are shown here. **Choose the required option prior to running the software.**



Press the run button  to start the chosen shutdown procedure.



The option to abort the PC switch off will be displayed for 10 seconds.

9. Troubleshooting. [Back to contents]

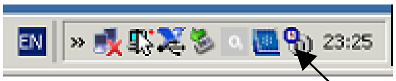
Problem / observation	Possible cause / fix / check
The LiDAR software is running, but the scanner isn't moving.	1. One or both of the motors may have been disabled. 2. Try to move the scanner by hand both in elevation and azimuth. If there is no resistance to movement for either azimuth or elevation then: • The scanner motors may not be powered. • The scanner software has not been stopped, or closed before other software has been started. • Both motors have been disabled in the scanner setup software (Follow the process below) 3. If there is lack of resistance on either az or el to manual movement, then it is likely that the motor has encountered high resistance to movement and has disabled itself. The solution is to stop all currently running software and run the scanner setup software: • Press the Disable motors button • Press the Enable motors button • Press the origin search button Make sure that both motors are functioning, and if they are, finish the scanner software and close it down. Normal operation should now be possible. 4. If the above fixes don't work, please contact Halo.
The LiDAR won't power up – the green power LED in the LiDAR connector panel is not lit.	• The 24V 10A fuse (F-1) may have blown. With all power cables disconnected, check the 10A fuse in the holder and replace if necessary. Check that the power supply module LEDs are coming on as normal – i.e. the 'I/P Active' and 'O/P Ready' when mains power is applied.
The software has frozen.	• Please make a note of the error message if any, and let Halo know. • If a message dialogue box is displaying a 'Stop' or 'Continue' option, try pressing 'Continue'. • Although there are no known issues with the software or hardware, there is always the chance of a system freeze due to mains spikes etc. If this happens:- • Try to close the software (using Ctrl-Alt-del) and try to restart the PC. If a remote connection is not possible, an SVGA monitor can be connected, along with a keyboard and mouse to the LiDAR connector panel. • Start the system up as normal
There seems to be reduced or no signal.	• Check the optical output window for dirt – clean if necessary. • The atmosphere could be exceptionally clean. • Check the focus setting – if fitted. • If the system is cold (<15ºC) when it was started, then the main amplifier may not have come on correctly. Check for a non-zero display on the 'Optical O/P' display on the 'Additional displays' tab. • The software will check for optical output every hour, so it is worth leaving it for a while to warm up inside. If the problem persists after the system is at 20ºC, then try stopping the software, performing a complete power cycle and then trying again.

There's a large bias in the Doppler display	The background file needs to be renewed.
Some of the Switch-on check LEDs are red.	Please make a note of any error messages and contact Halo.
The humidity and/or temperature LEDs are red.	The software will be prevented from starting up in this situation. If there is reason to suspect that the readings are false, please contact Halo.
The Trigger LED is red.	The system should not start up in this situation. Please note the reading and contact Halo.
The Acquisition card LED is red.	The software will stop if this happens. The card may fail if the software was not shut down properly. The PC power will need to be cycled.
The TEC LED is red	If this happens, then the software may stop. Try removing the F2 fuse for a few seconds before re-inserting. Try running the software again.
The Power LED is red.	Please make a note of the number (if any) in the power readout box and contact Halo. Try a complete shutdown and power off, and try again.
There's no picture displayed on the attached monitor.	• Make sure that you have tried pressing [Ctrl][Alt] and [F1] – this will enable the video output. • Make sure that your attached monitor can support a resolution of 1280 x 1024 • Check for a flashing green LED in the cluster of five on the connector panel.
When booting up, the picture on the attached monitor goes off after the Windows starting up screen is shown.	• The video output is being disabled by Windows, because the monitor was previously disconnected. Make sure that your keyboard is a simple USB type – with no hub or anything else that needs a driver installing to work. Try pressing the [Ctrl][Alt] and [F1] keys. • If no picture is displayed still, then you must make sure that there are no user accounts set up, that need to be selected requiring a password at startup. The operating system must be allowed to go straight to the Desktop after booting – otherwise the remote access software won't run at startup, and troubleshooting will be made extremely difficult. The Ctrl_Alt-F1 commands will also only work in a desktop environment, and not while in a mode where an account needs to be selected.
Can't connect to the PC after powering everything up.	• Make sure that the internal PC is powered up by connecting a monitor, keyboard and mouse to the SVGA connection, and checking for a flashing green LED on the connector panel LED cluster. • If there is no LED or SVGA signal, press the PC button on the connector panel • If there is a display, then check your network settings, and if correct, try a 'repair connection', or the LiDAR firewall might need to be turned off if the connecting PC is running Win7. • If the RJ45-BB is also connected to a hub, and the PC is visible on the Internet, then it may not be possible to also connect using the crossover connection.
The Laser LED is red, and the power number is below 2, but the system does not abort startup.	• Sometimes, the laser will take more time to come on than is given in software. The software Abort button can be pressed, followed by the run arrow being pressed, after which, the Laser LED should be green, and a value of >9 seen for the value. • It is possible to continue the software even if the Laser LED is red. If there is a genuine problem with the laser, then the Power LED will also be red, and the software will stop.

When starting the software, a message 'No ATS card found' is displayed, and the software stops.	• This may happen after the LiDAR PC has been re booted, or the LiDAR software has not been shutdown properly – I.e. by pressing the 'Stop software' button. The PC will need a power cycle – not simply a reboot. • Assuming that you are with the LiDAR: Run the shutdown module, and choose to include the PC with the power off. After the PC has gone off, press the external PC button to power it back up – there's no need to completely cycle the power to the whole LiDAR – which will invoke the start up time delay. • If you are controlling the LiDAR remotely and it is not convenient to go to it, then it will still need to be powered off – but there will be no way to physically turn it back on. The PC is set to come on each day at 12:20 PM (UTC) if it is off but has power.
After booting the PC, the cursor is moving around the desktop randomly.	• This happens when the operating system mistakes the GPS data for a serial ballpoint device. To correct it, unplug the GPS connector from the connector panel, then go to the control panel device manager and in the category labelled 'Mice and other pointing devices', choose and disable the Serial ballpoint device.

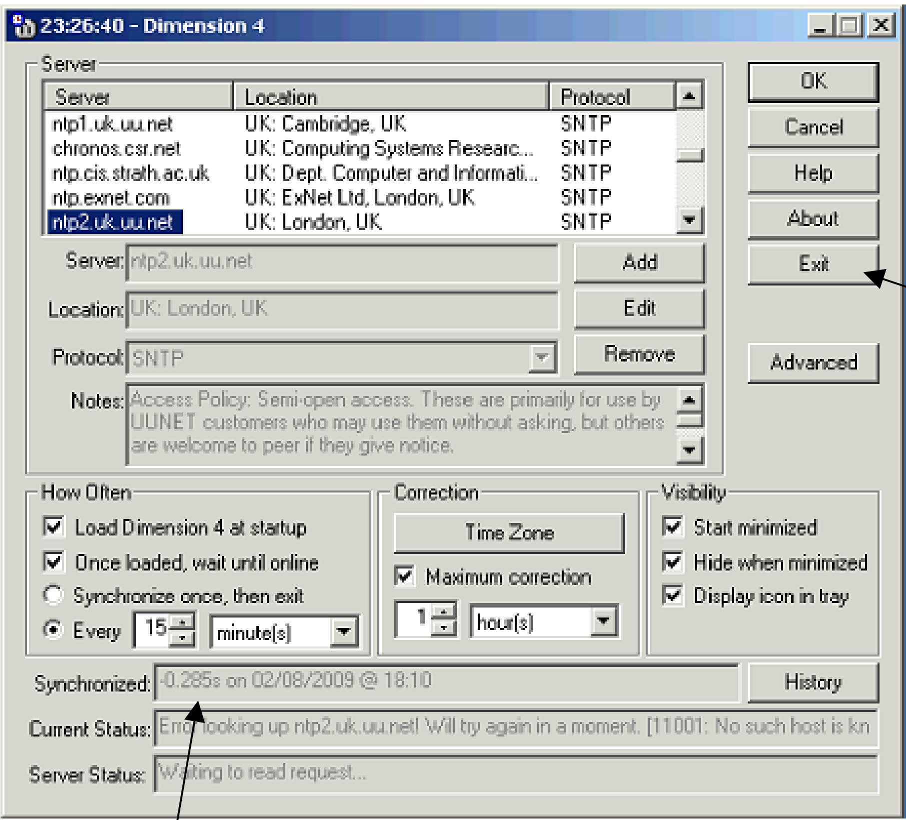
10. Time synchronisation software. [Back to contents]

The PC internal clock has been set to ignore daylight saving time adjustment, and will be set to GMT.



The LiDAR has a time synchronisation program installed that will keep the computer clock synchronised to a network time server. The PC needs to have Internet access for this feature to work.

To open the software, right click the icon and choose open.

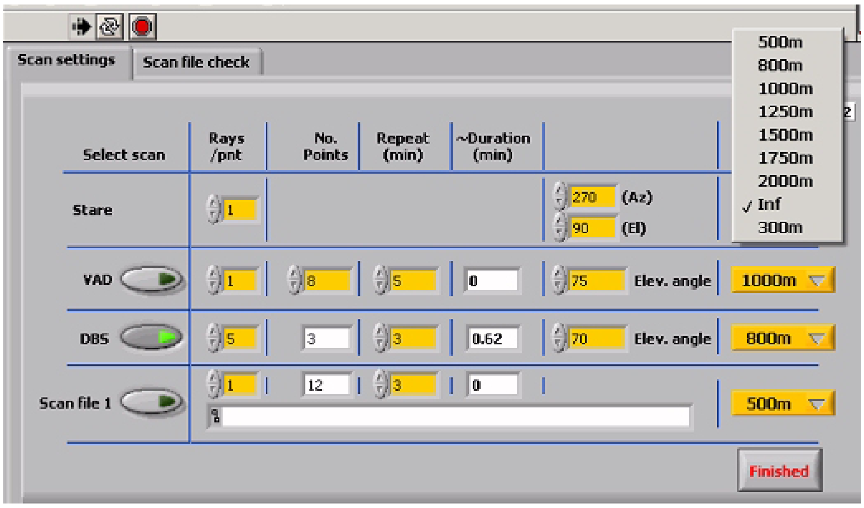


Use Exit to minimise this display.

This field shows the last synchronisation time.

11. Electronic Focus [Back to contents]

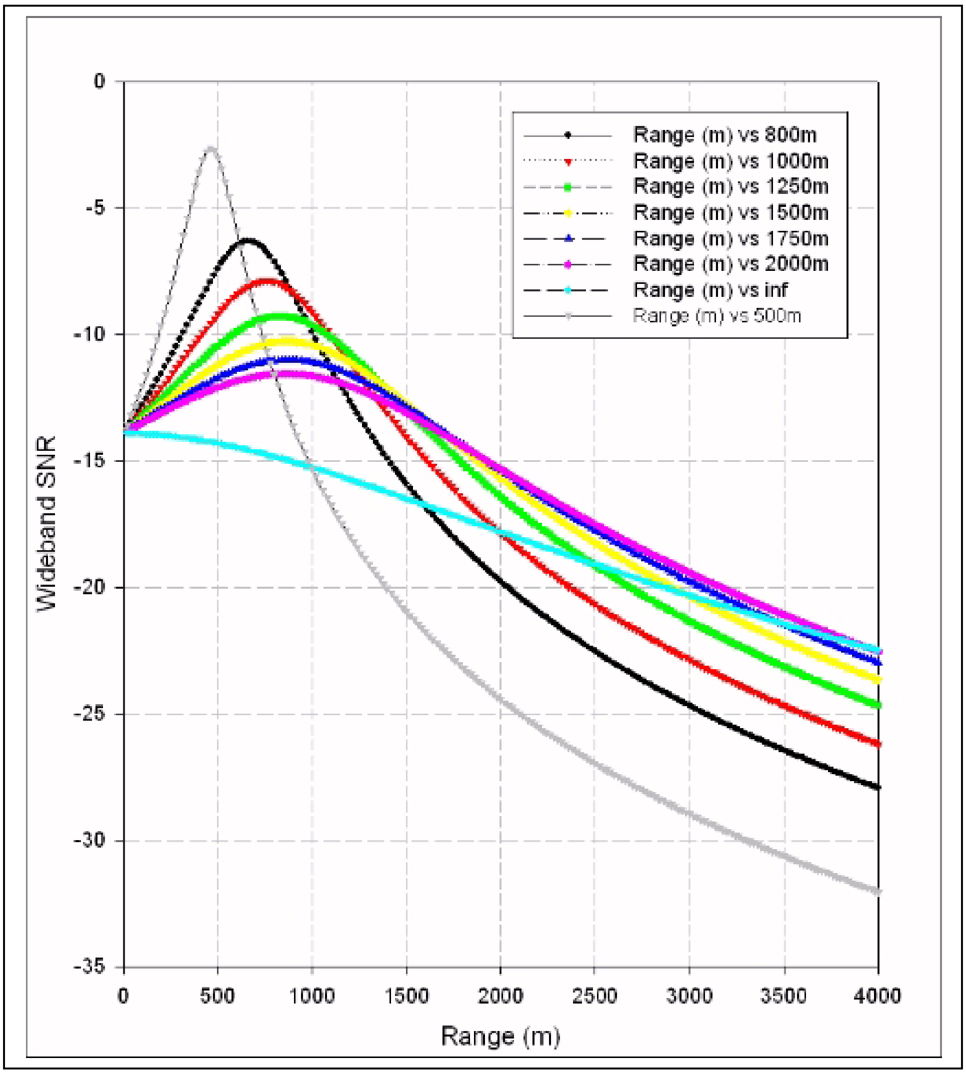
The large StreamLine systems (not XR) are fitted with an electronic focus control as standard. It is possible to choose a focus for each scan file using the scan schedule software.



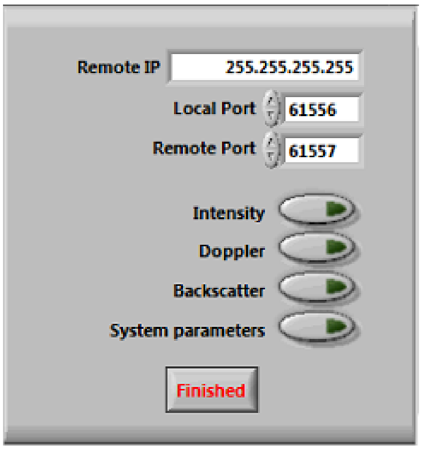
The options in the focus pull-down menus are as follows:

300m, 500m, 800m, 1000m, 1250m, 1500m, 1750m, 2000m and Infinity.

The focus range selections correspond to the effective focus enhancements shown in the graph below.



12. UDP data broadcasting. [Back to contents]



During set up, or if the ‘Change LiDAR settings’ button is pressed during data collection, UDP data output can be enabled or disabled. If the UDP button is enabled from a previously disabled state, then a pop-up window will be displayed, which allows the selection of the data to be output, and the IP and port information used. There is a limit on the amount of data that can be transmitted by UDP, which can be affected by the speed and quality of the network, so if overlapping and long range is selected, it may be that some of the data are lost.

Doppler – output for every ray
Intensity – output for every ray
Backscatter – output for every ray
System parameters – output every 2 minutes

Format for UDP broadcast data.
Common header file for Doppler, Intensity and Backscatter data:

93*Stare_93_20150109_14.hpl*xr*[d, i, b]*90.000*60.000*000.000*0.120*0.200*56*12*862*52 10' 45.54"N*2 19' 46.70"W*00044.8*60*20*100*3*[Data0*Data1*Data2*…..Data99][EoL]

93	System serial number
Stare_93_20150109_14.hpl	The processed data file that this data will be save to on the LiDAR. It contains the system serial number and then the year, month and day then the current hour.
xr	System model
d	Doppler data
i	Intensity data
b	Backscatter data
90.000	Azimuth
60.000	Elevation
000.000	Bearing (i.e. the homed position faces north for 000.000).
0.120	Pitch sensor output (degrees)
0.200	Roll sensor output (degrees)
56	Current minute
12	Current seconds
862	Current milliseconds
52 10' 45.54"N	Latitude (“N/A” if GPS not fitted or faulty)
2 19' 46.70"W	Longitude (“N/A” if not fitted or faulty)
00044.8	Height (m) (“N/A” if not fitted or faulty)
60	Range gate length (m)
20	Points per range gate
100	Number of gates
3	Graph multiplier (m) distance between successive gate centres
Data	Gates number of data points

An example of some data as received from a working system. Only the first 3 line of sight Doppler values are displayed, they are tab delimited with a carriage return character following the last one.

93*Stare_93_20150113_10.hpl*xr*d*289.999*8.002*0.000*-0.102*-0.110*51*28*.590*24 00' 0.00"N*120 59' 59.99"E**120*40*50*120*-0.670677*13.776644*10.183924* etc. etc.

System parameters output:

67*201310*sl*s*18/10/2013 16:07:47 30.81 4.34 0 24.61 54.50

This follows the same format as above, but contains a fixed number of elements – namely:
201310 – Data file name
18/10/2013 16:07:47 System time
30.81 – Internal temperature
4.34 – Internal humidity
0 – Not used
24.61 – Input voltage
54.50 – Data acquisition card temperature (if temperature reading option is enabled)

13. GPS time synchronisation. [Back to contents]

If your system has a GPS option installed, then it is possible to choose to synchronise to the GPS signal every hour. This feature will be useful when there is no network connection meaning that the regular network time sync software (D4) is not able to work. D4 is loaded at Windows start up – so if it needs to be disabled, it will possibly also have to be prevented from loading and running at boot.

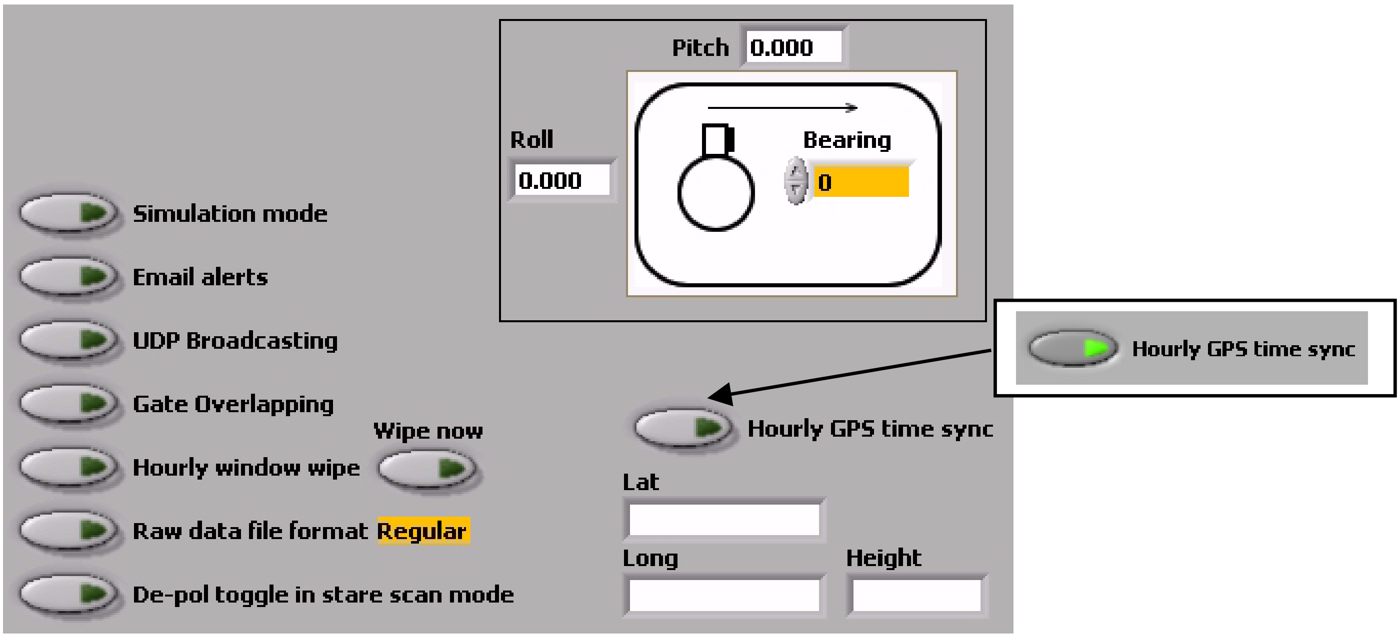
The GPS time synchronisation option will synchronise the LiDAR PC's internal clock to **UTC** during the backgrounding process, which takes place every hour. If you have a local time zone set up on the LiDAR, it's likely to be changed to UTC if this option is selected.

It is not recommended to enable GPS time syncing if the D4 software is enabled and capable of synchronising.

If your system doesn't have GPS, then the option is not available, but can be retro-fitted.

Selecting hourly GPS time synchronisation.

This is chosen at set up time, or if the 'Change LiDAR settings' button is pressed during data collection.



The chosen setting will be used the next time that the software starts up.

The GPS synchronisation will only take place if there are enough satellites in view in order to obtain a valid signal. A file is generated to log synchronisation events and is stored in the monthly level of the data logging directory with the file name structure - Time_Sync_SystemID_yyyymm.txt.

It is * delimited ASCII, as shown in the example file below:

Time before: *02/03/2015 17:00:02.647*Time after: *02/03/2015 17:00:02.262*Satellites in view: *04*Synchronisid? Yes*Lat: 52 10' 45.89"N*Long: 2 19' 47.26"W*Height (m): *00027.7