DRAFT Memorandum

To: Thunder Bay National Marine Sanctuary

From: Brent Johnston

Date: May 9, 2019

Subject:Installation and integration of Kongsberg EM2040C Multibeam Echosounder on NOAA vessel R/V Storm

An installation and integration of a Kongsberg EM2040C Multibeam Echo Sounder (2040C) was requested by the NOAA Thunder Bay National Marine Sanctuary (TBNMS) of Brent Johnston for the purposes of hydrographic survey and backscatter data collection on the R/V Storm (refer to Figure 1). The Storm is maintained and operated by Great Lakes Environmental Research Laboratory (GLERL) out of Muskegon, Michigan. R/V Storm is 50 foot, aluminum survey platform. Installation was commenced near the TBNMS facilities on May 03, 2019 in Alpena, Michigan. A moonpool and mount for the 2040C had been previously installed and were found to be in good working order. The moonpool on the R/V Storm is below decks forward on the port side, directly below an aluminum hatch in the floor of the wheelhouse. An Applanix POS/MV 320 V4 navigation system was already installed as well with the IMU mounted conveniently below decks very near the multibeam moonpool.



Figure 1 R/V Storm

It was determined on May 03 that a computer suitable to run Kongsberg Seafloor Information System (SIS) had not been provided with the EM2040C transducer and topside. Attempts were made to utilize existing computers that TBNMS had on hand but none were found that were suitable and on May 04 the

decision was made to procure a suitable new computer. The computer was delivered on May 05 and installation was performed and the system was tested and found to be complete. The vessel and crew departed Alpena, Michigan the afternoon of May 05 for transit to the project site in Rogers City Michigan. During the transit the multibeam system was configured and tested and found to be in good working order. Kongsberg includes a Built In Self Test (BIST) in SIS that tests communications and system hardware after installation was complete the BIST was performed and all tests were passed successfully. Results from the BIST are presented below in Figure 2.

	ameters					_	
						Installatio	n param
	EL	or Setup	System Pa	arameters [BIST System Report		
Clear all Run	all BISTs						
PU BIST Setup	,						
		0 =	CPU Test	:	11 = RX-CPU link		
		2 =	CBMF Te	st	7 = RX Channels		
		3 =	Sonar He	ad RX test	8 = TX channels via RX		
		4 =	Sonar He	ad TX test	9 = RX Noise Level		
		5 =	CBMF-C	PU link	10 = RX Noise Spectrum		
		6 =	RX-CBM	F link	15 = Software Date/Version		
Save BIST	Time	Ser. No.	BIST	Result	Description		<u> </u>
					To be implemented		
2019.05.08	20:36:25.543	10055	15	ОК	PU - serial 10055: - CPU: 2.7.0 190319 - DDS: 4.60 140106 - DSV: 3.1.8 141125 - VxWorks 6.9 SMP Build 1.09.01 Jun 29 2018 11:18:01 - CBMF: 1.08 17.09.8		
					Sonar Head - serial 1154 - TX: 1.01 Oct 22 2018 - RX: 1.00 Sep 28 2012		

Figure 2 Kongsberg SIS BIST results, green indicates a positive test result.

Offsets from a June 2018 dockside offset survey (refer to Table 1 below) were confirmed via tape measure and found to be sufficient.

	Alongship (Fwd +)	Acrossship (Stbd +)	Vertical (Down +)
EM2040C Transducer	1.005	-0.873	1.815

Table 1 Horizontal EM2040C Transducer Offsets units in meters

On May 06, a shallow depth (approximately 25 meters) multibeam calibration or "patch" test was performed on a target of opportunity and processed (refer to Figure 3 below). Derived angular offset values were found to be similar to previous values (refer to Table 2 below).

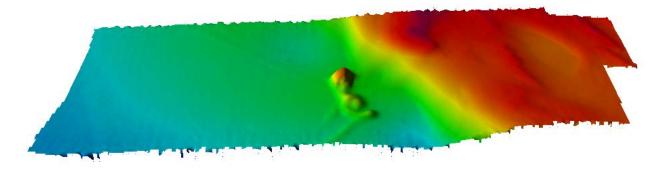


Figure 3 Processed Patch Test Results Surface

	Latency (Sec)	Pitch (Bow Up +)	Roll (Port up +)	Yaw (CW +)
EM2040C	0.0	2.8	2.35	-4.9
Transducer				

 Table 2 Angular EM2040C Transducer Offsets Units in degrees

A follow up field effort is scheduled for July 2019 at that time interface cabling will be tidied and labelled and any further optimization of the system will be performed should it prove necessary.

Utilizing three days of project data collection as a reference, the system was found to be reliable and self-consistent. One item of note, a four-port network card was added to the SIS collection computer to facilitate a second network connection. The second network connection allows for data transfer, SIS integration with Hypack and Synergy (software that allows a single mouse and keyboard to control both the Hypack and SIS computers). Twice this second network card failed to initialize when the computer was started. The workaround for this issue was to shut down the computer, remove, then reseat the network card in the computer and restart the computer. The network card was procured from the vessel spare computer parts, as it was convenient. In the future a different network card could be installed should the issue become problematic.

A deeper water patch test was not necessary to achieve satisfactory angular offset values and project multibeam data acquisition time was deemed more valuable, further refinement of patch values might be achieved with a patch test conducted on a good target in 40-70 meters water depth.

Current vessel horizontal offsets have generally sufficient for survey data collection. However, vessel data quality would likely be further improved if a total station or tape measure and level survey could be performed with survey equipment installed while the vessel was stored on land.

Currently the surface sound speed sensor for the Storm is deployed off a pole mounted to the starboard side of the vessel. Ideally this sensor would be mounted directly adjacent to the multibeam transducer on the underside of the ship's hull on a retractable mount. This would more precisely reflect sound speed at the sonar transducer and would also negate the need to always dock the vessel on the port side when the system is deployed.

Two items that are not necessary for quality data collection but would make it more acquisition more convenient and safer are an additional monitor for the Hypack station that has comparable specification to the vessel helm monitor. This would allow the sonar operator to see what is being displayed on the vessel helm display without having to leave their station. The other is a three to five port USB 3.0 hub for the Hypack station so that the Hypack license key and portable hard drives for data transfer can be conveniently plugged in on the desktop rather than on the top face of the Hypack computer where they are exposed to damage at an inconvenient knee level. Should TBNMS desire to add either of these, they could both be installed during the scheduled July 2019 field effort.

At the request of the NOAA data collection crew, offsets and adjustments, to the extent possible, were applied in the Caris vessel file rather than in Kongsberg SIS or the Applanix POS/MV firmware so that adjustments could be made in the future should they prove necessary. Screen captures of software and firmware settings for the Applanix POS/MV, Kongsberg SIS and Hypack are presented below.

X (deg)	e w.r.t. Ref. Frame	
	0.000	
V (dea)	0.000	
Y (deg)	0.000	
Z (deg)	0.000	
Ref. to Ves	ssel Lever Arm	
X (m)	0.000	
Y (m)	0.000	
Z (m)	0.000	
Ref. to Cer	ntre of Rotation Lever Arm	
X (m)	0.000	
Y (m)	0.000	
Z (m)	0.000	
	Apply View	I
	Ref. to Ves X (m) Y (m) Z (m) Ref. to Cen X (m) Y (m) Z (m)	Ref. to Vessel Lever Arm X (m) 0.000 Y (m) 0.000 Z (m) 0.000 Ref. to Centre of Rotation Lever Arm X (m) 0.000 Y (m) 0.000 Z (m) 0.000 Y (m) 0.000 Y (m) 0.000 Y (m) 0.000 Z (m) 0.000

Figure 4 POS/MV Lever arms and mounting angles

Lever Arms &	ዩ Mounting Angles			×
Lever Arn	ns & Mounting Angles	Sensor Mount	ng Tags, Multipath & AutoStart	
Ref. to	Aux. 1 GPS Lever Arm	Ref. to Aux	. 2 GPS Lever Arm	
X (m)	0.000	X (m)	0.000	
Y (m)	0.000	Y (m)	0.000	
Z (m)	0.000	Z (m)	0.000	
Ref. to	Sensor 1 Lever Arm	Sensor 1 F	rame w.r.t. Ref. Frame	
X (m)	1.005	X (deg)	0.000	
Y (m)	-0.873	Y (deg)	0.000	
Z (m)	1.815	Z (deg)	0.000	
Ref. to	Sensor 2 Lever Arm	Sensor 2 F	rame w.r.t. Ref. Frame	
X (m)	0.000	X (deg)	0.000	
Y (m)	0.000	Y (deg)	0.000	
Z (m)	0.000	Z (deg)	0.000	
-		Close	Apply View View ters go to Standby Mode !	

Figure 5 POS/MV Senor mounting

Input/Output Ports Set-up COM1 COM2 COM3		×
Baud Rate 9600 -	Parity Data Bits Stop Bits Flow Control	
Output Select	NMEA Output SINGST ↓ SINGGA 1 Hz SINHDT ↓ SINZDA Talker ID SINZTA IN	
Input Select Base 1 GPS	Base GPS Input Input Type RTCM 1 or 9 ▼ Line	
	Close	

Figure 6 POS/MV Input Com1 RTCM 1 or 9 (DGPS Corrections) from the Trimble AG132 DGPS

Input/Output Ports Set-up COM1 COM2 COM3 COM4	COM5		×
Baud Rate 4800 💌	Parity ⓒ None ⓒ Even ⓒ Odd	Data Bits Stop Bits O 7 Bits Image: C 1 Bits Image: C 8 Bits O 2 Bits	t None C Hardware
NMEA S S S S S S S S S	GPGST A Upd GPGGA 1 GPHDT GPZDA Talk GPVTG Talk	Hz Pitch Posi © Bow Up Heave Position	ve Sense D C Starboard Up itive Sense p C Stern Up sitive Sense Up C Heave Down
Input Select			
		Close	Apply

Figure 7 POS/MV Output Com2, GPGST, GPGGA, GPHDT, GPZDA, and GPVTG for output to Klein 3000 position and timing

Input/Output Ports Set-up COM1 COM2 COM3	COM4 COM5					×
Baud Rate	·······	Parity ⓒ None ◯ Even ◯ Odd	Data Bits C 7 Bits C 8 Bits	Stop Bits • 1 Bit • 2 Bits	Flow Control © None © Hardware © XON/XOFF	
Output Select	NMEA Output			Pitch Positive Bow Up Heave Positive	C Starboard Up Sense C Stern Up	
Input Select						
				Close	Apply	

Figure 8 POS/MV Output Com4 GPGGA, GPHDT, GPZDA, and GPGGK for output to the Kongsberg EM2040C TPU for position, heading and timing

Input/Output Ports Set-up		×
СОМ1 СОМ2 СОМ3 С	COM4 COM5	
Baud Rate 115200 💌	© None C Even	Data Bits Stop Bits Flow Control C 7 Bits I Bit None I Bits 2 Bits Hardware XON/XOFF
Output Select	Binary Output Update Rate 100 Hz ▼ Frame © Sensor © Sensor C Sensor SIMRAD 3000 (Tate-Bryant)	Disk Desitive Course
Input Select		
None		
		Close

Figure 9 POS/MV Output Com5, SIMRAD 3000 is output for Sensor1 motion into Kongsberg SIS

Ethernet Realtime Output Control	×
Output Group Select Output A Navigation Solution	
 9 GAMS Solution 10 General Status and Fault Detectior 11 Secondary GPS Data 12 Auxiliary 1 GPS Data 13 Auxiliary 2 GPS Data 14 Calibrated installation parameters 16 Time-tagged Gimbal data 	
POSPac Deselect All C	Ok Close Apply

Figure 10 POS/MV Ethernet realtime output Group 103 is checked to supply Attitude/Velocity to Kongsberg SIS

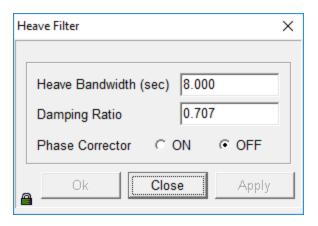


Figure 11 Applanix POS/MV Heave Filter settings

Installation and Test OK CANCEL PU Communication Setup Sensor Setup Input Setup Output Setup Conc. settings Port. COM1	Installation and Test OK CANCEL PU Communication Setup Sensor Setup Input Setup Output Setup Output Setup Clock Setup Port settings Port.		5				-		\times
OK CANCEL PU Communication Setup Sensor Setup Input Setup Output Setup Clock Setup Port: Port: COM1 Com. settings Input Formats	OK CANCEL PU Communication Setup Sensor Setup System Parameters Input Setup Output Setup Clock Setup Port settings Port: COM1 Com. settings Input Formats Baud rate 19200 Input Formats Com. settings Position Attitude DBS Depth Oktober GGA Clock DPT Depth Positise 1 Positise SKR82 Heading ROV. depth Parity: NONE MK39 Mod2 Attitude, no heave Height, special purpose only	Installation and Test					Installatio	n parame	ters 🔻
Data bits Image: Attrude Image: Attrude Image: Attrude Data bits Image: Attrude Image: Attrude Image: Attrude Stop bits: Image: Attrude Image: Attrude Image: Attrude Stop bits: Image: Attrude Image: Attrude Image: Attrude Parity: NONE Image: Attrude Image: Attrude NONE Image: Attrude Image: Attrude Image: Attrude MK39 Mod2 Attrude Image: Attrude		OK CANCEL PU Communication Set Input Setup Output S Portse Port Cor Bar Da Stc Partse	Setup Clock Setup ettings COM1	Position Formats Position F GGGK C GGA C GGA_RTK	Attitude 7 ZDA Clock 7 HDT Heading 5KR82 Heading	DPT Depth EA500 Depth ROV. depth		n parame	

Figure 12 Kongsberg SIS COM1 Input of position GGK and time ZDA and heading HDT from the POS/MV $\,$

stallation parameters					
allation and Test OK CANCEL Communication Setup Sensor Setup	Parameters BIST Sy	stem Report			
nput Setup Output Setup Clock Setup					
Port settings					
Port: COM2					
Com. settings	Input Formats				
Baud rate: 115200	Position	∀ Attitude	DBS Depth		
Data bits 8 💌	C GGK		DPT Depth EA500 Depth		
Stop bits: 1	C GGA	SKR82 Heading	ROV. depth		
Parity: NONE 👻	C GGA_RTK	MK39 Mod2 Attitude, no heave	F Height, special purpose only	/	
Interface: RS232 💌					
	<u> </u>				
CANCEL nmunication Setup Sensor Setup System Parameters BIST System Report Setup Output Setup Clock Setup Port settings Port: COM2 Com. settings Baud rate: 115200 × Data bits Position Stop bits: 1 × Parity: NONE × Parity: NONE ×					

Figure 13 Kongsberg SIS COM2 Input of Attitude from the POS/MV

	ettings				
B D S P	n. settings	Position Position GGK GGA GGA_RTK GGA_RTK SIMRAD90	Attitude ZDA Clock HDT Heading SKR82 Heading MK39 Mod2 Attitude, no heave Attitude/Velocity	DBS Depth DPT Depth EA500 Depth ROV. depth ROV. depth Height, special purpose only	
ſ	ernet Interface Settings DP Port settings UDP5: 5602 USE Ethernet UDP6: 3000 Use Ethernet				

Figure 14 Kongsberg SIS UDP5 Input of Attitude/Velocity from the POS/MV

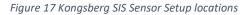
		Installation pa	rameters 🔻
allation and Test CANCEL Communication Setup Sensor Setup S	ystem Parameters BIST System Report		
nput Setup Output Setup Clock Setup			
	Clock Source: External ZDA Clock Offset (sec.): 0 1PPS Clock Synch. Falling Edge		

Figure 15 Kongsberg SIS clock setup synchronizing to the POS/MV

tallation parameters ation and Test 	rs BIST System Report	Installation para
Positioning System Settings Positioning System Ports: COM1 Time to use C Datagram C System I Enable position motion correction Position delay (sec.): Daturm: Uog all heights Enable Pos. qual. indicators for height acceptance	Attitude Sensor Settings Attitude Sensor Ports: COM2 Roll reference plane C Horizontal (DMS) C Rotation (POSMV/MRU) Attitude Delay (msec.):	Active Sensors Position: COM1 Y Attitude: COM2 Y Heading: COM2 Y Velocity: UDP5 Y

Figure 16 Kongsberg SIS sensor setup

					-		\times
					Installation	n param	eters 🔻
	tup System Parameters BIST Syst	em Report					1
ettings Locations Angular Offset	ROV. Specific						
	Location offset (m)						
				Downward (Z)			
	Pos, COM1:	0.00	0.00	0.00			
	Pos, COM3:	0.00	0.00	0.00			
	Pos, COM4/UDP2:	0.00	0.00	0.00			
	Sonar head 1:	0.00	0.00	0.00			
	Sonar head 2:	0.00	0.00	0.00			
	Attitude 1, COM2/UDP5:		0.00	0.00			
	Attitude 2, COM3/UDP6:	10.00	0.00	0.00			
	Waterline:			-0.98			
	Depth Sensor:	0.00	0.00	0.00			



Installation parameters						-		×
						Installatio	on param	eters 🔻
Installation and Test OK CANCEL PU Communication Setup Sensor Setup	System Parameters BIST System	n Report						
Settings Locations Angular Offsets F								
	Offset angles (deg.)				-1			
		Roll	Pitch	Heading				
		0.00	0.00	0.00				
		0.00	0.00	0.00				
	Attitude 1, COM2/UDP5:	,	0.00	0.00				
	Attitude 2, COM3/UDP6:	0.00	0.00	0.00				
	Stand-alone Heading:			0.00				

Figure 18 Kongsberg SIS Sensor Setup angular offsets

llation and Test		Installation pa
K CANCEL		
	level a second	
Communication Setup Sensor Setup System Para	imeters BIST System Report	
put Setup Output Setup Clock Setup		
······································		
	Datagram subscription	
UDP Host Port: SIS Logging	✓ Depth	Sound Speed Profile
Port addr.: 16101	Raw range and beam angle	Runtime Parameters
Totol	₩ Seabed Image	✓ Installation Parameters
Enable PU logging to disk	Central Beams	BIST Reply
Enable to logging to disk	✓ Position	₩ Status parameters
	I✓ Attitude	PU Broadcast
✓ Log watercolumn to separate file	✓ Heading	Detection quality
	I✓ Height	🔽 Internal, Scope Data
	V Clock	
✓ PU broadcast enable (on port 1999)	☑ Single beam echosounder depth	

Figure 19 Kongsberg SIS local output for .ALL logging

stallation parameters		- 0
llation and Test		Installation param
K CANCEL		
Communication Setup Sensor Setup System Para	and a loss loss and loss	
Communication Setup Sensor Setup System Para	imeters BIST System Report	
nput Setup Output Setup Clock Setup		
	CDatagram subscription	
UDP Host Port: User Defined 💌	₩ Depth	Sound Speed Profile
Port addr.: 16103	Raw range and beam angle	Runtime Parameters
10105	🔽 Seabed Image	✓ Installation Parameters
Enable PU logging to disk	🔽 Central Beams	₩ BIST Reply
	Position	✓ Status parameters
	✓ Attitude	🗖 PU Broadcast
✓ Log watercolumn to separate file	✓ Heading	Detection quality
	₩ Height	🔽 Internal, Scope Data
	Clock	
🔽 PU broadcast enable (on port 1999)	Single beam echosounder depth	
	1	

Figure 20 Kongsberg SIS output for swath display in Hypack

Illation and Test		Installation pa
K CANCEL		
Communication Setup Sensor Setup System Para	meters BIST System Report	
nput Setup Output Setup Clock Setup		
	Datagram subscription	
UDP Host Port: Watercolumn	☐ Depth	Sound Speed Profile
Port addr.: 0	Raw range and beam angle	Runtime Parameters
	F Seabed Image	M Installation Parameters
Enable PU logging to disk	🔽 Central Beams	BIST Reply
	V Position	Status parameters
	₩ Attitude	PU Broadcast
🔽 Log watercolumn to separate file	F Heading	Detection quality
	✓ Height	🔽 Internal, Scope Data
	Clock	
🔽 PU broadcast enable (on port 1999)	Single beam echosounder depth	
	1	

Figure 21 Kongsberg SIS output for local watercolumn logging

Position delay (sec.): 0.00 Forward (X) Starboard (Y) Downward (Z) Add Location offset (m)
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Figure 22 Kongsberg SIS External Sensors for input of transducer sound velocity probe

🐹 Data Distri	ibution						_		×	
	Data Distribution - MDM 400									
Source Port	Source File	Packets	Destination : Port	Destination : Port	Destination : Port	Destination : Port	Destination File			
16103		-1	192.168.10.11:1620*	192.168.10.11:16200						
0		-1								
0		-1								
0		-1								
0		-1								
0		-1								
0		-1								
0		-1								
0		-1								
0		-1								
c									> .	

Figure 23 Kongsberg SIS data distribution for output of sonar data to Hypack

HYPACK Combined Hardware		_	×
File Options Help			
	System HYSWEEP Survey Indude Installed on Towfish Sidescan Devices on Towfish Sidescan Survey Indude Installed on Towfish Sidescan Survey Indude Installed on Towfish Synchronize Computer Clock Select Device to Synchronize Clock Applanix POS M/V Network]	

Figure 24 Hypack Hardware Configuration

HYPACK Combined Hardware						_	×
File Options Help							
🖃 🦕 Hardware	Survey Devices S	Survey Connect Offs	ets				
Applanix POS M/V Network	Available	All Devices	~		Installed		
HYSWEEP Survey	Version 3D LR Indicator	Version or 16.1.2.	0 ^ 0	Add>	Applanix POS M/V Network HYPACK Generic Start/Stop		
Kongsberg Simrad EM2040	ADCP Driver AIS Interface	17.2.5. 14.0.2.	-	< Remove			
	AIS Tide Receiv Allied Signal LA		3				
		ystems S 14.0.1. 14.0.0.	2	Nav. Stations			
	View O DLL Name	Description			Name Applanix POS M/V Network		
	Re	escan Driver List		Driver	C:\HYPACK 2018\devices\p		
	Functions			Options			
	 ✓ Record raw message ✓ Position ✓ Heading ✓ Speed ✓ Tide ✓ Heave ✓ Record device specific messages 		Record raw data				

Figure 25 Hypack Applanix POS/MV driver configuration

HYPACK Combined Hardware		– 🗆 X
File Options Help		
🖃 🚰 Hardware	Survey Devices Survey Connect Offsets	
Boat Applanix POS M/V Network HYPACK Generic Start/Stop Driver HYSWEEP Survey	Enabled Imit Update Rate msec	
Applanix POS/MV Network	Device Connection	
Kongsberg Simrad EM2040	Network (0.0.0:5602,udp)	
	Recording Rate Device Interrogation O Endult Recording Rate Sec O Limit Recording Rate Sec O Do Not Record Device Initialization Script Comport Test Network Test Test Device Test Device	

Figure 26 Hypack Applanix POS/MV connection pararmeters

📨 HYPACK Combined Hardware		- 0	×
File Options Help			
🖃 🦕 Hardware	Survey Devices Survey Connect Offsets		
🖻 📥 Boat			
Applanix POS M/V Network	Applanix POS M/V Network	~	
HYSWEEP Survey	Position	Rotation	1
Applanix POS/MV Network	Enter Device Offset From Boat Reference Point (Center of Mass).	Enter Device Rotation from Forward (Yaw) and Vertical (Roll and Pitch)	
	The Vertical Offset is Positive Downward and Measured From Waterline.	Yaw rotation follows azimuth (dockwise rotation is positive). Bow up is positive pitch, port side up is positive roll.	
	Starboard 0.000 Forward 0.000 Vertical 0.000	Yaw 0.00 Pitch 0.00 Roll 0.00	
	Device Latency]
	Enter the Latency Time (Positive) in Seconds	0.000	
		Multiple Transducers	

Figure 27 Hypack Applanix POS/MV offsets

HYPACK Combined Hardware			_	×
File Options Help				
🖃 🦕 Hardware	Manufacturer / Model Connect Offsets			
Hardware Boat Applanix POS M/V Network HYPACK Generic Start/Stop Driver HYSWEEP Survey Applanix POS/MV Network Kongsberg Simrad EM2040	Manufacturer / Model Ins Association (LIS-5500 Analog Sidescan Applanix POS/MV Network Applanix POS/MV Serial Atas Bomasweep Atas Fansweep (Serial) Atas Fansweep (Serial) Atas Hydrosweep DS Atas Hydrosweep MD/30 Atas Hydrosweep MD/20 Benthos 162X Benthos 162X Benthos C3D BlueView 5000 BlueView MM2250/MB1350 Setup	astalled Applanix POS/MV Network Congsberg Simrad EM2040 ame Applanix POS/MV Network		

Figure 28 Hysweep Applanix POS/MV driver configuration

File Options Help Image: Second S
Boat Applanix POS M/V Network Applanix POS M/V Network Applanix POS M/V Network Applanix POS/MV Network Applanix POS/
Applanix POS M/V Network HYSWEEP Survey Applanix POS/MV Network Metwork Connection Port Internet Address Comport Test

Figure 29 Hysweep Applanix POS/MV connection parameters

File Options Help	
Applanix POS M/V Network	
MRU Offsets	
HYSWEEP Survey Applanix POS/MV Network Gr Mass). Position Enter Device Offset From Boat Reference Point (Center of Mass). The Vertical Offset is Positive Downward and Measured From Waterline. Rotation Enter Device Rotation from Forward (Yaw) and Vertical (Roll and Pitch) Yaw rotation follows azimuth (dockwise rotation is positive). Bow up is positive pitch, port side up is positive roll.	
Starboard 0.000 Yaw 0.00 Forward 0.000 Pitch 0.00 Vertical 0.000 Roll 0.00	
Enter the Latency Time (Positive) in Seconds 0.000 Multiple Transducers	

Figure 30 Hysweep Applanix POS/MV offsets

HYPACK Combined Hardware	>	×
File Options Help		
🖃 🦕 Hardware	Manufacturer / Model Connect Offsets	
	Manufacturer / Model Installed Analog Sidescan Applanix POS/MV Network Applanix POS/MV Network Add> Applanix POS/MV Network Add> Atlas Fansweep Atlas Fansweep (Serial) Atlas Hydrosweep MD/30 Atlas Hydrosweep MD/50 Atlas Hydrosweep MD/50 Setup Benthos C3D Setup BlueView MB2250/MB1350 Setup Specific Sonar Identification Simrad EM2040	

Figure 31 Hysweep Kongsberg EM2040C driver configuration

Figure 32 Hysweep Kongsberg EM2040C connection parameters

HYPACK Combined Hardware		- 0	×
File Options Help			
🖃 🦕 Hardware	Manufacturer / Model Connect Offsets		
🖻 📥 Boat			
Applanix POS M/V Network	Sonar Head 1	~	
HYPACK Generic Start/Stop Driver	Position	Rotation	1
Applanix POS/MV Network	Enter Device Offset From Boat Reference Point (Center of Mass).	Enter Device Rotation from Forward (Yaw) and Vertical (Roll and Pitch)	
	The Vertical Offset is Positive Downward and Measured From Waterline.	Yaw rotation follows azimuth (clockwise rotation is positive). Bow up is positive pitch, port side up is positive roll.	
	Starboard-0.873Forward1.005Vertical0.000	Yaw 0.00 Pitch 0.00 Roll 0.00	
	Device Latency		
	Enter the Latency Time (Positive) in Seconds	0.000	
		Multiple Transducers	

Figure 33 Hysweep Kongsberg EM2040C offsets