

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

Horizontal and Vertical Control Report

Type of Survey Navigable Area

Project No. OPR-J317-KR-18

Registry Nos. H13170, H13171, H13172, H13173, H13174,
H13175, H13176, H13177, H13178, H13179

Vessels R/V Sea Scout and R/V C-Wolf

Contractor Oceaneering International, Inc.

LOCALITY

State Florida

General Locality Approaches to Tampa Bay, FL

2018

CHIEF OF PARTY
Scott Melancon

LIBRARY & ARCHIVES

DATE: _____

A. INTRODUCTION

The R/V *Sea Scout* and R/V *C-Wolf* are equipped with two Oceaneering® C-Nav® 3050 receivers. C-Nav® systems can deliver Precise Point Positioning (PPP) with worldwide accuracy of 5 cm horizontally and 15 cm vertically (at 1-sigma within adequate GNSS satellite visibility). C-Navigator and C-Monitor® software systems are used to control and monitor the C-Nav® 3050 receivers on the R/V *Sea Scout* and R/V *C-Wolf*, respectively. In general, data from the primary C-Nav® 3050 system is used for horizontal positioning as well as vertical positioning. Vertical positioning with the ellipsoid heights recorded by the C-Nav® system was applied during post-processing. The secondary system is used as a back-up and may be used in place of the primary if necessary. Refer to Appendix A for additional information regarding the C-Nav® systems.

Prior to use in field operations, each C-Nav® receiver undergoes internal testing to ensure the positional accuracy of the system around a known point. Refer to Appendix B for additional information. This information is also included in the Data Acquisition and Processing Report (DAPR) Appendices III – Positioning and Attitude Reports.

B. HORIZONTAL CONTROL

The horizontal datum for this project is the North American Datum of 1983 (NAD83) 2011 realization. Products are referenced to Universal Transverse Mercator (UTM) zone 17 N, meters. No horizontal control stations were established for this survey.

C. VERTICAL CONTROL

Multibeam echosounder survey data were acquired vertically referenced to the water line. Survey data were processed to the ellipsoid during post-processing using the ellipsoid height recorded by the C-Nav® 3050 GNSS unit. For use in the CARIS 10.4 processing software, the GNSS data were filtered using Generic Mapping Tools (GMT), converted to NAD83(2011) using VDATUM version 3.9 and duplicate positions removed. The final file of time, latitude, longitude and height was imported into the MBES processing software to replace existing navigation. An ellipsoid separation model provided by NOAA (Table 1) was then used to reduce multibeam bathymetric data to chart datum. The datum to which the soundings were reduced to for this survey is Mean Lower Low Water (MLLW).

Table 1. VDATUM Model

VDATUM Version	Geoid	Area	Area Version	Separation Uncertainty
3.6.1	2012	FLwest01_8301 and FLapalach01_8301	1	13.1 cm

D. APPROVAL SHEET

LETTER OF APPROVAL

HORIZONTAL AND VERTICAL CONTROL REPORT

This report is respectfully submitted. This report has been reviewed and is considered complete and adequate as per the Statement of Work and Hydrographic Surveys Specifications and Deliverables (2018) document.

A handwritten signature in blue ink, appearing to read "Scott Melancon", with a long horizontal flourish extending to the right.

Scott Melancon
Chief of Party
Oceaneering International, Inc.
February 2019

A handwritten signature in blue ink, appearing to read "Nicole Galloway", written in a cursive style.

Nicole Galloway
Geoscientist
Oceaneering International, Inc.
February 2019



APPENDICES

APPENDIX A

C-Nav® 3050 Equipment Specifications

APPENDIX B

C-Nav® 3050 Positioning Reports



APPENDIX A

C-Nav® 3050 Equipment Specifications

C-Nav[®]

oceaneering.com/cnav

C-Nav3050[®]

GNSS Receiver



FEATURES

Integrated GNSS/L-Band receiver

Patented multipath rejection

Software configurable to user requirements

Connecting What's Needed with What's Next™

C-Nav3050®

Technical Specifications

Features

- » All-in-view parallel tracking with 66-channels
- » Satellite-based augmentation system (SBAS) tracking (WAAS / EGNOS / MSAS / GAGAN)
- » Built-in C-NavC¹ and C-NavC² L-Band receiver
- » C-NavC² operating mode with automatic fail-safe to C-NavC¹
- » C/A, P1, P2, L2C, L5, G1, and G2 code tracking
- » L1, L2, L5, G1 and G2 full wavelength carrier phase tracking
- » C-Nav® corrections over Internet
- » High-sensitivity / low-signal level tracking
- » Fast signal acquisition / re-acquisition
- » Superior interference suppression (both in- and out-of-band) using custom tuned antennas
- » Patented multipath rejection
- » RTK Extend™
- » C-Nav® over-the-air activation capabilities
- » Configurable as real time kinematic (RTK) base or rover
- » Programmable output rates
- » Event marker input / 1 pulse-per-second (PPS) output
- » 2GB internal data storage
- » C-Setup PC control software included



■ For more information: oceaneering.com/cnav

Dimensions/weight

Length	6.47 in / 164 mm
Width	4.60 in / 117 mm
Height	2.37 in / 60 mm
Weight	1.1 lb / 0.5 kg

Front status indication

Power/GNSS Status, correction service status, interface status, and Bluetooth status

External power

Input	AC / DC Adapter 110 / 220 VAC 12 VDC Nominal 0.5A (9.0V to 32 VDC)
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Connectors

I/O ports	2 x 9 pin Positronic
DC ports	1 x 9 pin Positronic
RF connector	TNC (with 5VDC bias for antenna / LNA)

Temperature (ambient)

Operating	-40°F to 158°F / -40°C to 70°C
Humidity	95% non-condensing

Accuracy (RMS) horizontal/vertical

RTK (<40km)	1 cm + 0.5ppm / 2cm + 1ppm
C-Nav® services (95%)	8 cm / 15 cm
Code DGNSS (<200 km)	40 cm + 3 ppm / 90 cm + 3 ppm
Velocity	0.01 ms
RTK extend (<15 mins)	3 cm + 1 ppm / 6 cm + 2 ppm

User programmable output rate

Position/velocity/time	1, 5, 10, 25, 50, or 100 Hz
Raw data	1, 5, 10, 25, 50, or 100 Hz

Data latency

Position/velocity/time	10 ms at all rates
Raw data	10 ms at all rates

Time-to-first-fix

Cold/warm/hot	< 60 s / < 50 s / < 20 s (Typical values measured per ION-STD 101)
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I/O connector assignments

Data interfaces	2 x RS232 (1-changeable to RS422, 4800 - 115200 baud rates) 1 x USB 2.0 (host or device) Bluetooth Ethernet (10T / 100T)
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Input/output data messages

NMEA-0183	ALM, GBS, GGA, GLL, GRS, GSA, GST, GSV, RMC, RRE, VTG, ZDA, GFA, DTM, GNS, MDA
Differential correction	RTCM 2.3 and 3.0, SBAS and C-Nav® (proprietary)
RTK connection	CMR / CMR+, RTCM, NavCom Ultra RTK
Receiver control	NavCom proprietary commands (ASCII)

Compliance/Approvals

IMO performance standard for GPS: IEC 60529
IMO performance standard for GNSS: IEC 61108-1:2003
NMEA-0183 compatibility up to V4.1
FCC Part 15 Class B, CE
QC message strings comply with the recommendations in OGP 373-19 and IMCA 5015 (July 2011)

MBRTK - Range and Bearing Option

High-accuracy range and bearing data between vessels
Multiple rovers can use a common base
RTK levels of accuracy for range, irrespective of differential correctors
Converter available to emulate a fanbeam output
Heading accuracy (degrees at 1 sigma) + 0.6 / baseline length in meters
Baseline horizontal accuracy + 1 cm + 1 ppm
MBRTK NMEA-0183 Outputs: HDT, TTM, ROT



APPENDIX B

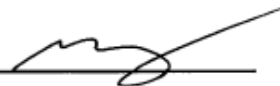
C-Nav® 3050 Positioning Reports

C-Nav DGPSC-Nav # 22179

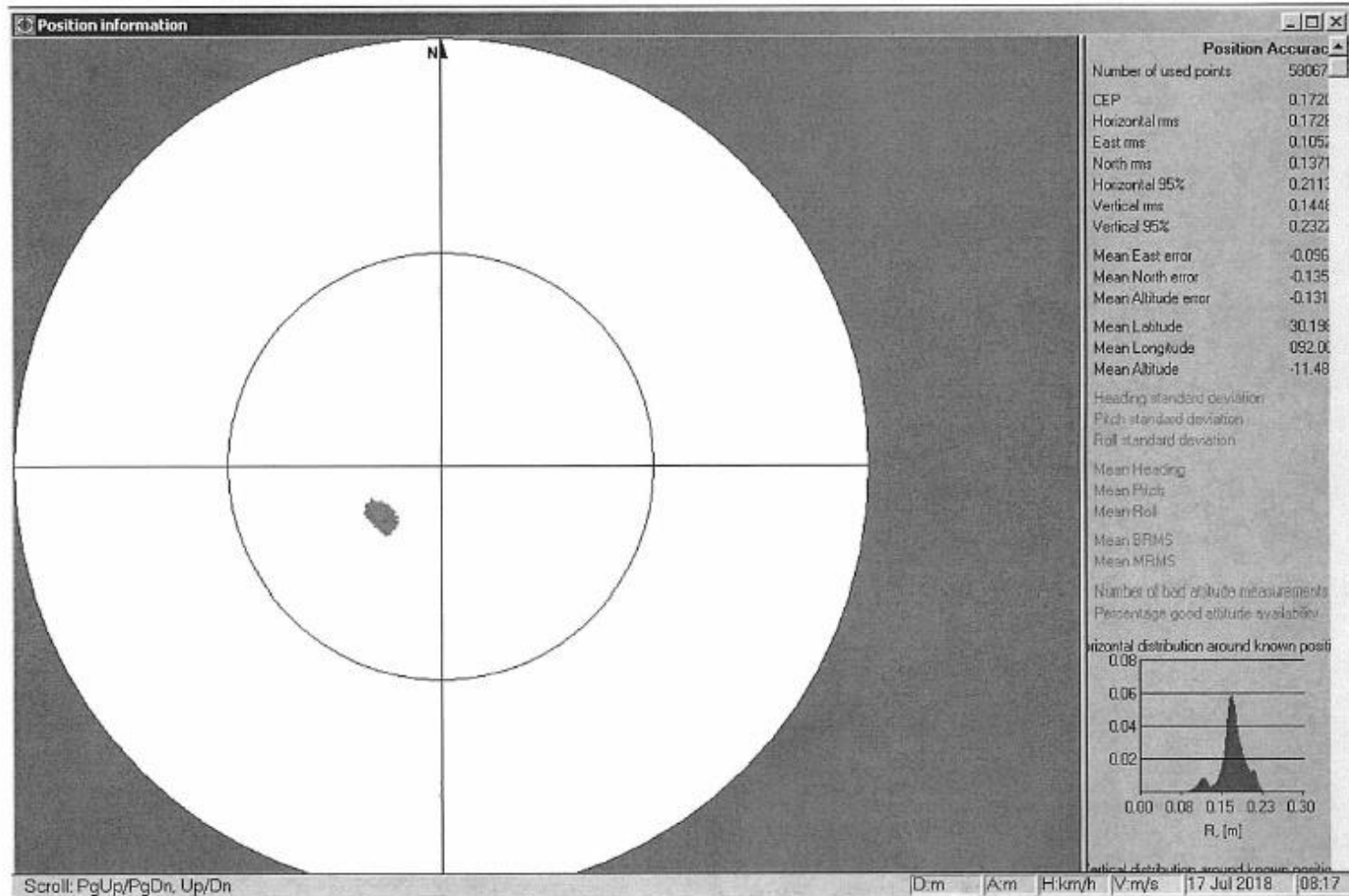
- 1) Visual Inspection:
All parts returned? Serial numbers match box? Physical damage?
- 2) Operates correctly
Locks in with L1, L2 and diff?
- 3) Expiration Date Greater than 3 months
- 4) Use terminal to check output string (GGA).
- 5) Check date on calibration sheet is less than 2 year.
- 6) Position comparison to known test point:
Lat. 30.198830133
Lon. -92.001001466 Within .2 meters of test point.
- 7) Inventory:
C-Nav unit
2 - Mounting Pipe
Power Supply
110 V AC Power Cable
DB-9/USB Cable
DB-9/Network Cable
Calibration Sheet
Pipe Collar
Threaded Antenna Adapter

The End User assumes all responsibility for any additions or modifications
(ie. Software installations, updates, etc) to this item after the date listed below!

Greg R.
Tech



17-Jul-18
Date



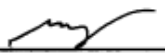
C-NAV 3050 22179

Signal 7-15-2021

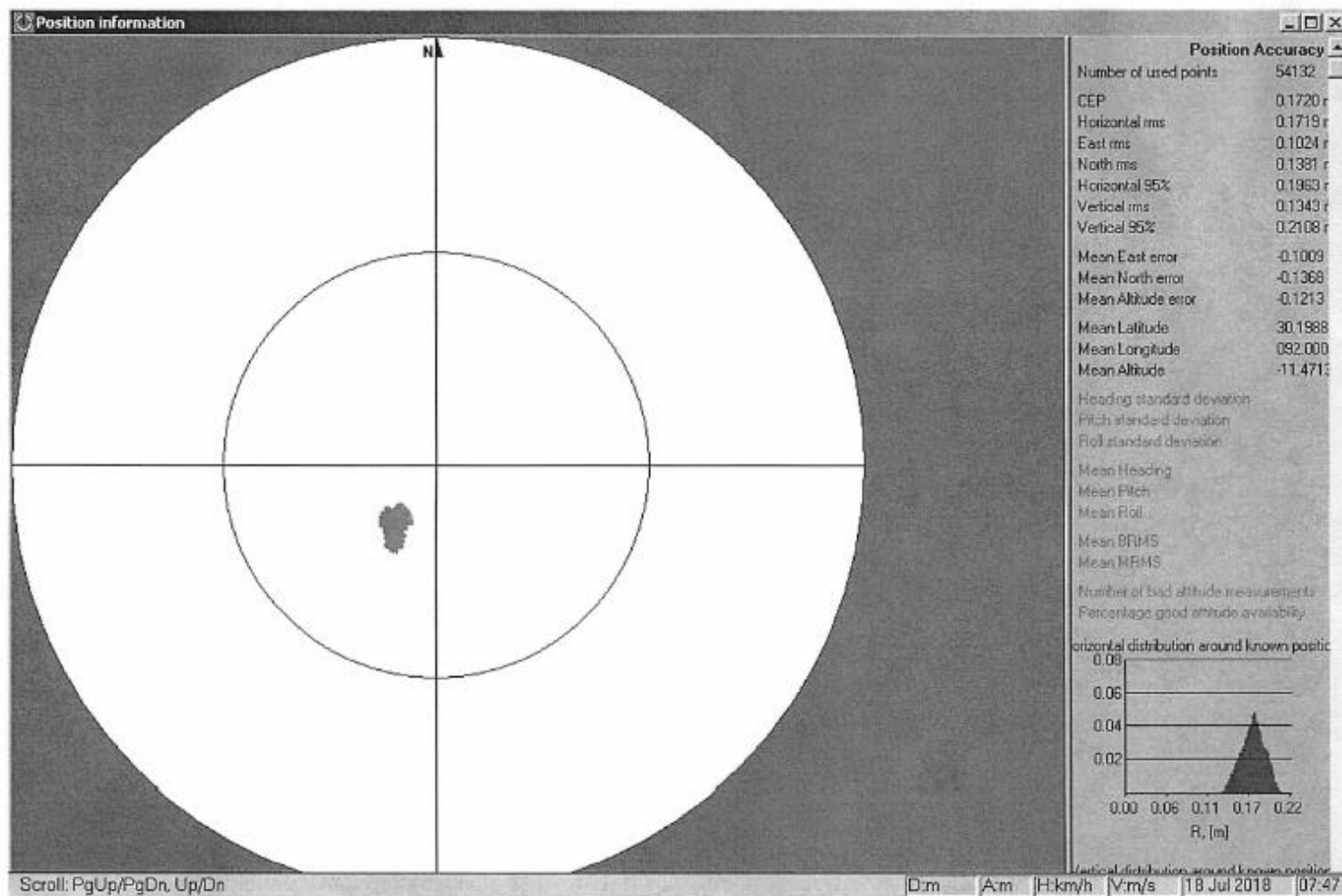
C-Nav DGPSC-Nav # 23107

- 1) Visual Inspection:
All parts returned? Serial numbers match box? Physical damage?
- 2) Operates correctly
Locks in with L1, L2 and diff?
- 3) Expiration Date Greater than 3 months
- 4) Use terminal to check output string (GGA).
- 5) Check date on calibration sheet is less than 2 year.
- 6) Position comparison to known test point:
Lat. 30.198830133
Lon. -92.001001466 Within .2 meters of test point.
- 7) Inventory:
C-Nav unit
2 - Mounting Pipe
Power Supply
110 V AC Power Cable
DB-9/USB Cable
DB-9/Network Cable
Calibration Sheet
Pipe Collar
Threaded Antenna Adapter

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Greg R. 
Tech

18-Jul-18
Date



C-NAV 3050 23107

Signal 7-16-2021

C-Nav DGPSC-Nav # 13769

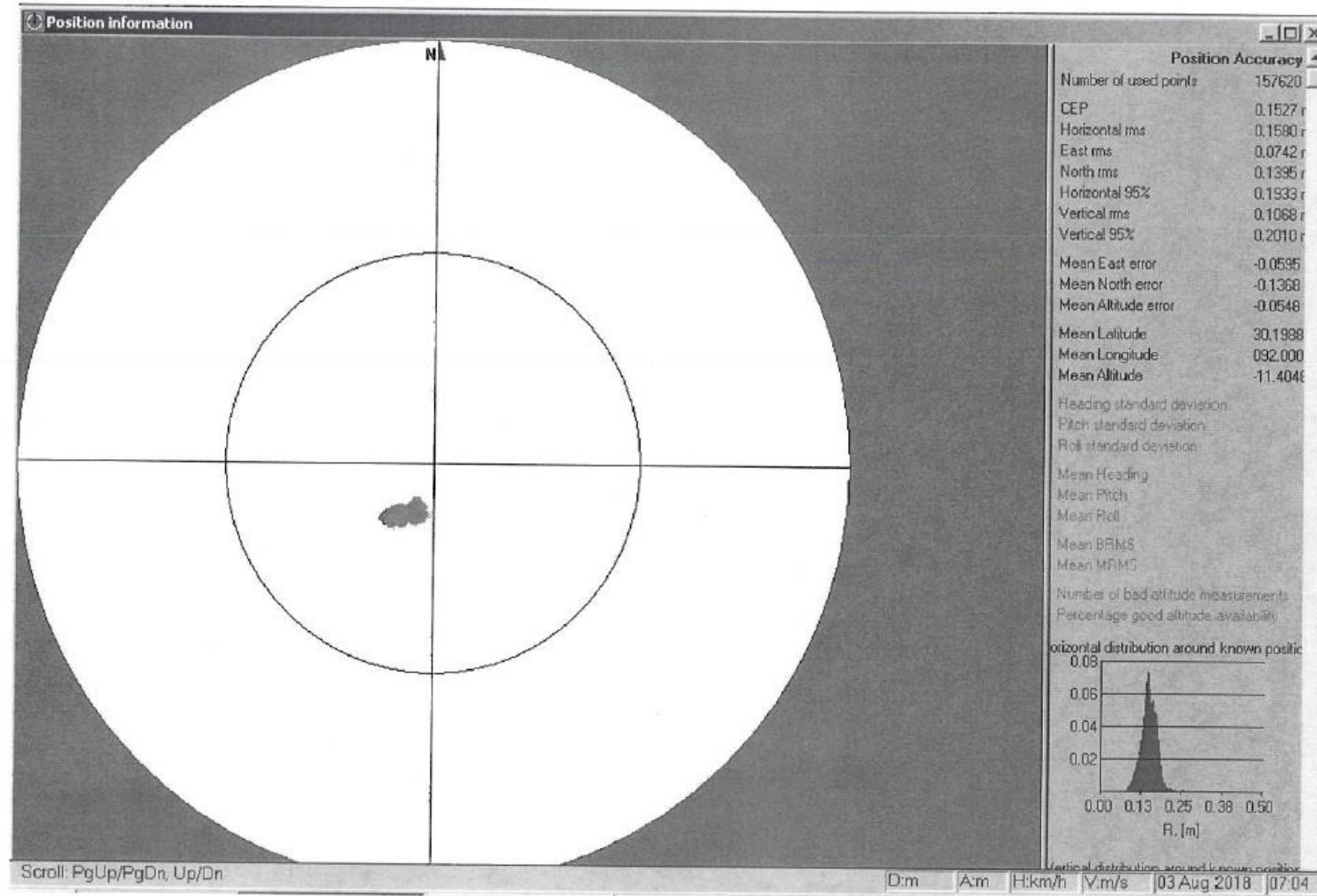
- 1) Visual Inspection:
All parts returned? Serial numbers match box? Physical damage?
- 2) Operates correctly
Locks in with L1, L2 and diff?
- 3) Expiration Date Greater than 3 months
- 4) Use terminal to check output string (GGA).
- 5) Check date on calibration sheet is less than 2 year.
- 6) Position comparison to known test point:
Lat. 30.198830133
Lon. -92.001001466 Within .2 meters of test point.
- 7) Inventory:
C-Nav unit
2 - Mounting Pipe
Power Supply
110 V AC Power Cable
DB-9/USB Cable
DB-9/Network Cable
Calibration Sheet
Pipe Collar
Threaded Antenna Adapter

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Greg R.
Tech



03-Aug-18
Date



C-NAV 3050 13769

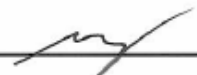
Signal 7-31-2021

C-Nav DGPS

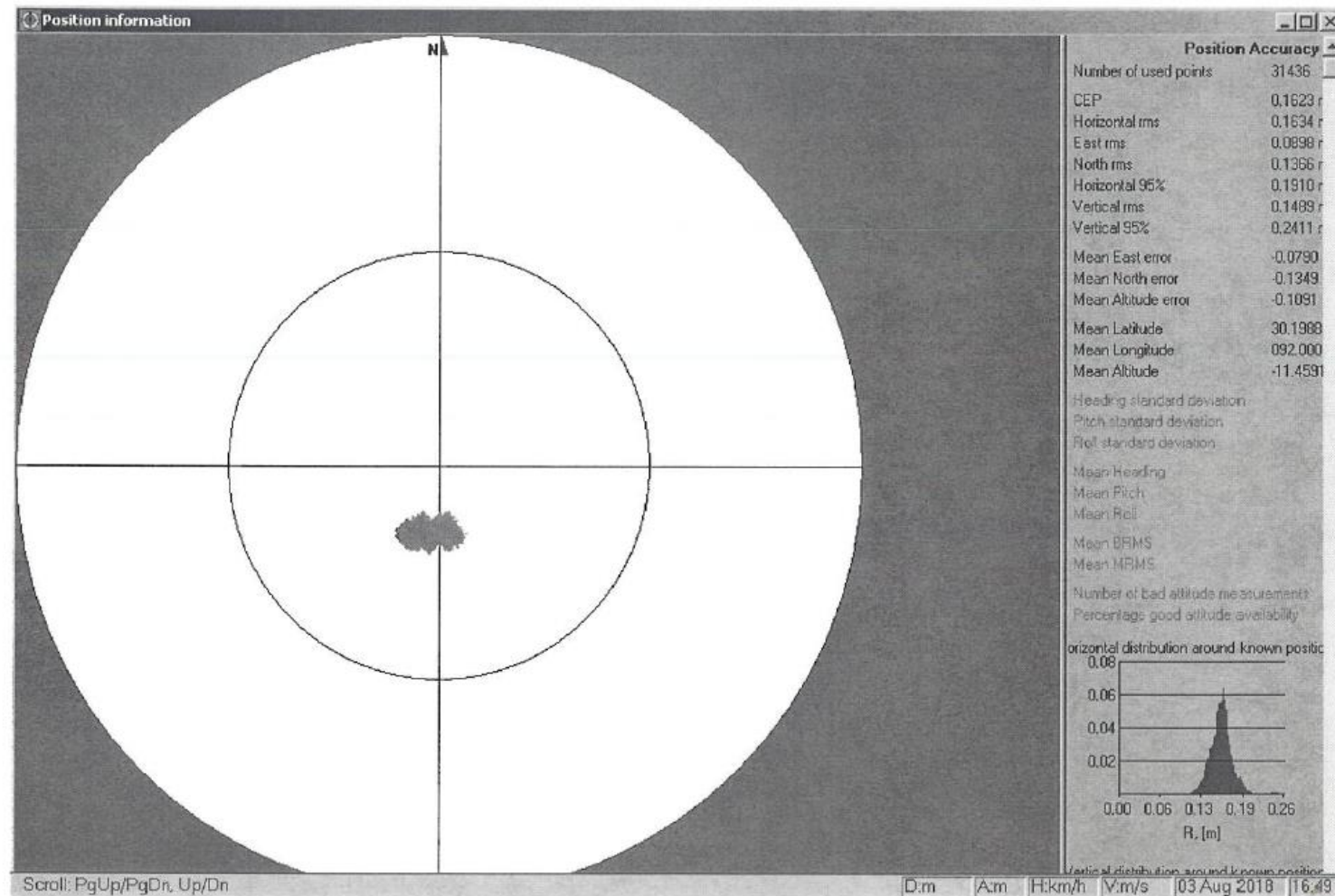
C-Nav # 15006

- 1) Visual Inspection:
All parts returned? Serial numbers match box? Physical damage?
- 2) Operates correctly
Locks in with L1, L2 and diff?
- 3) Expiration Date Greater than 3 months
- 4) Use terminal to check output string (GGA).
- 5) Check date on calibration sheet is less than 2 year.
- 6) Position comparison to known test point:
Lat. 30.198830133
Lon. -92.001001466 Within .2 meters of test point.
- 7) Inventory:
C-Nav unit
2 - Mounting Pipe
Power Supply
110 V AC Power Cable
DB-9/USB Cable
DB-9/Network Cable
Calibration Sheet
Pipe Collar
Threaded Antenna Adapter

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Greg R. 
Tech

03-Aug-18
Date



C-NAV 3050 15006

Signal 8-2-2021