Evo
Logics®

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 be employees of EvoLogics, are contained within the correspondence files associated with Category 3.

Supporting Documents/Files:
- Can be found within Category 3.

███████████████

Director of Sales/Operations
EvoLogics North America

███████████████

Factory and Test Certificate

Evo Logics®

Date of report:	10.02.2023	Filled by:	▮▮▮▮
Reference:	2022-04571	Tested by:	▮▮▮

Product Description

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

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

Installed Options

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

Other/ Comments

Tests Conducted

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

EvoLogics®

Date of report:	10.02.2023
Reference:	2022-04571

Filled by:	▮▮▮
Tested by:	▮▮▮

Product Description

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

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

Installed Options

☐ Acoustic wake-up module	☐ USBL Antenna
☐ AHRS	☐ Opto-coupler
☐ Data logger	☒ Sensor integration
☐ Additional virtual data channels	
☒ Distance and speed measurement	

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
☒	Source Level (SrcLev=0), dB re 1 uPa @ 1 m	189,40	OK
☒	Frequency Range, kHz	7-17	OK
☒	Power consumption Rx Mode, W	0,90	OK
☒	Power consumption Tx Mode, W	65,80	OK
☐	Power consumption WakeUp Idle Mode, mW		
☐	Power consumption WakeUp Active Mode, mW		
☒	Data Transmission, kbps	6,9	OK
☐	Vacuum test, bar		
☒	Pressure test, bar	500	OK
☐	Boot time (wake-up module), ms		
☒	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

Company Stamp

Sergey Yakovlev

Factory and Test Certificate

EvoLogics®

Date of report:	29.03.2023
Reference:	2023-04694

Filled by:	
Tested by:	

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:	

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

[X] Acoustic wake-up module	[ ] USBL Antenna
[ ] AHRS	[ ] Opto-coupler
[ ] Data logger	[X] Sensor integration
[ ] Additional virtual data channels	
[X] Distance and speed measurement	

Local address: 3
Remote Address: 0
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
[X]	Source Level (SrcLev=0), dB re 1 uPa @ 1 m	189,62	OK
[X]	Frequency Range, kHz	7-17	OK
[X]	Power consumption Rx Mode, W	1,10	OK
[X]	Power consumption Tx Mode, W	65,60	OK
[X]	Power consumption WakeUp Idle Mode, mW	1,27	OK
[X]	Power consumption WakeUp Active Mode, mW	284	OK
[X]	Data Transmission, kbps	6,9	OK
[ ]	Vacuum test, bar		
[X]	Pressure test, bar	500	OK
[X]	Boot time (wake-up module), ms	5344	OK
[X]	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 | | Filled by: | |
| Reference number: | 2023-04694 | | Tested by: | |

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		Housing Material:	Titanium
End-of-discharge voltage:	18,9 V		Maximum depth:	6000 m
Housing lengh/diameter:	346 mm /	113 mm		
Weight dry/wet:	9400 g /	3500 g		

OTHER/ COMMENTS

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

TESTS CONDUCTED

		Value	Status
X	Battery capacity, Ah	24,50	OK
X	Charge-Discharge cycles	5	OK
X	Thermal fuse test, °C	n/a	OK
X	Vacuum test, bar	n/a	OK
X	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

Evo Logics®

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

Order Confirmation

Our reference	:	**2022-04571**
Date	:	04/Jan/2023
Your reference	:	P2276
Payment terms	:	15 Days
De very terms	:	EXW

Invoicing address:
SUBSEA 20/20, Inc. ▮▮▮▮
2503 4 h Avenue Nor h
Sea e, WA 98109
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☎ ▮▮▮▮

Shipping address:
Oceanga e Inc., ▮▮▮▮
1205 Craf sman Way
Su e 107
Evere , WA 98201
Un ed S a es
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End customer
Oceanga e Inc. ▮▮▮▮
1205 Craf sman Way
Su e 107
Evere , WA 98201
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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)	1.0	24,200.00 €	24,200.00 €
	* Hous ng Ma er a : De r n (max dep h 200m)		-15 00% reseller discount	20 570 00 €
	* Power Supp y Type: Ex erna			
	* Power Supp y Vo age: 24 VDC			
	* Pr mary connec or ype: Subconn FCR1508M			
	* n erface connec or Layou 1: E herne + Power			
	* AHRS Sensor: Bu n			
2.	[S2C-970-180-110-L200-01F8] USBL Moun ng Frame	1.0	1,600.00 €	1,600.00 €
	* USBL An enna Type: LF An enna (7/17 12/24 15/27 18/34)		-15 00% reseller discount	1 360 00 €
	* Modem ma er a : De r n			
	* Connec or conf gura on: S andard one connec or			
	* Hous ng eng h: 200mm			
	* F ange Type: 8er F ange			
3.	[S2C-906-00] S2C S NAPS USBL Track ng Sof ware	1.0	2,000.00 €	2,000.00 €
	* Mu p a form opera on (W ndows/L nux)		-15 00% reseller discount	1 700 00 €
	* Upgrades for 1 year nc uded			

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)	1.0	23,200.00 € -15 00% rese er d scount	23,200.00 € *19 720 00 €*
	* 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)			
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	1.0	600.00 € -15 00% rese er d scount	600.00 € *510 00 €*
	* Hard case for ranspor (USBL)			

End-user price	52,800.00 €
Reseller discount	-7,920.00 €
Total Without Taxes	44,880.00 €
Taxes	0.00 €
Total	44,880.00 €

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- De very: TBC
- Transpor : D L: 968424391
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EvoLogics®

Order Confirmation

Our reference	:	**2022-04571**
Date	:	12/Jan/2023
Your reference	:	P2276
Payment terms	:	15 Days
De very terms	:	EXW

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

Invoicing address:
SUBSEA 20/20, Inc., ▮▮▮▮▮▮
2503 4 h Avenue Nor h
Sea e, WA 98109
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Shipping address:
Oceanga e Inc., ▮▮▮▮▮▮
1205 Craf sman Way
Su e 107
Evere , WA 98201
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End customer
Oceanga e Inc., Ph p Brooks
1205 Craf sman Way
Su e 107
Evere , WA 98201
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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) * Hous ng Ma er a : De r n (max dep h 200m) * Power Supp y Type: Ex erna * Power Supp y Vo age: 24 VDC * Pr mary connec or ype: Subconn FCR1508M * n erface connec or Layou 1: E herne + Power * AHRS Sensor: Bu n	1.0	24,200.00 € -15 00% rese er d scount	24,200.00 € *20 570 00 €*
2 .	[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% rese er d scount	2,000.00 € *1 700 00 €*
3 .	[S2C-310-25-S8F-E] S2C Cab e (Subcon MCIL8F, E herne RJ45, 25m) * Cab e connec or 1: Subconn MC L8F * Cab e connec or 2: RJ45; 4mm power p ugs * Leng h: 25m	1.0	800.00 € -15 00% rese er d scount	800.00 € *680 00 €*

Pos.	Description	Qty.	Unit Price	Price
4 .	[S2C-970-180-110-L200-01F8] USBL Moun ng Frame	1.0	1,600.00 € -15 00% rese er d s count	1,600.00 € *1 360 00 €*
	* USBL An enna Type: LF An enna (7/17 12/24 15/27 18/34)			
	* Modem ma er a : De r n			
	* Connec or conf gura on: S andard one connec or			
	* Hous ng eng h: 200mm			
	* F ange Type: 8er F ange			
5 .	[S2C-512-04-F8T .R-P5B1-T] S2C R ydroacous c Modem 7/17D T an um (rs232 ;s8m ;p5 ;N 10Ah r ck e;)	1.0	27,800.00 € -15 00% rese er d s count	27,800.00 € *23 630 00 €*
	* Hous ng Ma er a : T an um (max dep h 6000m)			
	* Power Supp y Type: n erna			
	* Power Supp y Vo age: 24 VDC			
	* n erna ba ery: N MH 20S 10 Ah			
	* 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)			
	* Tr ck e charge modu e: W h r ck e charge			
6 .	[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 s count	1,200.00 € *1 020 00 €*
7 .	[S2C-799-02] Transpor case	1.0	600.00 € -15 00% rese er d s count	600.00 € *510 00 €*
	* Hard case for ranspor (USBL)			

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

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Page 2 of 2

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

Order Confirmation

Our reference	:	**2023-04694**
Date	:	16/Mar/2023
Your reference	:	
Payment terms	:	15 Days
De very terms	:	EXW

Invoicing address:
SUBSEA 20/20, Inc., ▮▮▮▮▮
2503 4 h Avenue Nor h
Sea e, WA 98109
Un ed S a es
☎ +▮▮▮▮▮

Shipping address:
Oceanga e Inc., ▮▮▮▮▮
1205 Craf sman Way
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Evere , WA 98201
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End customer
Oceanga e Inc.
1205 Craf sman Way
Su e 107
Evere , WA 98201
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Pos.	Description	Qty.	Unit Price	Price
1 .	[S2C-512-04-F8T .R-WP5] S2C R ydroacous c Modem 7/17D T an um (rs232 ;s8m ;wake ;p5)	1.0	26,600.00 € -15 00% rese er d scount	26,600.00 € *22 610 00 €*
	* 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			
	* Wakeup Modu e: Acous c wake up modu e			
	* Pressure sensor: n egra ed pressure sensor (0 05% accuracy; 6000m dep h ra ed)			
2 .	Cus om Ba ery modu e (T an um hous ng, n egra ed L - on ba ery 7S7P 25.2V-24.5Ah=617Wh, connec or FCR1506F-T)	1.0	5,800.00 € -15 00% rese er d scount	5,800.00 € *4 930 00 €*
3 .	[S2C-402-01] Ba ery charger for n egra ed rechargeab e ba ery or ex erna rechargeab e pack (L h um)	1.0	300.00 € -15 00% rese er d scount	300.00 € *255 00 €*
4 .	[S2C-310-01-S8F-S6M] S2C Cab e (Subcon MCIL8F, Subconn MCIL6M, 1m)	1.0	700.00 € -15 00% rese er d scount	700.00 € *595 00 €*
	* Cab e connec or 1: Subconn MC L8F			
	* Cab e connec or 2: Subconn MC L6M			
	* Leng h: 1m			

Page 1 of 2

Pos.	Description	Qty.	Unit Price	Price
5 .	[S2C-300-SC-R] S2C R Modem/USBL/LBL Serv ce Cab e (1.5m; rs232) cab e for conf gura on from PC and f rmware upgrades * da a n erface: rs232 * modem end: MC L8F * user end: DB9; 4mm power p ugs	1.0	300.00 € -15 00% rese er d scount	300.00 € *255 00 €*
6 .	[S2C-930-03] Moun ng Frame for S2C Modem and Ba ery Pack	1.0	2,300.00 € -15 00% rese er d scount	2,300.00 € *1 955 00 €*
7 .	[S2C-799-02] Transpor case * Hard case for ranspor	1.0	600.00 € -15 00% rese er d scount	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 €

- Sa es subjec o our Genera Terms and Cond ons. The curren GT&C can be down oaded from h ps://evo og cs.de/documen s/GTC/GTC.pdf
- De very: ASAP
- Transpor : TBD
- A bank fees are respons b y of he cus omer

Page 2 of 2

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

Kiste
1/2

Packliste

Oceanga e Inc., ▮▮▮▮▮▮

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
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2022-04571 - P2276

📍 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 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 *Warentarifnummer 85235190 ECCN EAR99*	1,0 Stück	1,0 Stück
2	[S2C-310-25-S8F-E] S2C Kabel (Subconn MCIL8F, Ethernet RJ45 + Power, 25m) *Warentarifnummer 85444290 ECCN NLR*	1,0 Stück	1,0 Stück
3	[S2C-970-180-110-L200-01F8] USBL Halterung *Warentarifnummer 90159000 ECCN EAR99*	1,0 Stück	1,0 Stück
4	[S2C-930-01] Screw Fastened Delrin Clamps for S2C Modem (one pair) *Warentarifnummer 90159000 ECCN EAR99*	1,0 Stück	1,0 Stück

Seite 1 von 2
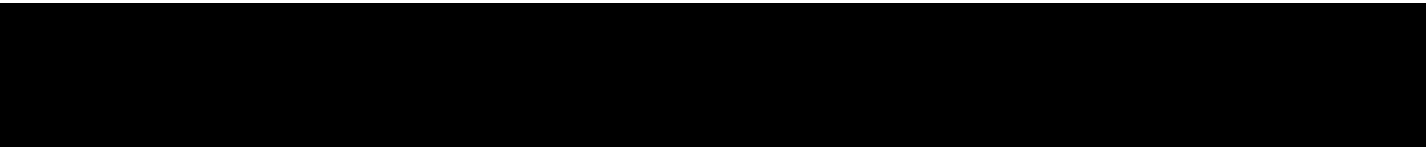
Versandt von:

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

Kiste 2/2

Packliste

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

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 *Warentarifnummer 39269097 ECCN EAR99*	1,0 Stück	1,0 Stück
2	[S2C-612-01-E-x] S2C R Hydroakustisches Modem mit USBL 7/17D Delrin (eth ;ahrs) *SN: 0717D/20#190/23* *Warentarifnummer 85176990*	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;) *SN: 0717D/20#191/23* *Warentarifnummer 85176990*	1,0 Stück	1,0 Stück

Seite 2 von 2

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

**Kiste
1/1**

Packliste

Oceanga e Inc., ██████████

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
☎ +██████████
✉ ██████████

2023-04694

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

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

Seite 1 von 1

Versandt von:

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

Kiste

1/1

Packliste

A. arvey Log s cs, ████████

📍 60 Wa er S .

S . John's NL A1C 1A3

Kanada

Empfänger:

A. arvey Log s cs, ████████

📍 60 Wa er S .

S . John's NL A1C 1A3

Kanada

📞 + ████████

✉ ████████

2023-04694

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 *Warentarifnummer 39269097 ECCN EAR99*	1,0 Stück	1,0 Stück
2	[S2C-512-04-F8Ti.R-WP5] S2C R Hydroakustisches Modem 7/17D Titanium (rs232 ;s8mti ;wake ;p5) *SN: 0717D/20#239/23* *Warentarifnummer 85176990*	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) *SN: 7S7PLI#234*	1,0 Stück	1,0 Stück
4	[S2C-402-01] Ladegerät für integrierte/externe Akku 24V Li-Ion *Warentarifnummer 85044055 ECCN EAR99*	1,0 Stück	1,0 Stück
5	[S2C-310-01-S8F-S6M] S2C Kabel (Subconn MCIL8F, Subconn MCIL6M, 1m) *Warentarifnummer 85444290 ECCN EAR99*	1,0 Stück	1,0 Stück
6	[S2C-300-SC-R] S2C R Modem/USBL/LBL Service Cable (1.5m; rs232) *Warentarifnummer 85444290 ECCN EAR99*	1,0 Stück	1,0 Stück
7	[S2C-930-03] Mounting Frame for S2C Modem and Battery Pack *Warentarifnummer 90159000*	1,0 Stück	1,0 Stück

Oceangate

Seite 1 von 1

SUBSEA 20/20, Inc.

Technology for Advanced Underwater Exploration

PURCHASE ORDER

2503 4th Avenue North

Seattle, WA 98109

Phone ▓▓▓▓▓▓▓

DATE:	December 20, 2022
PURCHASE ORDER	P2276
End User	▓▓▓▓▓▓▓
SHIP VIA	DHL: 968424391
TERM	PAID AT SHIPPING
NEED BY DATE:	ASAP

Order Remit To:
EvoLogics GmbH
Ackerstrasse 76
13355 Berlin
Germany

▓▓▓▓▓▓▓

Ship To:
OceanGate, Inc.
1205 Craftsman Way Ste 112
Everett, WA 98201

Attention: ▓▓▓▓▓▓▓
tel: ▓▓▓▓▓▓▓
email: ▓▓▓▓▓▓▓

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:

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SUBSEA 20/20, Inc.

Technology for Advanced Underwater Exploration

PURCHASE ORDER

2503 4th Avenue North

Seattle, WA 98109

Phone ▮▮▮▮▮▮▮▮▮▮

DATE:	January 11, 2023
PURCHASE ORDER	P2276v2
End User	▮▮▮▮▮▮▮▮▮
SHIP VIA	DHL: 968424391
TERM	PAID AT SHIPPING
NEED BY DATE:	ASAP

Order Remit To:
EvoLogics GmbH
Ackerstrasse 76
13355 Berlin
Germany

Tel ▮▮▮▮▮▮▮▮▮▮▮

Ship To:
OceanGate, Inc.
Attention: ▮▮▮▮▮▮▮▮
1205 Craftsman Way Ste 112
Everett, WA 98201

tel: ▮▮▮▮▮▮▮▮▮
email: ▮▮▮▮▮▮▮▮▮▮▮▮

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:

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▮▮▮▮▮▮▮▮
▮▮▮▮▮▮▮▮▮

SUBSEA 20/20, Inc.
Technology for Advanced Underwater Exploration

PURCHASE ORDER

2503 4th Avenue North
Seattle, WA 98109
Phone ████████

DATE: March 15, 2023
PURCHASE ORDER P2314
End User ████████
SHIP VIA TBD
TERM PAID AT SHIPPING
NEED BY DATE: ASAP

Order Remit To:	Ship To:
EvoLogics GmbH	OceanGate, Inc.
Ackerstrasse 76	Attention: ████████
13355 Berlin	1205 Craftsman Way Ste 112
Germany	Everett, WA 98201
Tel. ████████	tel: ████████
	email: ████████

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:
████████
████████
████████

EvoLogics GmbH
Ackerstr. 76
13355 Berlin, Germany

EvoLogics SiNAPS software: version 2.x

User Guide

Document version 1.0.B

February 2021

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EvoLogics GmbH, Ackerstrasse 76, 13355 Berlin, Germany

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Contents

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.

5

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.

6

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.

7

2.1.2 EvoLogics LBL Positioning system

A typical EvoLogics SiNAPS (S2C intelligent Navigation and Positioning Software) LBL (Long Baseline) positioning system is pictured in Fig. 2.

Figure 2: EvoLogics SiNAPS LBL positioning system

The system operates as follows:

- An LBL positioning system uses an array of seabed-mounted transponders that form the baseline of the system: positions of these baseline nodes are known (after calibration), so they are used as reference points for determining target positions. **Baseline transponders** reply to acoustic interrogation signals from a mobile target-mounted transponder with their own acoustic pulses, allowing the **Mobile transponder** on the target to calculate its position by measuring the distance between itself and each transponder of the baseline array.

  Baseline transponders are either mounted in seabed stands or equipped with acoustic release mechanisms and flotation collars for recovery to the surface. They are deployed around the work site and carefully calibrated prior to LBL system operation.

- **Mobile transponders** are mounted on positioning targets, for example, on autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs) etc., and use acoustic signals to determine distances to baseline nodes.

- A **GNSS 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 GNSS receiver provides the baseline nodes' positions in real-world coordinates.

8

- 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.

9

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

10

Evo Logics®

EvoLogics GmbH
Ackerstr. 76
13355 Berlin
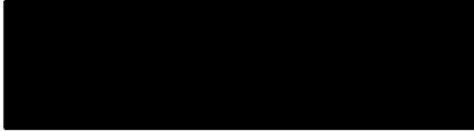
S2C Reference Manual

Edition **Standard**

Firmware Version 2.0

Document version 2.0.B.1

March 2020

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

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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 RECVSRV 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

CG 010   Confidential   OGTSB000897.0004
FOIA CONFIDENTIAL TREATMENT   Evo Logics Equipment Documents   35 of 57
REQUESTED BY OCEANGATE, INC.   OG_USCG_002463

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.

7

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EvoLogics

Underwater Acoustic Positioning System

User Guide

Document version 2.0.B

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CG 010

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Evo Logics Equipment Documents

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41 of 57

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Contents

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.

5

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Evo Logics Equipment Documents

OGTSB000898.0006
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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.

6

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.
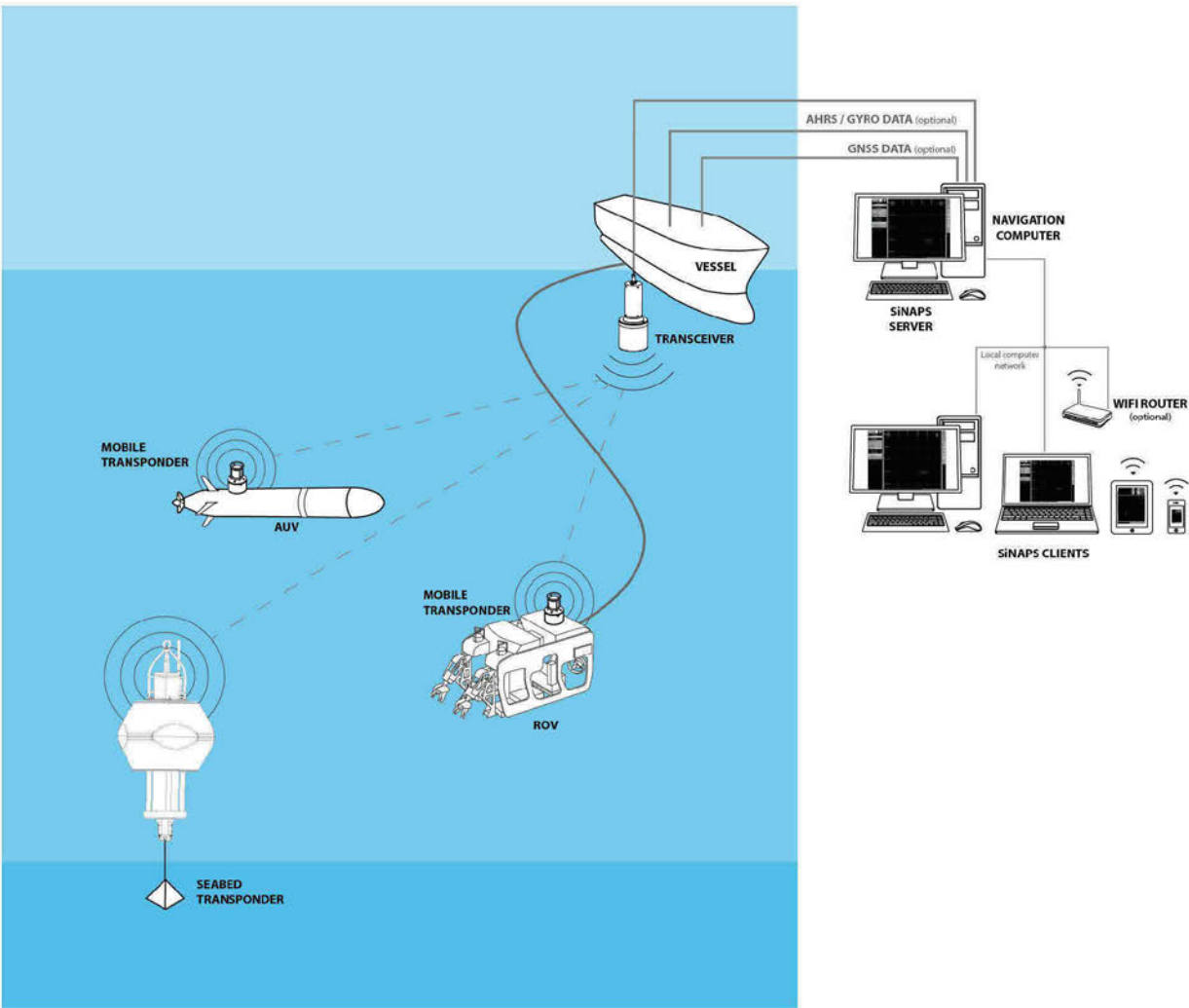

Figure 1: EvoLogics SiNAPS USBL positioning system

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.

7

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.
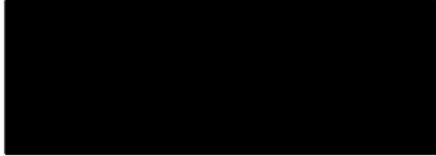
- Optional third-party external instruments (an **AHRS sensor** and/or a **Gyrocompass** and/or a **GNSS receiver**) provide information about the vessel's orientation and real-world coordinates.

- 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.

8

2.1.2 EvoLogics LBL Positioning system

A typical EvoLogics SiNAPS (S2C intelligent Navigation and Positioning Software) LBL (Long Baseline) positioning system is pictured in Fig. 2.

Figure 2: EvoLogics SiNAPS LBL positioning system

The system operates as follows:

- An LBL positioning system uses an array of seabed-mounted transponders that form the baseline of the system: positions of these baseline nodes are known (after calibration), so they are used as reference points for determining target positions. **Baseline transponders** reply to acoustic interrogation signals from a target-mounted transceiver with their own acoustic pulses, allowing the **Mobile transponder** on the target to calculate its position by measuring the distance between itself and each transponder of the baseline array.

  Baseline transponders are either mounted in seabed stands or equipped with acoustic release mechanisms and flotation collars for recovery to the surface. They are deployed around the work site and carefully calibrated prior to LBL system operation.

- **Mobile transponders** are mounted on positioning targets, for example, on autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs) etc., and use acoustic signals to determine distances to baseline nodes.

9

- 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.

10

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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

2

OGTSB000900.0002
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CG 010

Confidential
Evo Logics Equipment Documents

OGTSB000900.0003
53 of 57

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Revision History

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

Contents

CG 010
Confidential
Evo Logics Equipment Documents
OGTSB000900.0005
55 of 57
OG_USCG_002762

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)
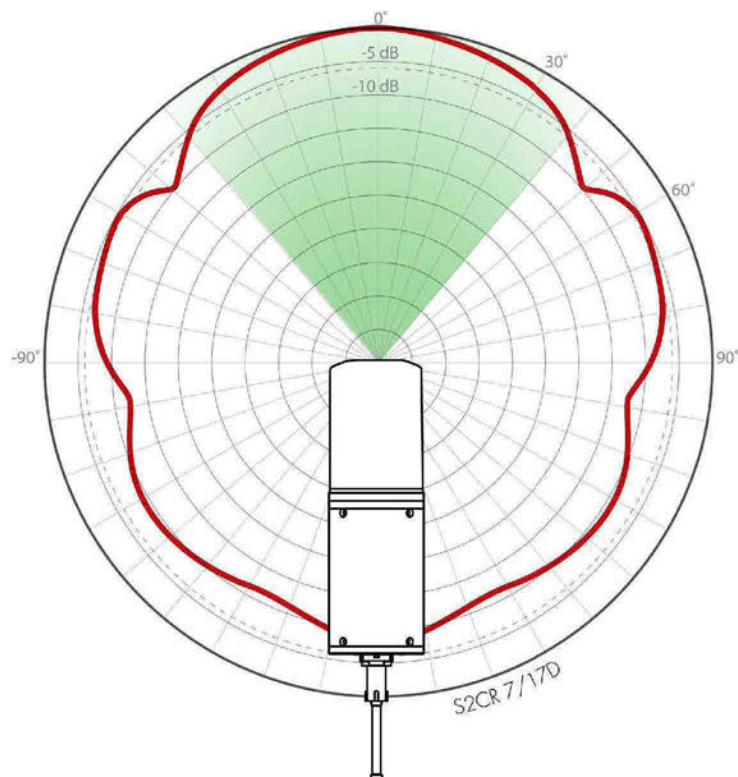
Figure 1: Transducer directivity pattern

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[1]Power 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.

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

5