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MicroEel Solid Analog Streamer

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Operation Manual

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1 – Introduction

The MicroEel Solid Analog Streamer is designed for high-resolution marine seismic imaging. It is ideal for shallow oil and gas investigations, stratigraphic and structural mapping, and teaching and research.

The MicroEel features solid-type construction specifically designed to withstand the harsh conditions of commercial marine surveys. The active section is built using Geometrics continuous-flotation molding method (Figure 1).



Figure 1. MicroEel active section with solid flotation (green) and tow cable (black).

In addition, the MicroEel uses unique proprietary polymer hydrophones, which unlike ceramic hydrophones are non-shattering. Polymer hydrophones provide superior durability and performance under the rigors of marine applications with a stable signal response up to 10 kHz.

Depending on your location, the MicroEel may require a US Department of Commerce license for export.

This manual provides operating instructions, including description of the MicroEel system components, setup, calibration, and warranty.

2 – System Components

The standard MicroEel Solid Analog Streamer system includes the following items:

- Active section cable with tow cable, tail and eye bolt, and deck cable, coiled in a plastic crate
- DHA-7/MicroEel Battery Pack
- Universal AC battery charger for the DHA-7/MicroEel Battery Pack
- CD with support documents (*.pdf) including the operations manual, connector wiring tables, and hydrophone calibration plots








2.1 Cable

The active section consists of a series of hydrophone groups, with the number of groups equal to the number of channels, either 12 or 24 as a standard; other channel counts are available through custom order. The available group intervals are a minimum of 1 m and a maximum of 6.25 m in length. For group intervals between 3.125 and 6.25 m, there are three depth-limited hydrophones spaced 0.11 m apart (0.22 m aperture) with the signal summed electrically and connected to a preamplifier. For hydrophone groups less than 3.125 m, there is one hydrophone per group connected to a preamplifier. Other hydrophone counts per group are available through custom order. All of the components are in-line molded to a multi-conductor cable with a polyurethane jacket and Kevlar center stress core; this is further encased in Geometrics' proprietary solid flotation material.

The tow, active section, and tail cables are all one integrated piece, with no interconnections in between. The tow cable connects to a topside deck cable. The deck and tow cables are terminated with mating waterproof connectors. The opposite end of the deck cable is finished with a Y-type termination to connect to the DHA-7/MicroEel Battery Pack and seismograph. The total maximum length of the streamer from head of the deck cable to tail of the active section is 400 m.

MicroEel Analog Streamer Block Diagram

Components

-  Seismograph
-  Power Supply
-  Deck Cable (no flotation)
-  Tow (Lead) Cable (no flotation)
-  Active Section
-  Hydrophone (group or single)
-  Tail Eye

Notes:

Standard configurations of 12 and 24 channels and three hydrophones per group, with group intervals of 3.125m and 6.25m.

Custom configurations available with 1 to 24 channels, up to 10 hydrophones per group, and group intervals to a minimum of 1m.

Maximum total length of 400m.

Drawing not to scale. Not all essential system components depicted.

Specifications subject to change without notice for product improvement/development.

MicroEelBlockDiagram_r3.cdr
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Figure 2. MicroEel solid analog streamer block diagram.

2.1.1 Hydrophones

The streamer uses Geometrics' unique proprietary polymer hydrophones. The hydrophone incorporates design features offering superior performance compared to previous polymer hydrophone designs as well as the traditional PZT ceramic-type hydrophones. Specifically, it is non-shattering and incorporates an isolating platform, making it immune to cable-borne energy. In addition, other design aspects allow its response to acoustic pressure alone to dominate the output.

The hydrophones are depth-limited and become inoperable at depths greater than 30 ± 5 m. The inoperable state is temporary and functionality fully recovers when the depth is reduced. This limitation allows the MicroEel to be exported under less strict US Department of Commerce laws.

2.1.2 Hydrophone Preamplifiers

The true differential preamplifier used with the hydrophone is of a single-pole low-cut and a single pole high-cut design. The low-cut frequency is determined by the $\frac{1}{2}\pi$ RC time constant which is related to the element capacitance and the input resistance of the preamplifier front-end. The preamplifier features exceptionally low noise. Nominal element capacitance is 7.2 nF at 22 degrees C. The design also provides full voltage regulation at each preamplifier. The voltage regulator isolates each channel from the other which is desired when all preamplifiers share a common power bus.

2.1.3 Deck and Tow Cable Connector Terminations

The standard topside deck cable termination is a Y-type with one 61-socket connector (PT06J-24-61S) for analog output, and one 4-pin connector [PT06A-8-4P(SR)] for power connection to the DHA-7/MicroEel Battery Pack (Figure 3). As an option, the analog output termination may be ordered with a 27-socket connector(s) (NK-27-21C) instead of the 61-socket connector. Adaptor cables are also available to connect to seismographs with other analog input connector types.

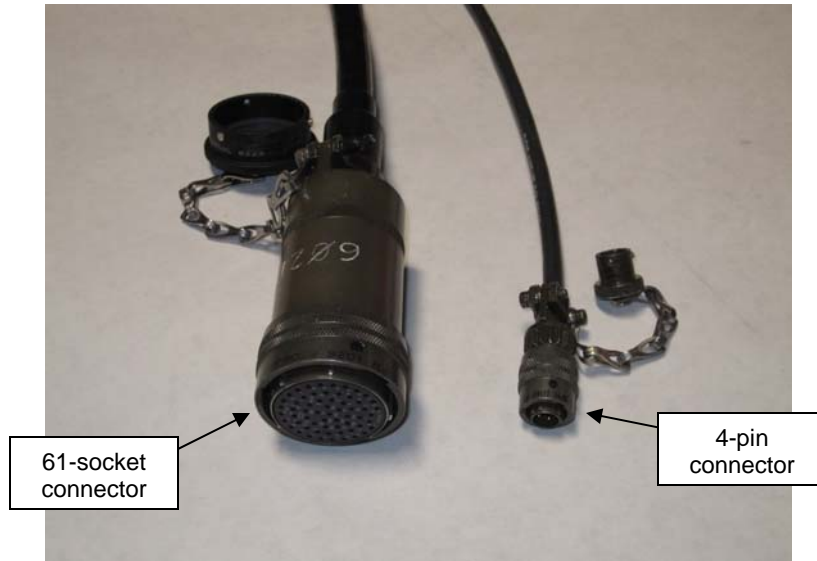


Figure 3. Topside deck cable connector terminations (NK-27 termination not shown).

The standard deck cable termination for analog input from the tow cable is one 55-socket waterproof connector (Glenair 220-06E16-55SN) (Figure 4).



Figure 4. Deck cable 55-socket connector termination.

The standard tow cable termination for analog output to the deck cable is one 55-pin waterproof connector (Glenair 220-01E16-55PN) (Figure 5).



Figure 5. Tow cable 55-pin connector termination shown with Kellems grip.

The connector pair between the deck and tow cables feature red marks on their collars to indicate when pin and socket are aligned.

2.1.4 Cable Crate

The streamer is shipped coiled in a crate for storage, transport, and deployment (Figure 6). The crate is fully composed of inorganic plastic to comply with international shipping regulations.



Figure 6. Crate for transport, storage, and deployment.

2.2 Power Supply and Requirements

The streamer is powered by the DHA-7/MicroEel Battery Pack. The battery pack is rechargeable using the included AC battery charger.

2.2.1 DHA-7/MicroEel Battery Pack

The DHA-7/MicroEel Battery Pack (Figure 7) contains two 12V DC deep discharge (5 Amp-hour) sealed lead-acid batteries used in a $\pm 12V$ DC differential power configuration. The deck cable power lead is connected to the battery pack via the 4-socket connector located on the right-hand side of the battery pack. This connector is also used to connect the AC battery charger. Next to the connector is a grounding post ($\frac{1}{4}$ "-20 bolt and nut).



Figure 7. DHA-7/MicroEel Battery Pack.

The battery pack front panel includes a Power ON/OFF switch, a VOLTAGE (Volts) meter, a CURRENT (Amps) meter with the associated +/- polarity switches for each respective meter (Figure 8). The metering provides a method of measuring the individual battery voltage and current being supplied to the streamer.



Figure 8. Detail of DHA-7/MicroEel Battery Pack.

The MicroEel is designed to be powered by the DHA-7/MicroEel Battery Pack; use of another power source is not advised and could damage the streamer and void the warranty. In addition, under no circumstances should power to the streamer be shared with another instrument.

2.2.2 Power Consumption

Each hydrophone preamplifier draws approximately ± 10.8 mA per channel. Based on this draw, a 12-channel streamer with 6.25 m group interval has a total current of approximately 130 mA, and a 24-channel streamer with 6.25 m group interval has a total current of approximately 260 mA. The battery pack, with two 5 Amp-hour batteries, should have sufficient capacity to power the streamer for the desired length of time. If the batteries are fully charged, a 24-channel streamer can be powered continuously for approximately 19 hours (5 Amp-hours divided by 260 mA).

The actual operating time will vary depending on the state, temperature, and age of the batteries. The ideal battery operation temperature is between 41 to 77 degrees F (5 to 25 degrees C). Long-term exposure to temperatures above 106 degrees F (41 degrees C) can shorten the life of the batteries. As temperature decreases, the available battery capacity and performance are reduced; however, this is not a permanent condition and capacity will be recovered as temperature rises.

2.2.3 AC Battery Charger

The AC battery charger is suitable for use anywhere in the world with a universal input from 90V AC to 264V AC. The output is 1.5 Amps constant current at 24V DC. Depending on the recharging mode of the charger and the state of the batteries, output levels will vary.

3 – System Set-up

3.1 Interconnections

The procedure for setting up the MicroEel, DHA-7/MicroEel Battery Pack, and seismograph interconnections is as follows.

- 1) With the battery pack power switch in the OFF position, connect the deck cable to the tow cable and the 4-pin power connector on the deck cable to the 4-socket power connector on the battery pack.
- 2) Move the battery pack power switch to the ON position. The CURRENT and VOLTAGE meters will turn on and indicate the status of the batteries.

Toggle the +/- switch next to the CURRENT meter to measure the battery draw for each polarity. Each current measurement should read approximately 130 mA for a 12-channel streamer and 260 mA for a 24-channel streamer.

Next, toggle the +/- switch next to the VOLTAGE meter to measure the battery potential for each polarity. The voltage should read from 11.8V DC to 13.4V DC for each battery. The streamer will operate with a minimum voltage of approximately 10.8V DC depending in the length of the cable lead. Recharge the battery pack (see Section 3.3) immediately when the minimum permissible voltage is reached.

- 3) Connect the analog output connector on the deck cable to the seismograph and check for incoming signal. It is also recommended that the seismograph gain be set to the lowest possible setting.

For ideal testing conditions allowing optimal hydrophone response, it is recommended that the streamer be in water with no direct contact with any solid surface, such as the ground, other parts of the cable, etc.

3.2 Deployment

Most MicroEel streamers are easily deployed by hand or a small winch may be desired. Avoid rubbing the tow cable jacket and active section flotation material on sharp or rough edges.

The MicroEel is designed to be neutrally buoyant in fresh water. Depending on the water salinity, weight may need to be added to the streamer. This is easily done with sheet lead (Ames 4#, 4 by 36 by 1/16-inches thick, or similar) and brown friction seawater (Bulldog) tape (2-inches thick, or similar) (Figure 9). If it is determined that the streamer is too buoyant, at a minimum, weight should be added at the head, middle, and tail of the active section. Simply use tin snips to cut sections of lead sheet to wrap around the

streamer; secure by wrapping with Bulldog tape.



Figure 9. Sheet lead, tin snips, and Bulldog tape.

3.3 Battery Charging

A new DHA-7/MicroEel Battery Pack should be charged for a minimum of 20 hours prior to use. In addition, the temperature when the charging occurs should be between 41 to 77 degrees F (5 to 25 degrees C). If charging takes place above 77 degrees F (25 degrees C), the time required for a full charge will increase and the potential recharge cycles will be reduced.

The procedure for charging the battery pack is as follows.

- 1) Plug the battery charger into an AC outlet and connect the 4-pin connector on the charger cable to the 4-socket connector on the battery pack. Open the battery pack enclosure vent located between the case latches to allow gas venting during the charge cycle.
- 2) Switch the battery pack power switch to the ON position (the power switch must be ON to charge the internal batteries from the external charger). The VOLTAGE and CURRENT meters will turn on and indicate the status of the batteries.
- 3) The charger changes the recharging mode based on the state of the batteries, as well, the values of the VOLTAGE and CURRENT meters will vary depending on the cycle mode of the charger. There is an LED on the charger to indicate charging status.

A lit LED indicates that the charger has power and is properly functioning.

An orange LED indicates that the charger is in charging mode with a constant current of approximately 1.5 Amps.

A flashing LED indicates that the charger is in deep-discharge charging pulse mode and charging starts at 0.5V DC, giving pulse currents up to 5V DC. This has the effect of removing loose sulphation formed during the deep-discharge

state of the batteries.

A green LED indicates that the charger is in standby mode and the current slowly reduces to zero.

Recharge the battery pack after every 6 to 8 hours of use. It will not be harmed if left on a continuous charge past the normal recharge time; however, continuous charging for extended periods of time will reduce the life of the batteries. Therefore, it is recommended that a continuous charge be limited to no more than 1 week.

The battery pack will lose capacity without use. A battery pack in storage must be recharged at least every 6 months or sulphation will reduce the storage capacity. Depending on the charging, depth of discharge, and use conditions, the expected number of recharge cycles is usually between 500 and 1000.

4 – Appendix

4.1 Connector Wiring

Wiring tables for the deck and tow cables are included on the serialized CD included with each shipment. Channel 1 is always wired as the first hydrophone/hydrophone group in the active section.

Figure 10 shows the battery pack-to-streamer wiring.

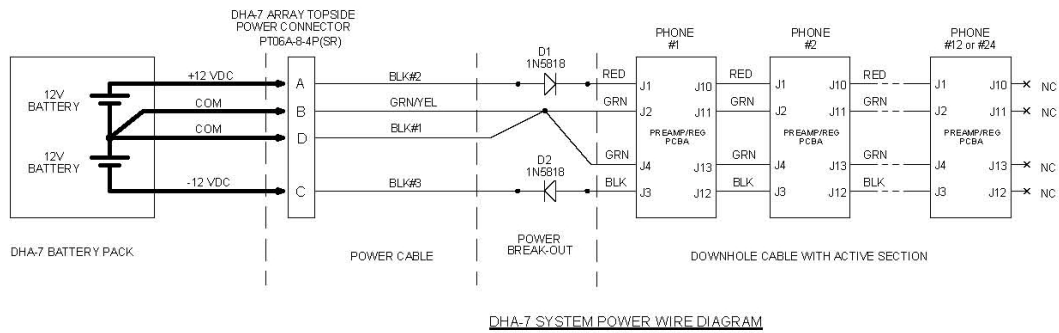


Figure 10. DHA-7/MicroEel-D Battery Pack wiring.

4.2 Calibration

All hydrophone channels of any given streamer have been low-frequency calibrated over a band from 0 to 200 Hz as a quality control measurement. The performance band defined by the low-cut of the polymer film capacitance and input resistance of 10 Hz, and a high-cut of 10 kHz has been demonstrated to be “predictably flat” over an entire band. Significant testing has demonstrated that the low frequency calibration of the hydrophone is 99.99% representative of the broadband response up to 10 kHz. This low frequency calibration is performed by the substitution method where a known calibrated reference is compared with the unknown hydrophone channel under calibration. The calibrated reference and the unknown are placed in a sealed chamber into which white noise is injected. A dual channel FFT analyzer is used to compare the response of the two and the resulting transfer function indicates the response in dB of the unknown in terms of sensitivity relative to 1V per μPa and phase.

All hydrophone channels in the streamer are guaranteed to be within a ± 1 dB relative span. The calibration plots for each hydrophone are provided on the serialized CD included with each shipment.

4.3 Specifications

Hydrophone

Sensor Type	Proprietary Polymer
Frequency Response	10 Hz to 10,000 Hz ± 1.0 dB
Capacitance	7.2 nF per element at 22° C
Sensitivity (Nominal)	-196 dB re 1 Volt per 1 μ Pa
Sensitivity to Acceleration	< -70 dB re 1 Volt per g
Operating Depth (Maximum)	30 ± 5 m

Preamplifier

Type	Ultra-low noise differential
Gain	6 dB
Low Corner Frequency	-3 dB at 10Hz
Current	11mA per channel
Power	± 12 V DC DHA-7/MicroEel Battery Pack (topside)

Active Section

Channels	12 or 24; other counts available*
Hydrophones per Group	1 or 3; other counts available*
Group Aperture	0 or 0.22 m; up to 1 m maximum*
Group Interval	3.125 m or 6.25 m; other intervals available to 1 m minimum*
Flotation Material	Polyurethane-based
Outside Diameter	32 mm
Weight (in air)	0.79 kg/m
Bend Radius	0.46 m
Strength Member	Kevlar center stress core
Working Load	182 kg
Breaking Strength	909 kg

Deck and Tow Cables

Type	Multi-conductor with polyurethane jacket
Length (Maximum Total)	400 m (including active section)
Termination	Deck: Y-type with one 61-socket connector (or 27-socket connector), one 4 pin connector (topside); one 55-socket waterproof connector Tow: one 55-pin waterproof connector
Outside Diameter	13.5 mm
Weight	0.15 kg/m
Bend Radius	0.46 m
Strength Member	Kevlar center stress core
Working Load	182 kg
Breaking Strength	909 kg

Temperature

Operating Range	-10°C to +60°C
Storage Range	-40°C to +60°C

*Please contact the factory to discuss your requirements.

4.4 Warranty and Service

Geometrics warrants the MicroEel system for 6 months. Warranties commence on the date of shipment. If the equipment fails during the applicable warranty period, Geometrics will repair or replace the defective item at its factory in San Jose, California at no charge to the customer for parts and labor. The cost to ship the equipment to Geometrics' factory and back to the customer's site is for the customer's account. Repairs might be done at a local service center, if available, nearest the customer's location. Geometrics must be notified within 7 days of system failure for any warranty claim. Geometrics must establish to its satisfaction that failures have not been the result of abuse or improper deployment of the system. Warranties are void for damage caused by incorrectly applying power, including over-voltage and reverse voltage.

The limited warranty stated herein is in lieu of all other warranties expressed or implied (including the implied warranties of merchantability and fitness for a particular purpose) and of all other obligations or liability on the part of Geometrics, and Geometrics neither assumes nor authorizes any person to assume for it any other liability. Geometrics shall not be liable for special, incidental, or consequential damages of any nature (including, but not limited to lost revenue or profits) with respect to any merchandise or services sold, delivered or rendered hereunder.

Should the instrument or any part thereof need to be returned to the factory for servicing, please contact the Customer Service Department via email at support@geometrics.com or telephone at 408-954-0522. Be ready to provide the serial number, which may be found on the tow cable connector collar, and an explanation of the problem. You will be issued an RMA number and instructions for shipping the instrument.