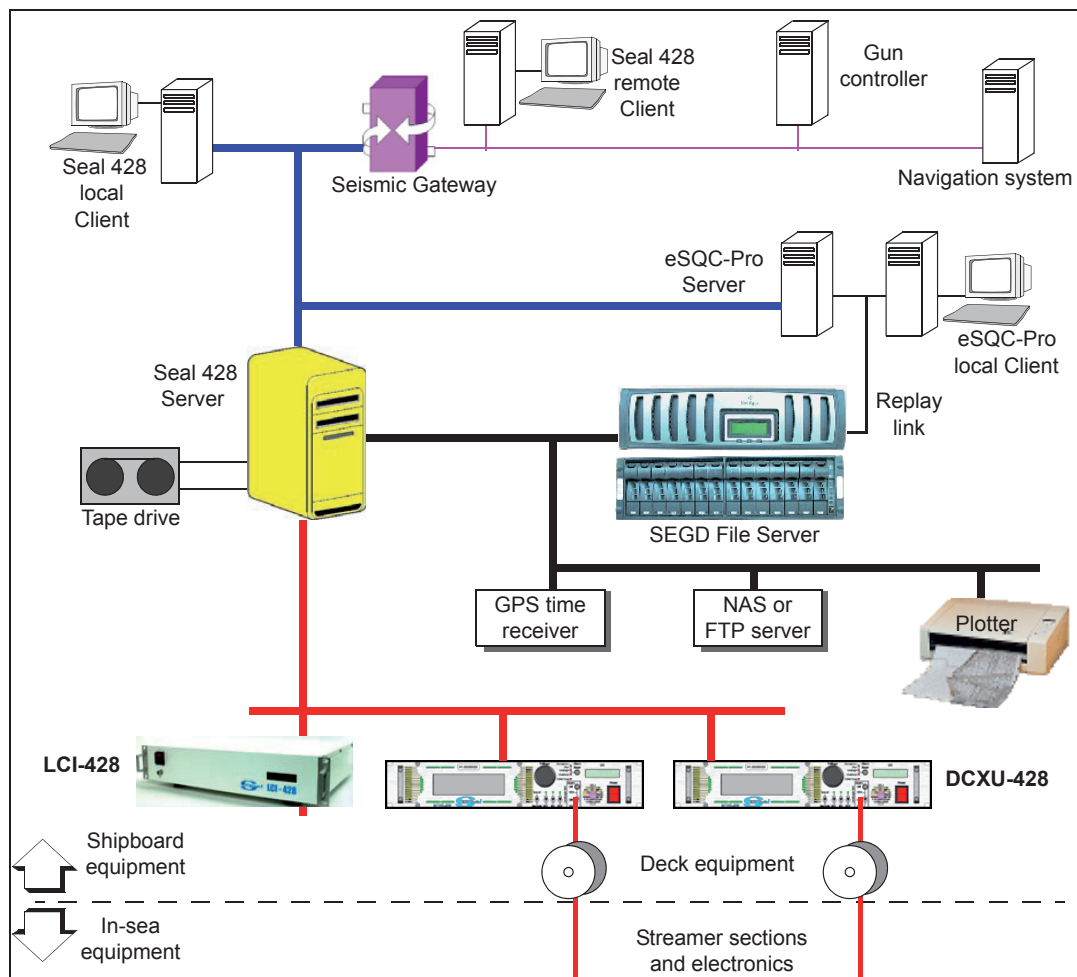


# SEAL 428

## GLOBAL ARCHITECTURE

- Flexible architecture
- Redundant data transmission modes
- Data transmission reconfiguration on line failure
- Upmost electronics integration
- ASICS technology
- 24 bit, Sigma /Delta
- Individual A/D converter per channel
- Active streamers sections with distributed electronics
- Multi-boats capability
- Fully integrated acquisition system
- High redundancy



## SHIPBOARD EQUIPMENT

### SERVER

Rackable x86 server running Linux Operating System. It manages the flow of acquired data from the streamers and auxiliary channels. It also manages processing of the data and export to various peripherals (FC-AL and SCSI tape drives, FTP server, NFS disks, plotters, QC tools).

Communications and synchronization with the navigation system and gun controllers are ensured via Ethernet links or a TO signal. Communications with DCXU-428s are ensured via Ethernet links too, therefore the server can manage a virtually unlimited number of DCXU-428s (streamers).

### SYSTEM SOFTWARE PACKAGE

- Server software for Linux server.
- Client software (Java) for Linux/Windows clients.
- Embedded software for Sercel electronics modules.

### GRAPHIC USER INTERFACE (GUI)

Rackable client PC (Linux or Windows) running intuitive graphical Java environments for setting up, controlling and troubleshooting the system.

Due to the Sercel Client/Server technology, the GUI PC can be located anywhere so long as an Ethernet connection is available.

### GPS TIME SERVER

Rackable 19" off-the-shelf equipment, used for system synchronization.

### DCXU-428

Shipboard interface with a streamer cable. Its built-in high-voltage power supply allows updated control of the streamer. DCXU-428s (and therefore streamers) are tightly synchronized via GPS, ensuring precise synchronization of seismic acquisition.

### LCI-428

Interface between the navigation system and the Seal 428, allows input of a physical  $T_0$  and manages auxiliary traces.

### AUXILIARY CHANNELS UNIT (AXCU)

Rack-mounted or installed near the sources, the AXCU is used to digitize analog auxiliary channels, using FDU electronics (typically 12 channels, extensions available up to 60 channels).

### SEG-D FILE SERVER

High-capacity storage for seismic data, with archive option and open Ethernet connection allowing real-time or postponed QC of seismic data.

## IN-SEA EQUIPMENT

### LEAD-IN

Armoured electro-optical cable used for towing the streamer.

### SHORT HEAD SECTION (SHS), HEAD ELASTIC SECTION ADAPTOR (HESA)

Dedicated sections allowing mechanical attachment at the head of the streamer.

### HEAD AUXILIARY UNIT AND HEAD AUXILIARY POWER UNIT (HAU-428 AND HAPU-428)

The HAU-428 assures the following functions:

- TLF0I power supply.
- Power supply to the first Acquisition Line Sections.
- Measurement of the tensile stress.
- Telemetry leakage measurement.
- HV and telemetry switching for easy troubleshooting.

The HAPU-428 performs the same functions, plus 28-V or 50-V, 30-W power supply for the head buoy, and consumption monitoring.

### HESE, RADIAL STRETCH, TAIL ELASTIC SECTION (TES), RVIM

Elastic sections used to mechanically uncouple the active streamer from the towing vessel or the tail buoy acoustic vibrations.

### SENTINEL® SOLID ACQUISITION SECTION (SSAS), OR ACQUISITION LINE SECTION (ALS-FLUID)

With a length of 150 m, an SSAS or ALS acquires data from 12 channels with a 12.5-m typical spacing. The typical channel arrangement in an SSAS features one overlapping hydrophone.

### LINE ACQUISITION UNIT MARINE (LAUM)

LAUMs provide data compression, data routing, and power supply. In a standard configuration, each LAUM handles these functions for 60 seismic channels. This means that in a typical 12.5-m group interval configuration, one LAUM is required for every five 150-m SSAS or ALS sections. For example, a 960-channel streamer is made up of 16 x 5 SSAS or ALS sections and 16 LAUMs

### TAIL AUXILIARY AND POWER UNIT (TAPU)

The TAPU assures the following functions:

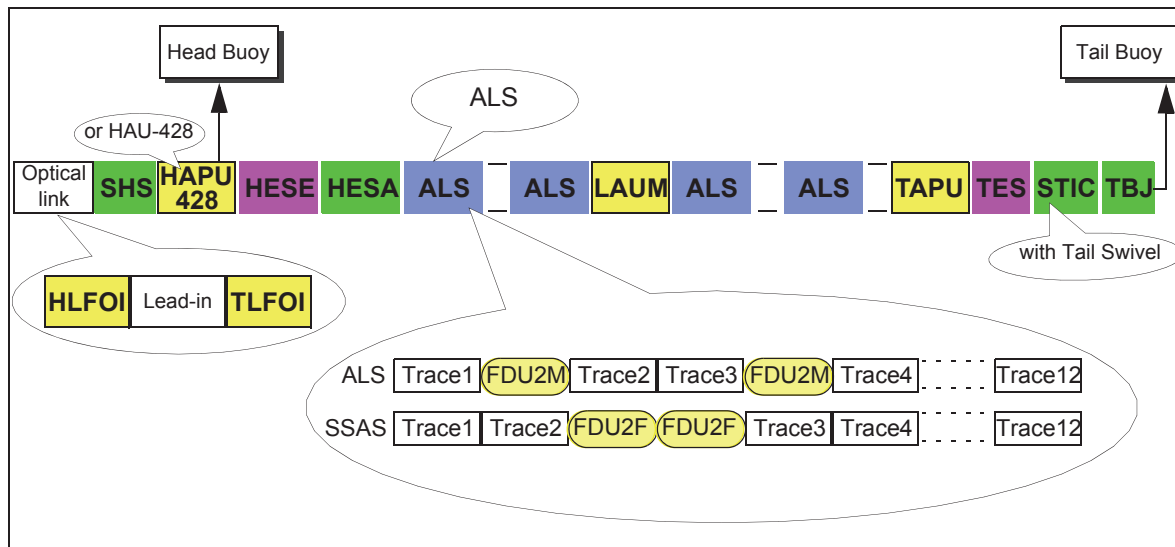
- completion of the transmission lines (in case of telemetry redundancy)
- 40-V, 30-W power supply for the tail buoy and consumption monitoring.

### STREAMER-TO-TAIL INTERFACE CABLE (STIC)

The STIC is a 25-m long section equipped with a breakable link, or fuse, to interface the streamer with the tail buoy.

### TAIL BUOY JUMPER (TBJ)

A 24-m non-pulling, non-elastic, small-diameter cable from the STIC to the electronics on board the tail buoy.



### MAINTENANCE EQUIPMENT

#### SST

Standalone tester for all types of active acquisition sections.

Tests include:

- Instrument
- Sensor
- Telemetry
- Insulation
- Continuity
- Polarity
- EEPROM coherency check

## SHIPBOARD EQUIPMENT

### RECORDING (BASIC CONFIGURATION)

Format:	4 byte, SEG-D Rev. 1.0 or 2.1 demultiplexed, 32 bit IEEE, code 8058
Tape media:	Up to 6 drives, simultaneous and alternated modes Drive model: 3590 model B, E, H, DLT, LTO IBM 3580, 3592
Ethernet media:	FTP or NFS protocol
Simultaneous multiple streamers:	Unlimited (depending on server performance)
Maximum number of seismic channels:	Not limited by Sercel shipboard hardware
Maximum recording capacity per streamer with telemetry redundancy:	960 channels @ 12.5 m, 2 ms (Typical @ 2 ms, depending on signal type and compression ratio)
Maximum record length:	- 47 s @ 2 ms in navigation-triggered acquisition mode - Unlimited in continuous acquisition mode (depending on server hardware configuration)
Sampling rate:	1/4 ms, 1/2 ms, 1ms, 2 ms, 4 ms
Maximum number of auxiliary channels:	60 analog. Gun digital auxiliary channels unlimited

### DCXU-428

- Ethernet connection to the server	
- Built-in high-voltage converter (power supply to streamer)	
- Remote or local operations	
- Connection to Deck safety devices (Emergency stop, warning lights)	
- Connection to the Streamer through a 2-m Deck cable Adaptor provided in the DCXU-428 accessory kit	
- Propagation of the GPS reference time	
- Auxiliary pair connection (bird, acoustic, modem, ...)	
- NAUTILUS specific connector available	
Output voltage:	from 100 VDC to 600 VDC (limited to 365 VDC by the Seal 428 software)
Output Current:	Max. 2.5 A
Safety features:	Current limitation, High Voltage leakage measurement
Width:	19" (482.6 mm)
Height:	2U (89 mm)
Length:	580 mm (without the rear panel connectors)
Weight:	18 kg

### LCI-428

- Ethernet connection to the server	
- Receiving navigation message (if using serial communications)	
- Receiving a physical TO (pulse)	
- Low Line port for connecting an auxiliary line (AXCU)	
- Synchronized with GPS time server connected to XDEV2 connector.	
Width:	19" (482.6 mm)
Height:	2U (89 mm)
Length:	420 mm
Weight:	4.1 kg

### GPS TIME SERVER

- Acquisition synchronization between streamers.	
- Synchronization of acquisition and navigation systems in continuous acquisition mode	
Width:	19" (482.6 mm)
Height:	1U (44.5 mm)
Length:	320 mm

### DECK CABLES

Length:	Up to 100 m.
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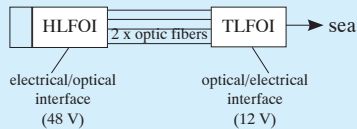
### STORAGE AND OPERATING TEMPERATURES (SHIPBOARD)

Storage:	-15°C to +55°C (5° to 131°F)
Operating:	+5°C to +40°C (41° to 104°F)

## IN-SEA EQUIPMENT

### STANDARD LEAD-IN CABLE

Optical data transmission



Cable Breaking strength 3 options : 300 kN ; 470 kN ; 570 kN  
Maximum length 1 500 m

### HAU-428

- 50 VDC (+/-25 VDC) power supply for active channels for the two lines.
- Tensile load measurement (0 to 70 kN)
- High Voltage Lines and telemetry switches
- High Voltage Lines mix.

Connectors: standard Seal dia. 70 mm  
Outside diameter: 81 mm  
Length: 277.5 mm

### HAPU-428

- 50 VDC (+/-25 VDC) power supply for active channels for the two lines.
- Tensile load measurement (0 to 70 kN).
- High Voltage Lines and telemetry switches.
- High Voltage Lines mix.
- Factory-configurable Head Buoy Connector pin-out

Head Buoy power supply: 50 VDC / 32 W or 28 V / 32 W output power  
Current measurement  
ON/OFF by remote operations

### LINE ACQUISITION UNIT MARINE (LAUM)

Functions: - Data pre-processing  
- Data routing  
- Power distribution

Physical specifications: - Mass/weight in sea water: 1 kg (2.2 lbs)  
- Max spacing along the cable: 750 m @ 12.5 m @ 2 ms  
- Outside diameter: 53 mm  
- Length: 350 mm

## FDU2F/FDU2M

Functions: - Data transmission with CRC control  
24 bits A/D conversion  
- D/A conversion with programmable bit stream

Full Scale Input Levels: @ G1600: 1.6 V RMS  
@ G400: 400 mV RMS

Offset: 0 (digitally zeroed)

Low Cut Filter: Analog 3 Hz  
(@ 20°C, 1 bar matching ± 5%)  
2-Hz option available for SSAS sections

High Cut Filter: 0.8 FN (linear or minimum phase)  
Stop Band

Attenuation: > 120 dB (above Nyquist)

Sample Rates: 4, 2, 1, 0.5, 0.25 ms

Word Size: 24 bits.

Time Standard: True synchronous system

### PERFORMANCE\*

Noise (3-200 Hz): @ G1600: 700 nV RMS  
@ G400: 200 nV RMS

Instant Dynamic Range: 124 dB  
System Dynamic Range: 136 dB

Distortion: -105 dB

Gain Accuracy: < 0.1%

Phase Accuracy: 20 µs

CMRR: 110 dB

### HEAD & TAIL POSITIONING BUOYS (TBC)

Dedicated buoy power supply module.  
Available power supply: 40 to 50 V / 30 W  
Current monitoring  
ON/OFF power supply remote control

\* Typical @ 2 ms

## SENTINEL® SOLID ACQUISITION SECTIONS (SSAS)

	<b>Sentinel®</b>	<b>Sentinel® Depth Restricted</b>
<b>Field Digitalization Unit (FDU2F)</b>		
Unit arrangement	one for two channels, 2 adjacent	one for two channels, 2 adjacent
Unit spacing (Typical)	50 m	50 m
Functions	A/D conversion, data digitizing, tests	A/D conversion, data digitizing, tests
<b>Hydrophone Specifications</b>		
Standard model	Sercel Flexible Hydrophone	Exportable Sercel Flexible Hydrophone
Nominal capacitance	31,7 nF @ 20 °C ± 10%	31,7 nF @ 20 °C ± 10%
Nominal sensitivity	-193 dB re 1 V/μPa ± 1,5 dB (22,4 V/bar) @ 20 °C	-193 dB re 1 V/μPa ± 1,5 dB (22,4 V/bar) @ 20 °C
<b>Hydrophones array arrangement* (Typical)</b>		
Hydrophones per group	12.5 m (one overlapping hydrophone) 8	12.5 m (one overlapping hydrophone) 8
Group capacitance	260 nF @ 20 °C	260 nF @ 20 °C
Group sensitivity (electronics included)	19.7 V/bar @ 20 °C	19.7 V/bar @ 20 °C
<b>Maximum length without power line nor telemetry line redundancy and with a 950 m long lead in</b>	15750 m / 1260 ch	15750 m / 1260 ch
<b>Physical specifications</b>		
Nominal section length	150 m	150 m
Cable diameter	59.5 mm (2.34 in) hydrophones included	59.5 mm (2.34 in) hydrophones included
Stress members	Twaron/Vectran	Twaron/Vectran
Groups per section*	12	12
Typical group spacing*	12.5 m	12.5 m
Jacket	Polyurethane, 3.5 mm wall (5.5 mm over hydrophones)	Polyurethane, 3.5 mm wall (5.5 mm over hydrophones)
<b>Environmental specifications</b>		
Operating temperature	-10° to +40 °C	-10° to +40 °C
Storage temperature	-35° to +50 °C	-35° to +50 °C
Maximum operating depth	50 m	22 m
Maximum survival depth	250 m	
Filled section weight in air	419 kg ± 10 kg	419 kg ± 10 kg
<b>Mechanical specifications**</b>		
Cable UTS	> 170 kN	> 170 kN
Terminated UTS	> 115 kN	> 115 kN
Operating tension	up to 58 kN	up to 58 kN
Streamer length @ 5 knots	up to 15.75 km	up to 15.75 km
Ballast fluid capacity	N/A	N/A
Drag of a 12 km Streamer	39 kN @ 5 knots	39 kN @ 5 knots
Maximum Retrieval Tension	< 26 kN	< 26 kN

\* Other configurations available on request

\*\* See operational model for more details

## ACQUISITION LINE SECTION (ALS)

	<b>ALS</b>	<b>ALS Depth restricted</b>
<b>Field Digitalization Unit (FDU2M)</b>		
Unit arrangement	one for two channels	one for two channels
Unit spacing (Typical)	25 m	25 m
Functions	A/D conversion, data digitizing, tests	A/D conversion, data digitizing, tests
<b>Hydrophone Specifications</b>		
Standard model	SLH 20 or Geopoint	Exportable SLH 20 or Geopoint
Nominal capacitance	16 nF @ 20 °C	16 nF @ 20 °C
	± 10%	± 10%
Nominal sensitivity	-194 dB re 1 V/μPa	-194 dB re 1 V/μPa
	± 1,5 dB (20 V/bar)	± 1,5 dB (20 V/bar)
	@ 20 °C	@ 20 °C
<b>Hydrophones array arrangement* (Typical)</b>		
Hydrophones per group	12.5 m	12.5 m
Group capacitance	16	16
Group sensitivity (electronics included)	256 nF @ 20 °C	256 nF @ 20 °C
	17.4 V/bar @ 20 °C	17.4 V/bar @ 20 °C
<b>Maximum length without power line nor telemetry line redundancy and with a 950 m long lead in</b>	12000 m / 960 ch	11250 m / 900 ch
<b>Physical specifications</b>		
Nominal section length	150 m	150 m
Cable diameter	50 mm (1.97 in)	50 mm (1.97 in)
Stress members	Two Vectran ropes	Two Vectran ropes
Groups per section*	12	12
Typical group spacing*	12.5 m	12.5 m
Jacket	Polyurethane, 3.3 mm wall	Polyurethane, 3.3 mm wall
<b>Environmental specifications</b>		
Operating temperature	-10° to +40 °C	-10° to +40 °C
Storage temperature	-35° to +60 °C	-35° to +60 °C
Maximum operating depth	30 m	17 m
Maximum survival depth	250 m	150 m
Filled section weight in air	320 kg	325 kg
<b>Mechanical specifications**</b>		
Terminated UTS	> 100 kN	> 100 kN
Operating tension	up to 30 kN	up to 30 kN
Streamer length @ 5 knots	up to 12 km	up to 12 km
Ballast fluid capacity	200 l	200 l
Drag of a 12 km Streamer	30 kN @ 5 knots	30 kN @ 5 knots
Maximum Retrieval tension	< 20 kN	< 20 kN

\* Other configurations available on request

\*\* See operational model for more details

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