SEAMAP
A MIND Technology Business

SEAMAP HYDROPHONES

CHARACTERISED, CALIBRATED, TEMPERATURE COMPENSATION, ONGOING TRACEABILITY

Seamap's state of the art design empowers our customers to test and re-calibrate hydrophones onboard, access and update calibration data from an internal EEPROM, and enable full integration and automation with GunLink systems.

This is a major departure from traditional products that purely offer the ability to manually read calibration data derived and valid at time of manufacture only.

Seamap's ground-breaking design utilises an in-built 128byte EEPROM device and thermometer to enable ongoing re-calibration and verification of data at chosen future intervals, typically pre and post survey, but with full flexibility to perform any time, without limitation. The stored data can be accessed at any time, via the HVRU, to provide traceability and performance monitoring, preventative maintenance, and reporting for auditors and clients. Armed with these tools it is possible to negate unnecessary hydrophone wastage in instances where the status would traditionally be unknown due to lack of test capability.

A portable 'Hydrophone Verification and Re-Calibration Unit (HVRU)' provides a range of features to allow testing over a band up to 500Hz, verification against original manufacturers calibration data, and re-calibration of hydrophones onboard the vessel. It can also be used in "Continuous Tone" mode to inject a signal into GunLink for full channel analysis via the recorded SEGD files. The HVRU contains a reference calibrated sound source and hydrophone to facilitate the precise and repeatable calibration of the hydrophone under test. The HVRU calibration is maintained through periodic re-certification at a dedicated Seamap facility, with traceability to NIST standards. The recommended interval is 12-18 months and by maintaining two HVRUs onboard, or several fleet spares, the vessel need not be without a HVRU with full and valid certification.

For digital GunLink systems (GL4000 and GL2500) the software has direct access (via the GFSM/GSM) to the NFH EEPROM and thermometer in real-time, offline or online, allowing it to retrieve and display the calibration information within the GUI, make optional adjustments for temperature variations, and record the calibration data and adjustments in the database. This provides an un-paralleled and streamlined approach to source controller and hydrophone integration for superior QC and source acoustic performance monitoring.

Calibration
Each Seamap hydrophone is precisely calibrated over a frequency range of 10Hz – 500Hz, in five steps, repeated three times at each step. The data from this calibration is stored in the NFH internal EEPROM, and five subsequent sets of calibration data can also be stored for analysis. Calibration is performed at time of manufacturing and re-validated immediately prior to shipping to the customer. All equipment used for the calibration process, including all HVRUs, are independently calibrated with traceability to NIST.

Characterisation
Each hydrophone, specifically designed for near field monitoring of air guns in the marine seismic environment, can be characterised against the HVRU internal reference and the resulting data stored in its internal EEPROM. In doing so, the performance over the seismic band can easily and accurately verified. The characterisation essentially details the full and exact performance of the product over a wide frequency range, temperature range, and provides reassurance and guarantee that when the array is deployed, the hydrophones will perform. It also allows the performance to be compared to previous calibration data points in order to predict and plan maintenance intervals.

Testing and Channel Characterisation
In addition to calibration and characterisation of NFHs, the HVRU Continuous Tone mode feature provides a precise tone from its reference speaker to be used as a source to inject fixed, known SPL levels into the entire GunLink channel, and recorded as SEGD in the GunLink software. Through the use of GunLink FFT and other SEGD analysis tools, each GunLink channel can be independently tested and verified, complimenting other GunLink QC features such as Instrument Tests.

- EEPROM memory device and thermometer inside the hydrophone enable optional automated GunLink Software adjustments in real-time. Any adjustments made are recorded in the GunLink database for QC/ Audit purposes.
- User can check hydrophone calibration over the frequency band of 10Hz-500Hz with immediate pass or fail results.
- Calibration data can be uploaded to PC via USB.
- Ongoing traceability feature on 4 pin hydrophones allows updated calibration data to be written to the EEPROM memory device inside the hydrophone for future reference.
- Acoustic sensitivity of 10V/bar @ 20°C (200dB +-1.5dB re 1V/µPa)
- Capacitance nominal 10nF +-1nF @20°C.
- Peak pressure pulse 20 bar-m max.
- Static pressure rating 50 bar max (500m water depth).
- Flat response from 1Hz up to 5KHz.

Through independent verification by partners and extensive field trials, plus field deployment for over 10 years, Seamap's NFH have demonstratable and proven robustness and stability (response) both over time and over a wide range of acoustic exposure. Ongoing verification against manufacturers calibration, plus periodic re-calibration performed by the customer onboard, provide powerful tools for monitoring long term performance of NFH capacitance and sensitivity, allowing for efficient asset management and optimal maintenance periods to avoid interruption to operations. The NFH data can be verified via a HVRU on a project by project basis, or as and when required, improving operational efficiency and reducing downtime through the identification of aging units and replacing before failure.

Seamap hydrophones are fully integrated with the GunLink 4000 or 2500 digital source controller systems but can also be purchased for use with GunLink 2000, benefiting from many of the same features, albeit with some minor intervention to import the calibration data into the GunLink software via a script, as opposed to data be automatically read via the GunLink 4000/2500 in-water modules.

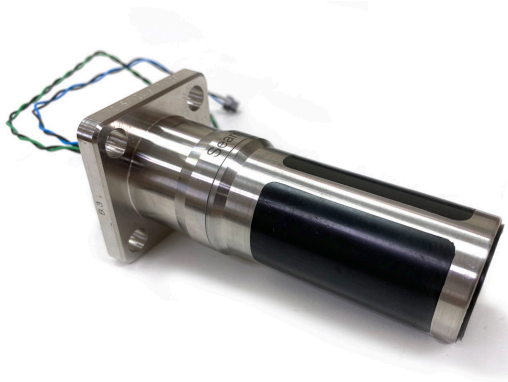
Hydrophone (NFH) Specifications:

Sensitivity	10V/bar @ 20°C (-200dB re 1V/µPa)
Capacitance	Nominal 10nF +/-1nF @20°C
Peak Pressure Pulse	20bar-m
Static Pressure Rating	50 bar max (500m water depth)
Flat Response	From 1Hz up to 5KHz, Omni-directional
Phase Shift/Distortion	None
Operating Temperature	-10°C to +50°C
Storage Temperature	-30°C to +70°C
Nominal Operating Depth	6-15m
Maximum Depth	Survives up to 500m
Mount	Integrated Bulkhead (with blind mate connector) or Non-integrated (1m cable)

NON INTEGRATED (CABLE TYPE):

02-94-2641 GunLink Hydrophone (PVDF), Calibrated (Traceable) - 1m, AGM1104M)

02-94-2642 GunLink Hydrophone (PVDF), Calibrated (Traceable), 1m, AGP2102F



INTEGRATED (BULKHEAD TYPE) -
FOR DIRECT MOUNT TO A GFSM/GSM:

02-94-2389 GunLink Hydrophone (PVDF), Calibrated (Traceable), Direct Mount

Verification and Re-Calibration Unit: Part #02-94-2418

- Allows operation remotely in a portable field unit for convenience.
- Tolerant to salt spray and rain, and general operation at sea, outdoors.
- -10°C to 35°C Operating Temperature.
- Checks the calibration of Seamap hydrophones over the frequency band of 10Hz – 500Hz.
- Logs the calibration data and has the ability to upload this data to PC via USB interface.
- Provides immediate pass or fail information to the user.
- Built-in calibrated reference hydrophone, accurate to +/-0.1 dB.
- Acoustic measurement accuracy of, at least, +/- 0.5dB from 10-200Hz and +/-1dB up to 500Hz.
- 2 Pin NFH has the same acoustic interface, but no access to the internal EEPROM and temperature sensor and is therefore not recommended.

- **TEST... avoid discarding hydrophones with an unknown state.**
- **VERIFY... new hydrophones before they are deployed on a string.**
- **RE-CALIBRATE... hydrophones on a per project basis.**

The Hydrophone Verification and Re-Calibration Unit can be used for all Seamap hydrophone variants. A short jumper cable is provided in order to adapt between 4 pin and 2 pin hydrophone types. The unit has the capability of reading from and writing to the EEPROM inside the 4 pin hydrophones. The USB-A connector with standard pin out allows programming of the processor and uploading and downloading of data.

The unit is simple to operate. The user plugs in the test hydrophone and sets the mode to automatic or manual. In automatic mode the HVRU automatically calibrates the hydrophone with a preset program and stores the data in the memory and also in the hydrophone EEPROM. In manual mode the user selects a frequency and the results are displayed, but not stored in the HVRU nor NFH EEPROM. The user controls are extremely simple and include a frequency selector for the manual mode, and a push button switch to instigate auto or manual testing or calibration.

The HVRU has a display for pertinent information such as the test frequency (Hz) and SPL (dB), and the resulting calibration values for sensitivity (dB re 1V/µPa and V/bar) and capacitance (nF) plus temperature (degrees Celsius). The measured sensitivity is relative to the HVRU internal reference hydrophone. In the manual mode, when the unit is not connected to another device, the display will show sound pressure level in the calibrator, such that the user can determine if the system is giving the correct output.

Power is supplied via an internal NiMH battery, which is recharged via an external adapter.

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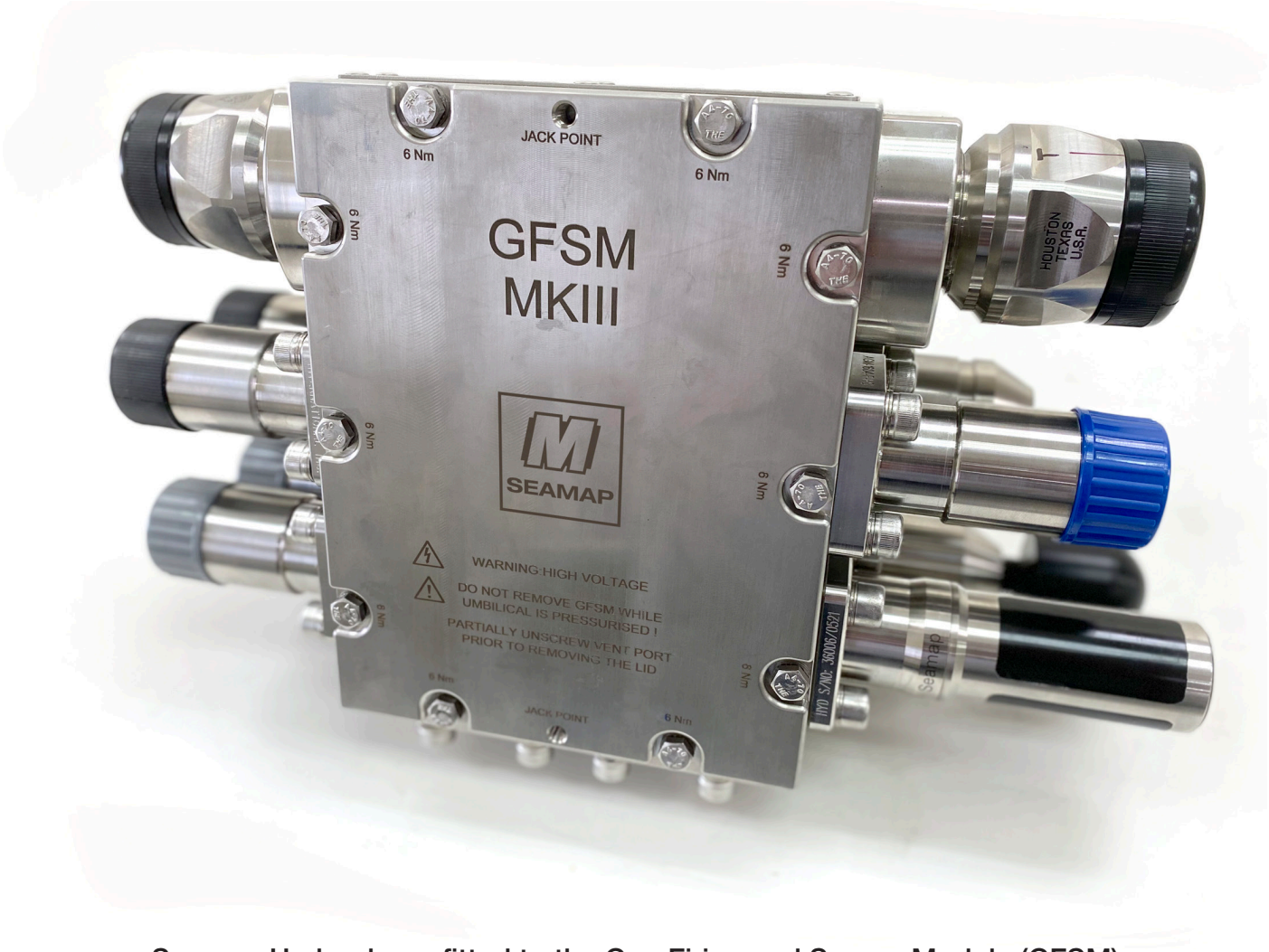

Seamap Hydrophone fitted to the Gun Firing and Sensor Module (GFSM).

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