



THE MULTIBEAM LOGGER

SENSORS · OFFSETS · COVERAGE · LOGGING

User Manual

Multibeam acquisition
for vessels, ROVs and AUVs

Version 1.0

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1 Introduction

The **Multibeam Logger** gathers multibeam data on a vessel, ROV or AUV. It reads the position, heading, motion and depth sensors and one or more multibeam heads, puts every sounding in the right place on the grid, shows the coverage and the swath as the data comes in, and logs each line - a raw log you can replay, the XYZ soundings and a line log.

It is kept simple: one window, three tabs, and a driver list for each kind of sensor. Every sensor has its port, latency, mount offsets from the CRP and C-O values, and the instrument list shows straight away if anything stops or slows down.

You want to	Use
Say what the vehicle is and where its CRP is	Set-up: System parameters (section 4)
Set the datum and projection	Set-up: Geodesy (section 5)
Use ZDA + PPS time	Set-up: Time (section 6)
Add a sensor or a multibeam head	Set-up: + Sensor (sections 7 to 10)
Check everything is coming in	Online: the instruments and alarms (section 11)
Log a line	Start logging / End line, F9 (section 12)
Play a line back, or see what was logged	The Lines tab (section 13)

2 Getting started

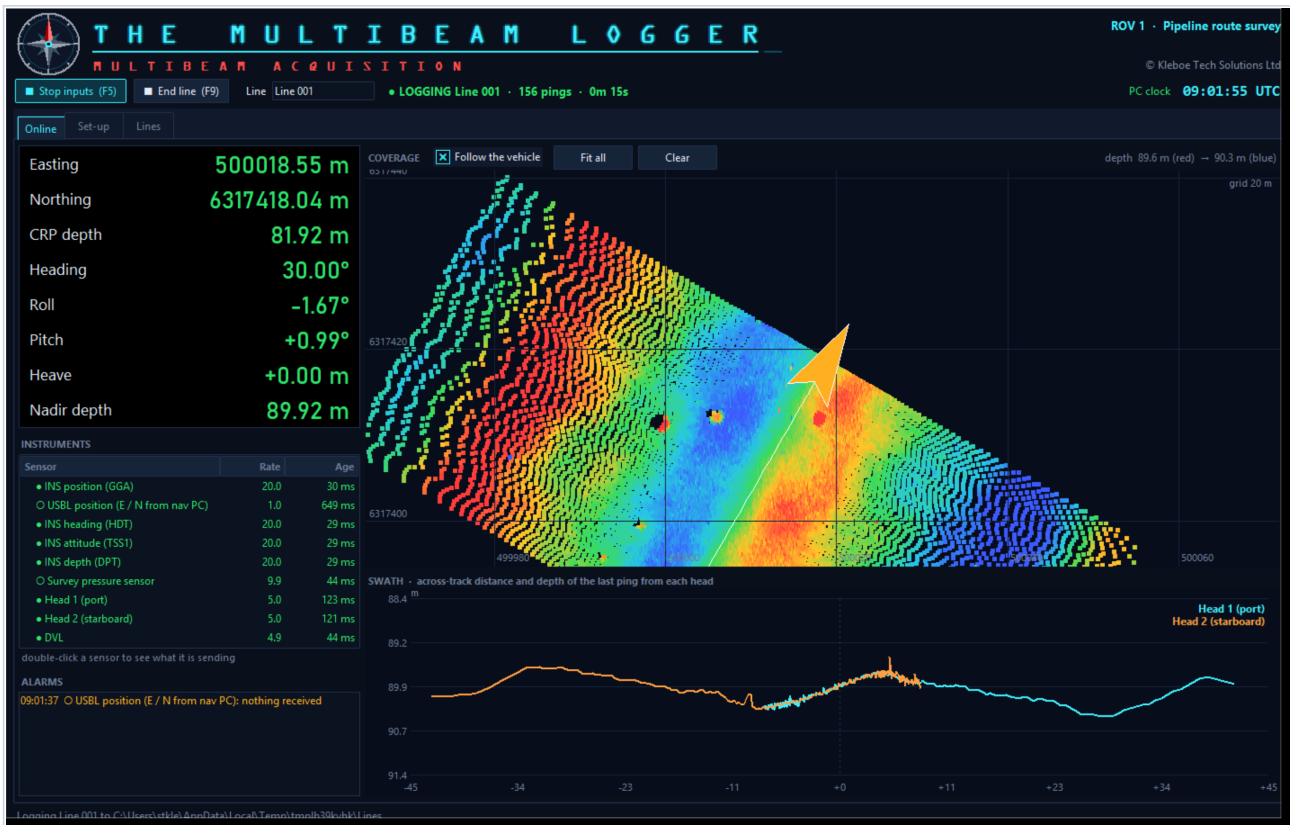
2.1 Installing and starting

Copy **MultibeamLogger.exe** into a folder of your choice and double-click it. There is no installer. The program opens the last set-up you used. You can also drag a set-up file (.mbf) onto MultibeamLogger.exe to open it.

Note

The first time you start the program, Windows may show a **Windows protected your PC** message. Click **More info**, then **Run anyway**. If Windows Firewall asks, allow the program on the network you use for the survey - otherwise the UDP data can't come in.

2.2 The main window



The Online tab while a line is being logged: an ROV with a dual-head multibeam.

Under the title are the two buttons you use most: **Start inputs (F5)** opens every port and starts reading, and **Start logging (F9)** starts a line (it becomes **End line** while logging). Next to them is the **line name**, the logging status (line, pings and time), and on the right the **time** and where it comes from.

- **Online** - the numbers, instruments, alarms, coverage and swath (section 11).
- **Set-up** - the system, geodesy, time and every sensor (sections 4 to 10).
- **Lines** - the lines logged, and replay (section 13).

2.3 Set-ups and saving

A set-up (.mbl file) holds the system, geodesy, time, sensors and logging settings. **File > Save set-up** (Ctrl+S) saves it. Once it has a file name, every change is saved straight away. **File > New set-up** starts with a GGA position, an HDT heading, a TSS1 motion sensor and one multibeam head, ready to change.

Tip

File > Open the example set-up opens an ROV with a dual-head multibeam, a USBL, two depth sensors, a DVL and an altimeter. The pictures in this manual are of the example.

3 How each sounding is placed

Everything is measured from one point on the vehicle, the **CRP** (common reference point) - usually the INS or motion sensor's centre. The offsets of every sensor and head are measured from the CRP in the vehicle's own frame:

Offset	Positive
X	to starboard
Y	forward
Z	down

For every ping the program:

- takes the position, heading, roll, pitch and heave (and the depth for an ROV or AUV) at the ping's time, from the sensors in use - each one corrected for its latency;
- moves the position from its sensor's offsets to the CRP, then out to the head's offsets, turned by the heading, roll and pitch;
- turns each beam by the head's mount angles and the vehicle's attitude, and runs it out along a straight line at the sound speed at the head;
- gives each sounding an Easting, Northing and depth, and leaves out any outside the filters and the scan window.

Roll is positive with the port side up, pitch positive with the bow up, and heave positive up.

Note

The program uses straight-line ray paths with the sound speed at the head. That is right for checking coverage and quality online. Process the final data with a full sound velocity profile in your processing software, from the raw log.

4 System parameters

System parameters

VEHICLE

Vehicle: ROV
 Name: ROV 1
 Use the depth sensor: ☒
 CRP above the waterline (m): 0
 Use heave: ☐

SCAN WINDOW (SOUNDINGS OUTSIDE IT ARE LEFT OUT)

Depth from (m): 0
 Depth to (m): 3000
 Across from (m): -150
 Across to (m): 150

LOGGING

Folder: C:\Users\stkle\AppData\Local\Temp\tmp1b39kvhk\Lines
 Line name: Line
 Raw log for replay (.mblraw): ☒
 XYZ soundings (.xyz.csv): ☒
 XYZ: every n-th beam: 1
 Line log (Line_log.csv): ☒

DISPLAY

Plot every n-th beam: 2
 Points kept on screen: 300000

JOB

System parameters.

Setting	What it does
Vehicle	Vessel, ROV or AUV.
Name	The vessel or vehicle name, shown at the top of the window.
Use the depth sensor	ROV / AUV: the CRP depth comes from the depth sensor in use.
CRP above the waterline	Vessel: the CRP's height above the water (negative if it is below).
Use heave	Vessel: the CRP moves up and down with the heave.
Scan window	Depth from / to and across from / to (negative = port). Soundings outside it are left out - an easy way to stop spikes and the far outer beams.
Logging	The folder for the line files, the line name, which files to write, and every n-th beam in the XYZ file (section 12).
Display	Plot every n-th beam, and how many points are kept on screen.
Job	Project, client, vessel, area and surveyor, written in the line log.

Click **Apply** after changing a page. If the inputs are running, stop and start them (F5 twice) so the changes are used.

5 Geodesy

Positions in latitude / longitude (GGA, LLD) are turned into grid Easting / Northing on the datum and projection set here. Positions that already come as grid Easting / Northing are used as they are.

Click **Geodesy** in the set-up list, then **Edit geodesy...** Choose the datum (or a custom ellipsoid and datum shift) and the projection: UTM with its zone, Transverse Mercator, Lambert or others. Take them from the project's geodetic parameters.

Choose the geodesy from the project's geodetic parameters. Latitude / longitude positions are turned into grid Easting / Northing with them.

DATUM

Datum WGS 84

Ellipsoid WGS 84 a (m) 6378137 1/f 298.257223563

Shift from this datum to WGS 84 (7-parameter Helmert):

tx	ty	tz	rx	ry	rz	scale
0	0	0	0	0	0	0
m	m	m	"	"	"	ppm

Rotation convention ☒ Position Vector (EPSG 9606) ☐ Coordinate Frame (EPSG 9607)

PROJECTION

Projection UTM

Zone 31 ☒ North ☐ South

k0 0.9996 · false easting 500 000 · false northing 0 (N) or 10 000 000 (S)

LATITUDE / LONGITUDE

Show on ☒ WGS 84 ☐ The project datum as Degrees minutes seconds

CHECK A POINT

Latitude Longitude → E / N Suggest UTM zone

Easting Northing → Lat / Long

OK Cancel

The Geodesy window.

6 Time

Every reading is given a UTC time when it arrives. Choose where the time comes from:

- **The PC clock** - fine when the PC is kept on GPS time by a time program.
- **A ZDA string (with PPS)** - the ZDA gives the date and time, and the PPS pulse on a serial pin marks the exact start of each second. Set the port, tick **Use the PPS pulse** and choose the pin (Ring indicator, pin 9, is usual). Without PPS, set the **ZDA delay** - how late the ZDA arrives.



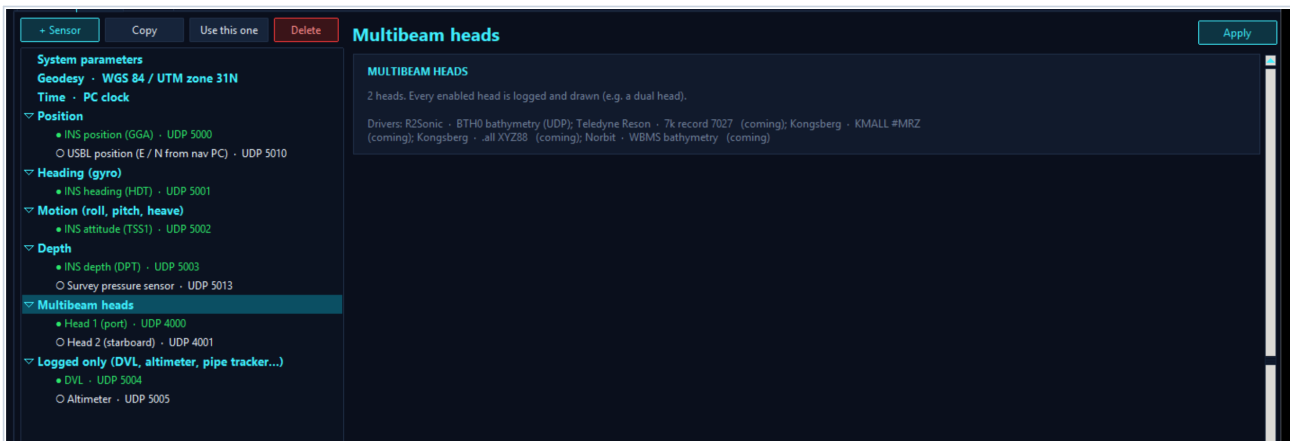
Time from ZDA with PPS on COM3.

The time and its source are shown on the right of the toolbar: green when it is good, amber when the ZDA or the PPS has stopped.

Tip

Each ping uses the multibeam's own time stamp when it is within 10 seconds of this time. So put the sonar on the same ZDA + PPS, and every ping lines up exactly with the navigation.

7 Sensors



The Set-up tab: the sensors on the left, and the drivers for multibeam heads.

7.1 Kinds of sensor

The sensors are listed in six groups: **Position**, **Heading (gyro)**, **Motion (roll, pitch, heave)**, **Depth**, **Multibeam heads** and **Logged only**. Click a group to see its drivers.

7.2 Adding, copying and deleting

- Select a group (or a sensor in it) and click **+ Sensor**. It is added with the next free UDP port.
- **Copy** makes a copy of the selected sensor on the next port - quick for a second head or a backup.
- **Delete** deletes the selected sensor.

7.3 The one in use

Where there are several sensors of one kind - two positions, two depth sensors - the one marked ● (green) is used for the soundings. The others (○) are still read, shown and logged, so you can compare them. Select one and click **Use this one** to swap. Every enabled multibeam head is always used. Untick **Enabled** to leave a sensor out without deleting it.

7.4 Input, latency and alarm

Setting	What it does
Driver	How the string or packet is read (see the table below).
Port	UDP (with the port number) or Serial (with the COM port and baud). The COM ports on the PC are listed next to it.
Latency (ms)	How late the data arrives after it was measured. It is taken off the time, so the reading is used for when it was measured.
Alarm below (per second)	An alarm is shown if the rate drops below this.

7.5 The drivers

Kind	Drivers
Position	NMEA GGA; USBL LLD; grid Easting / Northing in a text string (with an optional time column)
Heading	NMEA HDT / THS / HDG; heading in a column of a text string; heading from the motion string
Motion	\$PRDID; TSS1; \$PASHR; \$PSXN,23; EM3000 binary
Depth	NMEA DBT / DPT; depth in a column; pressure in a column; Paroscientific pressure; depth from the position sensor
Multibeam	R2Sonic BTH0. Coming: Teledyne Reson 7027, Kongsberg KMALL and .all, Norbit
Logged only	Any text string, logged as received

Note

Drivers marked **coming** are listed but can't be used yet - they need sample data to test. An INS native binary output (position, attitude and depth in one) is also coming. Ask if you need one of these.

8 Position, heading and motion

8.1 Position

A GGA or LLD position is given with the sensor's mount offsets, so it can be moved to the CRP. A grid Easting / Northing string - for example a USBL position sent from the navigation PC - is read from columns: set what the string **starts with**, the **separator**, and the **Easting** and **Northing** columns (counting from 1).

Position · USBL position (E / N from nav PC) Apply

SENSOR

Name: USBL position (E / N from nav PC)

Enabled: ☒

Driver: Grid Easting / Northing string

Easting and Northing in columns of a text string.

INPUT

Port: UDP

UDP port: 5010

COM port: COM1 on this PC: COM3, COM4

Baud: 9600

Latency (ms): 0 how late the data arrives; taken off its time

Alarm below (per second): 0.5

TEXT STRING

Starts with: USBL leave blank if the string has no fixed start

Separator: , , or ; or space or tab

Easting column: 3 columns count from 1

Northing column: 4

Time column: 2 0 = none. With a time (hh:mm:ss), the position is used for that time instead of when it arrives - best for positions sent over the network

MOUNT OFFSETS FROM THE CRP

X (m, + starboard): 0

Y (m, + forward): 0

A USBL position from the navigation PC, with its time in column 2.

Tip

Give a **time column** when the string has its own time (hh:mm:ss). The position is then used for that time rather than when it arrives - best for positions sent over the network, which can arrive late.

8.2 Heading

Set the **Gyro C-O** - the correction from the gyro calibration. It is added to the heading. A heading can also be taken from the motion sensor's own string, if it has one.

8.3 Motion

Set the **Roll C-O**, **Pitch C-O** and **Heave C-O** from the calibration. Heading and motion sensors have no offsets - they are taken at the CRP.

Motion · INS attitude (TSS1)

Apply

SENSOR

NameINS attitude (TSS1)

Enabled☒

DriverTSS1 (heave cm, roll / pitch 0.01°)

INPUT

PortUDP

UDP port5002

COM portCOM1on this PC: COM3, COM4

Baud9600

Latency (ms)0how late the data arrives; taken off its time

Alarm below (per second)0.5

A TSS1 motion sensor and its C-O values.

9 Depth

On an ROV or AUV the CRP depth comes from the depth sensor in use (tick **Use the depth sensor** in the system parameters). Its offsets are used to move the depth to the CRP, taking the pitch and roll into account. Set the **Depth C-O** from the calibration; it is added to the depth.

A pressure sensor gives pressure, which is turned into depth:

$$\text{depth} = (\text{pressure} - \text{surface pressure}) / (\text{density} \times \text{gravity})$$

Setting	Usual value
Pressure units	dBar, bar, kPa, psi or MPa
Surface pressure	10.1325 dBar (1 atmosphere), or the measured air pressure
Water density	1.0275 kg/dm³ for typical sea water, or from a CTD
Gravity	9.81 m/s², or the local value

Depth · Survey pressure sensor

Apply

SENSOR

NameSurvey pressure sensor

Enabled☒

DriverParoscientific pressure (*0001...) - 1

Digiquartz pressure string: depth = (pressure - surface pressure) / (density × gravity).

INPUT

PortUDP

UDP port5013

COM portCOM1on this PC: COM3, COM4

Baud9600

Latency (ms)0how late the data arrives; taken off its time

Alarm below (per second)0.5

MOUNT OFFSETS FROM THE CRP

X (m, + starboard)-0.05

Y (m, + forward)-0.18

Z (m, + down)0

DEPTH

Depth C-O (m)0added to the depth

Pressure unitsdBar

Surface pressure (dBar)10.132510.1325 = 1 atmosphere

Water density (kg/dm³)1.02751.0275 typical sea water

A Paroscientific pressure sensor.

10 Multibeam heads

Multibeam heads · Head 1 (port)
Apply

SENSOR

Name

Enabled
☒

Driver
R2Sonic - BTH0 bathymetry (UDP)

Ranges, beam angles and quality flags from the BTH0 packet, on the sonar's base port (4000 as standard).

INPUT

Port
UDP

UDP port

COM port
on this PC: COM3, COM4

Baud

Latency (ms)
how late the data arrives; taken off its time

Alarm below (per second)

MOUNT OFFSETS FROM THE CRP

X (m, + starboard)

Y (m, + forward)

Z (m, + down)

MOUNT ANGLES (FROM THE PATCH TEST)

Roll mount (°)
+ port up, e.g. ±20° on a dual head

Pitch mount (°)
+ bow up

Heading mount (°)
+ clockwise

SOUND SPEED AND TIME

Sound speed at the head
From the sonar's packets

Head 1 of a dual head, mounted 20° to port.

10.1 Port

An R2Sonic sends its BTH0 bathymetry over UDP to the sonar's base port (4000 as standard). For a dual head, give each head its own port.

10.2 Offsets and mount angles

The **mount offsets** are the head's acoustic centre from the CRP. The **mount angles** come from the patch test: roll (+ port up), pitch (+ bow up) and heading (+ clockwise). On a dual head the heads are usually tilted about $\pm 20^\circ$ in roll - the port head negative, the starboard head positive. The angles turn the beams; they don't move the head.

10.3 Sound speed and time

- **Sound speed at the head** - from the sonar's packets (from its SV probe), or a fixed value.
- **Ping time** - the sonar's time stamp (best, when the sonar is on ZDA + PPS) or when the packet arrives.

10.4 Scan filters

The screenshot shows two sections of the software interface. The top section, titled 'SOUND SPEED AND TIME', contains three settings: 'Sound speed at the head' set to 'From the sonar's packets', 'Sound speed (m/s)' set to '1500', and 'Ping time' set to 'The sonar's time stamp'. The bottom section, titled 'SCAN FILTERS', contains six settings: 'Quality at least' set to '1' (with a note 'BTHD: 1 = any detection'), 'Range from (m)' set to '0', 'Range to (m)' set to '20000', 'Beam angle from (°)' set to '-75' (with a note 'negative = port'), and 'Beam angle to (°)' set to '75'.

The rest of the head's page: sound speed, time and the scan filters.

Soundings are left out when their **quality** is below the setting, their **range** is outside the range from / to, or their **beam angle** is outside the beam angle from / to (negative = port). Together with the scan window in the system parameters, these keep the spikes out of the coverage and the XYZ file. The raw log always keeps everything.

11 The Online tab

11.1 The numbers

The large numbers on the left are the CRP's **Easting**, **Northing** and **depth**, the **heading**, **roll**, **pitch** and **heave**, and the **nadir depth** - the depth under the head - from the last ping.

11.2 Instruments and alarms

Every enabled sensor is listed with its **rate** (readings per second) and **age** (time since the last one): green when it is fine, amber when it is slow or a string can't be read, red when nothing is coming in. **Double-click a sensor** to see what it is sending.

```
USBL,09:01:39.56,500002.64,6317390.98
USBL,09:01:40.57,500004.17,6317392.89
USBL,09:01:41.58,500004.88,6317394.31
USBL,09:01:42.59,500005.87,6317396.44
USBL,09:01:43.60,500007.21,6317397.87
USBL,09:01:44.61,500007.68,6317399.77
USBL,09:01:45.62,500009.26,6317401.58
USBL,09:01:46.63,500009.85,6317403.06
USBL,09:01:47.64,500011.00,6317405.20
USBL,09:01:48.65,500012.20,6317406.58
USBL,09:01:49.66,500012.75,6317408.56
USBL,09:01:50.67,500014.33,6317410.28
USBL,09:01:51.68,500014.84,6317411.85
USBL,09:01:52.69,500016.12,6317413.93
USBL,09:01:53.70,500017.17,6317415.29
USBL,09:01:54.71,500017.84,6317417.35
USBL,09:01:55.75,500019.42,6317419.03
USBL,09:01:56.77,500019.87,6317420.70
USBL,09:01:57.78,500021.28,6317422.72
```

What the USBL is sending.

Under them, the **alarms** list each problem once, with the time, when it starts or changes - for example *DVL: nothing received* or *Head 2: rate 2.1 per second is below 4*.

11.3 Coverage

The coverage shows every sounding on the grid, coloured by depth from red (shallow) to blue (deep), with the track in white and the vehicle as an arrow. The depth range of the colours is shown above it.

- **Follow the vehicle** keeps the vehicle in the middle.
- **Fit all** fits all the coverage on screen; **Clear** clears it.
- **Drag** to move round, and use the **mouse wheel** to zoom.

11.4 Swath

The swath shows the last ping from each head across the track: distance across (negative = port) against depth, each head in its own colour. Soundings left out by the filters are grey. On a dual head the two swaths should overlap neatly in the middle - if they don't, check the mount angles and offsets.

11.5 Logged only

Sensors in **Logged only** - a DVL, an altimeter, a pipe tracker - aren't used for the soundings. They are shown in the instrument list and written to the raw log with their times and offsets, for processing.

12 Logging lines

With the inputs running, type the line name (or keep the one given) and press **Start logging** (F9). Press **End line** (F9) at the end. The next line name is ready, numbered on from the last (Line 001, Line 002...). The first time, you are asked for the logging folder.

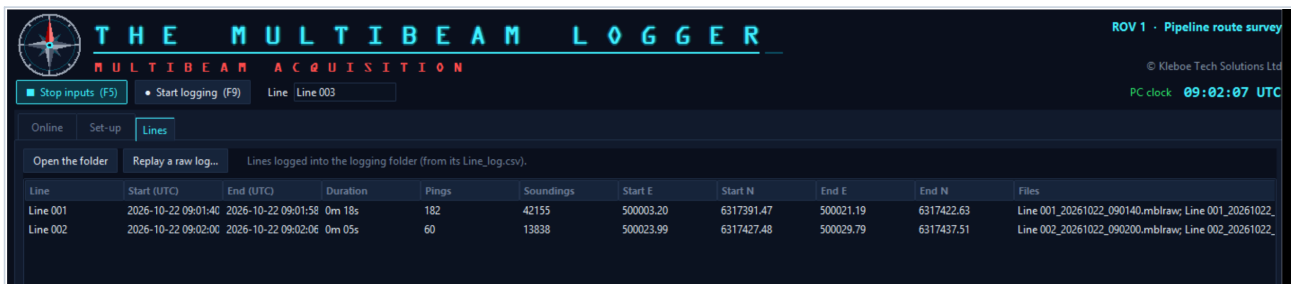
File	What is in it
Line 001_<UTC date and time>.mblraw	Every string and packet from every sensor, with its time, exactly as received - to replay or process.
Line 001_<UTC date and time>.xyz.csv	The soundings: UTC, head, ping, beam, Easting, Northing, depth.
Line_log.csv	One row per line: name, start and end time, duration, pings, soundings, start and end Easting / Northing, and the files.

Each of these can be switched off in the system parameters. The XYZ file can be thinned to every n-th beam.

Note

Ending a line, stopping the inputs or closing the program all close the files properly.

13 The Lines tab and replay



The Lines tab: the lines in the logging folder.

The Lines tab lists the lines from the logging folder's line log. **Open the folder** opens it in Windows.

13.1 Replay

Replay a raw log... (also on the File menu) plays a .mblraw file back through the same processing, at the speed you choose (1 = real time). The coverage, swath and numbers show as if it were live, and you can log it again as a new line - for example after correcting an offset or a C-O. Press F5 to stop.

13.2 Exporting the coverage

File > Export the coverage (XYZ)... saves the points on screen as an XYZ text file - a quick check or a picture of the coverage for the client. The full soundings are in the lines' .xyz.csv files.

14 Trial and licence

The program runs as a free 48-hour trial with everything working. A bar under the title shows how long is left. After that it needs a Survey Software Suite licence key: click **Enter licence key...**, paste the key from the email and click **Activate**. One key unlocks every program in the suite on the PC, on up to 4 PCs. With a licence the bar goes, and the window title shows **Licensed until** and the date. The licence is checked online now and then and works for up to 30 days at a time without internet. Your set-ups and logged lines are never affected.

15 Troubleshooting

Problem	What to check
A sensor is red (nothing received)	The port number or COM port; that the data is sent to this PC's IP address; Windows Firewall; that another program isn't already using the COM port.
A sensor is amber	Double-click it to see what it sends. Check the driver matches the string, and the columns for a text string.
Pings come in but nothing is plotted	The position, heading and motion in use must all be coming in. Check the scan window and filters aren't leaving everything out.
The swaths of a dual head don't meet	The roll mount angles (port head negative) and the X offsets.
The seabed tilts with the roll	The roll mount angle or the roll C-O; then the latency of the motion sensor.
A driver says it can't be used yet	It is still coming. Choose another, or ask for it to be added.
The time is amber	The ZDA or the PPS has stopped. Check the time port and the PPS pin.
A change has no effect	Click Apply, then stop and start the inputs (F5 twice).

Keyboard shortcuts

Keys	Command
F5	Start / stop the inputs (or stop a replay)
F9	Start logging / end the line
Ctrl+O / Ctrl+S	Open and save a set-up