Public Works and Government Services Canada

Travaux publics et Services gouvernementaux Canada

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RETOURNER LES SOUMISSIONS À:

Bid Receiving
PWGSC
33 City Centre Drive
Suite 480
Mississauga
Ontario
L5B 2N5
Bid Fax: (905) 615-2095

LETTER OF INTEREST
LETTRE D'INTÉRÊT

Comments - Commentaires

Title - Sujet
Next Generation Buoy and AVOS RFI

Solicitation No. - N° de l'invitation	Date
K3D33-120110/A	2012-07-06
Client Reference No. - N° de référence du client	**GETS Ref. No. - N° de réf. de SEAG**
K3D33-120110	PW-$TOR-224-5961
File No. - N° de dossier	**CCC No./N° CCC - FMS No./N° VME**
TOR-2-35076 (224)	

Solicitation Closes - L'invitation prend fin
at - à 02:00 PM
on - le 2012-08-20

Time Zone
Fuseau horaire
Eastern Daylight Saving Time EDT

F.O.B. - F.A.B.
Plant-Usine: ☐ **Destination:** ☐ **Other-Autre:** ☐

Address Enquiries to: - Adresser toutes questions à:	Buyer Id - Id de l'acheteur
Juan, Peggy	tor224
Telephone No. - N° de téléphone	**FAX No. - N° de FAX**
(905) 615-2467 ( )	(905) 615-2060

Destination - of Goods, Services, and Construction:
Destination - des biens, services et construction:

DEPARTMENT OF THE ENVIRONMENT
4905 DUFFERIN STREET
DOWNSVIEW
Ontario
M3H5T4
Canada

Instructions: See Herein

Instructions: Voir aux présentes

Vendor/Firm Name and Address
Raison sociale et adresse du fournisseur/de l'entrepreneur

Delivery Required - Livraison exigée	Delivery Offered - Livraison proposée
See Herein	

Vendor/Firm Name and Address
Raison sociale et adresse du fournisseur/de l'entrepreneur

Telephone No. - N°de téléphone
Facsimile No. - N° de télécopieur

Name and title of person authorized to sign on behalf of Vendor/Firm (type or print)
Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)

Signature **Date**

Issuing Office - Bureau de distribution
Public Works and Government Services Canada
Ontario Region
33 City Centre Drive
Suite 480
Mississauga
Ontario
L5B 2N5

Canada

See Attached.

Environment Canada Environnement Canada

REQUEST FOR INFORMATION REGARDING NEXT GENERATION PAYLOAD FOR MSC MOORED BUOY AND AVOS NETWORKS

TABLE OF CONTENTS

PART 1: REQUEST FOR INFORMATION

Environment Canada Next Generation Buoy and AVOS Payload RFI

1.1 BACKGROUND AND PURPOSE OF THIS REQUEST FOR INFORMATION (RFI)

(a) RFI Overview:

The Meteorological Service of Canada (MSC) of Environment Canada (EC) is seeking to upgrade the data acquisition, systems management, and communications systems (hereafter the term "payload" will be used) installed on the moored weather buoy and AVOS (Automated Volunteer Observing Ship) networks and is using the Request for Information (RFI) process to solicit industry opinions and feedback to help further define this requirement

Environment Canada (EC) is issuing this RFI as a means of gathering information to assist in accomplishing the following specific purposes:

- To validate EC's functional and technical requirements against *currently available* vendor marketplace offerings;
- To verify capability and interest from the marketplace to provide a new marine payload solution to EC which will need to be integrated into existing moored buoy hulls, and ship installations, and make use of the existing suite of sensors, satellite transmitters and periphery devices (antenna, solar panels etc.) ; and
- To determine the extent to which there exists **current** capacity within the marketplace to offer a "turn-key" or integrated solution as well as the ability to acquire related support services during and subsequent to the upgrade of the marine payload (i.e. integration, warranty, maintenance, training, etc.).

The information provided in response to this Request for Information (RFI) process should be reflective of what is ***currently*** available within the marketplace. The information provided, while incorporating any lessons learned therein, will partly contribute to the scope and range of service offerings sought by EC in any subsequent solicitation process.

(b) Background:

The mandate of the Meteorological Service of Canada (MSC) is to enhance public safety and informed decision making by issuing weather warnings; forecasting weather, ice and wave conditions; supporting critical weather-sensitive government services; monitoring atmospheric conditions and predicting the state of the climate; monitoring water levels, and providing scientific research for service improvement and policy advice.

Within EC, and part of the Meteorological Service of Canada, the National Marine Networks group manages and administers a network of operational weather buoys along with ship-board automated weather stations for the Government of Canada. The network consists of approximately 50 moored weather buoys strategically located on Canadian east and west coasts, some as many as 700 Km off shore. In addition to these permanent moorings seasonal buoys are deployed on the Great Lakes and other interior waterways. The ship-board automatic weather stations (AVOS) are presently installed on 55 vessels, with plans in place to expand the network to 75 vessels. Approximately half of the current AVOS systems are installed on Canadian Coast Guard vessels, including ice breakers that traverse Arctic waters.

The moored buoy and AVOS systems presently provide automated measurements of the following environmental variables;

- Wind speed and direction (dual anemometers on many systems)
- Atmospheric Pressure (dual barometers on many systems)
- Air temperature
- Dew point temperature
- Sea surface temperature
- Wave height (significant and maximum wave) and wave period
- AVOS also allows for input of manual elements included in standard FM13 SHIP reports

Both the moored buoy and AVOS systems are designed for autonomous operation for 12 months or longer. Current maintenance intervals target 12-month inspection and maintenance of the equipment; however this interval is frequently extended to 18 months or longer due to logistical constraints of ship time provided by the Canadian Coast Guard.

Image 1 - Map of current MSC moored buoy network.

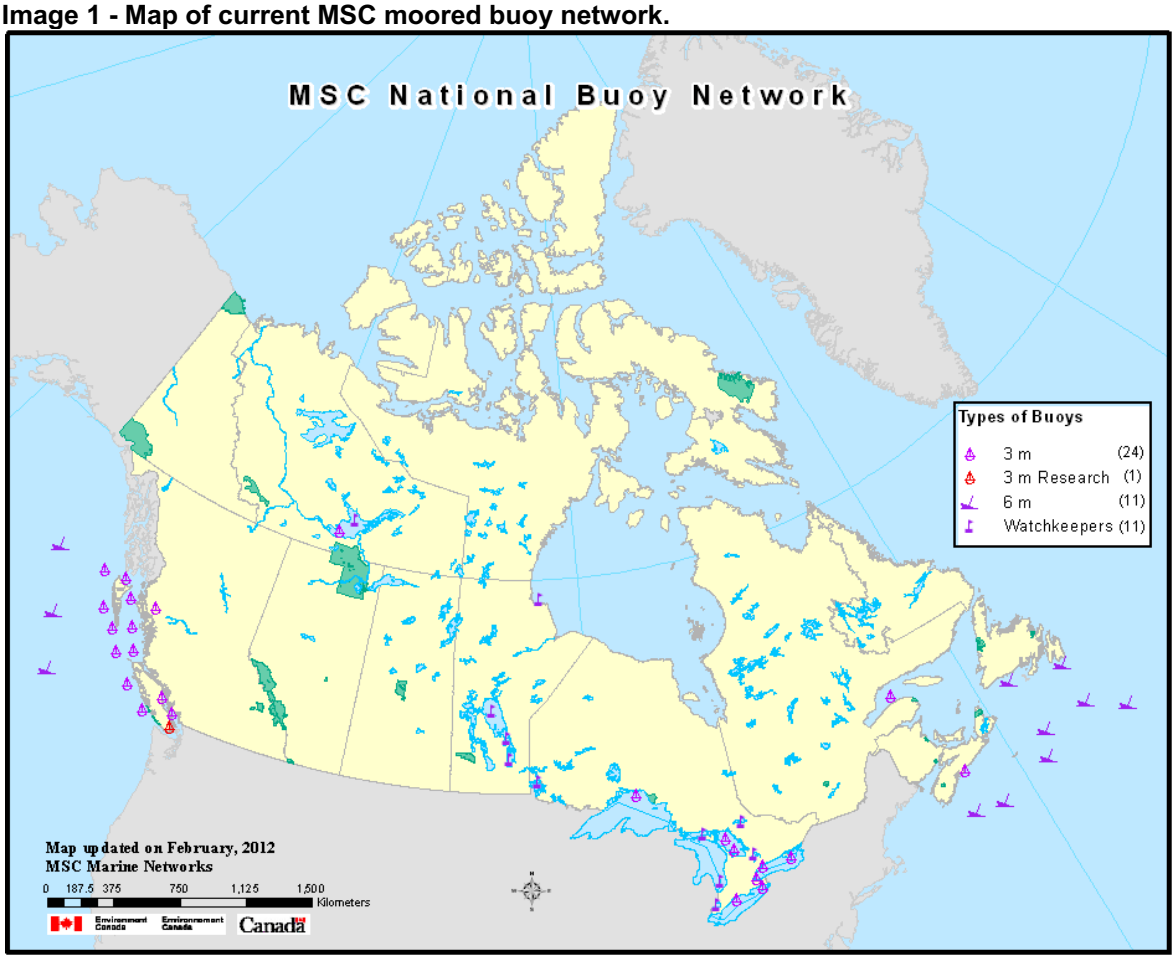
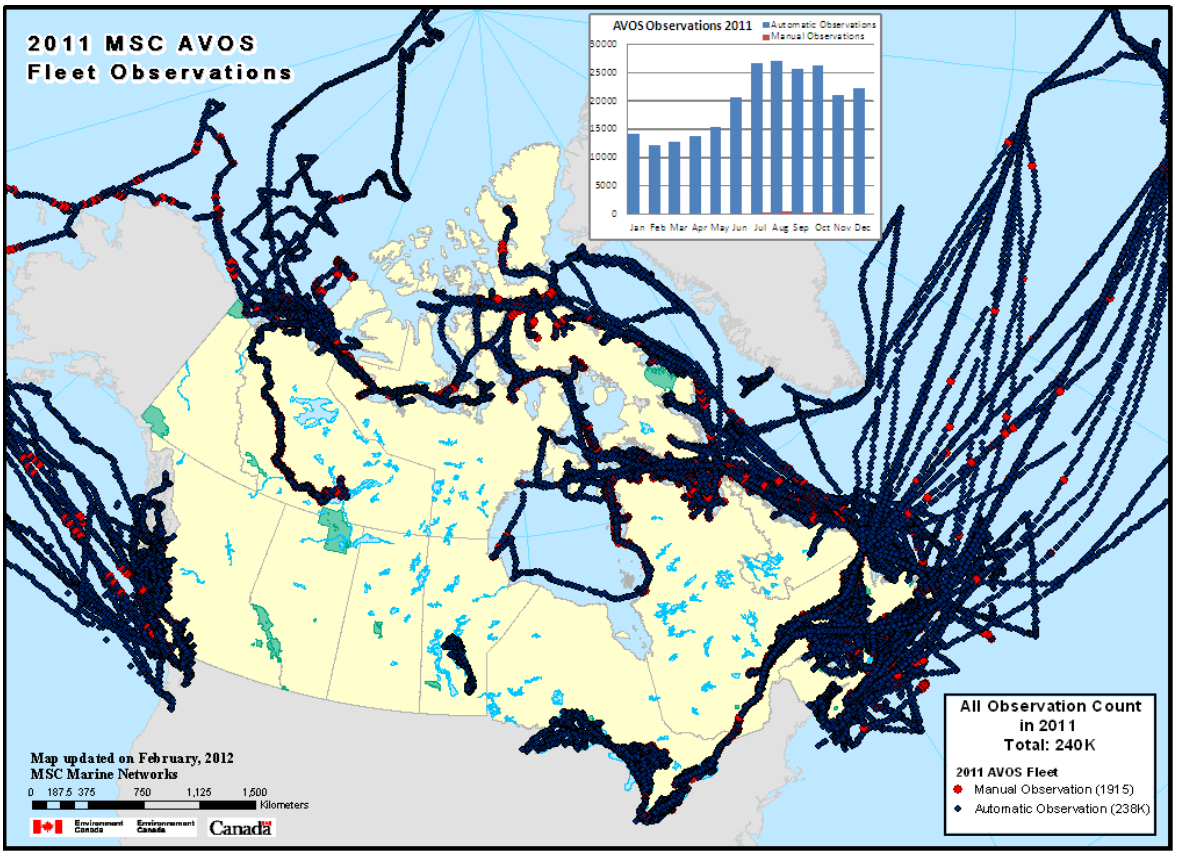


Image 2 - Map of current MSC AVOS network.



Presently, all moored buoy and AVOS systems deployed operationally by EC, along with network spares utilize the **WatchMan100** designed and built by AXYS Technologies Inc. located Sidney British Columbia, Canada. EC has worked closely with AXYS for over two decades to design, deploy, and operate the current buoy and AVOS networks. The WatchMan100 system has been used operation*a*lly by EC Marine Networks for more than 10 years, and a requirement has been identified to move to a newer generation system that will provide additionally functionality, and ensure operation for the next 5-10 years into the future.

For additional technical details and specifications regarding EC's planned upgrade requirement, please refer to:

- **Appendix A** - *MOORED BUOY AND AVOS BLOCK DIAGRAMS*
- **Appendix B** - *MOORED BUOY AND AVOS MECHANICAL DIAGRAMS*
- **Appendix C** - *LIST OF CURRENTLY DEPLOYED SENSORS & DEVICES*
- **Appendix D** *CURRENT PAYLOAD DATA SAMPLING REGIME AND DATA FORMAT FOR BUOYS*
- **Appendix E** - *AVOS BRIDGE SOFTWARE GRAPHICAL USER INTERFACE (GUI) FUNCTIONS DESCRIPTION*
- **Appendix F** - *MOORED BUOY POWER BUDGET*
- **Appendix G** - *SPACE AVAILABILITY OF MOORED BUOYS (Watchkeeper, 3 Meter Buoy, and Nomad) WITH PHOTOS*
- **Appendix H -** *LIST OF MSC OPERATIONAL MOORED BUOYS*
- **Appendix I -** *LIST OF AVOS IN MSC OPERATIONAL NETWORK*

(c) Purpose:

Through a future RFP process, Environment Canada will seek a single Contractor to complete all or portions of the design, supply, installation, and integration of a next generation marine payload. In addition to the supply and integration, Environment Canada, through this RFI, is also interested in understanding industry capacity to support future in-field service along with repair and maintenance requirements that will likely be required for 8-10 years following selection and implementation of a new Marine Payload technology.

To support this goal, EC is undertaking, through this RFI, an industry consultation process, to seek feedback and advice from industry about current capacity within the market to:

- Provide the equipment components for the planned upgrade that are capable of working with existing buoy hulls and current suite of sensors, while also meeting EC's requirements for a proven and rugged design suitable for the harsh marine environment.
- Provide and configure payloads for installation into existing moored buoy and AVOS networks and provide related support services subsequent to the upgrade (i.e. integration, warranty, maintenance, training, etc.).
- Limitations; power, sensors, space limitation,
- Limitation; power, operating conditions, space, connectors

(d) Scope:

The planned technology upgrade and integration of a new Marine Payload will involve the replacement of the existing systems, and will involve the physical installation and integration into MSC's existing moored buoy and AVOS networks. It is the intention of the MSC to continue to use the existing infrastructure including the moored buoy hulls and AVOS wind towers and component enclosures. In addition, the new marine payload must integrate the existing suite of environmental sensors and peripheries (i.e. GPS, antenna, satellite transmitters, solar panels) - See Appendix C for details. Finally, it is expected that the new Marine Payload will operate within the existing power budget for each type of moored buoy deployed in the network. Specific details of the current moored buoy and AVOS configuration can be found in Appendix A (system description) and Appendix B (drawings and photos).

In addition to the provision of the new Marine Payload, the MSC is also interested in understanding the capacity of industry to provide initial system integration and configuration, and possibly ongoing field support and installation services in Canada during the complete life cycle of the marine payload components.

(e) Definitions and Acronyms

Within this RFI, initially capitalized terms shall have the meanings set out in this Sub-section (whether capitalized or not), unless the context requires otherwise.

"RFI" means Request for Information and includes any schedules or parts of this document and its annexes.

"Respondent" means an Individual or Corporation that has submitted a response to, and in accordance with, this RFI.

"Response" means a written response to this RFI submitted by a Respondent.

"Marine Payload" means the onboard electronics which manage the data acquisition, power and communication systems on autonomous moored weather buoys and ship based automatic weather stations (AVOS).

1.2 NATURE OF THIS REQUEST FOR INFORMATION

This is not a bid solicitation. This RFI will not result in the award of any contract. As a result, potential suppliers of any goods or services described in this RFI should not reserve stock or facilities, nor allocate resources, as a result of any information contained in this RFI. Nor will this RFI result in the creation of any source list. Therefore, whether or not any potential supplier responds to this RFI will not preclude that supplier from participating in any future procurement.

Also, the procurement of any of the goods and services described in this RFI will not necessarily follow this RFI. This RFI is simply intended to solicit feedback from industry with respect to the matters described herein.

1.3 NATURE AND FORMAT OF RESPONSES REQUESTED

Respondents are requested to provide their comments, concerns and, where applicable, alternative recommendations regarding how the requirements or objectives described in this RFI could be satisfied. Respondents are also invited to provide comments regarding the content, format and/or organization of any draft documents included in this RFI. Respondents should explain any assumptions they make in their responses.

1.4 RESPONSE COSTS

EC will not reimburse any respondent for expenses incurred in responding to this RFI.

1.5 TREATMENT OF RESPONSES

(a) Use of Responses: Responses will not be formally evaluated. However, the responses received may be used by EC to develop or modify procurement strategies or any draft documents contained in this RFI. EC will review all responses received by the RFI closing date.

(b) Review Team: A review team composed of representatives of EC will review the responses. EC reserves the right to hire any independent consultant, or use any Government resources that it considers necessary to review any response. Not all members of the review team will necessarily review all responses.

(c) Confidentiality: Respondents should mark any portions of their response that they consider *Proprietary* or *Confidential.* EC will handle the responses in accordance with its obligations under the *Access to Information Ac and Privacy Act*.

Although one of the primary purposes of this RFI is to obtain information directly from industry that will be used by EC to develop or modify procurement strategies or any draft documents contained in this RFI, EC will in no way make any direct attribution of any information obtained from Respondents that has been identified as "confidential" or "proprietary" within their Responses.

(d) Follow-up Activity: Should Respondents include within their response information which is of particular relevance and interest to EC, and should EC (at its exclusive option) determine that follow-on clarification meeting(s) with one or more Respondents would be of potential benefit to EC, then EC may (at its exclusive option) invite selected Respondents to participate in one-on-one "clarification meeting(s)" to provide clarification on their Response(s), demonstrate their

technologies or make a presentation to MSC Representatives, in order for EC to learn more about the capabilities and features of their Response. Any information identified as *Confidential* or *Proprietary* by the Respondent during the follow-on clarification meeting (s) will be treated as confidential information to the extent permitted under the *Access to Information Act* and the *Privacy Act.*

Any requested clarification meetings may take place at EC's facilities, location to be determined, or may take place via teleconference or other mutually convenient means, as agreed to between EC and the selected Respondents.

EC will not reimburse any Respondent for expenses incurred in responding to this RFI. Respondents will be responsible for all of their costs associated with the preparation and submission of any Response to this RFI, including any costs associated with accepting EC's invitation(s) to participate in any clarification meeting(s) with EC.

1.6 CONFIDENTIALITY OF RESPONDENT INFORMATION

(a) Although EC is seeking detailed responses from Respondents to this RFI, it is understood that Respondents may not be willing or able to address all of the information sought by EC.

(b) EC will maintain the confidentiality of the information marked as *Confidential* or *Proprietary* in the Respondent's response to the extent permitted under the *Access to Information Act* and the *Privacy Act.*

(c) Although one of the primary purposes of this RFI is to obtain information and recommendations directly from industry knowledge leaders that will be used to support EC's preparation in project planning, EC will in no way make any direct attribution of any information obtained from Respondents that has been identified by Respondents as "confidential" or "proprietary" within their responses.

(d) EC will not impose any future obligations or commitments on Respondents with respect to claims or cost information contained within their responses to this RFI.

1.7 CONTENTS OF THIS RFI

(a) This RFI contains a draft Statement of Requirements. This document remains a work in progress and respondents should not assume that new requirements will not be added to any bid solicitation that is ultimately published by EC. Nor should respondents assume that none of the requirements will be deleted or revised. Comments regarding any aspect of the requirements are welcome.

1.8 FORMAT OF RESPONSES

(a) Cover Page: If the response includes multiple volumes, respondents are requested to indicate on the front cover page of each volume the title of the response, the RFI number, the volume number and the full legal name of the respondent.

(b) Title Page: The first page of each volume of the response, after the cover page, should be the title page, which should contain:

(i) the title of the respondent's response and the volume number;

(ii) the name and address of the respondent;

(iii) the name, address and telephone number of the respondent's contact;

(iv) the date; and

(v) the RFI number.

(c) Response Structure: In order to gain the greatest value from responses to this RFI, and to facilitate a consistent and structured assessment of the information provided to EC within their responses, Respondents are asked to structure their responses to match the order in which the questions are asked in Part 2 - Request for Information - Response Template, of this RFI package.

Any functionality identified by Respondents must be based upon the most recent release of a product that is currently commercially available.

(d) Documentation: Respondents are requested to provide one (1) softcopy of product datasheets, user, system and/or other manuals that describe the functionality and technical specifications of the Respondent's product / solution.

(e) Additional Capabilities: Respondents may also provide explanations of additional functionality (e.g. functionality not included in Section 2, that the supplier believes may be relevant to EC's business requirements) or extended capabilities (e.g. functionality that exceeds the requirements set out in Section 2). Respondents wishing to provide such information are asked to include with their submission a separate attachment that clearly itemizes additional functionality elements and extended capabilities, providing a brief description and including page references where more complete descriptions can be found in their documentation.

(f) Numbering System: Respondents are requested to prepare their response using a numbering system corresponding to the one in this RFI. All references to descriptive material, technical manuals and brochures included as part of the response should be referenced accordingly.

(g) Number of Copies: Canada requests that Respondents submit one (1) ***hardcopy*** and one (1) ***softcopy*** of their Response and one (1) ***softcopy*** of their product documentation (as per section 1.8 (d)). Softcopies may be provided on a CD or DVD with the main body of the Response. The documentation should be in one of the following file formats – PDF, MS Word or HTML.

(h) Complete Responses: Canada requests that Respondents submit complete and detailed Responses, addressing all of the issues specified in Section 2. Product brochures and other vendor documentation provided ***without*** a complete RFI response will not be evaluated. Canada reserves the right to determine which RFI response will be evaluated based on the quality and completeness of the responses received.

1.09 ENQUIRIES

Because this is not a bid solicitation, Canada will not necessarily respond to enquiries in writing or by circulating answers to all potential suppliers. However, respondents with questions regarding this RFI may direct their enquiries to:

Contracting Authority: Peggy Juan

E-mail Address: peggy.juan@pwgsc-tpsgc.gc.ca

Telephone: (905) 615-2467

Facsimile: (905) 615-2060

EC will undertake best efforts to provide answers to all questions that are received.

1.10 SUBMISSION OF RESPONSES

(a) Time and Place for Submission of Responses:
Response is to be provided to the Contracting Authority on or before the closing date of the RFI at this address:

Bid Receiving Unit

Public Works and Government Services Canada

33 City Centre Dr., Suite 480,

Mississauga, ON L5B 2N5

Responses should not be sent directly to the Contracting Authority.

(b) Responsibility for Timely Delivery:
Each respondent is solely responsible for ensuring its response is delivered on time to the correct address. Response received after closing date may not be reviewed by Canada.

(c) Identification of Response:

Each respondent should ensure that its name and return address, the RFI number and the closing date appear legibly on the outside of the response.

(e) Respondents may develop their Responses in either Official Language of Canada.

1.11 RESERVED RIGHTS

In addition to any other expressed or implied rights, EC reserves the right to:

(a) Cancel this RFI process at any time;

(b) Issue a new RFI for the same or similar information;

(c) Change the structure of the RFI process;

(d) Vary or extend any date or time in this RFI at any time, and for such period as EC, in its absolute discretion, considers appropriate;

(e) Make changes, including substantial changes to the requirements as described in this RFI. Substantial changes will be communicated to all potential Respondents;

(f) Request written clarification or the submission of supplementary information from any or all Respondents, or provide additional information or clarification;

(g) Contact any customer or reference provided within a Respondent's response, as part of its assessment process; and

(h) Not consider any response which contains information which EC (in its exclusive opinion) believes to contain misrepresentations or any other inaccurate, suspicious or misleading information.

PART 2: REQUEST FOR INFORMATION - RESPONSE TEMPLATE

Environment Canada Next Generation Marine Payload

In order to gain the greatest value from responses to this RFI and to facilitate a consistent and structured assessment of the information provided to EC, Respondents are asked to structure their responses in accordance with the following Response Template:

2.1 CORPORATE AND PRODUCT PROFILES:

Respondents are asked to provide brief Corporate and Product profile information as follows, to be included as a separate attachment to their submission:

2.1.1 CORPORATE PROFILE

Including:

(a) number of years in business;
(b) countries in which the Respondent does business;
(c) identity, including a brief description and location of any partners in Canada;
(d) revenues (most recently completed fiscal year);
(e) number and location of Canadian offices;
(f) number of staff currently employed, and any sub-Contracting relationships;
(g) other related business lines/products; and
(h) recent corporate highlights (e.g. accomplishments, awards, etc.).

2.1.2 PRODUCT PROFILE FOR MARINE PAYLOAD SOLUTION

Including:

(a) year in which product(s) was first released;
(b) number or frequency of new releases since first released;
(c) number of current installations;
(d) major clients and an indication of the extent of use of the product by the clients (also, where possible, provide a named individual agreeable to being contacted as a client reference);
(e) links to recent articles, reviews, press releases concerning the product(s); and
(f) testimonials or case studies describing customer successes.

2.1.3 PRODUCT AND SERVICE DELIVERY SCHEDULE

(a) Given the purpose and scope outlined in Section 1.1 of this RFI, what is the approximate time that would be required for delivery of a prototype buoy and AVOS payload for assessment and acceptance by MSC Technical Authority?
(b) Following acceptance of the prototype, how much time would be required to deliver the first ten complete units (i.e. initial production)?
(c) Following acceptance of the prototype, how much time would be required to provide complete technical documentation, along with training material (in both English and French)?
(d) Following delivery of the first production run of marine payloads, what is the approximate amount of time required to implement the capacity to provide technical field support to various locations across Canada (west coast, central, Great Lakes, and Atlantic Coast)?

2.2 TECHNICAL REQUIREMENTS

Respondents are asked to provide the following technical information.

2.2.1 MARINE PAYLOAD OVERVIEW

(a) Describe the payload's hardware architecture with respect to the make and model of the required payload components (e.g. sensor I/O boards, datalogger, power module and/or communications module).

(b) Describe the payload's software architecture with respect to:

1. The layers of software (e.g. the operating system, device drivers and/or datalogger programs).
2. The method to upgrade the operating system, device drivers and/or datalogger programs.
3. The programming language(s) used to develop the operating system, device drivers and/or datalogger programs.

(c) Can EC request the vendor to make relevant updates to the operating system, device drivers and/or datalogger programs? If so, please describe the required procedure.

(d) Can EC obtain the source code to modify the operating system, device drivers and/or datalogger programs? If so, please describe the tools (hardware and/or software) that are required to perform the modifications.

(e) Describe the payload's date/time synchronization with respect to:

1. The type of technology used (e.g. GPS).
2. The frequency of synchronization.
3. How the payload handles time synchronization failures (e.g. a GPS antenna malfunction).

2.2.2 ENVIRONMENTAL SENSOR INTEGRATION

(a) Describe the analog I/O measurements with respect to:

1. The number and type of input ports available (e.g. single-ended and/or differential)
2. The analog signal voltage range, accuracy, input resolution and maximum sampling frequency.
3. The number and type of analog output ports available (e.g. excitation channels).
4. Is it possible to expand the number of analog I/O ports? If so, please describe the expansion options.

(b) Describe the digital I/O measurements with respect to:

1. The number and type of digital input ports available (e.g. TTL, pulse counter, RS-232 and/or SDI-12).
2. The digital signal voltage range, accuracy, input resolution and maximum sampling frequency.
3. The number and type of digital output ports.
4. Is it possible to expand the number of digital I/O ports? If so, please describe the required expansion options.

(c) Provide examples of sensors (make and model) that have been integrated with the payload into operational moored weather buoys and automated observing ships.

(d) With respect to EC's environmental sensors (listed in Appendix C), are there any technical concerns integrating the sensors presently in use? If so, please describe the concerns.

2.2.3 DATA STORAGE

(a) What is the standard amount of storage memory that is included?

(b) What options are available for memory expansion?

(c) What type of storage medium is used? (e.g. SATA hard drive, SD card).

(d) Describe the payload's backup power (e.g. internal lithium battery) to retain data and firmware memory in the event of a power systems failure.

2.2.4 DATA STRUCTURE AND MESSAGE FORMATTING

(a) What are the options for configuring the output data?

(b) Does the payload support EC's current data format requirements (FM13 SHIP format for both moored buoy and automated observing ship applications)?

(c) Describe the data compression options supported by the payload.

(d) What are the options for managing and formatting spectral wave data?

(e) Are real-time wave observations normally sent along with other environmental observation data, or as a separate message?

(f) Is it possible to transmit the system status as part of the output message?

2.2.5 POWER MANAGEMENT

(a) What are the payload's power supply voltage and current requirements?

(b) Which options are available to minimize power usage (e.g. sleep mode)?

(c) Given EC's configuration and sampling requirements (listed in Appendix C and D), what is the payload's expected power usage? Please provide an explanation on how this value is derived.

(d) Does the vendor have any experience deploying the payload on moored buoys at latitudes above the Arctic Circle? If so, please describe the methods used to ensure the payload receives adequate power (e.g. installing wind turbines and/or additional battery banks).

2.2.6 COMMUNICATIONS

(a) Which satellite communications platforms are supported by the payload (e.g. GOES, Iridium and/or INMARSAT)?

(b) Can the system interface with the existing SUTRON SatLink2 GOES Transmitters, and Iridium 9601 and 9602 short burst data (SBD) modems used in moored buoy and AVOS networks? Refer to Appendix A, B and C for more information.

(c) Can the system manage multiple modes of communication (e.g. GOES as the primary method, and Iridium as the secondary method)? If so, can the communication system be selected remotely?

(d) Can the system utilize cellular networks (CDMA or GSM), short-range VHF, blue tooth or other remote methods within close proximity (range of ~1-2 Km)?

(e) Does the system offer bi-directional communication capabilities with satellite, cellular networks, short-range VHF, blue tooth or other remote methods? If so, please describe the types of functionality that can be achieved (e.g. the ability to reset systems, return system diagnostics, change mode of operation, suppress sensors)

2.2.7 MODES OF OPERATION

(a) Does the payload support multiple modes of operation? If so, is the mode selectable locally and remotely (refer to 2.2.6)?

(b) Can the payload automatically switch between modes? For example, it is desirable to have a storm mode that reports additional data more frequently during significant marine weather events. After the storm event concludes, the mode is reverted back to the normal mode of operation.

(c) Can the system be configured to sample and process sensors on different intervals (e.g. report an hourly message containing a 1-minute air temperature average, and a 10-minute wind speed average)?

2.2.8 DIAGNOSTIC

(a) Describe the payload's diagnostics with respect to:

1. The components required to obtain the diagnostic information (e.g. a Windows PC, proprietary software, a dongle).
2. The type of diagnostic information available (e.g. battery voltage, watchdog counter).

(b) Does the payload record a log file of generated events? If so, is the log file accessible via PC, satellite, cellular networks, short-range VHF, blue tooth and/or other remote methods?

2.2.9 ENVIRONMENTAL

(a) What is the operating temperature range of the payload? If the payload consists of multiple components, please provide the temperature range for each component.

(b) What is the storage temperature range of the payload? If the payload consists of multiple components, please provide the temperature range for each component.

(c) What is the payload's rated water tight integrity? If possible, please refer to a recognized standard such as IP65/IP66.

(d) What construction materials are used for the payload? Please describe the approach taken to mitigate salinity's corrosive effects.

(e) What connectors and cables are used in the payload? Are they rated for use in marine environments? If possible, please refer to a recognized standard such as IP65/IP66.

(f) Provide the following information with respect to the payload's survivability under adverse marine conditions:

1. Describe the field testing conducted by the vendor in marine conditions to validate the payload's functionality.
2. Describe the laboratory testing conducted by the vendor to validate the payload's functionality.
3. Has the vendor consulted a third party testing provider to perform specific tests? If so, please describe the testing methodology.
4. Has the vendor (or a third party) deployed the payload in open ocean conditions (at least 300km offshore)? If so, please describe the payload's performance with respect to reliability and successful data collection.

2.2.10 HARDWARE AND MECHANICAL

(a) What are the physical dimensions (length x width x height) of the requirement components of the payload?

(b) Do the payload components fit within EC's buoy and AVOS enclosures? Refer to Appendix B for information regarding EC's requirements.

(c) Does the payload installation require modifications to EC's AVOS and/or Buoy enclosures? If so, please describe the required modifications.

(d) Describe the payload installation methodology with respect to mounting and integration with EC's AVOS and buoy components.

(e) What is the payload's vibration (force and frequency) rating? If possible, please refer to a recognized standard.

2.2.11 SERVICES

(a) Does the vendor have any experience providing the level of service described in Part 1 - a more "turn-key" or integrated solution approach for the payload (e.g. integration, warranty, maintenance and/or training)? If so, please describe the vendor's approach using a recent example (i.e. within the last 5 years).

(b) Does the vendor offer operational monitoring services? If so, please describe the services offered.

(c) Does the vendor have the capability and experience to offer operational support to EC's moored buoy and AVOS networks? If so, please describe the capability both in terms of ongoing technical and engineering support, along with in-field support.

2.2.12 SUPPORT

(a) What documentation is provided with the payload (e.g. user guide, schematics)?

(b) Does the vendor provide training? If so, please describe the training courses offered (e.g. beginner, intermediate, advanced).

(c) In the event that the vendor wins the procurement contract, describe the vendor's support of EC's marine network with respect to:

1. How the support is managed (e.g. handled by the vendor, or a third party provider).
2. The speed of response to identified issues.
3. The methodology for tracking, diagnosing and correcting problems.
4. Does the vendor have experience working within a defined Service Level Agreement? If so, please describe a recent Service Level Agreement (i.e. within the last 5 years).

(d) Describe the vendor's internal quality standard (e.g. ISO 9001).

2.2.13 WARRANTY

1. What does the warranty cover? Please describe the type of components (hardware, software, firmware) that will be covered for the duration of the contract, along with what may be excluded?
2. What is the duration of the warranty period? Please provide detailed information on warranty period as pertains to hardware, firmware, and software.
3. What if labour is covered under the warranty period, if applicable?

2.2.14 LIFE CYCLE

(a) Does the payload require periodic calibration? If so, please describe:

1. The calibration services offered by the vendor and/or an authorized third party service provider.
2. The location of the calibration facilities (e.g. cities in Canada, the United States of America, and/or Europe).
3. The recommended frequency of calibration.

(b) Does the payload require periodic field maintenance? If so, please describe:

1. The type of maintenance required.
2. The recommended maintenance frequency.

(c) What is the expected life span of the payload?

(d) Describe the methodology used to determine the payload's life span.

2.2.15 AVOS GRAPHICAL USER INTERFACE

(a) Does the system provide a method to visually display real-time data (instantaneous and processed) to the ship's bridge?

(b) Is there an option to switch the display between daytime and night time operation (to optimize the display's contrast depending on the time of day)?

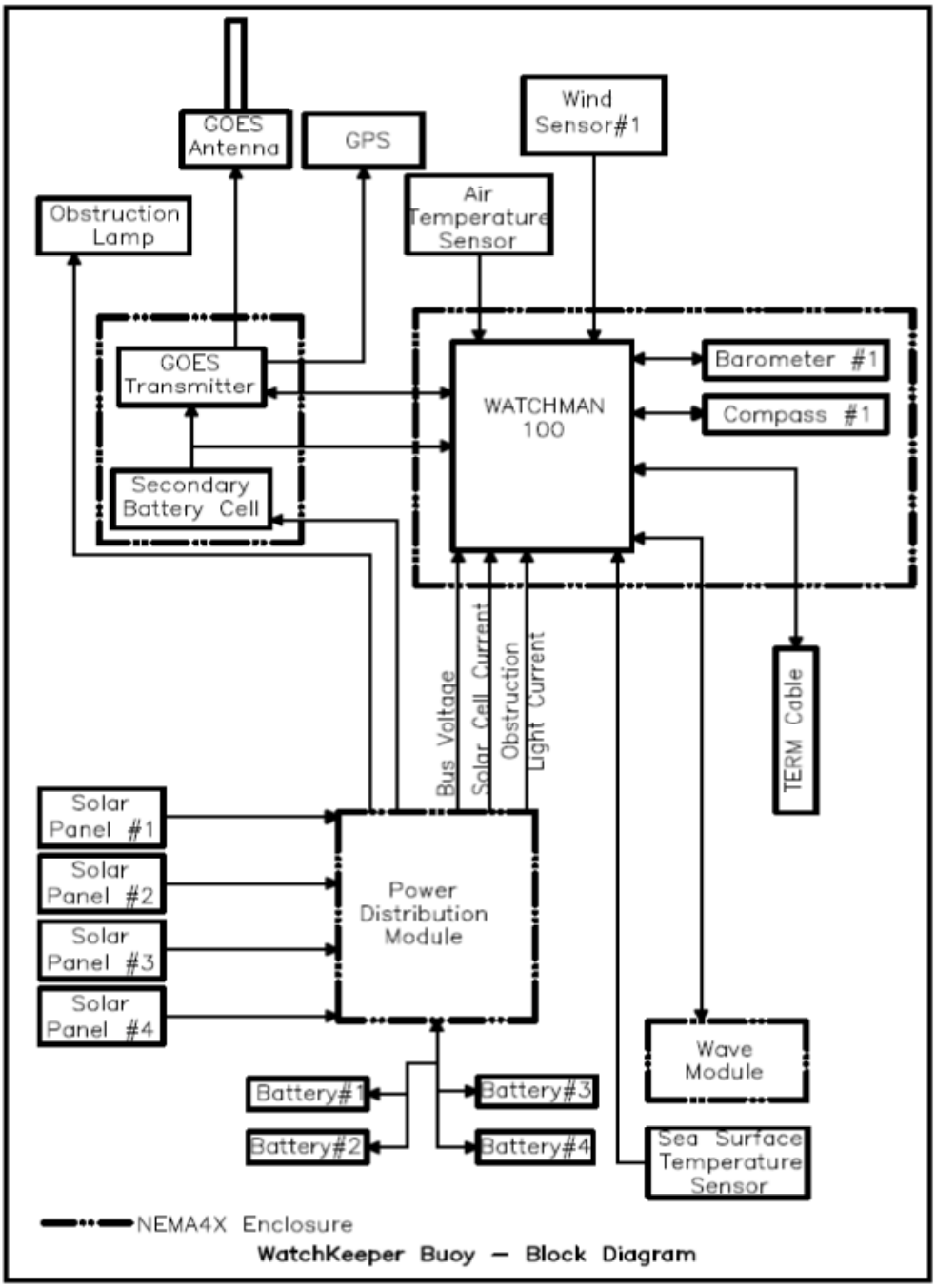
(c) Does the system allow the input of manual observations in the FM13 message? If so, does the output message include both the entered manual observations as well as the automated observations? Some examples of manual observations include present weather, visibility, or sea state.

(d) Does the system provide a method for the ship's crew to access log files of weather observations, along with diagnostic files?

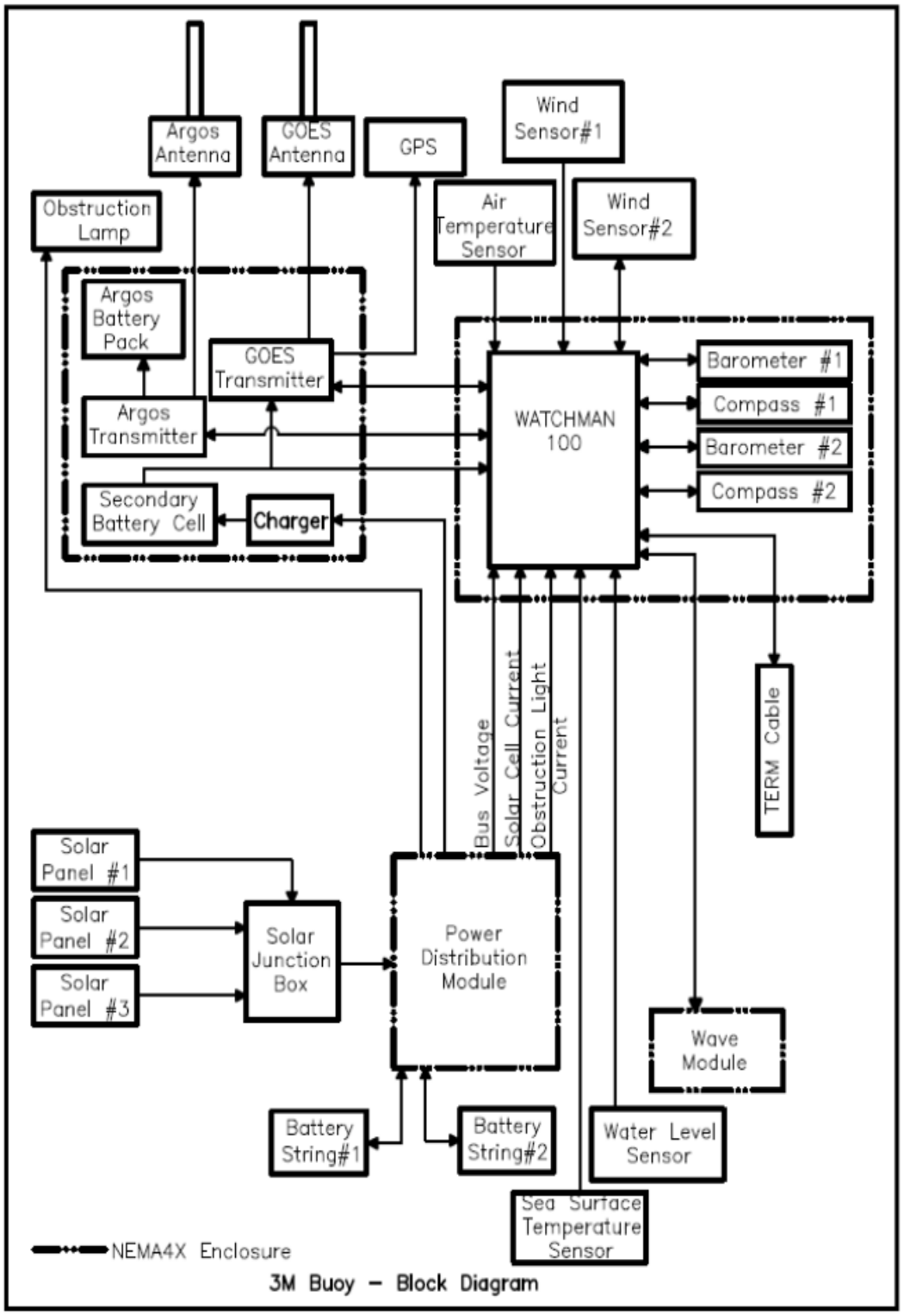
APPENDIX A: MOORED BUOY AND AVOS BLOCK DIAGRAMS

The following section provides technical details of Canada's moored buoy and AVOS networks. This section is included to assist in formulating response information.

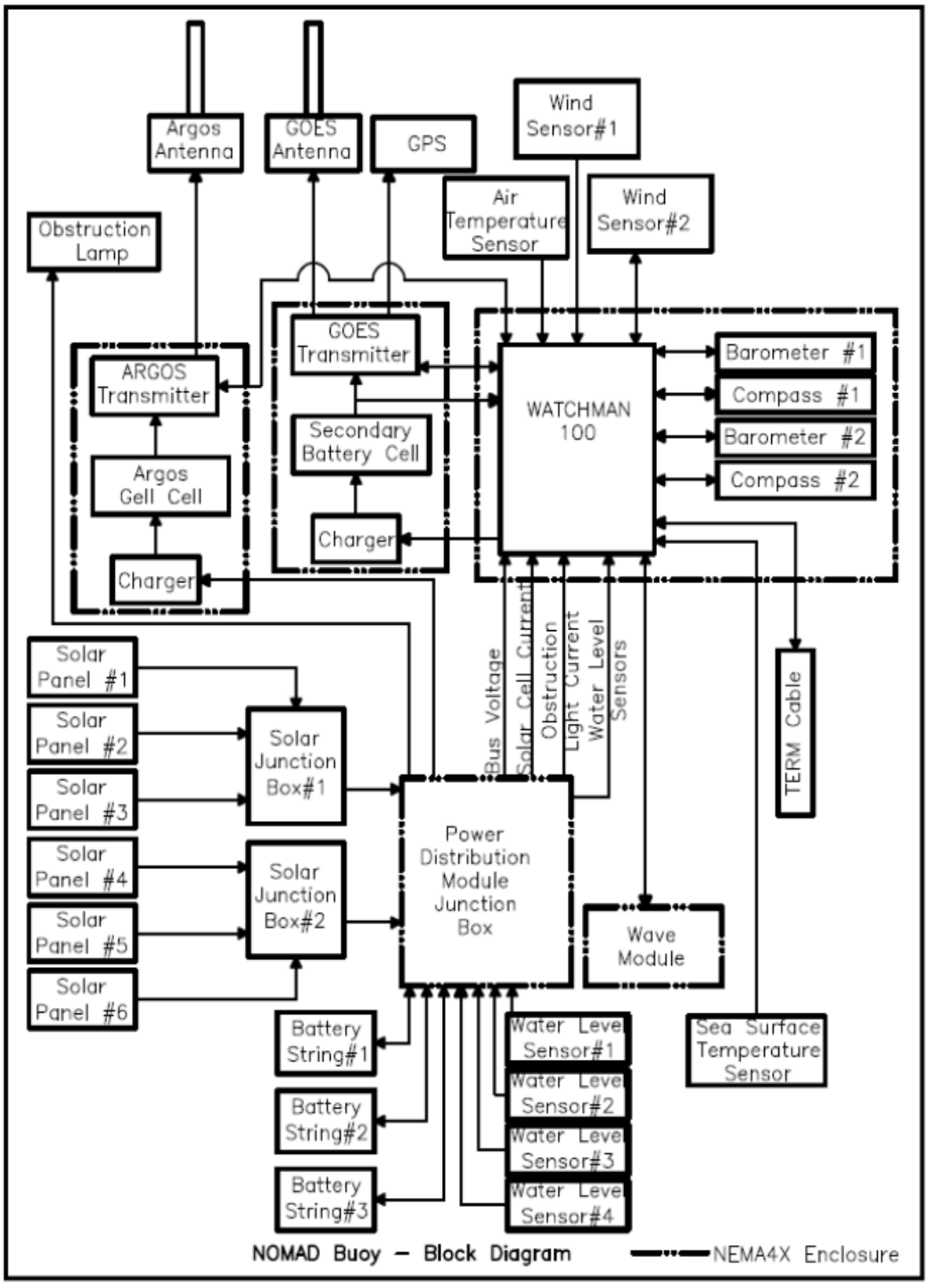
A.1 1.7 Metre Watchkeeper Buoy Block Diagram



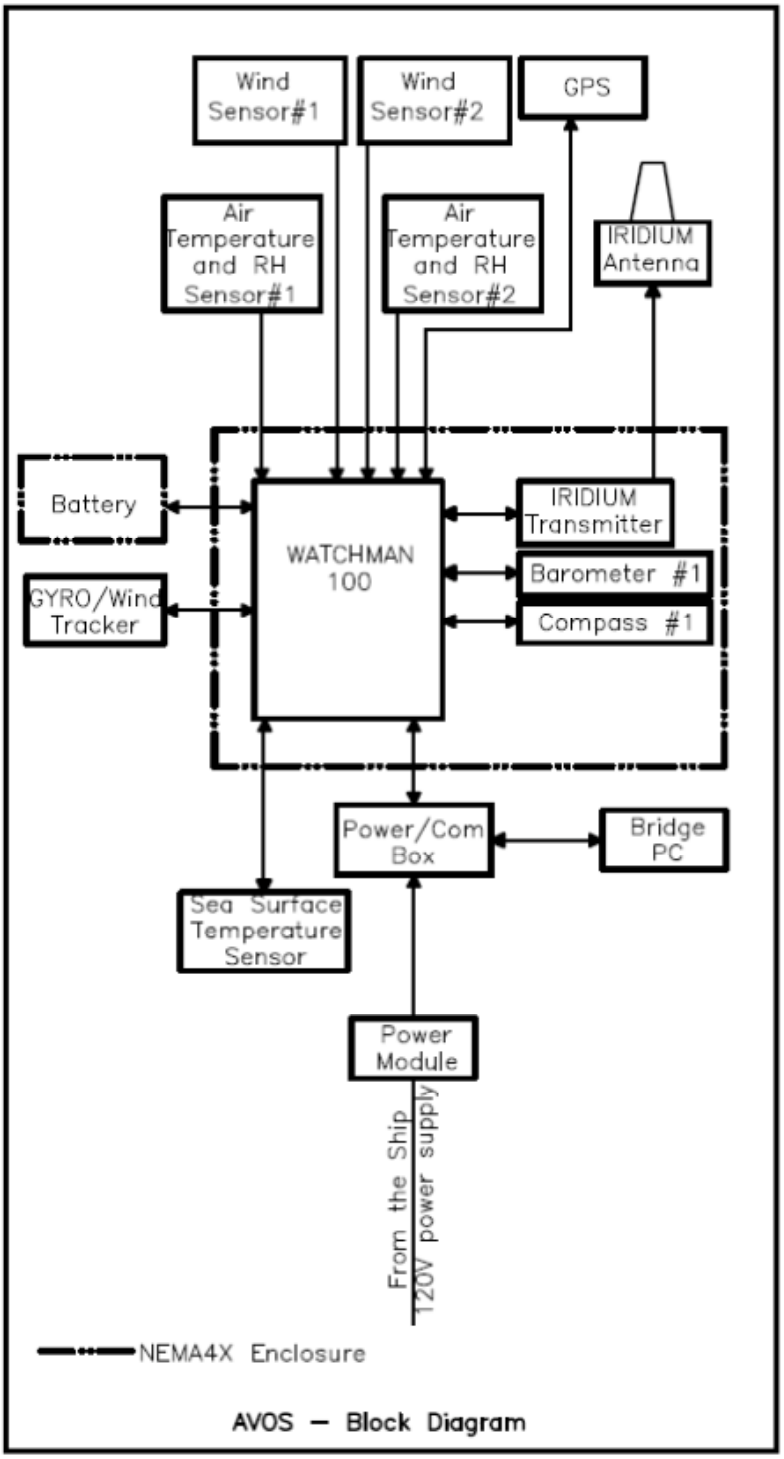
A.2 3 Metre Discus Buoy Block Diagram



A.3 Nomad Buoy Block Diagram



A.4 AVOS Block Diagram



APPENDIX B: MOORED BUOY AND AVOS MECHANICAL DIAGRAMS

The following section provides technical details of Canada's moored buoy and AVOS networks. This section is included to assist in formulating response information.

B.1 1.7 Metre Watchkeeper Buoy Mechanical Diagram

Note: See attached drawings:

MAR-17M-000-00, 1.7m BUOY Drawing Package.PDF

B.2 3 Metre Discus Buoy Mechanical Diagram

Note: See attached drawings:

MAR-30M-000-00, 3.0m Buoy Drawing Package.PDF

B.3 6 Metre Nomad Buoy Mechanical Diagram

Note: See attached drawings:

MAR-60M-000-00, 6.0m BUOY Drawing Package.PDF

B.4 AVOS Mechanical Diagram

Note: See attached drawings:
MAR-AVO-000-00, AVOS Layout Drawing.PDF

APPENDIX C: LIST OF CURRENTLY DEPLOYED SENSORS & DEVICES

The following section provides technical details of Canada's moored buoy and AVOS networks. This section is included to assist in formulating response information.

C.1 Buoy Sensors & Devices

Sensor/Device	Model	Output Type
GPS	Garmin GA 30	RS-232
Air pressure #1	Vaisala PTB-210B1T1B	RS-232
Air pressure #2	Vaisala PTB-210B1T1B	RS-232
Compass #1	KVH-C100	RS-232
Compass #2	KVH-C100	RS-232
Wind speed #1 mechanical	RM Young 05103	Pulse counter
Wind direction #1 mechanical	RM Young 05103	Analog
Wind speed #2 sonic	Vaisala Ultrasonic WS425	RS-232, RS-485, or analog
Wind direction #2 sonic	Vaisala Ultrasonic WS425	RS-232, RS-485, or analog
Dry bulb temperature	YSI703	Analog
Sea surface temperature	YSI44203	Analog
Sea surface temperature - optional	HATS	Rs485 or RS232
Wave height sensor (normally an external wave sensor module)	Jewel (Strap D) LCA-100	RS-232
Water level sensor (four possible)	AXYS, Part#662	Analog
Navigation and obstruction light current	ML-140/TF-3B MLED - 120E	Analog

Power distribution box: bus voltage	SunSaver-10 Solar Controller	Analog
Sensor/Device	**Model**	**Output Type**
Power distribution box: solar panel current	Solarex SX-MM-20	Analog
Cell battery voltage	UASA (12-17AH)	Analog
External connectors	Bulgin	
ARGOS/IRIDIUM	Seimac ARGOS Transmitter (Wildcat)	RS-232
GOES HDR SUTRON Transmitter	SUTRON SatLink2 40W	RS-232
GOES Omni-directional Antenna	Synergetics GOES Omni-directional Antenna (14A)	

C.2 AVOS Sensors

Sensor/Device	Model	Output type
Air temperature	MP101A	Analog
Humidity / dew point	MP101A	Analog
Sea surface temperature	AXYS-HATS YSI 4800LC	RS232 or RS485
Air pressure #1	Vaisala – PTB-210B1T1B	RS-232
Compass #1	KVH – Autocomp 1000	RS-232
Wind speed #1 mechanical	RM Young Wind Sensor - 05103	Pulse counter
Wind direction #1 mechanical	RM Young Wind Sensor - 05103	Analog
Wind speed #2 mechanical	RM Young Wind Sensor - 05103	Pulse counter
Wind direction #2 mechanical	RM Young Wind Sensor - 05103	Analog
GPS	16XHVS	RS-232
IRIDIUM Transmitter	NAL 9601 SBD modem	RS-232
Battery	UASA (12-17AH)	
Auxiliary Power Supply	Soltec- SunSaver Module	
External connectors	Bulgin	
Gyro	N/A	RS-232 or RS-485

APPENDIX D: CURRENT PAYLOAD DATA SAMPLING REGIME AND DATA FORMAT FOR BUOYS

The following section provides technical details of Canada's moored buoy.

D.1 Payload Data Sampling Regime

The textbox below describes about data acquisition interval, acquisition duration and regime, and is an excerpt from the "Operations/Maintenance/Reference Manual for Buoy Based Watchman 100 Payload" section 3.1.8.2:

3.1.8.2 Acquisition Interval, Duration, & Start Time

Acquisition Interval - This is the interval between acquisition start times. It must be an integral number of hours. It must also be an integral fraction of a day (i.e.., 1, 2, 3, 4, 6, 8, 12, or 24 hours). This is necessary to satisfy the DCP transmitter conditions. Thus the only acceptable values for the interval are 60, 120, 180, 240, 360, 480, 720, or 1,440 minutes
Acquisition Duration - This is the number of minutes of which the meteorological parameters are averaged. The number may be between 0 and 59. Ten minutes has been the time normally used in the planning of the system, and is recommended. If using longer times, beware of extending the acquisition cycle into the next hour. Do not forget that wave processing time and wave sensor warm-up are extra.
Acquisition Start Time - This is the time of day at which the acquisition cycle begins. It will then repeat at the acquisition interval.. The acquisition cycle for these buoys consists of roughly:

- 2 minutes wave sensor warm-up
- 37 minutes wave data collection and processing
- 10 minutes meteorological data collection (normally)
- 2 minutes data processing
- 51 minutes total approximately

Thus the Acquisition Start Time would normally be set for 51 minutes before the desired end of the met collection interval. For example, if it is desired to collect the met data for the 10 minutes just before the hour, set the Acquisition Start Time for 9 minutes after the previous hour.

If the Acquisition interval is one hour, then the hours in the acquisition start time are irrelevant. Otherwise, they will be used to set the timing of the daily cycle.

There is one important restriction on the timing. During the last two minutes while the data are being processed and the message being formatted, the WATCHMAN 100 demands information from the DCP. If the DCP is transmitting during this time, it will not supply the data. Hence be sure that the transmitter transmission time does not occur during this last two minutes. Be generous - allow a couple of minutes either way.

The following sections (D.3 and D.4) describe about GOES data format and ARGOS data format output from buoys. The data format is referenced from the “Operations/Maintenance/Reference Manual for Buoy Based Watchman 100 Payload” section 4.

D.2 GOES Data Format

The primary output from the buoy is via the GOES satellite. The data format is very similar to that of earlier DACT, ZENO, and VEEP payloads. The data is formatted into 303 ASCII characters sent out at 100 baud. Together with headers and tailers, the transmission takes about 30 seconds.

The transmitted message consists of 23 groups in six sections (0 to 5).
Each group is separated from the following group by a space (blank), as shown as "__" below. A solid (/) is used to preserve group length, to correspond to earlier formats.

The message is shown below in both upper and lower case. Lower case is used to indicate symbolic characters which will be replaced by a number, letter or symbol in the transmitted message. Upper case letters, numbers and spaces (represented by "__") will be transmitted as shown.

Carriage returns and line feeds are not transmitted by the DCP, but are inserted by the receiver processing equipment. Thus, the actual printed format will differ from that given below.

TYPICAL FORMAT

```
vvccc_hhmm_iiiii_46/
//_/dddfff(/dddfff)_
lnttt_4pppp(4pppp)_2
2200_0nwww_lkkkeee_3
33_92lfff(92lfff)_WA
VEyyy_Aljjjj_A2qqq_A
3uuu_A4bbb_A5zzzz_A6
ggrr_A7xxx_A8ssssss_
A9aaaa.aaa,aaaaa.aaa
_$ppppppppppppppppppp
ppppppppppppppppppppp
ppppppppppppppppppppp
ppppppppppppppppppppp
ppppppppppppppppppppp
ppppppppppppppppppppp
pEOT
```

Total 303 characters

E.g. GOES Message

- 28037 0003 46206 46/// /141008(/140018) 10054 40116(40116) 22200 00044 1000000 333 912026(912037) WQ14166 A10999 A2003 A3128 A4000 A52727 A60000 A7128 A94849.997,12559.830 A16+0438 A17/// A19000 A200 B1000 $|DE`C`Kd@`@`@`@`@`@`@`@`JcWU@P@PBpFccE~OtnylYLtkKkhKlJUJGZFkiEKW lyKliYh\gEf|eGF_EHEGCODDdUCobgcQcQcKd~blCjbUaB@@`@`@`@`/

DIVISION INTO SECTIONS AND GROUPS

Section 0 - Housekeeping

```
: 1 : 2 : 3 :
vvccc_hhmm_iiiii_
```

Section 1 - Meteorological Data

```
: 4 : 5 :
46///_/dddfff(/dddfff)_
: 6 : 7 :
lnttt_4pppp(4pppp)_
```

Section 2 - Marine Data

```
: 8 : 9 : 10 :
22200_0nwww_lkkkeee_
```

Section 3 - Regional Data

```
:11: 12 : 13 :
333_92lfff(92lfff)_WAVEyyy_
```

Section 4 - Comments

```
: 14 : 15 : 16 : 17 : 18 : 19 : 20 : 21 : 22 :
Aljjjj_A2qqq_A3uuu_A4bbb_A5zzzz_A6ggrr_A7xxx_A8ssssss_A9aaaa.aaa,aaaaa.aaa
```

Section 5 - Waves

```
: 23 :
$ppp-----p
```

(120 pseudo ASCII characters containing wave data)

This is all followed by an EOT (ASCII 04) END OF TEXT character.
(This is inserted by the Synergetics transmitter. See Synergetics Transmitter Manual p.3-6 [12.82.00]).

DETAILED EXPLANATION OF DATA

Section 0 - Housekeeping Data Groups

vv	**vv** is battery bus voltage in tenths of volts, with the leading tens digit omitted
ccc	**ccc** is the output current of the solar panels in hundredths of Amperes, i.e., each increment is 10 mA
hh	**hh** is hours.
mm	**mm** is minutes of GMT corresponding to the end of wave data averaging period.
iiiii	**iiiii** this is a five character station ID assigned to buoy

Section 1 - Meteorological Data Groups

46///	**46///** this indicates there is no precipitation sensor.
/	**/** indicates there is no cloud cover data.
ddd	**ddd** indicates the average wind direction in whole degrees of the first anemometer.
fff	**fff** is the average wind speed in tenths of meters per second of the first anemometer.
(/dddfff)_	Data from the anemometer #2 is in parentheses.
1	**1** indicates this is the air temperature group.
n	**N** is the sign, 0 for positive temperatures and zero, and 1 is for negative temperatures.
ttt	**ttt** is the air temperature in tenths of degrees Celsius.
4	The **4** indicates that this is the sea level pressure group.
pppp	**pppp** is the sea level pressure in tenths of millibars from barometer #1. The thousands digit is omitted.

(4pppp)	Data from barometer #2 is in parentheses.

Section 2 - Marine Data Groups

22200	The **222** indicates the start of section 2. The **00** (zero zero) indicates that this is the data from a buoy.
0nwww	The **0** (zero) indicates that this is the water temperature group. **n** is the sign bit, **0** for positive temperatures or zero, **1** for negative temperatures. **www** is the water temperature in tenths of degrees Celsius.
1	The `1` indicates that this is the instrumental wave group.
kkk	**kkk** is the peak period of the waves in tenths of seconds.
eee	**eee** is the significant wave height in tenths of meters.

Section 3 - Regional Data

333	**333** indicate this is the start of section 3.
921	The **921** indicates this is the maximum wind speed group.
fff	**fff** is the maximum wind speed in tenths of meters per second from anemometer #1.
(921fff)	The maximum wind speed from anemometer 2 is in parentheses.
WAVE	**WAVE** is the identifier of the peak wave data group.
yyy	**yyy** is the peak to peak wave height in tenths of meters.

Section 4 – Comments

A1	**Al** indicates the first group of analog data.
jjjj	**jjjj** are four characters that represent the water level in compartments 1 to 4 of the buoy. They will range from 0 (no water) to 3 (water above the sensors). 9 indicates the sensor is not functioning.
A2	**A2** indicates the second group of the analog data.
qqq	**qqq** indicates the obstruction lamp current in hundredths of Amperes, i.e., a minimum resolution of 10 mA.
A3	**A3** indicates the third group of analog data.
uuu	**uuu** indicates the secondary cell voltage in tenths of volts. This measurement is made by the transmitter package. It is made near the end of the data collection interval.
A4	**A4** indicates the fourth group of analog data.
bbb	**bbb** indicates the minimum voltage of the secondary cell observed during the previous radio transmission in tenths of volts. This is measured and stored by the transmitter package.

A5	**A5** indicates the fifth group of analog data.
zzzz	**zzzz** indicates the compass headings for the last instantaneous sample during the previous met sample. The first and second numbers indicate the AZ1 heading in tens of degrees while the third and fourth numbers indicate the AZ2 heading in tens of degrees.
A6	**A6** indicates the sixth group of analog data.
gg	**gg** indicates the forward power (in dBm), as measured by the Synergetics GOES transmitter during the last transmission
rr	**rr** indicates the reverse power (in dBm) as measured by the Synergetics GOES transmitter during the last transmission.
A7	**A7** indicates the seventh group of analog data.
xxx	**xxx** is the battery bus voltage in tenths of volts.
A8	**A8** indicates the eighth group of analog data.
ssssss	**ssssss** is the Scalar wind speeds in 10ths of metres per second. 3 characters for wind 1 and 3 for wind 2.
A9	**A9** indicates the ninth group of data.
aaaa.aaa,aaaaa.aaa	**aaaa.aaa,aaaaa.aaa** is the buoy position in degrees, minutes and decimal minutes for latitude and longitude.

Section 5 - Waves

The wave spectral data is transmitted as 120 pseudo ASCII words following a _$, i.e., blank dollar. The blank is the termination of the previous group and the dollar indicates the data to follow is not in ASCII. These pseudo ASCII words are formed in pairs from sixty 12 bit formatted data words. These formatted data words, represented as:

```
d11 d10 d9 d8 d7 d6 d5 d4 d3 d2 d1 d0
```

are transmitted as two pseudo ASCII words:

BIT:	7	6	5	4	3	2	1	0
	MSB							LSB
WORD 1:	p7	1	d5	d4	d3	d2	d1	d0
WORD 2:	p7	1	d11	d10	d9	d8	d7	d6

i.e., the 12 bit data words are split into 6 bit bytes and sent low byte first, with a 1 in the seventh position, and a p7 parity bit (odd) in the MSB position. This parity bit is inserted by the transmitter.(REF Synergetics Transmitter Manual, pp 3-6 [12.82.99]).

In turn, most of these 12 bit formatted data words are made up of an 11 bit data word and an odd parity bit p11, in the d11 position.

The data itself is composed of 60 words defined as follows:

HOUSEKEEPING

WORD 1
It is p11 f1 f0 0 0 0 1 1 1 1 0 0 where bits 0 - 8 (000111100) represent the number of 12 bit data words, i.e., 60. Bits 9 - 10 combine with five bits of word 2 to form a Data Field Identifier. Two DFIs in use now are 0 0 1 0 1 1 1 and 0 0 1 1 0 0 0. For this application we arbitrarily chose 0 0 1 0 1 0 1, i.e., f0 = 1, f1 = 0, f2 = 1, f3 = 0, f4 = 1, f5 = 0, f6 = 0.

WORD 2
It is p11 S5 S4 S3 S2 S1 S0 f6 f5 f4 f3 f2 where bits 0 - 4 (i.e., f2 - f6) are part of the data field identifier and bits 5 - 10 (i.e., S0 to S5) represent the binary second of the minute when data acquisition begins. P11 is the odd parity bit.

WORD 3
It is P11 h4 h3 h2 h1 h0 m5 m4 m3 m2 m1 m0 where bits 0 - 5 (m0 to m5) are the six bit binary representation of the minute of the hour when data acquisition begins and bits 6 - 10 are the five bit binary representation of the hour of the start of data acquisition. P11 is the odd parity bit.

WORD 4
This is P11 d10 d9 d8 d7 d6 d5 d4 d3 d2 d1 d0 where bits 0 - 10 (i.e., d0 to d10) are an 11 bit binary representation of the number of days since data acquisition was begun. P11 is the odd parity bit.

WORD 5
It is 1 0 0 0 0 0 0 0 0 00 0 where bit 0 is a zero indicating this is a non directional wave message, bits 1 to 10 are blank (i.e., zero) and bit 11 is the odd parity bit.

WORDS 6 - 12
These words are blank. Bits 0 to 10 are zero and bit 11 is a 1 for odd parity.

WORDS 13 & 14
These two words contain the floating point representation of C"m(o) which is the heave spectrum value at frequency zero in units of m*m/Hz with the response correction of the heave sensor applied. The words are:

WD13	p11	SM	SE	E_4	E_3	E_2	E_1	E_0	m_3	m_2	m_1	m_0
WD14	p11	m_{14}	m_{13}	m_{12}	m_{11}	m_{10}	m_9	m_8	m_7	m_6	m_5	m_4

where bits 9 of word 12 (i.e., SE) is the sign of the exponent (0 for positive, 1 for negative), and bit 10 (i.e. SM) is the sign of the mantissa. Bits 0 to 3 of word 13 and bits 0 to 10 of word 14 combine to form the 15 bit mantissa (MO - M14). P11 is the odd parity bit for each word.

WORD 15
This is the 11 bit offset binary representation of the most negative value of the raw sensor data (minimum heave). The heave output H in meters may be calculated from the offset binary value X by:

$$H = \frac{15X}{1024} - 15$$

i.e., for X = 1024 M = 0
X = 0 H = -15
X = 2048 H = +15

This gives a resolution of 0.015 m and a range of plus and minus 15.36 m. The 12th bit (bit 11) will be the odd parity bit.

WORD 16
This is the offset binary representation of the mean value of the raw (heave) sensor data. It is formatted as in Word 15.

WORD 17
This is the offset binary representation of the maximum value of the raw (heave) sensor data. It is formatted as in Word 15.

WORDS 18 & 19
These words represent C"m(f), which is the maximum of the heave spectrum values (after correction for sensor response) in the range 0.002 to 0.502 Hz.
These words are formatted in a floating point form as in Words 13 and 14.

WORDS 20 – 60

These are the 41 normalized, logarithmically scaled values C"f of the heave spectrum, corrected for sensor response, in the frequency range 0.002 to 0.502 Hz. These bands are collected and arranged as per the WATCHMAN 100 wave processing specification below. The form is P11 S d9 d8 d7 d6 d5 d4 d3 d2 d1 d0 where bits 0 to 9 are the 10 bit data value, S is the sign bit (0 for positive values) and P11 is the odd parity bit.

WATCHMAN 100 Wave Processing in Meteorological Buoys with Strapped Down Accelerometer and Axys Acceleration- to-Heave Integrator

Specifications for Wave Measurement and Processing.

Sampling	Sampling rate	1 Hz
	Burst duration:	34.13 min. (2048 samples)
	No. of blocks of data per burst	8 (256 samples per block). Blocks not contiguous.
	Filtering:	Sensor signal is low-pass filtered in the WATCHMAN 100 with a single corner at 10 Hz to reduce aliasing due to noise, etc.

Processing Procedure

- Mean of valid raw data is removed.
- A 10% cosine taper is applied to each block (i.e., the first and last 10% of the block is tapered by a cosine function).
- The FFT is calculated for the block.
- A spectrum is calculated for each block. The spectra are ensemble averaged into a single 128 band wave spectrum.
- The spectrum is corrected for the cosine taper effect.
- The spectrum between 2 seconds and 30 seconds is corrected for the transfer function of the heave sensor. This is given in the Datawell manual as:(the Axys Environmental Systems integrator is designed to the same specification)

$$1/((1-i2^{1/2}a-a^2)(l-ib)$$
where $a = T/30.8$
and $b = T/170$
where T = period Time.

- Band averaging is done as indicated below to reduce the number of spectral bands.
- Hs and Tp are calculated for frequencies between 0.5 and 0.033 Hz (2 seconds and 30 seconds).

Band Averaging

Each band has a band width of 0.003906 Hz (i.e., 1/256).
The first band includes all energy up to 0.002 Hz.
The second band is centered at 0.003906 Hz.
The bands continue up in increments of 0.003906 Hz.
The band averaging desired is as follows:

- No average bands 0(0.0 - .002 Hz) to 27 (.1035 - .1074 Hz)
- The following were averaged:

  Band #'s Freq. Range (Hz)
  28 - 29 .1074 - .1152

30 - 31 .1152 - .1230
32 - 33 .1230 - .1308
34 - 35 .1308 - .1387
36 - 38 .1387 - .1504
39 - 40 .1504 - .1621
42 - 45 .1621 - .1777
46 - 50 .1777 - .1973
51 - 56 .1973 - .2207
57 - 63 .2207 - .2480
64 - 73 .2480 - .2871
74 - 84 .2871 - .3301
85 - 102 .3301 - .4004
103 - 128 .4004 - .5020

This gives a total of 42 frequency bands of wave data.

D.3 ARGOS Data Format

The secondary output from the buoy is via the ARGOS satellite. The ARGOS transmitter is configured to transmit at a rate of between 56 and 110 seconds depending on the ARGOS assignment. Data are updated during message formatting at the end of each meteorological collection interval.

The ARGOS data are formatted as 32 eight bit words. Some information, with more or less bits, overlaps these boundaries. To achieve maximum resolution with the allowed bits, some offset and scaling factors are used, necessitating the use of a formula to recover the answer. The data are in true binary (not BCD) format.

Previous data is preserved and re-transmitted to allow for gaps in satellite reception.
ARGOS DATA FORMAT

E.g.
123 089 011 003 123 089 015 007 000 094 077 063 000 000 083 003
122 147 029 021 122 083 031 022 121 143 033 024 121 143 036 025

ARGOS WORDS	DATA BITS	PARAMETER	UNITS	CONVERSION
1	10	Barometric Pressure, #1	mBar	P = n/8 + 950
2	6	Average true wind direction, #1	Deg	D = N x 360/64
3	8	Peak wind speed, #1	m/s	S = N/4
4	8	Average wind speed, #1	m/s	S = N/4
5	10	Barometric Pressure, #2	mBar	P = n/8 + 950
6	6	Average true wind direction, #2	Deg	D = N x 360/64
7	8	Peak wind speed, #2	m/s	S = N/4
8	8	Average wind speed, #2	m/s	S = N/4
9-1	3	Spare		
9-2	5	GMT Hour of beginning of Met sample	Hour	none
10	8	Water temperature	Deg C	T = N/10 – 5

11	8	Air temperature	Deg C	T = N/5 - 10
12	8	Water level, four 2 bit words	-	-
13	8	Significant wave height	m	H = N/10
14	8	Period of band of max amplitude	S	P = N/10
15	8	Max wave height	m	H = N/5
16	8	Light Current	A	C = N/100
		ONR HOUR PREVIOUS DATA		
17	10	Barometric Pressure, #1	mBar	P = n/8 + 950
18	6	Average true wind direction, #1	Deg	D = N x 360/64
19	8	Peak wind speed, #1	m/s	S = N/4
20	8	Average wind speed, #1	m/s	S = N/4
21	10	Barometric Pressure, #2	mBar	P = n/8 + 950
22	6	Average true wind direction, #2	Deg	D = N x 360/64
23	8	Peak wind speed, #2	m/s	S = N/4
24	8	Average wind speed, #2	m/s	S = N/4
		TWO HOUR PREVIOUS DATA		
25	10	Barometric Pressure, #1	mBar	P = n/8 + 950
26	6	Average true wind direction, #1	Deg	D = N x 360/64
27	8	Peak wind speed, #1	m/s	S = N/4
28	8	Average wind speed, #1	m/s	S = N/4
29	10	Barometric Pressure, #2	mBar	P = n/8 + 950
30	6	Average true wind direction, #2	Deg	D = N x 360/64
21	8	Peak wind speed, #2	m/s	S = N/4
32	8	Average wind speed, #2	m/s	S = N/4

APPENDIX E: AVOS BRIDGE SOFTWARE GRAPHICAL USER INTERFACE (GUI) FUNCTIONS DESCRIPTION

The following section provides technical details of Canada's AVOS networks. This section is included to assist in formulating response information.

The AVOS payload collects sensor data automatically, allows for user observed marine weather data input and transmits the data via Iridium as required. The AVOS payload is designed to interface to a computer unit (AVOS Bridge PC) and graphical user interface (Touch Screen Monitor).

The AVOS Bridge PC functions as a data display unit, data logger as well as a user input device. The computer unit and monitor must be installed in a dry environment, where unobstructed access to the unit is possible.

The AVOS Bridge Software is designed to interface through a Touch Screen computer system as well as a standard computer with keyboard and mouse running Windows98 or newer. The standard computer system, provided by AXYS Technology, is an integrated touch screen monitor and PC configured in a single unit. Operational setup is normally without a keyboard and mouse. The unit can be fastened to the desk top with mounting brackets upright or flat on a desk, depending on the vessel.

Note: Ship's power passes through a UPS system, to regulate power and protect the bridge PC.

Functions of the AVOS Bridge Software include:

1. **Bridge Computer and Touch Screen Monitor**
2. **Display of AVOS Payload Data**
3. **Observer Input of Manually Observed Data**
4. **Priority Message Transmissions for SRPEP and STORM Conditions**
5. **Data Quality Control**
6. **Data Archiving**
7. **Data Transfer to Transmission.**
8. **PMO Access Command Menus (Pipeline)**

1. Bridge Computer and Touch Screen Monitor

The AVOS system allows the interfacing of a PC and monitor. With the use of customized software, this combination serves three main purposes:

-display of normal data, which is collected and sent by the payload
-allows a user to input visually observed data, or override the automatic data
-logs all IMMT data

2. Display of AVOS Payload Data

a. The display of 10-minutes automatic AVOS data, including
- Time of Observation (in UTC)
- Report Type (includes NORMAL, SPREP and STORM)
- Latitude
- Longitude
- Ship Speed (knots)
- Ship Direction
- Barometer Correction to MSL
- Barometer as Read
- Air Temperature (in Degree Celsius)
- Sea Surface Temperature (in Degree Celsius)
- Relative Humidity (%)
- Observer

The automatic AVOS data listed above are refreshed every 10 minutes, providing the average for the last 10-minute period and the position at the end of the 10 minutes.

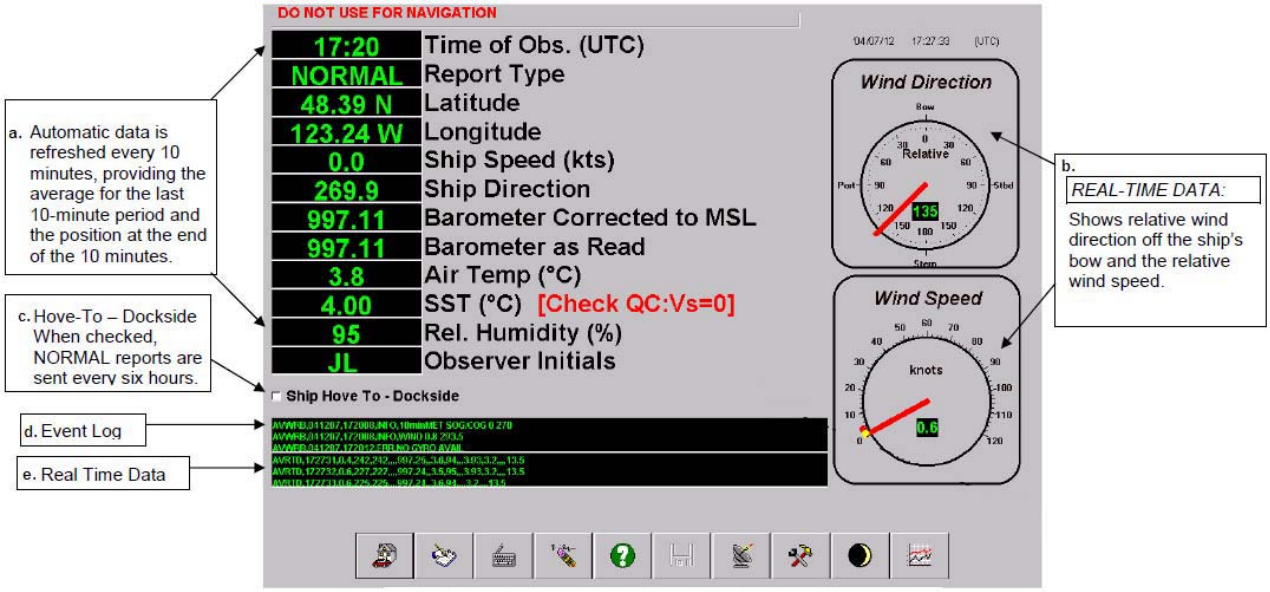
b. Display of real-time wind direction and wind speed.

c. Display and selection of “Hove-To”. When ship is at dockside, it is considered as at “Hove-To”. When “Hove-To” is selected, NORMAL reports are sent every six hours.

d. Displays event log of payload for information such as trouble shooting

e. Display of 1 Hz real-time data (same as “AVRTD” data when pipeline by PMO)

Image 1: Display of AVOS payload data

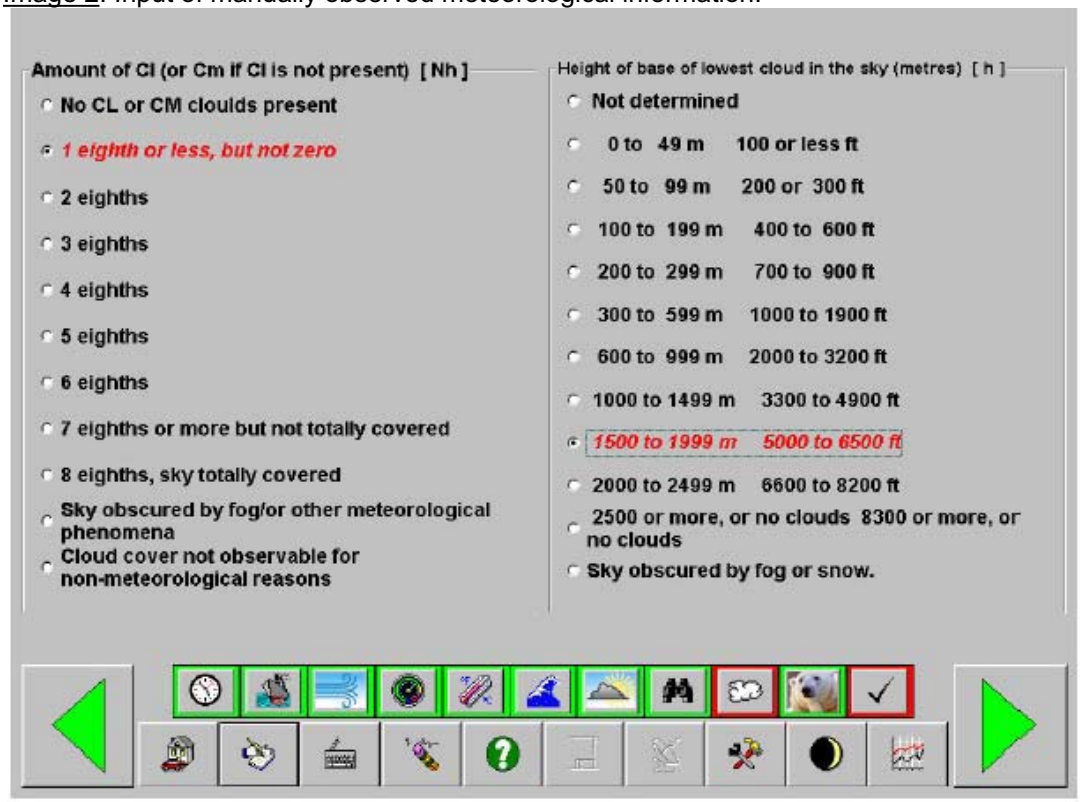


3. Observer Input of Manually Observed Data

Manually observed data can be entered by observers. Observers can select from the AVOS Bridge Software to enter the following information:

- Date/Time
- Ship Course and Speed
- Wind Direction/Speed
- Estimate Beaufort Wind Speed
- Air Pressure and Tendency
- Air Temperature, Dew Point Temperature and Sea Surface Temperature
- Wave Height and Period
- Present Weather
- Precipitation Type
- Visibility
- Cloud Cover
- Height of Base Cloud
- Sea Ice

Image 2: Input of manually observed meteorological information:



4. Priority Message Transmissions for SRPEP and STORM Conditions

The AVOS Bridge Software is able for observers to generate a SPREP or STORM message at anytime to issue a meteorological FM13 message to indicate special or storm weather conditions. For more information regarding SPREP and STORM (please refer to MANMAR for more details regarding SPREP and STORM messages).

Image 3: Ability for observer to select, input and transmit a NORMAL, SPREP or STORM message at anytime:

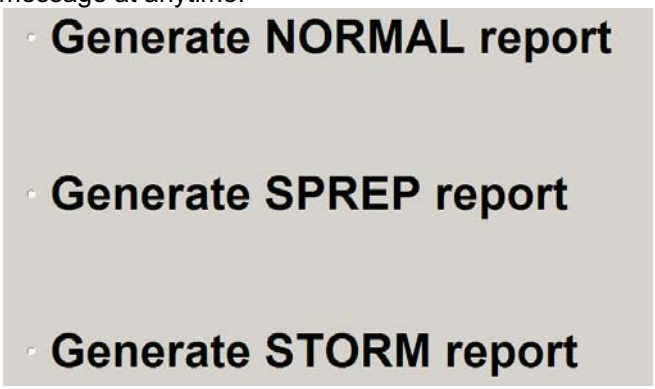


Image 4: The following is an example for users to select from the Bridge Software, the type of Wind Force happening:

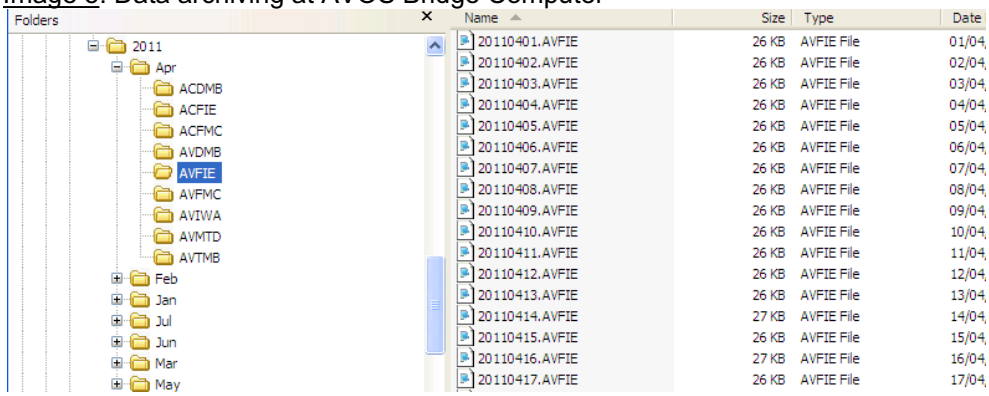
5. Data Quality Control

Bridge PC software system needs to have a quality control protocol built into the automatic and manually entered data for FM13 ship data following the latest MQCS criteria provided by the World Meteorological Organization (WMO), and is available from http://www.wmo.int/pages/prog/amp/mmop/mqc_soft.html.

6. Data Archiving

The data from payload is logged onto the AVOS Bridge Computer hard drive. The following is an example of how data is stored in the computer:

Image 5: Data archiving at AVOS Bridge Computer



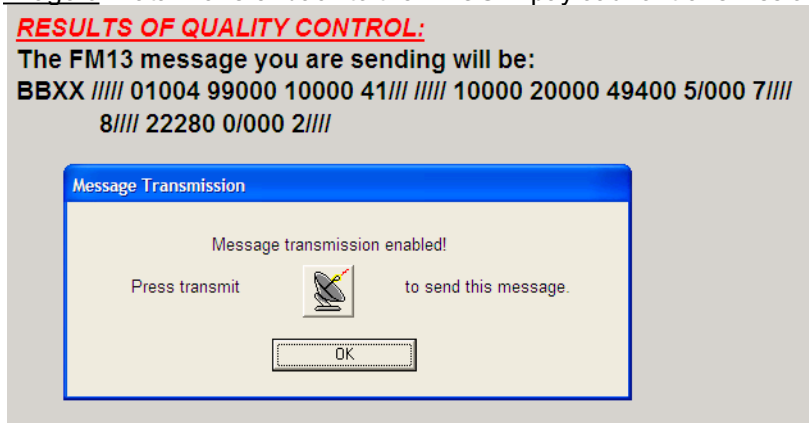
AVMTD - Full 10 minute average MET message with Housekeeping (will be logged by the Bridge Software). These messages typically use 24 kb storage per day.
AVTMB - AVOS payload current date and time (NORMAL state). These messages typically use 4 kb storage per day.
AVFMC – Archived FM13 message
AVDMB – Metadata string (maximum 20 characters per field). These messages are variable in size, but typically about 1 kb per record.
AVIWA - These are the normal messages generated. Error messages can be generated for missing Gyro, non-successful transmission of data and so on.
AVFIE – IMMT Message Format

Please note that messages with folder names start with “AV” are generated from the AVOS payload, folder names start with “AC” are generated from the AVOS Bridge Software. Archived data format would needs to be expandable to include other possible type of archived data to be developed.

7. Data Transfer back to the AVOS™ payload for Transmission.

Quality controled FM13 message is displayed on the software, and the data will be transferred to the AVOS payload for data transmission.

Image 6: Data Transfer back to the AVOS™ payload for transmission



8. PMO Access Command Menus (Pipeline)

At the AVOS Bridge Software, PMO is able to access to “PMO Use Only” with a password, and access the PMO access command menus. PMO can access pipeline to payload, for system performance detection, as well as for trouble shooting purposes.

Image 7: PMO Access Command Menus

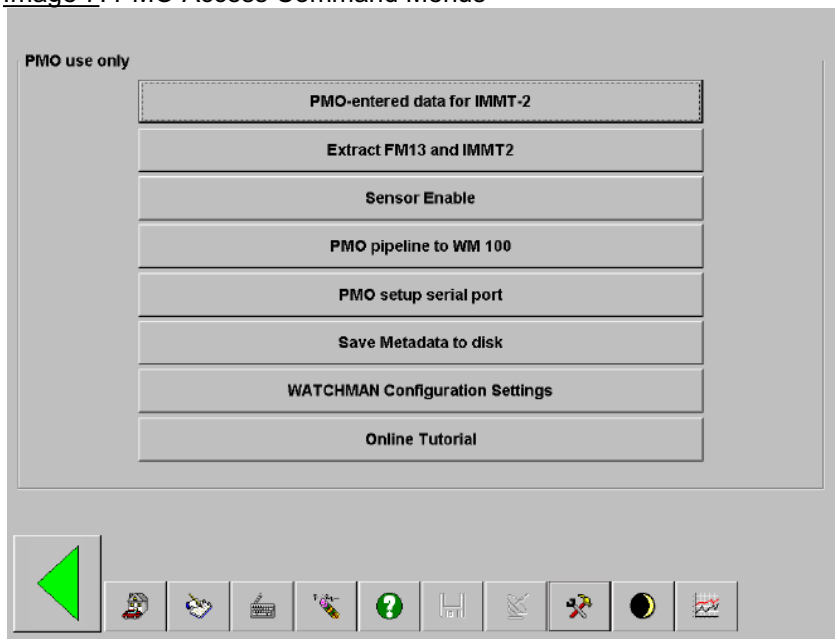


Image 8: Pipeline to Payload

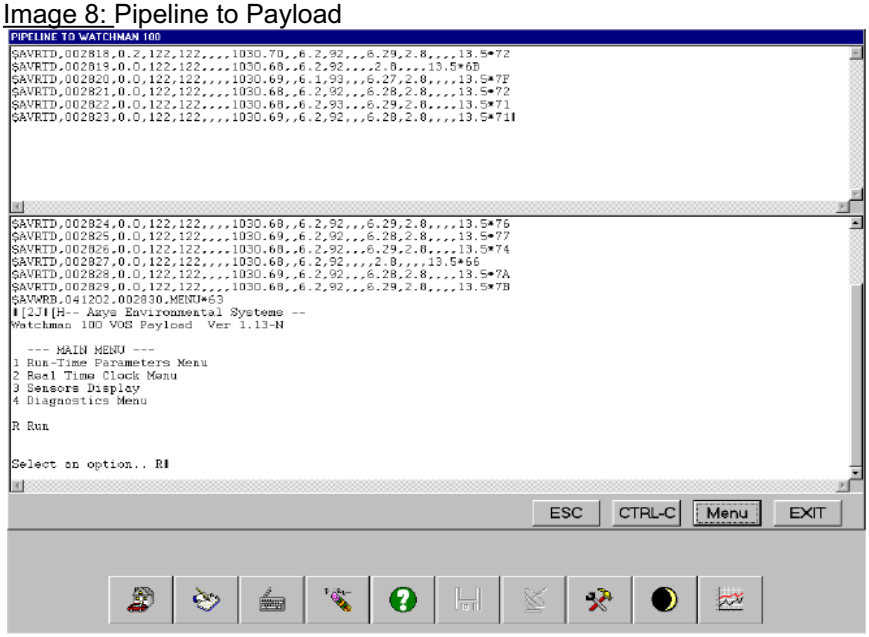


Image 9: Payload Configuration Settings from AVOS Bridge Software.

APPENDIX F: MOORED BUOY POWER BUDGET

The following section provides technical details of Canada's moored buoy.

AXYS Technologies Inc.

July 21, 2010

Payload Configuration: based on standard EC sampling algorithm	Power Estimate AHr/day
WM100 w/ Sutron Tx Module #0215:No Sensors	3.47
WM100 w/ Sutron Tx Module #0215:Sensors Connected: Heave, TAIR, SST, RM Young	3.85
WM100 w/ Sutron Tx Module #0215:Sensors Connected: Heave, TAIR, SST, WS425 Anemometer	4.32
WM100 w/ Seimac Tx Module #0257 Sensors Connected: Heave, TAIR, SST, RM Young	3.48

NOTES:

- Calculations based on 1Hz captured peak current log for a 1 hour cycle/3600*24 for average daily power.
- No external navigation lamp attached for these tests. Presently there are a variety of lamps being used in the network from the Tideland ML140 (incandescent bulbs with variable wattages), Tideland MLED140 (LED lamp), to standalone Carmanah 650 or 701 (no draw on buoy power). The power consumption from standard buoy powered Navigation lamps will vary by season and the length of the daylight off periods (as governed by an internal lamp daylight switch), and could average out to >25-30% of the entire load as shown in the table above.

Buoy Configuration(s):	Solar Panels	# of Batteries
WatchKeeper buoy	3 x 20 watt	4 x 100 AHr
3m Discus buoy	3 x 50 watt or 3 x 55 (currently shipping with these)	8 x 100 AHr
NOMAD	3 x 20 watt + 3 x 55 watt	12 x 100 AHr (Atlantic region may have more, but do not have this information)

APPENDIX G: SPACE AVAILABILITY OF MOORED BUOYS (Watchkeeper, 3 Meter Buoy, and Nomad) WITH PHOTOS

The following section provides technical details of Canada's moored buoy and AVOS networks. This section is included to assist in formulating response information.

Figure 1 – 1.7M Watchkeeper Buoy

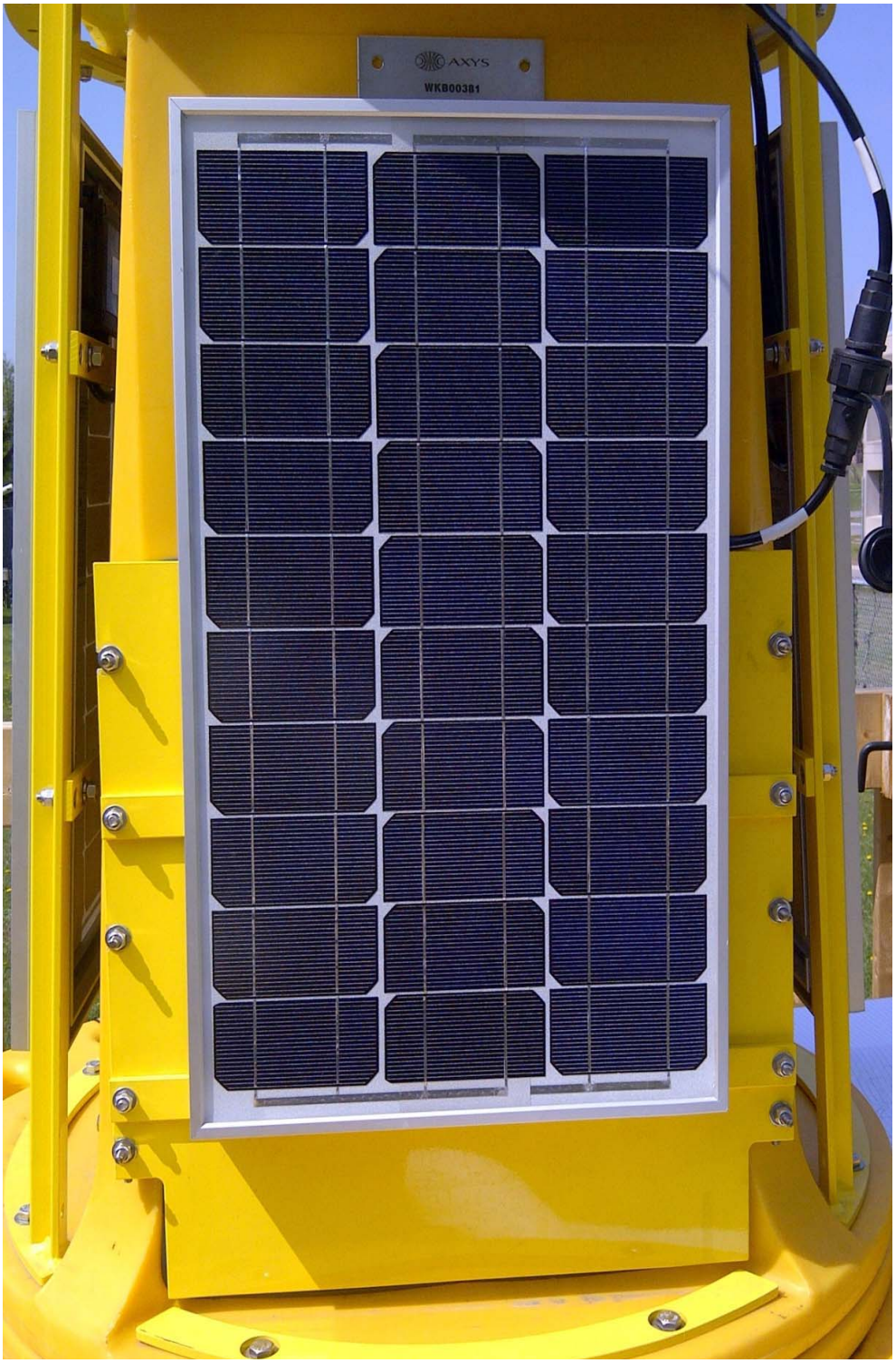


Figure 2 – 1.7M Watchkeeper Buoy- Payload Access Cover

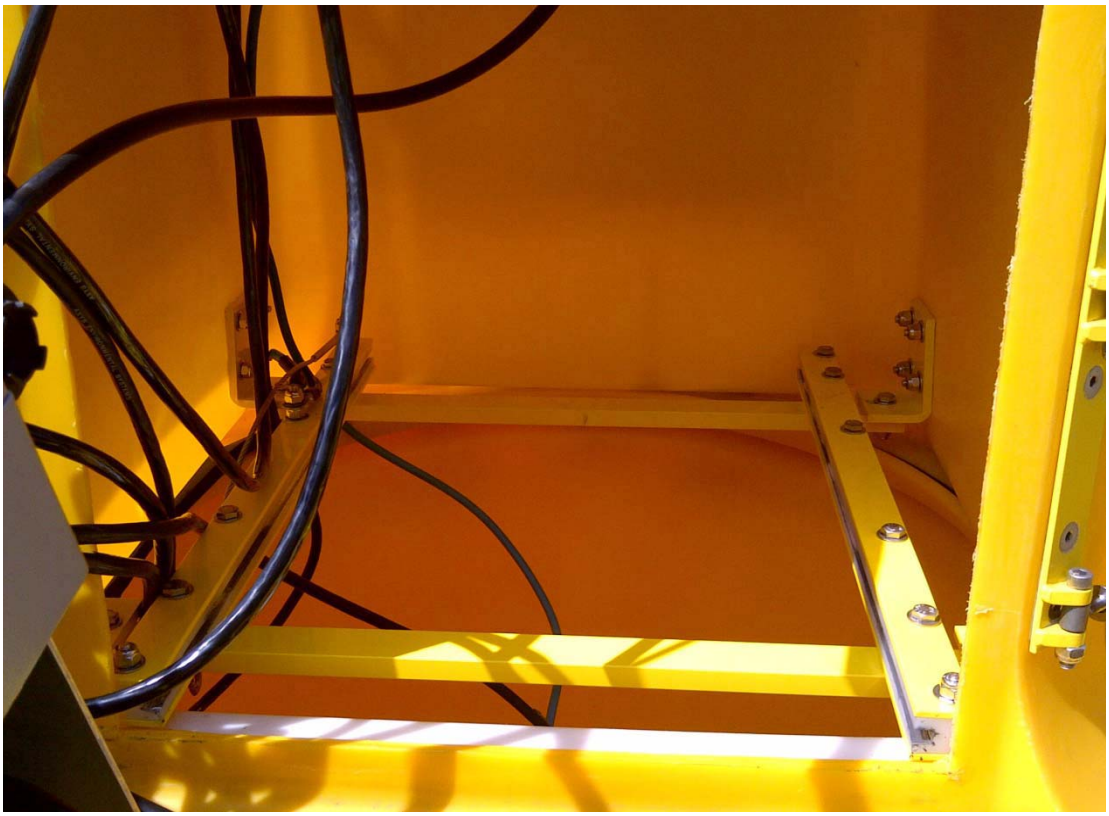


Figure 3 – 1.7M Watchkeeper Buoy- Tray Rails

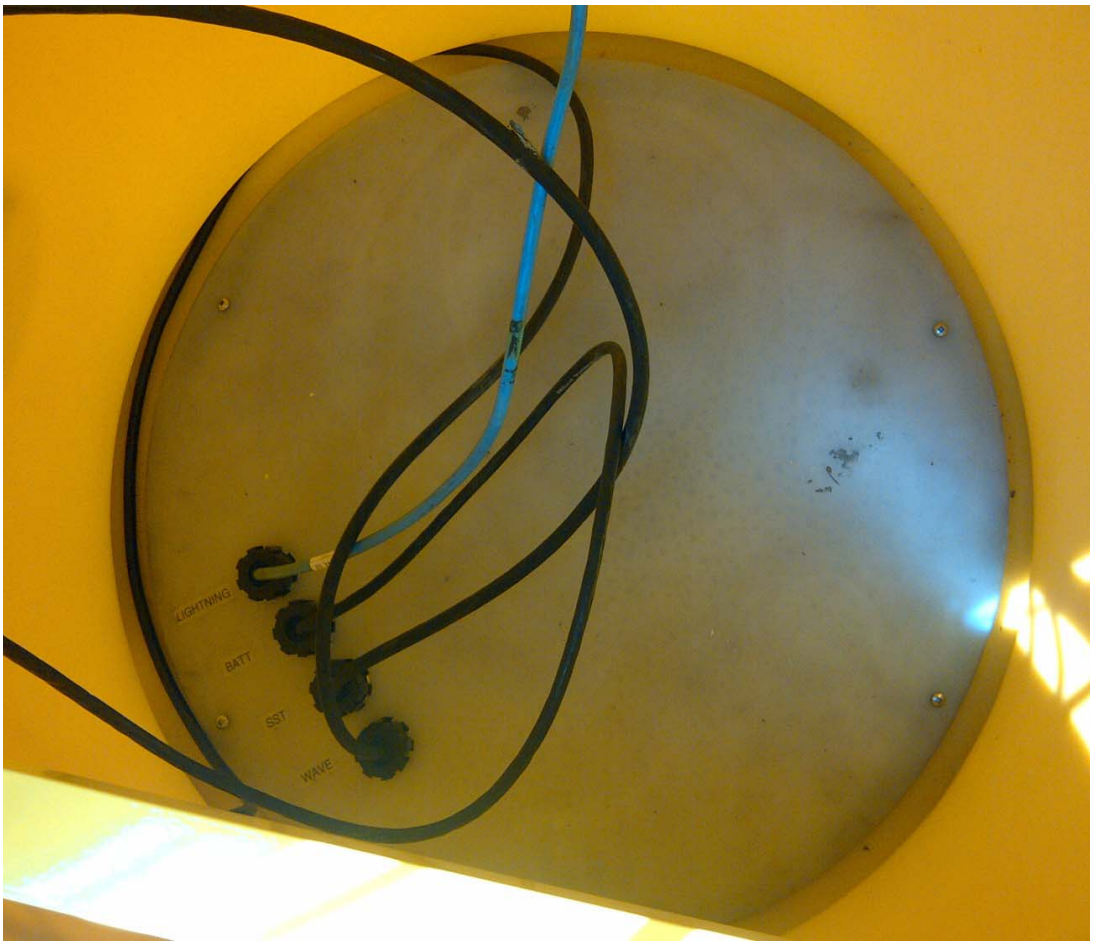


Figure 4 – 1.7M Watchkeeper Buoy- Mid Section Inside View

Figure 5 – 1.7M Watchkeeper Buoy- Payload Assembly

Figure 6 – 3M Discus Buoy

Figure 7 – 3M Buoy Discus - Battery and Payload Rack

Figure 8 – 3M Discus Buoy- Payload Shelf

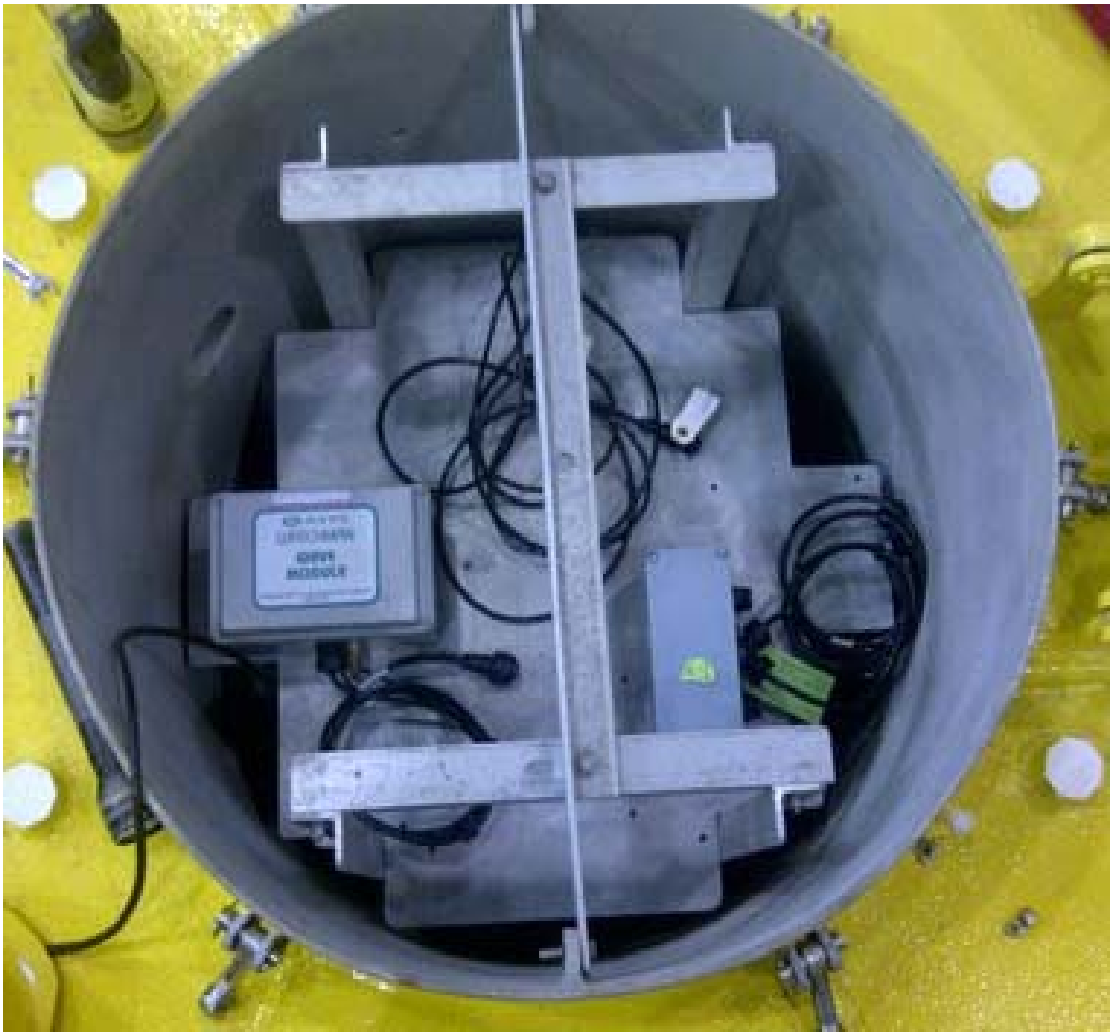


Figure 9 – 3M Discus Buoy- Hull Well Top View

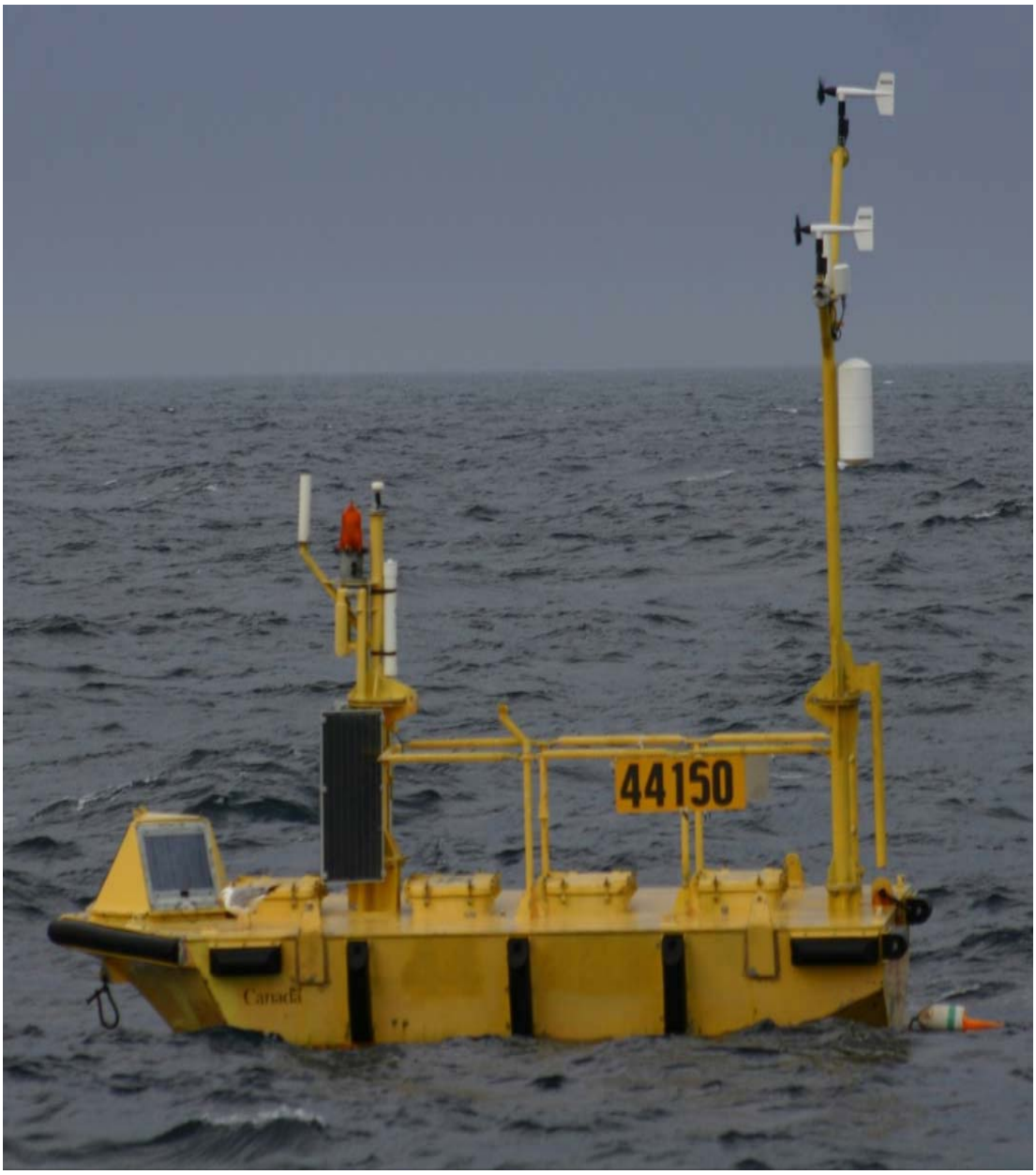


Figure 20 – 6M Nomad Buoy

Figure 31 – 6M Nomad Buoy- Payload and Transmitter Top View

Figure 41 – 6M Nomad Buoy- Payload and Transmitter Side View

Figure 52 – AVOS

Figure 63 – AVOS Enclosure Front View

Figure 74 – AVOS Enclosure Payload View

APPENDIX H: LIST OF MSC OPERATIONAL MOORED BUOYS

The following section provides technical details of Canada's Moored Buoy networks. This section is included to assist in formulating response information.

	Station name	WMO ID	Latitude	Longitude	Hull type
PYR	Middle Nomad	46004	50.930 N	136.095 W	6 Meter Nomad
PYR	South Nomad	46036	48.355 N	133.938 W	6 Meter Nomad
PYR	Sentry Shoal	46131	49.906 N	124.985 W	3 Meter Discus
PYR	South Brooks	46132	49.738 N	127.931 W	3 Meter Discus
PYR	Pat Bay	46134	48.648 N	123.495 W	3 Meter Discus
PYR	Central Dixon Entrance	46145	54.366 N	132.417 W	3 Meter Discus
PYR	Halibut Bank	46146	49.340 N	123.727 W	3 Meter Discus
PYR	South Moresby	46147	51.828 N	131.225 W	3 Meter Discus
PYR	Nanakwa Shoal	46181	53.833 N	128.831 W	3 Meter Discus
PYR	North Hecate Strait	46183	53.617 N	131.105 W	3 Meter Discus
PYR	North Nomad	46184	53.915 N	138.851 W	6 Meter Nomad
PYR	South Hecate Strait	46185	52.425 N	129.792 W	3 Meter Discus
PYR	West Sea Otter	46204	51.368 N	128.750 W	3 Meter Discus
PYR	West Dixon Entrance	46205	54.165 N	134.283 W	3 Meter Discus
PYR	La Perouse Bank	46206	48.835 N	125.998 W	3 Meter Discus
PYR	East Dellwood	46207	50.874 N	129.916 W	3 Meter Discus
PYR	West Moresby	46208	52.515 N	132.693 W	3 Meter Discus
ON	Port Stanley	45132	42.467 N	81.216 W	3 Meter Discus
ON	Prince Edward Pt	45135	43.791 N	76.874 W	3 Meter Discus
ON	Slate Island	45136	48.535 N	86.953 W	3 Meter Discus
ON	North Georgian Bay	45137	45.544 N	81.015 W	3 Meter Discus
QU	Mont Louis (Quebec)	45138	49.543 N	65.760 W	3 Meter Discus
ON	West Lake Ontario	45139	43.264 N	79.541 W	3 Meter Discus
PNR-E	Lake Winnipeg S. Basin	45140	50.800 N	96.733 W	1.7 Meter Watchkeeper
PNR-W	Great Slave Lake	45141	61.181 N	115.314 W	3 Meter Discus
ON	Port Colborne	45142	42.737 N	79.290 W	3 Meter Discus
ON	South Georgian Bay	45143	44.945 N	80.627 W	3 Meter Discus
PNR-E	Lake Winnipeg N.	45144	53.230 N	98.290 W	1.7 Meter Watchkeeper
PNR-E	Lake Winnipeg Narrows	45145	51.870 N	96.970 W	1.7 Meter Watchkeeper
ON	Lake St. Clair	45147	42.430 N	82.683 W	1.7 Meter Watchkeeper
ON	Lake of the Woods	45148	49.660 N	94.519 W	1.7 Meter Watchkeeper
ON	Southern Lake Huron(Bayfield)	45149	43.542 N	82.075 W	1.7 Meter Watchkeeper
PNR-W	Gt. Slave Lk N. Arm	45150	61.980 N	114.129 W	1.7 Meter Watchkeeper
ON	Lake Simcoe	45151	44.500 N	79.368 W	1.7 Meter Watchkeeper
ON	Lake Nipissing	45152	46.233 N	79.716 W	1.7 Meter Watchkeeper
ON	North Channel East	45154	46.051 N	82.637 W	1.7 Meter Watchkeeper
PNR-E	Hudson Bay SW	45158	59.000 N	94.000 W	1.7 Meter Watchkeeper
ON	NW Lake Ontario Ajax	45159	43.767 N	78.984 W	3 Meter Discus
ATL	East Scotia Slope	44137	42.234 N	62.018 W	6 Meter Nomad
ATL	SW Grand Banks	44138	44.251 N	53.633 W	6 Meter Nomad
ATL	Banqureau Bank	44139	44.240 N	57.103 W	6 Meter Nomad
ATL	Tail of the Bank	44140	42.868 N	51.467 W	6 Meter Nomad

ATL	Laurentian Fan	44141	42.993 N	57.958 W	6 Meter Nomad
ATL	La Have Bank	44150	42.505 N	64.018 W	6 Meter Nomad
ATL	Nickerson Bank	44251	46.444 N	53.392 W	6 Meter Nomad
ATL	NE Burgeo Bank	44255	47.267 N	57.336 W	6 Meter Nomad
ATL	Halifax Harbour	44258	44.502 N	63.403 W	3 Meter Discus

Region

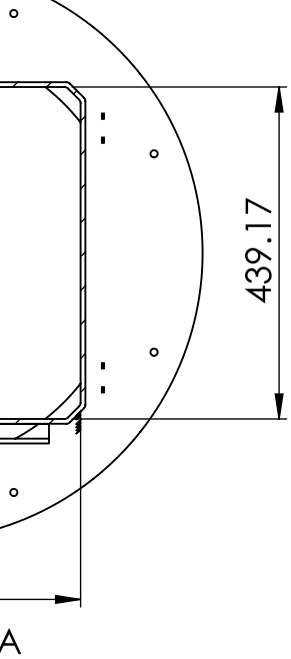
PYR	Pacific and Northern Region
ON	Ontario Region
PNR-E	Prairie and Northern Region (Edmonton Office)
PNR-W	Prairie and Northern Region (Winnipeg Office)
ATL	Atlantic Region

APPENDIX I: LIST OF AVOS IN MSC OPERATIONAL NETWORK

The following section provides technical details of Canada's AVOS networks. This section is included to assist in formulating response information.

	Ship Name	Call Sign	IMO number	Region
1	**AIVIK**	VOPP	7908445	Quebec
2	**ALGOSCOTIA**	VAAP	9273222	Atlantic
3	**AMUNDSEN**	CGDT	7510846	Quebec
4	**ARCTIC**	VCLM	7517507	Quebec
5	**AVALON**	VOKJ	9315044	Atlantic
6	**BARTLETT**	CGDR	7006778	Pacific and Yukon
7	**BLUE PUTTEES**	VXKF	9331177	Atlantic
8	**C. T. M. A. VACANCIER**	CFN3031	7310260	Quebec
9	**CABOT**	VCSZ	7700051	Atlantic
10	**CAMILLA DESGAGNES**	VOKF	8100595	Quebec
11	**ALGOMA ENTERPRISE**	VCJM	7726677	Ontario
12	**ALGOMA OLYMPIC**	VOPM	7432783	Ontario
13	**CTMA MADELEINE**	VCRG	7915228	Atlantic
14	**DARA DESGAGNES**	VCBW	9040089	Quebec
15	**DES GROSEILLIERS**	CGDX	8006385	Quebec
16	**DUMIT**	CG2522	7902192	Prairie and Northern
17	**EARL GREY**	CG3029	8412340	Atlantic
18	**ECKALOO**	CG2992	8712465	Prairie and Northern
19	**EDWARD CORNWALLIS**	CGJV	8320470	Atlantic
20	**GEORGE R. PEARKES**	CGCX	8320444	Atlantic
21	**GORDON REID**	CGBR	8818568	Pacific and Yukon
22	**GRIFFON**	CGDS	7022887	Ontario
23	**HENRY LARSEN**	CGHL	8409329	Atlantic
24	**HUDSON**	CGDG	5405279	Atlantic
25	**I. T. INTREPID**	8PSH	8710871	Atlantic
26	**JANA DESGAGNES**	VCDR	9046564	Quebec
27	**JOHN P. TULLY**	CG2958	8320420	Pacific and Yukon
28	**KELLY OVAYUAK**	CZ3695	8845561	Prairie and Northern
29	**LEIF ERICSON**	VOCJ	8917388	Atlantic
30	**LIMNOS**	CG2350	6804903	Ontario
31	**LOUIS S. ST-LAURENT**	CGBN	6705937	Atlantic
32	**MARIA DESGAGNES**	VCWL	9163752	Quebec
33	**MARTHA L. BLACK**	CGCC	8320432	Quebec
34	**NAMAO**	CZ9742	8624759	Prairie and

				Northern
35	**NEWFOUNDLAND LYNX**	VAAZ	9158202	Atlantic
36	**NORDIK EXPRESS**	VCYL	7391290	Quebec
37	**NULIAJUK**	CFN5537	9627277	Atlantic
38	**NUNAKPUT**	VC6750	7003556	Prairie and Northern
39	**OCEANEX SANDERLING**	VOLG	7603502	Atlantic
40	**OOCL MONTREAL**	VRYO3	9253739	Quebec
41	**PETER R. CRESSWELL**	VCBZ	8016641	Ontario
42	**PIERRE RADISSON**	CGSB	7510834	Quebec
43	**SAMUEL RISLEY**	CG2960	8322442	Ontario
44	**SIR WILFRID LAURIER**	CGJK	8320456	Pacific and Yukon
45	**SIR WILLIAM ALEXANDER**	CGUM	8320482	Atlantic
46	**SKAUBRYN**	3FZK3	8107103	Pacific and Yukon
47	**STRAIT EXPLORER**	VOFG	8023096	Atlantic
48	**TANU**	CGBY	6817754	Pacific and Yukon
49	**TERRY FOX**	CGTF	8127799	Atlantic
50	**W. E. RICKER**	CG2965	7809364	Pacific and Yukon
51	**WESTWOOD VICTORIA**	C6SI6	9226059	Pacific and Yukon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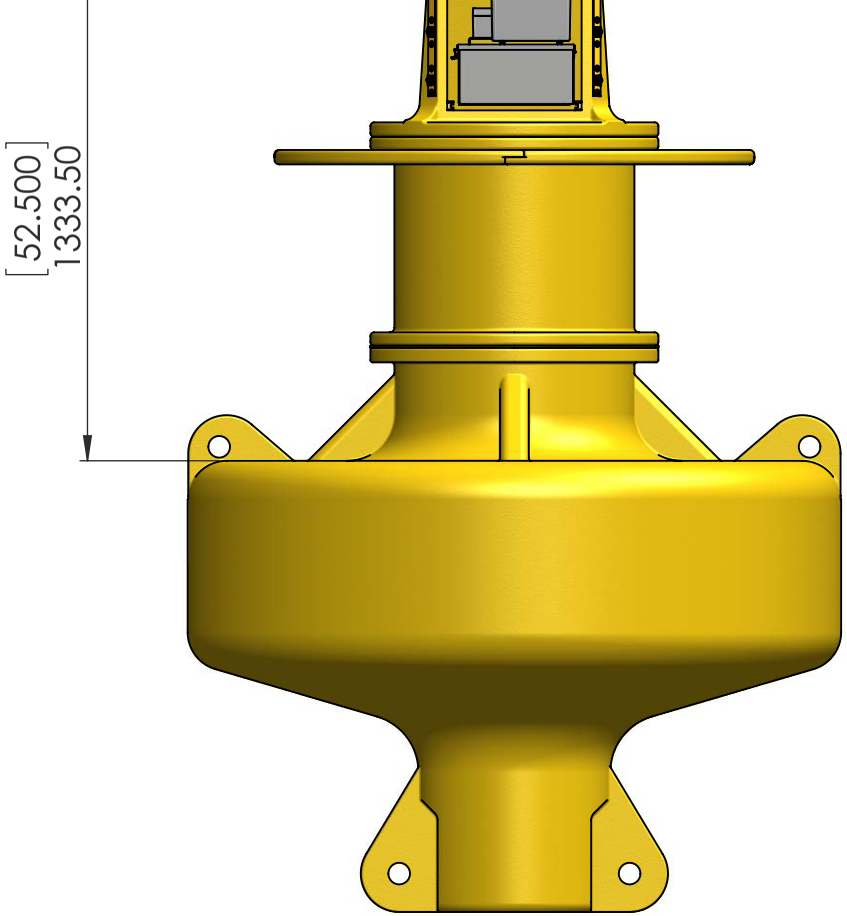
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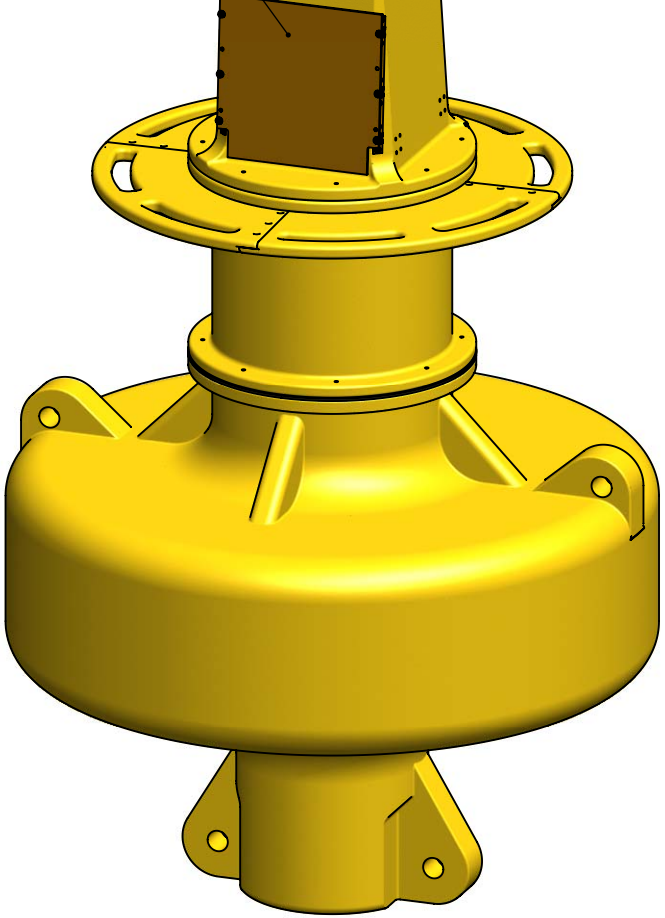

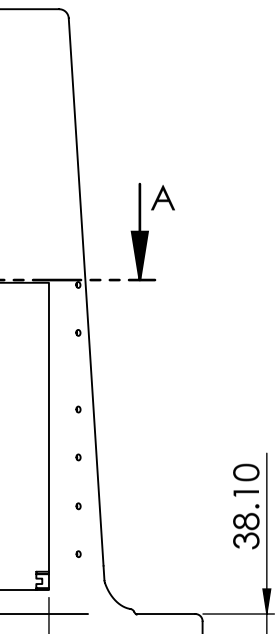
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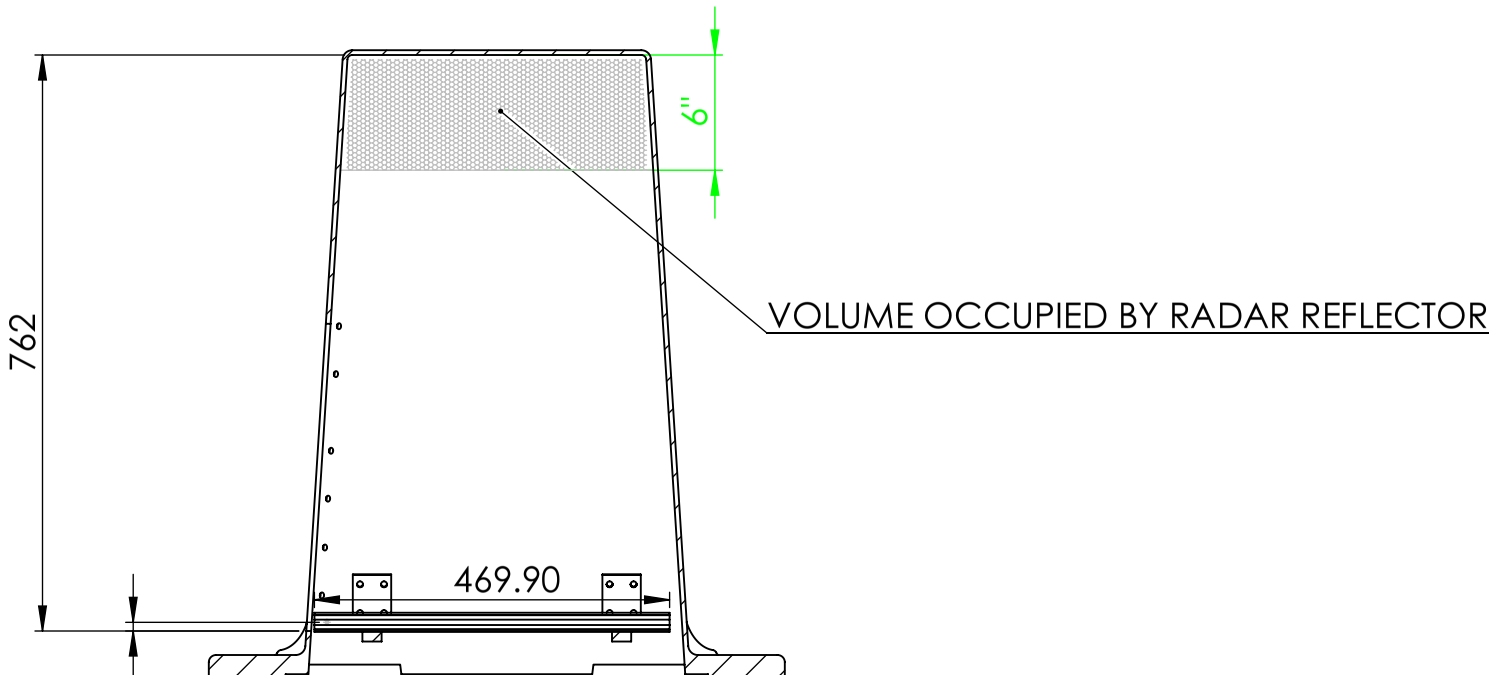
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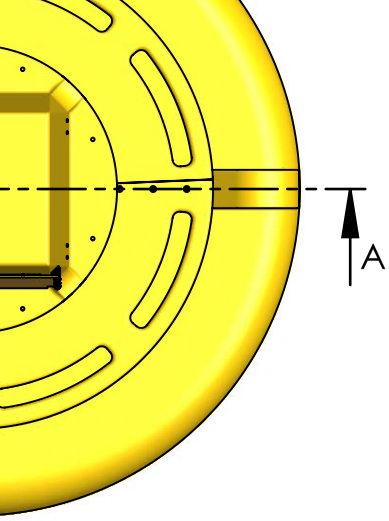
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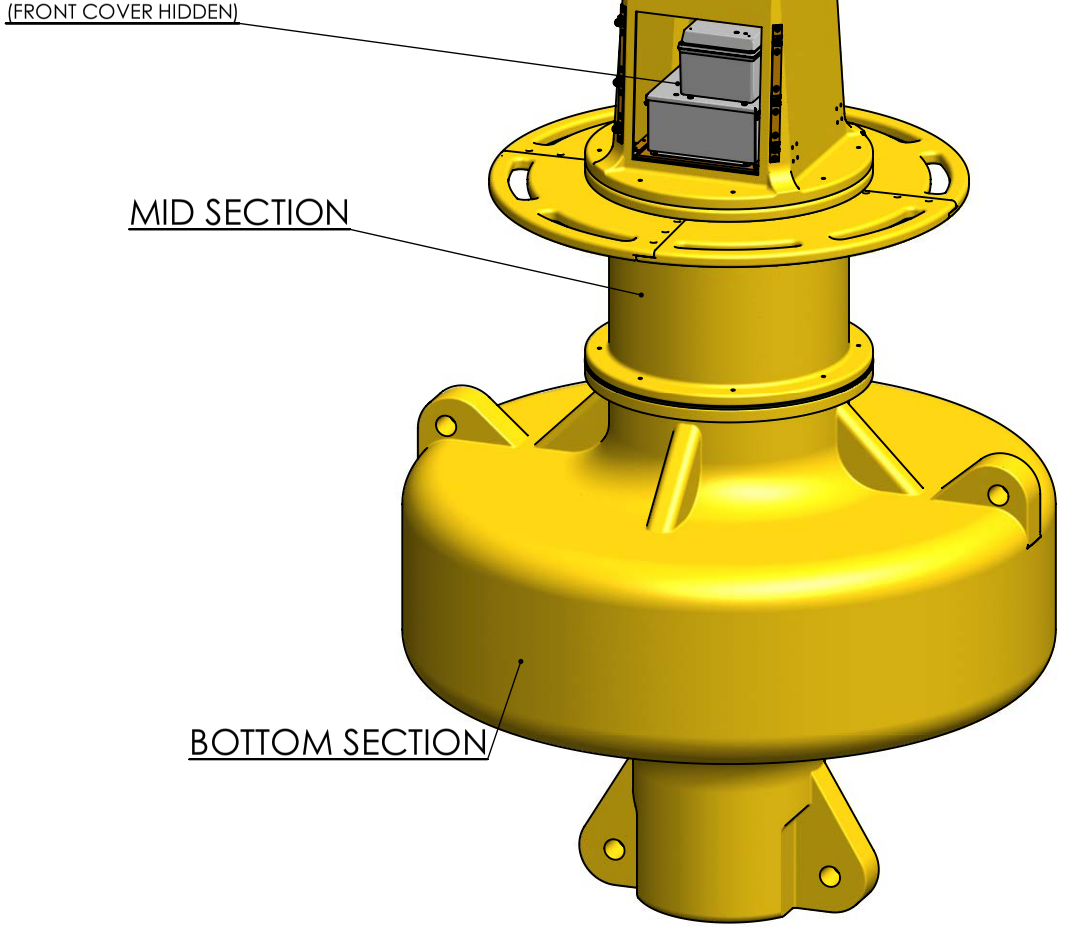
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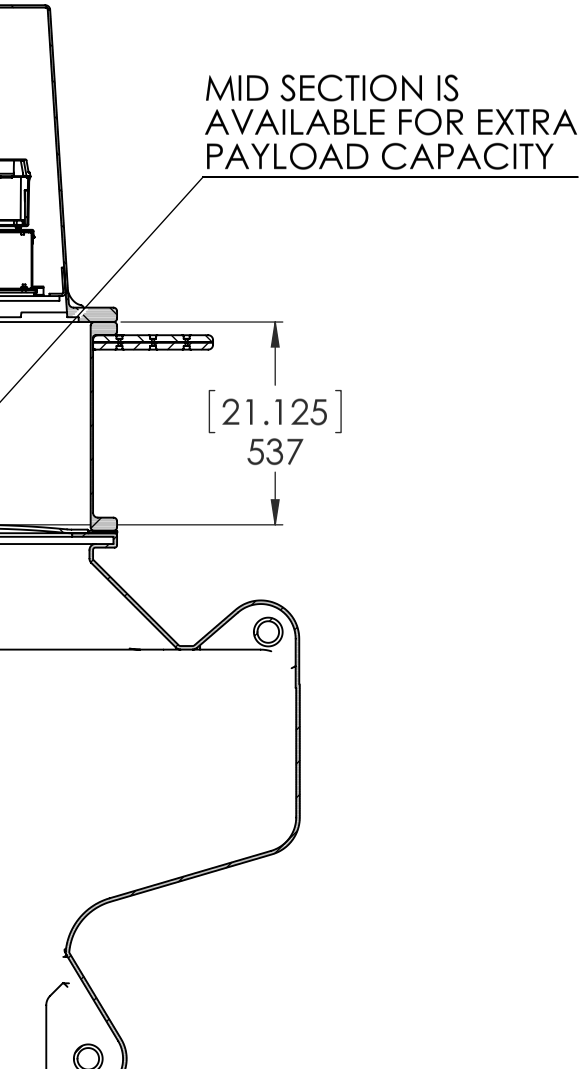
BOTTOM SECTION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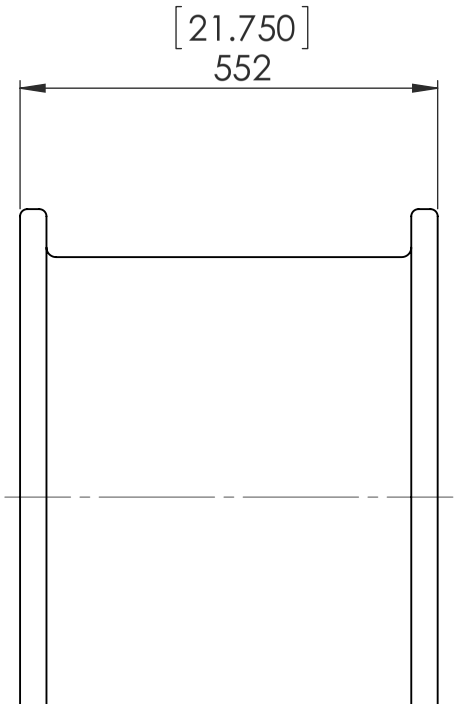
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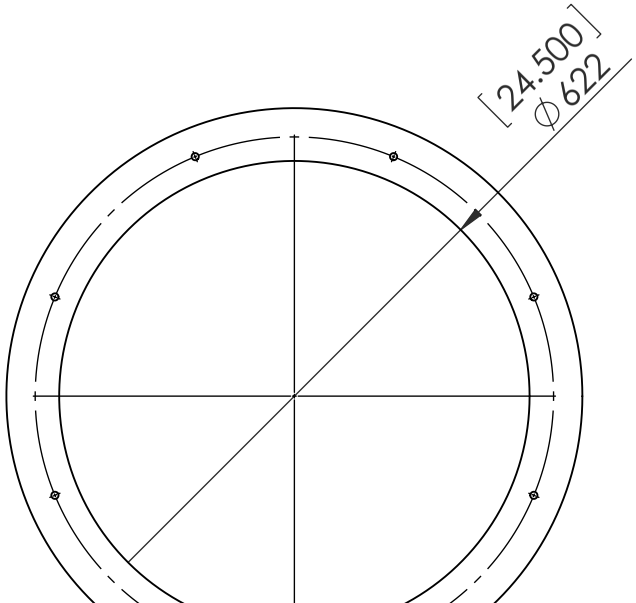
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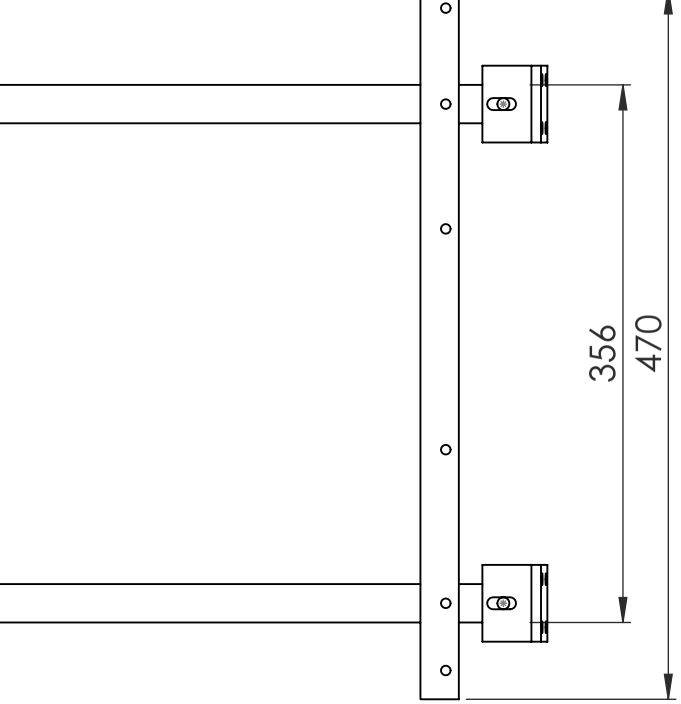
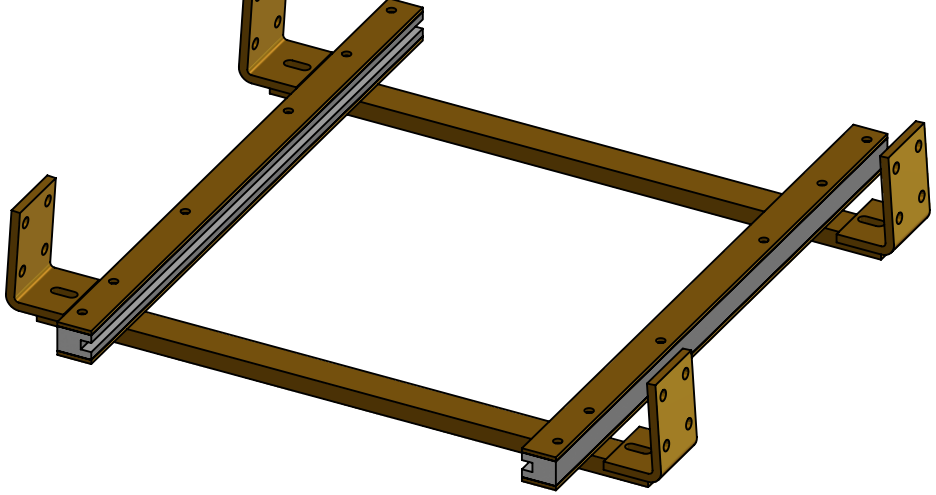
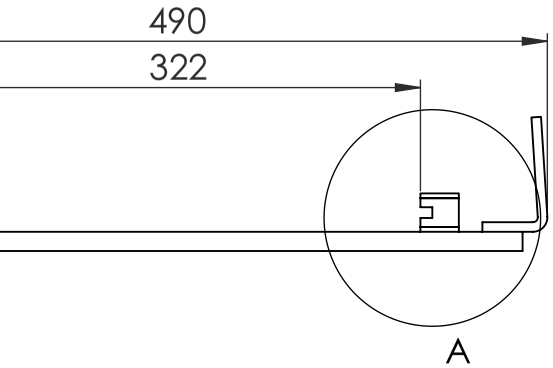
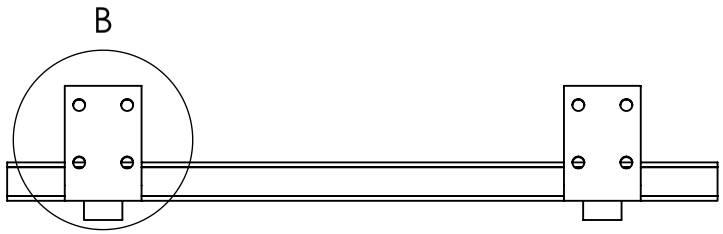
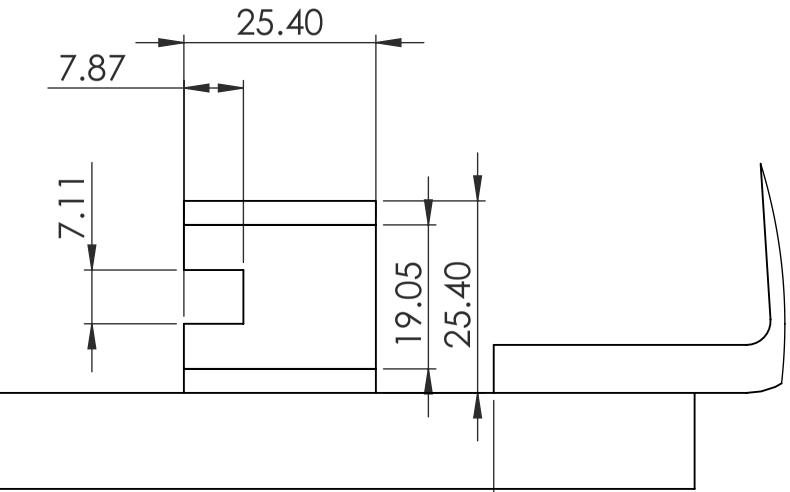
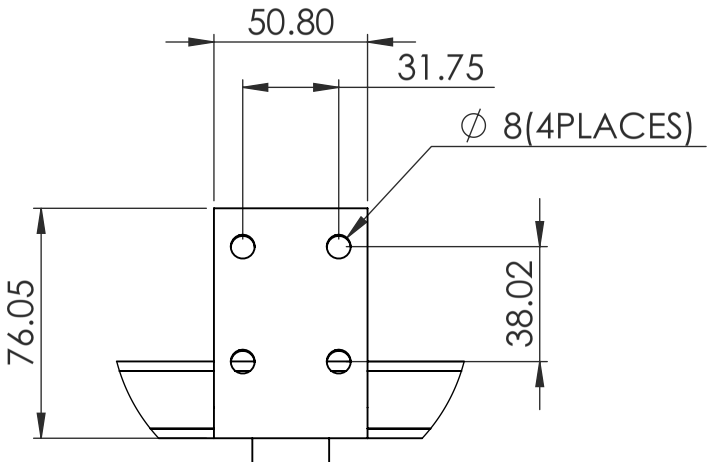

356
470

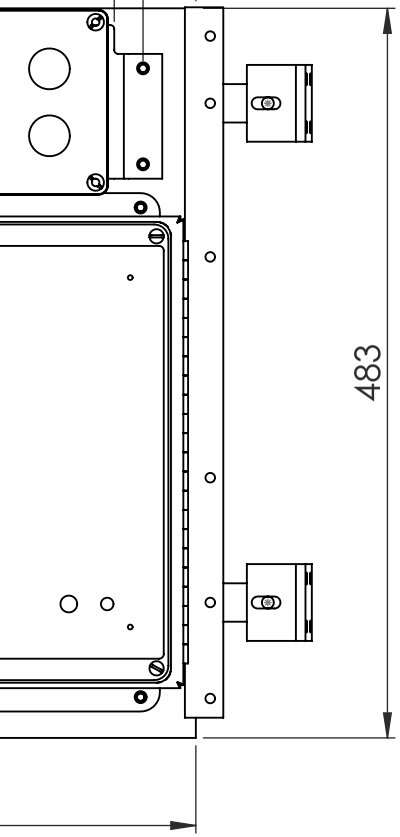


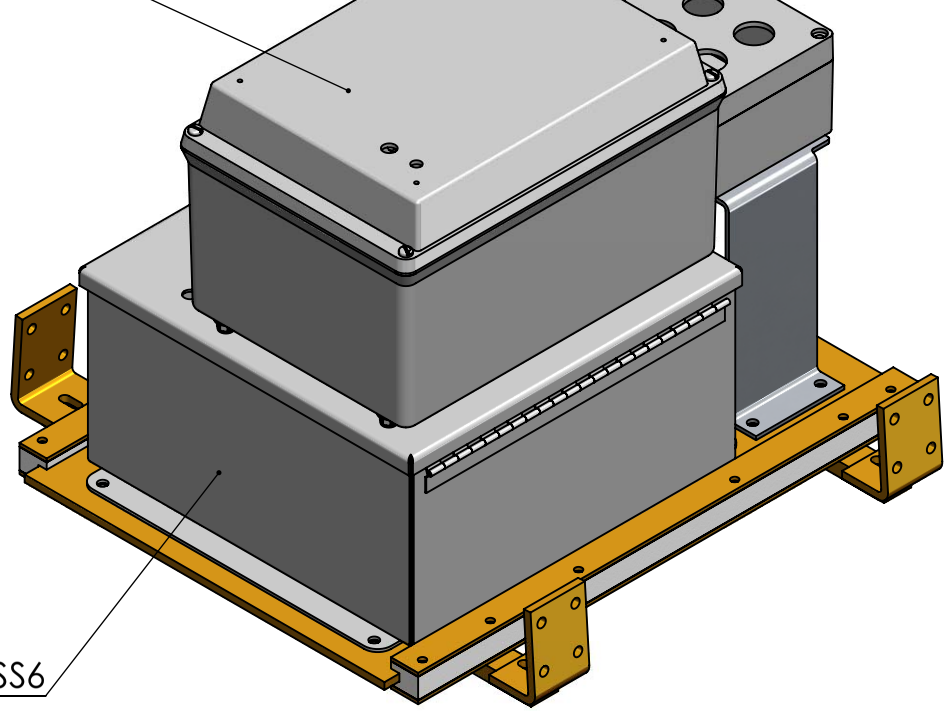

490
322
A


B

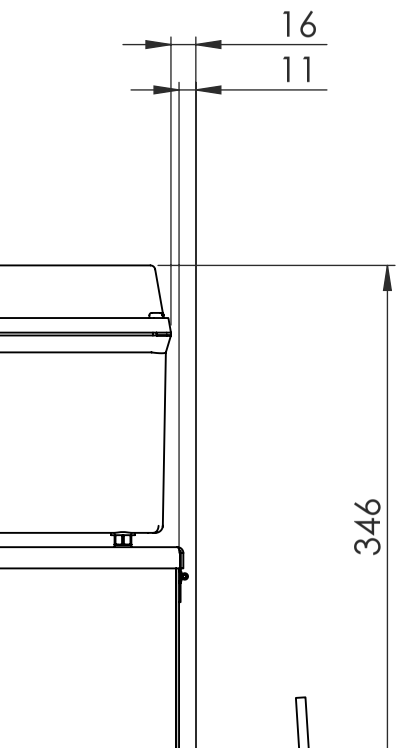

25.40
7.87
7.11
19.05
25.40

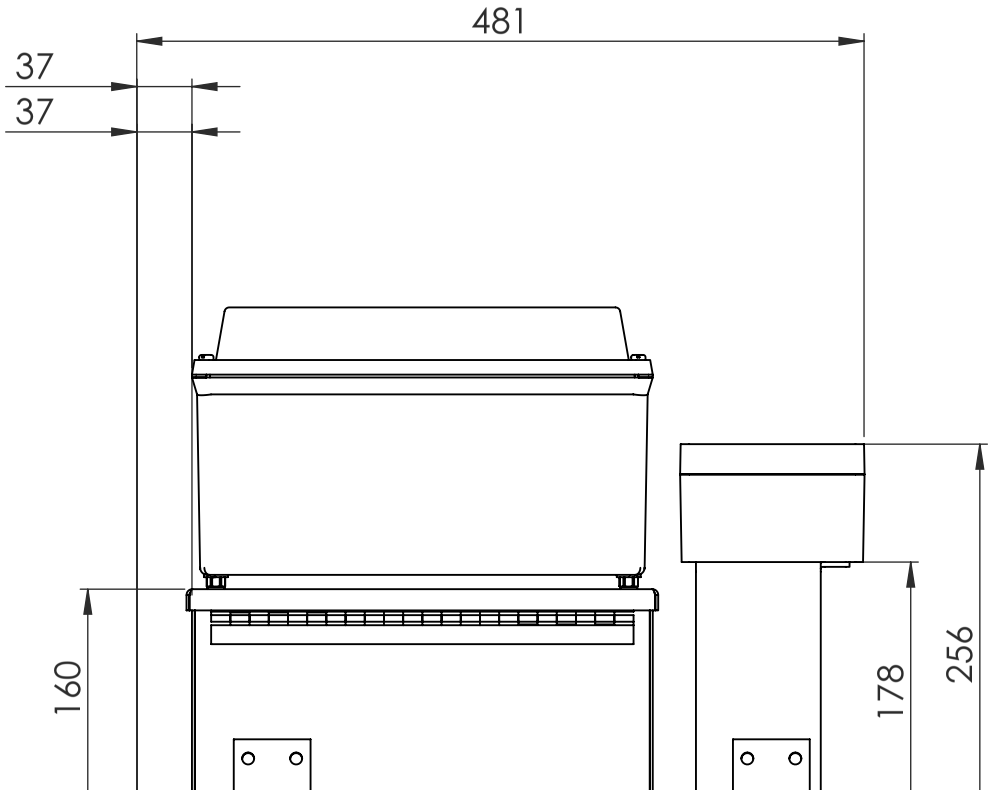

50.80
31.75
∅ 8(4PLACES)
76.05
38.02

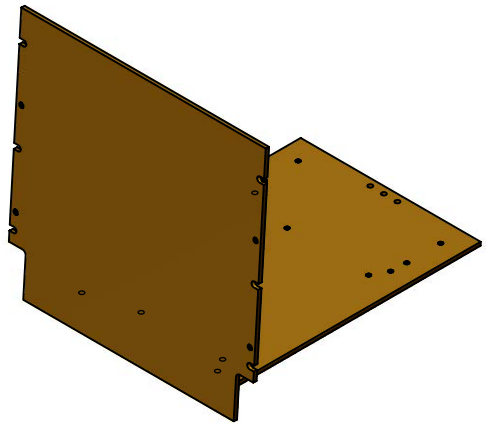




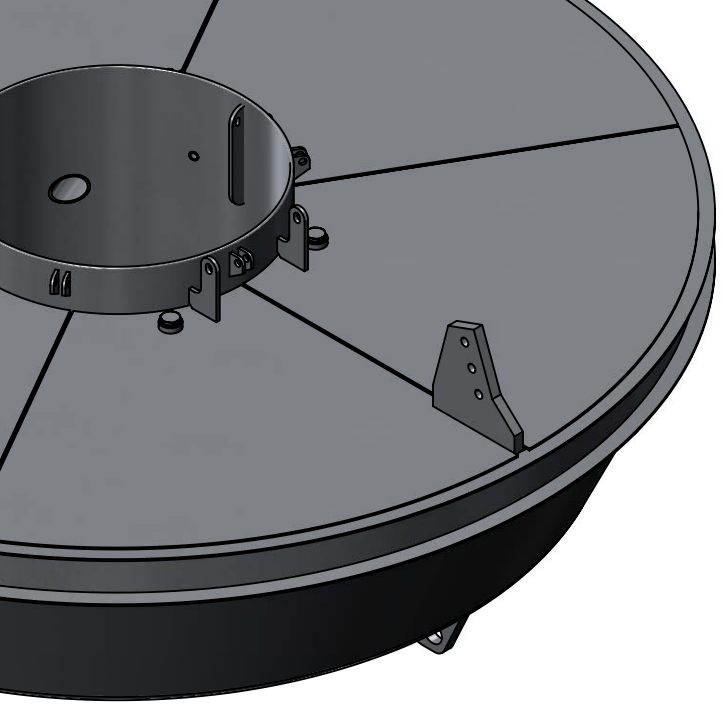
TRANSMITTER MODULE
HOFFMAN A1212CHNFSS6

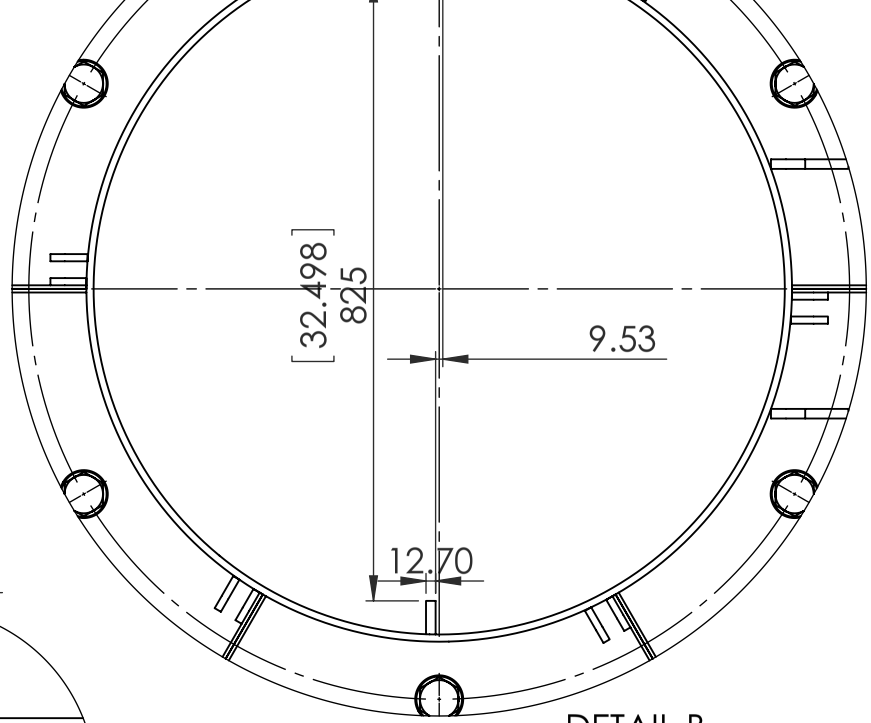




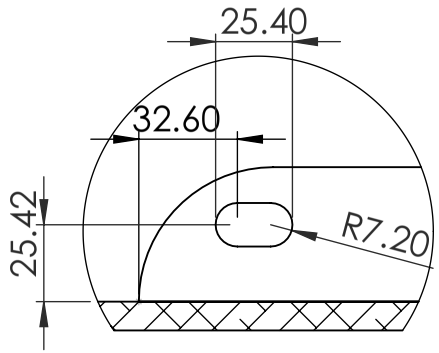


PAYLOAD TRAY WITH
FRONT COVER SHOWN
(FRONT COVER IS WELDED TO TRAY BASE PLATE AT AN 86.37° ANGLE)

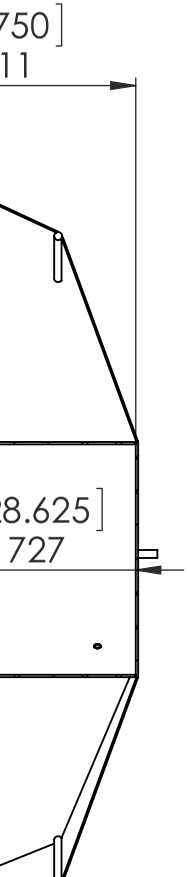


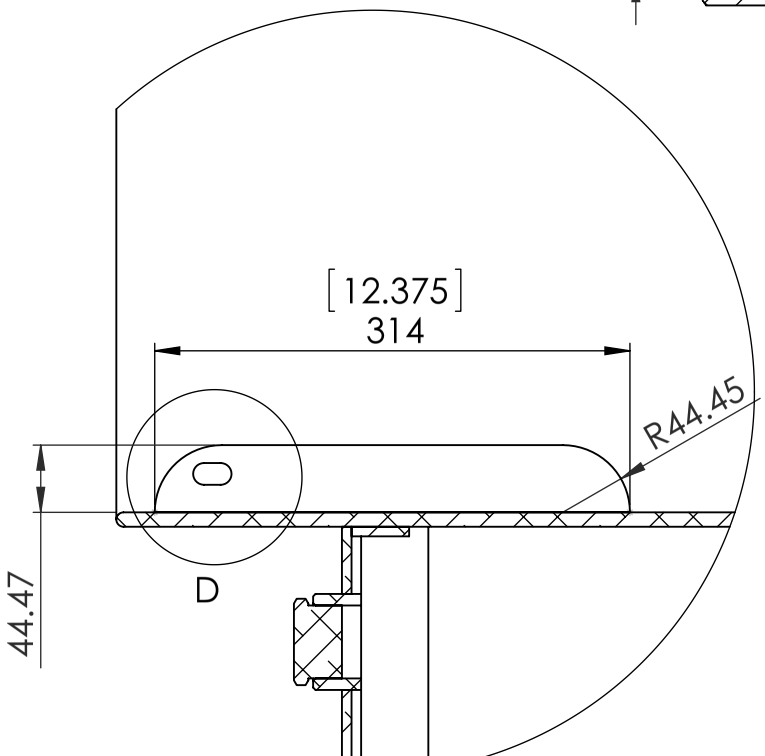


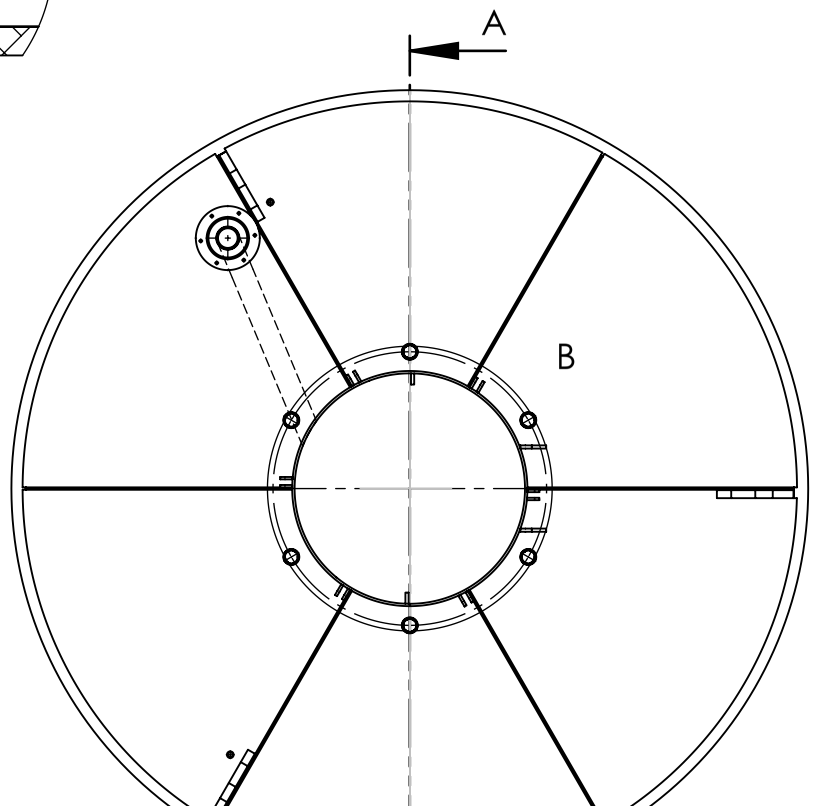
DETAIL B

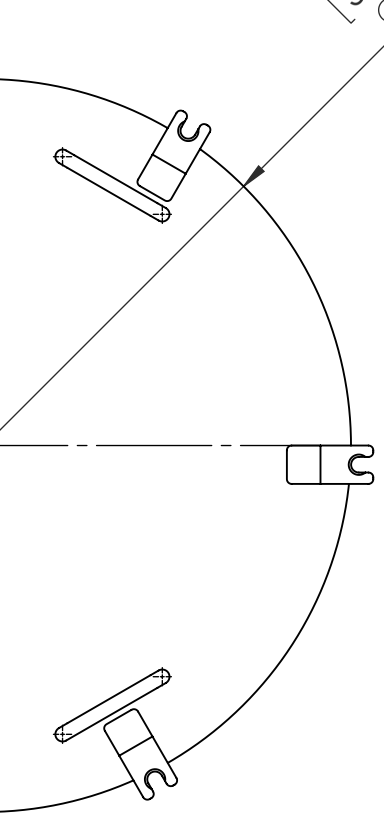


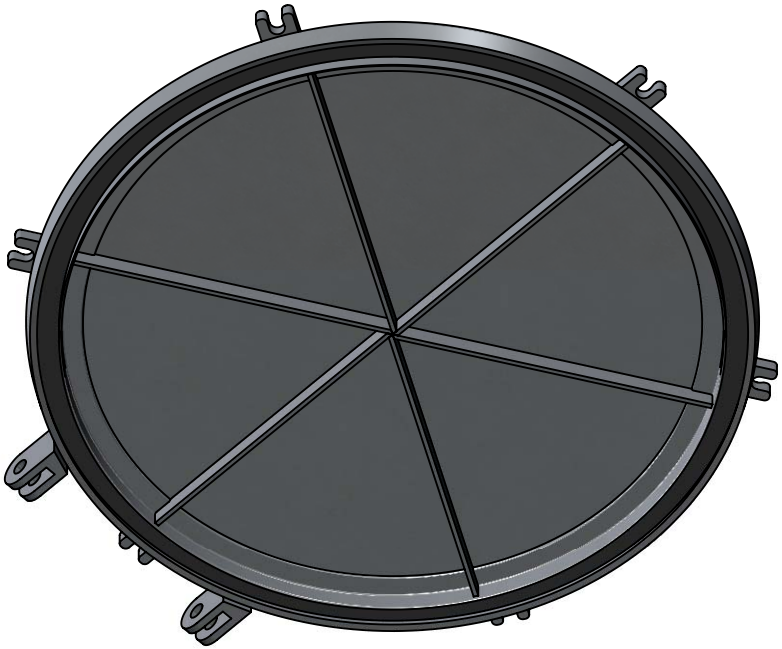
DETAIL D

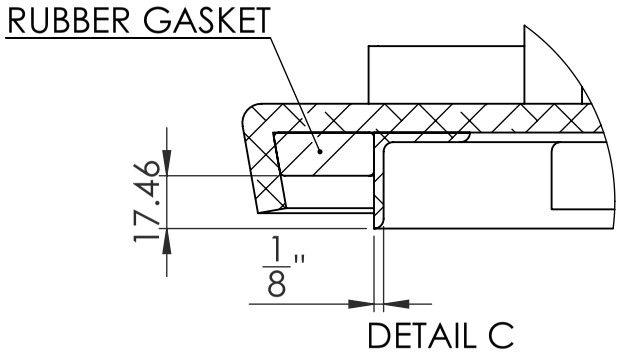


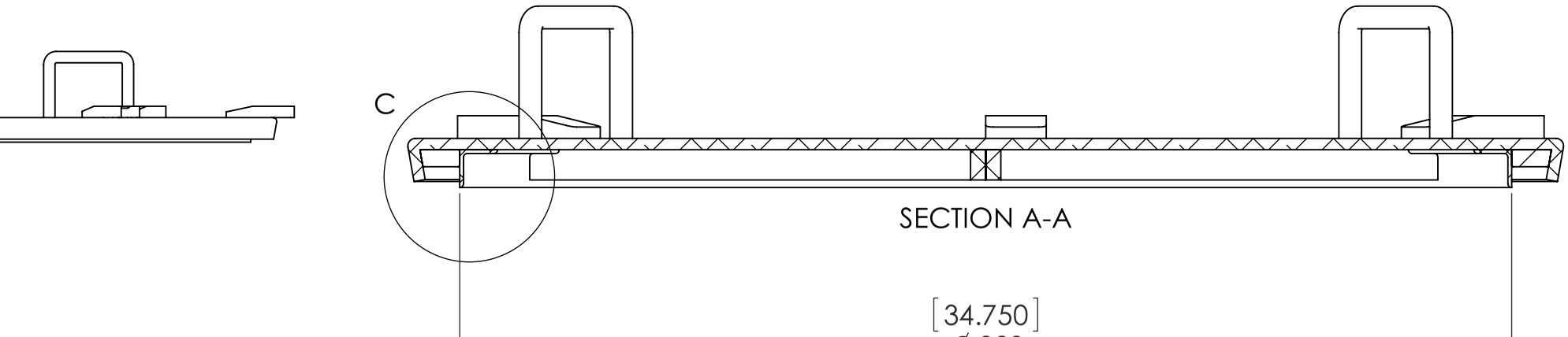


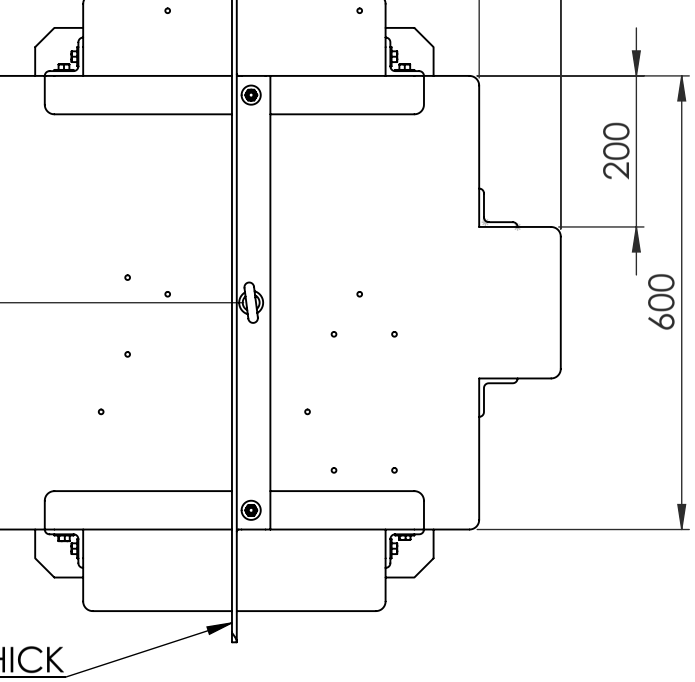


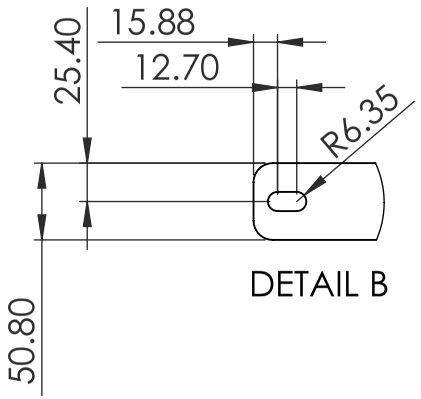


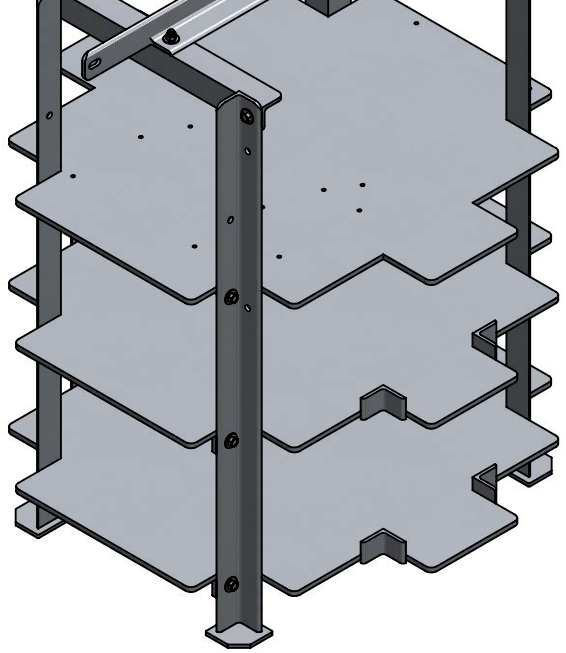


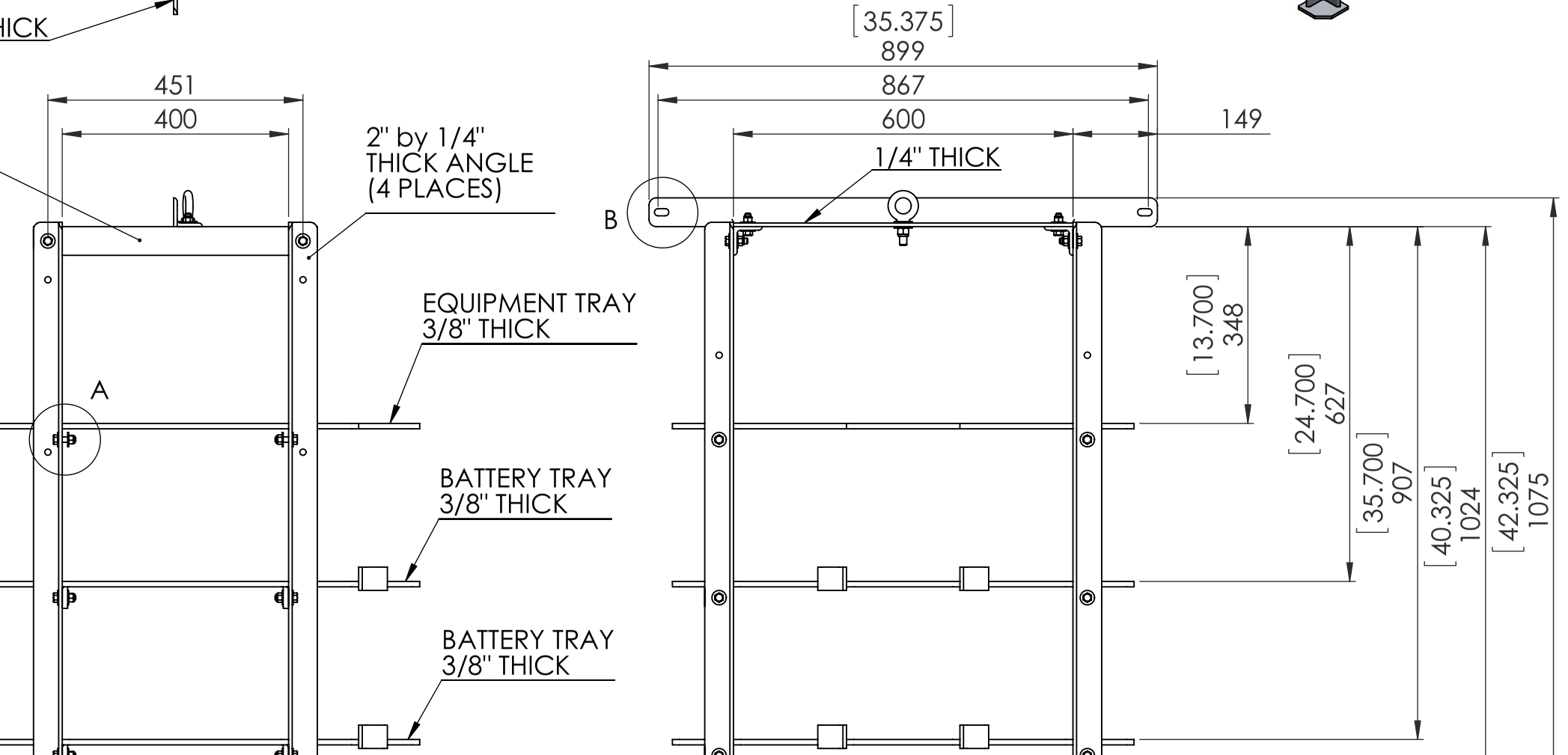

RUBBER GASKET
17.46
1/8"
DETAIL C

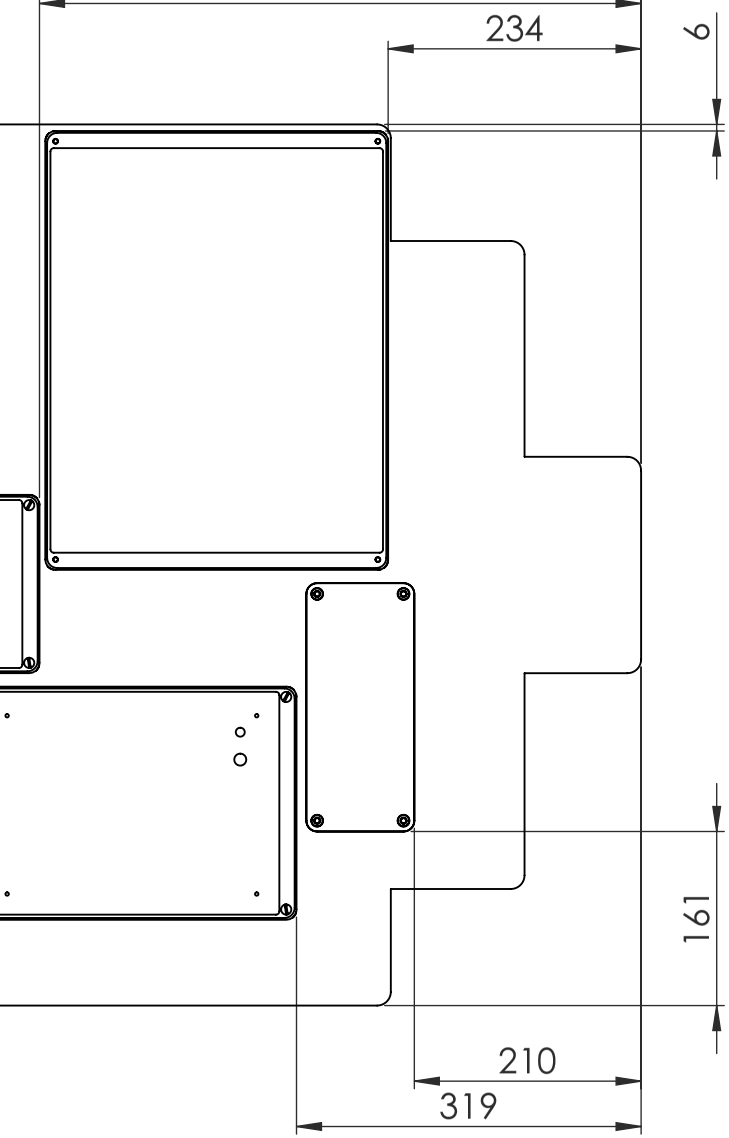

C
SECTION A-A
[34.750]

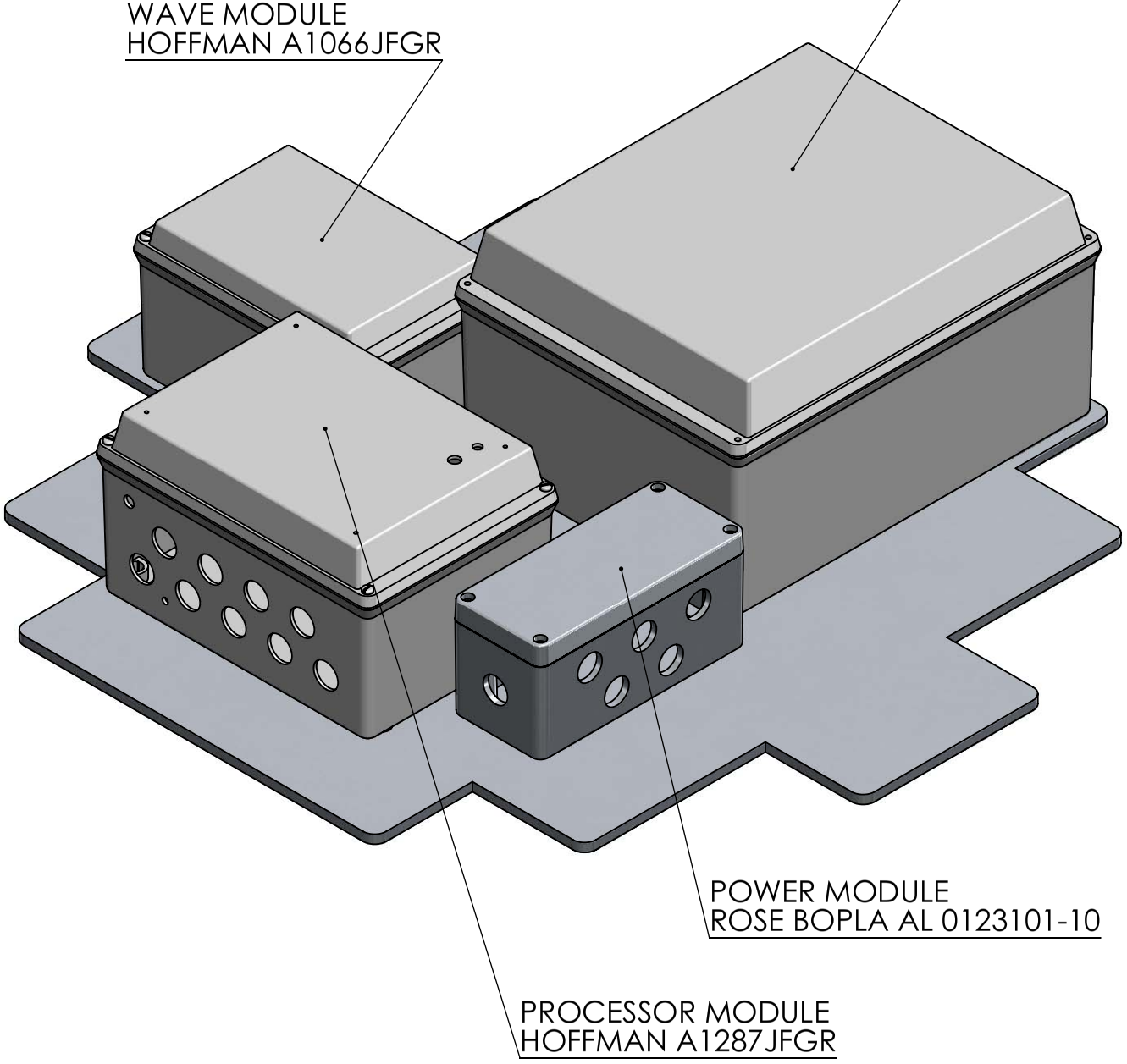

200
600
HICK

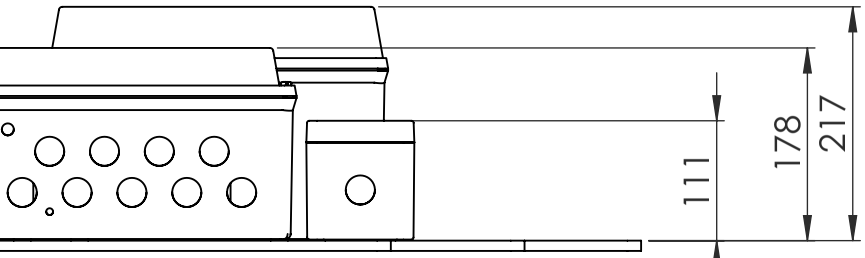

15.88
12.70
25.40
R6.35
50.80
DETAIL B

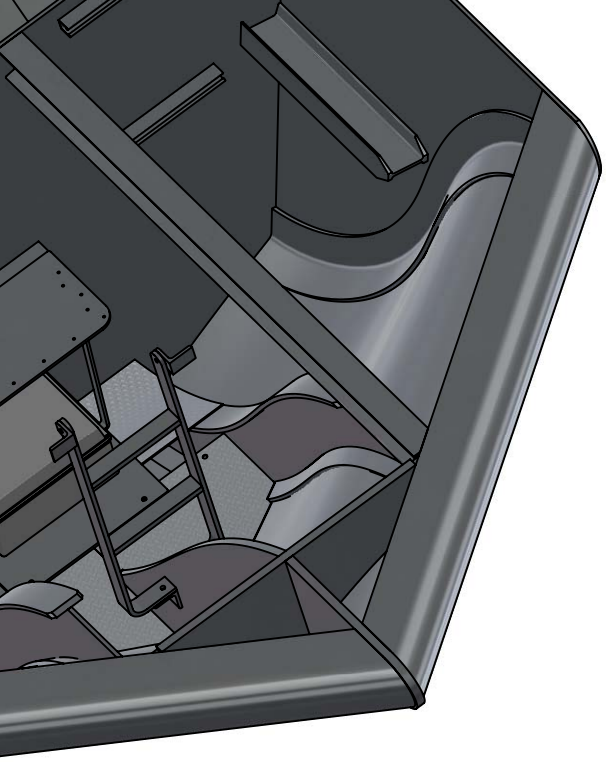


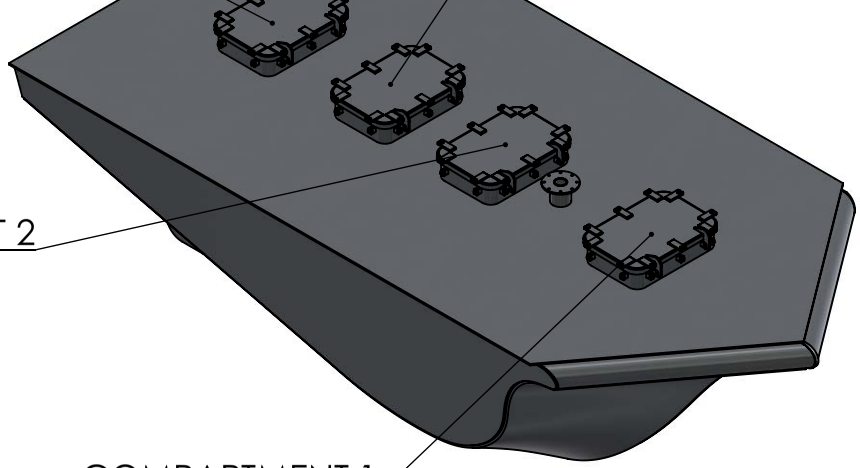

[35.375]
899
867
600
149
1/4" THICK
451
400
2" by 1/4"
THICK ANGLE
(4 PLACES)
B
A
EQUIPMENT TRAY
3/8" THICK
BATTERY TRAY
3/8" THICK
BATTERY TRAY
3/8" THICK
[13.700]
348
[24.700]
627
[35.700]
907
[40.325]
1024
[42.325]
1075


234
6
161
210
319

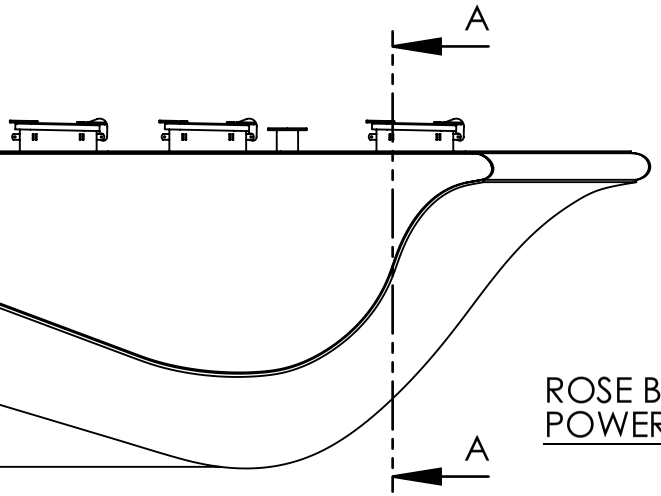

WAVE MODULE
HOFFMAN A1066JFGR
POWER MODULE
ROSE BOPLA AL 0123101-10
PROCESSOR MODULE
HOFFMAN A1287JFGR

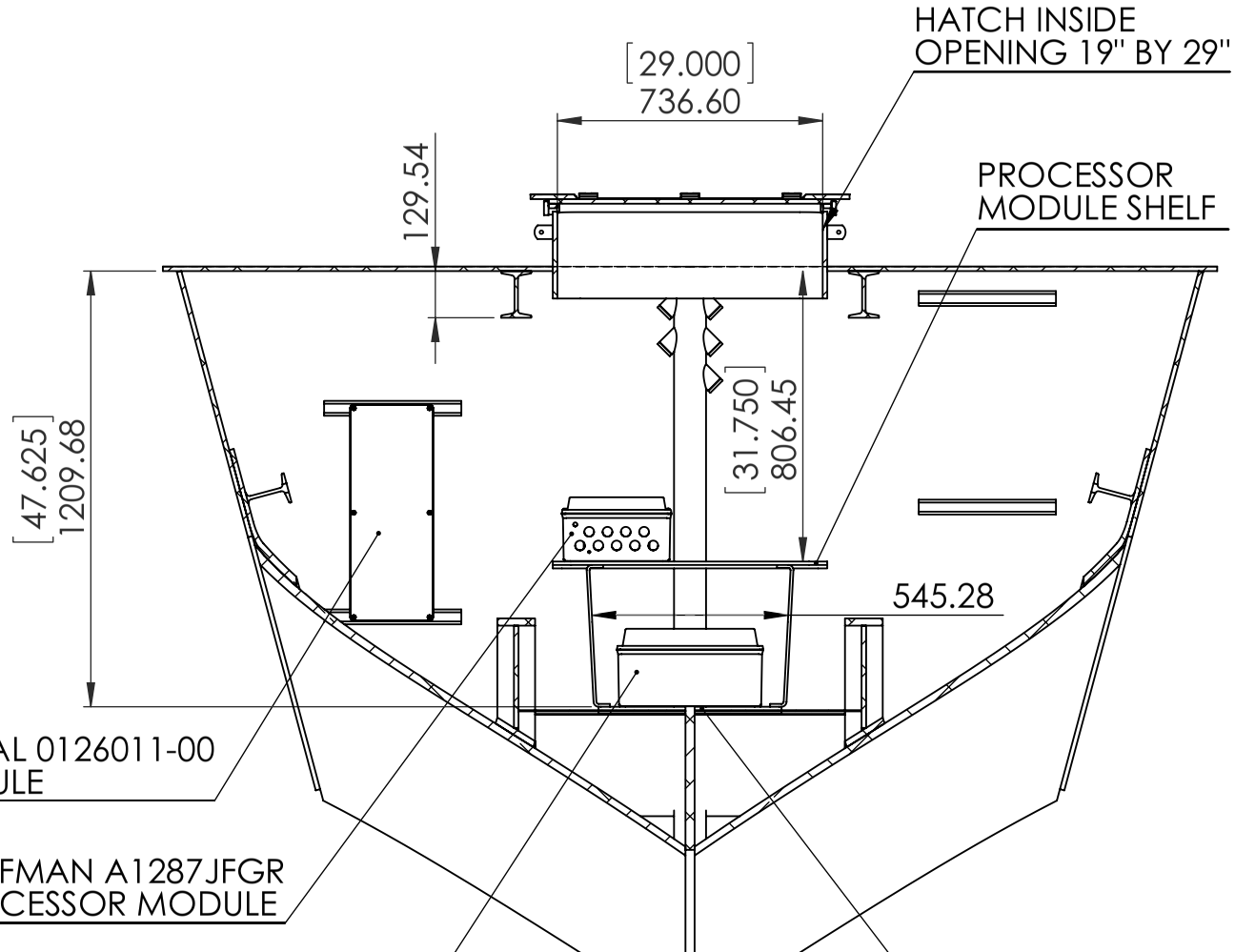

111
178
217

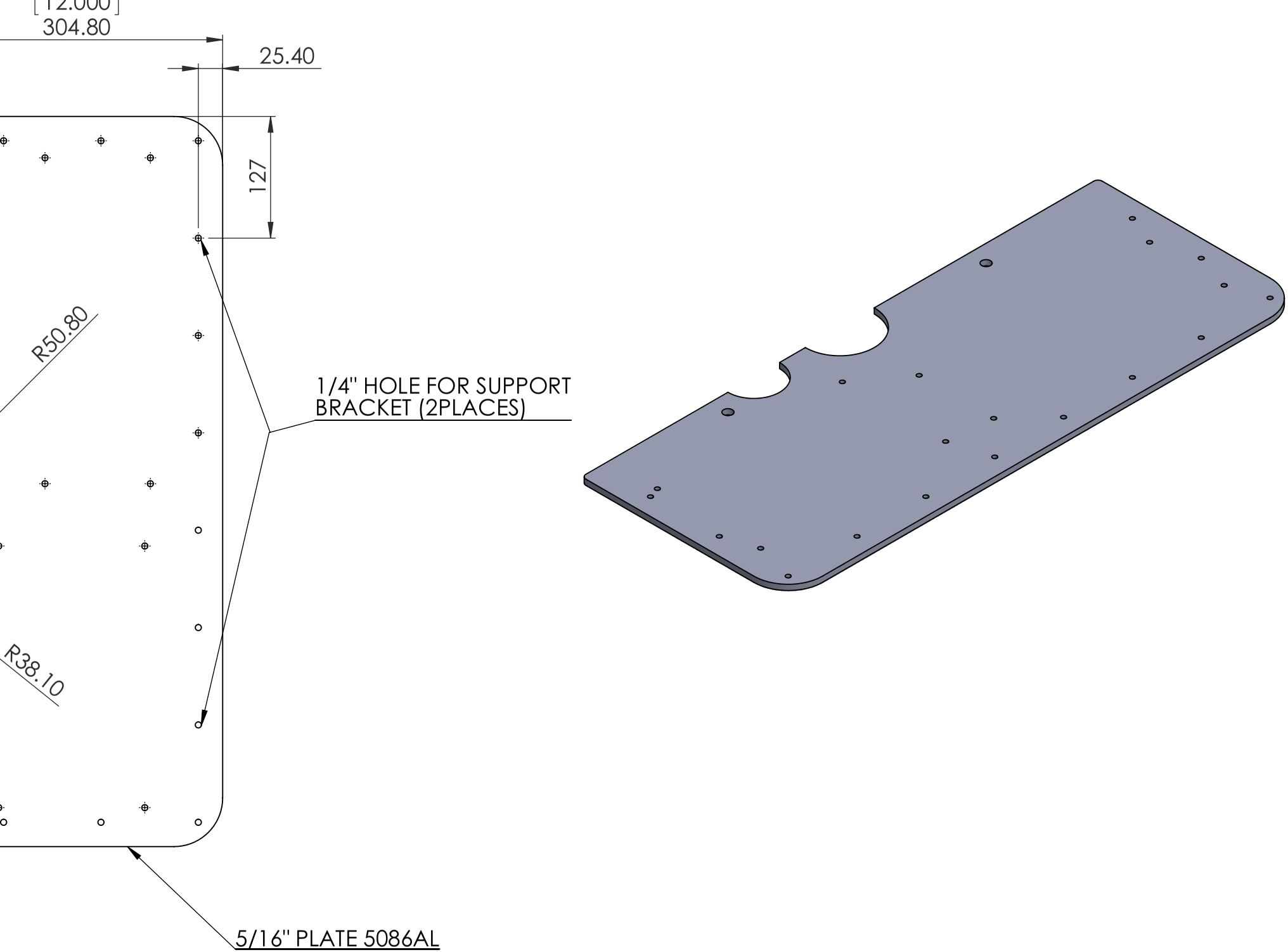


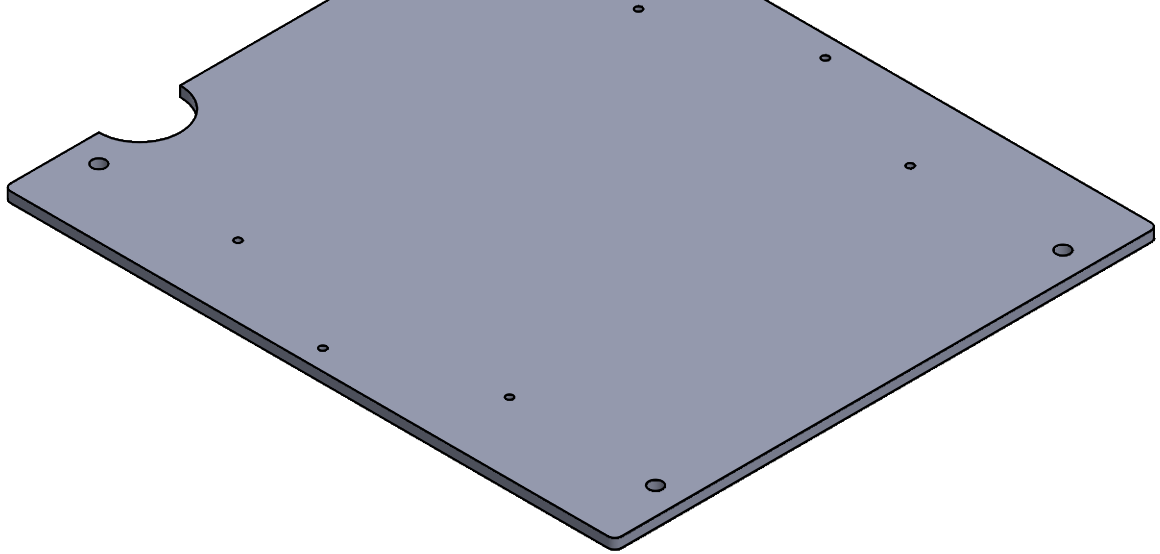


PARTMENT COVER ARE NOT SHOWN
BEAM NOT SHOWN
OUT REFERENCE ONLY






[12.000]
304.80
25.40
127
R50.80
R38.10
1/4" HOLE FOR SUPPORT
BRACKET (2PLACES)
5/16" PLATE 5086AL



' HOLE FOR SUPPORT
ACKET(2PLACES)

[22.500]
571.50

63.50

25.40

25.40

381

381

508

R38.10

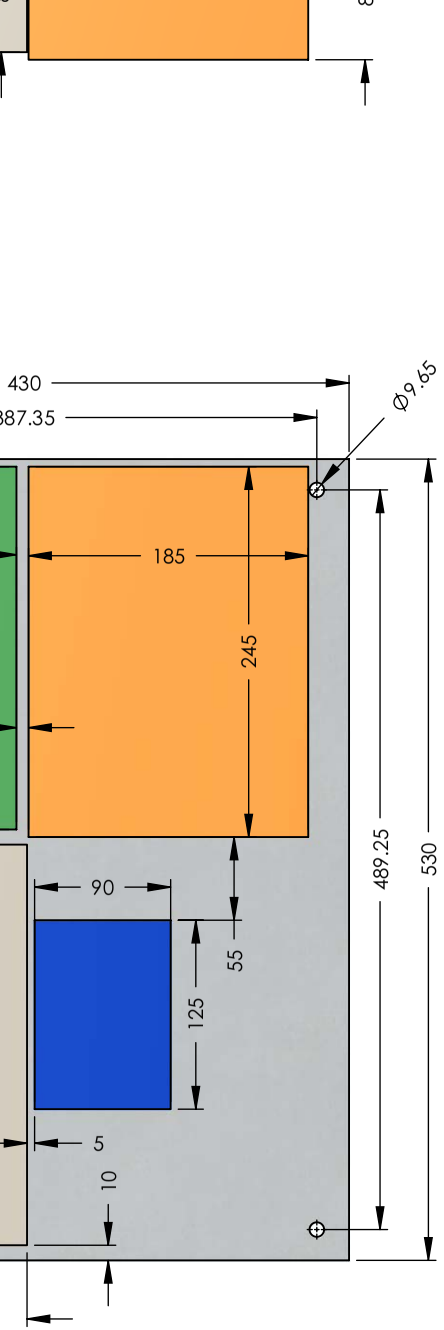
127

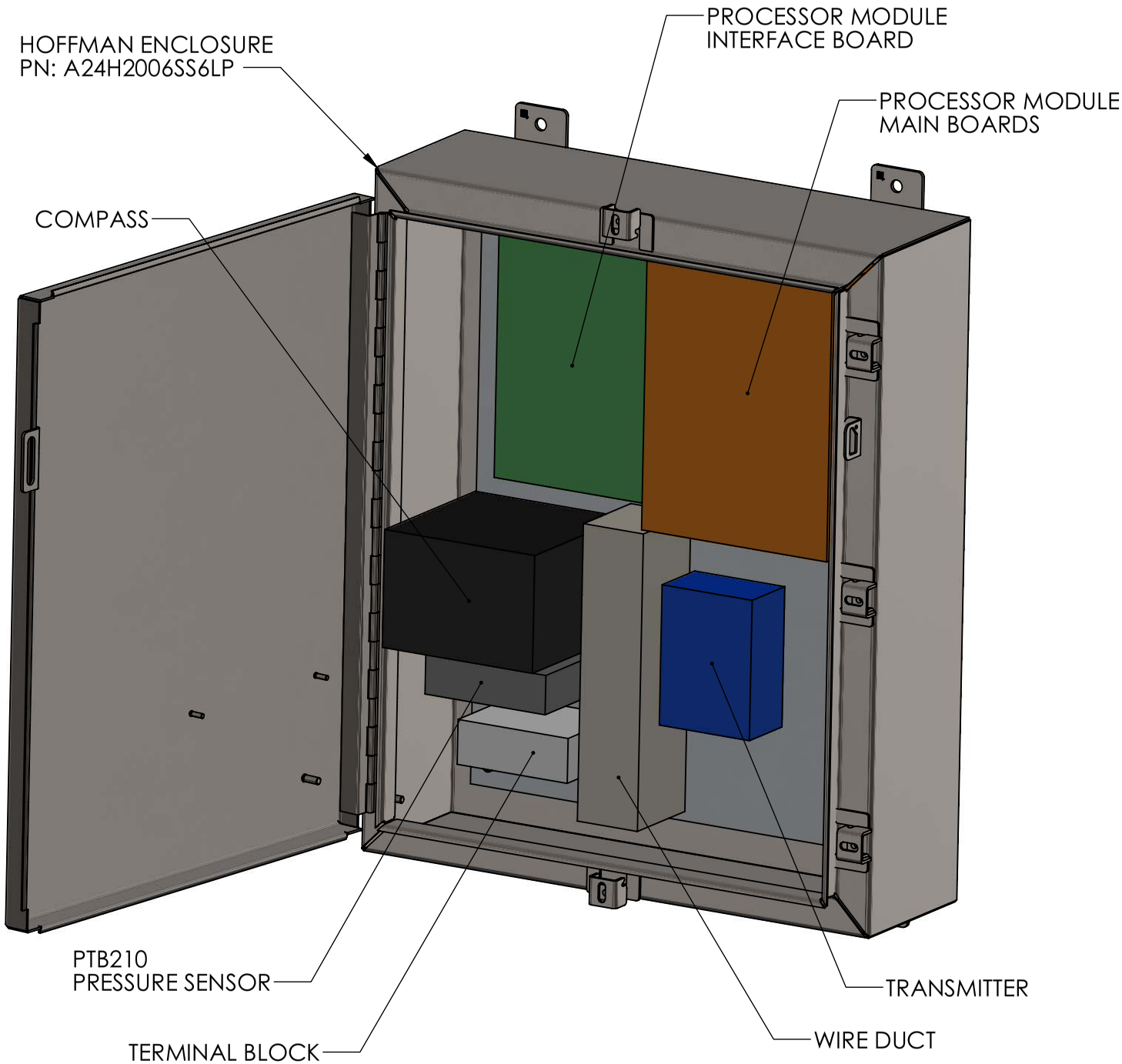
Ø6.35

3/8" PLATE 5086AL

292.10

19.05


430
387.35
Ø9.65
185
245
90
55
125
489.25
530
5
10
85
55
5


HOFFMAN ENCLOSURE
PN: A24H2006SS6LP
PROCESSOR MODULE
INTERFACE BOARD
PROCESSOR MODULE
MAIN BOARDS
COMPASS
PTB210
PRESSURE SENSOR
TERMINAL BLOCK
TRANSMITTER
WIRE DUCT