TWR Profiling Floats
(Lagrangian Subsurface Drifters)

TELEDYNE WEBB RESEARCH
A Teledyne Technologies Company

APEX –Autonomous Profiling EXplorer

APEX is an autonomous drifting profiler used to measure subsurface currents and make profile measurements. It surfaces at programmed intervals for data telemetry and geo-location via ARGOS or IRIDIUM satellite. Standard sensors include Conductivity (Salinity), Temperature and Pressure (Depth) but other sensor options are available.

APEX has a 4-year life with alkaline batteries fitted and can surface approximately 150 times from a maximum depth of 2000 metres. (6000m for APEX deep). Over **6000 APEX floats** have been delivered to users in **19 nations**. Floats are supplied deployment-ready, and are routinely deployed from merchant ships (VOS) whilst moving at 20+ knots.

APEX automatically adjusts buoyancy to follow an isobaric surface while drifting, or can be programmed to follow an isopycnal surface. The optional *"park and profile"* feature allows drift depth to be decoupled from maximum profile depth. For example, a float might be programmed to drift at 1000 dbar, then descend to 2000 dbar before profiling upward to the surface.

The APEX salinity profiler has been certified by US Dept. of Defense for air deployment from C130 aircraft. Proven VOS and aircraft deployment packages are available options.
APEX can be easily tested and re-programmed by connecting a terminal.

As well as having a flexible choice of sensor choices, optional features also include **Ice avoidance** algorithm and **recovery handle** and **strobe light.**

Specifications:

Dimensions 16.5 cm dia. x 127 cm long (not incl. 69 cm antenna), Mass 25 kg

Autonomy nominal 4 years; 150 ascents (with alkaline batteries)

Operating depth 2000 metres maximum (6000m for APEX deep)

Profile sample rate Programmable. Typically 100 TP or 50 CTP points at 5-10 m. intervals (resolution limited by telemetry data rate, not by design)

Battery options: Alkaline or Lithium

Sensor options include CTD, Oxygen, Turbidity, Fluorometers, PAR, Transmissometer, Rafos Acoustics or mixing / vorticity.

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APEX profiling float controller board, APF11.

Teledyne Webb Research have been producing autonomous profiling floats since before the inception of the ARGO programme. They have at their heart the hardware control board that governs the operation of the float, data sampling & handling and onward transmission.

The physical hardware and firmware have been developed and adapted as the needs of the applications developed and suitable technology became available such as new sensors or telemetry methods. Each adaptation was built on previous versions and so gradually become more complex and capable.

The firmware for the latest iteration of controller - the **APF11** - has been completely re-written from scratch, allowing for a much more flexible and versatile system that brings many new features, the most significant of which is the potential for future features as yet unrealised. New hardware can now be added for a much lower engineering cost due to the simplified structure of the firmware.

Work continues to transition specialised versions into APF11, such as the APEX RAFOS for acoustic positioning and APEX-EM for measurement of mixing and vorticity via electro-magnetic sensors.

Additional features unrelated specifically to the APF11 include extended hull lengths to accommodate increased battery capacity and extra hardware, Composite hull to reduce weight and improve performance in moderately low density surface waters, and a Nitrogen compensator device that harnesses the buoyancy stored in the compressed nitrogen gas – useful in extremely low density surface waters such as the Bay of Bengal.

Key features of the latest APF-11 controlled APEX profiling float may be divided into three.

Mission	**Intelligence**	**Data**
Configurable mission plan (descent, parking & ascent phases)	Ice avoidance	Continuous sampling at depth or time intervals (requires Iridium RUDICS or SBD)
“Deep profile first” option	Bottom avoidance	Averaging of temperature and salinity data into sub-divided bins (to 2 deciBar increments)
“Time of Day profile” option	Finer granularity of piston control to allow for better depth adjustment	Independent, user-programmable sampling of sensors at different times (except CTD & pH)
Recovery mode (stays at surface awaiting retrieval, transmitting GPS position)	Humidity and leak monitoring	Different sampling regimens for different mission phases
Emergency mode (self-activated return to surface on critical event)	Battery voltage and current draw monitoring	Data compression and Z-modem protocol to reduce transmission cost
		Mission and control reconfigurable at sea (via Iridium)
		In-air sampling (as per SCOR wg142 recommendation for DO sensor)

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