IDRONAUT OCEAN SEVEN 316*Plus* CTD PROBE

20Hz SAMPLING RATE - REAL-TIME AND SELF-RECORDING CAPABILITY

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 complete restyling of the probe electronics and the built-in 18-bit digitizer give the OCEAN SEVEN 316Plus very advanced performance and better CTD sensor resolution and accuracy with respect to the OCEAN SEVEN 316. The Ocean Seven 316Plus is equipped with the well-known and proven IDRONAUT pressure balanced full ocean depth, pump free and long-term stability sensors. Central to which, is the high accuracy seven-platinum-ring conductivity sensor, which can be cleaned in the field without the need for re-calibration. 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 AUVs, making this probe an ideal choice for both on-line profiling and self- recording moored applications.
Acquired data is output using the standard RS232C interface which provides ***20Hz sampling rate using REDAS-5 software.*** *FSK telemetry option is available for on-line full ocean depth real-time data transmission. Other interfaces like RS422 and* ***Wireless Bluetooth*** *can be optionally installed. 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 the stable, floating piezoresisitive transducer and the newly developed sensor interface. Temperature dependency and non-linearity of the sensor are mathematically compensated by the interfacing electronics. Standard pressure transducers immediately available: 100, 1000, 3000, 4000, 7000, 10000 dbar.

- **TEMPERATURE SENSOR**
  Features a very fast platinum resistance thermometer (time constant: 50 ms). Negligible self-heating effect.

- **FLOW CONDUCTIVITY SENSOR**
  Features a large diameter, seven-ring quartz cell, which does not require platinum black deposition and which can be cleaned without re-calibrating. No external pump is necessary even for high accuracy measurements.

- **OXYGEN SENSOR (7000 m operation)**
  Features an innovative pressure-compensated polarographic sensor, with a replaceable cap. Because stirring effects are negligible, no external pump is necessary.

- **pH GLASS SENSOR and SOLID GEL REFERENCE ELECTRODE (7000 m operation)**
  High-pressure glass membrane pH electrode in conjunction with a ceramic junction-less reference electrode and a differential amplifier system.

- **BLUETOOTH® WIRELESS ADAPTER**
  The IDRONAUT Wireless Adapter allows bidirectional full duplex communications between the OCEAN SEVEN 316*Plus* probe and a personal computer or PDA devices equipped with a Bluetooth® device.

- **DATA TRANSMISSION**
  Via RS232C interface. Optional interfaces are: long distance FSK (10000 m) telemetry, RS422 and Wireless Bluetooth.

- **DATA MEMORY**
  Allows storage of up to 4.000.000 data sets, for each of the 7 standard acquired parameters together with date & time, using the 512-Mbyte standard memory. **Memory can be optionally expanded to 1 Gbyte.**

- **OPTIONAL PROBES, SENSORS**
  The following sensors, probes are currently interfaced:
  - ☐ GENERAL OCEANICS - Rosettes mod. 1014,1016, 1018 and 1015.
  - ☐ IDRONAUT - String and Weight Bottom Sensor.
  - ☐ IDRONAUT – High Precision 0.01 % Pressure Transducer.
  - ☐ WET Labs - C-Star Transmissometer and WETStar Miniature Chlorophyll Fluorometer.
  - ☐ SEAPOINT - Fluorometers and Turbidity Meter.
  - ☐ TURNER DESIGNS – Fluorometers.
  - ☐ D & A INSTRUMENT COMPANY - OBS-3 Sensor.
  - ☐ CHELSEA - MINI*tracka* MkII In-Situ Miniature Fluorometer.
  - ☐ LI-COR - LI-192SA Underwater and LI-193SA Spherical Underwater Quantum sensors.
  - ☐ BIOSPHERICAL INSTRUMENTS - QSP-2200 - QSP-2300 PAR Sensors.
  - ☐ VALEPORT - MiniSVS Sound Velocity Sensors.
  - ☐ DATASONICS - PSA916D Sonar Altimeter, 6000 m.

TECHNOLOGY IN SEARCH OF NEW DEPTHS

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❑ **BATTERY OPERATION**
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. Ten batteries: 1.5V, 1.8 Ah, type AA cells are installed in the internal battery pack.

All the sensors installed in the OCEAN SEVEN 316*Plus* CTD (see table for SENSOR SPECIFICATIONS) 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 time constants: 50 milliseconds for physical parameters (CTD) at 1m/s profiling speed and 3 seconds for chemical parameters. The OCEAN SEVEN 316*Plus* 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.** OS316*Plus* 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.**

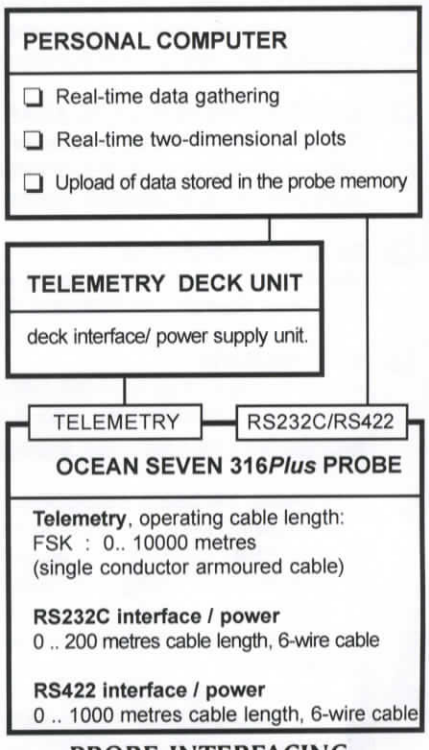
The unattended acquisition can be activated by means of a magnetic switch present on the probe top cover. Extension of the internal battery life is automatically obtained through a power management procedure that switches the probe OFF between data acquisitions. The probe is equipped with an internal non-volatile memory which can store up to a 4.000.000 data sets, 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 316*Plus* 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 FSK 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 316*Plus* CTD and facilitates real-time data acquisitions, configuration of unattended acquisition cycles and uploading of data stored in the probe memory. REDAS-5 programme is a true 32-bit Windows application, which flawlessly runs on Windows 98SE, ME, 2K and XP. 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 316*Plus* Telemetry System Performance Chart

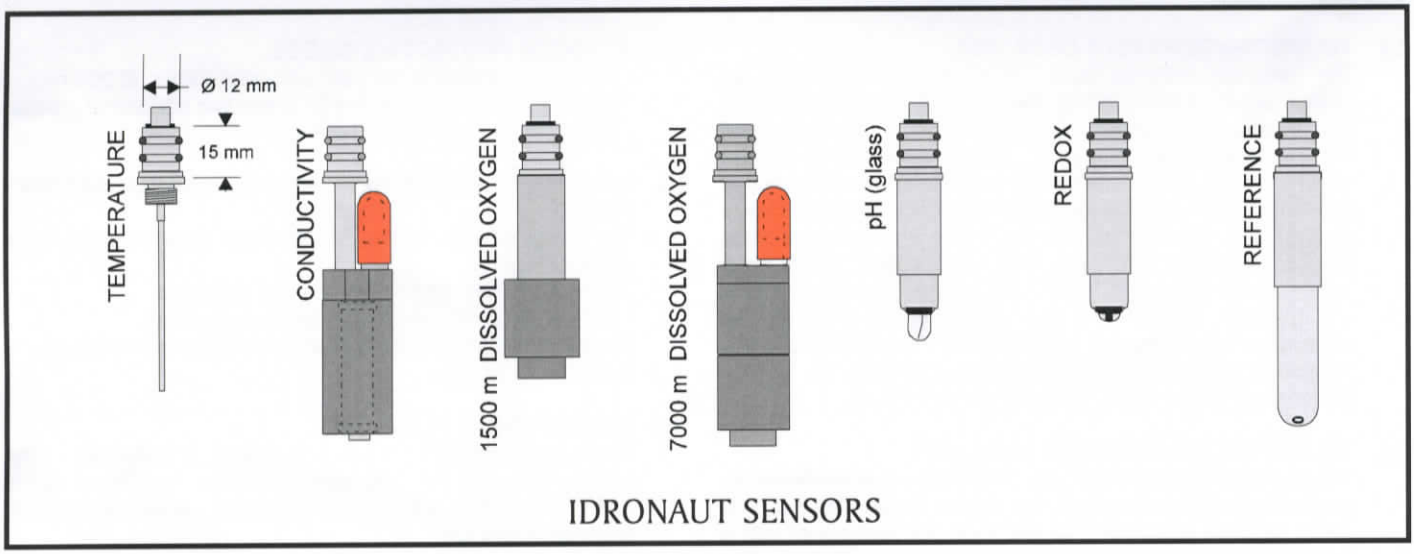
Telemetry Type	Max cable length	Max transfer rate
RS232C	200 metres	38400 bps
RS422	1000 metres	38400 bps
FSK (*)	10000 metres	9600 bps

(*) The above performance is obtained using the 6.4 mm diameter ($^1/_4$inch) Rochester cable 1-H-255 which has an electrical resistance of 23 Ω/km and a capacity of 138 pF/m.



PROBE INTERFACING

The Ocean Seven 316*Plus* CTD operates with the standard Rochester coaxial armoured cables ($^1/_{10}$, $^1/_8$, $^1/_4$, $^1/_2$ inch) present in oceanographic vessels having a total resistance up to 250 ohms.



IDRONAUT SENSORS

SENSOR SPECIFICATIONS

	Range	*Accuracy*	*Resolution*	*Time Constant*	
Pressure	0.. 1000 dbar*	0.05 % full scale	0.002 % full scale	50 ms	
Temperature	-3.. +50 °C	0.003 °C	0.0002 °C	50 ms	
Conductivity	0.. 70 mS/cm	0.003 mS/cm	0.0003 mS/cm	50 ms	(at 1 m/second flow rate)
Oxygen	0.. 50 ppm	0.1 ppm	0.01 ppm	3 s	(from nitrogen to air)
	0.. 500 % sat.	1 % sat.	0.1 % sat.	3 s	(from nitrogen to air)
pH	0.. 14 pH	0.01 pH	0.001 pH	3 s	
Redox	-1000.. +1000 mV	1 mV	0.1 mV	3 s	
Auxiliary inputs**	0.. 5000 mV	1 mV	0.1 mV	50 ms	

* 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. Available ranges are: 100, 1000, 3000, 4000, 7000 and 10000 dbar.

** 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.

The fundamental properties of seawater, like:
Salinity, Sound Speed, Water Density, Pressure to Depth Conversion, Potential Temperature, **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".

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 *basic:*	512-Mbyte non-volatile memory.
expansion:	1 GByte.
Battery power supply:	9 .. 18 V, 150 mA @ 12 V.

Physical characteristics for:	*1500 dbar*	*1500 dbar*	*7000 dbar*
Dimensions: *housing diameter:*	100 mm	75 mm	89 mm
total length:	710 mm	685 mm	770 mm
Weight: *in air:*	4,2 kg	4,0 kg	8,0 kg
in water:	0,2 kg	1,7 kg	4,3 kg
Materials:	white POM	black POM/AISI 316L	TITANIUM GR5

Diameter of protective cage/s: 260 mm, titanium.
Cable connectors: 2-pole connector (RMG-2-FS) for telemetry output, if installed;
6-pole connector (RMG-6-FS) for RS232C/RS422 outputs and power input.

ACCESSORIES

❑ **TELEMETRY PORTABLE DECK UNIT**
The Telemetry Portable Deck Unit powers and interfaces, by coaxial oceanographic cables, the Ocean Seven 316*Plus* CTD with a personal computer. The portable deck unit is equipped with a transceiver (modem) which allows half-duplex communication with the probe.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 MK DECK UNIT**
The Telemetry On-board MK Deck Unit powers and interfaces, by coaxial oceanographic cables, the Ocean Seven 316*Plus* CTD with a personal computer. The MK deck unit is equipped with a transceiver (modem) which allows half-duplex communication with the probe. The MK deck unit is housed in a 19" rack-mountable deck unit and is designed for on-board operations. The MK deck unit provides high voltage telemetry power supply (220 V DC) to allow the Ocean Seven 316*Plus* CTD to interface and power several additional probes. The MK deck unit internal power supply accepts AC voltage: 115/220V AC +/- 10%, 50-60 Hz +/- 5%.
Telemetry power supply: 220V DC (max 1A@12V).
Dimensions: 480 x 160 x 90 mm. 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 250 m of 5 mm polyurethane jacketed armoured cable or 100 m of 10 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 10 mm - POLYURETHANE**
Multi-conductor shielded cable - Kevlar amoured - type Idronaut Ø 10 mm - specifically designed for RS422 or RS232C interface. Composed of 3 pairs: one 2x16 AWG and two 2x22 AWG twisted together - breaking strength: 250 kg. Weight: 5,3 kg/100 m (in water); 13 kg/100 m(in air).

❑ **SENSOR PROTECTION ANTIFOULING KIT**
The antifouling kit is installed near the Ocean Seven 316*Plus* 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.

❑ **TITANIUM PROTECTIVE CAGES**
- For sensor and/or upper connector protection: Ø 260 mm.
- Mooring frame to house the CTD and two additional probes: Ø 350 mm ca, height 950 mm ca.

❑ **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 m max depth operation;
- Ø 79 x 330 mm, 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 316*Plus* CTD from a profiling CTD to a very accurate on-board thermosalinograph.

OPTIONS

❑ **HIGH-PRECISION (0.01%FS) PRESSURE TRANSDUCER**
The high-precision 0.01 %FS pressure transducer is based on the stable, floating piezoresisitive transducer and the newly developed sensor interface. Temperature dependency and non-linearity of the sensor are mathematically compensated by the interfacing electronics. Standard pressure transducers immediately available: 100, 1000, 3000, 4000, 7000, 10000 dbar.

❑ **TELEMETRY OUTPUT**, in addition to the RS232C output. Real-time data transmission to the Telemetry Deck Unit.

❑ **BLUETOOTH® WIRELESS ADAPTER**
The IDRONAUT Wireless Adapter allows bidirectional full duplex communications between the OCEAN SEVEN 316*Plus* 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.

❑ **MEMORY EXPANSION,** expands the probe basic memory to 1 Gbyte.

❑ **GENERAL OCEANICS ROSETTE INTERFACE**
This option interfaces General Oceanics Rosettes mod. 1014, 1016, 1018 and 1015 (Tone or Voltage Firing) in order 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.

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