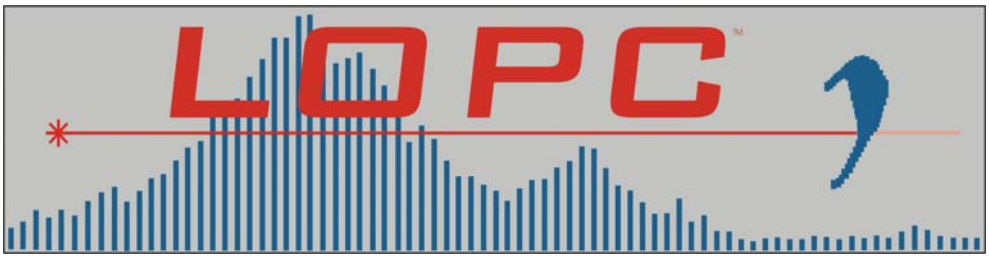

Laser Optical Plankton Counter

LOPC System Integration Guide

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Specification Summary

Underwater Sensor	
Physical / Mechanical	
Weight in Air	11.4 Kg [25 lbs]
Weight in Water	6.0 Kg [13 lbs]
Construction	Aluminum (anodized)
Depth Rating	660 m [2165 ft]
Electrical	
Voltage	140 VDC (supplied by Deck Unit)
Current	100 - 300 mA *
Power	< 20 W *
** Dependent on external instrumentation connected.*	
Telemetry	
Sensor to Deck Unit	Powerline modem (100 - 450 KHz)
	2 conductor cable (min) **
External Serial Input	RS-485 or RS-232
*** a single pair of conductors can provide both power and communications*	
Bulkhead connectors	
4-pin IE55 (male)	LOPC Interface (instrument power and communications)
6-pin MCBH (female)	Serial Input (RS-485 or RS-232)
8-pin MCBH (female)	Analog Input, Counter Input, Direct RS-232
Deck Unit	
Physical / Mechanical	
Weight	6.8 Kg [15 lbs]
Construction	Aluminum (powder coated)
Electrical	
Voltage	120 VAC, 60Hz or 240 VAC, 50Hz
The Deck Unit contains a multi-tap voltage system which allows the user to increase the voltage supplied to the LOPC if the situation requires it. For example, operating the LOPC on a very long sea cable using only a single pair of conductors, the voltage could be increased to offset line losses.	
Telemetry	
Deck Unit to PC	RS-232, 115,200 baud (8-N-1)
	Standard DB-9 serial cable
Deck Unit to Sensor	Powerline Modem
	2 conductor cable (min)
It can be desirable to operate the LOPC on a 2 pair (four (4) conductors, 2 pairs in parallel) sea cable if available. This greatly increases the efficiency of the cable and may be necessary on long cables.	

*** All physical/mechanical specs above are for the standard towed LOPC only.

1 SYSTEM OVERVIEW

The Laser Optical Plankton Counter (LOPC) was developed by Dr. Alex Herman, at the Bedford Institute of Oceanography (BIO) and is manufactured under license by Brooke Ocean Technology (BOT).

The prime application of the LOPC is the real-time characterization of plankton while being towed in an oceanographic or freshwater environment. In addition to counting plankton in the range of 100 microns to 3.5 cm, it is able to record their shape outlines, or profiles, for sizes greater than 1.5 mm.

The LOPC is powered externally, requiring two dedicated conductors in the sea cable. These wires provide power to the unit and communications between the instrument and the surface.

The LOPC can be used as a standalone unit or with other instrumentation. It has a serial interface for a CTD and a 0-5V analog interface for an auxiliary sensor such as a fluorometer. Data from these instruments is automatically integrated into the output data stream of the LOPC.

The LOPC is designed for operation in harsh marine environments. All electronics are housed in a single pressure case for enhanced reliability. The packaging is compact and adaptable - easily integrated into existing floats and tow-bodies.

The LOPC has been designed to be 'plug and play' compatible with the Brooke Ocean Technology (BOT) Moving Vessel Profiler (MVP). The combination of an MVP/LOPC/CTD enables vertical depth profiles to be taken while the vessel is underway.

2 ELECTRICAL SYSTEM

The LOPC underwater sensor is powered by 140 VDC which is supplied by the LOPC Deck Unit (see attached drawing, DWG No. 0400-0-2-3-09) via the Sea Cable (a sample configuration is shown in DWG No. 0400-0-2-3-08). When powered by the Deck Unit at 140 VDC the LOPC will draw approximately 120mA with NO external instruments connected. The Deck Unit itself can be configured to operate at 120 or 240 VAC (60 or 50 Hz).

The underwater end of the Sea Cable connects to the LOPC via the 4-pin male IE55 bulkhead (Part # IE55-1204-BCR) located on the LOPC end cap. The surface end of the Sea Cable

connects the LOPC to the Deck Unit via the “SEA CABLE” connector at the rear of the Deck Unit (connector Part # KPT02E10-6S).

NOTE: The LOPC can also be wired to use four conductors of a sea cable; 2 conductors for Positive High Voltage (+HV) and 2 conductors for Negative High Voltage (-HV). This can be useful to help reduce voltage losses on long sea cables.

The Deck Unit also has an AC outlet that can be used to power a logging computer or other devices. This AC outlet has the same voltage level as the main AC input and is NOT powered off when the Deck Unit power is off so any connected instruments can remain running without having the LOPC powered.

3 LOPC TELEMETRY SYSTEM

The telemetry of the LOPC is based on a system of spread-spectrum power line modems operating in the 100 – 450 KHz range. These modems communicate over the same power conductors used to supply the 140 VDC to power the LOPC; therefore, no additional conductors are required for communications. There a modem in the LOPC underwater sensor (the master) and another compatible modem in the Deck Unit (the slave); together they continuously negotiate and maintain a stable connection.

The Deck Unit electronics receive data from the LOPC via its power line modem and the signals are then converted to RS-232 levels and output to a logging PC via the DB-9 connector labeled “Serial Interface (Main)”.

The communication parameters for this serial interface to the LOPC logging computer is 115,200 baud, 8-N-1.

4 EXTERNAL SENSORS

The LOPC can integrate up to three additional sensors (see DWG No. 0400-0-2-3-06):

Serial input (via 6-pin “INSTR” bulkhead)
- Can be configured for RS-232 or RS-485
- Example: CTD

Analog input (via 8-pin “AUX1” bulkhead)
- 0-5V input
- Example: Fluorometer

Electronic Counter (via 8-pin “AUX1” bulkhead)
- Electronic counter input (Counter Constant configurable)
- Example: G.O. Flow meter

5 LOPC DATA STREAM

The LOPC uses a proprietary compressed binary data format which is transmitted from the underwater sensor to the surface Deck Unit. This data is then transmitted to the logging PC running the LOPC Interface Software which will perform the decompression/conversion from the compressed binary format to engineering units which are used in the display software and logged to an ASCII data file.

The compressed binary format is employed to reduce bandwidth requirements due to large data volumes and avoid data loss over the 115,200 baud communications link.

6 DATA ACQUISITION AND LOGGING

This section discusses the data files that store the data acquired from the LOPC and processed by the interface software. The data files are described in reverse order to which they are written since it provides an easier means of describing the raw data format.

6.1 Processed Data Files

Processed data files (*.dat) are ASCII text files containing data received from the LOPC after it has been extracted from its raw binary, byte-stuffed format.

```
L1 0 0 0 0 0 0 5 9 8 8 1 3 0 2 4 4 3 5 10 5 7 3 1 4 1 0 3 4 4 0 2 2
L2 0 2 0 0 0 0 1 2 1 1 0 0 1 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0
L3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
L4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
L5 0 100 30 4 43 0 2549 0 0 2248
C +20.6601 2.35578 -0.056 0.2567 3.8045
M 34 19068 12 32942
M 33 19065 15 174
M 32 19070 3 107
M 31 19048 23 265
M 30 19056 9 131
M 34 19506 14 32966
M 33 19506 14 195
M 32 19512 5 124
M 34 19935 9 32948
M 33 19933 13 178
M 32 19939 1 103
C +20.6602 2.35579 -0.056 0.2600 3.8046
M 26 20845 1 32869
M 25 20826 30 291
M 24 20831 21 186
M 4 23768 7 33251
M 3 23760 23 1403
M 2 23761 22 1092
M 8 24538 11 33091
M 7 24534 19 719
M 6 24535 16 469
M 19 31613 3 32881
M 18 31611 8 141
M 17 31605 20 281
M 16 31609 11 171
M 24 32464 6 33017
M 23 32456 23 1409
M 22 32458 20 1232
L1 0 0 0 0 0 0 6 8 8 7 4 2 3 2 2 7 3 5 4 6 5 3 1 2 3 7 2 3 0 4 2 0
L2 3 2 0 3 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0
L3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
L4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
L5 0 100 31 7 116 0 2550 0 0 2247
```

File format description:

L1 - L4 These four lines contain the 128 bins (32 bins per line) of single element plankton counted during this half-second sample. The 128 bins are split over 4 lines of 32 each to make the data files more readable by a user.

```
L1 0 0 0 0 0 0 6 8 8 7 4 2 3 2 2 7 3 5 4 6 5 3 1 2 3 7 2 3 0 4 2 0
L2 3 2 0 3 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0
L3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
L4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
L5 0 100 31 7 116 0 2550 0 0 2247
```

For example, in the sample above, there are 6 counts in Bin-28 (the first bin = Bin-0), 10 counts in Bin-29, 12 counts in Bin-30, 8 counts in Bin-31, 2 counts in Bin-32, etc. Each bin count value will be appended to the stored bin counts found on the bin plot.

L5 System status/engineering data.

Description of the L5 line from the sample above (from left to right):

0 = Snapshot Indicator
100 = Threshold
31 = Sample Number
7 = Flow Counts
116 = Delta Time
0 = Buffer Overrun
2550 = Laser Monitor (LMon in A/D counts)
0 = Electronic Counts
0 = Count Period
2247 = Laser Voltage (LVolt in A/D counts)

The binned data (L1-L5 lines) is transmitted by the LOPC every half-second (2 Hz).

The electronic counts and count period are used to calculate flow speed from an external counter device such as a flow meter.

NOTE: Electronic counts and count period values are only present for LOPC firmware 2.25 and later.

The laser voltage (LVolt) represents the output voltage to the laser control line, allowing the LOPC to maintain a preset laser intensity which is monitored in the LMon field.

NOTE: Laser voltage is only present for LOPC firmware 2.36 and later.

C Indicates a line of **'Instrument'** data from any attached serial instruments. The rate at which this is transmitted by the LOPC, and the data it contains, depends on the instrument model in use (ex. Micro CTD (AML) has a sample rate of 25Hz, whereas a SBE 19plus has a sampling rate of 4Hz). This data string format is determined by the instrument in use.

Instrument connected via Deck Unit Mux:
If the instrument (CTD) is connected via the Deck unit multiplexer, no extra data fields are append to the sample. The data that is logged in the 'C' line will be exactly as output from the instrument. Such as the sample of SBE 19plus data below (a SBE 19plus CTD sample with two SBE 0-5v inputs at the end):

```
C +20.6602 2.35579 -0.056 0.2600 3.8046
```

Instrument connected directly to LOPC (via INSTR bulkhead):
The 'C' line will contain the instrument data, however, it will also have an additional field attached to the end which is the analog sample (in A/D counts) from the LOPC's AUX bulkhead. The LOPC's analog interface in sampled each time a new Instrument data

sample is received, so the analog sampling rate is determined by the attached serial instrument. From the SBE 19plus sample above, if the CTD was attached directly to the LOPC, it would have an additional analog voltage sample (3209) from the LOPC appended to the end as shown below:

```
C +20.6602 2.35579 -0.056 0.2600 3.8046 3209
```

With LOPC firmware version 2.25 and greater, a second data field is appended to the instrument data (in addition to the analog data). This field is the Counts Per Second (CPS) detected by the LOPC. This field is presented here so it can be output to other devices, tow bodies, AUV's, etc. so that the information can be used/integrated into another data set. This would further add to the CTD sample as shown below (CPS = 122):

```
C +20.6602 2.35579 -0.056 0.2600 3.8046 3209 122
```

M Indicates a portion of Multi-Element Plankton (MEP) data, where the form is 'M *Element-Number Scan-Number Scan-Length Peak- Laser Monitor*'. The MEP data is sent whenever the opportunity is available. Both the binned data (**L1-L5** lines) and the Instrument data (**C** lines) take precedence over MEP data.

```
M 26 20845 1 32869
M 25 20826 30 291
M 24 20831 21 186
M 4 23768 7 33251
M 3 23760 23 1403
M 2 23761 22 1092
```

In the sample MEP data above, it can be observed that some of the Peak-Laser fields (last field on each line) appear much larger than the others (i.e. the 1st and 4th lines).

This field is an overloaded 16 bit number with the most significant bit set to indicate that this line of data is the start of the new MEP. When the data is parse by the surface software (or post-processing software) this is removed from the data by masking the 16th bit or just subtracting 32768 from the field value. The max value for this field is only 14 bits so there is no risk of missing the start of an MEP or falsely creating a new one.

```
M 21 21190 32 33184
M 20 21210 47 635
M 19 21222 32 479
M 18 24474 8 32916
M 17 24469 47 787
M 16 24471 43 588
```

This is required for situations as in the sample above. It may appear without the overloaded bit method that the data above represents a single MEP (since the elements numbers are in order) when in fact it is not. It is actually two MEP's, each with 3 elements. The overloaded bit field is also required for framing. The MEP data stream can be interrupted by 'C' lines or 'L' lines because they take priority. Therefore, if we have MEP data, followed by CTD data and then more MEP; the only way to know for sure if this is the same MEP or not is by the 'overloaded bit method'.

In the example below this represents ONE MEP:

```
M 21 21190 32 33184
M 20 21210 47 635
M 19 21222 32 479
```

```
C 0110.3 37.255 09.773 0 0
M 18 24469 47 787
M 17 24471 43 588
```

However, in this very similar example, this represents two separate MEP's:

```
M 21 21190 32 33184
M 20 21210 47 635
M 19 21222 32 479
C 0110.3 37.255 09.773 0 0
M 18 24474 8 32916
M 17 24469 47 787
M 16 24471 43 588
```

6.2 Description of Log File Fields

Snapshot Indicator
This value indicates whether or not a snapshot is in progress. A **'1'** indicates a snapshot is in progress, **'0'** indicates no snapshot is in progress. [*Found on **L5** lines – position 1*]

Threshold
The threshold is used to set a lower limit on signal level detection, which ensures that the LOPC is operating above the "noise level" of internal active components. This improves the accuracy and reliability of detection data. [*Found on **L5** lines – position 2*]

Sample Number
A counter indicating number of samples taken by the LOPC at 2Hz. [*Found on **L5** lines – position 3*]

Flow Counts
The Flow Counts indicate the number of counts within a pre-determined size range within the current 0.5-second sample (can be used in combination with Delta Time for flow calculations). [*Found on **L5** lines – position 4*]

Delta Time
Delta Time is the accumulated time for all counts detected in the Flow Counts window to pass through the beam (can be used in combination with Flow Counts for flow calculations). [*Found on **L5** lines – position 5*]

Buffer Overrun
Used to indicate an internal buffer overrun. "1" if a buffer overrun occurs, "0" otherwise. [*Found on **L5** lines – position 6*]

Laser Monitor (LMon)
Laser Monitor is the mean laser intensity detected by all 35 elements of the photo-diode array during this 0.5-second sample. [*Found on **L5** lines – position 7*]

Laser Voltage (LVolt)
Laser Voltage is the input voltage to the laser. This value is a monitor of a laser control circuit that will increase or decrease the laser input voltage as required to maintain a preset level (LMon). [*Found on **L5** lines – position 10*]

Element-Number
Indicates the element within the 35-element photo-diode array to which this line of MEP data pertains. [*Found on **M** Lines – position 1*]

Scan-Number
The Scan-Number is read from a 16-bit internal counter (0 – 65535) that is incremented every 35μs to provide a measure of time. The Scan-Number indicates the "time" at which the MEP entered the beam for this element. [*Found on **M** Lines – position 2*]

Scan-Length
Scan-Length indicates the number of scans, or the "length of time", a portion of a MEP was detected on the element in question. [*Found on **M** Lines – position 3*]

Peak- LaserLevel
The maximum level of laser light detected on this element during passage of a MEP. [*Found on **M** Lines – position 4*]

6.3 Raw Data Files

The raw data files are a binary byte-stuffing format that has been employed to decrease bandwidth requirements. The binary data is framed according to the type of data (binned data, CTD data or MEP data).

The data types (binned data, CTD and MEP data) can be identified in the binary data by the framing characters used to differentiate between three data types. Binned data frames (**L1-L5** lines), begin with a '**~L'**, end with a **'~*'** and have a frame length of 276 bytes (including the start and end characters). CTD data frames begin with a **'~C'** and end with a **'~*'**. The data content of CTD frames are in ASCII form since the processing work involved in converting double precision fractional numbers to binary is considered too great compared to the minimal bandwidth saved by doing so. MEP frames begin with **'~M'** and end with **'~*'**. The frame length of MEP data frames is variable since the amount of data sent in each frame is not predetermined.

6.4 File Header

Each raw data file that is created (the *.bin files) will have a file header inserted at the beginning before any data is logged to the file. A sample of the header is below:

```
# ___  PC DATE-TIME  ___
# Date: Monday, August 09, 2004
# Time: 14:55:28

# ___  USER SUPPLIED HEADER  ___
# Cruise:
# Ship:
# Station:
# Chief_Scientist:
# LOPC_Serial#:
# Other Instruments:

# ___  LOPC SOFTWARE CONFIG  ___
# External_Instrument:    SBE 19plus CTD (SeaBird)
# Ext_Instr_Serial#:              None
# Ext_Instr_Link:                 Deck Unit Mux
# Survey_Lat:                     45.0000
# Tunnel_Type:            Standard
# Counter_Constant:               0.134365
# Aux_Port_Mode:          Not In Use
# Data_Directory:                 C:\LOPC_DATA\
# File_Naming:            Custom Naming
# NAV Configuration:
#   Sentence_To_Parse:    $GPGGA
#   LatPos: 3, NS: 4, LongPos: 5, LongEWPos: 6, TimePos: 2.

# -- SBE 19plus CTD (SeaBird) --
```

```
# OUTPUTFORMAT:                 0
# SBE_ANALOGS:                  2
# Log_Raw_Data_To_Ascii_File:   NO
# A0: 1.26704100e-003, A1: 2.64920000e-004, A2: -8.16872500e-007, A3: 1.79550800e-007
# G: -1.05527900e+000, H: 1.51578300e-001, I: -3.89692500e-004, J: 5.02756100e-005,
CPcor: -9.5700e-008, CTcor: 3.2500e-006
# PA0: -9.65709000e-001, PA1: 1.54452700e-003, PA2: 6.45445200e-012, PTCA0:
5.11069900e+005, PTCA1: -2.51470600e+001, PTCA2: -2.57308400e-001, PTCB0:
2.40587500e+001, PTCB1: -8.50000000e-004, PTCB2: 0.00000000e+000, PTEMPA0: -
6.48460600e+001, PTEMPA1: 5.12614500e+001, PTEMPA2: -2.27064700e-001
**********
# CFXVER=2.36
# DSPVER=2.32
# DIRECT_RS-232_MODE=0
# SERIAL_INPUT=RS-232,9600,8-N-1
# THRESHOLD=100
# CALIBRATION_COEFF=1.000
# MIN_BACKGROUND=512
# MINUS_THRESHOLD=-100
# MINUS_TIMEOUT=995
# FLOW_WINDOW=10-20
# SCAN_TIMEOUTS=3-1000
# SCAN_ELEMENTS=0-34
# BKGRND_COEFF_AB=0.005/0.995
# SIGNAL_COEFF_AB=0.600/0.400
# CF1_SN=51314
# BIOS=2.27
# PicoDOS=2.27
# LASER_SET_RANGE=1650-2500
# LASER_CTRL_INC=1
# LASER_INIT=2100
# LASER_CTRL_INTERVAL=50
# BKGRND_CTRL=2550
# CTRL_MODE=1
# COMBINED_ELMENTS=2
**********
```

 # ___ PC DATE-TIME ___

This section contains the current date and time when this file was created as read from the logging computer.

 # ___ USER SUPPLIED HEADER ___

Custom header information as input by the user (see “Settings” section).

 # ___ LOPC SOFTWARE CONFIG ___

This section list a series of parameters that are configured in the LOPC software.

Following the “LOPC SOFTWARE CONFIG” section, there may be a section illustrating a CTD configuration. This may or may not exist depending on whether or not the CTD actually requires any configuration. For instance, if the LOPC software is configured to operate with a SBE 19 or SBE 19plus, this section would exist. However, if the CTD being used were an AML Micro CTD, this section would not exist since the AML CTD has no configuration parameters.

If this section is present, it will contain CTD configuration details as well as the calibration coefficients for this instrument.

The final section (contained between the “**********” lines) lists operational and configuration parameters from the LOPC’s memory. This block is read from the LOPC and provides a record of the LOPC configuration under which this data file was collected.

7 DIRECT RS-232 CONNECTION

The LOPC can be configured to bypass the internal power-line modem and communicate directly with other devices using RS-232.

NOTE: This option is only available on units with an 8-pin 'AUX' bulkhead connector.

This ability is typically used when integrating the LOPC with sensor arrays or AUVs that supply power to the sensor and require RS-232 data communication. In this scenario, the deck unit is not required for power, or long distance communication.

The pin connections for this mode of operation can be found in DWG No. 0400-0-2-3-06. Please refer to the LOPC Operations Manual for details on how to configure the LOPC for direct RS-232 communication.

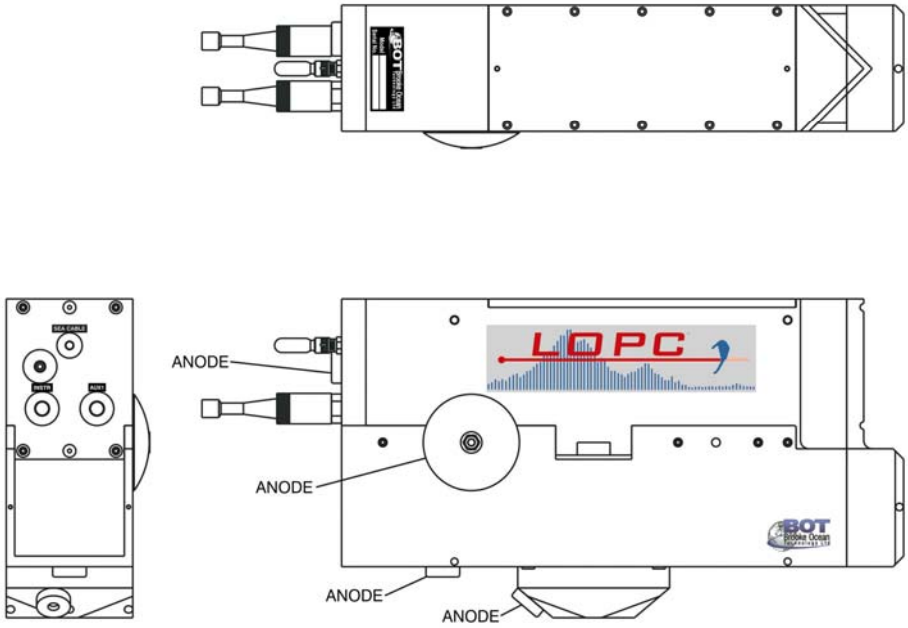
When operating in "Direct RS-232" mode, the LOPC may be powered by a DC source other than the Deck Unit (for example, a DC power source from the tow body itself). In this case, the LOPC must be powered by a minimum 48VDC 10-watt supply. If additional sensors are connected to the LOPC (CTD, fluorometer, etc.), then the required wattage for the supply will increase accordingly. The typical current draw by the LOPC with no sensors attached is approximately 200mA at 48VDC.

8 TOW BODY INSTALLATION

The LOPC has been designed with the knowledge that it will need to be mounted on/in various tow body styles. The LOPC is supplied with a bolt hole mounting pattern on both sides of its pressure case (see DWG No. 0400-0-0-0-01), this allows for an adapter plate to be added which will allow mounting to the customer preferred tow body.

When mounting the LOPC, every effort should be made to electrically isolate the LOPC from the tow body or mounting plate (see DWG No. 0400-0-0-0-14).

The LOPC has several sacrificial anodes installed to help protect the aluminum housing from corrosion.



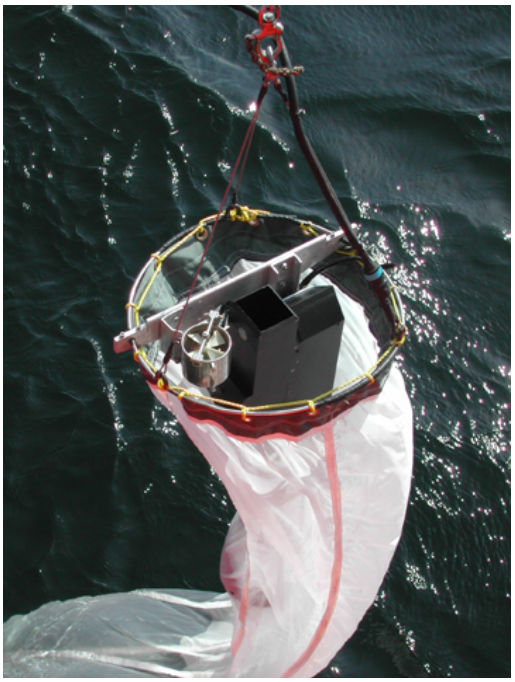
There are three small anodes mounted on the underside and rear of the LOPC, using #8-32UNC x 3/8" long socket head cap screws. The forth anode is a larger 'dome style' anode and mounts to either side of the aluminum housing using a 1/4-20UNC x 3/4" long socket head cap screw. The larger anode uses one of the provided 1/4-20UNC mounting holes in the aluminum housing. This allows the anode to be moved to the opposite side of the aluminum housing when the LOPC is being mounted to a tow body.

9 SAMPLE LOPC INSTALLATIONS AND DEPLOYMENTS

The following is a sample of the various tow body installations and deployments used with the LOPC.

VLOPV Frame
Vertical LOPC Frame is often used to do vertical, 'on-station' drops with the LOPC and can be used with dual LOPCs plus CTDs, fluorometers, etc.

Photo courtesy of Dr. Alex Herman, Bedford Institute of Oceanography.

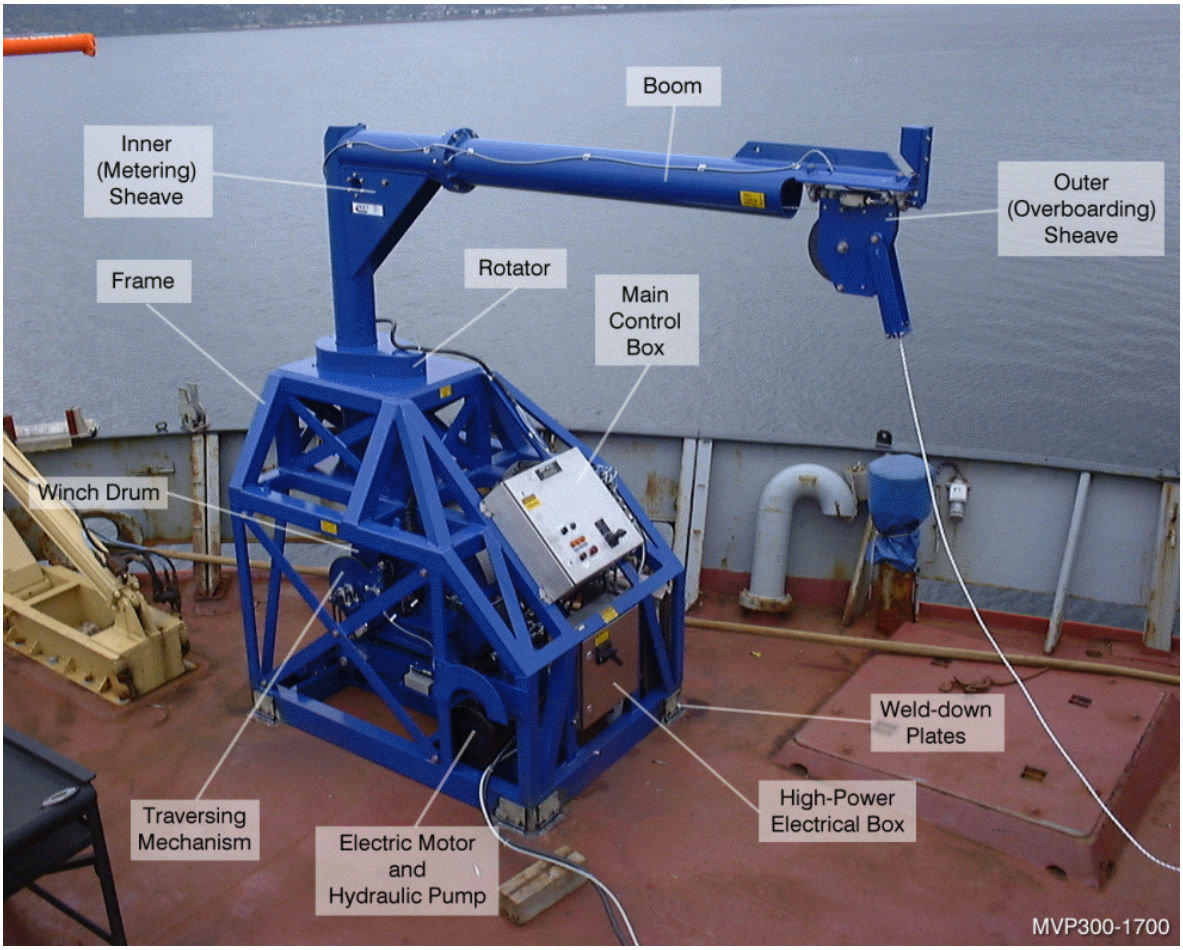


Ring Nets
The LOPC is often deployed on ring nets which allow the user to compare data collected by the LOPC with samples collected by the net. This specific example has a flow meter installed as well.

Photo courtesy of Dr. Alex Herman, Bedford Institute of Oceanography.

Moving Vessel Profiler (MVP)

The Moving Vessel Profiler (MVP) system is a self-contained profiling system capable of sampling water column profiles from a vessel moving at up to 12 knots, and deeper depths at slower speeds. The system provides vertical profiles of oceanographic data such as Sound Velocity, CTD, LOPC, etc. for various operations including the calibration of multi-beam sounder systems for hydrographic operations. The MVP is completely autonomous and can be controlled by computer without the requirement for personnel on deck. The system consists of a single or multi-sensor free-fall fish, an integrated winch and hydraulic power unit, towing boom and a remotely located user interface controller.

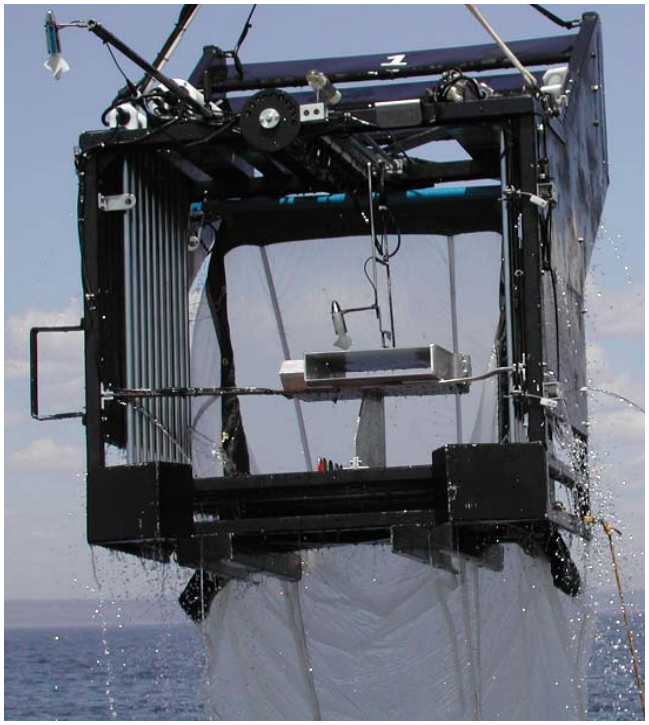


Nv-Shuttle

The LOPC has been installed and deployed by LOPC users from the University of Massachusetts during their cruise of the Hudson River.

The Nv-Shuttle was developed and is manufactured by Chelsea Technologies Group & the Plymouth Marine Laboratory, UK

Photo courtesy of Meng Zhou and Jay Peterson; U. Mass.



Bioness

The Bioness is multiple net sampling system used for zooplankton. The LOPC in this particular situation was testing an experimental wide tunnel system.

NOTE: The current wide tunnel available from BOT is 2.5X the standard tunnel size.

Photo courtesy of Dr. Alex Herman, Bedford Institute of Oceanography.

Bongo Nets

Illustrations of LOPC installed on Bongo Nets as well as a custom deployment on a frame profiling a body of fresh water.

Photos courtesy of: Kalevi Salonen & Pia Högmander
University of Jyväskylä, Finland

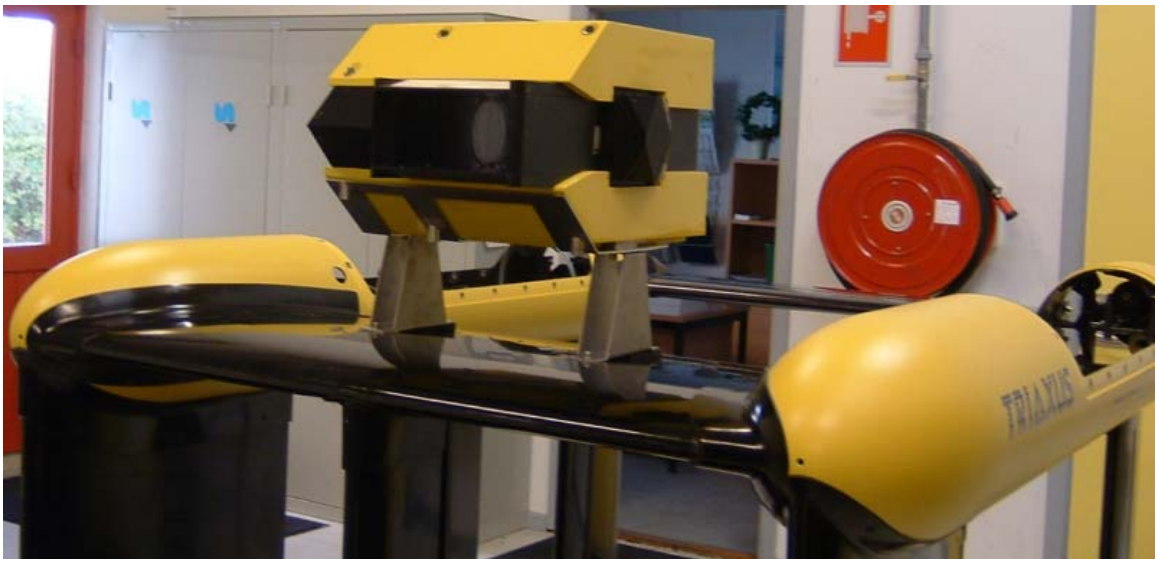
LOPC + Triaxus

These pictures show the installation of an LOPC on a MacArtney Triaxus.

In this installation the LOPC is powered by the Triaxus and is configured for Direct RS-232 communications via the Triaxus' digital multiplexer.

This LOPC was purchased by University of Alaska, Fairbanks; Dr. Russ Hopcroft and is being integrated by MacArtney and Steven Hartz, U. of Alaska.

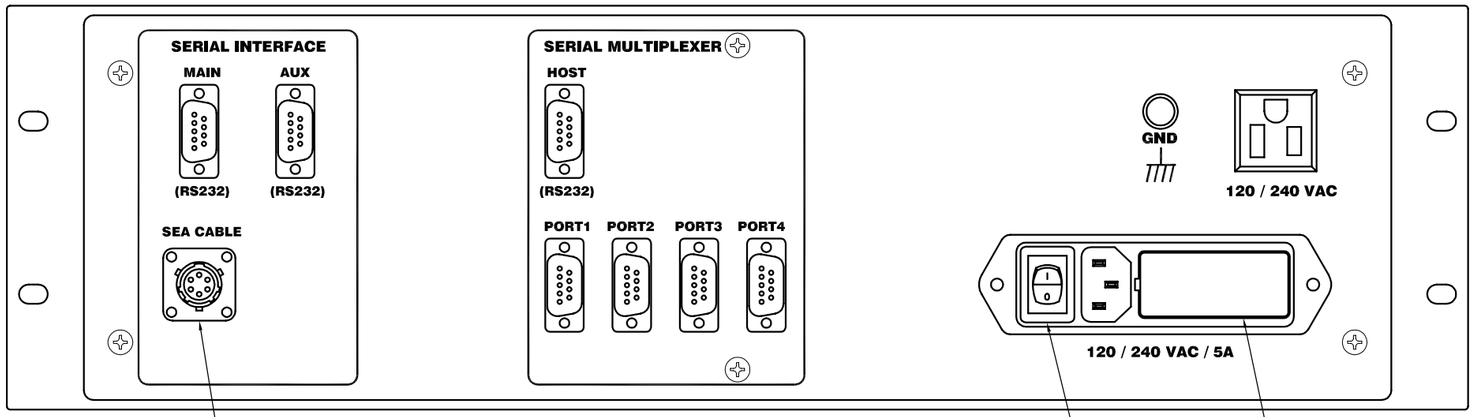
Photos courtesy of Steven Hartz.



This photo shows another installation of an LOPC on a MacArtney Triaxus. This LOPC was purchased by the NW Fisheries Center in Oregon.

Photo courtesy of Jay Peterson.

COTS/IMC #	ITEM NO.	QTY.	DESCRIPTION	SPECIFICATION/ PART #/MRN	MANUFACTURER/ NSCM

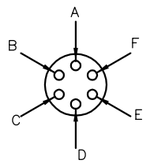


BULKHEAD PART # KPT02E10-6S
(MATING CONNECTOR PART # KPT06J10-6P)

VOLTAGE CONFIGURATION
(120 OR 240 VAC)

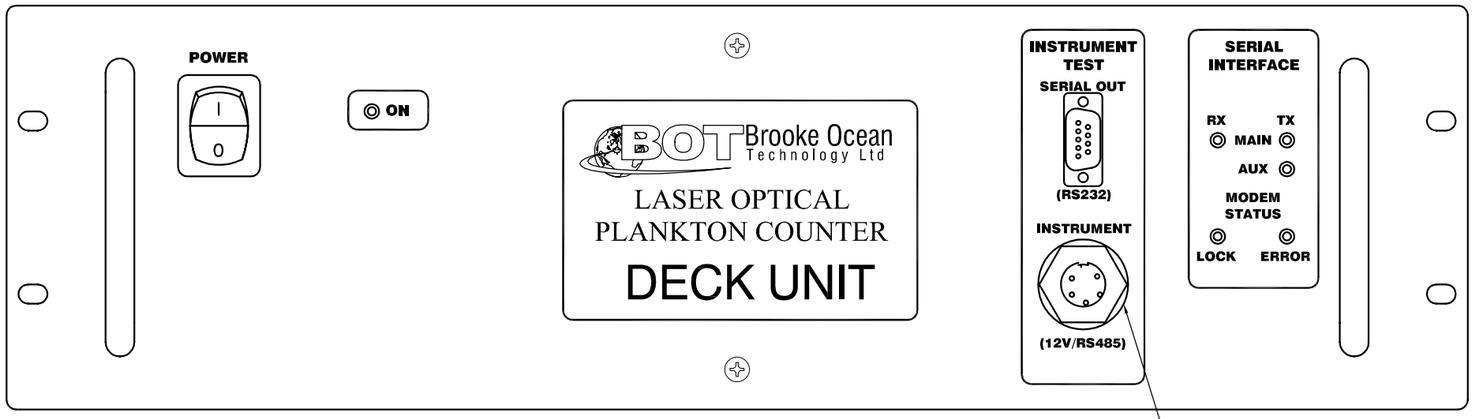
MAIN POWER SWITCH

BACK VIEW



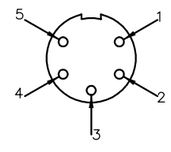
A. SHIELD
B. +HV1
C. +HV2
D. -HV1
E. -HV2
F. NO CONNECTION

(FEMALE)



BULKHEAD PART # RKFL 56
(MATING CONNECTOR PART # RSM 5711-1M)

FRONT VIEW



1. SHIELD
2. TXB
3. 0V12
4. +12V
5. TXA

(FEMALE)

REV.	DATE	REMARKS
	AUG. 04/04	PRODUCTION ISSUE

REVISIONS

NSCM

UNLESS OTHERWISE NOTED
1. DIMENSIONS IN INCHES
2. X.X ± 0.025"
3. X.XX ± 0.010"
4. X.XXX ± 0.003"
5. FRACTIONS ± 1/32"
6. ANGLES ± 1/2°
7. ECCENTRICITY .003 MAX
8. FLATNESS 0.003" T.I.R.
9. SURFACE FINISH 125
10. BREAK EDGES

THIRD ANGLE

BROOKE OCEAN TECHNOLOGY LTD.
50 THORNHILL DRIVE, UNIT 11
DARTMOUTH, NOVA SCOTIA
CANADA B3B 1S1
TEL: (902) 468-2928 FAX: (902) 468-1388

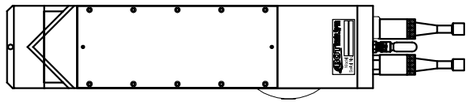
DESIGNED	MP
DRAWN	MS
CHECKED	G. LAP
APPROVED	MDP
QA	

PROJECT: LASER OPTICAL PLANKTON COUNTER

TITLE: DECK UNIT
FRONT / BACK PANELS

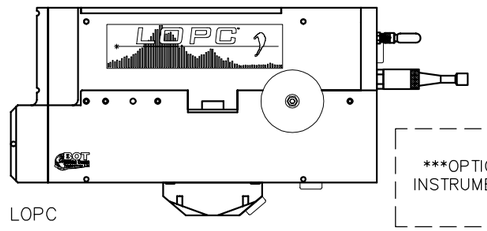
B	PROJECT NO. 0400	REVISION
	DRAWING NO. 0400-0-2-3-09	
SCALE 1:2	DATE AUG. 04/04	SHEET 1 OF 1

COTS/IMC #	ITEM NO.	QTY.	DESCRIPTION	SPECIFICATION/ PART #/MRN	MANUFACTURER/ NSCM



WATERTIGHT DUMMY PLUGS

8 PIN AUX INSTRUMENT (ANALOG, COUNTER, RS–232)
4 PIN SEA CABLE (TO DECK UNIT)
6 PIN MAIN INSTRUMENT (SERIAL INPUT)



LOPC

OPTIONAL
INSTRUMENTATION

SEA CABLE (OPTIONAL)
2 CONDUCTORS MINIMUM REQUIRED

IMPULSE FEMALE
PIGTAIL
IE55–1204–CCP
(OPTIONAL)

DECK

LAB

WARNING
MAX DEPTH RATING
OF LOPC IS 660M

IMPULSE MALE PIGTAIL
IE55–1204–CCR
(OPTIONAL)

TEST CABLE
(5m)

DECK UNIT

LOPC INTERFACE (140V DC)

MAIN
SERIAL INTERFACE

SERIAL INTERFACE CABLE
1.8m

115,200 BAUD (N,8,1)

AC POWER CORD

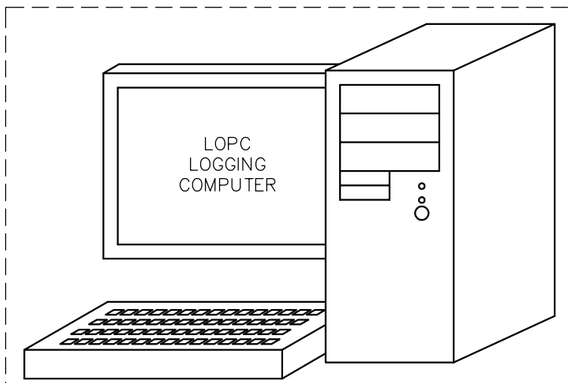
120V / 60Hz / 5A
OR
240V / 50Hz / 5A

AC IN

MAIN
POWER SWITCH

AC OUT (5A FUSE)

DECK UNIT
POWER SWITCH



CLIENT TO SUPPLY COMPUTER

REV.	DATE	REMARKS
	AUG. 04/04	PRODUCTION ISSUE

REVISIONS

NSCM

UNLESS OTHERWISE NOTED
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3. X.XX ± 0.010"
4. X.XXX ± 0.003"
5. FRACTIONS ± 1/32"
6. ANGLES ± 1/2°
7. ECCENTRICITY .003 MAX
8. FLATNESS 0.003" T.I.R.
9. SURFACE FINISH 125
10. BREAK EDGES

THIRD ANGLE

BROOKE OCEAN TECHNOLOGY LTD.
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DARTMOUTH, NOVA SCOTIA
CANADA B3B 1S1
TEL: (902) 468–2928 FAX: (902) 468–1388

DESIGNED MP
DRAWN MS
CHECKED G. LAP
APPROVED MDP
QA

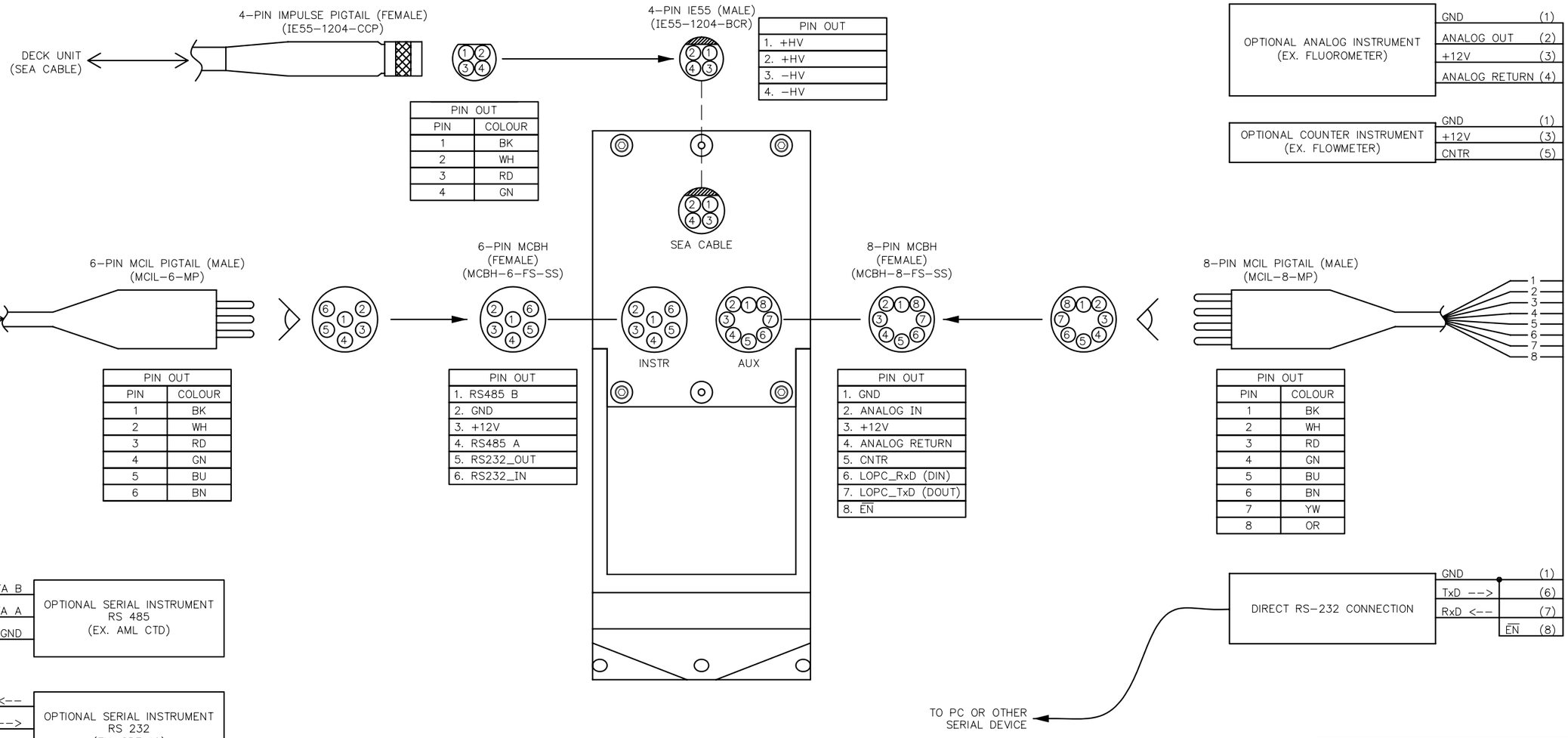
PROJECT
LASER OPTICAL PLANKTON COUNTER

TITLE
LOPC GENERAL SET–UP

PROJECT NO.	0400	REVISION
DRAWING NO.	0400–0–2–3–08	
SCALE NTS	DATE AUG. 04/04	SHEET 1 OF 1

B

COTS/IMC #	ITEM NO.	QTY.	DESCRIPTION	SPECIFICATION/ PART #/MRN	MANUFACTURER/ NSCM



REV.	DATE	REMARKS
D	JUN. 29/05	OPT. SERIAL INST. UPDATE
C	MAR. 16/05	PIN OUT DESIGNATIONS UPDATED
B	OCT. 25/04	PIN OUT DESIGNATIONS UPDATED
A	AUG. 20/04	PIN OUT CORRECTION AS PER ECO# 1284
	AUG. 04/04	PRODUCTION ISSUE

REVISIONS

NSCM

UNLESS OTHERWISE NOTED
1. DIMENSIONS IN INCHES
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3. X.XX ± 0.010"
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CANADA B3B 1S1
TEL: (902) 468-2928 FAX: (902) 468-1388

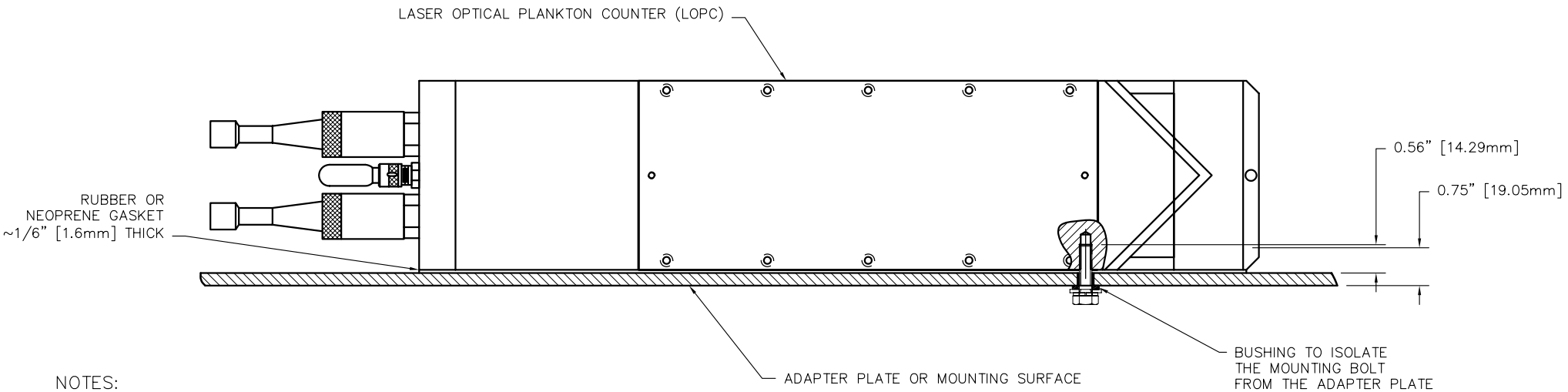
DESIGNED	DR
DRAWN	MS
CHECKED	DR
APPROVED	AF
QA	

PROJECT: LASER OPTICAL PLANKTON COUNTER

TITLE: EXTERNAL INSTRUMENT WIRING

B	PROJECT NO. 0400		REVISION D
	DRAWING NO. 0400-0-2-3-06		
	SCALE NTS	DATE AUG. 04/04	SHEET 1 OF 1

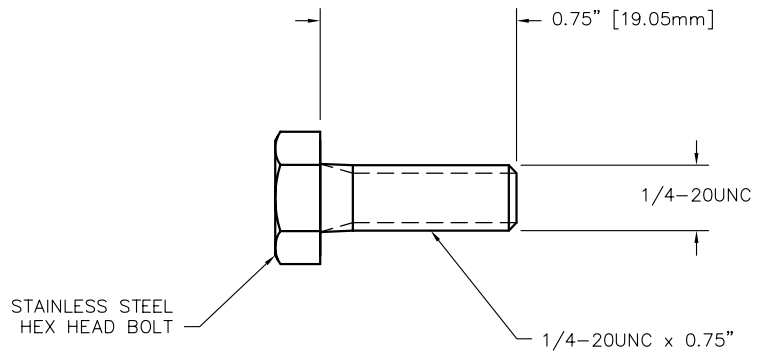
TITLE: LENGTH OF MOUNTING BOLTS REQUIRED TO ATTACH THE LOPC TO AN ADAPTER PLATE



NOTES:

1. THE PROVIDED MOUNTING HOLE(S) LOCATED ON THE LOPC ARE 1/4–20UNC x 0.50"[12.70mm] DEEP

2. EVERY EFFORT SHOULD BE MADE TO ELECTRICALLY ISOLATE THE LOPC FROM THE ADAPTER PLATE AND / OR TOW BODY.



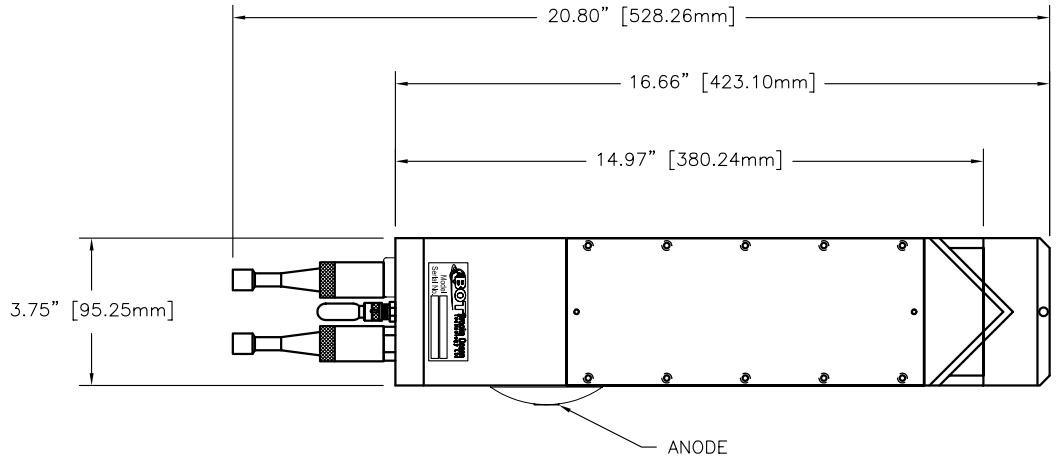
BROOKE OCEAN
TECHNOLOGY LIMITED

DWG No.: 0400–0–0–0–14
DATE : NOV. 17/04

TITLE: LASER OPTICAL PLANKTON COUNTER
GENERAL DIMENSIONS AND INFORMATION

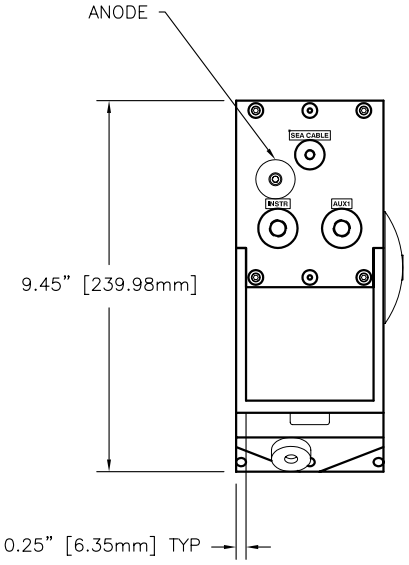
STANDARD TOWED LOPC (LOPC-660)

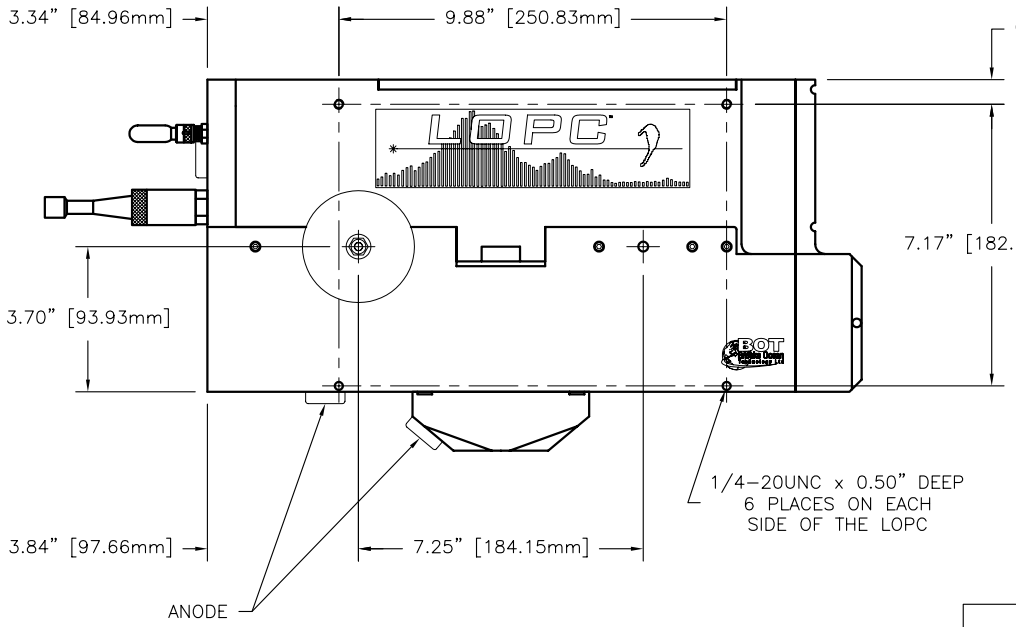
ALUMINUM CONSTRUCTION

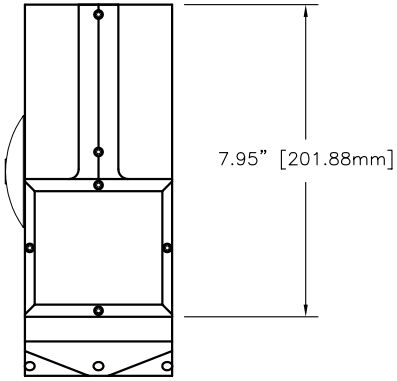


GENERAL INFORMATION

1. WEIGHT IN AIR = 11.4 kg [25 lbs]
2. WEIGHT IN SALTWATER = 6.0 kg [13 lbs]







BROOKE OCEAN
TECHNOLOGY LIMITED

DWG No.: 0400-0-0-0-01C
DATE : SEPT. 23/04