



KONGSBERG

User manual

Dual Axis Scanning Sonar



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Dual Axis Scanning Sonar ***User Manual***

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About this document

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1 INTRODUCTION

The Dual Axis Scanning profiling head (DAS) is designed for profile point acquisition of underwater bottom surfaces. This sonar targets scour monitoring or sediment aggregation measurements applications. The DAS profiling head is primarily designed for operation in standalone mode to minimize the deployment infrastructure requirements. This provides significant flexibility in the system configuration supporting both KML supplied system solutions, operating either in MS1000 or standalone modes, and third party configurations connecting directly to the DAS head.

Considering the significant variety of power and telemetry configuration available at the remote monitoring location the DAS Head was designed to operate in one of the two power-up configuration modes:

MS 1000 hosted mode – The DAS requires the MS 1000 infrastructure, including the MS 1000 Interface unit. The MS 1000 software provides GUI based user configuration and operation of the sonar. The data is visualized on screen and recorded for further post processing. All the MS1000 capabilities and external sensor interfaces are available for enhanced system configurations.

Standalone head mode – This mode uses the KML supplied or other third party RS485 telemetry and power infrastructure and provides profile data acquisition using pre-defined configurations for the operational settings.

NOTES:

1. The power-up mode is factory configured. The power-up configuration can be switched between the standalone mode and the MS1000 mode using the “DASCfg.exe” utility.
2. The MS1000 hosted mode can be entered from the standalone mode without changing the power-up configuration. The DAS head will return to the standalone mode if power is cycled OFF/ON or a reset command is sent to the head.
3. When operating in standalone mode the operational settings of the pre-defined configurations can be changed only using the KML supplied “DASCfg.exe” utility software.

2 DAS HEAD OPERATION IN STANDALONE MODE

In the standalone mode the DAS head will complete one scan with the current configuration settings and the acquired profile data is both uplinked in real time and stored in volatile memory for subsequent upload if the telemetry link is not available continuously during the data acquisition. The profile data is streamed to the serial port in real time regardless of the telemetry link status. The same data is stored in the head and is available for uplink on demand provided the head has not been powered OFF after the scan completion. Data is available in NMEA type ASCII sentences as points described in both “**x, y, z**” coordinates and “**tilt, azimuth, range**” coordinates. There is also a sentence to uplink the raw sample

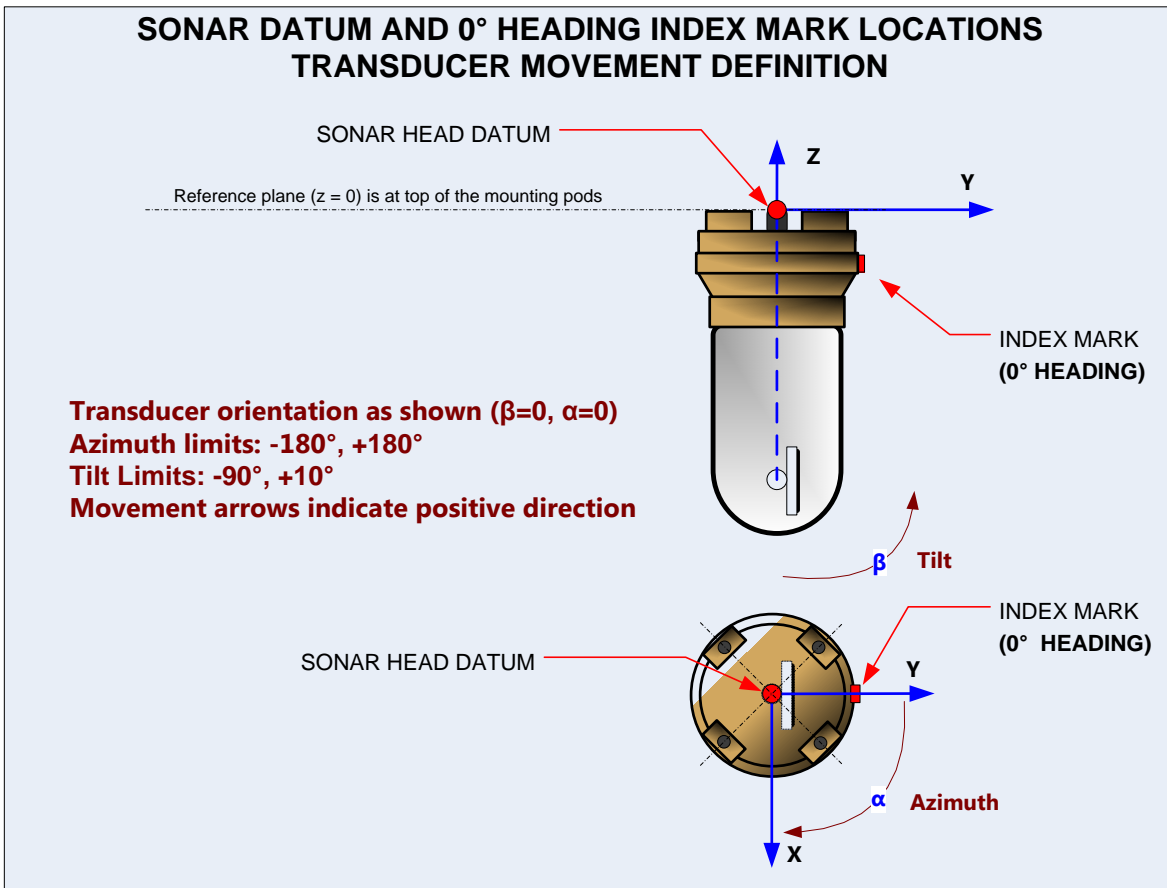
data if necessary. The profile data can be imported in CAD or point cloud software for visualization and further post processing.

After a scan is completed the head will enter the “idle” state where it will wait for a new command. Operational controls are available when using the terminal interface built in the DASCfg utility, or when using terminal software like HyperTerminal or similar software to communicate with the sonar head.

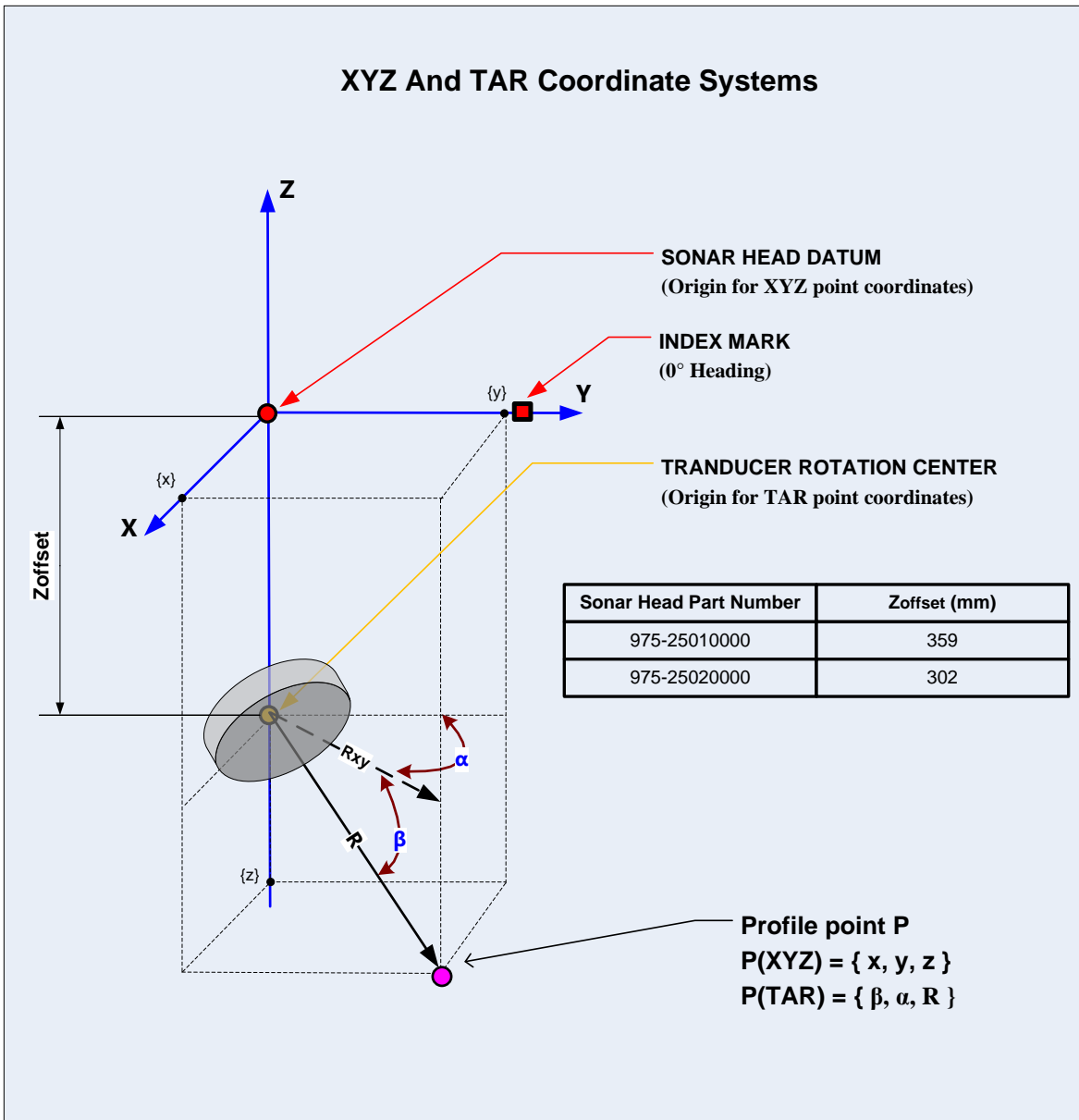
NOTE: The head configurations can be modified only with the KML supplied “DASCfg.exe” utility.

2.1 DAS profiler coordinate system

The sonar head datum is the reference point for the XYZ coordinates of the profile points. It is located on the plane defined by the top side of the mounting pods ($z = 0$) and at the centre of the circle that includes the four mounting holes at the top of the pods ($x = 0, y = 0$). The direction of the Y axis (0° Heading) is determined by the index mark located on the side of the housing.



The reference point for the TAR coordinates is the centre of rotation for the transducer. This point is located on the z axis at a location below the sonar head datum defined by a Z_{offset} as described in the following drawing.



2.2 Uplink data format

The uplinked data is packaged in an ASCII string that loosely follows the format of NMEA 0183 sentences.

The output data can be set in one of the following four output formats:

1. \$PKMLX,<device_ID>,<x>,<y>,<z>
2. \$PKMLT,<device_ID>,<tilt>,<azimuth>,<range>
3. \$PKMLR,<device_ID>,<tilt>,<azimuth>,<range>,<sample_interval>,<start_position>,<end_position>,<sample_{sp}>.....,<sample_{ep-1}>,<sample_{ep}>
4. \$PKMLM,<device_ID>,<tilt>,<azimuth>,<sample_interval>,<start_position>,<end_position>,<sample_{sp}>.....,<sample_{ep-1}>,<sample_{ep}>

The output data parameters are described in the following table:

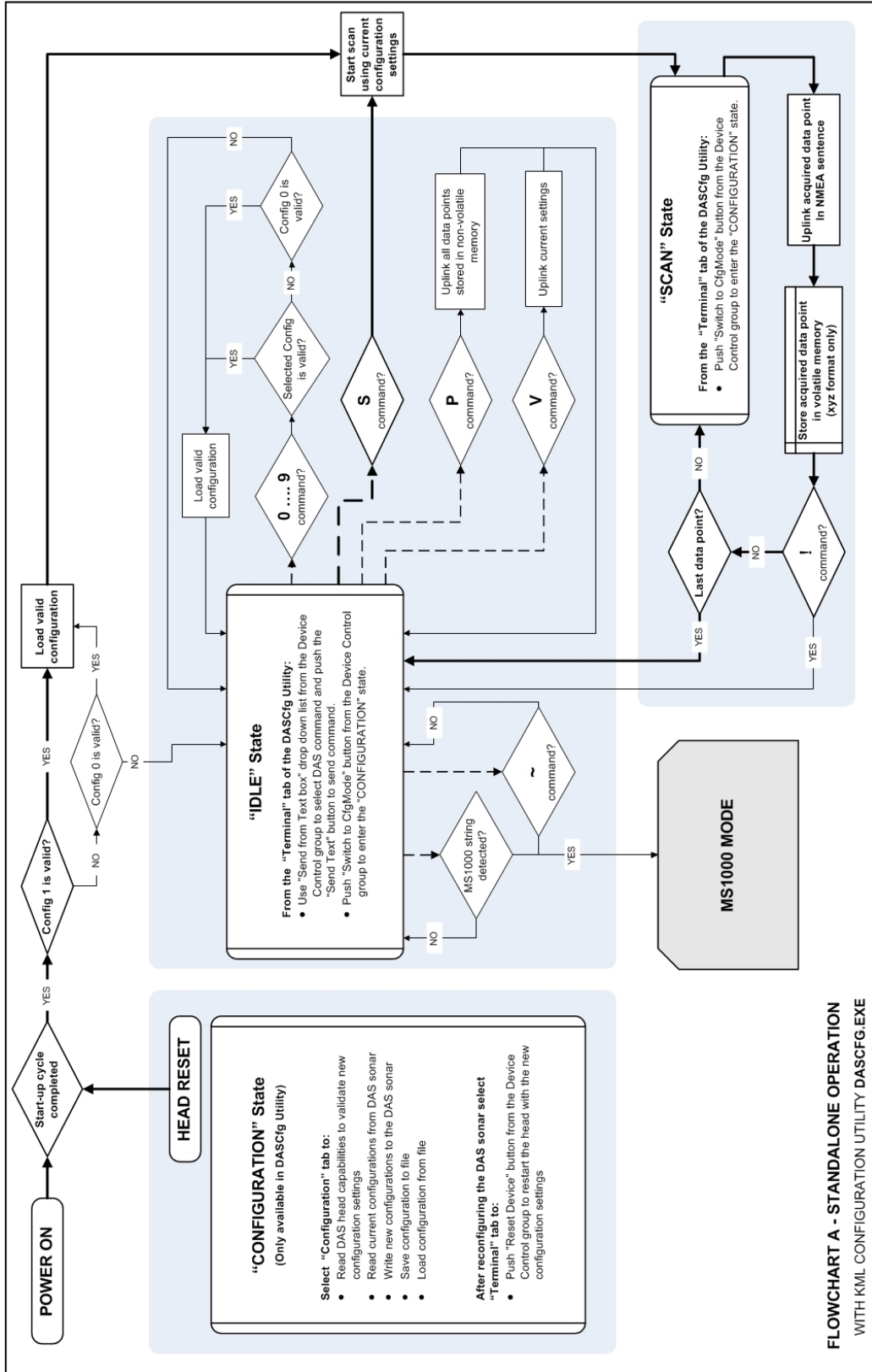
Parameter	Unit or (Format)	Description
\$PKMLX		Output tag for x, y, z coordinate of the profile point data.
\$PKMLT		Output tag for tilt, azimuth, range coordinate of the profile point data.
\$PKMLR		Output tag for tilt, azimuth, range coordinate of the profile point data and raw sample data.
\$PKMLM		Output tag for tilt, azimuth, range coordinate of the profile point data and raw sample data (future use)
<device_ID>	(ASCII)	Device ID from the active configuration
<x>	meters	“x” coordinate of profile point with respect to head datum
<y>	meters	“y” coordinate of profile point with respect to head datum
<z>	meters	“z” coordinate of profile point with respect to head datum
<tilt>	degrees	Transducer tilt from horizontal (range is +10° to -90°)
<azimuth>	degrees	Transducer azimuth with respect to heading index (range is +180° to -180°)
<range>	meters	Distance from transducer to the profile point

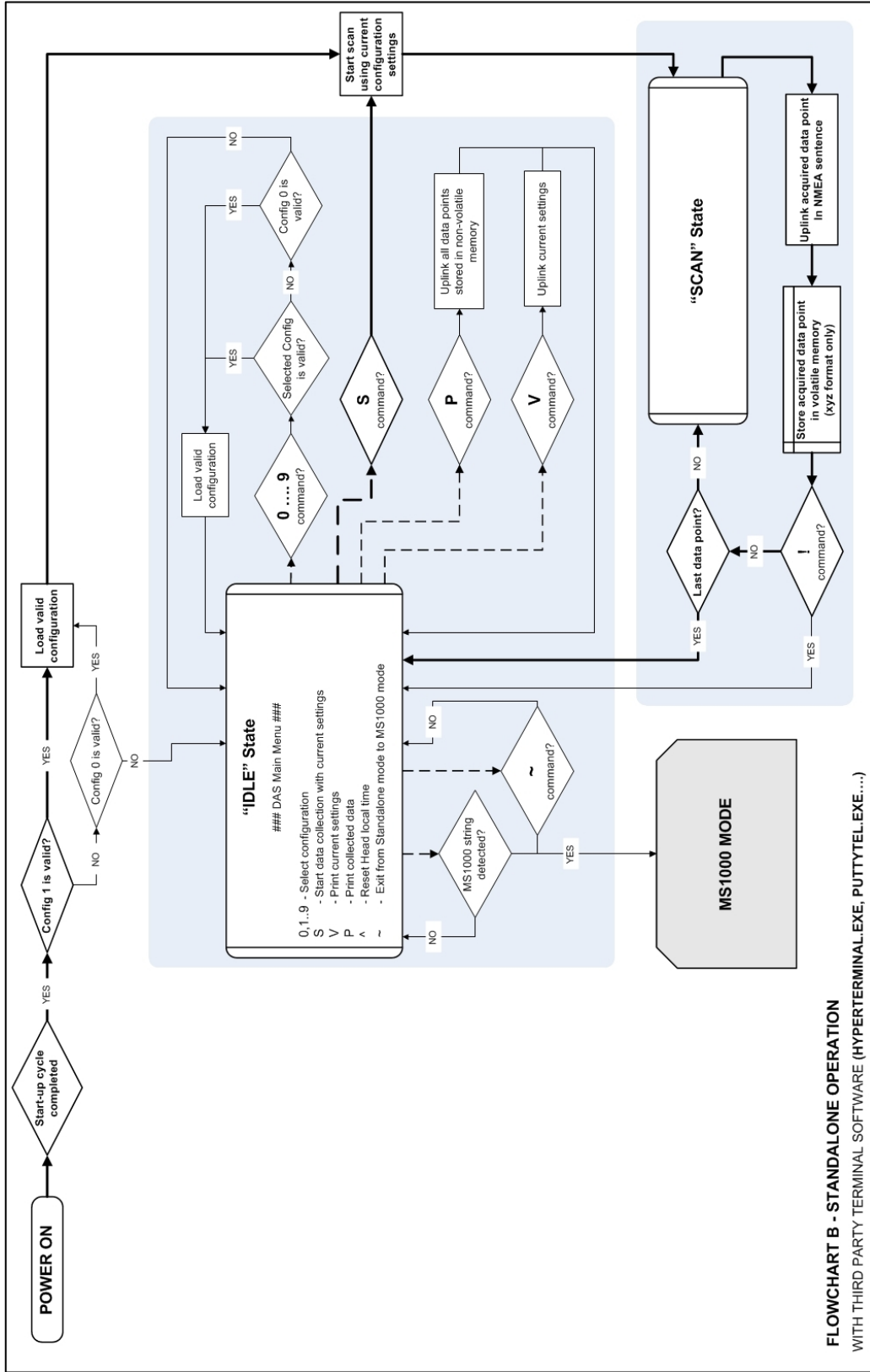
<sample_interval>	meters	Distance between two consecutive samples
<start_position>	(Decimal integer)	Sample number at the start of raw data output of the current ping. Determined by the minimum range set for profiling in the active configuration.
<end_position>	(Decimal integer)	Sample number at the end of raw data output of the current ping. Determined by the maximum range set for profiling in the active configuration.
<sample _{sp} >	(Hex integer)	Amplitude value of the first uplinked raw data sample, as determined by the minimum range set for profiling in the active configuration. (value range is 0 to FF in hex)
<sample _{ep} >	(Hex integer)	Amplitude value of the last uplinked raw data sample, as determined by the maximum range set for profiling in active configuration. (value range is 0 to FF in hex)

NOTE: The data stored in the sonar during a scan is only in the x,y,z format irrespective of the configured uplink data format. The print data command (P) will uplink the saved scan data only in the \$PKMLX format.

2.3 Standalone mode operational flowcharts

The standalone operation requires terminal type communication software. The options are to use a third party solution like “HyperTerminal” or “PuttyTel”, or use the KML supplied DASCfg.exe utility that has built-in terminal capabilities. The “DASCfg.exe” utility also allows reconfiguration of the head settings stored in configurations 1 to 9. This capability is not available when using the third party terminal software.





FLOWCHART B - STANDALONE OPERATION
 WITH THIRD PARTY TERMINAL SOFTWARE (HYPERTERMINAL.EXE, PUTTYTEL.EXE...)

2.4 Power up operational sequence

Terminal type software (PuttyTel, HyperTerminal...) or the KML supplied DASCfg utility is required to configure the PC serial COM port to receive and capture the uplinked data and control the head operations using commands from the terminal console.

After power-up the sonar will send the initial head message:

```
Telemetry Type=RS485 Baudrate=115200
DAS Mode Is=TRUE
DAS Terminal Mode Is=TRUE
Fpga=0705 Sw=1219.0 modified @ Jul 31 2013, 08:49:30
```

The current configuration settings are uplinked prior to starting the scan, either at power-up or any time after receiving a command to start a new scan. A typical uplinked configuration setting is shown below:

```
----- Das Configuration Setup...

===== Device SN=N13020029 ID=55, Configuration=1 Created=T2013-09-18-10-22-07 =====
= Device Position Offsets: x=0.000 m, y=0.000 m, z=0.000 m, Pitch=0.000 deg, Roll=0.000
deg, Yaw=0.000 deg
= Receiver Settings: Range=200.0 m, NumberOfSamples=16382, Bandwidth=WIDE,
PeakDetection=OFF, SonarFrequency=330000 Hz, Tunable=False, ExtSync=Disabled, PulseType=CW
= Gain Settings:40.0 %, LOW
= TVG Setup: A=0.0, B=0.038, C=0.0, L=96.0
= Transmitter Settings: PulseLength=40 uS, PowerState=MEDIUM, Optimize=Manual Setup,
ExtSync=Disabled
= Profiler Settings: Threshold=128, Min Width=0.016 m, Min Range=0.000 m, Max Range=0.040
m, SpeedOfSound=1475 m/s, Algorithm=First Return, LinkToRange=False
= Scanning: Algorithm=Optimize for Sphere
= Azimuth Scan:Begin=10.000 deg, End=-90.000 deg, Shots=444, StepSz=0.225 deg
= Azimuth Scan:Begin=-10.000 deg, End=10.000 deg, Shots=88, StepSz=0.225 deg
= Motor Position Monitor: AzimuthTolerance=None, TiltTolerance=None
Successfully Activated Setup #1
```

Data acquisition and uplink starts immediately after the configuration settings uplink. Depending on the selected configuration settings for motor position monitoring, a calibration table may be generated prior to starting the scan. A typical data acquisition header is shown below:

```
***** Data Collection Process: To stop the process press ! symbol *****
Head Local Time=3.397s After Reset
Start scanning ...
AZIMUTH motor Extended Calibration...
  AZIMUTH motor simple calibration...
    AZIMUTH motor create calibration table...
Motor AZIMUTH Calibration Table
Q      Min      Max
0      -21      -1
1         0      398
2       399      796
3       797     1196
4      1197     1599
5      1600     1998
6      1999     2396
```

```

7      2397      2421
8      -21       -2
9       -1       398
10     399       795
11     796       1195
12    1196       1598
13    1599       1998
14    1999       2395
15    2396       2421

```

```

-----
TILT motor Extended Calibration...
TILT motor simple calibration...
TILT motor create calibration table...

```

```
Motor TILT Calibration Table
```

```

Q      Min      Max
0      -21      -3
1       -2      404
2      405      798
3      799      869
4    32500    -32500
5    32500    -32500
6    32500    -32500
7    32500    -32500
8       -21      -4
9       -3      402
10     403      795
11     796      869
12    32500    -32500
13    32500    -32500
14    32500    -32500
15    32500    -32500

```

```
--- Data Collection: a0=-800, a1=800, as=1600, t0=0, t1=-400, ts=400 ---|
```

2.5 "Scan" state

The head will enter the "scan" state after power up, reset or every time when the scan command "S" is applied. In the "scan" state the sonar head executes one scan with the current configuration setting and uplinks the scan data. At the same time it stores the current scan profile data for subsequent uplink after the end of the scan if requested using the "P" command.

NOTE: Any previously stored scan data is overwritten at the beginning of a new scan.

To exit the "scan" state the stop character "!" must be entered.

2.6 "Idle" state

The head is in the "idle" state every time it is not scanning. In the "idle" state the head continuously uplinks a series of characters (" ", "-", "\", "|"), one every second, to indicate the head is "alive". This feature can be disabled using the "}" symbol and enabled again using the "{" symbol. In the idle mode the head provides access to setting and operational controls. It will also switch to the "MS1000" hosted mode if the MS1000 detection string is detected.

DAS Main Menu

After using the “!” key to exit the “scan” state the following message is displayed:

```
Interrupted by User
... Scanning STOPPED
```

In “idle” mode the following main control menu is displayed:

```
--- DAS Main Menu ---
0,1..9 - Select configuration
S      - Start data collection with current settings
P      - Print collected data
~      - WARNING: Exit from Terminal mode a go to a Host controlled mode
^      - Reset Head local time
Head Local Time=1m:10.715s
;
```

0,1..9 - select configuration

This menu options activates one of the selected pre-configured operational settings. Some comments regarding the head configurations:

Configuration 0 – is a factory default that cannot be modified. Its purpose is to provide known scan settings that can be used for system troubleshooting.

Configuration 1 – is the default configuration. After power-up, or reset, the sonar will start automatically one scan for data acquisition using the operational settings present in this configuration.

Configuration 1 to 9 – These configurations are programmed at the factory and require a configuration utility for any changes.

If the selected configuration is available it will be loaded and activated:

```
Selected Configuration #1
----- Das Configuration Setup...

===== Device SN=N13020029 ID=55, Configuration=1 Created=T2013-09-18-10-22-07 =====
= Device Position Offsets: x=0.000 m, y=0.000 m, z=0.000 m, Pitch=0.000 deg, Roll=0.000
deg, Yaw=0.000 deg
= Receiver Settings: Range=200.0 m, NumberOfSamples=16382, Bandwidth=WIDE,
PeakDetection=OFF, SonarFrequency=330000 Hz, Tunable=False, ExtSync=Disabled, PulseType=CW
= Gain Settings:40.0 %, LOW
= TVG Setup: A=0.0, B=0.038, C=0.0, L=96.0
= Transmitter Settings: PulseLength=40 uS, PowerState=MEDIUM, Optimize=Manual Setup,
ExtSync=Disabled
= Profiler Settings: Threshold=128, Min Width=0.016 m, Min Range=0.000 m, Max Range=0.040
m, SpeedOfSound=1475 m/s, Algorithm=First Return, LinkToRange=False
= Scanning: Algorithm=Optimize for Sphere
= Azumuth Scan:Begin=10.000 deg, End=-90.000 deg, Shots=444, StepSz=0.225 deg
= Azumuth Scan:Begin=-10.000 deg, End=10.000 deg, Shots=88, StepSz=0.225 deg
= Motor Position Monitor: AzimuthTolerance=None, TiltTolerance=None
Successfully Activated Setup #1
```

If the selected configuration is not available then configuration 0 will be loaded and activated:

Selected Configuration #2

```
----- Das Configuration Setup...
Can't find User defined Setup #2, Trying to use Factory Setup #0

===== Device SN=N13020029 ID=0, Configuration=0 Created=T2013-07-11-11-10-34 =====
= Device Position Offsets: x=0.000 m, y=0.000 m, z=0.000 m, Pitch=0.000 deg, Roll=0.000
deg, Yaw=0.000 deg
= Receiver Settings: Range=10.0 m, NumberOfSamples=476, Bandwidth=MEDIUM,
PeakDetection=HIGH, SonarFrequency=330000 Hz, Tunable=False, ExtSync=Disabled, PulseType=CW
= Gain Settings:40.0 %, LOW
= TVG Setup: GainType=20 dB, GainOffset=DEFAULT (+0 dB), GainLimit=DEFAULT (+0 dB)
= Transmitter Settings: PulseLength=23 uS, PowerState=HIGH, Optimize=Optimize for
Resolution, ExtSync=Disabled
= Profiler Settings: Threshold=128, Min Width=0.100 m, Min Range=0.200 m, Max Range=10.000
m, SpeedOfSound=1475 m/s, Algorithm=First Return, LinkToRange=True
= Scanning: Algorithm=Optimize for Sphere
= Azimuth Scan:Begin=0.000 deg, End=-90.000 deg, Shots=400, StepSz=Any
= Azimuth Scan:Begin=-180.000 deg, End=180.000 deg, Shots=1600, StepSz=Any
= Motor Position Monitor: AzimuthTolerance=None, TiltTolerance=None
= Telemetry: Mode=NoChanges, Phy=NoChanges
Successfully Activated Setup #0
```

S - Start data collection

This command restarts the profile data acquisition with the current configuration settings. The current configuration settings are typically the values stored in the selected configuration. Typical uplink sequence is:

```
----- Das Configuration Setup...

===== Device SN=N12020060 ID=0, Configuration=4 Created=T2013-06-12-16-03-01 =====
= Device Position Offsets: x=0.000 m, y=0.000 m, z=0.000 m, Pitch=0.000 deg, Roll=0.000
deg, Yaw=0.000 deg
= Receiver Settings: Range=10.0 m, NumberOfSamples=476, Bandwidth=MEDIUM,
PeakDetection=HIGH, SonarFrequency=330000 Hz, Tunable=False, ExtSync=Disabled, PulseType=LFM
= Gain Settings:40.0 %, LOW
= TVG Setup: GainType=20 dB, GainOffset=DEFAULT (+0 dB), GainLimit=DEFAULT (+0 dB)
= Transmitter Settings: PulseLength=203 uS, PowerState=MEDIUM, Optimize=Optimize for
Resolution, ExtSync=Disabled
= Profiler Settings: Threshold=245, Min Width=0.100 m, Min Range=0.200 m, Max Range=10.000
m, SpeedOfSound=1475 m/s, Algorithm=First Return, LinkToRange=True
= Scanning: Algorithm=Optimize for Sphere
= Azimuth Scan:Begin=0.000 deg, End=-90.000 deg, Shots=12, StepSz=7.200 deg
= Azimuth Scan:Begin=-10.000 deg, End=10.000 deg, Shots=2, StepSz=7.200 deg
= Motor Position Monitor: AzimuthTolerance=None, TiltTolerance=None
= Telemetry: Mode=NoChanges, Phy=NoChanges
Successfully Activated Setup #4

**** Data Collection Process: To stop the process press ! symbol ****
Head Local Time=1m:13.833s After Reset
Start scanning ...
AZIMUTH motor Extended Calibration...
AZIMUTH motor simple calibration...
TILT motor Extended Calibration...
TILT motor simple calibration...
--- Data Collection: a0=-44, a1=44, as=2, t0=0, t1=-400, ts=12 ---
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
```

```
$PKMLX,0,0.000,0.000,0.000
.
.
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
$PKMLX,0,0.000,0.000,0.000
<== Execution Time=20.210s
Scanning FINISHED Head Local Time=1m:41.219s
```

P - Print collected data

This menu options uplinks the profile data from the last scan. This scan data is stored in the sonar head volatile memory and is lost if the power supply is turned OFF. A typical printout is shown below:

```
Start uploading ...
--- Data Collection: a0=-44, a1=44, as=5, t0=0, t1=-400, ts=25 ---
$PKMLX,1202060,0.967,2.186,3.000
$PKMLX,1202060,0.983,2.188,3.000
$PKMLX,1202060,0.999,2.231,3.000
$PKMLX,1202060,1.019,2.230,3.000
$PKMLX,1202060,1.031,2.186,2.988
.
.
.
.
.
$PKMLX,1202060,0.997,2.012,2.811
$PKMLX,1202060,0.999,2.012,2.811
$PKMLX,1202060,0.999,2.000,2.811
$PKMLX,1202060,0.999,2.000,2.811
<== Execution Time=2.574s
Collected data uploaded
\
|
/
-
```

^ - reset Head local time

The sonar head doesn't have a real time clock but it can keep track of the time elapsed since the last power ON. This time can be reset using this command to allow synchronization between the start of the data collection and the time of the PC used for data collection at the moment a new scan command was issued.

~ - WARNING: Exit from Terminal mode a go to a Host controlled mode

This menu options stops the standalone operation and allows head detection and control using the MS1000 software. Please note that the head will not respond to any commands and the power has to be cycled OFF/ON if standalone operation is required.

2.7 “Configuration” state

The “Configuration” state can be entered only from the “DASCfg.exe” utility supplied by KML. There is no other mechanism to modify the operational settings in the pre-set configurations for the standalone mode operation.

DASCfg configuration Utility

The “DASCfg.exe” configuration utility supplied with the DAS profiling sonar provides the basic functionality required to configure and operate the DAS sonar in Standalone mode.

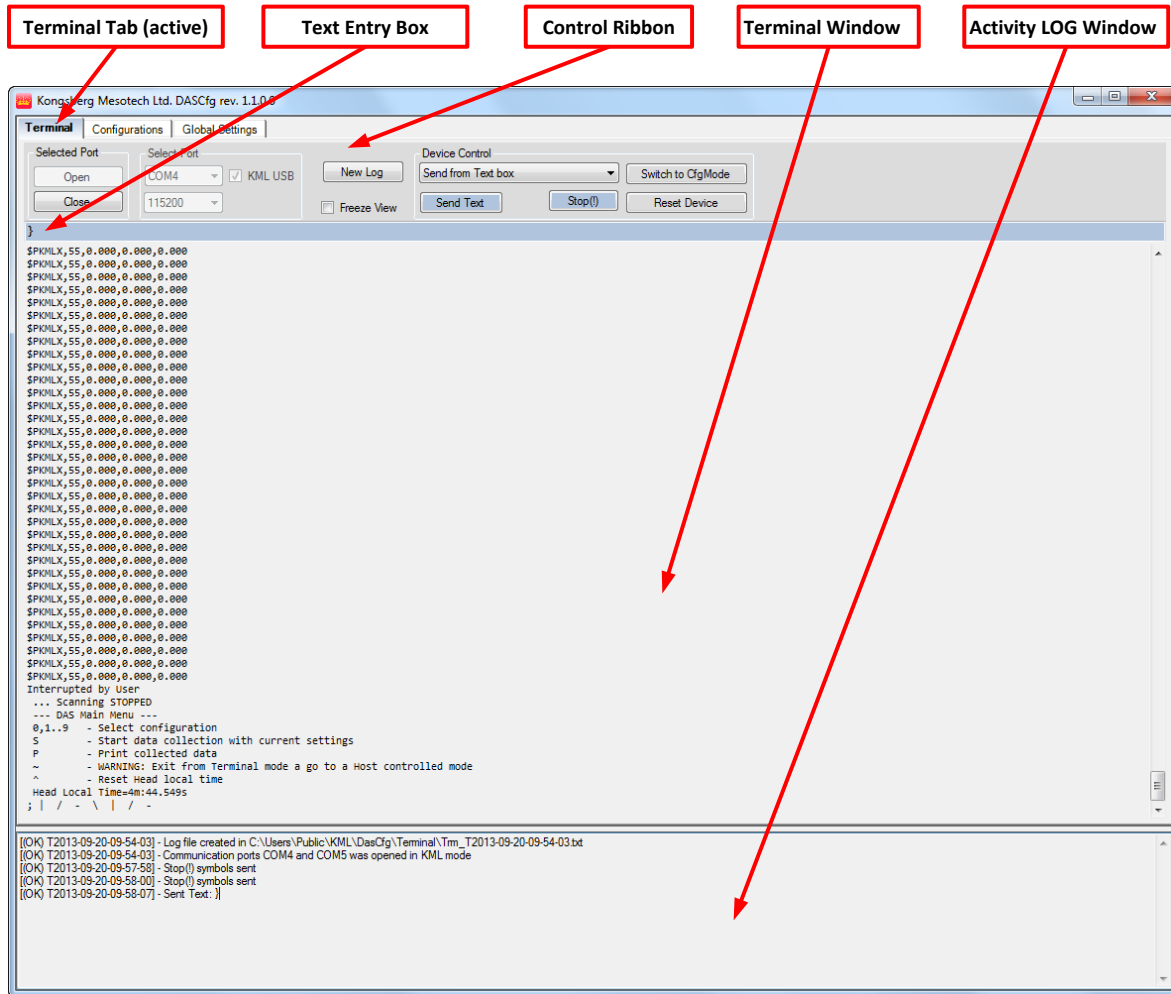
The configuration utility interfaces with the sonar in two modes, the terminal mode and the configuration mode. The two modes are available by selecting the appropriate tab.

The configuration utility also provides the capability of switching between the standalone operating mode and the MS1000 hosted mode. This is achieved by selecting the appropriate operating mode from the global settings tab.

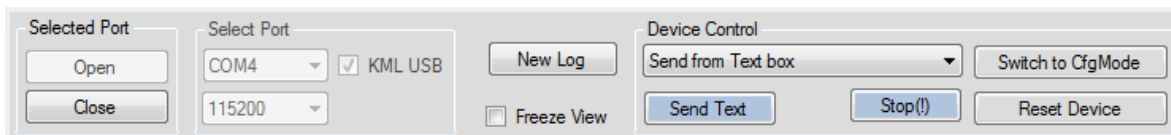
Terminal Tab

The Terminal Tab is divided in four main areas:

- Control ribbon,
- Text entry box,
- Terminal window and
- Activity Log window




The **Control** ribbon includes the following items:



- “Selected Port” group includes:
 - “Open” button to open the selected port and
 - “Close” button to close the selected port
- “Select Port” group includes
 - “COMx” drop down list that will enumerate the available COM ports and allow selection of the applicable port.
 - “Baud rate” drop down list that allows the baud rate setting for the selected port
 - “KML USB” check box that enables compatibility of the DASCfg utility with the dual port operation of the KML supplied USB/serial converters.
- “New Log” button starts a new terminal communication log file. The typical path for the terminal Logs is “C:\Users\Public\KML\DasCfg\Terminal”. The terminal file name includes creation time information and the naming convention structure is “Trm_Tyyyy-MM-dd-hh-mm-ss.txt”.
- “Freeze View” check box allows stopping the real time update of the terminal window for 10 seconds to allow for inspecting the received data. The incoming data during the 10 second display “freeze” is buffered and displayed when the terminal window resumes updating.
- “Device Control” group includes:
 - “Standalone commands list” drop down list that allows selecting the standalone command entered in the “Text Entry” box.
 - “Send Text” button that sends to the sonar head the text present in the “Text Entry” box.
 - “Stop(!)” button sends the stop command to the sonar head to terminate the current scan. This command may have to be sent repeatedly until the head stops.
 - “Switch to CfgMode” button switches the operating mode of the sonar head to the configuration mode. This button will turn either green when the head enters the configuration mode or red is the head fails to enter the configuration mode. If the button turns red it can be pushed again to retry entering the configuration mode. If the button turns green select the configuration tab to get access to the configuration GUI.
 - “Reset Device” restarts the device in standalone operating mode. This button is used only when returning to the terminal tab from the configuration tab after the desired changes have been written to the pre-set configurations.

The **Text entry** box allows manual text entries or commands selected from the standalone command drop down list.



Text entry box

The box contents are sent to the head by pushing the “Send Text” button.

The **Activity Log** window is common to all the “DASCfg.exe” utility tabs. This window lists all the system commands and messages.

```
[(OK) T2013-09-20-09-54-03] - Log file created in C:\Users\Public\KML\DasCfg\Terminal\Tm_T2013-09-20-09-54-03.txt
[(OK) T2013-09-20-09-54-03] - Communication ports COM4 and COM5 was opened in KML mode
[(OK) T2013-09-20-09-57-58] - Stop(!) symbols sent
[(OK) T2013-09-20-09-58-00] - Stop(!) symbols sent
[(OK) T2013-09-20-09-58-07] - Sent Text: }
```

To clear the Activity log right-click inside the window area and select the “Clear Log Window” pop-up control.

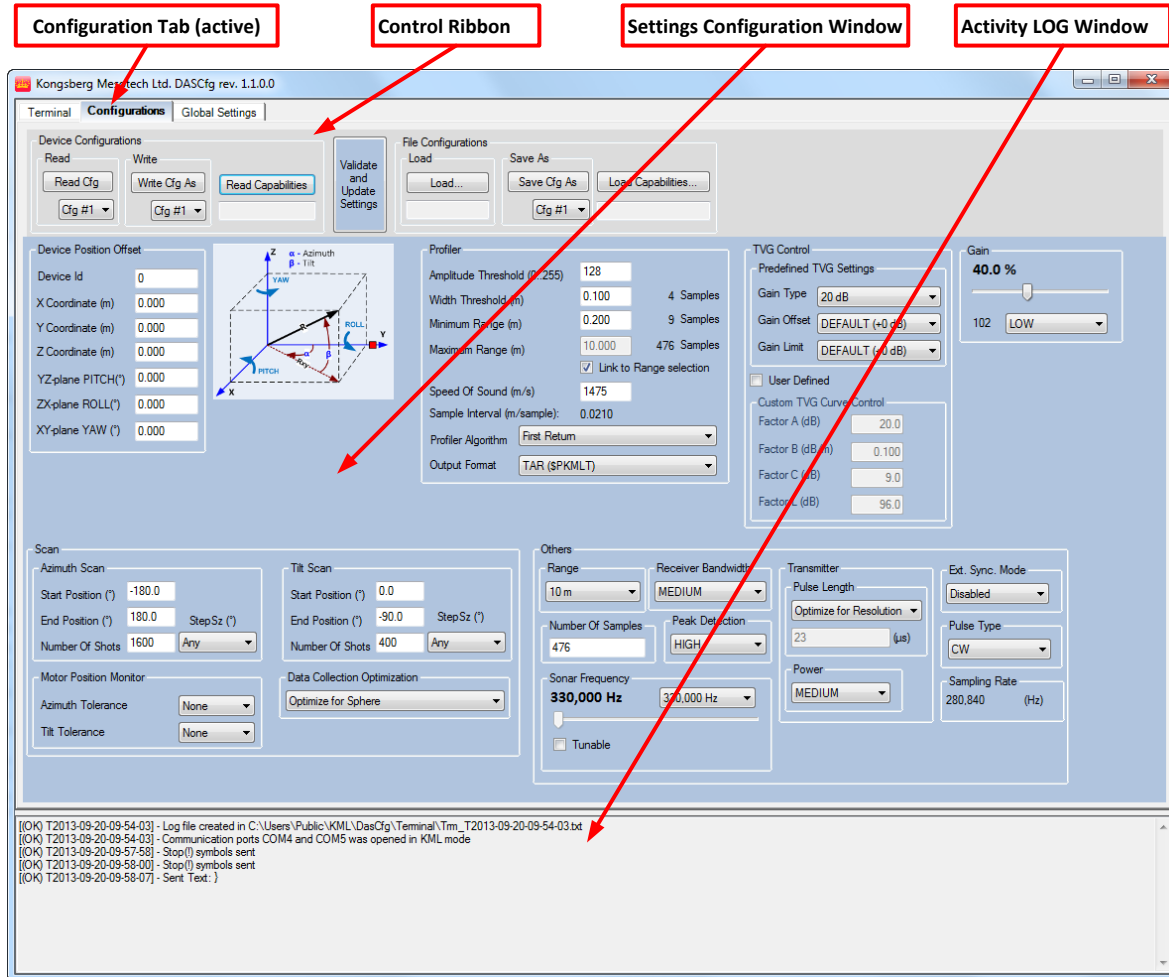
```
[(OK) T2013-09-20-09-54-03] - Log file created in C:\Users\Public\KML\DasCfg\Terminal\Tm_T2013-09-20-09-54-03.txt
[(OK) T2013-09-20-09-54-03] - Communication ports COM4 and COM5 was opened in KML mode
[(OK) T2013-09-20-09-57-58] - Stop(!) symbols sent
[(OK) T2013-09-20-09-58-00] - Stop(!) symbols sent
[(OK) T2013-09-20-09-58-07] - Sent Text: }
```

Clear Log Window

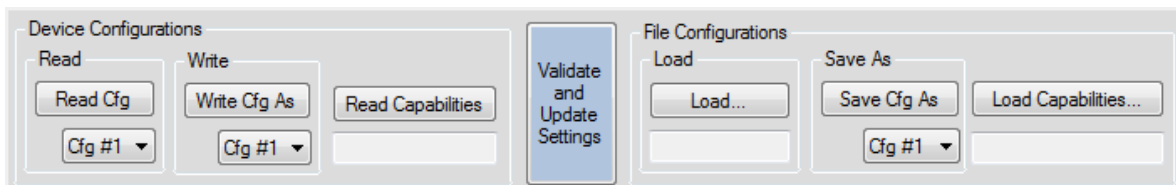
Configuration Tab

The Configuration Tab is divided in three main areas:

- Control ribbon,
- Configuration Settings window and
- Activity Log window



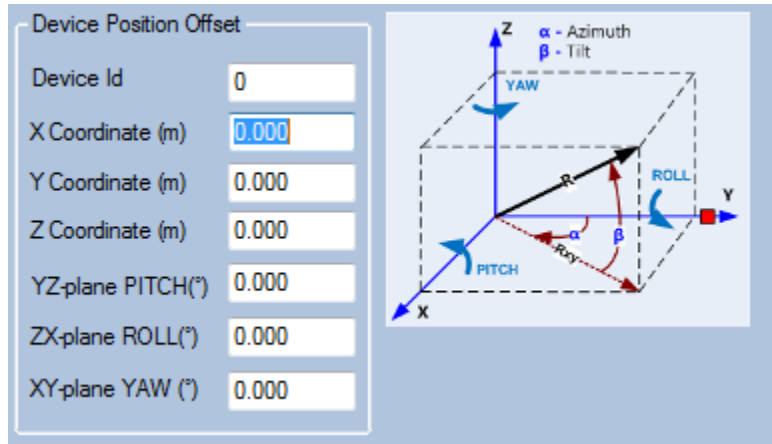
The **Control** ribbon includes the following items:



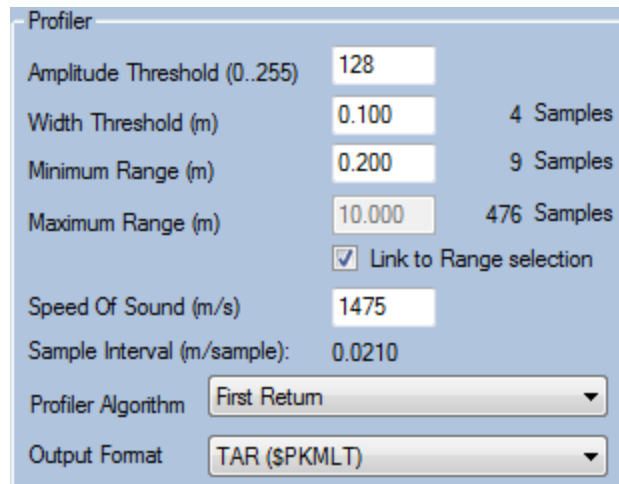
- “Device Configurations” group includes all the controls required for reading and writing configuration and capability information when a head is connected.
 - “Read” group includes:
 - “Read Cfg” button to read the head pre-set configuration number selected from the drop down list. Each time a configuration is read it is saved in to a binary file and a XML file. The typical path for the archived configurations is “C:\Users\Public\KML\DasCfg\Devices\Cfg”. The configuration file name includes the head serial number and the

- configuration number and the naming convention structure is
“Nserialnumber_Cn.Bin” and “Nserialnumber_Cn.xml” respectively.
- “Cfg number” drop down list
 - “Write” group includes:
 - “Write Cfg As” button to write the desired settings in the head configuration number selected from the drop down list. Each time a new configuration is written to the head the old configuration is saved in a file. The typical path for the archived configurations is “C:\Users\Public\KML\DasCfg\Archive”. The configuration file name includes the head serial number, the configuration number and creation time information and the naming convention structure is “Nserialnumber_Cn_Tyyyy-MM-dd-hh-mm-ss.Bin”.
 - “Cfg number” drop down list
 - “Read Capabilities” button reads the capabilities of the head connected to the configuration utility. Each time the capability is read it is saved in to a binary and an XML file. The typical path for the archived capability is “C:\Users\Public\KML\DasCfg\Devices\Cap”. The capability file name includes the head serial number and the naming convention structure is “Nserialnumber.Bin” and “Nserialnumber.xml” respectively.
 - “Serial Number” box displays the serial number of the head connected to the configuration utility.
 - “Validate and Update Settings” button validates the new setting against the head capabilities. If the desired settings are beyond the head capabilities then the settings are adjusted to match the head capabilities.
 - “File Configurations” group includes all the controls required for loading and saving configuration and capability information when using file storage.
 - “Load” group
 - “Load” button allows selection of the desired configuration file.
 - “Loaded cfg” box indicates the configuration number of the loaded configuration file.
 - “Save As” group
 - “Save Cfg As” button allows saving to file the current configuration settings under the configuration number selected from the drop down list.
 - “Cfg number” drop down list
 - “Load Capabilities” button allows loading head capabilities that were previously saved to file.
 - “Serial Number” box indicates the serial number of last loaded head capabilities file. If none the box is blank.

The **Configuration Settings** window includes the following items:

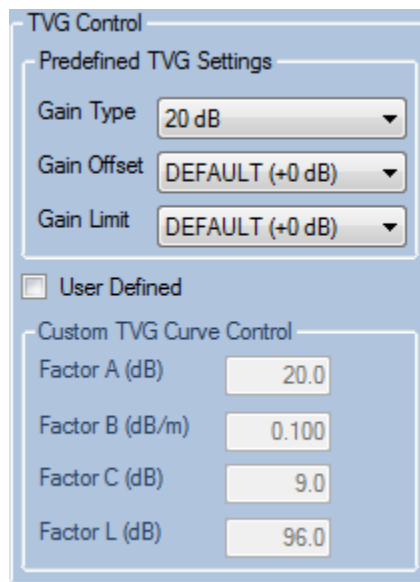


- “Device Position Offset” group contains offset information used to correct the position of the profile point with respect to a deployment datum and includes:
 - “Device Id” box allows to set individual head ID in case of multiple head deployments
 - “X Coordinate” box for x offsets in meters.
 - “Y Coordinate” box for y offsets in meters
 - “Z Coordinate” box for z offsets in meters
 - “YZ plane PITCH” box for pitch offsets in degrees
 - “ZX plane ROLL” box for roll offsets in degrees
 - “XY plane YAW” box for yaw offsets in degrees



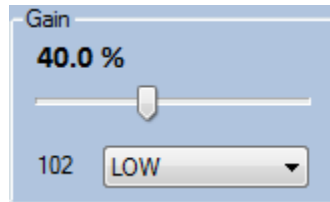
- “Profiler” group contains profile extraction settings as described in the profiling algorithm section and includes:
 - “Amplitude Threshold” box
 - “Width Threshold” box

- “Minimum Range” box
- “Maximum Range” box
- “Link to Range selection” check box to link the maximum range to the the selected operating range
- “Speed of Sound” box
- “Sample interval” display
- “Profiler Algorithm” drop down list to select from:
 - First Return – described in profiling algorithm section
 - Peak Return – described in profiling algorithm section
- “Output Format” drop down list to select from:
 - XYZ (\$PKMLX)
 - TAR (\$PKMLT)
 - RAW (\$PKMLR)
 - MS1000 RAW (\$PKMLM)
 - XYZ (\$PKMLX) + TAR (\$PKMLT)

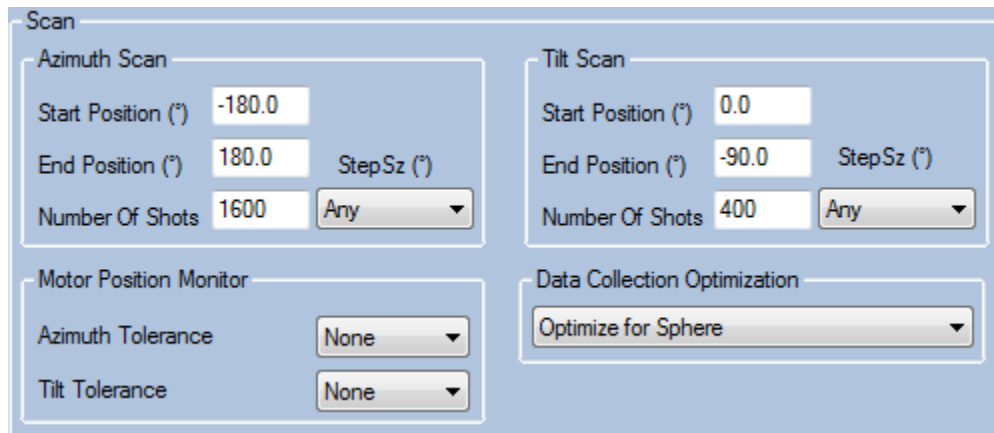


- “TVG Control” group
 - “Predefined TVG settings” group to select typical TVG curves
 - “Gain Type” drop down list to select from the 20, 30 or 40 dB curve.
 - “Gain Offset” drop down list to select from:
 - LOW (-20 dB)
 - DEFAULT (0 dB)
 - HIGH (+20 dB)
 - “Gain Limit” drop down list to select from:
 - LOW (-6 dB)
 - DEFAULT (0 dB)
 - HIGH (+6 dB)
 - “User Defined” check box to enable custom TVG curves

- “Custom TVG Curve Control” group
 - “Factor A” box to enter curve type
 - “Factor B” box to enter absorption rate
 - “Factor C” box to enter gain offset
 - “Factor L” box to enter maximum allowable TVG gain

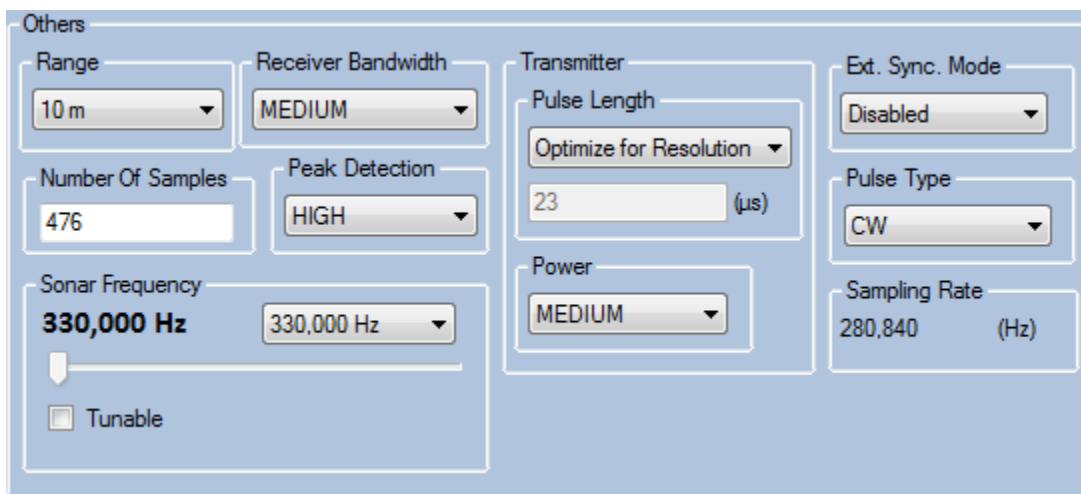


- “Gain” group
 - “Gain” slider to control gain from 0 to 100%
 - “Gain multiplier” drop down list to select from:
 - LOW (25% of HIGH)
 - MEDIUM (50% of HIGH)
 - HIGH



- “Scan” group
 - “Azimuth Scan” group defines the scan coverage and the number of shots per azimuth sweep:
 - “Start Position” box in degrees
 - “End Position” box in degrees
 - “Number Of Shots” box to enter the desired number of shots per one azimuth sweep if “Any” is selected in the “StepSz” drop down list. The scan sector will be divided by that number and each resulting ping direction would be mapped to the closest position on 0.225 degree intervals. If a specific step size is selected from the “StepSz” drop down list the number of shots is calculated and displayed.
 - “StepSz” drop down list to select from increments of 0.225 degrees. Selecting “Any” allows entering an arbitrary number of shots.

- “Tilt Scan” group
 - “Start Position” box
 - “End Position” box
 - “Number Of Shots” box to enter the desired number of shots per one tilt sweep if “Any” is selected in the “StepSz” drop down list. The scan sector will be divided by that number and each resulting ping direction would be mapped to the closest position on 0.225 degree intervals. If a specific step size is selected from the “StepSz” drop down list the number of shots is calculated and displayed.
 - “StepSz” drop down list to select from increments of 0.225 degrees. Selecting “Any” allows entering an arbitrary number of shots.
- “Motor Position Monitor” group provides position monitoring and positional error corrections during the scan when the position error exceeds the set limits.
 - “Azimuth Tolerance” drop down list to select from 0.450 to 6.975 degrees in 0.225 degrees increments.
 - “Tilt Tolerance” drop down list to select from 0.450 to 6.975 degrees in 0.225 degrees increments.
- “Data Collection Optimization” drop down list to select from:
 - “No Optimization – Linear” is an equiangular increment in the scan intervals determined by the selected step size. The point density increases as the tilt approached 90 degrees resulting in an oversampling of the nadir region.
 - “Optimize for Sphere” is an equispace increment of the scan intervals for both the azimuth and tilt directions when scanning the surface of a virtual sphere. This mode minimizes the number of samples acquired during a scan.



- “Others” group
 - “Range” drop down list to select the desired operating range.

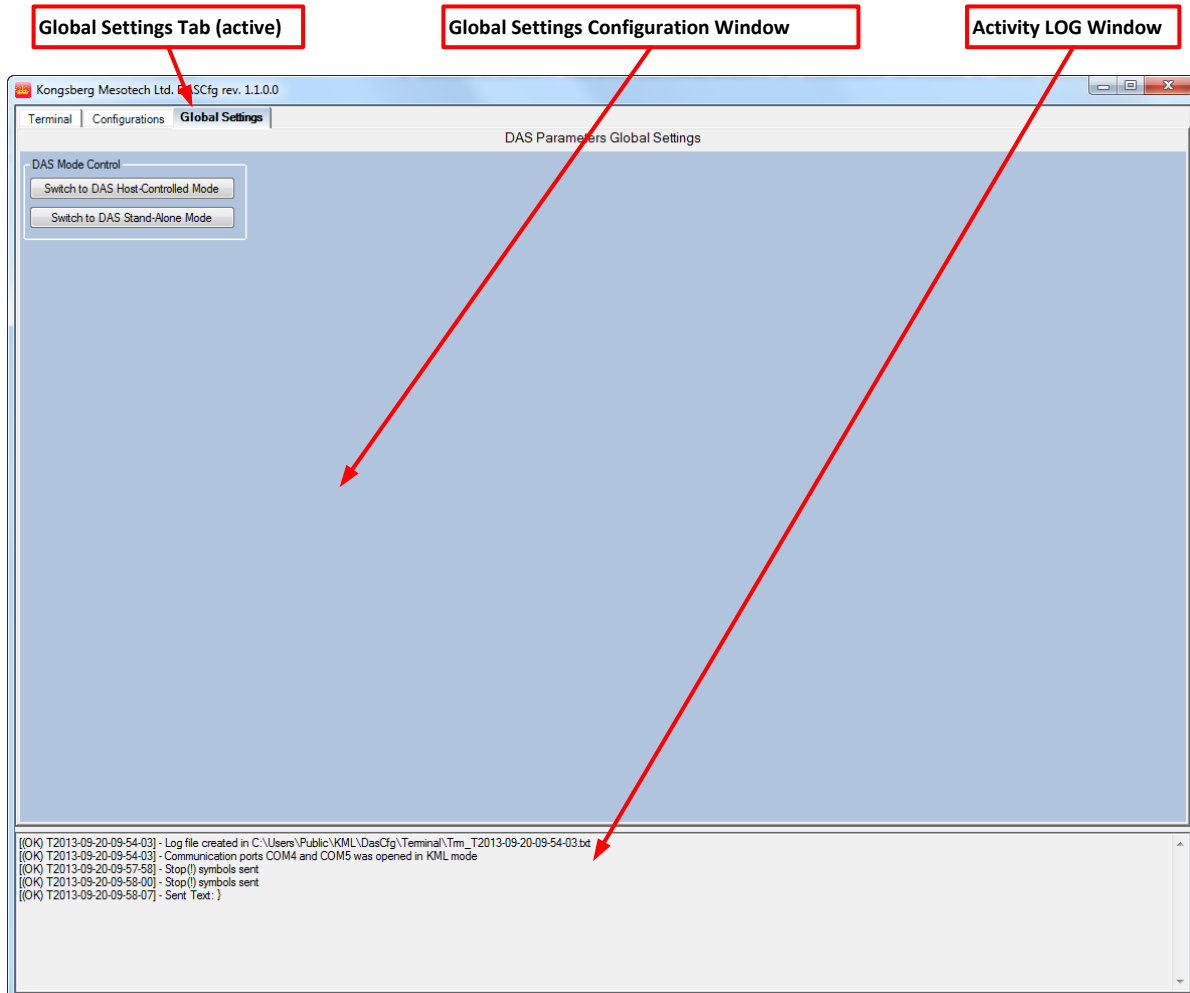
- “Receiver Bandwidth” drop down list provides options to optimize the signal to noise ratio for CW pulses. The receiver bandwidth is matched to the pulse length when set to MEDIUM.
 - NARROW
 - MEDIUM
 - WIDE
- “Number Of Samples” box to enter the desired number of samples over the specified operating range. Typical numbers are 476 or 238 that match the MS1000 number of samples.
- “Peak Detection” drop down list provides the ability to oversample the selected range so small targets falling between the sample points are detected and stored in the next sample. The oversampling options are:
 - OFF
 - LOW
 - MEDIUM
 - HIGH
- “Sonar Frequency” group provides sonar frequency selection when this option is available. This information is obtained from the head capabilities.
 - “Sonar freq” drop down list (current DAS runs at 330 kHz only)
 - “Sonar freq” slider (current DAS runs at 330 kHz only)
 - “Tunable” check box is disabled (current DAS runs at 330 kHz only)
- “Pulse Length” group provides control over the pulse width when using CW pulses. The pulse lengths setting is either automatically calculated based on range and number of samples and optimized for resolution or range, or set manually.
 - “Pulse length selection” drop down list to select from:
 - OPTIMIZE FOR RESOLUTION
 - OPTIMIZE FOR RANGE
 - MANUAL SETUP
 - “Pulse width value” box either displays the calculated value or allows manual entry of value depending if manual setup is selected.
- “Power” drop down list to select the transmitter power :
 - HIGH
 - MEDIUM (11% of HIGH)
 - LOW (50% of MEDIUM)
 - MINIMUM (50% of LOW)
- “Sampling Rate” display
- “Ext Sync Mode” drop down list (future use when multiple heads use a common sync cable).
- “Pulse Type” drop down list to select from:
 - CW (continuous wave)
 - LFM (linear frequency modulation - chirp)

The **Activity Log** window is common to all the “DASCfg.exe” utility tabs. This window lists all the system commands and messages. To clear the Activity log right-click inside the window area and select the “Clear Log Window” pop-up control.

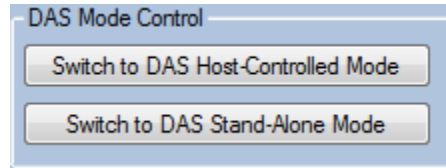
Global Settings Tab

The Global Settings TAB is divided in two main areas:

- DAS Parameters Global Settings window and
- Activity Log window



The **DAS Parameters Global Settings** window includes the following items:



- “DAS Mode Control” group
 - “Switch to DAS Host-Controlled Mode” button to change the power-up configuration to the MS1000 hosted mode.
 - “Switch to DAS Stand-Alone Mode” button to change the power-up configuration to the standalone mode.

The **Activity Log** window is common to all the “DASCfg.exe” utility tabs. This window lists all the system commands and messages. To clear the Activity log right-click inside the window area and select the “Clear Log Window” pop-up control.

3 DAS HEAD OPERATION IN MS1000 MODE

The DAS system will recognize the MS1000 telemetry data when the head is in the “idle” state or the hosted mode has been invoked by entering the “~” symbol or the “Switch to CfgMode” button was used in the terminal tab of the “DASCfg.exe” utility

If a terminal software or the “DASCfg.exe” utility is used to set or confirm the “idle” state then prior to starting the MS1000 software close the terminal application to release the COM port for use in the MS1000. From this point most of the operational settings are described in the MS1000 manual. The only item requiring some description is the setup of the 3D scanning settings.

3.1 Step 1 – Head Preparation for MS1000 mode

To enter the MS 1000 mode:

- Set up the third party terminal software or the terminal tab of the “DASCfg.exe” utility to enable communication with the DAS head.
- Power the head and wait for data uplink.
- Stop the head using command “ ! ”. Try repeatedly until the scan stops and the head enters the “idle” state.
- Use one of the three options as available:
 - Leave head in the standalone “idle” mode or
 - send the “ ~ ” command to force the MS1000 mode in the head or
 - push the “Switch to CfgMode” button in the terminal tab of the “DASCfg.exe” utility.

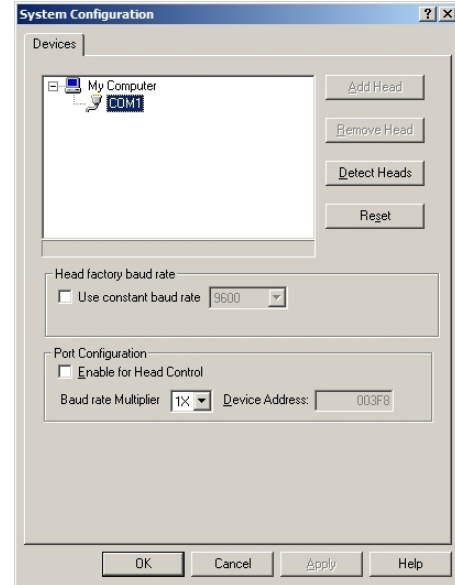
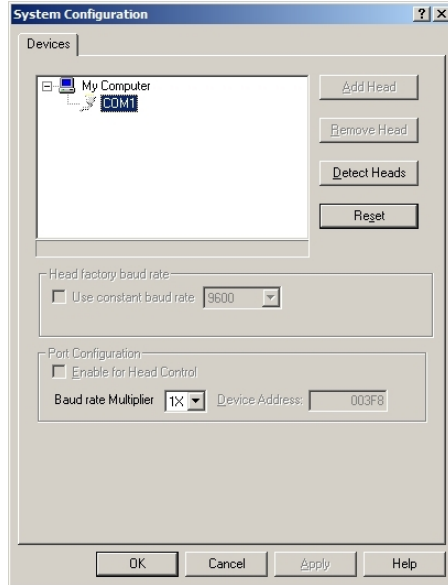
(NOTE: In the last two cases the head will wait for the MS 1000 telemetry and will not be responsive to any other interactions. Cycle power ON/OFF to return to standalone mode).

- Disconnect the terminal software to free the COM port for the MS1000 application.
(NOTE: Do not turn power OFF unless you want to return to standalone operation).

3.2 Step 2 – Head Setup in MS1000

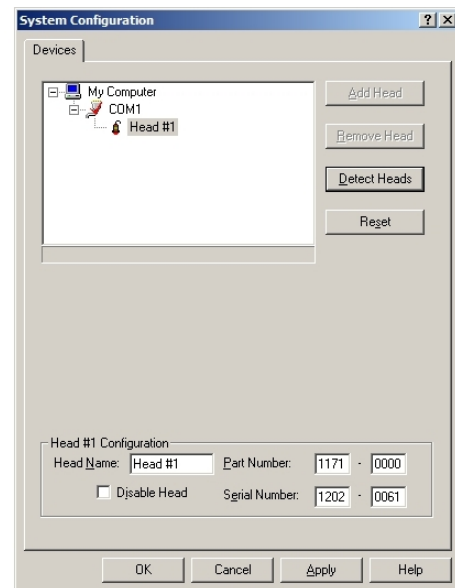
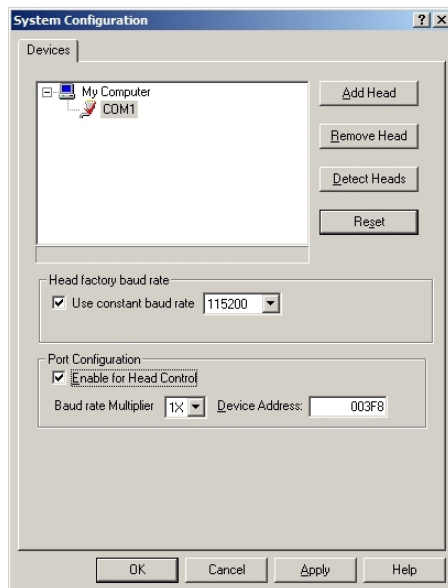
- Start MS1000 software.
- Go to Setup tab and select “Connect Sonar”.
- In the System Configuration dialog Reset the devices

- Select the COM port running the sonar (NOTE: if the sonar COM port is greyed out then the port is still used by HyperTerminal. Disconnect and push Reset again.)
- Check the “Use constant baud rate” box and set baud rate to 115200 from the drop down list.
- Check the “Enable for Head Control” box.

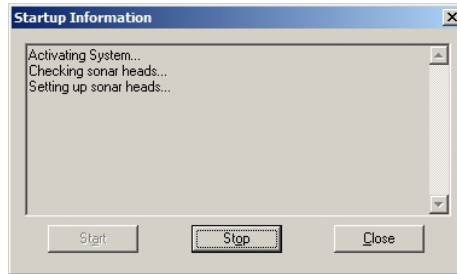


- Detect head

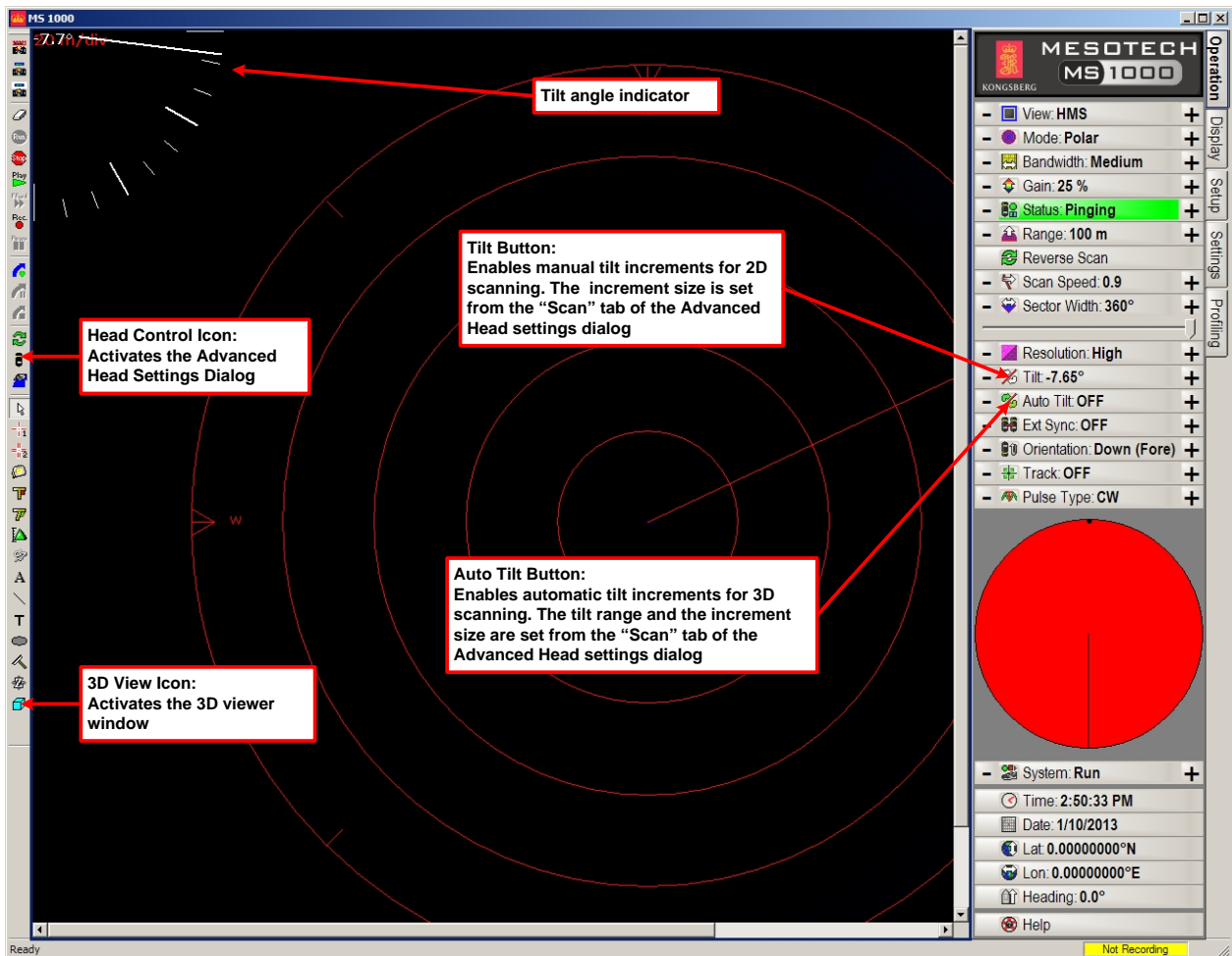
(NOTE: if the head is in “idle” mode then the first detection attempt will just set it in MS1000 mode then time out. Push again the “Detect Head” button to complete the detection process.)



- Run head

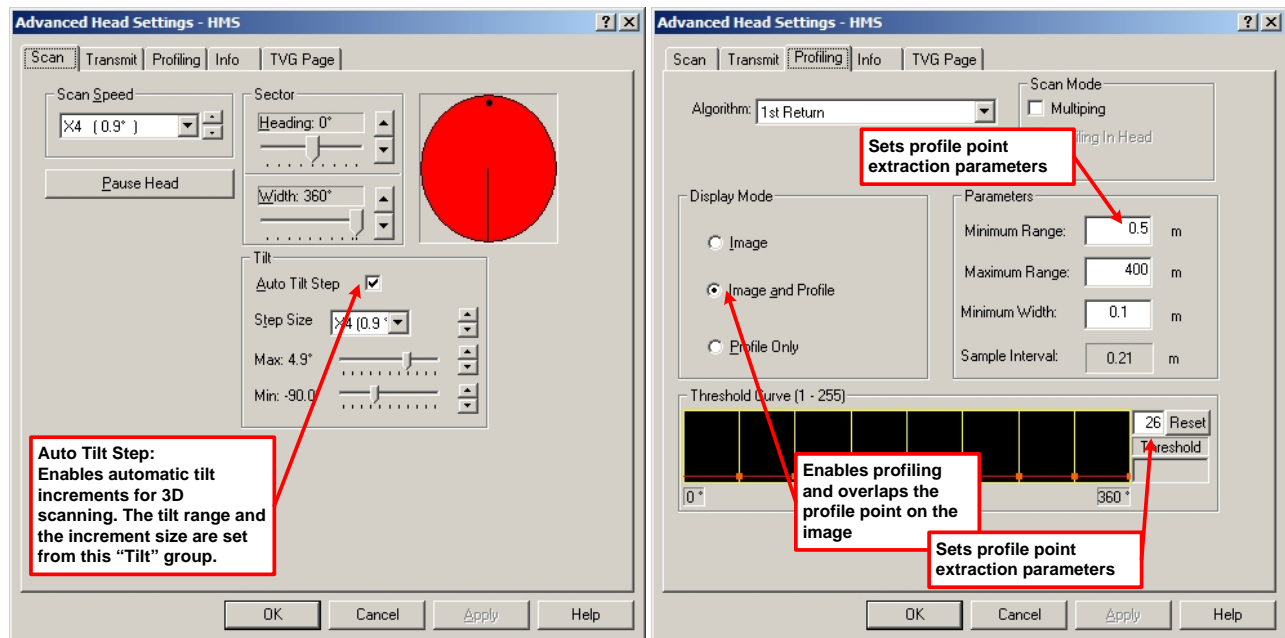


- Once the head starts running the MS 1000 display will start a 2D scan showing the range and bearing of the sonar returns over the set scan area and with a selectable transducer tilt. All the operational settings can be adjusted as necessary to optimize the data acquisition.



3.3 Step 3 – 3D profile data acquisition setup in MS1000

- During the scan the profile parameters can be adjusted to optimize the profile point extraction. The profile parameters can also be changed on any recorded data by choosing to override the recording profile settings in case further optimization is required.
- To automatically perform a 3D scan additional setup is required to enable auto tilt and define the tilt ranges.
- Setup the Profiling and Auto Tilt Scan parameters.



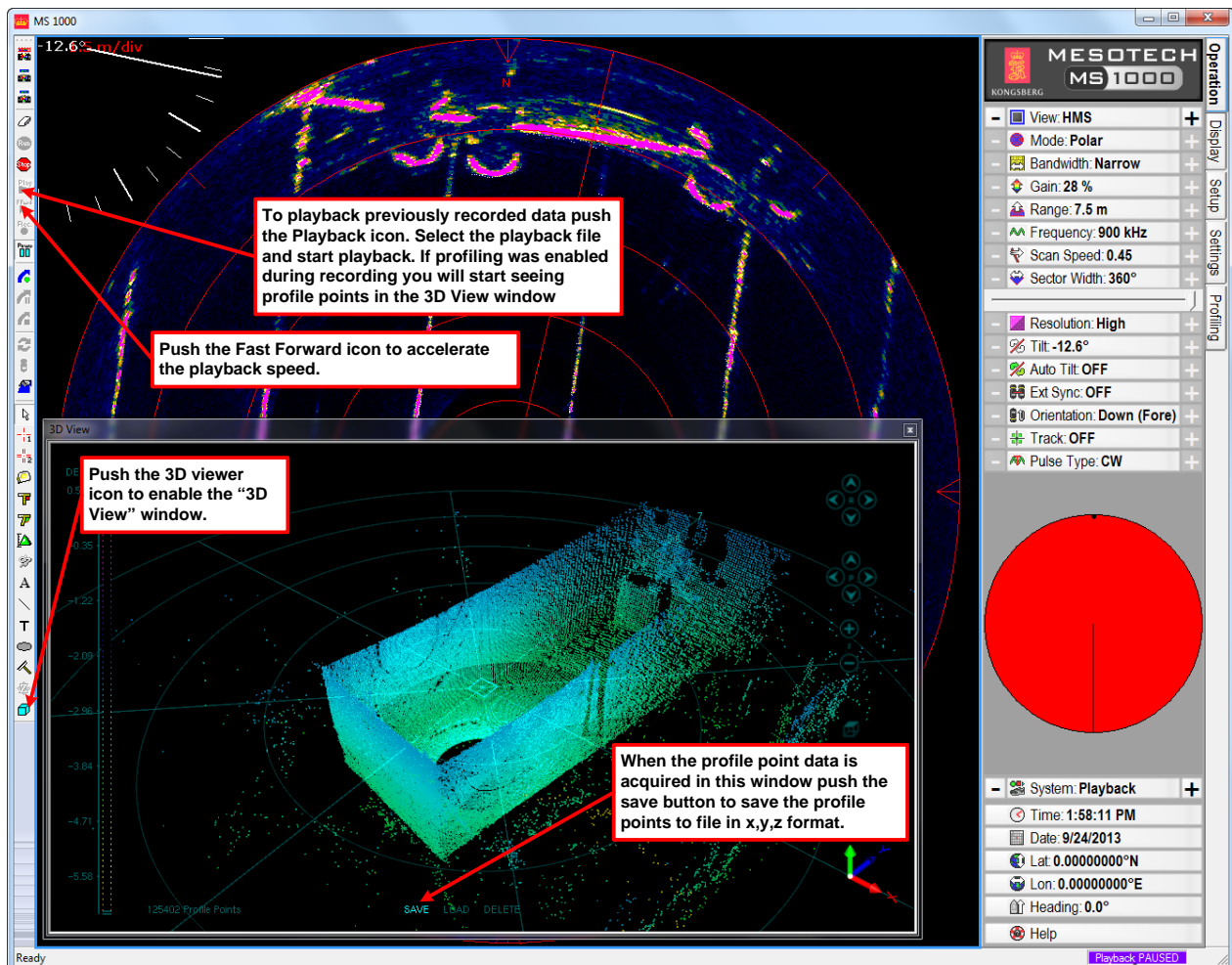
- Start recording

3.4 Step 4 – Profile point data visualization

The scan data will be displayed on screen as a 2D image containing the entire ping data, the extracted profile points or both depending on the profiling settings. This data is displayed in the range and bearing format with an additional indicator for tilt. To visualize the acquired profile points the 3D visualization window should be activated from the “Tools” toolbar. The 3D visualization tool allows visualization of the profile points in real time during acquisition for quality assurance purpose. The profile data can also be displayed when playing back any MS1000 recording. The displayed profile data can be saved using the x, y, z format in a text file. This is necessary in preparation for importing the point cloud data in

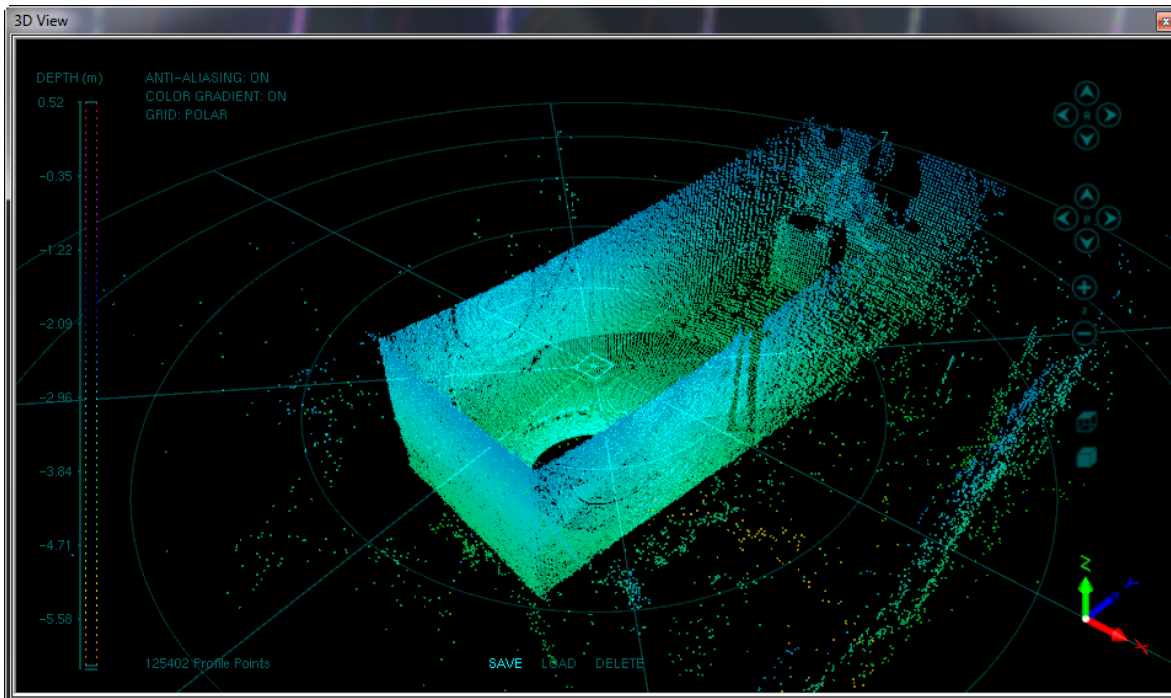
CAD software or other specialized post processing software. Also any text file containing x,y,z points can be loaded for visualization in this module.

- Activate 3D visualization window using the icon from the tool bar. The 3D viewer window will pop-up on top of the MS1000 display and can be dragged and resized as necessary.
- The point cloud is updated in real time with any new profile points. The point cloud data can be panned, zoomed or rotated as necessary.
- Once the scan covers the desired area you can save the profile point in x,y,z format direct from the 3D visualization window.



3.5 Step 5 – 3D Profile point data saving and retrieval

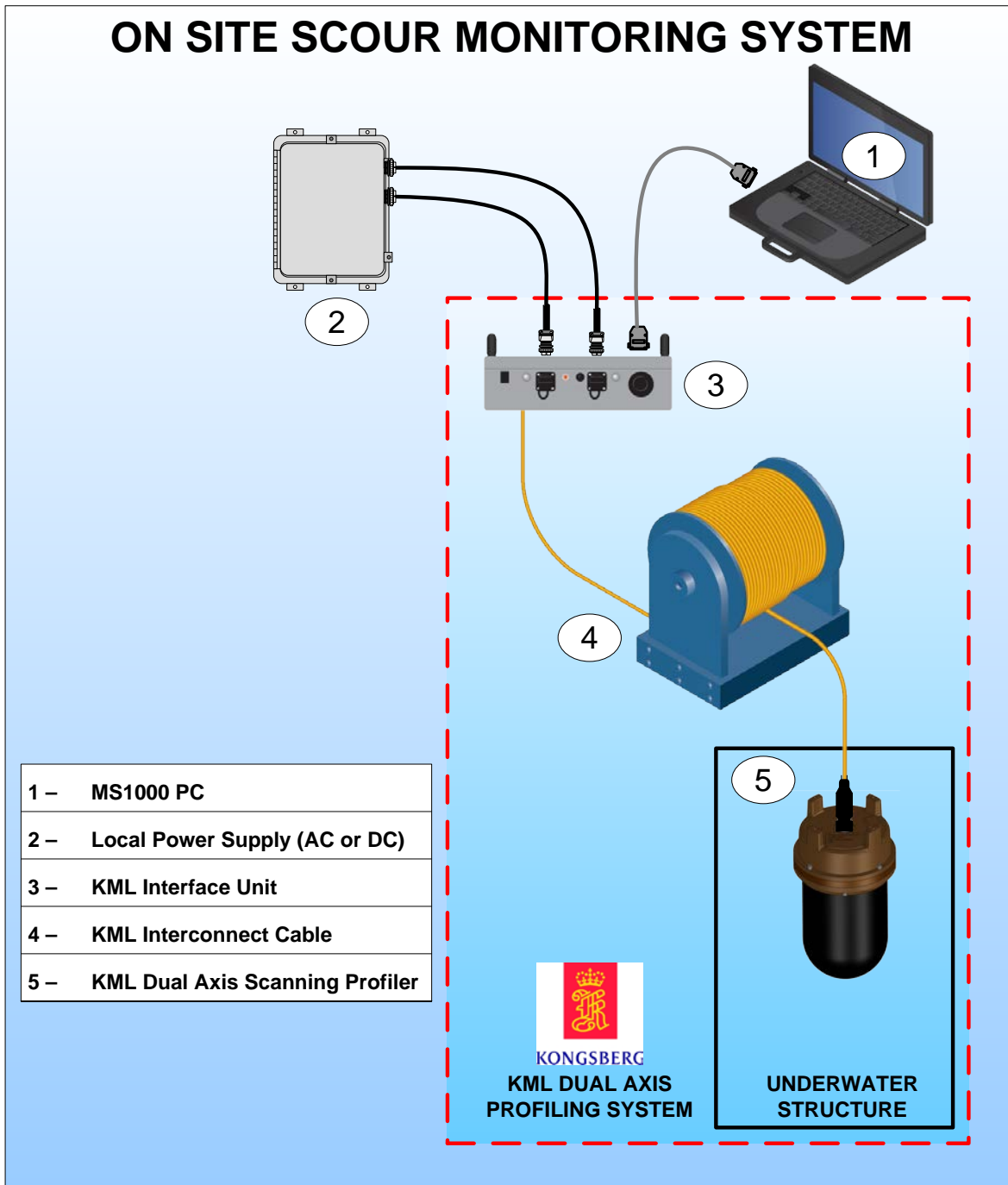
- The 3D viewer window has controls allowing to save the profile points to a text file, load saved profile points from a text file and clear any of the loaded profile points.



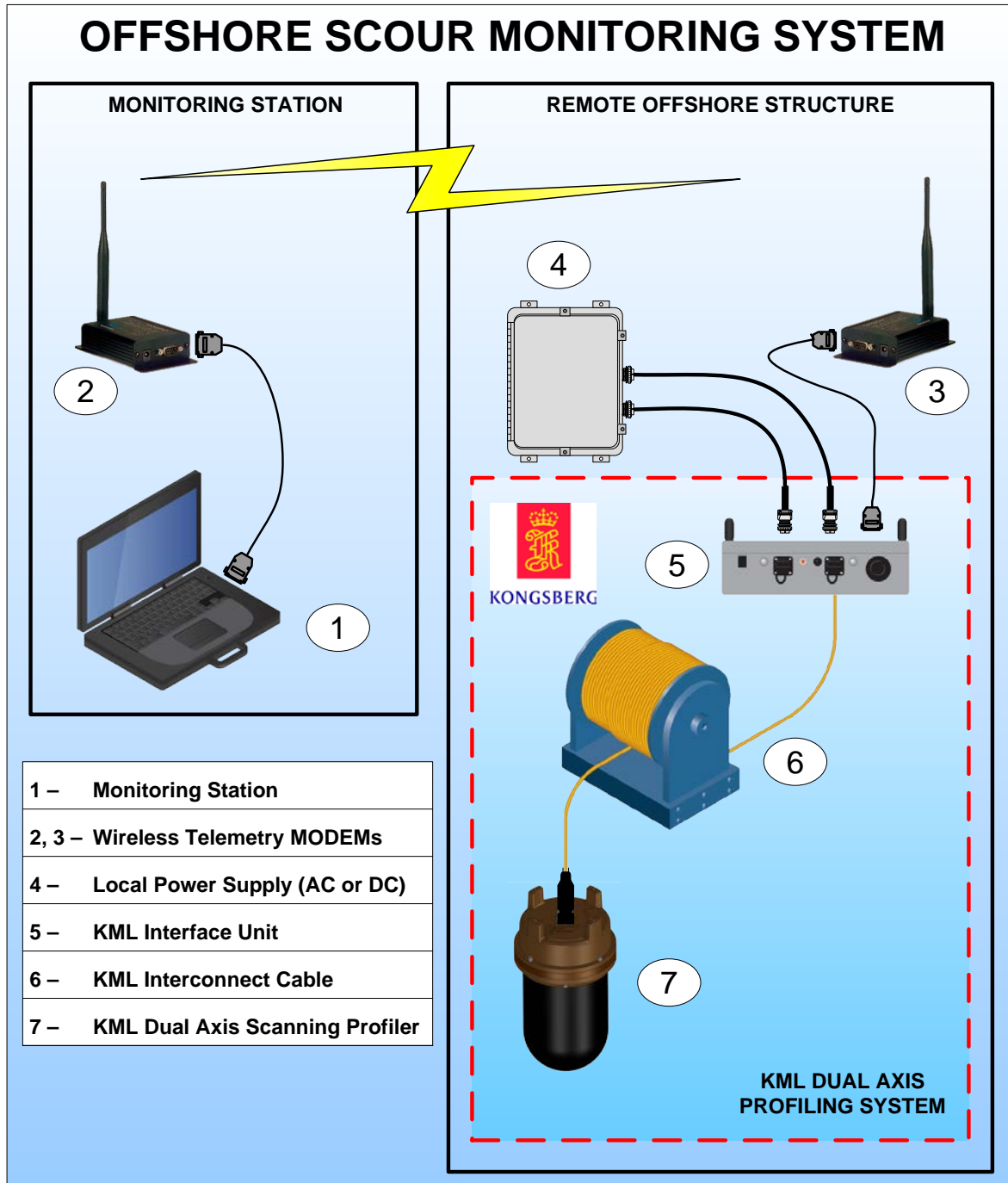
- The profile point data saved in the text file is in the x,y,z format.

4 TYPICAL EQUIPMENT CONFIGURATION

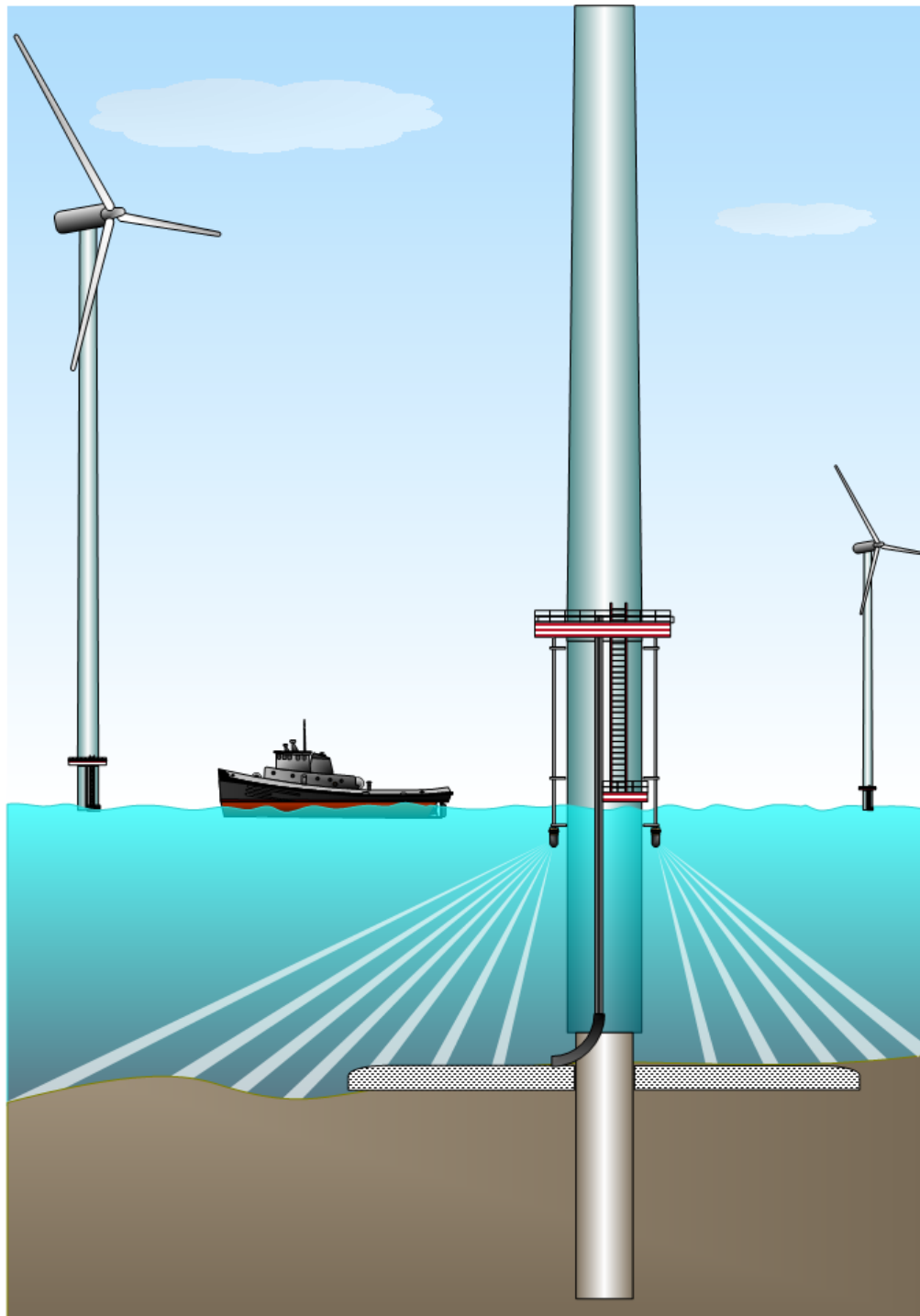
4.1 On site deployments



4.2 Remote deployments



4.3 Dual head deployment for monopiles foundation scour monitoring



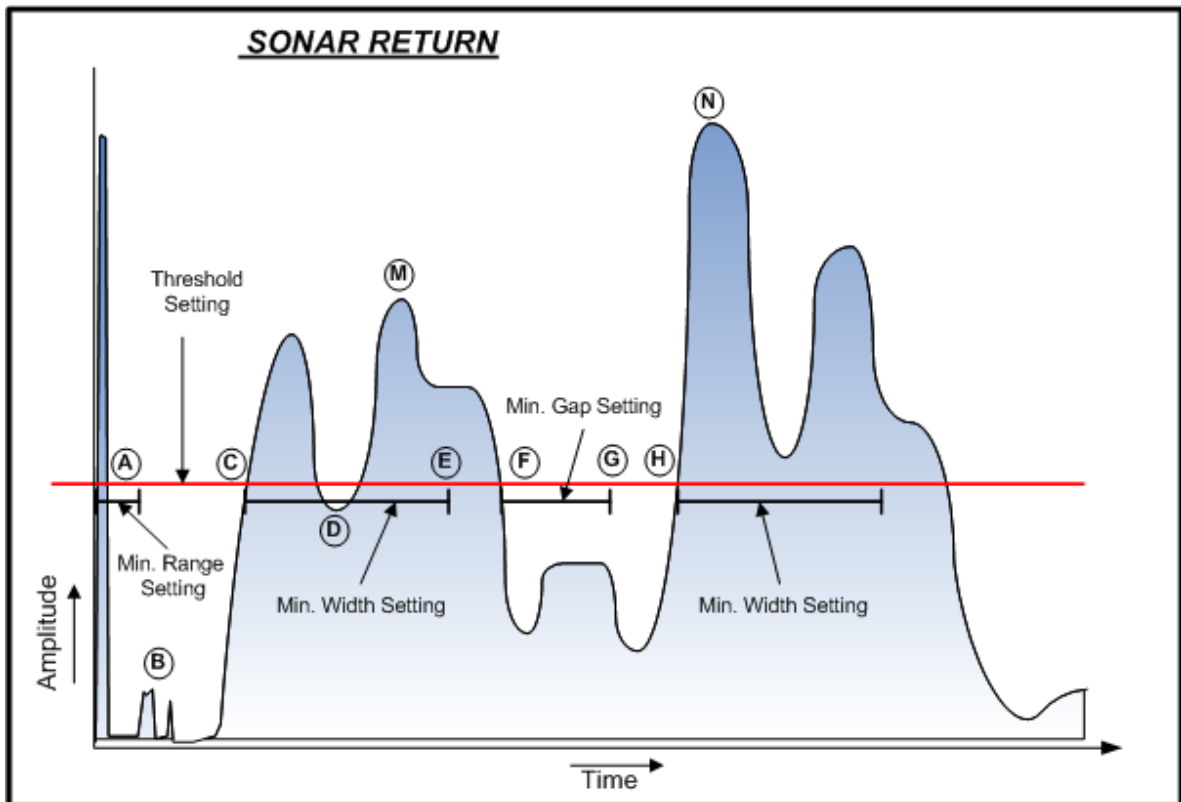
5 DAS HEAD RE-CONFIGURATION OPTIONS

The DAS head operating modes, operational configurations and settings can be re-configured as necessary. The head firmware can also be updated without opening the head. The pre-requisites for these firmware updates, configuration and settings changes are listed in the table below:

Action	Required operating mode	Required software	Notes
Update firmware	MS1000	MS1000.exe	Use KML supplied “upgrade.hsw” file
Update power-up configuration	MS1000	DASCfg.exe	Allows setting the power up mode to standalone or MS1000. NOTE: Contact factory if other power up configuration changes are required.
Change operational settings in MS1000 mode	MS1000	MS1000.exe	Manual setting selection or use previously saved setting.
Activate pre-set operational configuration in Standalone mode	Standalone operation mode	DASCfg.exe or other terminal application	Select desired pre-set configuration number and start scan.
Modify pre-set operational configuration in Standalone mode	Standalone configuration mode	DASCfg.exe	Set head in Configuration mode. Manual re-configuration of current settings or use previously saved settings.

6 DAS HEAD PROFILE POINT DETECTION ALGORITHM

The following figure shows a typical shape for the amplitude of the sonar return signal:



The profile point extraction software starts processing the sonar data from range (time) 0. At the start of the ping, at point **A**, there is a large signal from the transmitted pulse which will be ignored by the profile point detection software. The software starts looking for a target return starting after the end of the transmit pulse and after a user-specified minimum range parameter. If the user specifies a minimum range less than the range corresponding to the transmit pulse length, then the pulse length value will be used as the minimum range. Otherwise the user value is employed. This parameter can also be used to eliminate unwanted returns from objects near to the sonar (e.g. marine structures, piers... etc.) by setting the value beyond the range of these objects. However, care must be taken to not set the value too high and consequently missing desirable returns.

A user-specified threshold parameter is used to set the level above which the sonar data will be detected as returns. This is usually set high enough so that small unwanted targets and noise (such as at **B**) do not become detected as returns.

Return samples are then evaluated proceeding to longer ranges. There may be low-level returns and noise that are ignored because they are below the threshold. At some point **C** the signal rises above the threshold at the start of a potential return value. This return is qualified to meet a minimum width as determined by a user-specified minimum width parameter. After point **C** is detected, the program evaluates the sample data in the width interval following the first sample over the threshold (over the interval **C** to **E**). Provision is included so that some samples may actually fall below (low) the threshold **D**, but the majority of samples over the width must be greater (high) than the threshold. If the majority is greater, then the return is flagged as a valid return and its peak value **M** is recorded as well as the range **C**. If the tested return is not valid, then the search for a return resumes at the first sample after **C**.

If the return is valid and the profiling algorithm parameter is set to **FIRST RETURN** then profile detection terminates and the value **C** is taken as the altitude and **M** is taken as the amplitude.

If the algorithm is set to **PEAK RETURN**, the return just validated is saved as a potential altitude and the search for further returns continues after **F**. In order to help distinguish between distinct returns, the software first looks for an 'absence' of return signal where the level solidly drops below the threshold level for a specified distance. This distance is controlled by the minimum gap parameter, which is automatically set by the software based on the operational settings. The signal cannot be above the threshold anywhere in the gap. As shown in the figure, the gap will probably not be right after the width test - the program will continue to search for the gap until one is found **F** to **G**.

After the gap is found, the program resumes looking for another return after the point **G**, using the same threshold value and width checking as for the first return. A buffer of up to 30 potential altitudes can be built up in the **PEAK RETURN** mode.

Once all potential returns have been found to the end of the ping, the program then chooses the altitude value from the return that has the highest amplitude. Referring to the figure above, a second return was found at **H** with an amplitude **N** - the program would then use the altitude **H** with amplitude **N**.

Care must be used when employing the **PEAK RETURN** mode. This mode is not appropriate when the desired altitude is the first return and it has an amplitude less than later returns or when the gain is increased so that normal sonar background noise becomes a level higher than the threshold (especially near the end of the ping with the increase in TVG). This noise will probably can easily be detected and returned as altitude in the **PEAK RETURN** mode.

The additional maximum range parameter can be set to limit the maximum range at which the search for returns in the data will stop. When this value is less than the range setting, no sonar samples beyond that range will be evaluated as possible returns. This may be useful in some situations when there are unwanted targets (real targets or noise) at ranges much larger than the actual altitude being measured.

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