

# TIMBERS protocol for the EM2040 multibeam system

*This protocol is largely based on the SIS User Manual, Kongsberg technical notes and advice from Marc Roche and Koen Degrendele (FOD-Economie, Brussels). For the preparation of this protocol, the Kongsberg EM2040DRx-0.4, installed on the hull of the RV Simon Stevin (Flanders Marine Institute in Ostend), was used. For more information regarding the chosen settings, contact Nore Praet.*

## 1. Multibeam system specifications

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### Kongsberg EM2040DRx-0.4

- The shallow-water system of Kongsberg
- One transmitter Tx (0.4°), dual receiver Rx (0.7°) (also called dual head)
- Single swath (**not** multi-swath or multi-ping) and multi-sector (3 sectors)
- Tx transmits 3 sectors with a ping delay of msec
- Each sector has unique frequency and pulse length (own beam pattern)
- Two receivers have different sensitivity (manufacturing, i.e. the  $\pm 1$  dB inherent transducer sensitivity reported for Kongsberg systems; Hammerstad, 2000) but also slightly different frequency (linked to PL)

### Technical specifications

- Frequency range 200 to 400 kHz
- Max ping rate 50 Hz
- Swath coverage sector: 200° (dual receiver)
- Beam patterns Equiangular, equidistant and high density
- No. of beams per ping: 800
- Roll stabilised beams  $\pm 15^\circ$
- Pitch stabilised beams  $\pm 10^\circ$
- Yaw stabilised beams  $\pm 10^\circ$

### Pulse length

	200 kHz mode		300 kHz mode		400 kHz mode	
	CW	FM	CW	FM	CW	FM
Normal mode	38, 108 & 324 $\mu$ s	3 & 12 ms	38, 108 & 324 $\mu$ s	2 & 6 ms	27, 54 & 108 $\mu$ s	N/A

Single sector mode	19, 38 & 81 $\mu$ s	1.5 ms	19, 38 & 81 $\mu$ s	1.5 ms	14, 27 & 54 $\mu$ s	N/A
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### Beam width

	200 kHz	300 kHz	400 kHz
TX EM 2040-04	0.7°	0.5°	0.4°
RX	1.5°	1°	0.7°

## 2. Runtime parameters (Sis 4)

In this section, the TIMBERS settings are explained.

### 2.1. Sounder Main tab

The screenshot shows the 'Runtime parameters' window with the 'Sounder Main' tab selected. The window is divided into several sections:

- Sector Coverage:**
  - Port <-> Starboard: A button to toggle between Port and Starboard settings.
  - Max Angle Port RX (deg): 65
  - Max Angle Starb. RX (deg): 0
  - Max. Coverage (m): 500
  - Angular Coverage mode: MANUAL
  - Sector Mode: SNGL CENT
  - Beam Spacing: ☒ Equal heads, EQANGLE
- Depth Settings:**
  - Force Depth (m): 1
  - Min. Depth (m): 1.00
  - Max. Depth (m): 50.00
  - Ping Mode: 400kHz
  - Pulse Type: LONG CW
  - ☐ FM disable
  - Detector Mode: NORMAL
- Transmit Control:**
  - ☒ Pitch stabilization
  - Along Direction (deg.): 0.0
  - Yaw Stabilization Mode: OFF
  - Heading: 0.0
  - Heading filter: WEAK
  - Max. Ping Freq. (Hz): 10
  - Min. Swath Dist. (m): 0.0
  - ☐ External Trigger
  - 3D Scanning:**
    - ☐ Enable scanning
    - Min. (deg.): -10
    - Max. (deg.): 10
    - Step (deg.): 1

#### 2.1.1. Sector Coverage

The sector coverage controls the spacing between depth points within the swath.

- Port <-> Starboard: **Do not use**
- Max Angle Port RX (°) and Max Angle Starb. Rx (°)

Max Angle Port Rx (deg): **65° (Port) - 0° (Starboard)**

Max Angle Starb RX (deg): **0° (Port) - 65° (Starboard)**

- Max Coverage (m): **Will not be used**
- Angular Coverage mode: **Manual** (Only the Max angles are used, not the Max coverage)
- Sector Mode: **Sngl cent** (only center sector is used, PortRx+StbRx)
- Beam Spacing: **Equiangular**
- Equal heads: **ON**

### 2.1.2. Depth Settings

The depth settings control the depth range in which the sounder listens to echoes.

- Force depth (m): **1** (default)  
**Do not force depth**
- Min. Depth (m)  
Depth at which sounder starts listening: **1 m**
- Max. Depth (m)  
Depth at which sounder stops listening: **in North Sea: 50 m**
- Ping Mode: **400 kHz**  
*>>> Recommendation Steering Meeting: Higher frequency (eg 400 kHz nominal for EM2040) in order to catch as much possible, the fine particles in suspension. Usually BS studies use minimum of 500 khz-5 Mhz*
- Pulse Type: **Long CW (54 µs)**  
*>>> Recommendation Steering Meeting: Longest pulse length available to optimize the S/N ratio of the Water Column amplitude signal.*
- FM Disable: **Uncheck**
- Detector Mode: **Normal**

### 2.1.3. Transmit Control

The transmit control controls an even distribution of the depth soundings.

- Pitch Stabilization: **ON**
- Along Direction (°): **0.0**
- Yaw Stabilization
  - Mode: **Off**

No heading stabilization

>>> *Discussed with Kevin Weerman (Kongsberg)*

- Heading: **0.0**
- Heading filter: **Weak**
- Max Ping Freq (Hz): **10 hz**
- Min Swath Dist (m): **0 (= not used)**
- External Trigger: **Unchecked**
- 3D Scanning  
Enable scanning: **Unchecked**

## 2.2. Sound Speed tab

Runtime parameters

Sounder Main | **Sound Speed** | Filter and Gains | Data Cleaning | GPS and Delayed Heave | Simulator | Survey Information

**Sound Speed Profile**

Use Sound Speed Profile: 1521.asvp

Abs. coeff. files, salinity: D:\sisdata\common\svp\_abscoeff\1521\_salinity\_03306

Abs. coeff. files, CTD: D:\sisdata\common\svp\_abscoeff\default

**Sound Speed at Transducer**

Source: SENSOR

Sound Speed (m/sec.): 1487.0

Sensor Offset (m/sec.): 0.0

Filter (sec.): 10

**Depth/Pressure Sensor**

Scaling: 1.00 ☒ Manual override

Offset: 0.00 ☒ Manual override

### 2.2.1. Sound Speed Profile

The accuracy of the depth data depends on the use of a correct sound speed profile.

- **Use Sound Speed Profile**

Check the sound speed value at transducer (sensor) and when it changes (or every half hour) choose a (constant) profile that matches this transducer value.

- **Absorption coefficient files**

Selecting a new SVP profile will affect the absorption coefficient settings in the system.

### 2.2.2. Sound Speed at Transducer

The sound speed at the transducer depth is used by the beamformer when calculating the beamformer coefficients, and as a starting point in the ray bending corrections.

- Source: **sensor**
- Sound Speed (m/s): **not necessary**
- Sensor Offset (m/s) → **only for measured profiles, not constant ones**
  - Setting a correction offset that will be added to the used sound speed values
- Filter (sec.): **Default: 10 sec**

### 2.2.3. Depth/Pressure Sensor

Only for ROV operations

*Scaling:* 1.00 (default)

*Offset:* 0.00 (default)

## 2.3. Filter and Gains tab

The screenshot shows the 'Runtime parameters' window with the 'Filter and Gains' tab selected. The window has a title bar and a menu bar with options: Sounder Main, Sound Speed, Filter and Gains, Data Cleaning, GPS and Delayed Heave, Simulator, and Survey Information. The 'Filter and Gains' tab contains several sections: 'Filtering' with dropdowns for Spike Filter Strength (OFF), Range Gate (NORMAL), Phase ramp (SHORT), and Penetration Filter Strength (OFF), and checkboxes for Special TVG, Slope, Aeration, Sector Tracking, Interference, and Special amp detect; 'Absorption Coefficient' with a Source dropdown (Manual) and a table of Salinity (parts per thousand) values for frequencies from 200.0 kHz to 400.0 kHz; 'Water Column' with dropdowns for log R (30) and dB Offset (20); 'Special Mode' with checkboxes for Sonar and Passive; 'TX Power' with a TX power level (dB) dropdown (Max.); and 'Backscatter Adjustment' with a Normal incidence corr. (deg.) input (10) and a checkbox for Use Lambert's law.

Frequency (kHz)	Salinity (parts per thousand)
200.0	65.31
250.0	72.94
300.0	77.98
350.0	81.48
400.0	84.04

### 2.3.1. Filtering

This tab controls the filtering of “false detections” in a multibeam echosounder, e.g. fish, interference, soft sediment, bad weather interference or aeration.

- Spike Filter Strength: The filter defines to what degree a non-smooth bottom is accepted.

➔ Off

- Range Gate: Filter for detecting only echoes from the desired target (= here the sea bottom) range.

➔ Normal

- Phase ramp: Filter for specifying the range overlap (= how many samples that will be used for the phase detection between detections).

➔ Short

- Penetration filter strength: Filter that reduces the chance that the central beams will track sediments below the seafloor. Only necessary in areas with soft sediments.

➔ Off

- Special TVG: Filter that reduces problems with multipaths at shallow water.

➔ Uncheck

- Slope Filter: Filter that Checks for bottom slopes that tilt inwards.

➔ Uncheck

- Aeration Filter: The filter will force the system to keep tracking the same depth for a longer period.

➔ Uncheck

- Sector tracking Filter: The filter turns on an autogain compensation to avoid amplitude offsets between sectors.

➔ Uncheck

- Interference Filter: The filter reduces interference problems, when the vessel is equipped with other echosounders.

➔ Uncheck

- Special amp detect: This is an alternative detection mode for beams close to the normal incidence.

➔ Uncheck

### 2.3.2. Backscatter Adjustment

- Normal incidence corr (°): This defines the angle at which the bottom BS is not affected by the strong increase at normal incidence.

→ 10°

- Beam Intensity: Selecting “Use Lambert’s law” results in the adjustment of backscatter values based on loss due to low incident angle.

→ Uncheck

### 2.3.3. Absorption Coefficient

- Source: **Manual**

The average absorption coefficient is manually specified for each frequency.

### 2.3.4. Tx Power

- TX power level (dB)

Maximum power by which the sound is emitted: **Max.** (*recommended, best SNR*)

### 2.3.5. Water Column

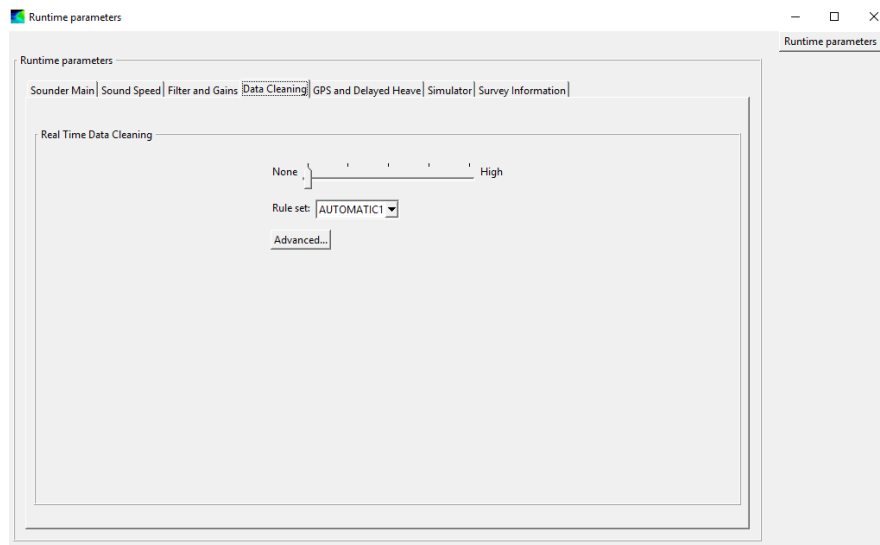
TVG function in **active mode**:  $X\log R + 2\alpha R + C$  (set by operator)

- X Log: **30**
- dB Offset (C): **20 dB**

### 2.3.6. Special Mode

- Sonar: **Uncheck**
- Passive Mode: not possible when sonar is unchecked

## 2.4. Data Cleaning tab



### 2.4.1. Real time Data Cleaning

In this tab, the echo sounder data is processed using rules (i.e. a set of parameters that controls the algorithms used in processing)

- Slide selector: **None**  
**Rule set:** the predefined rule sets by Kongsberg and custom-made rule sets (using advanced display)
- Advanced setup: not necessary