REVISION HISTORY			
RELEASE DATE	REV.	CHANGE	PAGES EFFECTED
08/26/2011	01	INITIAL RELEASE	-
11/08/2011	02	Body, Format	All

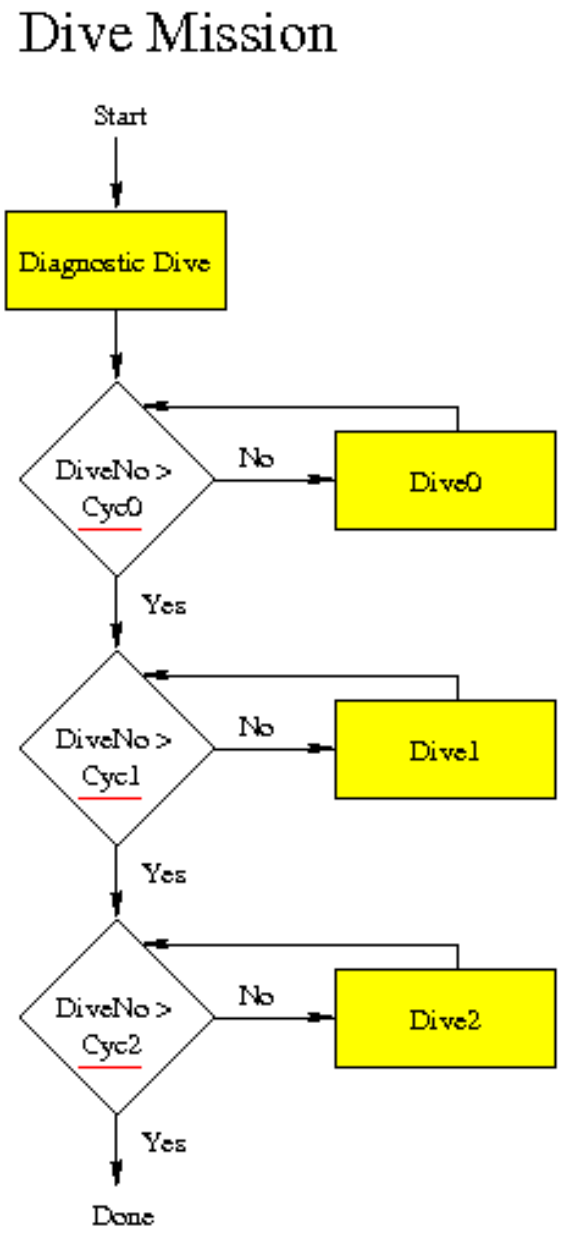
Contents

1. Scope

The Solo-II Argo (S2A) is an unmanned autonomous underwater vehicle that is designed to perform various ocean measurements. The parameters for this mission are programmed prior to shipment. These parameters determine the dive profile for the S2A, number and frequency of the measurements, as well as various control parameters. The mission parameters must be loaded prior to deployment and are stored in the S2A's internal EEROM. Once the mission has been programmed into a S2A, it can be boxed up for shipment for deployment in the ocean.

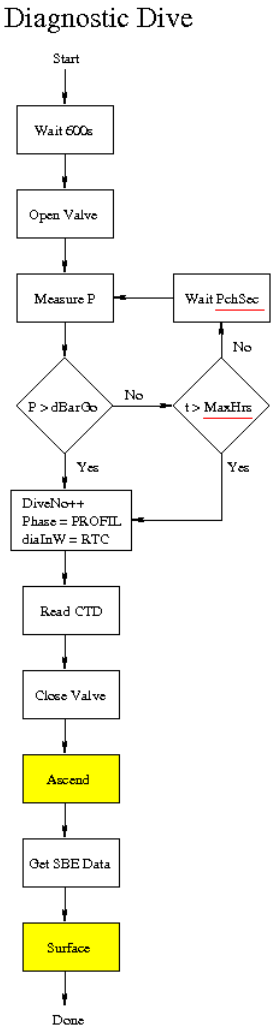
2. DEPLOYMENT

The S2A must first be primed for deployment. This is done while the S2A is still in the shipping box. A hole is punched in the box and a magnet is swiped past the reed switch inside the S2A. The location of the switch is marked on the exterior of the S2A's p-case. After the switch has been triggered,– the hydraulic pump audibly runs for about a second. The CPU checks the dive number ("DiveNo" stored in EEPROM) and whether or not a communication cable is connected. If DiveNo < 1 and no cable is connected, the Built In Test (BIT) is initiated. After passing the BIT, the external bladder fills with oil within 5 minutes and then empties again after 10 minutes, DiveNo is set to 0, and the S2A is ready to be deployed. The S2A should not be deployed without first observing the audible pump cycle and the inflating of the external bladder. When deployed, the S2A is dropped in the ocean in its shipping box. The box will disintegrate, and the S2A will begin to sink. When the S2A electronics wakes up, the S2A begins the diagnostic dive followed by the various mission dives.



3. DIAGNOSTIC DIVE

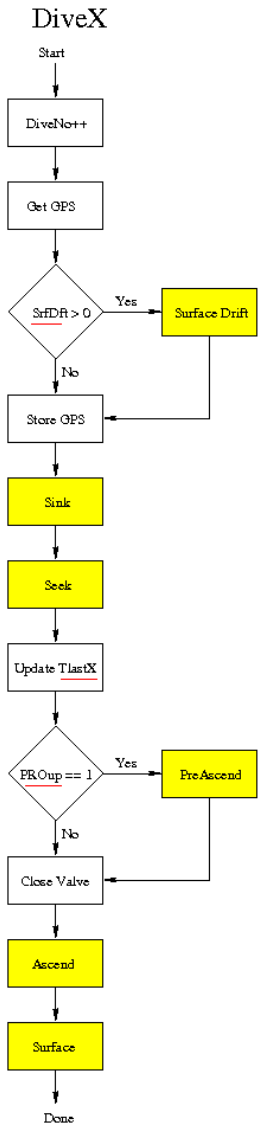
The S2A starts the Diagnostic Dive in a low-power mode waiting for deployment. In this state, the S2A electronics wakes up every "PchSec" seconds (commonly 600 seconds, or 10 minutes), for up to "MaxHrs" hours (commonly 2160 hours, or 90 days) and measures external pressure. When the electronics wakes up and detects that the measured pressure exceeded "dBarGo" (commonly 50 dbar), the CTD is turned on and the hydraulic pump is activated, bringing the S2A back to the surface. The S2A will follow the same **Ascend** algorithm as will all other dives. Once, it reaches the surface, the **Surface** algorithm will be performed. This will involve processing the CTD data, obtaining a GPS fix and uploading the information via Iridium. The format of this diagnostic data file is distinct from that of all subsequent dives. The depth, and therefore time required, for the diagnostic dive varies depending on the timing of the deployment relative to the pressure sampling schedule, but it should not be much more than 100 meters deep or 45 minutes in duration.

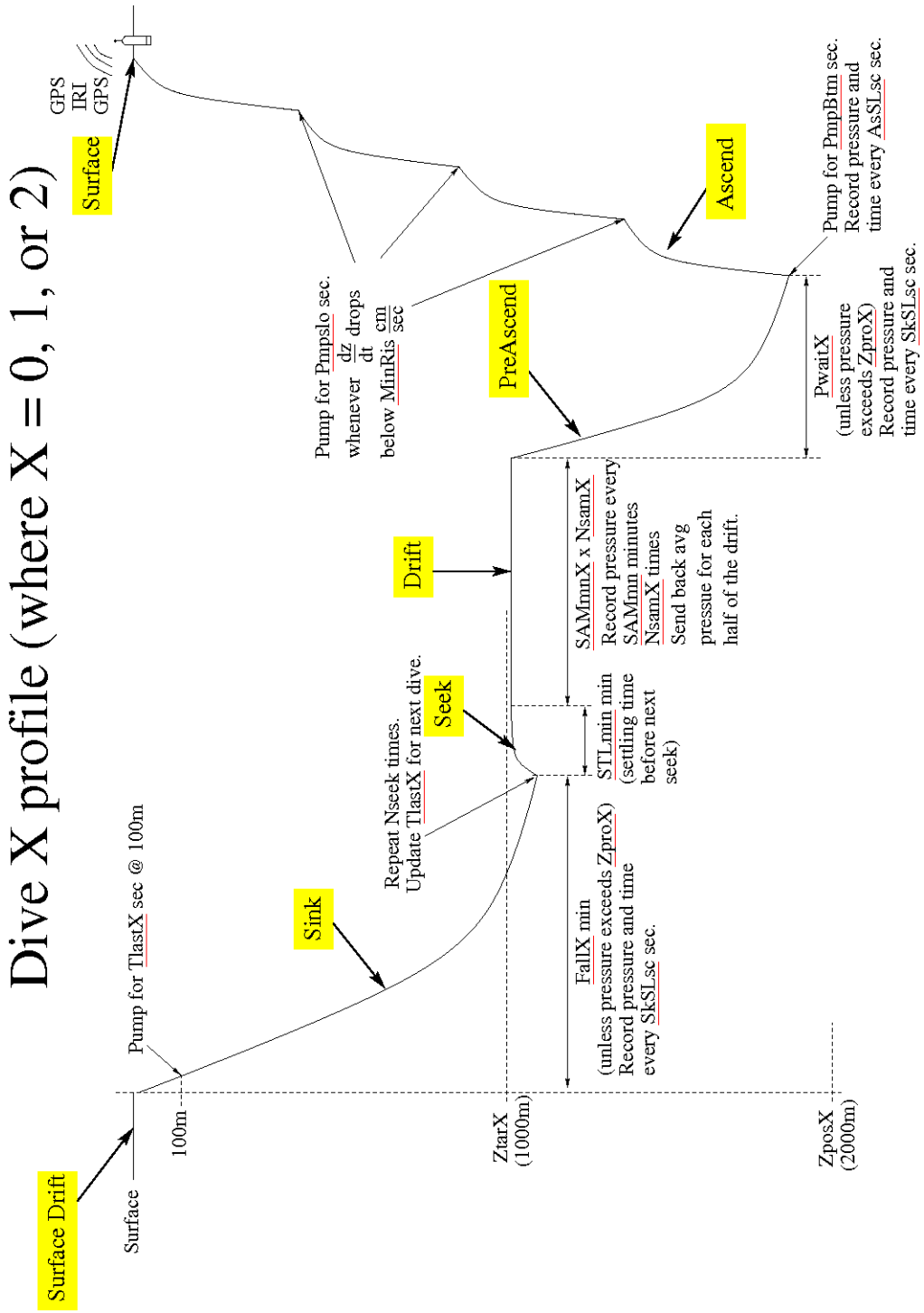


4. DIVE PROFILE

Following the diagnostic dive, the S2A will start the mission dives. The profiles for these dives follows the same form. Once the dive starts, it will enter an initial **Surface Drift** phase to try to get closer to the desired location. Next comes the **Sink** phase followed by the **Seek** phase to get to the target depth. Once at this depth, the S2A will enter the **Drift** phase. Next the S2A will enter the **PreAscend** followed by the **Ascend** phase to get to the surface.

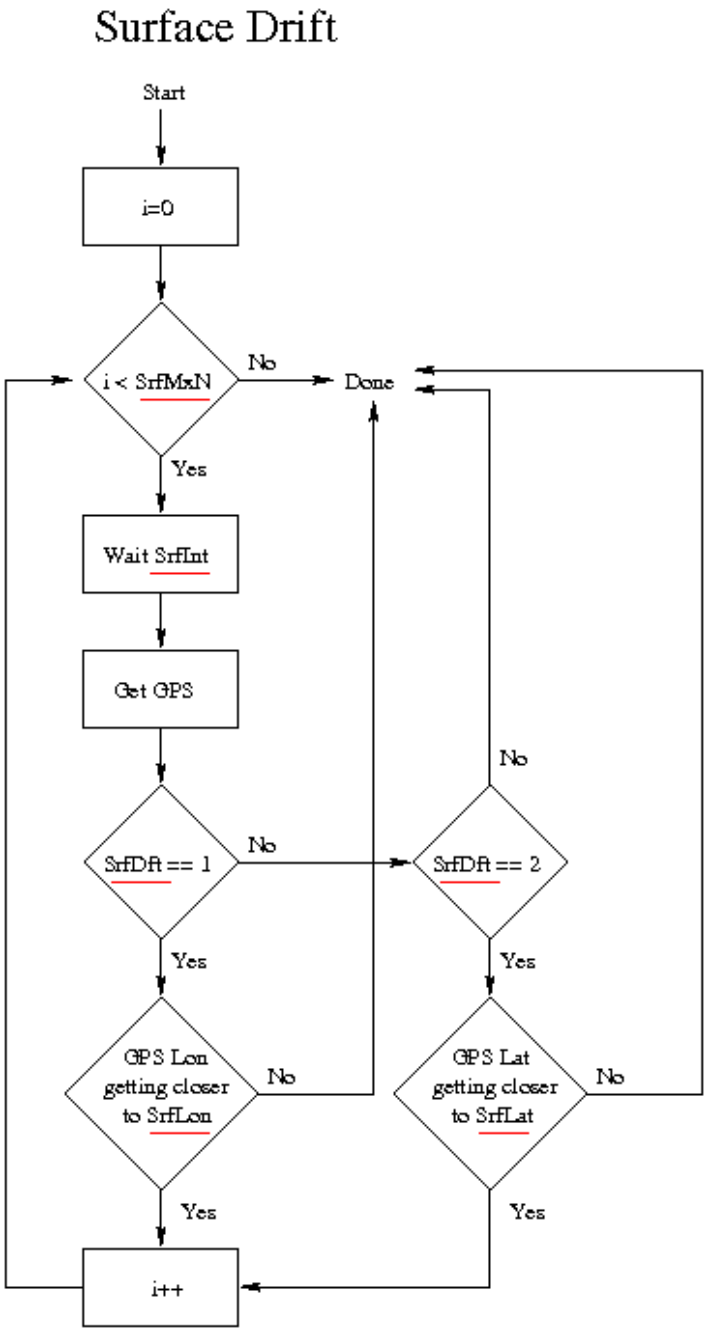
The profile for these dives are determined by parameters stored in EEPROM. Many of these parameters have 3 different versions, distinguished by a "0", "1", or "2" at the end of the parameter name. A set number of dives, specified by the parameter "Cyc0", are completed using the parameter set with names ending in "0". Then "Cyc1" dives are completed using parameter set "1", followed by "Cyc2" dives using parameter set "2". “Cyc2” dives are intended to continue until the batteries are exhausted and therefore have a max dive number of 999.





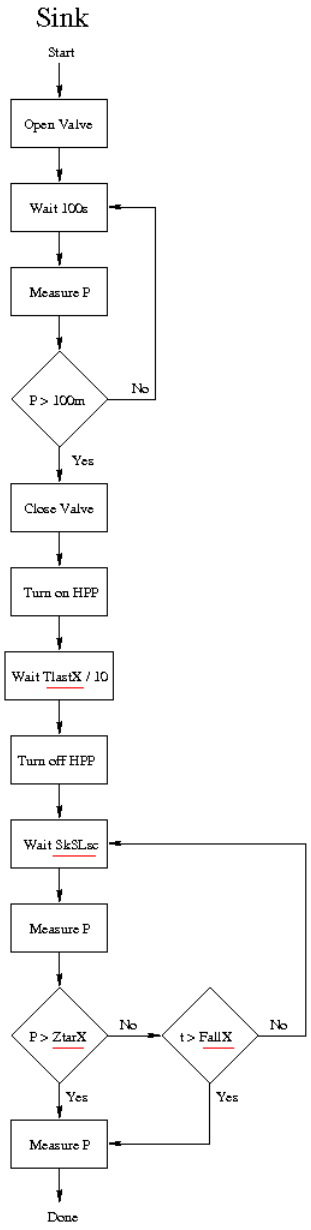
a. SURFACE DRIFT

The first phase of the dive is to drift on the surface. An initial GPS fix is taken and compared with a desired location. Then a subsequent GPS fix is taken to determine if the S2A is drifting closer to the desired location. If the S2A is not getting closer or the maximum count has been hit, then the S2A will enter the **Sink** phase.



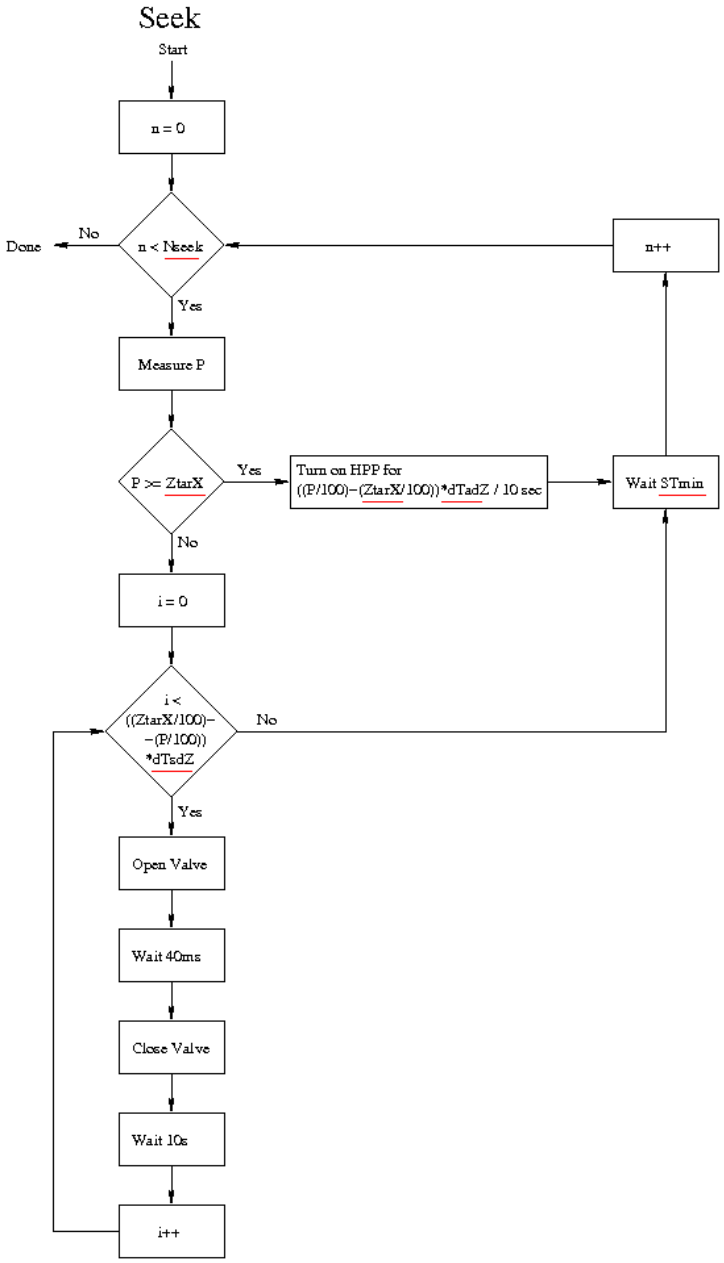
b. SINK

In the **Sink** phase, the valve is opened, allowing oil to flow into the internal reservoir, and the S2A begins to sink. Pressure and time are measured/recorded at intervals of "SkSLsc" seconds, and later sent back. After a pressure greater than 100 dbar is observed, the hydraulic pump operates for "Tlast**X**" seconds, where the "**X**" is a "0", "1", or "2". "Tlast**X**"is chosen such that the S2A reaches neutral buoyancy at the target depth "Ztar**X**". The S2A is allowed to approach its neutral depth for "Fall**X**" minutes, unless it exceeds the profile depth "Zpro**X**", which triggers an early transition to the **Seek** phase.



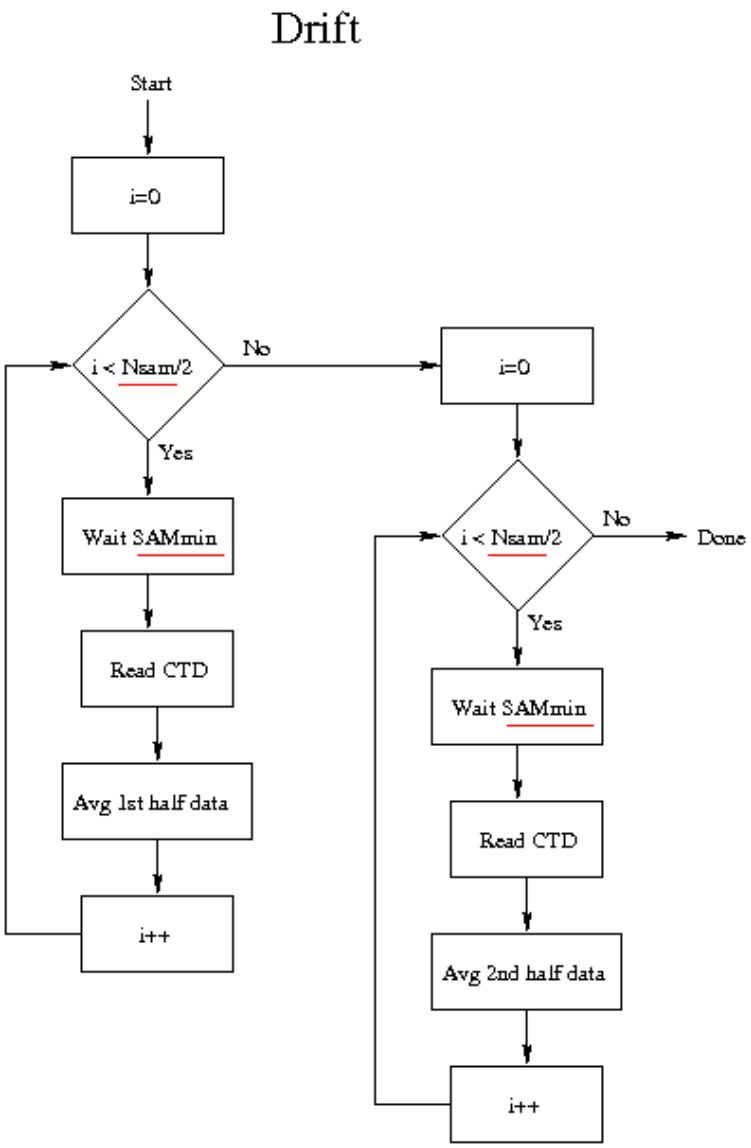
c. SEEK

If the depth of the S2A at the end of the **Sink** phase exceeds "Ztar**X**", the hydraulic pump runs for an amount of time calculated by multiplying the depth by which the S2A overshot by "dTadZ". The S2A is allowed to settle on its new equilibrium depth for "STLmin" minutes. This process is repeated "Nseek" times. The total time pumped during both the **Sink** and **Seek** phases is logged, and "Tlast**X**" is updated to that value. If the depth of the S2A at the end of the **Sink** phase is too shallow, the fuse is fired a number of times determined by multiplying the depth shortfall by "dTsdZ". The ratio between "dTsdZ" and "dTadZ" is used to convert the number fuse firings to an effective pump time (negative) which is used to update "Tlast**X**" for the next iteration. After a few dives, "Tlast**X**" should converge on the correct value.



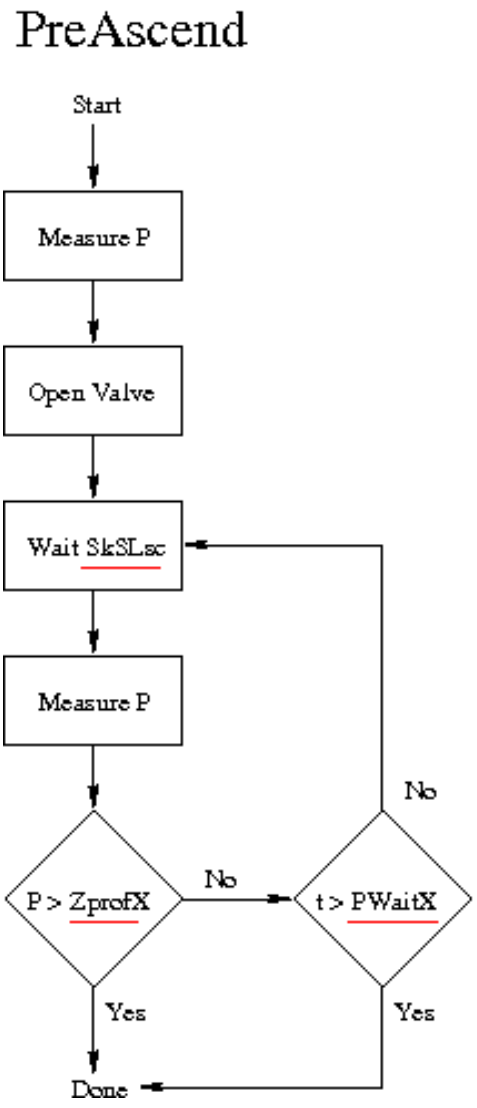
d. DRIFT

During the **Drift** phase, the S2A records pressure, temperature, and salinity samples every "SAMmn**X**" minutes until it has obtained "Nsam**X**" samples. The duration of the **Drift** phase, in minutes, is thus the product of these two parameters. Rather than sending back all the samples, as is done for the **Sink**, **PreAscend**, and **Ascend** phases, they are averaged into two bins, and the average pressure, temperature, and salinity from each half of the **Drift** phase is reported.



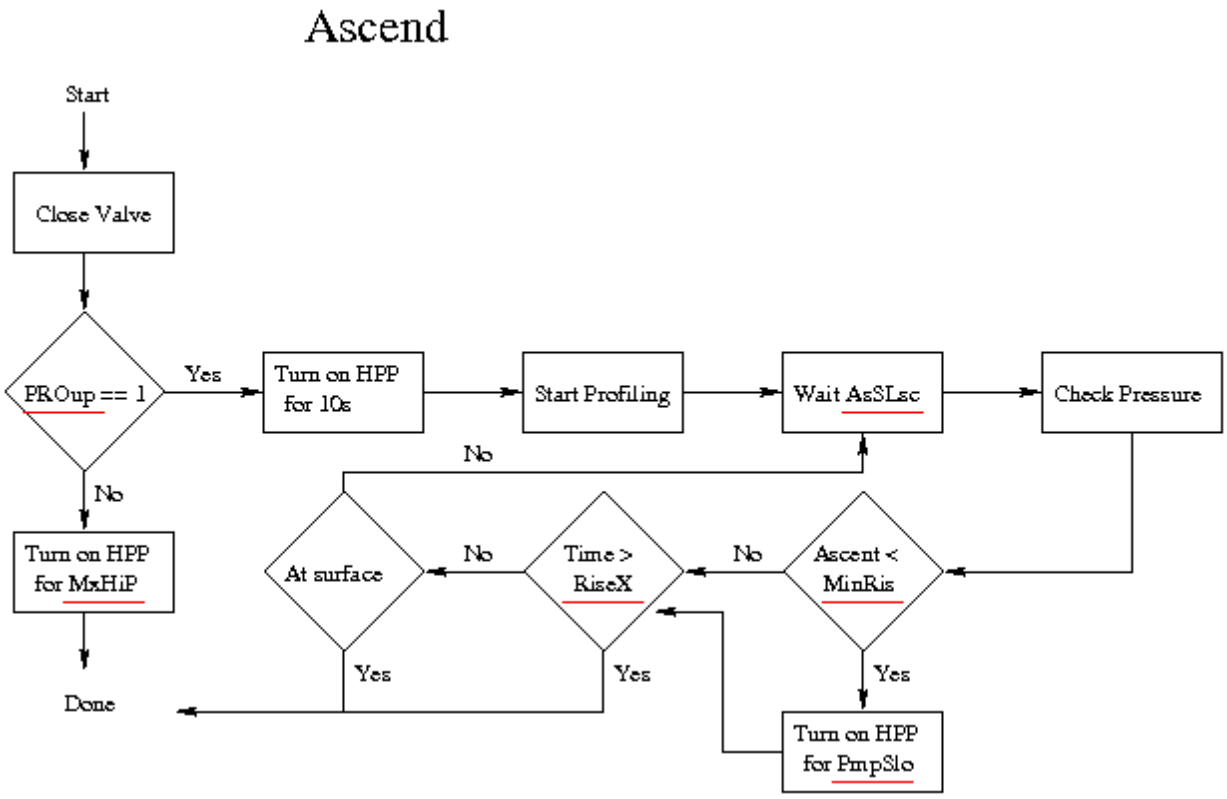
e. PREASCEND

If the PROup mission parameter is set, then the S2A will perform profiling during the ascent. To do this, the valve is then opened allowing the oil into the internal reservoir to sink to a profiling depth. Pressure and time are recorded every "SkSLsc" seconds. The S2A sinks for "Pwait**X**" minutes or until a depth of "Zpro**X**" is reached, at which time the valve closes, the hydraulic pump runs for "PmpBtm" seconds and the CTD turns on.



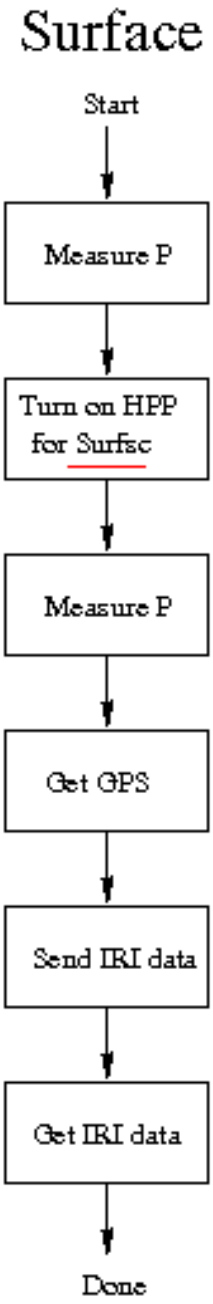
f. ASCEND

During **Ascend**, pressure and time are recorded at intervals of "AsSLsc" seconds. Each time the vertical speed computed from these measurements drops below "MinRis" (typically 11 cm/sec--rising too slowly is inefficient because of the power required by the SBE pump) the hydraulic pump runs for “Pmpslo" seconds.



g. **SURFACE**

Upon reaching the surface, the hydraulic pump runs until either the internal oil pressure sensor reports a value below "OILvac" or the total pump time for the dive reaches "MxHiP" seconds. The profile is binned by the CTD and then transferred to the HC12. A GPS fix is obtained (or attempted for "GPSsec" seconds), and the data is sent back via Iridium, (or attempted for "IRIsec" seconds").



5. THE MISSION PARAMETERS

All of the mission parameters are stored in an EEROM inside the S2A. Each parameter is defined by a key string that is up to 6 characters and a value. The following tables outline the different mission parameters.

Start of profiling mission

PchSec	seconds between checks of pressure
MaxHrs	time to start, independent of dBarGo [hours]
dBarGo	minimum pressure increase to start profile [dBar]
ABcymn	minutes between Iridium transmits in Abort

Specification of multiple duty-cycles

Cyc0	cycles to target Ztar0
Cyc1	cycles to target Ztar1
Cyc2	cycles to target Ztar2
Ztar0	target depth for Cyc0 [meters]
Ztar1	target depth for Cyc1 [meters]
Ztar2	target depth for Cyc2 [meters]
Zpro0	profile depth for Cyc0 [meters]
Zpro1	profile depth for Cyc1 [meters]
Zpro2	profile depth for Cyc2 [meters]
Tlast0	estimated pump time during Seek to reach ZTAR0 [seconds]
Tlast1	estimated pump time during Seek to reach ZTAR1 [seconds]
Tlast2	estimated pump time during Seek to reach ZTAR2 [seconds]
Rise0	minutes to rise from ZTAR0
Rise1	minutes to rise from ZTAR1
Rise2	minutes to rise from ZTAR2
Fall0	minutes to fall to ZTAR0
Fall1	minutes to fall to ZTAR1
Fall2	minutes to fall to ZTAR2
SAMmn0	minutes between drifting samples for Cyc0
SAMmn1	minutes between drifting samples for Cyc1
SAMmn2	minutes between drifting samples for Cyc2
Nsam0	samples to take while drifting for Cyc0
Nsam1	samples to take while drifting for Cyc1
Nsam2	samples to take while drifting for Cyc2
Pwait0	minutes to spend waiting to Zpro0
Pwait1	minutes to spend waiting to Zpro1
Pwait2	minutes to spend waiting to Zpro2

Dive timing info

PmpBtm	seconds to run the hpp at bottom of dive
Pmpslo	seconds to run on ascent when rate is too slow
MinRis	threshold for ascent rate [cm/s], pump when rising slower
MxHiP	maximum seconds to run the hpp
MxSfP	maximum seconds to run the hpp at surface
GPSsec	maximum seconds to acquire GPS fix in normal dive
IRIsec	maximum seconds to spend communicating with Iridium
DURat	down/up ratio
dTadZ	millisecs req'd to ascend by 100 m
dTsdZ	millisecs req'd to sink by 100 m
mxSeek	maximum time to use during a seek [seconds]
Nseek	seeks to perform
STLmin	minutes to spend waiting to settle
Surfsc	seconds to run HPP at surface
Ventsc	maximum seconds to run vent pump
Ventop	0 do nothing,1 report LLD output, 2 run vent
SkSLsc	seconds to sleep between pressure reads when sinking
AsSLsc	seconds to sleep between pressure reads when ascending
PROup	true if profile on way up, else false
Ndives	total dives to do
CTDofZ	depth to stop CTD pumping [meters]
SrfDft	1 for lat (NS), 2 for lon (EW), 3 for both, 0 for none
SrfLon	target Longitude (20th/degree)
SrfLat	target Latitude (20th/degree)
SrfMxN	maximum number of drift intervals
SrfInt	seconds between fixes while drifting.

6. THE MISSION FILE FORMAT

The mission parameters are preloaded into the S2A from values contained in a single mission file. The mission file is an ASCII file that contains the specific parameters for the S2A's mission. The first line in the file contains a description string for the mission. The second line contains the version string for the S2A's operational software. This must match the software that has been programmed on the S2A. The remaining lines contain the various parameters. If a line begins with a **#**, then it is a comment. If a line begins with a **!**, then it is setting one of the mission parameters. In a line begins with a **%**, then it is setting a parameter for the Seabird CTD.

The mission file does not need to set all of the mission parameters. Default values are provided for parameters that do not need to be changed. The format for each line that changes one of the mission parameters is very specific. It must start with a **!** in the first column. The **!** may be followed by 0 or more spaces. The next non-space character denotes the start of the parameter name. The parameter name is a maximum of 6 characters and is case sensitive. There must be at least one space after the parameter name. The parameter value follows next and must be a decimal number.

7. MISSION FILE EXAMPLE

SBE 41CP SOLO2 10dy Kaharoa 2000db SBE602 16Jun11
SBE602 01Jun11
#ABOVE LINE MUST BE SAME AS ONBOARD SOLO!!!!!!!
because some of these board sets may have been paired using the SOLO defaults,
setting the calibration values here.
! Mcur0 0
! Mcur1 52
! Poff 10
! Pgain 25
! Toff 5
! Tgain 1000
! Soff 1
! Sgain 1000
#BIT threshold values
! CBmin 600 6.0 VDC
! PBmin 1250 12.5 VDC
! VACmn 600 6.0 inHg
! MCmax 5000 5Amp max current
#!dVACmn 150 1.5 inHg to fill bladder
Checking for being in water
!dBarGo 50 start when pressure exceeds 50 dBar
!PchSec 600 checking P every 600 seconds
!MaxHrs 1440 for 1440 hours=60 days
multi-duty cycle information
! Cyc0 1 DIVES: 240 Hours ea dive = 10 days
! Cyc1 3 DIVES: 240 Hours ea dive
! Cyc2 999 DIVES: 240 Hours ea dive
!Ndives 9999 total number of dives to do
Fall & Rise timing
#Bounty Bay deployment sinks to 1000 dBar where it drifts.Then it sinks 450 dbar
#to the ballasting target depth of 1450 dBar. Float never sinks all 1450 dBar
#in one motion so don't need as long a FALL time
! Fall0 360 minutes (1000 m @ 3.3 cm/s avg. expected rate)
! Fall1 400 minutes (The expected rate is 14 c/s in fall from surface to 1000dBar)
! Fall2 400 minutes (and 10c/s from 1K to 1.4K since float net buoy=-53 gms)
! Rise0 180 minutes (1000m @ 10 cm/s avg)
! Rise1 600 minutes
! Rise2 600 minutes
! Pwait0 0 minutes
! Pwait1 100 minutes (500m @ 8 cm/s avg)
! Pwait2 300 minutes But if the ballasting is right on, it will be falling very slowly at the end.
Check the pressure intervals
!SkSLsc 1200 Check every 20 minutes while sinking

```
!AsSLsc  2000     Check every 33.3 minutes while ascending
!PmpBtm   70    Seconds to pump at the bottom to get up to speed. need 50 s of pumping beyond
neutral
!Pmpslo   24    Seconds to pump when ascent rate too low.
!MinRis   11  Target ascent Rate (11-12 for maximum effeciency)
! MxHiP  600   Maximum pumping time for a cycle
! MxSfP  400   Maximum pumping time at the surface
!OILvac 129                 Stop Pumping when vacuum is half FS
#  SEEK information
! Nseek 1  seeks to reach target depth
!STLmin 120  settle 120 mins=2 hours after seek
# Ztar yyy dBars: zz gms >>to ascend to yyy dBars need to pump zz gms out
# floats are ballasted to be neutral @ 1660 dBar
# but the drifting depth is 1000 dBar
! Ztar0 1000 dBars: 650 m / 14.7 (m/gm) = 44 gms +4 for temp=48
! Ztar1 1000 dBars: 48 gms more buoyant than with piston all the way in
! Ztar2 1000 dBars: 48 *180/40= 217 seconds of out pumping
! Zpro0 1100 Profile depth a little below drift to give it some room to seek
! Zpro1 1500
! Zpro2 2000
!Tlast0 256 tenths of seconds to pump out from full in to target guess for 1st dive
!Tlast1 300 these values should be computed from Ztar lines
!Tlast2 300 1000 db @4.1cc/100db=> 41 cc / 1.6cc/s  => 25.6 s
!mxSeek 60 max secs to pump in SEEK = 1 min
! DURat 100  down/up pump rate ratio * 100
! DURat 4
! dTadZ 2440 (3.9cc/100m) /1.6 cc/s in millesecnds
! dTsdZ 1560  (3.9cc/100m)/(2.5cc/opening) in thousands
#gm/100 7.0 ( gms/100 dBar : add X gms buoyancy will rise 100 dBar )
#  Drifting & sampling
!SAMmn0 0
!SAMmn1 135   4*135 minutes=9hours.=>1 day cycles
!SAMmn2 663   20*663 minutes=221 hours=9.21 days
! Nsam0 0
! Nsam1 4
! Nsam2 20
#Surface parameters
!GPSsec 300                  Allow 5 minutes to get a gps fix
!IRIsec 1200
!SrfDft   0                  No surface "seeking" 1=NS, 2=EW
!SrfLon   0
!SrfLat   0
!SrfMxN   0
!SrfInt   1200   wait for 20 minutes between GPS fixes
#  SBE parameters
! PROup 1  profile on way up after sinking to ballast before ascend
```

```
# 56 bins for SBE )
#  profile = 0-10 dBar @1 dBar/bin,10-2000 @ 2 dB/bin )
#
#SBE41CP does bin processing internally based on %CPxx params)
# with  bin_int  max_dep  bin_size in top,mid,bottom part )
%CPtp 1 10 1
%CPmd 2 2000 2
%CPbt 2 2028 2
!  BLOK   1
!   PB1  10
!   PB2  1005
!   AV1   2
!   AV2  2
!CTDofZ 1
!Ventsc 5
!Ventop 25
#  Surface & transmitting
!ABcymn 60
!Surfsc 500
```