

APEX profiling float controller board, APF11.

Teledyne Webb Research have been producing autonomous profiling floats since before the inception of the ARGO programme. Originally with the “ALACE” model and latterly the “APEX”, they have at their heart the hardware control board that governs the operation of the float, data sampling & handling and onward transmission.

This board controls the air and buoyancy pumps and interfaces with the GPS receiver, the satellite modem, the CTD, and any additionally installed science sensors. It also includes the float’s microcomputer, an internal clock, operational firmware and program and data memory, and it and processes signals from internal pressure and humidity sensors. Other “vital” readings include air bladder pressure, battery voltage & current and a Coulomb counter to monitor energy consumption throughout the life of the float.

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 rewritten 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.



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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)

Many of the most widely used 3rd party sensors are already coded for integration and others can be added. Seabird SBE41 & SBE41cp CTDs, SBE41N CTD+pH, SBE61 CTD (Deep), RBRargo CTD, Aanderaa DO, JFE Advantech DO, various WETLabs fluorometers, WETLabs C-Rover transmissometer, Satlantic SUNA nitrate, Satlantic OCR 504 radiance and irradiance, True North Technologies compass & tilt.



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