



August 24th, 2023

Dear U.S Coast Guard Marine Board of Investigation,

In response to the July 23rd, 2023 subpoena issued to EvoLogics North America, our teams at EvoLogics North America LP and EvoLogics GmbH have gathered (70) documents and files believed to qualify as relevant and necessary to provide under the four categories of items sought by this subpoena. In an effort to deliver an easy-to-follow compilation of documents, these files have been placed into folders corresponding with one of the four categories outlined on the subpoena. In addition to the documents and files provided, a relatively brief summarization accompanies each category.

While preparing this response to the aforementioned subpoena, the team at EvoLogics made every effort to locate and provide all documents relevant to the subpoena's parameters. However, due to the span of time in which these documents would have originated, it is possible that some files, correspondences, and/or documents may have been lost or unintentionally omitted. If this is ever found to be the case, EvoLogics will make a diligent effort to notify the U.S Coast Guard's Marine Board of Investigation in writing.

Please understand that a portion of the documents and correspondences provided utilize the common US date format; MM/DD/YY, and a portion of them display a European date format; DD/MM/YY. If a date reflected on any of these documents is determined to be of particular importance, and is not completely clear to the reader, we are happy to provide clarification as needed.

Additionally, please understand that English is not the primary language of all of the creators of the provided documents and correspondences. If any question or uncertainty arises pertaining to the context and/or translations of information portrayed within these documents, we are happy to provide clarification as needed.

EvoLogics
North America LP

111 Cybernetics Way
Suite 210
Yorktown, VA 23693

www.evologics.com

EIN 36-5033896

Category 1 – *“Model, serial number, and other identifying information for the acoustic modem purchased by OceanGate and used on the submersible vessel TITAN”*

Summary:

OceanGate purchased a total of three acoustic modems from EvoLogics. Two of these three modems are either believed to have been used on the Titan submarine, or could have been aboard the Titan submarine at some point. These modems can be best described as follows:

- (1) S2C R Hydroacoustic Modem 7/17D
 - Serial # 0717D/20#191/23
 - This modem would be approximately 16.5"/420mm in length, cylindrical in shape, housed in titanium, and would have "EvoLogics.de" engraved/etched on the exterior.
 - This modem was equipped with an integrated 20S 24V-10Ah NiMH battery.
- (2) S2C R Hydroacoustic Modem 7/17D
 - Serial # 0717D/20#239/23
 - This modem would be approximately 8.6"/220mm in length, cylindrical in shape, housed in titanium, and would have "EvoLogics.de" engraved/etched on the exterior.
 - This modem was sold with an external battery, also housed in titanium, 12.9"/330mm in length, and would have a relatively similar appearance to the modem housing described above.
 - Battery Serial # 7S7PLI#234

EvoLogics has limited knowledge as to OceanGate's final use applications of products purchased from EvoLogics. It is believed that OceanGate intended to attach modem (1) to their submarine, the Titan, and Modem (2), with the external battery, were intended to be placed on the seafloor near the Titanic wreck, to be used as a "destination beacon" for future dives. EvoLogics has no definitive information as to whether OceanGate ever carried out their placement of this modem (2) on the seafloor, still had plans to, or were carrying it down during their June 18th mission.

Supporting Documents/Files:

- (4) Factory test certificates. *Includes model and serial numbers.

Category 2 - *“Purchase orders and correspondence records with OceanGate related to the acoustic modem purchased by OceanGate and used on the submersible vessel TITAN”*

Summary: All of the EvoLogics products purchased by OceanGate, were purchased through our authorized dealer SubSea 20/20 out of Seattle, Washington. The majority of the provided purchase documents and correspondences related to the initial inquiries, and purchase of these products will reflect the involvement of this company, SubSea 20/20.

Supporting Documents/Files:

- (27) Correspondences relating to purchases made by OceanGate.
- (19) Various documents relating to the purchase, packing, and shipping of products purchased by OceanGate.

Category 3 - *“All documents, correspondence, records, data, and imagery collected and maintained by EvoLogics related to OceanGate and their operations from June 1, 2023 to June 25, 2023.”*

Summary: OceanGate reached out to EvoLogics for emergency support on June 19th, 2023. The discussions which ensued from this request for assistance are contained within the two correspondence files associated with this category. A number of the e-mails within these two files are duplicative. During the course of EvoLogics' provided assistance, a number of TeamViewer sessions were established with the crew aboard the Polar Prince. During these TeamViewer sessions, the SiNAPS screenshot, the SiNAPS chat log, and the eleven Noise Files and Spectrograms were obtained.

Supporting Documents/Files:

- (2) Correspondence files
- (1) SiNAPS screenshot from 06/20/23
- (1) SiNAPS chat log between Titan and Polar Prince
- (1) SiNAPS position CSV file
- (4) Titan descension files
- (11) Noise Files and Spectrograms

Category 4 – “Any calculations and other notes completed by EvoLogics employees relating to the troubleshooting of the acoustic modem used aboard the submersible vessel TITAN from June 1, 2023 to June 25, 2023.”

Summary: Any professional calculations or notes relating to the troubleshooting of the Modem aboard the Titan submarine, generated by employees of EvoLogics, are contained within the correspondence files associated with Category 3.

Supporting Documents/Files:

- Can be found within Category 3.

[REDACTED]

Director of Sales/Operations
EvoLogics North America

[REDACTED]

Factory and Test Certificate



Date of report: 10.02.2023
Reference: 2022-04571

Filled by: [REDACTED]
Tested by: [REDACTED]

Product Description

Please visit evologics.de/eol for information on firmware support

Product name: S2C R 7/17D Hydroacoustic Modem w/USBL
Serial Number: 0717D/20#190/23
Nominal input voltage: 24 VDC (19-28 VDC)
Housing Material: Delrin
Transducer type: 7/17D
Firmware: v2.0.28
Interfaces: 1. Ethernet 192.168.0.190
2.
3.
Maximum depth (m): 200
Maximum depth (m): -

Installed Options

- ☐ Acoustic wake-up module
☒ AHRS
☐ Data logger
☐ Additional virtual data channels
☒ Distance and speed measurement

- ☒ USBL Antenna
☐ Opto-coupler
☐ Sensor integration

Local address: 1
Remote Address: 2
Sensor name:

Other/
Comments

Tests Conducted

	Test	Value	Status
<input checked="" type="checkbox"/>	Source Level (SrcLev=0), dB re 1 uPa @ 1 m	190,61	OK
<input checked="" type="checkbox"/>	Frequency Range, kHz	7-17	OK
<input checked="" type="checkbox"/>	Power consumption Rx Mode, W	2,50	OK
<input checked="" type="checkbox"/>	Power consumption Tx Mode, W	65,10	OK
<input type="checkbox"/>	Power consumption WakeUp Idle Mode, mW		
<input type="checkbox"/>	Power consumption WakeUp Active Mode, mW		
<input checked="" type="checkbox"/>	Data Transmission, kbps	6,9	OK
<input checked="" type="checkbox"/>	Vacuum test, bar	-0,8	OK
<input checked="" type="checkbox"/>	Pressure test, bar	20	OK
<input type="checkbox"/>	Boot time (wake-up module), ms		
<input checked="" type="checkbox"/>	Noise level, dB	-103	OK

Connector Configuration

Data/Power Eth			
Description	PIN	Description	PIN
TxD+OUT	1		
TxD-OUT	2		
RxD+IN	3		
RxD-IN	4		
V+ (24V)	5		
V- (Power_GND)	6		
POWER ON	7		
NC	8		
Subconn FCR1508M		not installed	

Signed by

Sergey Yakovlev

Company Stamp

Factory and Test Certificate

Evo
Logics®

Date of report: 10.02.2023
Reference: 2022-04571

Filled by: [REDACTED]
Tested by: [REDACTED]

Product Description

Please visit evologics.de/eol for information on firmware support

Product name: S2C R 7/17D Hydroacoustic Modem
Serial Number: 0717D/20#191/23
Interfaces:
Nominal input voltage: 24 VDC (19-28 VDC)
Firmware: v2.0.28
1. RS232 19200 8N1
2.
3.
Housing Material: Titanium
Maximum depth (m): 6.000
Transducer type: 7/17D
Maximum depth (m): -

Installed Options

☐ Acoustic wake-up module
☐ AHRS
☐ Data logger
☐ Additional virtual data channels
☒ Distance and speed measurement
☐ USBL Antenna
☐ Opto-coupler
☒ Sensor integration
Local address: 2
Remote Address: 1
Sensor name: Pressure sensor RBR PA-8

Other/
Comments: Integrated 20S 24V-10Ah NiMH rechargeable battery w. trickle-charge unit;
Integrated Pressure sensor, rating 600 bar

Tests Conducted

	Test	Value	Status
<input checked="" type="checkbox"/>	Source Level (SrcLev=0), dB re 1 uPa @ 1 m	189,40	OK
<input checked="" type="checkbox"/>	Frequency Range, kHz	7-17	OK
<input checked="" type="checkbox"/>	Power consumption Rx Mode, W	0,90	OK
<input checked="" type="checkbox"/>	Power consumption Tx Mode, W	65,80	OK
<input type="checkbox"/>	Power consumption WakeUp Idle Mode, mW		
<input type="checkbox"/>	Power consumption WakeUp Active Mode, mW		
<input checked="" type="checkbox"/>	Data Transmission, kbps	6,9	OK
<input type="checkbox"/>	Vacuum test, bar		
<input checked="" type="checkbox"/>	Pressure test, bar	500	OK
<input type="checkbox"/>	Boot time (wake-up module), ms		
<input checked="" type="checkbox"/>	Noise level, dB	-104	OK

Connector Configuration

Data/Power RS232			
Description	PIN	Description	PIN
NC	1		
NC	2		
RS232 Data TxOUT	3		
RS232 Data RxIN	4		
Charger+	5		
V- (Power_GND)	6		
BAT POWER ON	7		
RS232 Gnd	8		
Subconn FCR1508M-Ti		not installed	

Signed by Sergey Yakovlev

Company Stamp

Factory and Test Certificate

Evo
Logics®

Date of report: 29.03.2023

Filled by: [REDACTED]

Reference: 2023-04694

Tested by: [REDACTED]

Product Description

Please visit evologics.de/eol for information on firmware support

Product name: S2C R 7/17D Hydroacoustic Modem

Firmware: v2.0.29

Serial Number: 0717D/20#239/23 Interfaces:

1. RS232 19200 8N1
2.
3.

Nominal input voltage: 24 VDC (19-28 VDC)

Housing Material: Titanium

Maximum depth (m) 6.000

Transducer type: 7/17D

Maximum depth (m) -

Installed Options

- ☒ Acoustic wake-up module
☐ AHRS
☐ Data logger
☐ Additional virtual data channels
☒ Distance and speed measurement

- ☐ USBL Antenna Local address: 3
☐ Opto-coupler Remote Address: 0
☒ Sensor integration Sensor name: Pressure sensor

Other/
Comments DSP version: 17074552;
Wake-Up module version: 0xb:0x71707
Waveform ID: 1;
Integrated Pressure sensor, rating 600 bar

Tests Conducted

	Test	Value	Status
<input checked="" type="checkbox"/>	Source Level (SrcLev=0), dB re 1 uPa @ 1 m	189,62	OK
<input checked="" type="checkbox"/>	Frequency Range, kHz	7-17	OK
<input checked="" type="checkbox"/>	Power consumption Rx Mode, W	1,10	OK
<input checked="" type="checkbox"/>	Power consumption Tx Mode, W	65,60	OK
<input checked="" type="checkbox"/>	Power consumption WakeUp Idle Mode, mW	1,27	OK
<input checked="" type="checkbox"/>	Power consumption WakeUp Active Mode, mW	284	OK
<input checked="" type="checkbox"/>	Data Transmission, kbps	6,9	OK
<input type="checkbox"/>	Vacuum test, bar		
<input checked="" type="checkbox"/>	Pressure test, bar	500	OK
<input checked="" type="checkbox"/>	Boot time (wake-up module), ms	5344	OK
<input checked="" type="checkbox"/>	Noise level, dB	-101	OK

Connector Configuration

Data/Power RS232			
Description	PIN	Description	PIN
NC	1		
NC	2		
RS232 Data TxOUT	3		
RS232 Data RxIN	4		
V+ (24V)	5		
V- (Power_GND)	6		
NC	7		
RS232 Gnd	8		
Subconn FCR1508M-Ti		not installed	

Signed by Sergey Yakovlev

Company Stamp



FACTORY AND TEST CERTIFICATE

Date of report: 29.03.2023

Reference number: 2023-04694

Filled by: [Redacted]

Tested by: [Redacted]

PRODUCT DESCRIPTION

Product name:	S2C 7S7P Li-Ion Battery Pack			Serial number:	7S7PLI#234	
Cell type:	Li-Ion Rechargeable Battery Pack w. BMS			Battery configuration:	7S7P	
Nominal battery capacity:	24,5	Ah	617,4	Wh	Cell chemistry:	Li-Ion (LiNiCoAlO2)
Nominal voltage:	25,2	V				
Maximum voltage:	29,4	V				
End-of-discharge voltage:	18,9	V				
Housing length/diameter:	346	mm	/	113	mm	
Weight dry/wet:	9400	g	/	3500	g	
Housing Material:	Titanium			Maximum depth:	6000	m

OTHER/ COMMENTS

Cells: LG Li-Ion Rechargeable Battery (INR 18650 MJ1);
Fused 10 A

TESTS CONDUCTED

		Value	Status
<input checked="" type="checkbox"/>	Battery capacity, Ah	24,50	OK
<input checked="" type="checkbox"/>	Charge-Discharge cycles	5	OK
<input checked="" type="checkbox"/>	Thermal fuse test, °C	n/a	OK
<input checked="" type="checkbox"/>	Vacuum test, bar	n/a	OK
<input checked="" type="checkbox"/>	Pressure test, bar	500	OK

CONNECTOR CONFIGURATION

Power/Charge			
Description	PIN	Description	PIN
BAT+	1		
BAT+	2		
NC	3		
BAT-	4		
BAT-	5		
NC	6		
Subconn FCR1506F-Ti		not installed	

Signed by

Sergey Yakovlev

Company Stamp



SUBSEA 20/20, Inc., [REDACTED]
2503 4th Avenue North
Seattle, WA 98109
United States

Invoicing address:

SUBSEA 20/20, Inc. [REDACTED]
2503 4th Avenue North
Seattle, WA 98109
United States
[REDACTED]

Shipping address:

Oceange Inc., [REDACTED]
1205 Craftman Way
Suite 107
Everett, WA 98201
United States
[REDACTED]
[REDACTED]

End customer

Oceange Inc. [REDACTED]
1205 Craftman Way
Suite 107
Everett, WA 98201
United States
[REDACTED]
[REDACTED]

Order Confirmation

Our reference : 2022-04571

Date : 04/Jan/2023

Your reference : P2276

Payment terms : 15 Days

Delivery terms : EXW

Pos.	Description	Qty.	Unit Price	Price
1.	[S2C-612-01-E-x] S2C R ydroacous c Modem w/USBL 7/17D Der n (e h ;ahrs) * Hous ng Ma er a : Der n (max dep h 200m) * Power Supp y Type: Ex ema * Power Supp y Vo age: 24 VDC * Pr mary connec or ype: Subconn FCR1508M * n erface connec or Layout 1: E herne + Power * AHRS Sensor: Bu n	1.0	24,200.00 € -15.00% reseller discount	24,200.00 € 20 570 00 €
2.	[S2C-970-180-110-L200-01F8] USBL Moun ng Frame * USBL An enna Type: LF An enna (7/17 12/24 15/27 18/34) * Modem ma er a : Der n * Connec or configura on: S andard one connec or * Hous ng eng h: 200mm * F ange Type: 8er F ange	1.0	1,600.00 € -15.00% reseller discount	1,600.00 € 1 360 00 €
3.	[S2C-906-00] S2C S NAPS USBL Track ng Sof ware * Mu p a form opera on (W ndows/L nux) * Upgrades for 1 year nc uded	1.0	2,000.00 € -15.00% reseller discount	2,000.00 € 1 700 00 €



Pos.	Description	Qty.	Unit Price	Price
4 .	[S2C-W-512-04-F8T .R-P5] S2C R ydroacous c Modem 7/17D T an um (rs232 ;s8m ;p5) * Hous ng Ma er a : T an um (max dep h 6000m) * Power Supp y Type: Ex erna * Power Supp y Vo age: 24 VDC * Pr mary connec or ype: Subconn FCR1508M T * n erface connec or Layou 1: RS232 & Serv ce + Power * Pressure sensor: n egra ed pressure sensor (0 05% accuracy; 6000m dep h ra ed)	1.0	23,200.00 € -15 00% rese er d scount	23,200.00 € 19 720 00 €
5 .	[S2C-930-01] Screw Fas ened De r n C amps for S2C Modem (one pa r)	1.0	1,200.00 € -15 00% rese er d scount	1,200.00 € 1 020 00 €
6 .	[S2C-799-02] Transpor case * Hard case for ranspor (USBL)	1.0	600.00 € -15 00% rese er d scount	600.00 € 510 00 €
End-user price				52,800.00 €
Reseller discount				-7,920.00 €
Total Without Taxes				44,880.00 €
Taxes				0.00 €
Total				44,880.00 €

- Sa es subjec o our Genera Terms and Cond ons. The curren GT&C can be down oaded from [h ps://evoogcs.de/documen s/GTC/GTC.pdf](https://evoogcs.de/documents/GTC/GTC.pdf)
- De very: TBC
- Transpor : D L: 968424391
- A bank fees are respons b y of he cus omer



Order Confirmation

SUBSEA 20/20, Inc., [REDACTED]
2503 4th Avenue North
Seattle, WA 98109
United States

Our reference : 2022-04571

Date : 12/Jan/2023

Your reference : P2276

Payment terms : 15 Days

Delivery terms : EXW

Invoicing address:

SUBSEA 20/20, Inc., [REDACTED]
2503 4th Avenue North
Seattle, WA 98109
United States
☎ + [REDACTED]

Shipping address:

Oceange Inc., [REDACTED]
1205 Craftman Way
Suite 107
Everett, WA 98201
United States
☎ + [REDACTED]
[REDACTED]

End customer

Oceange Inc., Philip Brooks
1205 Craftman Way
Suite 107
Everett, WA 98201
United States
☎ [REDACTED]
[REDACTED]

Pos.	Description	Qty.	Unit Price	Price
1.	[S2C-612-01-E-x] S2C R ydroacous c Modem w/USBL 7/17D De r n (e h ;ahrs) * Housing Material : De r n (max depth 200m) * Power Supply Type: External * Power Supply Voltage: 24 VDC * Primary connector type: Subconn FCR1508M * Interface connector Layout 1: Ethernet + Power * AHRS Sensor: Built in	1.0	24,200.00 € -15.00% reseller discount	24,200.00 € 20 570.00 €
2.	[S2C-906-00] S2C S NAPS USBL Tracking Software * Multipatform operation (Windows/Linux) * Upgrades for 1 year included	1.0	2,000.00 € -15.00% reseller discount	2,000.00 € 1 700.00 €
3.	[S2C-310-25-S8F-E] S2C Cable (Subconn MCIL8F, Ethernet RJ45, 25m) * Cable connector 1: Subconn MC L8F * Cable connector 2: RJ45; 4mm power plugs * Length: 25m	1.0	800.00 € -15.00% reseller discount	800.00 € 680.00 €



Pos.	Description	Qty.	Unit Price	Price
4.	[S2C-970-180-110-L200-01F8] USBL Mounting Frame * USBL Antenna Type: LF Antenna (7/17 12/24 15/27 18/34) * Modem manufacturer: Derin * Connector configuration: Standard one connector * Housing length: 200mm * Flange Type: 8er Flange	1.0	1,600.00 € -15.00% reseller discount	1,600.00 € 1,360.00 €
5.	[S2C-512-04-F8T.R-P5B1-T] S2C R hydroacoustic Modem 7/17D T an um (rs232 ;s8m ;p5 ;N 10Ah rck e;) * Housing Manufacturer: T an um (max depth 6000m) * Power Supply Type: internal * Power Supply Voltage: 24 VDC * internal battery: N MH 20S 10 Ah * Primary connector type: Subconn FCR1508MT * interface connector Layout 1: RS232 & Service + Power * Pressure sensor: integrated pressure sensor (0.05% accuracy; 6000m depth rated) * Tracking charge module: WH rck e charge	1.0	27,800.00 € -15.00% reseller discount	27,800.00 € 23,630.00 €
6.	[S2C-930-01] Screw Fastened Derin C amps for S2C Modem (one pair)	1.0	1,200.00 € -15.00% reseller discount	1,200.00 € 1,020.00 €
7.	[S2C-799-02] Transport case * Hard case for transport (USBL)	1.0	600.00 € -15.00% reseller discount	600.00 € 510.00 €

End-user price	58,200.00 €
Reseller discount	-8,730.00 €
Total Without Taxes	49,470.00 €
Taxes	0.00 €
Total	49,470.00 €

- Sales subject to our General Terms and Conditions. The current GT&C can be downloaded from <https://evo-logics.de/documents/GTC/GTC.pdf>
- Delivery: TBC
- Transport: DHL: 968424391
- All bank fees are responsibility of the customer



SUBSEA 20/20, Inc., [REDACTED]
2503 4th Avenue North
Seattle, WA 98109
United States

Invoicing address:

SUBSEA 20/20, Inc., [REDACTED]
2503 4th Avenue North
Seattle, WA 98109
United States
☎ + [REDACTED]

End customer

Oceange Inc.
1205 Craftman Way
Suite 107
Everett, WA 98201
United States
☎ [REDACTED]
[REDACTED]

Order Confirmation

Our reference : 2023-04694

Date : 16/Mar/2023

Your reference :

Payment terms : 15 Days

Delivery terms : EXW

Shipping address:

Oceange Inc., [REDACTED]
1205 Craftman Way
Suite 107
Everett, WA 98201
United States
☎ + [REDACTED]
[REDACTED]

Pos.	Description	Qty.	Unit Price	Price
1.	[S2C-512-04-F8T.R-WP5] S2C R hydroacoustic Modem 7/17D T an um (rs232 ;s8m ;wake ;p5) * Housing Material : T an um (max depth 6000m) * Power Supply Type: External * Power Supply Voltage: 24 VDC * Primary connector type: Subconn FCR1508MT * Interface connector Layout 1: RS232 & Service + Power * Wakeup Module: Acoustic wake up module * Pressure sensor: Integrated pressure sensor (0.05% accuracy; 6000m depth rated)	1.0	26,600.00 € -15.00% reseller discount	26,600.00 € 22,610.00 €
2.	Cus om Battery module (T an um housing, Integrated L - on battery 7S7P 25.2V-24.5Ah=617Wh, connec or FCR1506F-T)	1.0	5,800.00 € -15.00% reseller discount	5,800.00 € 4,930.00 €
3.	[S2C-402-01] Battery charger for Integrated rechargeable battery or external rechargeable pack (Lithium)	1.0	300.00 € -15.00% reseller discount	300.00 € 255.00 €
4.	[S2C-310-01-S8F-S6M] S2C Cable (Subconn MCIL8F, Subconn MCIL6M, 1m) * Cable connector 1: Subconn MC L8F * Cable connector 2: Subconn MC L6M * Length: 1m	1.0	700.00 € -15.00% reseller discount	700.00 € 595.00 €



Pos.	Description	Qty.	Unit Price	Price
5 .	[S2C-300-SC-R] S2C R Modem/USBL/LBL Service Cable (1.5m; rs232) cable for configuration from PC and firmware upgrades * data interface: rs232 * modem end: MC L8F * user end: DB9; 4mm power plugs	1.0	300.00 € -15.00% reseller discount	300.00 € 255.00 €
6 .	[S2C-930-03] Mounting Frame for S2C Modem and Battery Pack	1.0	2,300.00 € -15.00% reseller discount	2,300.00 € 1,955.00 €
7 .	[S2C-799-02] Transport case * Hard case for transport	1.0	600.00 € -15.00% reseller discount	600.00 € 510.00 €

End-user price	36,600.00 €
Reseller discount	-5,490.00 €
Total Without Taxes	31,110.00 €
Taxes	0.00 €
Total	31,110.00 €

- Sales subject to our General Terms and Conditions. The current GT&C can be downloaded from <https://evo-logics.de/documents/GTC/GTC.pdf>
- Delivery: ASAP
- Transport: TBD
- All bank fees are responsibility of the customer

Versandt von:

EvoLog cs Gmb , Ackers r. 76, 13355 Ber n, Germany

Kiste

1/2

Empfänger:

Oceanga e Inc., [REDACTED]

📍 1205 Craf sman Way

Su e 107

Evere , WA 98201

USA - Vere ng e S aa en von Amer ka

☎ + [REDACTED]

✉ [REDACTED]

2022-04571 - P2276

Packliste

Oceanga e Inc., [REDACTED]

📍 1205 Craf sman Way

Su e 107

Evere , WA 98201

USA - Vere ng e S aa en von Amer ka

Nummer : **LS-01226**

Datum : 22.02.2023

Ursprung : 2022-04571

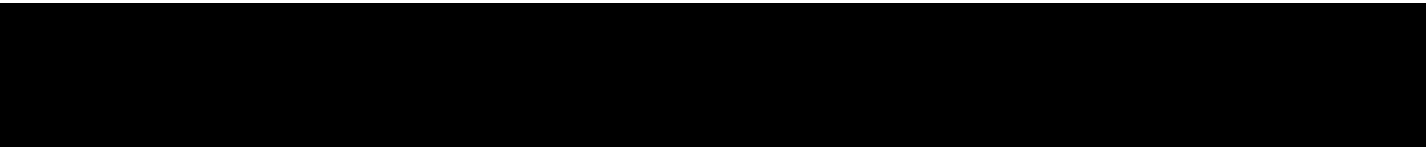
Ihre Referenz : P2276

Case 1

56,0 x 36,0 x 23,0 cm

10,1 kg

Pos.	Beschreibung	Bestellte Menge	Gelieferte Menge
1	[S2C-906-00] S2C SiNAPS USBL Tracking Software <i>Warentarifnummer 85235190 ECCN EAR99</i>	1,0 Stück	1,0 Stück
2	[S2C-310-25-S8F-E] S2C Kabel (Subconn MCIL8F, Ethernet RJ45 + Power, 25m) <i>Warentarifnummer 85444290 ECCN NLR</i>	1,0 Stück	1,0 Stück
3	[S2C-970-180-110-L200-01F8] USBL Halterung <i>Warentarifnummer 90159000 ECCN EAR99</i>	1,0 Stück	1,0 Stück
4	[S2C-930-01] Screw Fastened Delrin Clamps for S2C Modem (one pair) <i>Warentarifnummer 90159000 ECCN EAR99</i>	1,0 Stück	1,0 Stück



Versandt von:

EvoLog cs Gmb , Ackers r. 76, 13355 Ber n, Germany

Kiste

2/2

Empfänger:

Oceanga e Inc.,
1205 Craf sman Way
Su e 107
Evere , WA 98201
USA - Vere n g e S aa en von Amer ka
+
2022-04571 - P2276

Packliste

Oceanga e Inc.,
1205 Craf sman Way
Su e 107
Evere , WA 98201
USA - Vere n g e S aa en von Amer ka

Nummer : **LS-01226**
Datum : 22.02.2023
Ursprung : 2022-04571
Ihre Referenz : P2276

Case 2 87,0 x 58,0 x 38,0 cm 39,0 kg

Pos.	Beschreibung	Bestellte Menge	Gelieferte Menge
1	[S2C-799-02] Transportkoffer <i>Warentarifnummer 39269097 ECCN EAR99</i>	1,0 Stück	1,0 Stück
2	[S2C-612-01-E-x] S2C R Hydroakustisches Modem mit USBL 7/17D Delrin (eth ;ahrs) <i>SN: 0717D/20#190/23</i> <i>Warentarifnummer 85176990</i>	1,0 Stück	1,0 Stück
3	[S2C-512-04-F8Ti.R-P5B1-T] S2C R Hydroakustisches Modem 7/17D Titanium (rs232 ;s8mti ;p5 Ni10Ah trickle;) <i>SN: 0717D/20#191/23</i> <i>Warentarifnummer 85176990</i>	1,0 Stück	1,0 Stück

Versandt von:

EvoLog cs GmbH, Ackersr. 76, 13355 Berlin, Germany

Kiste

1/1

Empfänger:

Oceange Inc., [REDACTED]
1205 Crawford Way
Suite 107
Everett, WA 98201
USA - Vereinigte Staaten von Amerika
☎ + [REDACTED]
✉ [REDACTED]
2023-04694

Packliste

Oceange Inc., [REDACTED]
1205 Crawford Way
Suite 107
Everett, WA 98201
USA - Vereinigte Staaten von Amerika

Nummer : **LS-01295**
Datum : 31.03.2023
Ursprung : 2023-04694
Ihre Referenz :

Case 1 83,0 x 56,0 x 35,0 cm 37,1 kg

Pos. Beschreibung		Bestellte Menge
1	[S2C-799-02] Transportkoffer <i>Warentarifnummer 39269097 ECCN EAR99</i>	1,0 Stück
2	[S2C-512-04-F8Ti.R-WP5] S2C R Hydroakustisches Modem 7/17D Titanium (rs232 ;s8mti ;wake ;p5) <i>SN: 0717D/20#239/23</i> <i>Warentarifnummer 85176990</i>	1,0 Stück
3	[S2C-95L-04] S2C Li-Ion Rechargeable Battery Titanium Housing (7S7P, 24.5 Ah, 617.4 Wh, 25.2 V) <i>SN: 7S7PLI#234</i>	1,0 Stück
4	[S2C-402-01] Ladegerät für integrierte/externe Akku 24V Li-Ion <i>Warentarifnummer 85044055 ECCN EAR99</i>	1,0 Stück
5	[S2C-310-01-S8F-S6M] S2C Kabel (Subconn MCIL8F, Subconn MCIL6M, 1m) <i>Warentarifnummer 85444290 ECCN EAR99</i>	1,0 Stück
6	[S2C-300-SC-R] S2C R Modem/USBL/LBL Service Cable (1.5m; rs232) <i>Warentarifnummer 85444290 ECCN EAR99</i>	1,0 Stück
7	[S2C-930-03] Mounting Frame for S2C Modem and Battery Pack <i>Warentarifnummer 90159000</i>	1,0 Stück

Versandt von:

EvoLog cs GmbH, Ackersr. 76, 13355 Berlin, Germany

Kiste

1/1

Empfänger:

A. Harvey Logistics, [REDACTED]

60 Water St.

S. John's NL A1C 1A3

Kanada

☎ + [REDACTED]

✉ [REDACTED]

2023-04694

Packliste

A. Harvey Logistics, [REDACTED]

60 Water St.

S. John's NL A1C 1A3

Kanada

Nummer : **LS-01295**

Datum : 31.03.2023

Ursprung : 2023-04694

Ihre Referenz :

Case 1

83,0 x 56,0 x 35,0 cm

37,1 kg

Pos.	Beschreibung	Bestellte Menge	Gelieferte Menge
1	[S2C-799-02] Transportkoffer <i>Warentarifnummer 39269097 ECCN EAR99</i>	1,0 Stück	1,0 Stück
2	[S2C-512-04-F8Ti.R-WP5] S2C R Hydroakustisches Modem 7/17D Titanium (rs232 ;s8mti ;wake ;p5) <i>SN: 0717D/20#239/23</i> <i>Warentarifnummer 85176990</i>	1,0 Stück	1,0 Stück
3	[S2C-95L-04] S2C Li-Ion Rechargeable Battery Titanium Housing (7S7P, 24.5 Ah, 617.4 Wh, 25.2 V) <i>SN: 7S7PLI#234</i>	1,0 Stück	1,0 Stück
4	[S2C-402-01] Ladegerät für integrierte/externe Akku 24V Li-Ion <i>Warentarifnummer 85044055 ECCN EAR99</i>	1,0 Stück	1,0 Stück
5	[S2C-310-01-S8F-S6M] S2C Kabel (Subconn MCIL8F, Subconn MCIL6M, 1m) <i>Warentarifnummer 85444290 ECCN EAR99</i>	1,0 Stück	1,0 Stück
6	[S2C-300-SC-R] S2C R Modem/USBL/LBL Service Cable (1.5m; rs232) <i>Warentarifnummer 85444290 ECCN EAR99</i>	1,0 Stück	1,0 Stück
7	[S2C-930-03] Mounting Frame for S2C Modem and Battery Pack <i>Warentarifnummer 90159000</i>	1,0 Stück	1,0 Stück

Oceangate

SUBSEA 20/20, Inc.

Technology for Advanced Underwater Exploration

2503 4th Avenue North
Seattle, WA 98109
Phone [REDACTED]

DATE: December 20, 2022

PURCHASE ORDER P2276

End User [REDACTED]

SHIP VIA DHL: 968424391

TERM PAID AT SHIPPING

NEED BY DATE: ASAP

Order Remit To:
EvoLogics GmbH
Ackerstrasse 76
13355 Berlin
Germany
[REDACTED]

Ship To:
OceanGate, Inc.
1205 Craftsman Way Ste 112
Everett, WA 98201
Attention: [REDACTED]
tel: [REDACTED]
email: [REDACTED]

Part Number	DESCRIPTION	QTY	AMOUNT	TOTAL
TOPSIDE UNIT				
S2C-601-01-E	S2C R Series Hydroacoustic USBL Modem 7/17D * (D) Directional Beam Pattern * USBL transceiver * Delrin housing, 200m depth rated * Data interface: Ethernet * Combined data/power connector (Subconn FCR1508M) * 24VDC input power configuration	1	€ 21,200.00	€ 21,200.00
S2C-903-00	AHRS Integrated module for motion compensation, (xSens Mti), optional for increased accuracy (USBL)	1	€ 2,300.00	€ 2,300.00
S2C-906-00	SiNAPS USBL tracking software for graphic display of positioning	1	€ 2,000.00	€ 2,000.00
S2C-930-03	Stainless mounting frame for USBL modem	1	€ 2,300.00	€ 2,300.00
DOWNSIDE UNIT				
S2C-501-04-S	S2C R Series Hydroacoustic Modem 7/17 * (D) Directional Beam Pattern * Titanium housing, 6000m depth rated * Data interface: Either RS232 * Combined data/power connector (Subconn FCR1508M) * 24VDC input power configuration	1	€ 20,400.00	€ 20,400.00
S2C-901-01	Integrated Pressure Sensor, optional for increased vertical accuracy (USBL)	1	€ 2,800.00	€ 2,800.00
S2C-930-01	Clamps screw fastened	1	€ 1,200.00	€ 1,200.00
S2C-799-02	Transport case	1	€ 600.00	€ 600.00
			SUBTOTAL	€ 52,800.00
			AGENCY DISCOUNT	€ (7,920.00)
			TOTAL	€ 44,880.00

For questions concerning this Purchase Order, please contact:

[REDACTED]
[REDACTED]
[REDACTED]

SUBSEA 20/20, Inc.

Technology for Advanced Underwater Exploration

2503 4th Avenue North
Seattle, WA 98109
Phone [REDACTED]

DATE: January 11, 2023

PURCHASE ORDER P2276v2

End User [REDACTED]

SHIP VIA DHL: 968424391

TERM PAID AT SHIPPING

NEED BY DATE: ASAP

Order Remit To:

EvoLogics GmbH
Ackerstrasse 76
13355 Berlin
Germany

Tel [REDACTED]

Ship To:

OceanGate, Inc.
Attention: [REDACTED]
1205 Craftsman Way Ste 112
Everett, WA 98201

tel: [REDACTED]
email: [REDACTED]

Part Number	DESCRIPTION	QTY	AMOUNT	TOTAL
TOPSIDE UNIT				
S2C-601-01-E	S2C R Series Hydroacoustic USBL Modem 7/17D * (D) Directional Beam Pattern * USBL transceiver * Delrin housing, 200m depth rated * Data interface: Ethernet * Combined data/power connector (Subconn FCR1508M) * 24VDC input power configuration	1	€ 21,200.00	€ 21,200.00
S2C-903-00	AHRS Integrated module for motion compensation, (xSens Mti), optional for increased accuracy (USBL)	1	€ 2,300.00	€ 2,300.00
S2C-906-00	SiNAPS USBL tracking software for graphic display of positioning	1	€ 2,000.00	€ 2,000.00
S2C-310-15	S2C R Cable Single Connector 25m	1	€ 800.00	€ 800.00
S2C-930-03	Stainless mounting frame for USBL modem	1	€ 2,300.00	€ 2,300.00
DOWNSIDE UNIT				
S2C-501-04-S	S2C R Series Hydroacoustic Modem 7/17 * (D) Directional Beam Pattern * Titanium housing, 6000m depth rated * Data interface: Either RS232 * Combined data/power connector (Subconn FCR1508M) * 24VDC input power configuration	1	€ 20,400.00	€ 20,400.00
S2C-901-01	Integrated Pressure Sensor, optional for increased vertical accuracy (USBL)	1	€ 2,800.00	€ 2,800.00
	Integrated 10Ah battery for modem with titanium housing	1	€ 3,900.00	€ 3,900.00
S2C-949-00	Integrated trickle-charge module	1	€ 700.00	€ 700.00
S2C-930-01	Clamps screw fastened	1	€ 1,200.00	€ 1,200.00
S2C-799-02	Transport case	1	€ 600.00	€ 600.00
			SUBTOTAL	€ 58,200.00
			AGENCY DISCOUNT	€ (8,730.00)
			TOTAL	€ 49,470.00

For questions concerning this Purchase Order, please contact:

[REDACTED]
[REDACTED]
[REDACTED]

SUBSEA 20/20, Inc.

Technology for Advanced Underwater Exploration

2503 4th Avenue North

Seattle, WA 98109

Phone [REDACTED]

DATE: March 15, 2023

PURCHASE ORDER P2314

End User [REDACTED]

SHIP VIA TBD

TERM PAID AT SHIPPING

NEED BY DATE: ASAP

Order Remit To:

EvoLogics GmbH
Ackerstrasse 76
13355 Berlin
Germany

Tel. [REDACTED]

Ship To:

OceanGate, Inc.
Attention: [REDACTED]
1205 Craftsman Way Ste 112
Everett, WA 98201

tel: [REDACTED]

email: [REDACTED]

Part Number	DESCRIPTION	QTY	AMOUNT	TOTAL
S2C-512-04-F8Ti.R-WP5	S2C R Hydroacoustic Modem 7/17D Titanium (rs232 ;s8mti ;wake ;p5) * Housing Material: Titanium (max. depth 6000m) * Power Supply Type: External * Power Supply Voltage: 24 VDC * Primary connector type: Subconn FCR1508M Ti * Interface connector Layout 1: RS232 & Service + Power * Wakeup-Module: Acoustic wake-up module * Pressure sensor: Integrated pressure sensor (0.05% accuracy, 6000m depth rated)	1	€ 26,600.00	€ 26,600.00
Custom Battery module	Titanium housing, Integrated Li-ion battery (7S7P 25.2V-24.5Ah=617Wh) Connector FCR1506F-Ti	1	€ 5,800.00	€ 5,800.00
S2C-402-01	Battery charger for integrated rechargeable battery or external rechargeable pack (Lithium)	1	€ 300.00	€ 300.00
S2C-310-01-S8F-S6M	S2C Cable (Subcon MCIL8F, Subconn MCIL6M, 1m) * Cable connector 1: Subconn MCIL8F * Cable connector 2: Subconn MCIL6M * Length: 1m	1	€ 700.00	€ 700.00
S2C-300-SC-R	S2C R Modem/USBL/LBL Service Cable (1.5m; rs232) cable for configuration from PC and firmware upgrades * data interface: rs232 * modem end: MCIL8F * user end: DB9; 4mm power plugs	1	€ 300.00	€ 300.00
S2C-930-03	Mounting Frame for S2C Modem and Battery Pack	1	€ 2,300.00	€ 2,300.00
S2C-799-02	Hard case for transport	1	€ 600.00	€ 600.00

SUBTOTAL € 36,600.00

AGENCY DISCOUNT € (5,490.00)

TOTAL € 31,110.00

For questions concerning this Purchase Order, please contact:

[REDACTED]
[REDACTED]
[REDACTED]



EvoLogics GmbH
Ackerstr. 76
13355 Berlin, Germany



EvoLogics SiNAPS software: version 2.x

User Guide

Document version 1.0.B

February 2021

2000 - 2021 EvoLogics GmbH. All rights reserved.

Printed in Germany.

EvoLogics GmbH, Ackerstrasse 76, 13355 Berlin, Germany

Trademarks: Trademarks and service marks of EvoLogics GmbH (EvoLogics) contained in this document are attributed to EvoLogics with the appropriate symbol. For queries regarding EvoLogics trademarks, contact us at the address shown above.

All other trademarks are the property of their respective holders.

Restricted Print Permission: This publication is protected by copyright and any unauthorized use of this publication may violate copyright, trademark, and other laws. Except as specified in this permission statement, this publication may not be copied, reproduced, modified, published, uploaded, posted, transmitted, or distributed in any way, without prior written permission from EvoLogics. This statement grants you permission to print one (1) hard copy of this publication subject to the following conditions:

- The publication may be used solely for personal, informational, and noncommercial purposes;
- The publication may not be modified in any way;
- Any copy of the publication or portion thereof must include all original copyright, trademark, and other proprietary notices and this permission statement; and
- EvoLogics reserves the right to revoke this authorization at any time, and any such use shall be discontinued immediately upon written notice from EvoLogics.

Disclaimer: Information in this publication is subject to change without notice and does not represent a commitment on the part of EvoLogics. The information contained herein is the proprietary and confidential information of EvoLogics or its licensors, and is supplied subject to, and may be used only by EvoLogics customer in accordance with, a written agreement between EvoLogics and its customer. Except as may be explicitly set forth in such agreement, EvoLogics does not make, and expressly disclaims, any representations or warranties as to the completeness, accuracy or usefulness of the information contained in this document. EvoLogics does not warrant that use of such information will not infringe any third party rights, nor does EvoLogics assume any liability for damages or costs of any kind that may result from use of such information.

Contents

1	About this document	6
2	System overview	6
2.1	Underwater acoustic positioning: basic principles	6
2.1.1	EvoLogics USBL positioning system	6
2.1.2	EvoLogics LBL Positioning system	8
2.2	EvoLogics SiNAPS: basic principles	10
3	Software installation	10
3.1	System requirements	10
3.2	SiNAPS server installation	11
3.2.1	Windows	11
4	SiNAPS Launcher: opening SiNAPS	12
5	SiNAPS introduction	14
5.1	Main screen and user interface	14
5.2	SiNAPS concepts: Targets and Devices	17
5.3	SiNAPS concepts: Database	17
5.4	SiNAPS concepts: Mission settings	17
6	SiNAPS configuration	18
6.1	Mission configuration: USBL positioning	18
6.1.1	Vessel settings	19
6.1.2	USBL transceiver settings	21
6.1.3	AHRS, GNSS, Pressure sensor settings	27
6.1.4	Data output settings	32
6.1.5	Target transponder settings	34
6.1.6	Status indicators	36
6.2	Configuration Wizard: USBL positioning	37
6.2.1	Step 1: Configure the Vessel	39
6.2.2	Step 2: Configure the transceiver	40
6.2.3	Step 3: Configure the GNSS input	41
6.2.4	Step 4: Configure the AHRS input	42
6.2.5	Step 5: Configure the target	43
6.2.6	Step 6: Start positioning	44
6.3	Mission configuration: iUSBL positioning	45
6.3.1	Configuring the Transceiver-side SiNAPS	46
6.3.2	Configuring the Target-side SiNAPS	48
6.3.3	Positioning	50
7	During the mission: USBL positioning	51
7.1	Start and stop tracking targets	51
7.2	Vessels Widget	52
7.3	Devices Widget	54
7.4	Targets Widget	55
7.5	Mission controls	57

7.5.1	Rename mission	57
7.5.2	Create new mission	58
7.5.3	Open mission	59
7.5.4	Clear mission settings	59
7.5.5	Save mission settings	60
7.5.6	Load mission settings	60
7.5.7	Sound velocity profile upload	61
7.6	Map display options	62
7.6.1	Map display modes	62
7.6.2	Map rotation	64
7.6.3	Move to	65
7.6.4	Compass widget	66
7.7	Display tools	67
7.7.1	Zoom-in	67
7.7.2	Zoom-out	67
7.7.3	Zoom to targets	67
7.7.4	Full screen	67
7.8	Rulers tool	68
7.9	Layers and maps	71
7.10	Adding background maps	72
7.10.1	Loading the online map	72
7.10.2	Creating and adding an offline map	73
7.11	Extra display settings	75
7.12	Logbook tool	76
7.13	Chat tool	77
A	Coordinate frame conventions	79
A.1	Common Reference Frame	79
A.2	USBL antenna reference frame	80
A.3	USBL antenna and the Common reference frame alignment	81
A.4	Reference frame for CRP definition	82
B	USBL Transceiver calibration	83
B.1	Before you begin: planning vessel maneuvers	84
B.2	Calibration procedure	85
B.2.1	Mission plan configuration	85
B.2.2	Test and deploy the reference transponder	86
B.2.3	Calibration steps	86
C	Data Input	90
C.1	CSV data input	90
C.2	TSS1 data input	91
C.3	NMEA data input	92
C.3.1	Pseudo-NMEA data input	92
D	NMEA data output	93
D.1	Supported NMEA strings	94
D.2	NMEA message format	95
D.3	PEVOACA: acoustic activity notification	96

D.4	PSIMSSB: relative target coordinates	97
D.5	PEVOSSB: target coordinates	98
D.6	PEVOSSA: target direction	100
D.7	PEVORPY: vessel alignment	101
D.8	PEVOGPS: CRP coordinates	102
D.9	PEVOLBP: Target location output	103
D.10	PEVOLBL: Baseline node location	104
D.11	PEVORCP: LBL interrogation control	106
D.12	PEVORCT: Signal transmission notification	108
D.13	PEVORCM: Signal reception notification	110
D.14	PEVOTPC: Pressure and alignment	111
D.15	NMEA output example: USBL positioning	112
D.16	NMEA output example: LBL calibration	114
D.17	NMEA output example: LBL positioning	116
D.17.1	Self-positioning scenario	116
D.17.2	Positioning scenario	118
E	NMEA commands	120
E.1	NMEA command format	120
E.2	PEVOCTL: positioning control	120
F	Instant messages format	122
F.1	USBL positioning: instant messages format	122
F.2	Pressure and voltage data: instant messages format	123
F.3	Multi-ping responses: instant messages format	124
F.4	iUSBL positioning/Chat: instant messages format	125

Revision History

Revision	Date	Description
1.0.A	January 2021	First release.
1.0.B	January 2021	iUSBL configuration added. Chat tool description added. Minor rewordings and text additions.

1 About this document

This document describes the **EvoLogics SiNAPS version 2.x** software for underwater acoustic positioning.

It provides information on installing the software, a general overview of its user interface and contains instructions on configuring and using SiNAPS to track underwater targets.

2 System overview

The following sections provide a brief overview of EvoLogics acoustic positioning systems, their methods of operation and main system components.

2.1 Underwater acoustic positioning: basic principles

2.1.1 EvoLogics USBL positioning system

A typical EvoLogics SiNAPS (S2C intelligent Navigation and Positioning Software) USBL (ultra-short baseline) positioning system is pictured in Fig. 1.

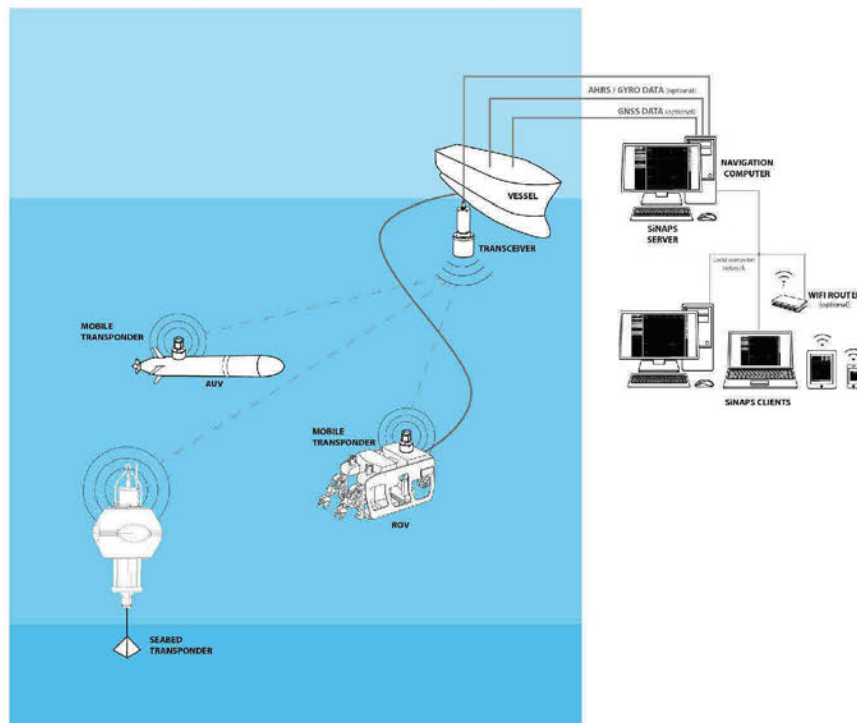


Figure 1: EvoLogics SiNAPS USBL positioning system

The system operates as follows:

- A **USBL transceiver** is mounted on a **Vessel** and uses acoustic signals to determine the distances and bearings to the tracking targets.

The **USBL transceiver** measures the time from transmission of its acoustic interrogation signal until an acoustic reply from the **Transponder** is detected and converts it to distance to the **Transponder**. Containing several transducers separated by a short distance (the ultra-short baseline antenna), the transceiver calculates the angle to the **Transponder**.

- **Transponders** are attached to several tracking targets, for example, to autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs), towfish etc.

The **Transponders** reply to acoustic signals from the **USBL transceiver** with their own acoustic pulses, allowing it to calculate their positions.

- Optional third-party external instruments (an **AHRS sensor** and/or a **Gyrocompass** and/or a **GNSS receiver**) provide information about the vessel's orientation and real-world coordinates.
- The customer's **Navigation computer** is interfaced with the USBL transceiver and the external instruments and is connected to the local computer network. EvoLogics positioning software, the **SiNAPS**, is installed on the **Navigation computer**.
- **EvoLogics SiNAPS** positioning software controls the positioning system and provides display features to monitor the mission in real-time.

As every task is unique, exact configuration and the hardware components of an USBL underwater acoustic positioning system may vary.

- Third-party or built-in **AHRS sensor** (Attitude and Heading Reference System) provides information about the vessel's orientation during calibration to eliminate positioning errors.
- Optional third party instruments: a **Sound Velocity Profiler** used at the work site for more accurate distance calculations.
- The **Navigation computer** is interfaced with the vessel transceiver and the external instruments and is connected to the local computer network. EvoLogics positioning software, the **SiNAPS**, and the **Transponder communication utility**, a web-based tool to monitor and control the baseline transponders, are accessible from the **Navigation Computer**.
- **EvoLogics SiNAPS** positioning software controls the positioning system and provides display features to monitor the mission in real-time.
- The **Transponder communication utility** with a web-based user interface provides basic controls to communicate with the deployed baseline nodes and trigger the acoustic releases, monitor the battery voltage, pressure and orientation of the transponders.

2.2 EvoLogics SiNAPS: basic principles

EvoLogics SiNAPS is a client-server application.

- **SiNAPS server** is a software component, installed on the **Navigation computer** interfaced with a transceiver and other external instruments on the vessel. The **SiNAPS server** receives, processes and stores data from the transceiver and external instruments. It performs all the necessary calculations to display this information on-screen.
- **SiNAPS client** is the web-based user interface of the positioning system. It displays real-time information about the positions of the **Vessel** and the targets, provides access to data management tools and system configuration settings.

The user interface can be opened in most current web-browsers on any device in the local computer network (see the list of compatible web-browsers in section 3.1). It is possible to open **SiNAPS clients** on multiple devices at once.

To access the SiNAPS user interface, one must simply navigate the web-browser to the correct address.

3 Software installation

This section provides instructions on installing the SiNAPS server on your navigation computer and information about accessing the SiNAPS user interface with your web-browser of choice.

3.1 System requirements

SiNAPS server Operating system:

- **Microsoft Windows**

Recommended configuration:

- Windows 7 or higher
- 256 MB of RAM

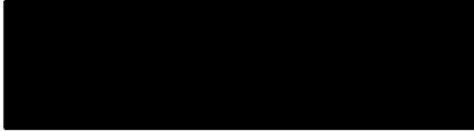
- **Linux**

Recent versions of the following Linux distributions are officially supported:

- Debian
- Ubuntu
- CentOS
- RedHat



EvoLogics GmbH
Ackerstr. 76
13355 Berlin



S2C Reference Manual

Edition **Standard**

Firmware Version 2.0

Document version 2.0.B.1

March 2020

2000-2020 EvoLogics GmbH. All rights reserved.

Printed in Germany.

EvoLogics GmbH., Ackerstr. 76, 13355 Berlin, Germany

Trademarks: Trademarks and service marks of EvoLogics GmbH (EvoLogics) contained in this document are attributed to EvoLogics with the appropriate symbol. For queries regarding EvoLogics trademarks, contact us at the address shown above.

All other trademarks are the property of their respective holders.

Restricted Print Permission: This publication is protected by copyright and any unauthorized use of this publication may violate copyright, trademark, and other laws. Except as specified in this permission statement, this publication may not be copied, reproduced, modified, published, uploaded, posted, transmitted, or distributed in any way, without prior written permission from EvoLogics. This statement grants you permission to print one (1) hard copy of this publication subject to the following conditions:

- The publication may be used solely for personal, informational, and noncommercial purposes;
- The publication may not be modified in any way;
- Any copy of the publication or portion thereof must include all original copyright, trademark, and other proprietary notices and this permission statement; and
- EvoLogics reserves the right to revoke this authorization at any time, and any such use shall be discontinued immediately upon written notice from EvoLogics.

Disclaimer: Information in this publication is subject to change without notice and does not represent a commitment on the part of EvoLogics. The information contained herein is the proprietary and confidential information of EvoLogics or its licensors, and is supplied subject to, and may be used only by EvoLogics customer in accordance with, a written agreement between EvoLogics and its customer. Except as may be explicitly set forth in such agreement, EvoLogics does not make, and expressly disclaims, any representations or warranties as to the completeness, accuracy or usefulness of the information contained in this document. EvoLogics does not warrant that use of such information will not infringe any third party rights, nor does EvoLogics assume any liability for damages or costs of any kind that may result from use of such information.

Revision History

Revision	Date	Description
1.8.0	January 2015	First Release.
1.8.1	July 2015	Reference Frame Updated.
1.8.2	September 2015	Global Settings Control modified.
1.8.3	October 2015	Transponder Communication Utility added, Remote Device Control updated.
1.8.4	June 2016	Minor fixes, Optocoupler Control added - Firmware v.1.8.14 and up.
1.9.A	November 2016	Advanced Timekeeping Module added - Firmware v.1.9.3 and up.
1.9.B	December 2016	S2C Configuration Shell added - Firmware v.1.9.4 and up.
1.9.B.1	February 2017	S2C HS bitrate added - Firmware v.1.9.4 and up.
1.9.C	February 2017	RECV/USBL string order added, -1 USBLANGLES accuracy added - Firmware v.1.9.6 and up.
1.9.D	July 2017	Retry Timeout description expanded, end-of-line settings section added, putty link added, Configuration shell description expanded - Firmware v.1.9.6 and up.
1.9.E	January 2018	Executing commands from Configuration shell added - Firmware v.1.9.13 and up.
1.9.E.1	June 2018	Minor edits to Service cable and Configuration shell - Firmware v.1.9.13 and up.
1.9.E.2	June 2018	RECVEND notification edited - Firmware v.1.9.13 and up.
1.9.F	January 2019	Minor typos fixed, PBM delivery status (AT?DP), System Time + System Clock (AT?UPX) added - Firmware v.1.9.13 and up.
2.0	February 2019	Notifications control, command description help, STATUS and RECVRV ext. notifications, IM loopback added. Firmware 2.0 and up.
2.0.B	November 2019	Firmware EOL note added, notes on using Configuration Shell with Wake-Up added, minor typos fixed. Firmware 2.0 and up.
2.0.B.1.	March 2020	Disabled transmissions added (AT!TX) - Firmware 2.0.6-3 and up.

Firmware support life cycle

Please mind the information on **firmware support life cycle** listed at evologics.de/eol

Contact EvoLogics to request a firmware update for your previously purchased devices, if needed.

Contents

1	Introduction	7
2	Device Features	7
2.1	Communication protocols	7
2.1.1	Physical layer: the S2C protocol.	7
2.1.2	Data-link layer: the D-MAC protocol.	8
2.1.3	D-MAC protocol: data delivery algorithms	8
2.2	Networking features	10
2.2.1	Developer solutions	11
2.3	Wake-Up Module	12
2.4	USBL positioning	13
2.4.1	Positioning Strings	13
2.5	Advanced Timekeeping Module	14
3	Device Interfaces	15
3.1	Connecting to device interfaces	15
3.1.1	End-of-line settings	15
3.2	Data Channels	16
3.2.1	Extended Protocol Mode	16
3.2.2	Channel Priority	18
3.3	Interface configuration: the Interface String	19
3.3.1	RS-232 Interface	20
3.3.2	Ethernet Interface	21
3.3.3	Data pre-processing: filters overview	22
3.3.4	Command interpreter: at filter or net filter.	23
3.3.5	Data Compression: the zlib filter.	26
4	Device operation	27
4.1	AT Commands	27
4.2	Data Mode	27
4.2.1	Guard Time Escape Sequence	27
4.2.2	Time Independent Escape Sequence	28
4.2.3	Back Escape Sequence	28
4.3	Command Mode	29
4.4	Device timekeeping	30
4.4.1	UTC Time: NMEA input	30
5	Commands	32
5.1	Introduction	32
5.1.1	AT Command syntax	32
5.1.2	End-of-line markers	33
5.1.3	Command Responses and Error messages	34
5.1.4	Notifications	37
5.2	Help commands	38
5.2.1	AT? or AT\$: See all Help sections	38
5.2.2	AT*\$: See Data Control Help sections	38
5.2.3	AT&\$: See Settings management Help sections	38

5.2.4	AT?\$: See Requests Help sections	38
5.2.5	AT!\$: See Settings Help sections	38
5.2.6	AT@\$: See interface and data channel Help sections	38
5.2.7	AT<keyword>\$: Search Help sections	38
5.2.8	AT<cmd>\$: See command format/description	39
5.3	General commands	40
5.3.1	ATC: Switch to Command Mode	40
5.3.2	ATO: Switch to Data Mode	40
5.3.3	ATS: Switch to Deaf State	40
5.3.4	ATN: Switch to Noise State	41
5.3.5	ATA: Switch to Listen State	42
5.3.6	ATD: Establish an acoustic connection	42
5.3.7	ATHn: Close an acoustic connection	43
5.3.8	ATZn: Reset the device, drop data and/or instant messages.	44
5.3.9	ATIn: View firmware information	45
5.4	Data control: send and receive burst data	46
5.4.1	Send burst data	46
5.4.2	Receive burst data	46
5.4.3	AT?ZE: Burst data delivery counter	47
5.5	Data control: send and receive instant messages	48
5.5.1	AT*SENDIM: Send instant messages	48
5.5.2	AT*SENDIMS: Send synchronous instant messages	51
5.5.3	AT*SENDPBM: Send piggyback messages	53
5.5.4	Instant message notifications	55
5.5.5	AT?DI:Instant message delivery status	57
5.5.6	AT?DP: Piggyback message delivery status	58
5.5.7	RECVIM: Receive instant messages	59
5.5.8	RECVIMS: Receive synchronous instant messages	60
5.5.9	RECVPBM: Receive piggyback messages	61
5.6	Data control: extended notifications	63
5.7	Status requests	66
5.7.1	AT?MODE: Command interpreter	66
5.7.2	AT?PHY: Physical layer status	67
5.7.3	AT?BV: Battery Voltage	67
5.7.4	AT?S: Acoustic Connection Status request	68
5.8	Settings management	69
5.8.1	AT&V: Get current settings	69
5.8.2	AT&W: Store settings profile	71
5.8.3	AT&F: Restore factory settings	72
5.9	Settings and Requests: global	73
5.9.1	AT?L and AT!Ln: Source Level	73
5.9.2	AT?LC and AT!LCn: Source Level Control	74
5.9.3	AT?G and AT!Gn: Gain	75
5.9.4	AT?C and AT!Cn: Carrier Waveform ID	76
5.9.5	AT?AL and AT!ALn: Local Address	77
5.9.6	AT?AR and AT!ARn: Remote Address	78
5.9.7	AT?AM and AT!AMn: Highest Address	80
5.9.8	AT?ZC and AT!ZCn: Cluster Size	81

5.9.9	AT?ZP and AT!ZPn: Packet Time	82
5.9.10	AT?RC and AT!RCn: Retry Count	83
5.9.11	AT?RT and AT!RTn: Retry Timeout	84
5.9.12	AT?KO and AT!KOn: Keep Online Count	85
5.9.13	AT?ZI and AT!ZIn: Idle Timeout	86
5.9.14	AT?PID, AT?ZS and AT!ZSn: Channel Protocol ID	87
5.9.15	AT?ZSL: Interface List	88
5.9.16	AT?UT and AT!UTn: System Time	89
5.9.17	AT?CLOCK: System Clock	90
5.9.18	AT?UTX: System Time and System Clock	91
5.9.19	AT?CA and AT!CAn: Sound Speed	92
5.9.20	AT?RI and AT!RI n: IM Retry Count	93
5.9.21	AT?RP and AT!RPn: Promiscuous Mode	94
5.9.22	AT?TX and AT!TXn: Disabled transmissions mode	95
5.10	Settings and requests: interface and data channel	96
5.10.1	AT?CTRL and AT@CTRL: Global Settings Control	96
5.10.2	AT?ZF and AT@ZF n: Extended Protocol Mode	97
5.10.3	AT?ZB and AT@ZB n: Notifications Control	99
5.10.4	AT?ZX and AT@ZX n: Extended Notifications Control	100
5.10.5	AT?ZL and AT@ZL n: Pool Size	101
5.10.6	AT?ZD and AT@ZD: Drop counter	102
5.10.7	AT?ZO and AT@ZO: Overflow Counter	103
5.10.8	AT?ZU and AT@ZU n: Positioning Data Output	104
5.10.9	AT?ECLK, AT?ZA and AT@ZA: External Clock Output	105
5.11	Positioning: tracking remote targets	107
5.11.1	USBLLONG: Positioning Data Output	107
5.11.2	USBLANGLES: Target Direction Output	109
5.11.3	USBLPHYP: Coordinates Array Output	110
5.11.4	USBLPHYD: Transducer Delays Output	111
5.11.5	AT?UP: Positioning (Deprecated)	113
5.11.6	AT?UPX: Motion-Compensated Positioning (Deprecated)	114
5.12	Wake-Up Module: settings and requests	115
5.12.1	AT?DA and AT!DAn: Wake-Up Active Time	116
5.12.2	AT?DT and AT!DTn: Wake-Up Period	117
5.12.3	AT?ZH and AT!ZH n: Hold Timeout	118
5.12.4	AT?DW and AT!DW n: Awake Remote Mode	119
5.12.5	AT?DR and AT!DR n: Remote Active Time	120
5.13	Acoustic channel: parameter requests	121
5.13.1	AT?BL: Local-to-remote bitrate	121
5.13.2	AT?BR: Remote-to-local bitrate	121
5.13.3	AT?E: RSSI	123
5.13.4	AT?I: Signal Integrity Level	123
5.13.5	AT?T: Propagation Time	123
5.13.6	AT?V: Relative Velocity	124
5.13.7	AT?P: Multipath Structure	124
5.13.8	AT?NOISE: Noise sample	125
5.14	Remote Device Control extension: commands and requests	126
5.14.1	AT%STATUS: Status	126

5.14.2	Unsupported: Wrong command syntax notification	126
5.14.3	AT%RESET: Reset	127
5.14.4	AT%RELEASE: Acoustic Release Control	128
5.14.5	AT%VOLTAGE: Check battery voltage	130
5.14.6	AT%PRESSURE: Check pressure sensor data	131
5.14.7	AT%AHRS: Check AHRS data	132
5.14.8	AT%OPTO: Optocoupler Control	134
5.14.9	AT%CONFIG: Change Remote Device Settings	137
6	Support	138
A	Appendix I: S2C Configuration Utility	139
A.1	S2C Configuration Utility	139
A.1.1	Opening the S2C Configuration utility	139
A.1.2	S2C Configuration utility: IP Settings	140
A.1.3	S2C Configuration utility: Device Settings	141
A.1.4	S2C Configuration utility: Advanced Device Settings	143
A.2	Transponder Communication Utility	145
A.2.1	Opening the utility	145
A.2.2	Transponder Communication Utility: Control elements	146
A.2.3	Transponder Communication Utility: Status log	149
A.3	Atomic Clock Utility	150
A.3.1	Atomic clock: an overview	150
A.3.2	Connecting the external GPS receiver	151
A.3.3	Opening the utility	152
A.3.4	Disciplining the atomic clock	153
A.3.5	Synchronizing the atomic clock	156
B	Appendix II: S2C Configuration Shell	157
B.1	Opening the S2C Configuration Shell	157
B.1.1	S2C Configuration Shell over Serial interface	157
B.1.2	S2C Configuration Shell over Ethernet interface	159
B.1.3	Open the S2C Configuration Shell	159
B.2	Configuration Commands	160
B.3	Device Settings	161
B.4	System diagnostic and control commands	163
C	Appendix III	166
	Index	167

1 Introduction

This document describes operating and configuring the S2C Underwater Acoustic Modem/S2C USBL Underwater Communication Device.

The manual focuses solely on the firmware of the S2C-series devices. Please refer to the S2C Quick Installation Guide for hardware installation, testing and maintenance instructions.

Along with a comprehensive overview of the firmware features, this document provides detailed information about performing communication tasks and modifying settings configurations of the S2C Underwater Acoustic Modem/S2C USBL Underwater Communication Device.

Aimed at system integration specialists, this manual is intended to serve as a comprehensive guide to the low-level command set that provides full control over S2C devices. This document is not a tutorial for programming, instead, it contains detailed descriptions of each command and examples of its application.

This manual describes the Standard command set, best for raw sensor data transmissions. Refer to the S2C Underwater Acoustic Modem Guide Networking Version for the Networking command set description.

2 Device Features

The highlight of S2C communication devices is the EvoLogics' patented Sweep-Spread Carrier (S2C) Communication Technology.

S2C Technology provides significant advantages for applications in underwater acoustic channels, where dynamic parameters of the environment and multipath signal propagation challenge communication efforts. S2C communication devices achieve high data rates in underwater acoustic channels both in deep and reverberant shallow waters as adaptive algorithms adjust S2C performance to match the current channel parameters and maintain the highest bitrate possible.

In spite of the half-duplex nature of an underwater acoustic link, S2C communication devices with a proprietary data exchange protocol provide full duplex bidirectional data transmissions.

The digital stack of the device consists of the ADC (Analog-to-Digital Converter), DAC (Digital-to-Analog Converter), DSP (Digital Signal Processor) and FPGA (Field-Programmable Gate Array) that implement the physical layer S2C protocol, and an ARM processor, implementing the D-MAC data-link layer protocol.

We will describe these protocols in the sections below.

2.1 Communication protocols

2.1.1 Physical layer: the S2C protocol.

The physical layer protocol of your device implements the patented S2C (Sweep Spread Carrier) spread spectrum signal modulation technique. The S2C modulation increases speed, reliability and efficiency of data transmissions in harsh underwater environments.



EvoLogics GmbH
Ackerstr. 76
13355 Berlin, Germany
Tel.: +49 30 4679 862 - 0
Fax: +49 30 4679 862 - 01
Email: support@evologics.de

EvoLogics

Underwater Acoustic Positioning System

User Guide

Document version 2.0.B

February 2021

2000 - 2021 EvoLogics GmbH. All rights reserved.

Printed in Germany.

EvoLogics GmbH, Ackerstrasse 76, 13355 Berlin, Germany

Trademarks: Trademarks and service marks of EvoLogics GmbH (EvoLogics) contained in this document are attributed to EvoLogics with the appropriate symbol. For queries regarding EvoLogics trademarks, contact us at the address shown above.

All other trademarks are the property of their respective holders.

Restricted Print Permission: This publication is protected by copyright and any unauthorized use of this publication may violate copyright, trademark, and other laws. Except as specified in this permission statement, this publication may not be copied, reproduced, modified, published, uploaded, posted, transmitted, or distributed in any way, without prior written permission from EvoLogics. This statement grants you permission to print one (1) hard copy of this publication subject to the following conditions:

- The publication may be used solely for personal, informational, and noncommercial purposes;
- The publication may not be modified in any way;
- Any copy of the publication or portion thereof must include all original copyright, trademark, and other proprietary notices and this permission statement; and
- EvoLogics reserves the right to revoke this authorization at any time, and any such use shall be discontinued immediately upon written notice from EvoLogics.

Disclaimer: Information in this publication is subject to change without notice and does not represent a commitment on the part of EvoLogics. The information contained herein is the proprietary and confidential information of EvoLogics or its licensors, and is supplied subject to, and may be used only by EvoLogics customer in accordance with, a written agreement between EvoLogics and its customer. Except as may be explicitly set forth in such agreement, EvoLogics does not make, and expressly disclaims, any representations or warranties as to the completeness, accuracy or usefulness of the information contained in this document. EvoLogics does not warrant that use of such information will not infringe any third party rights, nor does EvoLogics assume any liability for damages or costs of any kind that may result from use of such information.

Contents

1	About this document	6
2	System overview	7
2.1	Underwater acoustic positioning: basic principles	7
2.1.1	EvoLogics USBL positioning system	7
2.1.2	EvoLogics LBL Positioning system	9
2.1.3	Factors affecting system performance	11
2.2	SiNAPS Software	12
2.3	Transceiver	13
2.3.1	Overview	13
2.3.2	Interfaces	14
2.4	Seabed Transponder	15
2.4.1	Overview	15
2.4.2	Interfaces	16
2.5	Mobile Transponder	16
2.5.1	Overview	16
2.5.2	Interfaces	16
3	Hardware installation	17
3.1	Installations on the vessel	17
3.1.1	Transceiver installation	17
3.1.2	Navigation Computer	24
3.1.3	Third-party AHRS sensor	25
3.1.4	Third-party Gyrocompass	26
3.1.5	Third-party GNSS receiver	27
3.2	Mobile transponder installation	28
3.2.1	Devices with cable-mounted transducer	28
3.2.2	OEM devices without housing	29
3.2.3	EMI mitigation	29
3.2.4	Transponder power supply	30
3.2.5	Connection to data source	31
3.2.6	Noise: lab test and analysis	32
4	Software installation	33
4.1	System requirements	33
4.2	SiNAPS server installation	33
4.2.1	Windows	33
5	SiNAPS Launcher: opening SiNAPS	34
5.1	SiNAPS configuration	37
6	Turning on the system	38
6.1	Transceiver	38
6.1.1	Devices without a Wake-Up Module	38
6.1.2	Devices with a built-in Wake-Up Module	38
6.2	External sensors	39
6.3	Navigation computer	39

6.4	Seabed transponder	40
6.4.1	Devices without a Wake-Up Module	40
6.4.2	Devices with a built-in Wake-Up Module	40
6.5	Mobile transponder	42
6.5.1	Mobile transponder with external power supply	42
6.5.2	Mobile transponder with built-in battery	43
7	Before the mission: near shore	46
7.1	Operating conditions	46
7.2	Battery charging	47
7.2.1	Seabed transponder	47
7.2.2	Mobile transponder	49
7.2.3	Checking battery voltage	50
7.3	Seabed transponder: assembly and arming	51
7.3.1	Unpacking	51
7.3.2	Assembly	52
7.3.3	Arming the acoustic release	58
8	Before the mission: open water	62
8.1	On-site measurements	62
8.1.1	Air pressure measurement	62
8.1.2	Sound velocity measurement	62
8.2	USBL: transceiver calibration	63
8.3	LBL: baseline deployment and calibration	64
8.3.1	Baseline array: geometry recommendations	64
8.3.2	Seabed transponder: pre-deployment test	65
8.3.3	Baseline array: deployment	67
8.3.4	Baseline array: communication test	67
8.3.5	Baseline array: calibration	68
9	System Operation	70
9.1	USBL positioning	70
9.2	LBL positioning	71
10	After the mission	72
10.1	Seabed transponder recovery	72
11	Maintenance	74
12	Transport and handling	75
12.1	Handling devices	75
12.2	Transporting devices	75
13	Storage	76
13.1	Recharging the batteries	76
A	USBL Transceiver calibration	77
A.1	Before you begin: planning vessel maneuvers	78
A.2	Calibration procedure	79

B Noise	80
B.1 Overview	80
B.2 Analysing noise levels - installations on the vessel	80
B.3 Analysing noise levels - system integration of OEM devices	81
C Interfaces	83
C.1 Data output format	83
C.2 Supported NMEA strings	84
C.3 Data input	85
C.3.1 CSV data input	85
C.3.2 TSS1 data input	86
C.3.3 NMEA data input	87
C.3.4 Pseudo-NMEA data input	87
D System cables list	88
D.1 Vessel transceiver	88
D.2 Seabed transponder	89
D.3 Mobile transponder	90
D.3.1 Mobile transponder with external power supply	90
D.3.2 Mobile transponder with internal battery	91
D.3.3 OEM mobile transponder (no housing)	92
E Accessories list	93
E.1 Vessel transceiver	93
E.2 Seabed transponder	93
E.3 Mobile transponder	93
E.3.1 Mobile transponder with external power supply	93
E.3.2 Mobile transponder with internal battery	93
E.3.3 OEM mobile transponder (no housing)	94
F Installation checklist	95
F.1 Installations on the vessel	95
G Before the mission checklist	95

Revision History

Revision	Date	Description
1.0.A	July 2017	First release.
1.0.B	November 2017	Minor issues fixed.
2.0.A	February 2021	SiNAPS 2 update.
2.0.B	February 2021	Turning on devices with Wake-up module updated.

1 About this document

This document provides an overview of the hardware and software that comprise an EvoLogics underwater acoustic positioning system and outlines the main recommendations on hardware installation and system operation.

EvoLogics SiNAPS software for underwater acoustic positioning is described in a separate document, supplied with the system.

Each EvoLogics underwater acoustic modem and USBL transceiver comes with a dedicated **Getting Started Guide** with details on how to set up your device, turn it on and perform a quick functionality test. It contains recommendations on handling, operating and storing S2C devices.

Another document, the **S2C Reference Guide**, provides an in-depth view of device operation, using its features and offers a comprehensive list of control commands.

2 System overview

The following sections provide an overview of EvoLogics acoustic positioning systems, their methods of operation and main system components.

2.1 Underwater acoustic positioning: basic principles

2.1.1 EvoLogics USBL positioning system

A typical EvoLogics SiNAPS (S2C intelligent Navigation and Positioning Software) USBL (ultra-short baseline) positioning system is pictured in Fig. 1.

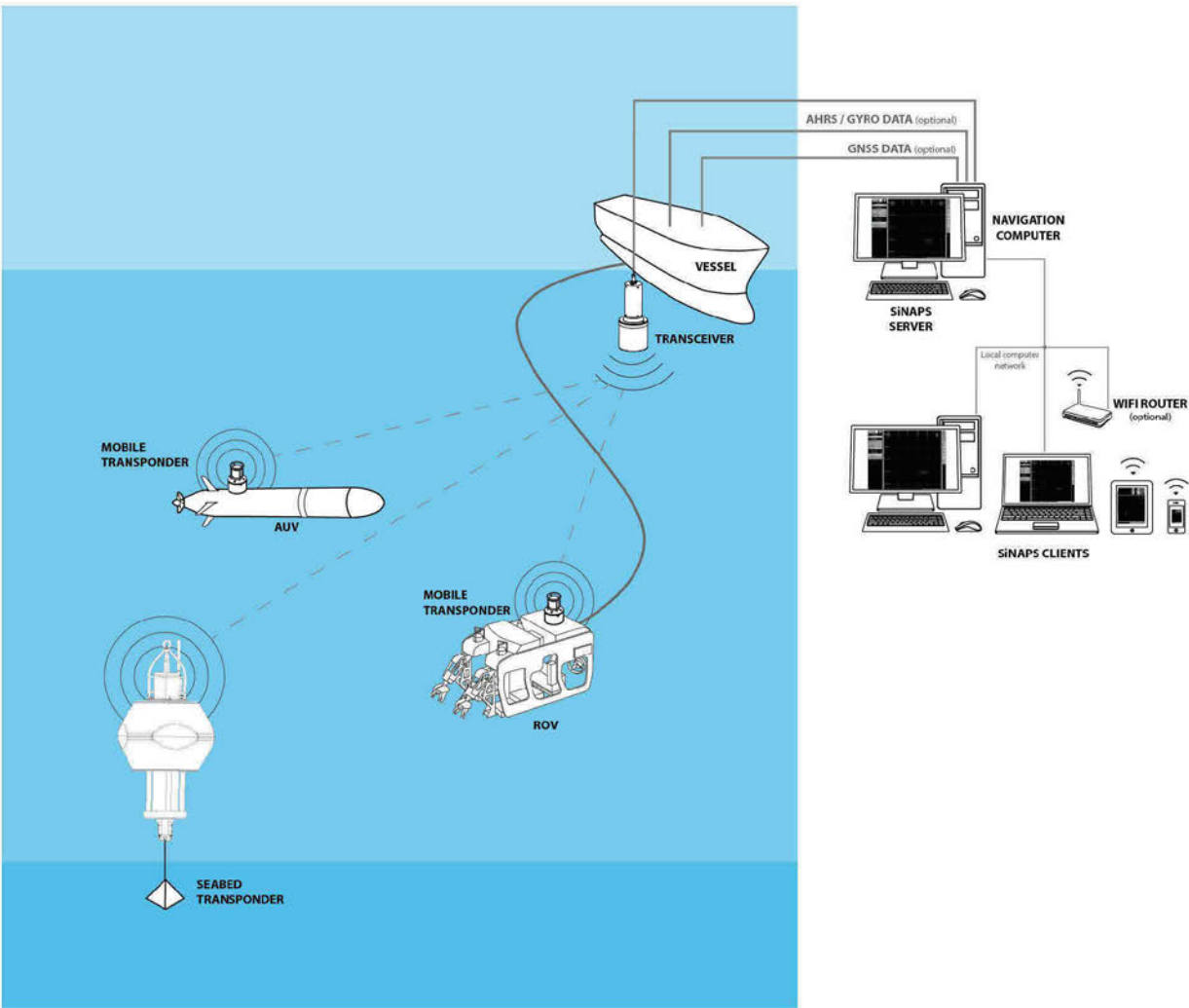


Figure 1: EvoLogics SiNAPS USBL positioning system

The system operates as follows:

- A **USBL transceiver** is mounted on a **Vessel** and uses acoustic signals to determine the distances and bearings to the tracking targets.

The **USBL transceiver** measures the time from transmission of its acoustic interrogation signal until an acoustic reply from the **Transponder** is detected and converts it to distance to the **Transponder**. Containing several transducers separated by a short distance (the ultra-short baseline antenna), the transceiver calculates the angle to the **Transponder**.

- **Transponders** are attached to several tracking targets, for example, to autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs), towfish etc.

The **Transponders** reply to acoustic signals from the **USBL transceiver** with their own acoustic pulses, allowing it to calculate their positions.

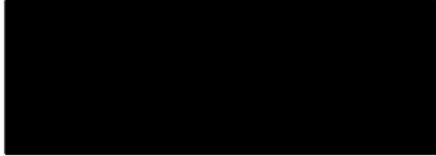
- Optional third-party external instruments (an **AHRS sensor** and/or a **Gyrocompass** and/or a **GNSS receiver**) provide information about the vessel's orientation and real-world coordinates.
- The customer's **Navigation computer** is interfaced with the USBL transceiver and the external instruments and is connected to the local computer network. EvoLogics positioning software, the **SiNAPS**, is installed on the **Navigation computer**.
- **EvoLogics SiNAPS** positioning software controls the positioning system and provides display features to monitor the mission in real-time.

As every task is unique, exact configuration and the hardware components of an USBL underwater acoustic positioning system may vary.

- A **GPS receiver** is installed on the **Vessel** for accurate calibration of the baseline transponder array after its deployment. During calibration, the vessel moves above the deployed baseline transponders to accurately determine their location. Coupled with a **Vessel transceiver**, the GPS receiver provides the baseline nodes' positions in real-world coordinates.
- Third-party or built-in **AHRS sensor** (Attitude and Heading Reference System) provides information about the vessel's orientation during calibration to eliminate positioning errors.
- Optional third party instruments: a **Sound Velocity Profiler** used at the work site for more accurate distance calculations.
- The **Navigation computer** is interfaced with the vessel transceiver and the external instruments and is connected to the local computer network. EvoLogics positioning software, the **SiNAPS**, and the **Transponder communication utility**, a web-based tool to monitor and control the baseline transponders, are accessible from the **Navigation Computer**.
- **EvoLogics SiNAPS** positioning software controls the positioning system and provides display features to monitor the mission in real-time.
- The **Transponder communication utility** with a web-based user interface provides basic controls to communicate with the deployed baseline nodes and trigger the acoustic releases, monitor the battery voltage, pressure and orientation of the transponders.



EvoLogics GmbH
Ackerstr. 76
13355 Berlin, Germany



Getting Started Guide

S2C R 7/17D USBL Underwater Positioning and Communication system

Configuration: external power supply 24 VDC; standard build with housing;
standard modem firmware

Document version 1.2.A

February 2021

2000-2021 EvoLogics GmbH. All rights reserved.

Printed in Germany.

EvoLogics GmbH., Ackerstr. 76, 13355 Berlin, Germany

Trademarks: Trademarks and service marks of EvoLogics GmbH (EvoLogics) contained in this document are attributed to EvoLogics with the appropriate symbol. For queries regarding EvoLogics trademarks, contact us at the address shown above.

All other trademarks are the property of their respective holders.

Restricted Print Permission: This publication is protected by copyright and any unauthorized use of this publication may violate copyright, trademark, and other laws. Except as specified in this permission statement, this publication may not be copied, reproduced, modified, published, uploaded, posted, transmitted, or distributed in any way, without prior written permission from EvoLogics. This statement grants you permission to print one (1) hard copy of this publication subject to the following conditions:

- The publication may be used solely for personal, informational, and noncommercial purposes;
- The publication may not be modified in any way;
- Any copy of the publication or portion thereof must include all original copyright, trademark, and other proprietary notices and this permission statement; and
- EvoLogics reserves the right to revoke this authorization at any time, and any such use shall be discontinued immediately upon written notice from EvoLogics.

Disclaimer: Information in this publication is subject to change without notice and does not represent a commitment on the part of EvoLogics. The information contained herein is the proprietary and confidential information of EvoLogics or its licensors, and is supplied subject to, and may be used only by EvoLogics customer in accordance with, a written agreement between EvoLogics and its customer. Except as may be explicitly set forth in such agreement, EvoLogics does not make, and expressly disclaims, any representations or warranties as to the completeness, accuracy or usefulness of the information contained in this document. EvoLogics does not warrant that use of such information will not infringe any third party rights, nor does EvoLogics assume any liability for damages or costs of any kind that may result from use of such information.

Revision History

Revision	Date	Description
1.2.A	February 2021	Additional information on Wake-Up Module, handling and maintenance.

Contents

1	Introduction	4
1.1	Overview	4
1.2	About this document	4
2	Technical specifications	5
3	First steps: an overview	6
4	Before you begin	6
4.1	Firmware compatibility and life cycle	6
5	Connecting to a power source	7
5.1	DC Power Source selection	7
5.2	Connecting to a power source	8
6	Turning the device on/off	9
6.1	Devices without a Wake-Up Module	9
6.2	Devices with a built-in Wake-Up Module	10
6.3	Connecting to a PC	11
6.3.1	Establishing connection to a PC	12
6.3.2	Testing the connection to a PC	18
7	Testing S2C devices	19
7.1	Setup for testing in water	19
7.2	Setup for testing in air	21
7.3	Testing an acoustic link with standard terminal applications	22
7.3.1	Connecting to the host device	22
7.3.2	Checking the host device connection	22
7.3.3	Changing host device settings	22
8	Configuring S2C devices	24
9	Maintenance	25
10	Transport and handling	26
10.1	Handling devices	26
10.2	Transporting devices	26
11	Storage	27
12	System integration recommendations	28
12.1	General considerations	29
12.2	USBL antenna installation	30
12.3	Noise analysis	31
12.4	Galvanic corrosion	32
13	Support	33

1 Introduction

1.1 Overview

The S2C R 7/17D USBL underwater acoustic positioning and communication device provides accurate Ultra-Short Base-Line (USBL) positioning and a full-duplex digital communication link using EvoLogics' patented S2C (Sweep-Spread Carrier) modulation technique.

S2C is a sophisticated spread spectrum communication method. It exploits the advantages of carefully optimized chirp pulses to transmit data in harsh subsea conditions, delivering an excellent performance, highly resistant to the negative effects of multipath propagation, ambient noise, Doppler shifts etc.

Furthermore, the challenges of high-speed data transmissions in dynamic underwater environment are met with the self-adaptive algorithms that adjust S2C parameters to maintain the highest bitrate possible in given conditions. Reliability of the underwater communication link is increased with software-embedded FEC (Forward Error Correction) processing. ARQ (Automatic Repeat Query) technique ensures that data with unrecoverable errors is automatically retransmitted. EvoLogics' own MAC (Media Access Control) communication protocol implements a novel interwoven order of data packets and protects the transfers from long propagation delays.

Each S2C device responds to remote connection requests, as it has a configurable individual address. Data exchange between S2C devices is bidirectional. Commands and high-priority messages can be transmitted as Instant Messages from the receiver to the transmitter without interrupting the main data flow from the transmitter to the receiver or affecting the network throughput. In addition, S2C devices provide useful features of measuring the physical parameters of the underwater acoustic channel.

The device's firmware includes an extensive set of commands that offers full control over its functionality (see S2C Reference Guide for more information).

A wide selection of configuration options enables seamless integration into any underwater system, proving the device to be a reliable and highly adjustable tool for multiple subsea applications.

1.2 About this document

This document is a guide to set up your device, turn it on and perform a quick functionality test. It contains recommendations on handling, operating and storing S2C devices.

However, this guide does provide detailed information on device features and does not describe the command set to operate your device. A separate document - the **S2C Reference Guide** - is dedicated to device operation and is supplied along with the hardware.

2 Technical specifications

model:	S2C R 7/17D USBL
operational range:	up to 8000 m (can vary depending on environmental conditions)
operational depth:	200 m (Delrin housing) 1000 m (AlMg housing) 2000 m (Stainless steel housing) 6000 m (Titanium housing)
transducer beam pattern:	directional, 80 degrees (see directivity diagrams in Fig. 1)
interface:	Ethernet and/or RS-232 / RS-485 / RS-422
nominal acoustic bitrate:	up to 6.9 kbps
power supply:	external 24 VDC (19 VDC-28 VDC)
operational frequency band:	7 kHz - 17 kHz
power consumption:	
Standby mode	2.5 mW
Receive mode	1.4 W
Transmit mode	up to 65 W (software configurable)
Listen mode ¹	5 mW - 285 mW (software configurable)

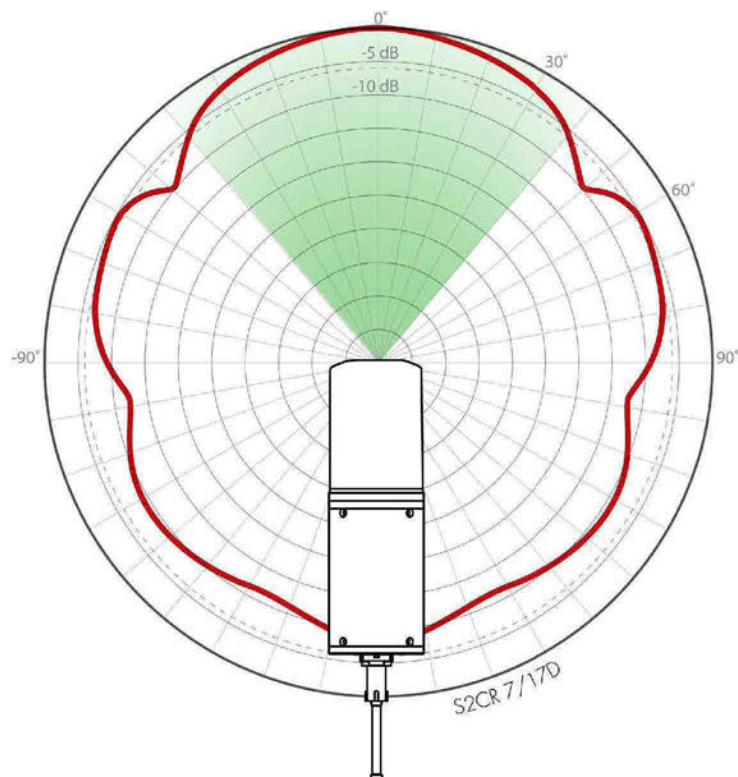


Figure 1: Transducer directivity pattern

¹Power consumption listed for the RS-232 interface option. Power consumption increases by 800 mW with an AHRS installed. Add 500 mW for the Ethernet interface option.

²User-configurable Listen Mode is only available with a Wake-Up module installed. Power consumption in Listen Mode depends on Listen Mode settings.