



# IDRONAUT OCEAN SEVEN 316Plus CTD for Oceanography

PROFILER AND RECORDER EQUIPMENT - SMALL SIZE - FAST SAMPLING RATE: 20Hz  
O<sub>2</sub>, pH, ORP - ARCTICA, ANTARCTICA - FERRYBOX - BRINE - CCS - ROVs, AUVs

*The OCEAN SEVEN 316Plus CTD multiparameter probe is the evolution of the well-known OCEAN SEVEN 316 probe, more than 1000 units sold all over the world. The Ocean Seven 316Plus is equipped with the well-known IDRONAUT full ocean depth, pump-free and long-term stability sensors. Central to which, is the high accuracy seven-platinum-ring quartz conductivity cell (patented), which can be cleaned in the field without the need for re-calibration. This unique quartz cell employs a large diameter (8 mm) and a short length (46 mm) to guarantee self-flushing and no clogging after long-term deployment even in biologically active waters. Competitors' sensors, which present few mm only of cell orifice and very long cell length, are prone to clog even if protected by dangerous and poisonous antifouling devices. The OCEAN SEVEN 316Plus CTD multiparameter probe does not require pumps or any other external device to flush the sensors, which minimizes its power consumption and allows the use in **Arctica** and **Antarctica** boreholes. For added flexibility, the OCEAN SEVEN 316Plus CTD multiparameter probe can be operated in either verbose or non-verbose mode, the latter being especially convenient for system integrations on buoys, ROVs, USVs and AUVs, thus making this probe an ideal choice for both on-line profiling and self-recording moored applications. Optional data telemetry is available for on-line full ocean depth, real-time data transmission (20Hz sampling rate with REDAS-5 software). The OCEAN SEVEN 316Plus CTD multiparameter probe can also optionally accommodate up to a maximum of 16 sensor analogue inputs, including 2 digital inputs, which can, if required, be added later.*

## ■ **HIGHLY ACCURATE/PRECISE (0.01%FS) PRESSURE TRANSDUCER**

The high-precision 0.01%FS pressure transducer is based on a piezoresistive bridge, floating on oil, with drift-free sensor interface. Temperature dependency and nonlinearity are mathematically compensated by the interfacing electronics. Standard pressure transducers immediately available: 100, 1000, 2000, 4000, 6000, 10000 dbar.

## ■ **TEMPERATURE SENSOR**

Features a very fast platinum resistance thermometer (response time: 50 ms). Negligible self-heating effect.

## ■ **CONDUCTIVITY CELL**

The high accuracy seven-platinum-ring quartz conductivity cell (patented) can be cleaned in the field without the need for re-calibration. This unique quartz cell employs a large diameter (8mm) and a short length (46mm) to guarantee self-flushing and no clogging after long-term deployment even in biologically active waters. Furthermore, an optional UV LED (280 nm), integrated into the conductivity cell, sterilizes the sample under measurement, thus avoiding the early growth of biofouling inside the quartz measuring cell.

## ■ **OXYGEN SENSOR (7000 m operation)**

Features a pressure-compensated polarographic sensor with a replaceable cap or/and advanced optical dissolved oxygen sensor. Both sensor can be installed at the same time.

## ■ **pH GLASS SENSOR and SOLID GEL REFERENCE ELECTRODE (7000 m operation)**

High-pressure low impedance glass membrane pH electrode in conjunction with a unique KCl or NaCl gel double junction reference electrode and a differential pH preamplifier,  $10^{13} \div 10^{14}$  ohm input impedance.

## ■ **DATA TRANSMISSION**

Via RS232C interface. Optional interfaces are: long distance (10000 m) data telemetry, RS422 and Wireless Bluetooth.

## ■ **DATA MEMORY**

Allows storage of up to 16M dataset, for each of the 7 standard acquired parameters together with date & time, using the 4 GByte non volatile memory.

## ■ **OPTIONAL PROBES, SENSORS**

- GENERAL OCEANICS - Rosette Water Samplers 1018 and 1015.
- IDRONAUT – High Precision 0.01 % Pressure Transducer.
- IDRONAUT - String and Weight Bottom Sensor.
- IDRONAUT – Optical dissolved oxygen sensor
- IDRONAUT – MISS Sampling system
- PSA916D Sonar Altimeter, 6000 m.
- LI-COR - LI-192SA and LI-193SA Underwater Quantum sensors.
- CHELSEA - Unilux and Trilux Fluorometers.
- WET Labs - C-Star Transmissometer and ECO Fluorometers.
- SEAPOINT - Fluorometers and Turbidity Meter.
- TURNER DESIGNS – Cyclops, CFluor Fluorometers.
- D & A INSTRUMENT COMPANY - OBS-3 Sensor.
- BIOSPHERICAL INSTRUMENTS - QSP-2200 - QSP-2300 PAR Sensors.
- VALEPORT - MiniSVS Sound Velocity Sensors.



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OF NEW DEPTHS**

## BATTERY-OPERATED SELF RECORDING MODES

The internal and the optional external submersible battery packs permit continuous probe operation for about 12 and 120 hours respectively. Rechargeable or lithium batteries can also be used. Twelve batteries: 1.2V, 2.85 Ah, NiMH cells are installed in the internal battery pack. The OCEAN SEVEN 316Plus CTD can measure, store and transmit sensor data by these modes of operation:

- **Pressure:** Data is sampled at regular pressure intervals. Multiple profiles can be obtained by switching the CTD ON and OFF.
- **Timed:** OS316Plus collects a series of samples and then sleeps for the configured time interval before waking up again and repeating the acquisitions. Time interval can be configured from 0.1s up to 1 day. Battery power is conserved while the probe is in sleep mode.
- **Conditioned:** Data is sampled at configurable sampling rates starting when the selected parameter overcomes the configured boundary. Sampling continues until the selected parameter falls below the configured boundary. Whenever the acquisition cycle starts, a configurable sampling rate 0.1..12 Hz is used. Monitoring of the selected parameter occurs at the configurable interval between 0.1s up to 1 day.
- **Continuous:** Data is sampled at configurable sampling rates starting when the operator switches on the probe. Sampling continues until the probe is switched off. Multiple cycles can be obtained by switching the CTD ON and OFF.
- **Real-time:** Data is sent to the control system at sampling rates of: **12 and 20 Hz using REDAS-5 software.**

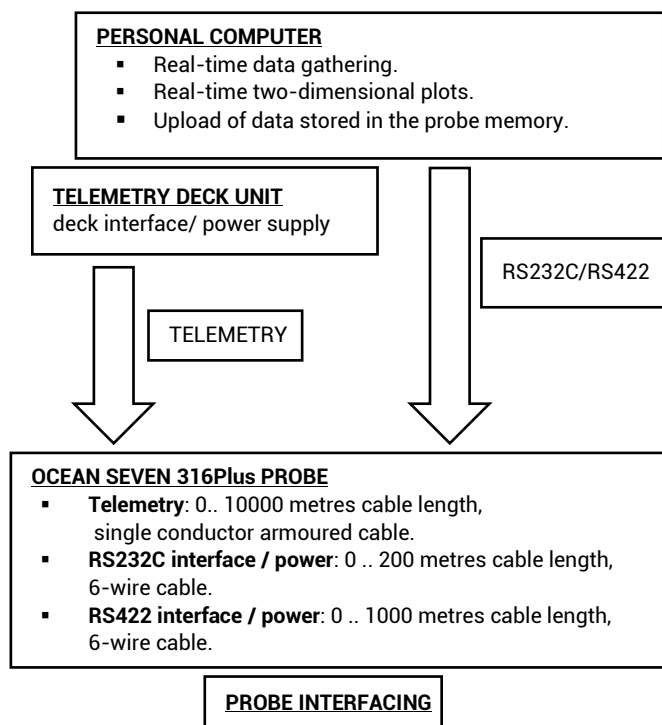
The unattended acquisition can be activated by means of a magnetic switch present on the probe top cover. Extension of the internal battery life is automatically obtained through a power management procedure that switches the probe OFF between data acquisitions. The probe is equipped with an internal non-volatile memory which can store up to a 16M dataset, each data set being composed of date, time and measurement of the standard sensors. Stored data is uploaded at the end of the measuring cycles.

The OCEAN SEVEN 316Plus CTD can be configured to be directly interfaced to a personal computer by means of the RS232C serial port or by telemetry. The telemetry and RS422 interfaces remedy the limitations of the RS232C serial interface (cable length and number of conductors). When using the telemetry interface, the Telemetry Deck Unit is required to convert serial, RS232C type signals from a PC communication port, into telemetry signals (and vice versa) which must flow superimposed on the probe power supply along the armoured single conductor coaxial cable.

Probe communication is achieved through one of the two male connectors installed on the top end cap of the probe. A six-pole connector is used for the RS232C and RS422 interfaces and for the power input, while, a two-pole connector is used for the telemetry interface.

## IDRONAUT REDAS-5 Windows Software

REDAS-5 software, through a simplified and friendly operator interface, allows taking full control of the OCEAN SEVEN 316Plus CTD and facilitates real-time data acquisitions, configuration of unattended acquisition cycles and uploading of data stored in the probe memory. REDAS-5 program is a true 32-bit Windows application, which flawlessly runs on Windows. REDAS-5 shows the acquired data graphically and numerically thus allowing the operator to dynamically change the graphical and numerical set-up during data acquisition. Post-processing functions and data extraction procedures, in function of time, pressure or numerical intervals can be applied to acquire data in real time or on data retrieved from the probe memory. Among the operations that REDAS-5 can perform, it is worth mentioning: automatic start and stop of data acquisition; management of the bottle sampling (Rosette); processing and filtering of acquired data in real time (time lag compensation, smoothing etc.); acquisition of geographical coordinates from a GPS device; acquired data conversion into text files; automatic scaling of the graphical window X and Y axis. **REDAS-5 software allows 12 and 20 Hz sampling rate.**



**OCEAN SEVEN 316Plus Telemetry System Performance Chart**

<u>Telemetry Type</u>	<u>Max cable length</u>	<u>Max transfer rate</u>
RS232C	200 metres	38400 bps
RS422	1000 metres	38400 bps
Telemetry (*)	10000 metres	9600 bps

(\*) The above performance is obtained using the 6.4 mm diameter (1/4inch) Rochester cable 1-H-255 which has an electrical resistance of 23 Ω/km and a capacity of 138 pF/m. The Ocean Seven 316Plus CTD operates with the standard Rochester coaxial armored cables (1/10, 1/8, 1/4, 1/2 inch) present in oceanographic vessels having a total resistance up to 250 ohms.

## SENSOR SPECIFICATIONS

All the sensors installed in the OS316Plus CTD are manufactured by IDRONAUT and are exported all over the world. They are used by several other multiparameter probe manufacturers. All sensors have extremely low response time: 50 milliseconds for physical parameters (CTD) at 1m/s profiling speed and 3 seconds for chemical parameters.



	Range	Initial Accuracy	Resolution	Response Time
<b>Pressure</b>	0.. 1000 dbar (1)	0.05 % full scale	0.002 % full scale	50 ms
<b>Temperature</b>	-3.. +50 °C	0.002 °C	0.0002 °C	50 ms
<b>Conductivity</b>	0.. 70 mS/cm	0.003mS/cm	0.0003 mS/cm	50 ms (3)
<b>Oxygen Polarographic</b>	0.. 50 ppm	0.1 ppm	0.01 ppm	3 s (4)
	0.. 500 % sat.	1 % sat.	0.1 % sat.	3 s (4)
<b>Oxygen Optical</b>	0..45 mg/l	0.1 mg/l	0.025 mg/l	5 s (5)
	0..250 %sat.	±0.2 %sat.	0.05 % sat.	5 s (5)
<b>pH</b>	0.. 14 pH	0.01 pH	0.001 pH	3 s
<b>Redox</b>	-1000.. +1000 mV	1 mV	0.1 mV	3 s
<b>Auxiliary inputs (2)</b>	0.. 5000 mV	1 mV	0.1 mV	50 ms

(1) Other standard pressure transducers, immediately available, have 10, 40, 100, 200, 500, 2000, 4000, 6000, 10000 dbar ranges. **Optionally, the IDRONAUT Highly Accurate Precise (0.01%FS) Pressure Transducer can be installed instead of the standard pressure transducer.**

(2) Through the auxiliary inputs, optional sensors like: Fluorometer, Turbidity Meter, Transmissometer, Altimeter, Par, can be interfaced. Six auxiliary analogue inputs are available inside the probe.

(3) At 1 m/second flow rate.

(4) From nitrogen to air.

(5) A **special FAST membrane, with response time 3s**, is available upon request.

The fundamental properties of seawater, like: **Salinity, Sound Speed, Water Density, Oxygen ppm** are obtained using the algorithms described in the UNESCO technical papers in marine science no. 44 "Algorithms for computation of fundamental properties of sea water".

The freshwater properties like: **TDS (Total Dissolved Solids), Fresh Water Conductivity** corrected at 20°C and 25°C are automatically calculated.

## ELECTRONIC SPECIFICATIONS

**Sampling rate:**

User selectable: 12 and 20 Hz raw data CTD using REDAS-5 software.

**Communication protocol:**

Proprietary byte-oriented, binary and plain message protocol.

**Operator interface:**

Friendly menu-driven user interface.

**Data memory:**

4 GByte SD card non-volatile memory.

**Battery power supply:**

9 .. 18 V, 150 mA @ 12 V.

## PHYSICAL SPECIFICATIONS

Housing	1500 dbar	2000 dbar	7000 dbar
<b>Diameter</b>	100 mm	105 mm	89 mm
<b>Length</b>	710 mm	710 mm	720 mm
<b>Weight in air</b>	4,2 kg	4,2 kg	8,0 kg
<b>Weight in water</b>	0,2 kg	0,2 kg	4,3 kg
<b>Materials</b>	White POM	White POM	Titanium

## ACCESSORIES

### TELEMETRY PORTABLE DECK UNIT:

The Telemetry Portable Deck Unit powers and interfaces, by coaxial oceanographic cables, the OS316Plus CTD with a PC. The portable deck unit is equipped with a transceiver (modem) which allows half-duplex communication with the CTD. The portable deck unit is housed in a waterproof plastic case and is provided with an internal mains rechargeable lead battery (12V DC, 7 A/h) which permits probe operation even in the absence of the mains supply. The internal battery guarantees up to 15 hours of continuous probe and deck unit operation. The portable deck unit comes complete with an international battery charger: 115/220VAC +/-10%, 50-60 Hz +/-5% Telemetry power supply: 30V DC (max 0.3A@12 V). Dimensions: 340 x 300 x 160 mm. Weight: 6.5 kg.

### TELEMETRY ON-BOARD MKPlus DECK UNIT:

The MKPlus Deck Unit powers and interfaces the OS316Plus CTD with an auto-adaptive V32/V32bis modem to optimize the full-duplex communication in real time, depending on the connection conditions. The communication speed of 14.400 bps over the oceanographic cable allows obtaining a higher transfer rate from the interfaced CTDs. Visual feedback is provided to the operator during communication to indicate the line quality and speed automatically selected by the MKPlus modem. The MKPlus Deck Unit provides high voltage telemetry power supply (220 VDC) to allow the CTDs to interface and power several additional probes. The MKPlus Deck Unit is housed in a 19" rack-mountable metallic box and is designed for on-board operations. The MKPlus Deck Unit operates with: 115/220 VAC +/-10%, 50-60 Hz +/- 5%. Telemetry power supply: 220 VDC (max 1A@12V). Dimensions: 80x160x90. Weight: 3 Kg.

### PORTABLE READER:

Portable lightweight and extremely rugged reader based on the Windows Mobile™ software, which overcomes the limitations that the use of a PC in the field and in hostile environments normally implies, like: battery endurance, display reading under sunlight, water and dust tightness, weight, etc. The Portable Reader interfaces the probe through a built-in RS232-C interface and a dedicated programme.



### MANUAL PORTABLE WINCH:

Includes 2-way or 5-way slip ring and it can hold up to 350 m of 5 mm polyurethane jacketed armoured cable or 100 m of 8.3 mm polyurethane multi-conductor shielded cable.

### COAXIAL ARMoured CABLE - Ø 5 mm - POLYURETHANE:

A strain relieved 5 mm polyurethane jacketed armoured cable type Idronaut - breaking strength: 200 kg - weight per km: 40 kg.

### RS232C/RS422 CABLE - Ø 8.3 mm - POLYURETHANE:

Multi-conductor shielded cable - Kevlar armoured - type Idronaut Ø 8.3 mm - specifically designed for RS422 or RS232C interface. Composed of 2 pairs: one 2x24 AWG twisted together and one 2x19 AWG - breaking strength: >250 kg. RS232C data transmission limits this cable length to 200 metres. RS422 data transmission enables this cable length to 1000 metres. Weight: 3,6 kg/100 m in water; 9.6 kg/100 m in air.

### SENSOR PROTECTION ANTIFOULING KIT:

The electrochemical antifouling kit is installed near the OS316Plus probe measuring sensors. It greatly extends the sensor operations by protecting them from the bio fouling. The antifouling kit has been specifically developed for moored applications and does not release any poison.

### TITANIUM PROTECTIVE CAGES:

For sensor and/or upper connector protection: Ø 260 mm. Mooring frame to house the CTD and two additional probes: on custom request.

### EXTERNAL SUBMERSIBLE RECHARGEABLE BATTERY PACKS:

The following battery packs, 14.4VDC (no. 12 NiMH cells), 4.5Ah are available:  
- Ø 75 x 315 mm, 1500/7000 m max depth operation;  
The external battery pack is held by the probe by means of one or two POM flanges.

### TRANSPARENT FLOW CELL:

Easily connectable to a pumped source of seawater (water volume 200-300 ml), this option converts the Ocean Seven 316Plus CTD from a profiling CTD to a very accurate FerryBox thermosalinograph.

## OPTIONS

### BLUETOOTH® WIRELESS ADAPTER:

The IDRONAUT Wireless Adapter allows full duplex communications between the OCEAN SEVEN 316Plus probe and a personal computer or PDA devices equipped with a Bluetooth® device. The Wireless Adapter provides an interface conforming to the Bluetooth® class 1 (100 m) connectivity SPP protocol.

### RS422 INTERFACE:

Instead of the RS232C interface, allows real-time communication with the probe using cables long up to 1000 m.

### GENERAL OCEANICS ROSETTE INTERFACE:

General Oceanics Rosettes mod. 1018 and 1015 are interfaced to perform attended and unattended bottle firing in function of time and/or depth variations. The latter is obtained through user's configurable depth profiles or depth steps. Furthermore, bottle firing can be accomplished in real time whenever the probe operates with the telemetry system.



**IDRONAUT S.r.l**

Via Monte Amiata, 10 - ITALY  
20861 BRUGHERIO (MB)

Tel. +39 039 879656

Fax +39 039 883382

E-mail: [idronaut@idronaut.it](mailto:idronaut@idronaut.it)

<http://www.idronaut.it>

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