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FLANDERS DREDGING CORPORATION

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PUERTO BOLIVAR EMERGENCY MAINTENANCE DREDGING (2020)

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SURVEY PROJECT MANUAL

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DOCUMENT DISTRIBUTION AND ACCESS

The latest approved version of this Manual is accessible to all Surveyors on Site of Flanders Dredging Corporation and to all members of the Project Management Team by the project network server or CD-ROM.

All relevant project staff is notified of this latest revision by means of internal memo or per internal e-mail. The controlled document will be made available on the server at the discretion of all involved personnel.

REVISION CHANGE DETAILS

Revision	Location	Brief description of change
01	Entire document	Initial Revision

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1 PURPOSE

This Survey Project Manual (SPM) has been prepared by FDC in close co-operation with the management and with respect to the works described in the Contract Agreement.

Survey operations play a key role in the realisation of the works and ensure the proper execution of the different activities. It also allows the Employer to evaluate project progress.

It is prepared in accordance with the ISO 9001:2008 Standards and to cover the scope of works as per contract.

2 FIELD OF APPLICATION

2.1 GENERAL

In this document general procedures are described for the In-Survey, Interim Construction Surveys and Out-Surveys, as well as ongoing Construction Support Surveys. Survey procedures ensure that the survey methods used, comply with the Client's specifications and that surveys are carried out in an accurate and efficient manner. This document demonstrates the capabilities of FDC to provide adequate expertise to fulfil the requirements of the Client. Obviously, the procedures could be adapted to suit the specific requirements of the Client/Project.

The procedures cover all survey works related to following sections of the contract:

- Dredging

The survey activities will include, but will not be limited to:

- Installation of survey equipment at the site and required facilities
- Acceptance of survey vessel
- In-Surveys
- Dredge support surveys
- Out-Surveys

Furthermore, this document describes the procedures related to the calibration and use of all survey equipment, the survey operations as well as the data handling and reporting.

The hydrographic survey works will be undertaken with a dedicated survey vessel.

FDC will appoint experienced hydrographic and topographic surveyors to undertake these survey tasks. The persons appointed should be responsible to the Project Survey Manager or Survey Party Chief who will work closely with the operational superintendent(s). All acquired survey data will be processed in the site office. The final survey will be according to the contract requirements.

2.2 BRIEF PROJECT DESCRIPTION

The site is located at Puerto Bolivar, in Machala, Ecuador. The project contains the maintenance of the existing channel to the port.

The TSHD Charles Darwin will be mobilized to execute the dredging works.

Scope of dredging works

3 REFERENCES

This document should be read in conjunction with the following documents:

ISO 9001:2008 Standard

ISO 9001:2008	Quality management system
§ 4.2.2	Quality manual

Table 3-1: ISO 9001:2008 Elements

4 TERMS & DEFINITIONS

4.1 ABBREVIATIONS

Abbreviation	Written in Full
WGS84	World Geodetic System of 1984
UTM	Universal Transverse Mercator Grid System
GPS	Global Positioning System
DGPS	Differential Global Positioning System
C-O	Calculated minus Observed values
TSHD	Trailing Suction Hopper Dredger
MSL	Mean Sea Level
MLWS	Mean Lowest Water Spring
GDOP	Geometric Dilution of Position
HDOP	Horizontal Dilution of Position
KP	Kilometre Post
KM	Kilometre
kHz	kilo Hertz (frequency)
LRK	Long Range Kinematics
STPM	Suction Tube Position Monitoring System
DPM	Dredged Profile Monitor
UHF	Ultra High Frequency
SBES	Single Beam Echo Sounder
MBES	Multi Beam Echo Sounder
Diff	Differential Signal
PPM	Parts Per Million
QA/QC	Quality Assurance / Quality Control

Table 4-1: Abbreviation

4.2 DEFINITIONS & IDENTIFICATION

4.2.1 Definitions & Terminology used in ISO 9001

Term	Definition
Audit	'Systematic, independent and documented process for obtaining "audit evidence" and evaluating it objectively to determine the extent to which "audit criteria" are fulfilled'. NOTE 1: Internal audits, sometimes called first-party audits, are conducted by, or on behalf of, the organization itself for management review and other internal purposes, and may form the basis for an organization's declaration of conformity. In many cases, particularly in smaller organizations, independence can be demonstrated by the freedom from responsibility for the activity being audited. NOTE 2: External audits include those generally termed second- and third-party audits. Second-party audits are conducted by parties having an interest in the organization, such as customers or by other persons on their behalf. Third-party audits are conducted by external, independent auditing organizations, such as those providing certification / registration of conformity to IS0 9001, IS0 14001 or OHSAS 18001.
Continual improvement	'Recurring activity to increase the ability to fulfil requirements'. NOTE: The process of establishing objectives and finding opportunities for improvement is a continual process through the use of audit findings and audit conclusions, analysis of data, management reviews or other means and generally leads to corrective or preventive action.
Corrective Action	'Action to eliminate the cause of a detected nonconformity or other undesirable situation'.
Customer satisfaction	'Customer's perception of the degree to which the customer's requirements have been fulfilled'. NOTE 1: Customer complaints are a common indicator of low customer satisfaction but their absence does not necessarily imply high customer satisfaction. NOTE 2: Even when customer requirements have been agreed with the customer and fulfilled, this does not necessarily ensure the achievement of customer satisfaction.
Document	'Information and its supporting medium'. EXAMPLE: record, specification, procedure, drawing, report, standard. NOTE 1: The medium can be paper, magnetic, electronic or optical computer disc, photograph or master sample, or a combination thereof. NOTE 2: A set of documents, for example specifications and records, is frequently called "documentation".
Procedure	'Specified way to carry out an activity or a process'. NOTE: Procedures can be documented or not.
Record	'Document stating results achieved or providing evidence of activities performed'. NOTE 1: Records can be used, for example, to document traceability and to provide evidence of verification, preventive action and corrective action. NOTE 2: Generally records need not be under revision control.
Requirement	'Need or expectation that is stated, generally implied or obligatory'. NOTE 1: "Generally implied" means that it is custom or common practice for the organisation, its customers and other interested parties, that the expectation under consideration is implied. NOTE 2: A qualifier can be used to denote a specific type of requirement, e.g. product requirement, quality management requirement, customer requirement. NOTE 3: A specified requirement is one that is stated, for example, in a document. NOTE 4: Requirements can be generated by different interested parties.

Table 4-2: Terminology defined in ISO 9001:2008

4.2.2 Project Definitions

Term	Definition
PRINCIPAL	CLIENT or MAIN CONTRACTOR, with whom Flander Dredging Corporation has some kind of agreement to deliver a service or project.
Project Management Team	All personnel of Flander Dredging Corporation assigned to a management function in the project organisation as defined in the "Organisation Chart"
Project	A project is a temporary endeavour with a defined beginning and end (usually time-constrained, and often constrained by funding or deliverables), [a] undertaken to meet unique goals and objectives, [b] typically to bring about beneficial change or added value. NOTE: The temporary nature of projects stands in contrast with business as usual (or operations), [c] which are repetitive, permanent, or semi-permanent functional activities to produce products or services.

Table 4-3: Project definitions

5 RESPONSIBILITIES AND AUTHORITIES

The Project Manager and Project Survey Manager will ensure that:

- all survey personnel will have been briefed on safety, environmental and emergency procedures.

The Project Survey Manager and the On-Line surveyor will ensure that:

- the positioning systems are operational prior to the mobilisation of any vessel.
- the above mentioned systems are operating as specified and that the Survey QC/QA procedures are followed.
- the correct survey data is on board of all vessel involved.
- the correct positioning data will be on board the survey vessel(s) to fulfil the task and that the survey and positioning systems are working properly by carrying out operational checks.
- calibrations will be carried out as defined in the calibration procedures.

The Project Manager and Project Survey Manager will ensure that:

- all data handling and reporting is done quickly and efficiently and to the required standards in order to minimise delays.
- there are sufficient spares for the survey and positioning equipment.
- surveys are carried out to the Employer's survey specifications and the FDC survey QC/QA procedures.

The On-line Surveyor will ensure that:

- the survey data is acquired and logged correctly.
- the survey vessel is operated within the defined limits and tolerances.

The operational Superintendent will ensure that:

- the survey data is used and interpreted correctly.
- the vessel is operated within the defined limits and tolerances.

The operational Superintendent and Project Survey Manager will ensure that:

- the required surveys are planned and performed according to schedule.
- the required deliverables for both the Employer and the dredger will be forwarded so as to cause minimal delays to progress.

Prior to any activity the Project Manager will notify all relevant authorities. The Project Manager will ensure that upon demobilisation all personnel and equipment will be removed from site and he will notify all authorities FDC will be responsible to.

6 SURVEY PROCEDURES

6.1 GEODETIC PARAMETERS AND REFERENCE LEVELS

6.1.1 Horizontal Datum

Datum	ITRF2008
Ellipsoid (Spheroid)	WGS84
Semi-major axis (m)	6378137.000 m
Inverse Flattening (1/f)	1/298.257223563

6.1.2 Mapping Projection

Projection Parameters

Projection	Universal Transverse Mercator UTM
Latitude Of Origin	00;00;00.000 N
Zone	17S
Longitude Of Origin	81;00;00.000 W
Scale Factor of Central Meridian	0.9996
False Northing	10,000,000.000 m
False Easting	500,000.000 m
Unit	metres

Transformation parameters from local system to WGS-84

DX= 0.000
DY= 0.000
DZ= 0.000
Scale factor 0.000

6.1.3 Vertical Datum

All survey and design levels will be related to Chart Datum ("CD"), being referred to as Mean Low Water Spring (MLWS), 1.7 m below MSL.
The geoid model EGM08 model will be taken into account to compensate for the geoid surface over big distances.

6.1.4 Control Points

The coordinates of the survey points in the Project area (Fixed Bench Marks) given by Yilport, which define the coordinate system, will be checked prior to the commencement of the Works.

Name BM	Easting (m)	Northing (m)	Height (m) MSL	Height (m) MLWS
BM 1	610980.808	9639505.559	2.812	4.512
BM 2	610990.537	9639645.880	2.618	4.318
BM 3	610998.900	9639797.291	2.714	4.414

6.2 EQUIPMENT

6.2.1 Positioning System

6.2.1.1 Differential Global Positioning System

Positioning during all survey, dredging and installation works will be provided by Differential Global Positioning Systems (DGPS). A Land based Real Time Kinematic Differential Station will be used as primary system. Alternatively a Septentrio Terrastar system can be used which receives the DGPS correction signal from the satellites.

Differential corrections for GPS positioning correct the coded raw pseudo ranges received from selected GPS satellites. A DGPS positioning system consists of a base receiver, also named reference station, located at a known point and (a) mobile receiver(s). The receiver at the reference station computes the satellite pseudo range corrections and transmits these to the mobile receiver(s) via a telemetry link. The mobile receiver(s) apply these corrections to their own observed satellite pseudo ranges and so obtain the corrected pseudo ranges to be used for the position computations. The positions derived by the DGPS receiver are calculated in WGS84 co-ordinates and then transformed to the local Grid.

The reference station will be a Septentrio AsteRx-U (or similar) high accuracy dual frequency GPS receiver (see Annex 01) that will be installed at a known WGS84 coordinate. The unit will calculate the corrections which will be broadcasted via internet or by a UHF radio modem. The Septentrio RTK provides a geographical accuracy of better than ±0.03 m precision in the horizontal plane in Kinematic mode at the remote receiver for 95% of the time.

The TerraStar-C global subscription service provides solid and reliable Precise Point Positioning (PPP) capabilities over the Earth's surface. Using GPS and GLONASS satellites enables the user of Septentrio receivers to maintain an accurate and reliable position in the most difficult of environments. These corrections are broadcasted via geostationary satellites, providing worldwide coverage and enabling precise real-time navigation without the need for local ground base stations. Terrastar-C provides better than 0.10 m horizontal and 0.15 m vertical accuracy (95%).

For calibration purposes and topographic measurements a Trimble R8s Rover or similar (backpack type, See Annex 02), consisting of a RTK DGPS system and a handheld computer, will be used. Before using the instrument, a calibration on a known benchmark will be executed.

The position of the reference station at the site will be established by using official geodetic points. These control points will also be used for calibration purposes.

System checks and position confidence checks are described in section 6.3 Calibrations and Checks.

6.2.1.2 Single Beam and Multi Beam Echosounder

An Odom CV200 Echo sounder or similar can be used to obtain bathymetric data using both its 210 and 33 KHz channels. The transducers of the SBES are hull mounted on the survey vessel or are installed in the vessel's moonpool or side mounted on a pole.

The high frequency transducer will have a beam width of 9 degrees and the low frequency transducer a beam width of 20 degrees. The first seabed return will be digitised and logged simultaneously for both frequencies.

All bathymetric data found using both transducers will be heave compensated and will be logged directly to the survey computer system with event marks, generated by the internal annotator, recorded on the analogue or digital record.

See Annex 03, Odom CV200 Echo sounder for more detailed information. In section 6.3 Calibrations and Checks details are presented on the calibration of the single beam echo sounder system.

The survey vessel will be equipped with a sonar head Kongsberg 2040C (or similar equipment) multi beam echo sounder.

The Kongsberg 2040C system uses frequencies between the 200 and 400 kHz band. The MBES has a maximum swath of 130 degrees. The transducer will be installed in the vessel's moonpool or side mounted whichever is more suitable for the purpose.

When using the swathe sounding system special attention will be paid to the quality of the required bathymetric data and steps will be taken in accordance with written procedures and manufacturer's instructions.

The accuracy of MBES depth measurements depends on the following parameters:

- Speed of sound; of emission of the individual sound beams depends on the speed of sound, this may result in a position error super-imposed on depth errors.
- Horizontal alignment of the transducers; in relation with each other and with respect to the longitudinal axis of the vessel.
- Vertical alignment of the transducers; in relation with each other as well as an inclination of the entire transducer array.
- Alignment of the inclinometer; effect as transducer misalignments.
- Heave compensation; accuracy of the system in the same manner as a normal echo sounder.

In order to calibrate the the angular mounting components (roll, pitch and yaw) the patch test is performed (In section 6.3 calibration and check details are presented concerning the MBES calibration). This is a data collection and processing procedure which happens before the survey starts.

All bathymetric data collected by the MBES will be on-line compensated for heave, pitch and roll. It will be logged directly to the navigation computer system with event marks, generated by the internal annotator.

See Annex 04 for more detailed information on the Kongsberg EM2040C.

6.2.2 Sensors

6.2.2.1 Heave Compensator or Motion sensor

The survey vessel will be equipped with an IXSEA Octans motion sensor (or similar equipment) to compensate the acquired raw echo sounder data for heave (vertical movement), pitch and roll of the transducer caused by the survey vessel movement in any seaway.

The motion sensor will be deployed close to the transducer head to compensate the heave, pitch and roll of the echo sounder data online.

See Annex 05 for more detailed information on the equipment mentioned above.

6.2.2.2 Gyro Compass

The TSHD is fitted with a gyro-compass. Compass information will be used to obtain the vessels' heading and to calculate and display the relevant positions on the vessel.

The gyro outputs a heading related to True North and is converted to Grid North by the on-line positioning software system.

The survey vessel will be equipped with an Ixsea Octans (or similar equipment) fibre optic gyro compass and motion sensor to compensate the acquired raw multibeam data with heading and vessel motion.

Gyro calibrations and checks are described in section 6.3 Calibrations and Checks.

6.2.3 Tidal Observations

6.2.3.1 Conventional Tide Gauges

The Tidal observations over the work area will be accomplished by means of an installed tide gauge as near as possible to the working and survey area. The system used will be a Valeport Tide Recorder (or similar equipment), transmitting through a radio-modem to be able to have online tide-compensation during surveys and dredging activities. The tide gauge(s) will transmit data at an interval of 3 minutes, and will continually log all tidal data internally for subsequent later download to a computer. The tide gauges will log and transmit simultaneously.

6.2.3.2 Tide Predictions

When it's not possible to receive the tide gauge values on board of one of the vessels or the survey vessel due to the remote location of the work area, then tidal predictions will be used during works.

6.2.4 Survey Vessel Installation

The survey vessel will have sufficient space and consumables to allow the operating of all survey equipment, on-line processing, recording systems and the necessary display units. It will be capable of continuous survey operations.

The following survey equipment (or similar equipment) will be installed on the Survey Vessel:

- DGPS Positioning — Septentrio AsteRX-U (or similar)
- Gyro Compass — OCTANS Motion Sensor
- Single beam echosounder — ODOM CV200 dual channel 33KHz/210KHz
- Multibeam echosounder — Kongsberg EM2040 C, 200-400KHz (or similar)
- Heave compensator — OCTANS Motion Sensor
- Data Collecting Computer — HP Desktop with QINSy package
- Sound velocity measurement — Valeport Swift
- UPS

6.2.5 Dredging Equipment Installation

The navigation/positioning system to be installed on the Dredging Equipment will comprise:

- DGPS Positioning: — Septentrio AsteRx + C-Nav 3050M (or similar)
- Gyro compass — Anschutz Standard 22 (or similar)
- Data Collecting Computer: — HP Desktop with QINSy package
- Navigation Package
- UPS / power stabiliser

Trailer Hopper Suction Dredger (TSHD)

On the TSHD, the positioning computer will be interfaced to the dredge's process computer STPM system.
The STPM is a system comprising a system of angle transducers on every lid of the suction pipe, which allows determination of the drag and jet head position relative to the ship. This makes relative X, Y and Z co-ordinates of the drag and jet head available to the positioning and dredging computers.

6.3 CALIBRATIONS AND CHECKS

All equipment will be sent to the site or vessel with a valid test and calibration certificate from the manufacturer or with a validation sticker issued by Survey department from JDN/FDC. Upon arrival the equipment will be checked and tested again. Once the equipment has been found functioning correctly it will be installed.

In the next sections calibrations and checks for the equipment are described. Although different in terminology, calibrations or checks are used to obtain the same objective: that the equipment is working correctly and that a high level of confidence is maintained throughout all aspects of the operations.

6.3.1 DGPS

All equipment will be sent to the site with a "Checked by" sticker issued by Survey department in the FDC Head office. Upon arrival the equipment will be checked and tested again. Once the equipment has been found functioning correctly it will be installed.

Reference Station:

Before installing the DGPS Reference Station on location, the radio transmitters and receivers are tested.

DGPS receivers:

The verification of the DGPS receivers on board of the survey vessel includes the checking and testing of the equipment as well as verifying if the transformation and projection from WGS84 coordinates to local grid coordinates is being done correctly.

The positioning will be checked as follows:

After installation of the equipment on board the vessel, the exact coordinate of a specific vessel will be measured. To do so, a an RTK backpack will be used. This measurement needs to be repeated at least ten times.
During these measurements, the survey system on board of the vessel should at least log the time, Easting and Northing (in local grid coordinates) of the measured offset.

This verification should result in a clear conclusion: difference in easting and northing should be less than the proposed accuracy. If not, the exact reason for the error should be investigated. Whether it's the DGPS receiver or one of its components which is malfunctioning (which will then be replaced and tested again) or it's an error in the transformation from WGS84 to the local coordinate system.

Note: A gyro calibration should be performed prior to the position verification.

The RTK backpack will be checked on a benchmark closest to the field area prior to any survey activities. The GPS antenna will be placed at a fixed height above the reference mark, and the X-Y-Z reading will be compared to the known coordinates.
The result of this check will be written down in the "DGPS Rover Position Check Report". Each measurement or calibration done with this specific RTK backpack needs a reference to this "DGPS Rover Position Check Report".

The RTK backpack survey will only be executed if the verification error is less than 3cm.

6.3.2 Tidal values

The tide gauge is a radar sensor and measures the distance to the waterline. First, the distance from the vertical reference level (MLWS) to the sensor should be defined. This difference is known as 'offset'. Once the offset is known, the tide can be calculated by taking the difference between the fixed offset and the measured distance (sensor to water line).

The tide gauge loggings of records will be synchronized with the GPS clock.

6.3.3 Echo Sounder

6.3.3.1 Single Beam Echo Sounder System

The Echosounder should be checked without the effect of the Heave Compensator; if there is a Heave Compensator it should be switched off.

The Echosounder is calibrated at the start of an official survey, using a steel plate which is lowered below the transducer. The steel cable to lower the plate has graduations every 1 or 2 meters.
First a sound velocity profile will be taken.
Then the immersion of the echosounder transducers is measured with a tape measure. This value will be used to set the draft value of the transducer in the echosounder. As a verification the plate will be hanged at different depths and depth reading will be checked.

6.3.3.2 Multi beam echo sounder

The calibration of the Multi beam system consists of a patch test calibration

The multibeam system shall be calibrated by way of a calibration survey commonly referred to as a patch test.
The patch test consists of a series of survey lines strategically sailed over various seabed topographies.
These varying seafloor scenarios, specifically a flat seafloor, a sloping seafloor and a conspicuous feature, enable the operator to detect and quantify the various systematic errors.
The calibration survey shall determine the roll, pitch and heading misalignments of the transducer.
These misalignment values will be accounted for either online by the real time software, or offline by the post processing software.
A Velocity Probe will be operated to measure conductivity (salinity), density and temperature to determine a complete velocity profile throughout the water column. This measurement is to be conducted before each survey and the correct data will have to be inserted in the multibeam system.
When using the swath sounding system special attention will be paid to the quality of the required bathymetric data and steps will be taken in accordance with written procedures and manufacturer's instructions.

The accuracy of MBE depth measurements depends on the following parameters:

- Speed of sound; of emission of the individual sound beams depends on the speed of sound, this may result in a position error super-imposed on depth errors.
- Horizontal alignment of the transducers; respect to each other and with respect to the longitudinal axis of the vessel.
- Vertical alignment of the transducers; respect with each other as well as an inclination of the entire transducer array.
- Alignment of the inclinometer; effect as transducer misalignments.
- Heave compensation; accuracy of the system in the same manner as a normal echo sounder.

* To test the roll angle, an area is located which is smooth and flat. A 100 m long line is run in both directions at a normal survey speed.
* To test pitch, reciprocal survey lines across the bank are run at normal survey speed.

* To test yaw, a second line parallel and at the working depth offset to the latency and pitch line is run. The line is run at the normal survey speed and in the same direction.

All bathymetric data collected by the MBE will be on-line compensated for heave, pitch and roll. It will be logged directly to the Navigation computer system with event marks, generated by the internal annotator.

6.3.4 Speed of Sound Establishment

The speed of sound through the water column will be observed using a direct reading velocity meter, type Valeport Swift or similar. This will be done each day before a survey operation. The probe is able to establish the speed of sound using the 'sing around' method by transmitting and receiving an acoustic signal. The sensor of the instrument will be lowered at regular depth intervals, over the entire water column. Speed of sound values are logged or recorded and the computed average speed of sound will be used during the survey. The instrument will automatically compute the speed of sound.

6.3.5 Heave compensator or Motion Sensor

The motion sensor will be provided with all the factory calibration sheets. It will only be checked for correct functioning and for correction compensation.

6.4 SURVEY OPERATIONS

6.4.1 In- Survey

The Employer's representative/Engineer will be invited to witness and check the In-Survey. A full set of data of the In-Survey of that section will be handed over to the Employer's representative/Engineer for approval before the start of the dredging works.

The In-Surveys comprise measurements of which the results can be compiled and presented into Bathymetrical Charts. The surveys are available for Employer's review.

RTK height will be used to refer the bathymetrical data to MLWS.

6.4.2 Construction Support Surveys

During the works construction support surveys (or progress surveys) will be carried out on a regular basis or as required by the Project Management to monitor dredging progress.

These surveys comprise measurements of which the results can be compiled and presented into Bathy Charts or Cross Sections.

RTK height will be used to refer the bathymetrical data to MLWS.

6.4.3 Out- Survey

An Out-Survey for each section will be performed immediately after the completion of the dredging works in that section. This survey will be executed in the same manner as the In-Survey.

The Employer's representative/Engineer will be invited to witness and to check the Out-Survey. A full set of data of the Out-Survey will be handed over to the Employer's representative/Engineer for approval.

RTK height will be used to refer the bathymetrical data to MLWS.

6.5 DREDGE ON-LINE MONITORING

The dredge process is monitored on-line by displaying a 3-D model of the seabed, and updating it from the dredge head positions. A theoretical or 'design' model can also be superimposed to enable operators to assess when the desired datum has been reached. The models can be colour-banded relative to each other, or relative to a local datum, for ease of monitoring.

The dredge head positions can be measured and adjusted for tide and draft before displaying over the model and automatically updating it. Profiles can be drawn across and along the track through the dredge heads, and will show:

Both models
The vessel in profile
The dredge head positions

Other display windows that can be added to the screens are:

Colour legend
Attitude display to compare gyro, course made good, and design heading
Histograms for cross-course and position quality

6.6 SOFTWARES

Following softwares will be used:

Navigation: QINSy (from QPS)

Singlebeam acquisition: Navaq (from BeamworX)

Singlebeam Processing: Autoclean/Singlebeam Editor (from BeamworX)

Multibeam acquisition: QINSy (from QPS)

Multibeam Processing: Autoclean (from BeamworX)

Producing charts and sections and calculate volumes: Terramodel (from Trimble)

Process patch test: Autopatch (from BeamworX)

7 ANNEXES TO BE READ, ATTACHED AND FILED WITH THIS DOCUMENT

Annex 01	Septentrio AsteRx RTK receiver
Annex 02	Trimble R8s Rover
Annex 03	Odom CV200 singlebeam echosounder
Annex 04	Kongsberg EM2040C multi beam echosounder
Annex 05	Octans GIV Motion Sensor
Annex 06	Valeport Tidemaster
Annex 07	Valeport Swift
Annex 08	Autopatch

Annex 01

Septentrio AsteRx RTK receiver

AsteRx-U

Multi-constellation, dual antenna GNSS receiver

septentrio

The AsteRx-U is an all-in-one multi-frequency GNSS receiver with UHF radio, WiFi, Bluetooth and a L-Band receiver combined with spectrum analyzer for the broadest range of applications.

Key Features

- **544 channels for tracking all known and future signals from GPS, GLONASS, GALILEO, BEIDOU, IRNSS, QZSS and SBAS on both antennas**
- **Precise and solid heading calculation**
- **cm-level (RTK) and sub dm-level (PPP) position accuracy**
- **Dual L-band channel with support for TerraStar corrections**
- **Septentrio GNSS+ algorithms for solid performance**
- **Integrated cellular modem, Bluetooth and WiFi optional UHF radio**

Consistently accurate now and into the future

The AsteRx-U is powered by the AsteRx4, the most advanced multi-constellation dual antenna receiver from Septentrio. Its multi-frequency engine can track all current and future Global Navigation Satellite System (GNSS) constellations - GPS, GLONASS, Galileo, BeiDou, IRNSS and QZSS – on both antennas. This guarantees you reliable and accurate GNSS positioning now and into the future.

Centimeter scalable accuracy

Septentrio's knowledge and experience in the GNSS industry ensures that the AsteRx-U MARINE offers you the highest possible accuracy, scalable to a centimeter. LOCK+ technology maintains tracking during heavy vibration and IONO+ technology assures position accuracy even under periods of elevated ionospheric activity. The AsteRx-U features special interference mitigation technology which filters out ambient intentional and unintentional RF interference.

Connect with any device

Use any device with a web browser to operate the AsteRx-U without any special configuration software via the built-in webserver accessible over WIFI, network or USB connection.

AsteRx-U

FEATURES

GNSS Technology

544 hardware channels for simultaneous tracking of all visible satellite signals

Supported signals: GPS (L1, L2, L5), GLONASS (L1,L2,L3), GALILEO (E5ab, AltBoc, E6), BEIDOU (B1, B2, B3), IRNSS (L5), QZSS (L1,L2,L5) (Galileo, Beidou and IRNSS, are optional features)

All-in-view SBAS (EGNOS, WAAS, GAGAN, MSAS, SDCM) (incl. L5 tracking)

Integrated dual channel L-band receiver

100 Hz Raw data output (code, carrier, navigation data) (optional feature)

20 Hz SBAS, DGNSS, PPP and RTK (50 Hz available in future firmware versions)

A Posteriori Multipath Estimator Technique (APME+), including code and phase multipath mitigation

AIM+/WIMU interference mitigation unit, including chirp jammers

ION+ Advanced scintillation mitigation

RAIM

DGNSS (base station and rover)

RTK (base and rover) (base is an optional feature)

Use of TerraStar services (optional feature)

Moving base RTK positioning (optional feature)

8 GB Internal Memory, expandable with an external SD card

Connectivity

3 hi-speed serial ports (RS232)

Ethernet port (TCP/IP and UDP)

Full speed USB (host and device)

2 Event markers

xPPS output (max. 100 Hz)

Integrated Bluetooth (2.1 + EDR/4.0)

Integrated Quadband Cellular Modem (EDGE, 2G, 3G, 3.5G)

Integrated Wi-Fi (802.11 b/g/n)

(optional) Integrated UHF (406-470 MHz)

Formats

Highly Compact and fully documented Septentrio Binary Format (SBF) output

NMEA v2.30 output format, up to 20 Hz; NMEA 4.0; NMEA 3.01

RTCM v2.2, 2.3, 3.0 or 3.1

CMR2.0 and CMR+ (CMR+ input only)

UHF: Pacific Crest (GMSK, 4FSK, FST), SATEL, Trimtalk (450S_P, 450S_T)

PERFORMANCE

Position accuracy[1,2,3]

	Horizontal	Vertical
Standalone	1.2 m	1.9 m
SBAS	0.6 m	0.8 m
DGNSS	0.4 m	0.9 m
TerraStar-D[4]	6 cm	<10 cm

RTK Performance[1,2,3,6,7]

Horizontal accuracy[3]	0.6 cm + 0.5 ppm
Vertical accuracy[3]	1 cm + 1 ppm
Average time to fix[7]	7 s

Velocity Accuracy[1,2,3]

	Horizontal[3]	Vertical[3]
	0.01 m/s	0.015 m/s

Heading Accuracy[1,2,3]

	Heading	Pitch/Roll
1m antenna separation	0.1°	0.2°
10m antenna separation	0.01°	0.02°

Maximum Update rate

Position	20 Hz (50 Hz in future firmware version)
Measurements	100 Hz

Latency

< 20 m/s

Time accuracy[3]

xPPS Out	10 ns
Event accuracy	< 20 ns

Time to first fix

Cold start[8]	< 45 s
Warm start[9]	< 20 s
Re-acquisition	avg. 1.2 s

Tracking performance (C/N0 threshold)

Tracking	20 dB-Hz
Acquisition	33 dB-Hz

Dynamics

Acceleration	10 g
Jerk	4 g/s

PHYSICAL AND ENVIRONMENTAL

Size	164 x 157 x 54 mm
Weight	1.5 kg
Input voltage	9–36 V DC
Power Consumption	7 W Typical
Operating temperature	-30°C to +65°C
Storage temperature	-40°C to +75°C
Humidity	MIL-STD810G, Method 507.5, Procedure I
Dust	MIL-STD-810G, Method 510.5, Procedure I
Shock	MIL-STD-810G, Method 516.6, Procedure I/II
Vibration	MIL-STD-810G, Method 514.6, Procedure I

Connectors

Antennas	TNC female
Power	LEMO 4 pins female
USB/ETH	LEMO 16 pins female
PPS-OUT	LEMO 5 pins female
Serial 2	LEMO 9 pins female
Serial 1 and 3, USB-host	LEMO 14 pins, female
Events/GPIO	LEMO 7 pins, female

Antenna LNA Power Output

Output voltage	5 V DC
Maximum current	200 mA

[1] 1-20 Hz measurement rate
[2] Performance in open sky conditions
[3] RMS level
[4] Requires service activation from TerraStar
[6] RTK fixed ambiguities
[7] Baseline: < 40 km
[8] No information available (no almanacs, no approximate position)
[9] Ephemeris and approximate position known

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septentrio

Annex 02

Trimble R8s Rover

DATASHEET

Trimble R8s

JOBSITES THAT HAVE COMPLEX UTILITY SYSTEMS DEMAND PRECISE INFORMATION TO ENSURE DELIVERY OF THE CRITICAL SERVICES BUILDINGS DEPEND ON. FOR THESE SYSTEMS, TRIMBLE HIGH-ACCURACY GNSS, GLOBAL NAVIGATION SATELLITE SYSTEM, SYSTEMS DELIVER SUB-CENTIMETER POSITION DATA THAT ENABLES MEP CONTRACTORS TO HAVE CONFIDENCE IN THE ACCURACY OF THEIR SITE WORK AND UTILITY LAYOUT.

For more than 30 years, Trimble has been setting the standard in positioning technology and we continue to raise the bar. The combined technology of the Trimble® R8s GNSS system and the Trimble Field Link layout software provides MEP contractors just the features and benefits you need, in one easy-to-use system. It's never been easier to use GNSS technology for MEP site work and utility layout.

THE COMPLETE SOLUTION

Create an industry-leading field solution by pairing the Trimble R8s GNSS receiver with a powerful Trimble tablet controller loaded with our easy to-use Trimble Field Link software. Trimble Field Link software offers the features and capabilities to simplify everyday work. The streamlined workflow designed for the MEP contractor guides your layout crew through common project types including, top of deck layout, equipment pads, underground utilities, light pole placement, excavation and trenching locations, enabling them to get the job done faster. Once you're back in the office, Trimble Field Link enables you to import your point data with confidence.

SUPERIOR GNSS TECHNOLOGY

Each Trimble R8s comes integrated with powerful Trimble 360 tracking technology that supports signals from all existing and planned constellations. Trimble 360 technology can expand the reach of your GNSS rover to sites that were previously inaccessible due to moderate obstructions by taking advantage of the availability of additional satellite signals.

Data corrections are required for the highest level of GNSS accuracy. These corrections can be broadcast and received through an integrated wide band UHF radio or received via an internet connection to a Trimble VRS™ System. Trimble VRS, Virtual Reference Station, systems are available from a variety of public and commercial vendors.

If you are performing long distance or utility layout the Trimble R8s is the next must have addition to your layout tool box complementing your use of Trimble's Robotic Total Stations. The combination of Trimble Field Link and the Trimble R8s ensure you are able take advantage of your coordinated models, the intuitive interface of Trimble Field Link and the accuracy of GNSS for a complete office to field roundtrip workflow.

Key Features:

- Available in base only or rover only configurations
- Advanced satellite tracking with Trimble 360 receiver technology
- Intuitive Trimble Field Link interface
- Layout workflow software designed for the MEP contractor
- Manage long distance layout situations without multiple station set ups
- Perform high-accuracy QA/QC

Trimble

DATASHEET

GENERAL SPECIFICATIONS

PERFORMANCE SPECIFICATIONS[1]

Measurements

- Advanced Trimble Maxwell™ 6 Custom Survey GNSS chips with 440 channels
- Future-proof your investment with Trimble 360 tracking
- High precision multiple correlator for GNSS pseudorange measurements
- Unfiltered, un-smoothed pseudorange measurements data for low noise, low multipath error, low time domain correlation and high dynamic response
- Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwidth
- Signal-to-Noise ratios reported in dB-Hz
- Proven Trimble low elevation tracking technology
- Satellite signals tracked simultaneously:
  - GPS: L1C/A, L1C, L2C, L2E
  - GLONASS: L1C/A, L1P, L2C/A, L2P, L3
  - Galileo: E1, E5A, E5B
  - BeiDou (COMPASS): B1, B2
- Positioning rates: up to 20 Hz

POSITIONING PERFORMANCE[2]

Real Time Kinematic surveying

Single Baseline <30 km	
Horizontal	8 mm + 1 ppm RMS
Vertical	15 mm + 1 ppm RMS
Network RTK[3]	
Horizontal	8 mm + 0.5 ppm RMS
Vertical	15 mm + 0.5 ppm RMS
Initialization time[4]	typically <8 seconds
Initialization reliability[4]	typically >99.9%

HARDWARE

Physical

Dimensions	19 cm x 10.4 cm (7.5 in x 4.1 in), including connectors
Weight	1.52 kg (3.35 lb) with internal battery, internal radio and antenna 3.81 kg (8.40 lb) items above plus range pole, controller & internal radio
Operating Temperature[5]	-40° C to +65° C (-40° F to +149° F)
Storage Temperature	-40° C to +75° C (-40° F to +167° °F)
Humidity	100%, condensing
Ingress Protection	IP67 dustproof, protected from temporary immersion to depth of 1 m (3.28 ft)
Shock and vibration	Tested and meets the following environmental standards:
Shock	Non-operating: Designed to survive a 2 m (6.6 ft) pole drop onto concrete. Operating: to 40 G, 10 msec, sawtooth
Vibration	MIL-STD-810F, FIG.514.5C-1

ELECTRICAL

- Power 11 V DC to 24 V DC external power input with over-voltage protection on Port 1 (7-pin Lemo)
- Rechargeable, removable 7.4 V, 2.8 Ah Lithium-ion smart battery
- Power consumption is <3.2 W in RTK rover mode with internal radio and Bluetooth® in use[6]
- Operating times on internal battery[7]:
  - 450 MHz receive only option ..... 5.0 hours
  - 450 MHz receive/transmit option (0.5 W) ..... 2.5 hours

COMMUNICATIONS

- Serial: 3-wire serial (7-pin Lemo) on Port 1; full RS-232 serial (Deub 9 pin) on Port 2
- Radio Modem[1]: fully integrated, sealed 450 MHz wide band receiver/transmitter with frequency range of 403 MHz to 473 MHz:
  - Transmit power: 0.5 W
  - Range: 3–5 km typical / 10 km optimal[8]
- Bluetooth: fully integrated, fully sealed 2.4 GHz communications port (Bluetooth)[9]

Data Formats

- CMRx

Supported Trimble Controllers[8]

- Trimble Field Tablet

CERTIFICATIONS

FCC Part 15 (Class B device), Part 15.247 and Part 90; ICES-003, RSS-210 and RSS-119; CE Mark; C-Tick; Bluetooth EPL

1 Based on Trimble R8 GNSS receiver configuration

2 Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The specifications stated recommend the use of stable mounts in an open sky view, RM and multipath clean environment, optimal GNSS constellation configurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation time appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static specification.

3 Network RTK FKP values are referenced to the closest physical reference station.

4 May be affected by atmospheric conditions, signal multipath, obstructions and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.

5 Receiver will operate normally to -40° C, internal batteries are rated to -20° C, optional internal cellular modem operates to -40° C.

6 Tracking GPS and GLONASS.

7 Varies with temperature and wireless data rate. When using a receiver and internal radio in the transmit mode, it is recommended that an external 6 Ah or higher battery is used.

8 Varies with terrain and operating conditions.

9 Bluetooth type approvals are country specific.

Specifications subject to change without notice.

CE Bluetooth

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Trimble
http://mep.trimble.com

Annex 03

Odom CV200 singlebeam echosounder


ECHOTRAC™ CV
HYDROGRAPHIC ECHO SOUNDER
Dual Frequency with Optional Third Channel and Optional LCD Display
Modular "black box" configuration includes rack mount option, Ethernet LAN interface, frequency agile configurable transceivers, standard serial interfaces for data acquisition systems, motion sensors and DGPS receivers.
Options include modular sunlight viewable color LCD chart with internal data storage, high-resolution thermal paper recorder or display and control on your PC!
TELEDYNE
ODOM HYDROGRAPHIC
A Teledyne Technologies Company

ECHOTRAC™ CV

You asked for more convenience and superior efficiency in your hydrographic survey tools. Teledyne Odom answered.

With the Echotrac CV, Teledyne Odom delivers the perfect union of flexibility and technology, viewed through a user-friendly networked Windows interface, e-Chart. Alongside the advanced features and options that made the Echotrac MKIII a stand-out product, the CV brings users to the next level by providing an optional third acoustic channel. Whether it's a side scan, bathymetric or a shallow subbottom investigation, the CV has the flexibility to handle the task!

GENERAL SPECIFICATIONS

Frequency
- High band: 100 kHz – 1 MHz
- Low band: 3.5 kHz – 50 kHz

Output Power
- High: 100 kHz – 1 kW RMS max 200 kHz – 500 W RMS max, 750 kHz – 300 W RMS max
- Low: 12 kHz – 2 kW RMS max, 50 kHz – 2 kW RMS max

Input Power
- 110 or 220 V AC – 24 V DC 120 watts start/ 50 watts run

Resolution
- 0.01 m/0.1 ft

Accuracy
- 0.01 m/0.10 ft +/- 0.1% of depth @ 200 kHz
- 0.10 m/0.30 ft +/- 0.1% of depth @ 33 kHz
- 0.18 m/0.60 ft +/- 0.1% of depth @ 12 kHz

Depth Range
- 0.2 – 200 m /0.5 – 600 ft @ 200 kHz
- 0.5 – 1600 m/1.5 – 5000 ft @ 33 kHz
- 1.0 – 4000 m/3.0 –20,000 ft @ 12 kHz

Phasing
- Automatic scale change, 10%, 20%, 30% overlap or manual

Printer (optional)
- High resolution 8 dot/mm (203 dpi), 16 gray shades
- 216 mm (8.5 in) wide thermal paper or film
- External ON/OFF switch
- Paper advance control

Paper Speed
- 1 cm/min (0.5 in/min) to 22 cm/mm (8.5 in/min), Auto = one dot row advance for each Ping

LCD Display (optional)
- 15 in TFT screen
- High-Bright (500 NIT)
- Internal data storage DSO on 40 GB hard disk
- Data transfer via Ethernet interface or USB flash drive
- Windows XP Embedded

Sound Velocity
- 1370 – 1700 m/s
- Resolution 1 m/s

Transducer Draft Setting
- 0 – 15 m (0 – 50 ft)

Depth Display
- On control PC and remote LCD display

Clock
- Internal battery backed time, elapsed time and date clock

Annotation
- Internal – date, time, GPS position
- External – from RS232 or Ethernet

Interfaces
- 4 x RS232 or 3 x RS232 and 1 x RS422
- Inputs from external computer, motion sensor
- Outputs to external computer, remote display
- Outputs with LCD chart – VGA video out
- Ethernet interface
- Heave – TSS1 or sounder sentence

Blanking
- 0 to full scale

Installation
- Desktop or optional rack mount and bulkhead mount

Software
- e-Chart supplied

Environmental Operating Temperature
- 0° – 50° C, 5 – 90% relative humidity, non-condensing

Dimensions
- 89 mm (3.5 in) H x 432 mm (17 in) W x 325 mm (12.8 in) D

Weight
- 16 kg (35 lbs.)

Options
- Third acoustic channel (multiple configurations)
- Remote display
- Side scan transducer – single or dual channel side looking 200 kHz or 340 kHz for search and reconnaissance
- Built-in DGPS
- Subbottom Array (3.5 kHz 4 element array with stainless steel mounting frame typical)
- Wide selection of transducers

Features:
- Selectable Receiver bandwidth for shallow/ deep water echo sounding
- Silas compatible output for sediment analysis

TELEDYNE ODOM HYDROGRAPHIC
A Teledyne Technologies Company

▸ See our entire product line at: odomhydrographic.com

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Annex 04

Kongsberg EM2040C multi beam echosounder

EM® 2040C
Multibeam echo sounder

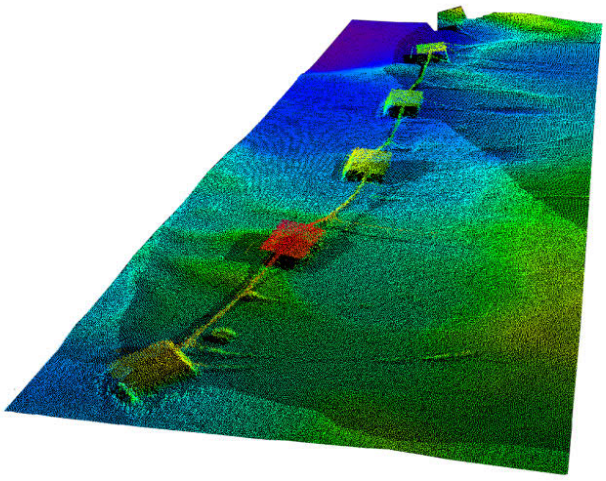
KONGSBERG

Key facts

Description

The EM 2040 Compact is a shallow water multibeam echo sounder based on the EM 2040 technology, an ideal tool for any high resolution mapping and inspection application. The receiver and transmitter are integrated in a common Sonar Head, with the same dimensions as the EM 3002. The system fulfils and even surpasses the IHO-S44 special order and the more stringent LINZ specification.

The EM 2040C is available in an EM 2040CX version where the subsea part has a depth rating of 1500 m for operation on ROV or AUV.



System features:

- High resolution
- Wide frequency range
- Short pulse lengths, large bandwidth
- FM chirp
- Complete roll and pitch stabilization
- Nearfield focusing both on transmit and receive
- Water column
- Seabed image
- Depth rated to 50 m or 1500 m depending on version
- Easy to install
- Dual Head
- Dual swath as option

The operating frequency range is from 200 to 400 kHz with frequency selection in step of 10 kHz, enabling the user to choose on the fly the best operating frequency for the application. Due to the very large operating bandwidth available the system will have an output sample rate of more than 60 kHz. The system will thus effectively operate with very short pulse lengths, less than 25 microseconds, which gives a raw range resolution ($c\tau/2$) of 18 mm.

By utilizing both CW and FM chirp pulses, the system can achieve a much longer range capability with a high resolution. The maximum depth range is 490 m at 200 kHz with a swath with up to 625 m with Dual Head.

The angular coverage for 200 to 300 kHz is 130º with one Sonar Head, allowing coverage of 4.3 times water depth. With two Sonar Heads, tilted 35-40 degrees to each side, 200 º can be covered. This allows surveying to the water surface or up to 10 times water depth on flat bottoms. For frequencies above 320 kHz the angular coverage per head is gradually decreasing to 70º at 400 kHz.

As an option the EM 2040C can be delivered with the dual swath capability, allowing a sufficient sounding density along track at a high vessel speed.

Components

The basic EM 2040C has three units: A Sonar Head, a processing unit and a workstation. For completeness, data input from a motion sensor and a positioning system is required, as is the sound speed profile of the water column between the transducers and the bottom. Sound speed at the transducer depth is an optional input. Optionally, the Sonar Head(s) may be delivered mounted on a frame together with the motion sensor and a sound speed sensor, factory aligned for ease of mounting. All electronics are contained in the Sonar Head(s) which is interfaced to the Processing Unit via GBit Ethernet. The Processing Unit also supplies 48 V power via the same cable. Operator control, data quality inspection and data storage is handled by the hydrographic workstation running SIS software or by 3rd party software.

EM 2040C Technical specifications

Specifications

Frequency range:	200 to 400 kHz in steps of 10 kHz
Beam width:	1 * 1° at 400 kHz
Max ping rate:	50 Hz
Swath coverage sector:	Up to 130º (single head) / 200 º (dual head)
Sounding patterns:	Equiangular, equidistant and high density
No. of soundings per ping:	400 (single head, single swath) 800 (single head, dual swath) 1600 (dual head, dual swath)
Roll stabilized beams:	+/-15°
Pitch stabilized beams:	+/-10°
Pulse length:	25 µs to 12 ms

Coverage example for EM 2040C in cold ocean water with bottom type rock (BS = - 10 dB), FM mode:

	Max depth	Max coverage across	
		Single head	Dual head
200 kHz	490 m	525 m	625 m
300 kHz	450 m	525 m	625 m
350 kHz	400 m	475 m	570 m
400 kHz	350 m	350 m	500 m

Physical dimensions (excluding connectors and mounting arrangements)			
Sonar head EM 2040C	332 * 119 (diameter * height)	18.8 kg (8.4 kg in water)	Depth rating 50 m
Sonar head EM 2040CX	332 * 122 (diameter * height)	26.1 kg (17 kg in water)	Depth rating 1500 m
Processing Unit (2U 19" rack) *	482.5 x 88.6 x 424 mm (W x H x D)	10.5 kg	NA

* One PU can process two swaths

Laptop, HWS and monitor can be delivered on request.

EM® is a registered trademark of Kongsberg Maritime AS in Norway and other countries.

Kongsberg Maritime is engaged in continuous development of its products, and reserves the right to alter the specifications without further notice.

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KONGSBERG

Annex 05

Octans GIV Motion Sensor

OCTANS 3000

HIGH-PERFORMANCE SUBSEA GYROCOMPASS AND MOTION SENSOR

OCTANS 3000 is a subsea survey-grade gyrocompass and complete motion sensor for water depths up to 3,000m. Based on **iXBlue**'s FOG technology it outputs heading, roll, pitch, heave, rate of turn and acceleration. **OCTANS 3000** can be easily upgraded to full INS mode (i.e. ROVINS).

FEATURES

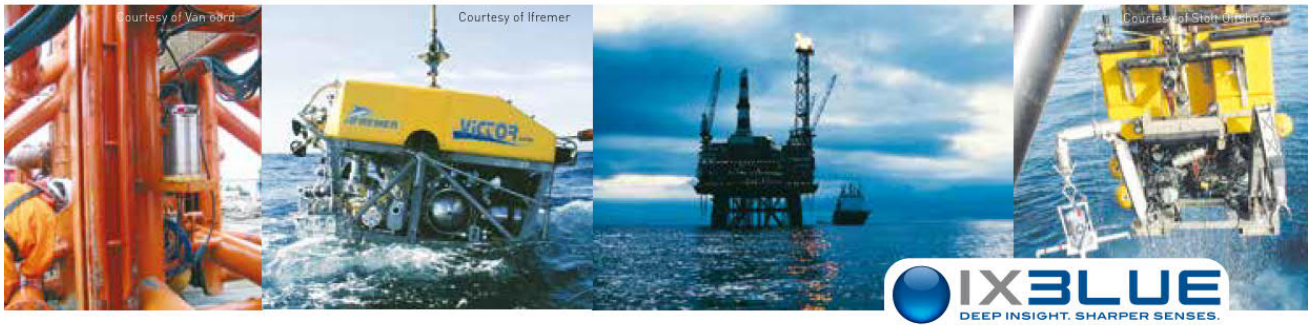
- Complete gyrocompass and motion sensor
- Smart Heave™
- Fiber Optic Gyroscope (FOG), unique strap-down technology
- Ethernet, Web-based Man-Machine Interface (MMI)
- Titanium made, small, portable plug and play system
- Optional full featured Inertial Navigation System

BENEFITS

- High-performance real-time outputs of true heading, roll, pitch, heave, surge, sway, acceleration and rate of turn
- No spinning element hence maintenance free
- Lightweight corrosion free housing for water depth up to 3,000 m, easy to integrate and interface, saves valuable mobilization time
- Obtain INS-class system with simple software upgrade

APPLICATIONS

• ROV & offshore survey • Multibeam and sonar motion reference
• Dredging • Marine construction



Annex 06

Valeport Swift

OCTANS 3000
TECHNICAL SPECIFICATIONS

Ethernet

PERFORMANCE

Heading	
Accuracy [1][2]	0.1 deg secant latitude
Resolution	0.01 deg
Full accuracy settling time (all conditions)	< 5 min
Heave accuracy [3]	2,5 cm or 2,5% (whichever is greater)
Roll / Pitch	
Dynamic accuracy [2]	0.01 deg
Resolution	0.001 deg

OPERATING RANGE / ENVIRONMENT

Operating / Storage Temperature	-20 to +55°C/ -40 to +80 °C
Follow-up speed	Up to 750 deg/s
Acceleration dynamic range	±15 g
Heading / Roll / Pitch	0 to +360 deg / ±180 deg / ±90 deg
MTBF (computed/observed)	40,000 hours / 80,000 hours
No warm-up effects, insensitive to thermal shocks	
Shock and vibration proof	

PHYSICAL CHARACTERISTICS

Depth rating (m)	Material	Weight in air/water [kg]	Housing dimensions (Ø x H mm)	Connector	Mounting
3000	Titanium	15 / 6,2	213 x 375	5 x SEACON MI-CON	6 Ø 6,6 holes

INTERFACES

Serial RS232/RS422 port	5 inputs / 5 outputs / 1 configuration port
Ethernet port [5]	UDP / TCP Client / TCP server
Pulse port [6]	3 inputs / 2 outputs
Sensors supported	GPS, Speed log
Intput/Output formats	Industry standards: NMEA0183, ASCII, BINARY
Baud rates	600 bauds to 115.2 kbaud
Data output rate	0.1 Hz to 200 Hz
Power supply	24 VDC
Power consumption	< 20 W

[1] secant latitude = 1 / cosine latitude
[2] RMS values
[3] Smart Heave™
[4] All input /output serial ports are available and can be duplicated on Ethernet ports
[5] Input of GPS PPS pulse for accurate time synchronization of OCTANS 3000
[6] Maximum error = 3 or RMS error
Specifications subject to change without notice

2012-02-PS-OCT3000

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IXBLUE DEEP INSIGHT. SHARPER SENSES.

Annex 06

Valeport Tidemaster

VALEPORT

TideMaster

TideMaster has been designed to provide an accurate, versatile and easily deployed tide gauge for use in short or long term survey operations. Optional control/display panel, Bluetooth, SD card memory and optional weather sensor provide unrivalled functionality. Low power consumption and user selectable sampling regime allow for up to a year of autonomous operation, whilst optional telemetry packages extend the capabilities for real time operations. TideMaster is compatible with a wide range of hydrographic software and tools.

Pressure Transducer

Type: Vented strain gauge, with stainless steel mounting bracket.
Range: Standard 10dBar (approx 10m), with 20m cable. Other ranges and lengths available.
Accuracy: ±0.1% Full Scale.
Calibration: Held within logging unit.
Dimensions: 18mm diameter x 80mm.

Weather Sensor

Type: Ultrasonic - Wind Speed and Direction
Range: 0-60m/s 0-359°
Accuracy: ±2%@12m/s
±3°@12m/s
Calibration: Held within Sensor.
Dimensions: 142mm x 160mm.

Logging Unit

Housing: Injection moulded housing rated to IP67, with injection moulded mounting bracket.
Display: Optional control/display (128x64 OLED) panel for system configuration and data display.
Power: 4 "C" cells within separate sealed compartment.
Tool-less battery change.
Alkaline cells provide power for up to a year of autonomous sampling
Memory: 512 MB SD card memory allowing for effectively unlimited data storage.
Sampling: Raw data sampled at 8Hz, mean and standard deviation of burst samples is logged.
5 pre-programmed burst modes + custom sampling mode.
Continuous Sampling Mode (1Hz)
Switching: Power switch on unit.
Resolution: Data logged to 1mm resolution.
Comms: Integral Bluetooth for short range wireless communication
RS232/RS485 for cabled communication
Dimensions: Housing 52 mm x 144.5 mm x 197 mm.
Bracket 35 mm x 210 mm x 159 mm.
Mounted 61.5mm x 210 mm x 197 mm
Weight: 1.1 kg (approx) including batteries.

Radio Telemetry

Frequency: Selectable frequency UHF synthesised radio transceiver, operating in UK licence exempt band (458.5 - 458.9 MHz).
Power output: Supplied as nominal 100mW peak output.
RS232 output: 4800 baud, 8,1,N.

Aerials
Transmitter: ¼ wave 'rubber duck' (standard, ~2km).
3dB omni-directional (option, ~10km)
Receiver: 3dB omni-directional.

Power input
Transmitter: External 12vDC supply.
Current: 0.04mA sleep, 120mA receive, 410mA transmit.
Receiver: External 12vDC input
Current: 120mA receive, 410mA transmit.

Transmitter Physical
Materials: IP67 Black anodised aluminium box.
Size: 200mm x 200mm x 70mm.
Connectors: To antenna, TideMaster & external power supply.

Receiver Physical
Materials: Desktop style anodised aluminium box.
Size: 200mm x 180mm x 70mm.
Connectors: To antenna, 12vDC input & RS232 output.

GSM/GPRS/Bluetooth Telemetry

Please contact Valeport to discuss GSM/GPRS/Bluetooth telemetry requirements

Ordering

0741001 TideMaster Portable water level recorder set c/w 1 Bar Titanium vented transducer, wall mounting bracket and 20m cable, electronics/logger (**with display**) in rugged injection moulded housing with batteries. Supplied with Windows based TideMaster Express software and operating/instruction manual.

0741002 TideMaster Portable water level recorder set c/w 1 Bar Titanium vented transducer, wall mounting bracket and 20m cable, electronics/logger (**without display**) in rugged injection moulded housing with batteries. Supplied with Windows based TideMaster Express software and operating/instruction manual.

Datasheet Reference Number: TideMaster v1A

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Annex 07

Valeport Swift

SWiFT SVP Sound Velocity /Temperature/ Pressure Salinity /Conductivity / Density

Designed from the outset with the intention of a seamless workflow, the SWiFT profiler provides survey-grade sensor technology coupled with the convenience of Bluetooth connectivity and rechargeable batteries. An integral GPS module, to geo-locate each profile, completes the package. Data can be easily and quickly downloaded and reviewed wirelessly, via Bluetooth, using the SWiFT App on iOS devices and instantly shared, in industry standard SVP formats through email and cloud services. Using the provided USB adapter or cable, Valeport's DataLog x2 software package provides further tools.

In addition to the directly measured sound speed, temperature and pressure observations, Conductivity, Salinity and Density are calculated using Valeport's proprietary algorithm developed from extensive laboratory and field work.

With an operational battery life of up to 5 days and the convenience of charging via USB, SWiFT is intended for coastal, harbour and inland hydrographic survey use and offers the highest quality sound velocity profiles in a compact, robust and portable package.

Optionally, the supplied deployment weight is available to bolt onto the sensor protection cage to help get the SWiFT to depth in fast flowing currents.

Sensor Specifications

The SWiFT SVP is fitted with Valeport's digital time of flight sound velocity sensor, temperature compensated piezo-resistive pressure transducer and a PRT temperature sensor

Sound Velocity	
Range:	1375 – 1900 m/s
Resolution:	0.001 m/s
Accuracy:	±0.02 m/s
Pressure	
Range:	10 Bar or 20Bar
Resolution:	0.001% FS
Accuracy:	±0.05% FS
Temperature	
Range:	-5°C to +35°C
Resolution:	0.001°C
Accuracy:	±0.01°C

Calculated Accuracies	
Conductivity:	±0.05 mS/cm
Salinity:	±0.05 PSU
Density:	±0.05 kg/m³

Physical	
Materials:	Titanium Stainless Steel deployment weight
Depth Rating:	200m
Dimensions:	Ø78mm x Length 277mm 321mm with deployment weight
Weight:	2.0kg (in air) / 0.9kg (in water) 3.0kg (in air) /1.8kg (in water) with deployment weight

Communications (set up and data offload)

USB Serial
Bluetooth v4 - low energy

Memory

2 GB Internal Flash Card Storage

Electrical	
Battery:	Internal Rechargeable Battery Pack
Battery Life:	Up to 5 days of operations
Charging:	USB typically, 1 hour fast charging will give 12 hours operation

Software

iOS App for Bluetooth 4 compatible iPad and iPhone – instrument set up, data offload, display and translation to common SVP formats, Android to follow.
DataLog x2 Windows based PC software, with both USB cable and Bluetooth 4 connectivity, for instrument setup, data extraction, display and translation to common SVP formats.

Ordering

0660047 **XX**	SWIFT SVP Profiler - Titanium housing rated to 200m
Note: **XX** pressure transducer range - select from 10 or 20 Bar	
	Supplied with: • Deployment weight • 20m deployment line • PC Bluetooth adapter • USB interface and charging cable • 1.5 A charger • DataLog x2 software, operating manual • System transit case

Data Sheet Reference: SWiFT SVP - May 2016

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Annex 08

Autopatch