Automatic Profiling Buoy APB5

Operating Manual

Program version 5.49xwx

SAIV A/S *Environmental Sensors & Systems*

Contents

Introduction

The standard APB5 is designed for automatic CTD profiling and monitoring of water quality in coastal waters, fjords, lakes and fish farms.

The unique feature with the APB5 is the OWAS (out of water system) functionality that will keep the profiling multi-parameter CTD clean from biofouling all year round. For making the OWAS to work the CTD must out of the water. The CTD is a multi-parameter instrument with option of having optional sensors as oxygen (OX), turbidity, fluorescence and PAR.

A unique feature with the CTD is that it has a built in short range radio. With the CTD above water "OWAS" the APB5 use radio communication for downloading data, preform recalibration of sensor that needs daily calibration and other settings. The radio also makes the profiling cable free, with only a wire strong rope it can perform profiling to 150 meter.

The APB5 system can optionally be fitted with weather station and ADCP. All data is instant sent to selected server where it also can retrieve new settings. The APB5 is an IoT based system with web- and file server. It has communication possibilities like WIFI, LTE, CDMA and Satellite. The system is powered with solar energy, and has a large lithium power "reservoir". A detailed battery status is also sent to server with every profile.

Even if the APB5 seems maintains free, it has to be treated with the same responsibility as any anchored vessel on sea/water.

Words and abbreviations.

APB5	Automatic Profiling Buoy generation 5.
APB5-HD	Automatic Profiling Buoy generation 5- Heavy Duty.
ADCP	Acoustic Doppler Current profiler
CTD	Conductivity Temperature Depth
PAR	Photosynthetically Active Radiation
IoT	Internet of Things
OWAS	Out of Water System
LTE	Long-Term Evolution (4G mobile network)
CDMA	Code Division Multiple Access (mobile network)
FTP	File Transport protocol
SFTP	Secure File Transport protocol
IP	Internet protocol
Service	Maintenance
WI-FI	Wireless Fidelity (wireless network)
GPS	Global Positioning System
WAN	Wide area network, also known as the Internet
LAN	Local area network
VPN	Virtual Private Network
URL	Uniform Resource Locator (address/link used in browsers)
DNS	Doman name server
DDNS	Dynamic Domain name server
SSID	Service Set Identifier (name of WIFI network)
SIM	Subscriber identity module (used by network modules for internet access)
ICC-ID	Unique serial number for SIM cards
APN	Access Point Name
PHP	A general purpose scripting language towards web development.
FBB	Fleet Broad Brand
USB	Universals Serial Bus
Router	Switching device for network. Among other things, they are used for Internet Access.
Server	A computer or system that provides resources to other computer known as clients
User	In this manual the user can be the operator/customer of SAIV/ the person that want to start, run and use the APB5 system.

What you need to remember after reading this manual:

USERNAME   :_____

PASSWORD   :_____

URL/IP Direct access after WIFI connect is establish: ***http://192.168.1.2***

URL Top-server WEB address: http://Station.saivas.net/USERNAME

FTP top-server FTP address: ftp://station.saivas.net

Username to give to third party/database use:

USERNAME_RO   :_____

192.168.1.2

APB5 Facts & system overview

The APB5 can be set to operate to desired profiling depth and interval frequency.
In between profiles, the sensor unit rests above the water inside the APB5 body, which eliminates biofouling on the instruments known as the OWAS (Over water system).

The pictures below showing instruments that has been in the APB5 for a year in Norway (to the left) and a picture from an instrument that was in a APB5 for 4 month in Turkey (middle) As picture shows there are no biofouling on sensors only at the lower protection kit that is constant in water. The sensors are kept clean thanks to the OWAS, 3D-illustarion to the right show how the instrument is docked in the APB5.

The instrument SD208 is a CTD (Conductivity Temperature Depth) with multi-parameter functionality with sensors like Oxygen, Turbidity, fluorescence and photosynthetic light sensor (PAR). The instrument is equipped with a short-range radio giving the option for cable free profiling for depth down to optional 150 meters. A wire strong Dyneema type rope 3-4 mm is proved for many years to be reliable for profiling.

The instrument will operate as a standalone unit only supplied by its own battery support. The instrument has very low current consumption and batteries only need to be changed once a year, if reasonable measuring and profiling interval is selected.

The APB5 system has several communication options, WI-FI for local settings and mobile network router for remote settings and data transfer. These are parts of the standard equipment's. Satellite communication is optional. With satellite communication the APB5 will automatically become an APB5-HD version. APB5-HD has more buoyancy and is bigger.

With the APB5 system also come`s a remote. This remote is for on-site use(50 meter range). It can interrupt the APB5. After an interrupt by remote the APB5 always turns on its communications units like WIFI and stay online until next full hour change. In this online period, various settings and configuration can be performed on the IoT based webserver. Note: APB5 listen only for remote interrupt between 9-16 daytime hours if in offline mode. It will always be listen in online mode, but then also available on WIFI.
If APB5 is been trigged by remote it will always set run mode to "service" and communication mode to "offline/always offline", even so, the system will be online to nearest hour, this is called window time. Service mode will also give the options of manually run the winch up and down with the arrows on remote. A trigger by remote will also read new

settings from top-server, if present. This functionality is handy if user wants to start the APB5 with remote, but be aware that it can also be confusing for a user that is not informed or forget that presetting is done, and the APB5 start when being awaken from remote. A stop APB5 from reading new settings is possible from top-system, but must be done before the reading.

The APB5 system can be equipped with ADCP for measuring a current profile, with resolution of 1 meter to max depth. Depth is depended on selected unit. Interval of data collection is based on the APB5 measuring interval

The APB5 can be fitted with a weather station. This will measure air temperature, air pressure, wind speed and direction. GPS position will also be recorded. Humidity is always more or less 100% at surface and is not needed to be measured. Interval of measurement follows the APB5 system interval.

APB5 has 4 run modes and 3 communication modes. Run modes are Auto, Off, Single-run and service/maintenance. Communication modes are Online, Offline and Windows time. The APB5 system is designed to use as little power as possible in profiling and between profiles, therefor there is different modes of communication and run modes. The communication mode "Offline" and Run mode "Auto" is the most used and use less energy and recommended from supplier. Even if this mode is selected the system will always log on to server for new settings and send data files if FTP is enabled. Windows time is a combination of offline and online, where user can select to have the system online for a period during the day. Some users have public IP, static or dynamic on the mobile and satellite SIM cards. This will give them access to the internal APB5 webpage when online.

All APB5 systems are delivering with a free server space for data storage and remote settings options. This server is referred to as a top-server for APB5 system. It´s server web-page is station.saivas.net and is online 24/7. After logging in to the server, user can pre-set settings for the APB5. When the APB5 is connecting to internet after a completed profile it will read new settings if there are new settings and also leave a note for doing this.
If the APB5 is in run mode "off" and communication mode "offline or online", it will every morning at 0900 and evening at 1500 log on to the top-system and check for new settings/commands. If no new settings it will send an event/status file with info as battery level in volt.
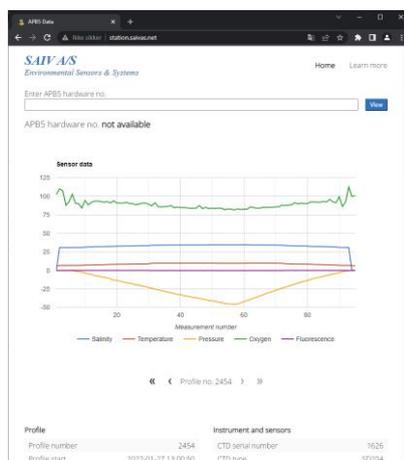
FTP is being used for sending data files. The files will be sent immediately to top-server after a profile is finish, regardless of the communication mode (online/offline and window time). There is also an internal/local FTP server onboard the APB5. This is for backup. Both FTP modes can be disabled and enabled from a web page. The mobile router can be set to use VPN if security is needed.

The APB5 is self-contained with power from a combination of solar panels and batteries. The batteries are of type lithium lifepo4 and have over 2.5-Kilowatt capacity. The current consumption of a single profile is very low thanks to a special designed winch with brushless motor. The battery capacity is way over a single profile usage, but since the year has winter and summer the battery capacity is there for storing energy during summer and to use it during winter. This "reservoir" solution is only possible since the lithium batteries have low self-discharge. In between profiles the system uses a minimal of power if correct communication mode is selected.
The system will send info about the batteries every time it does a profile. The file will contain power usage and charging between profiles and during profile.

In near-shore application (such as fish farms), the APB5 system can in darkest winter moths be powered from an external cable supply (optional), this is only necessary if an often profile interval is needed, more than 6-8 profiles a day, it is recommended to only use the charging cable in these months to prevent the cable for damage in the rest of the year. The cable is easy to plug in and out from the APB5 system.

Versions:

4.xxa_xxm has lithium batteries with 16.8 volt. 3 power gates for winch, 1 for ADCP
5.xxb_xxm has lithium batteries with 16.8 volt. 2 power gates for winch, 2 for ADCP.
5.xxa has lithium Lifepo4 batteries 14.4 volt. 2 power gates for winch, 2 for ADCP
m = with number in front is depth. Is not possible to change rope length without changing program
5.49(a/b)W(p)_xxm New internal webpage and new communication with batteries (max., min. avg. reading need updated batteries) a/b 14.4/16.8 Volt, W = new Web page with responsive design. p = old password.

Features:

- No Biofouling on Sensors
- Cable free profiling.
- Attached 300 kg water filled ballast for increase stabilization and prevent the APB5 for being able to flip upside down regardless of anchor fasten or not.
- Real-Time Data on Webpage, accessible on Internet (HTTP)
- Two-Way Communication
- Programmable Speed, Depth & Intermediate Stops
- LTE & Satellite (INMARSAT/Iridium)
- Profiling Depth: - Standard 75m - Ext. 150m
- Weather Station (Optional)
- Current Speed/Direction from ADCP (Optional)
- IoT, FTP, WIFI, HTTP
- 32 GByte USB backup memory storage

First time start up and land test before deployment:

Following text do not describe all in details, if anything unclear, study the manual for more information before contact manufacturer. The user should obtain good knowledge about all connected equipment/parts before preforming land-test.

1.Testing facilities:

Place the APB5 on two (2) tables/stacked pallets (approx. 1 meter over ground) or similar that make it possible to access the inside of the buoy. (Make sure that the table or other support is stable and strong.) Weight off APB5 is about 350Kg. HD 555 kg. If user decides to just flip the APB5 sideways while doing the land test, it must not be more than 45 degree, if more the APB5 will not profile.

2. Main switch:

Turn on the power button inside the buoy if not already on. Then wait 60 sec. The APB5 has a low current consumption if in run mode = off and communication mode = offline. Power button is only need to be taken off for long time storage or transport.
The system will always remember its settings, even after infinity long time without power. Toggling switch on and off will not help solving any problem. It is not possible to reset the system with toggling on and off the main switch.

3.WIFI Direct access:

60-90 seconds after main switch has been turn on, check your WIFI network from a computer or smart phone. It should appear a SSID correspond with the APB5 series number/username. If not present the APB5 might be in offline communication mode. Then use Remote.
PS! It is not a problem to trig the APB5 with remote while APB5 WIFI is on. This only set the system in service, and offline even so it stays online until nearest full hour.

4. Remote

Insert batteries in the Remote control if not already inserted. Check the time. If between 9-16 day times the APB5 will respond to remote. Hold "waking button" a ***red diode*** light turns on. Keep the pressure on the button until ***green diode*** led turns on. This can take up to 40 sec. If you not get green light try again after 2 seconds and hold another 30-50 seconds. Green led is indication of Ok answer from the APB5.Let go of the wake button once green led appears.
If you immediately press the waking button again for checking if APB5 is online it will always show red diode light and then green, because the APB5 has to answer. PS. As long as you keep pressing the wake you will restart the APB5 wakeup procedure.
A waking from remote will always set the APB5 in run mode = service and communication mode = offline, still it will go online(WIFI) for a period and that period will last until next full hour change, in example if time is 14:55 it will only be online for 5 min. In that case it has to be wakening again. To prevent a sleep you must change communication mode to online before the 5 min has past (run settings).

5. Index page.

The APB5 WIFI SSID should now be present. Log on to this WIFI network with correct password (Password should be typed in printed manual delivered with APB5). After success fully login. Open a browser like chrome or similar on you PC or Smart phone/tablet. Type ***192.168.1.2*** or in the address field/URL field and press "enter" on PC/Windows/Mac or "go"

on smart phone. On smart phones, you can also use the camera to scan this IRQ:

The APB5 internal webpage will appear. You can at this point make a bookmark named APB5 and store it on your desktop/smart phone.

6. CTD SD208:

If instrument is present inside the APB5 jump to 7.
Else fasten the Instrument. For more rope, the winch can be winched manually by remotes arrows. The system must be in mode = Service. As it is form a remote wakeup.
After mounted the protection-kit on the Instrument units, fasten the instrument with the shackle. If rope is cut or shackle must be replaced, a knot example is described later in manual. Secure the shackle with small strips. Use remote to winch it back into the buoy.

7. Land test:

Note: For newer or upgraded system 5.49- a link to "run settings" is present in index(home/root webpage), else aprun.htm or short "apr" has to be typed after 192.168.1.2/

The run settings page should be available. Land test can now be performed.
Land test should always be performed before deployment for verify that all is working.
Land test flag ON prevent the APB5 for listening for the instrument in climate zone just below surface and also perform a slow controlled drop out of the CTD SD208. If land test flag is not set while on land, APB5 will quickly drop the instrument into climate zone, be aware that this is not good for the can cause damage to the winch if done repeatedly. Also the Instrument can get damaged if hitting the floor/ground. Further the APB5 will hear the instrument and not perform a profile. It will than indicate an error by leaving the instrument in climate zone. The event log and status page will write "no water detected".
Be aware that the APB5 will send files to the top-server if an error occurs and user/you must be prepare that the system will respond a little slow while doing this. Wait about 3 min to do a new test, if you know that you did an error.
A new test can be performed, the user do not need to drag the instrument up with remote. This will be performed when user start a new profile, by correct run-settings and RUN is pressed.
Typical land test run settings:
Run mode = single run, (do not use auto since this is a single test)
Depth more than 3 meter, i.e. 6 meter (need some meter to run)
Stop is not needed,
Preform the profile NOW
Set network to "always" on for keeping WIFI on.
Time duration is only active in "windows time" leave it as it is.
And last
SET LAND TEST = ON.
Now press RUN.

The profiling sequence:

It is possible to follow the whole sequence by using debug mode. Read more in manual.

1. The instrument is being dragged up until end-stop detect instrument,
2. Then the main controller of APB5 will try to wake and calibrate the CTD via radio link, this can take some minutes.
3. When instrument is awake. All calibration and deleting of old data from last profile is performed. If something goes wrong, APB5 will start over. Therefore it sometimes can take a while. If the testing area has a lot of WIFI net and other interference sources it can make trouble for the short range radio communication. At sea this is not a problem. When finish the instrument will be set to run according to its interval.
4. After instrument communication is done, winch profiling can be performed. The instrument will first be winched to climate zone for getting a chance to get same temperature as water this will last for 30 seconds.
5. BE AWARE: When instrument is in the climate zone the user has to be ready to simulate the selected depth in meter, by holding the instrument in the lower end wait for drop and then drag it with slightly force until selected depth is reached. If weather station is present a recording of weather data will be done at this point. After this, again help it back to climate zone position, where it will rest for some seconds, the winch now get commands for lifting the instrument out of water and finaly it will be winched up to end stop.
    NOTE: do not let the APB5 drag the instrument while lying on the ground, Instrument weight less in water and speed settings is based on this, unless the APB5 is to be used in strong current, then speed settings must be set based on this (speed settings))
6. When instrument is back in resting position (docking) all data is transferred to the APB5 and can be displayed on the APB5 internal webpage. After a minute or two data files will be sent to the FTP server. The APB5 has to wait for the network routers to establish network contact. Even if in online mode, it will perform same routine as if it was offline.
7. If ADCP is present a current profile will immediately be performed after instrument profile. These data will also be sent to FTP server.
8. Now, Check that data is present at FTP. External (station.saivas.net) and internal FTP (192.168.1.1). For checking that files has arrived on FTP server, a FTP client as Filezilla/Total Commander can be used on PC or on smart phone/tabled an app called FTP client can be installed. Use same username and password typed in printed manual for FTP. Internal FTP will need to use "root" as username.
9. A graphical view of the profile can be seen at the APB5 top-server after preforming correct logging. Station.saivas.net.
10. Check the access log and look for log time corresponding with profile end time, make sure that it is has only (,1) in the end. This means that it has not got any new settings from the top-system. This is explained in the manual.

8. Finish tested and ready for deployment.

When all above steps are preformed correctly APB5 is ready for deployment. Be aware that if instrument has sensor like OX, will have protections cap and storage o-ring that needs to be removed and set in correct position.

9. Last visual check:

Always do a visual check: Look for loose cables, that the winch rope is not damaged (part of the rope that are in the pulley get the most mechanical load). Loose or damaged solar panels, that anchor shackle has iron ring between itself and the plastic. Make sure that there are no damages on the APB5 body. Also look for leakages, parts that still wet, even after the APB5 has been on land for a long time.

PS, Make sure that the lantern is working. After 16:00 place a black bag or similar over the light and wait some minutes, it should start blinking. The lantern has no power between the times 9 to 16.

System parts overview

The APB5 system contains a IoT control unit with, an Embedded Web Server, a LTE/CDMA and WIFI router with optional satellite (INMARSAT/Iridium) router, a winch, a short range radio for communication with sensor unit, solar cells and battery pack.
PS! Wind-mill is no longer in use.

Figur 1- APB5 buoy

Figur 2- Cross section view of APB5 showing CTD in OWAS position.

Figur 3 - Main parts. 1. Main controller, 2. Winch, 3. Remote, 4. Mutiparameter CTD with protection kit

Power: Solar panels and land power.

The APB5 system is powered from solar panels on the buoy body. The APB5 system can also be powered via cable connection with charger from a power source. All panels are connected to two separate terminal boxes inside, one for each battery.

Batteries:

APB5 has been delivered with 2 types off lithium batteries 14.4 volt LifePo4 and 16.8 volt NMC. The 14.4 version is delivered with new system. Main battery has 4 plugs (2,2,4,6 pin) and Slave has 2 plugs (2,4 pin).   The 2 pin plug is used for charging. Battery voltage can be measured via these pins. To make it clear, one APB5 system has either 14.4 or 16.8 volt. Each batteries has 100 Amps 13.4 x 100 = 1340 Watts x 2 = 2680 Watts total.

Figur 5- Main battery 14.4 volt

Figur 5. Slave battery 16.8 volt

Main switch:

The Power Switch is set to off when APB5 is transported or stored for long time.

The power switch (Fig 6) is located on the inside of the buoy and accessible from below.

Figur 6-Power switch box inside the buoy.

- Open the switch box with a screwdriver (4 screws)
- Turn on (=1) the black switch
- Fasten the lid back on the box with the 4 screws (not too tight)
- Tips: Total voltage level of the system can be measured her. (–) and one of the 2 black wires from the switch. If switch is "off" only one wire will show battery voltage.

End stop and knot protector:

Fasten the SD204/SD208 to the winch rope (usually prepared from factory.).
A combined end stop and knot protector is used. There are 2 knots that can be used, one is a clove hitch with a half hitch to lock it and the other is a "fireline knot". More pictures in appendix.

Figur 7- A clove hitch is used to fasten the CTD to the winch rope.
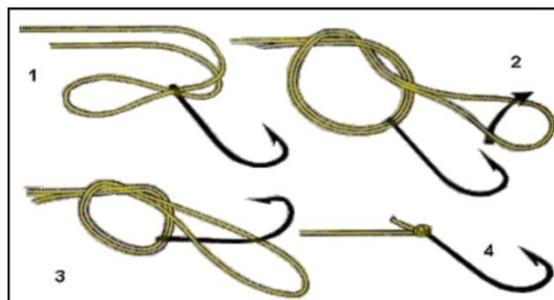
Figur 8- Alternative is a FireLine Knot.

End- stop detector:

While the end-stop is close to the instrument the end-stop detector is hanging inside the APB5 buoy body. The end-stop detector is mounted in a specific height so that the lower part of the instrument is under water. This means that the whole lower protection kit is under water. There are two benefits by this.

1. The buoyancy that is attached to the protection kit makes the instrument a bit lighter.
2. It slows down the movement of the instrument.

Reduce movement of instrument:

The instrument is hanging in the very center of the APB5. This is done by 2 pulleys. One pulley is making sure that the winch rope is in center and the other one is making sure that the instrument is hanging in the center of the APB5.

This means that the instrument is hanging straight down and do not move with the APB5's movement. In high waves the APB5 buoy body will be moved into the instrument and start movement. This means that in normal waves condition the instrument hang unaffected by the APB5 buoy body movement.
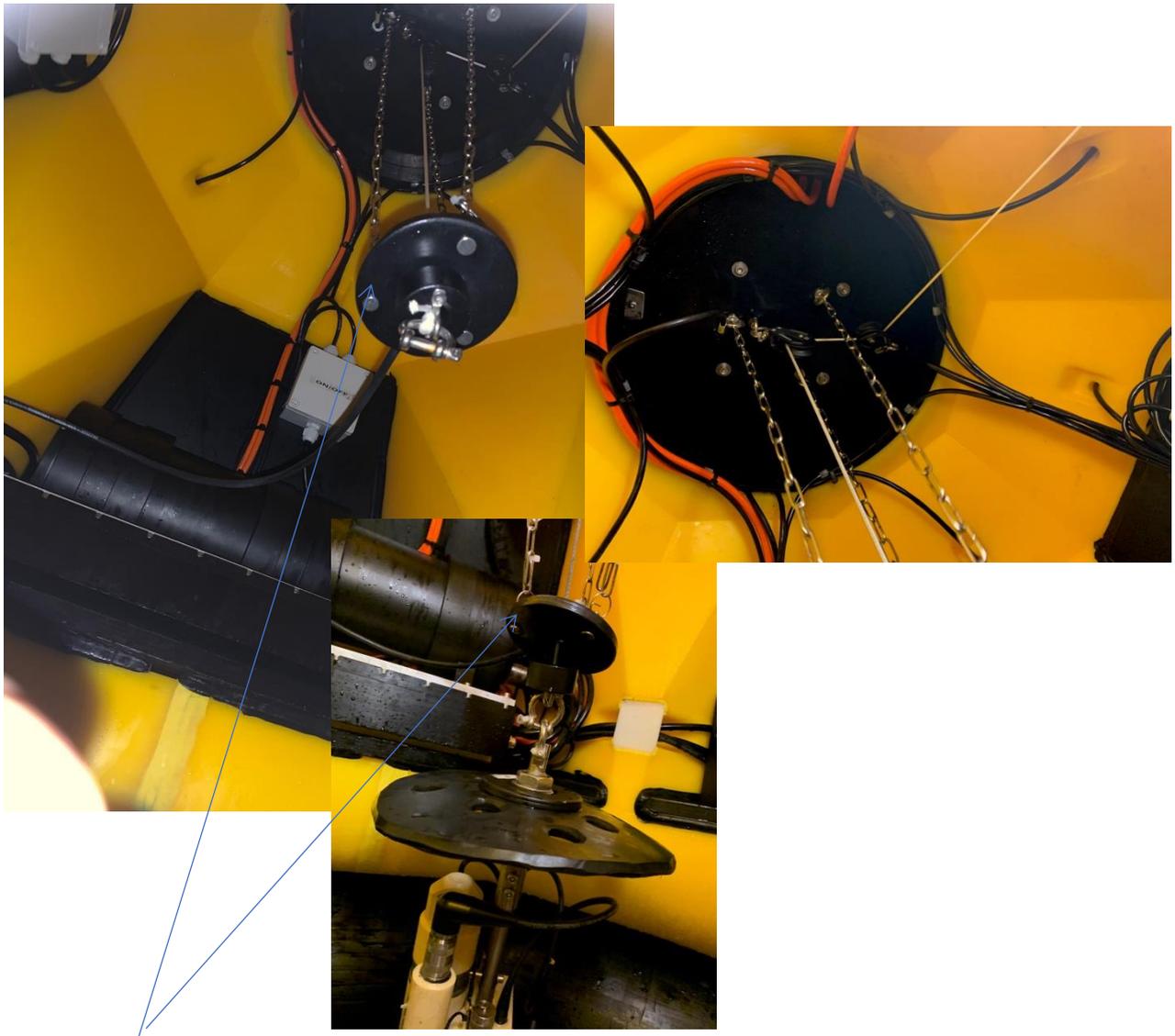
Figur 9- End stop detector.

Remote control:

The remote is used to interrupt /wake the APB5. When remote has been able to interrupt the APB5 a green led will indicate this on the remote. At this point settings like run mode and communication mode has been changed to Service and Always Offline. The APB5 will not go back in AUTO mode when remote has been used. Even if the communication mode is set by remote to offline it will make the system be online until next full hour change. Then it will go offline.

Remote:
1. Remote can be used to stop the system if in Auto, but not while preforming a profile.
2. Remote can wake/interrupt the system if in offline (9-16) in mode passive or auto.
3. Remote can wake/interrupt the system if online in mode passive or auto.
4. Remote can wake/interrupt the system if in windows time in mode passive or auto.
5. Remote can start the system if presetting's from top-system is present.
6. Remote can manually run the winch up and down.

Different versions of remote control:

Version 1 White button as wake, up = red, down = green. 2 indicators led.
Version 2.Red button as wake, up = white, down = black. 2 indicators led.
Version 3.Square button as wake, arrow for up and down, one led for indicates red- and green-led.
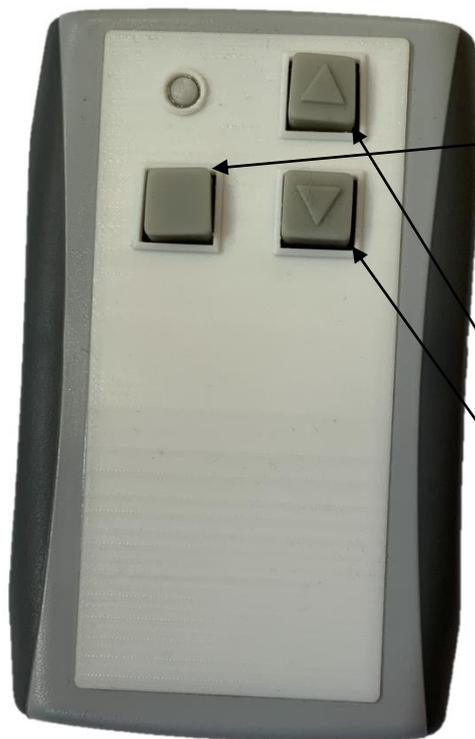
How to wake and operate the buoy from remote control:
- Press wake button for interrupt of APB5.
- The red light will turn on.
- Hold the wake button for 1 minute or until the red light goes off and the green light goes on. Repeat after 1 minute if not turn green. Note: APB5 do not respond while profiling.
- The system is now set to run mode = service and communication mode = offline, but will be online until next full hour.
- Arrows UP/DOWN can be used to winch the instrument up and down. Wait 30 Seconds for system to start.

Figur 10-Remote control version 3.

Remote properties:

Maximum distance between the buoy and the remote control is 40-50 m.
The Remote Control uses 2 pc. AA 1,5volt alkaline batteries
The version 3 remote comes with USB cable with USB mini plug for connect to remote and USB B version for connect to PC.
USB-cable serves 2 purposes:
1. The remote control can be used to connect wireless to CTD operation as transceiver.
2. Address change of remote. In case the CTD needs to be replaced.
PS! Not for charge remote control battery.

Check address in remote:

The remote control address is the same as Instrument serial number.
This address/number has to be stored in the APB5 (Radio settings) done from manufacturer.
Example using a different instrument with the APB5, the new address/instrument serial number has to be updated to the APB5.
The remote also need to have the same address/instrument serial number.
To change or check the remote address, use SD200w and use the build in radio to change address or simply rewrite the address again. The SD200w terminal program will replay with
RX:1102
TX:1102
After "OK" is pressed. In this case 1102 was the address/serial number.

Note! for connecting the remote, some computer do not have the FTDI chip driver for the USB installed (this is the same driver as for the USB converter used with the instrument.) For get latest driver go to FTDIchip.com and use menu "Drivers" and choose VCP driver (VCP = virtual Com Port). Find you corresponding OS driver in the list. (Setup executable is recommended for windows). The driver is also on the USB-pen also used as MAG-KEY.
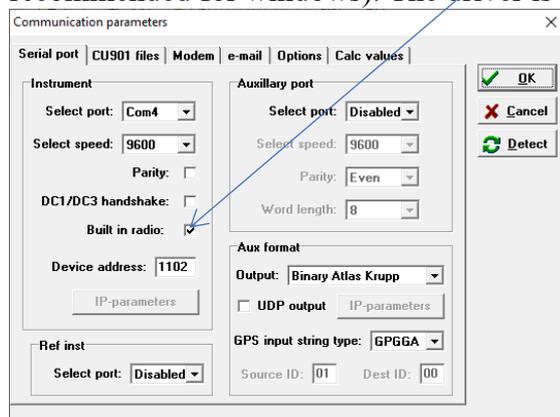
To see address again type <CTRL+R> and then <M> for view the menu of the radio.
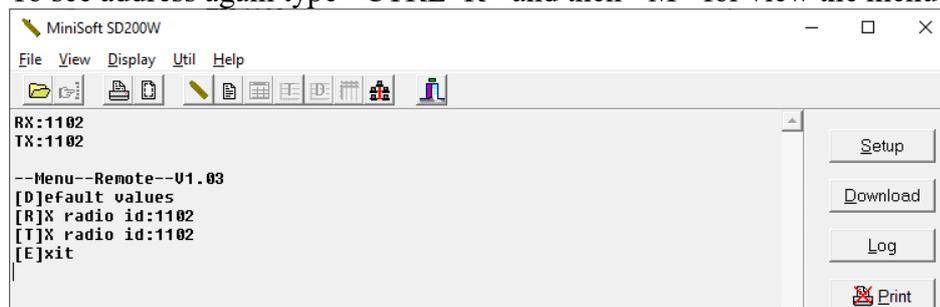
CTD SD208/SD204w:

CTD/STD must be the SAIV model SD204(W)/SD208, where (W) stands for Wireless (built in radio unit). All SD208 units and newer SD204 has built in radio. The CTD must have radio set to active and operate in APB5 mode.

In the suitcase that follows the instruments is a manual and something called Mag-key for starting and stopping the instrument. The Mag-Key is also a USB memory pen. Manuals, software and USB converter driver is stored on this.

Figur 11 Mag-key

Is it recommended that user learn to use the instrument as a standalone unit before implement it in the APB5. In this learning process, will activities like doing measurements in sea and downloading data to Minisoft-SD200w be a part of the learning. Remember to set it back to 10 seconds interval if changed.
This will give a wider understand the system for later use.

The SD204/SD208 must be mounted with a protection kit before the sensor is installed in the buoy.
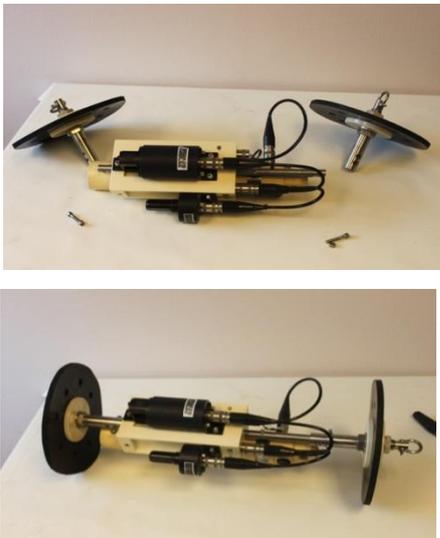
Figur 12- CTD protection kit

Cables in APB5 system.
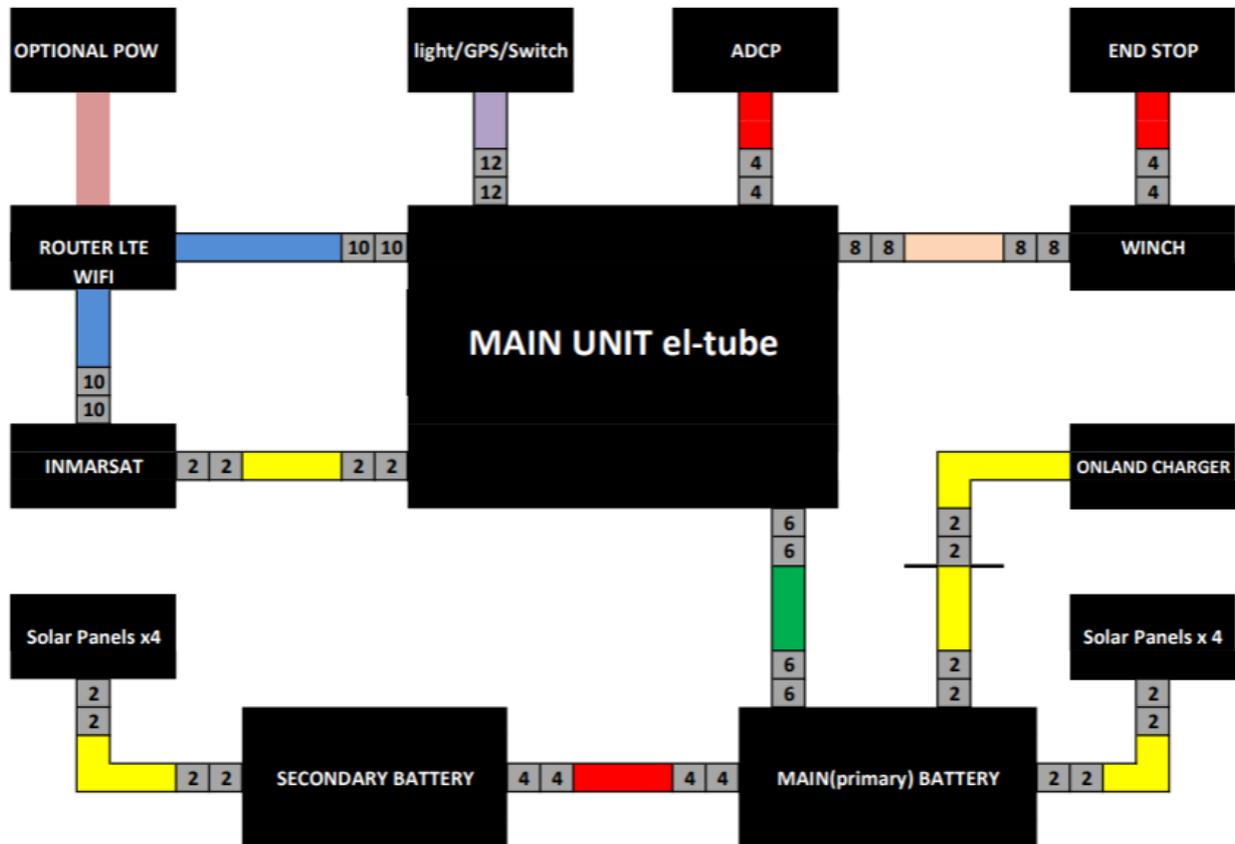
The diagram shows all units in the APB5 system and the cables between the units.
The diagram also show how many pins each plug have. The ones without numbers has only pigtail.
The plugs in the APB5 system is of type Lemo insert with titanium housing. All plugs are manufactured at SAIV.
The plugs are called CCP and BCR. Where CCP is the cable plug and the BCR is the bulkhead connector that is places in the containers /tube.

Figur 13- Main controller/Unit el-tube w/6 different pins number.

LAN, WAN & SIM-cards :

Inside of the APB5 buoy body is the LAN network, The LAN network connects to the WAN via SIM cards provided by mobile provider and satellite provides.
Note: All LAN APB5 web-pages can be accessible on WAN if SIM is activated with public dynamic or static IP. Without public IP on SIM, the Top-server is the only communication link to the APB5 system when out of WIFI range (50 meters). The APB5 can managed without public IP, but it's a great advantage when comes to maintenance of the APB5 system. Public IP is a grate benefit if user wants to have the best support from manufacturer.

LAN of the APB5 system:

Unit	Port	IP Address	Net mask	Gateway
Router/WIFI	NET1	192.168.1.1	255.255.255.0	192.168.1.1
APB5 web	NET2	**192.168.1.2**	255.255.255.0	192.168.1.1
Satellite	NET2	192.168.1.3	255.255.255.0	192.168.1.3

WAN:

The land based station called Top-server, is available as a free of charge server at SAIV office. The server has a public static IP and via DDNS it is has web address "http://station.saivas.net" All APB5 has this as their default server. The APB5 can be configured to other servers.

Network diagram APB5
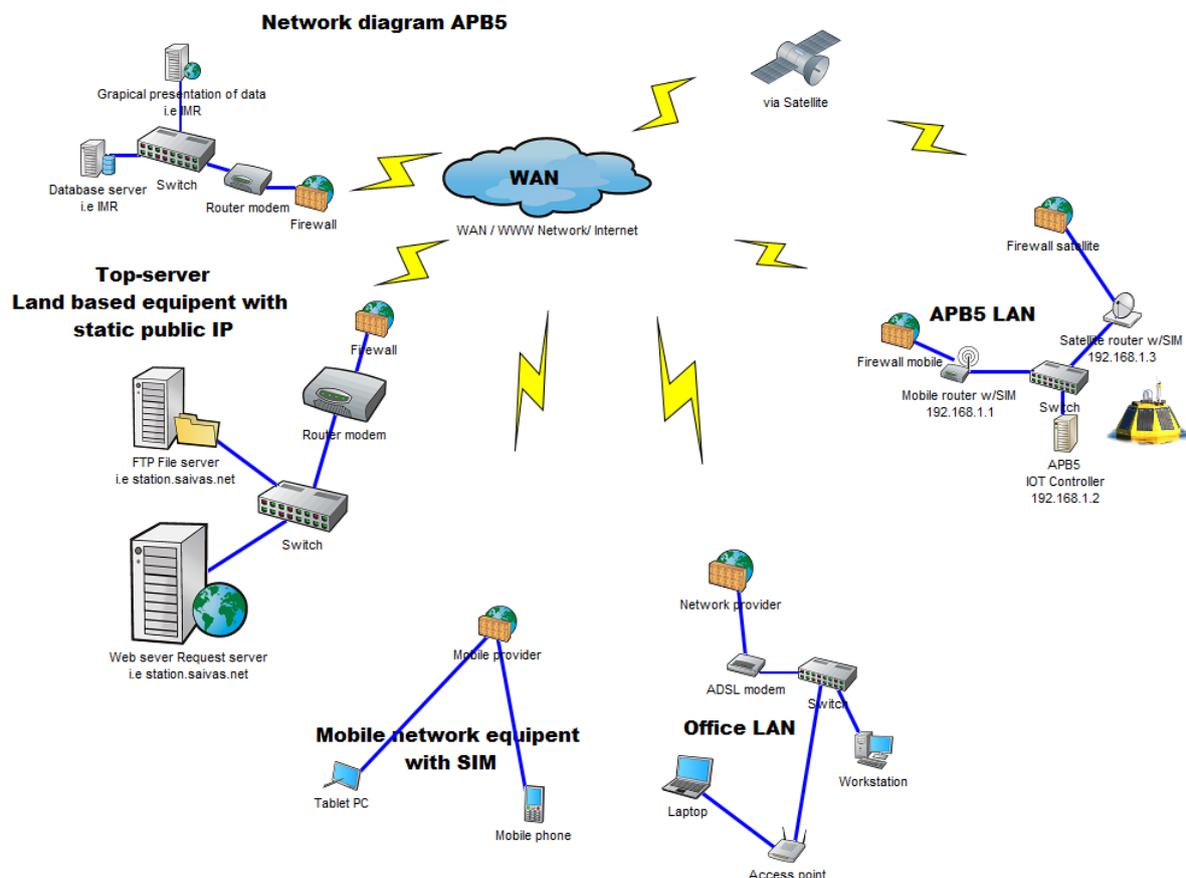
SIM card:

The APB5 system will need an active SIM for mobile to be able to connect to the WAN. User must provide this from local provider.

Optional is satellite:
In this case and active SIM for satellite is also required for joining the WAN. User must provide this from local supplier

The APB5 will only use one network router at the time. User has to select which to use before deployment. Satellite is more expensive and power consuming device. Satellite should only be selected if mobile coverage is not possible.

Antennas:

All communications units need antennas. There are 2 types of mobile routers that have been used by for the APB5 system. Both internal and external antennas are been used.
One of the communications routers is called RUT955. This one has a single dome as antenna. This includes 2 WIFI, 2 mobile and 1 GPS antenna. The antenna is placed on top of the RUT955 container and is placed on one of the top brackets of the APB5. It looks like a dome.

The white dome is a satellite antenna.

When the APB5 has LR77-V2 installed it has an external antenna next to the Light. It has also some antennas inside the container (appendix).

Light/lantern:

The light/lantern is a L.E.D lantern from Jotron, type Ml-300 white led with 25 flashes per minute. The light force/luminous intensity is 5 Candela
The lantern gets power from the system between 1600-0900. The lantern also has a light detector, the detector need about 1 minute to detect darkness.

Mooring example:

Mooring has to be done by a local authorized mooring company. The illustration under is a simplify example of mooring. The APB5 can me moored with support -buoys underwater and at surface.

With use of underwater support-buoys are a chain should be added between the support-buoy and APB5 to keep the mooring rope/chain tight. If chain is used it is best to have the chain connected directly to the APB5 shackle. This will make the APB5 even more stable since the chain weight increase when lifted above water in high waves.

Length of these chains is depended on how the APB5 floating after fasten the anchors. If support-buoys are used, these must be dragged towards the APB5 when moored. This drag force can reduce the weight of the surface chain. Be aware that if the APB5 anchors are loose, it can result in rotation of the APB5 body on top of high waves and in worst case could damage/destroy the anchor point.

Surface buoys are sometimes used if they are already at the place. This is often a case when comes to fish farms or other installations at sea. Here is it also important to have surface chains or even a load that keeps the mooring rigid/tight. Note: at least 3 points are required (than 2 of the APB5 anchor point must chare one surface buoy).

The APB5 has a ballast ring that will be filled with water when deployed. It will look a little strange while filling. Water line is where the buoy arc end and where the flat area with SAIVAS.no mark starts. After anchor is fastened it should not float much deeper than a 1-2 cm compared without anchors. About 10 kg on each anchor point for a standard APB5 and 40-50 kg for APB5-HD

Mooring Example
3 or 4-Point Anchoring System for the APB5 Automatic Profiling Buoy
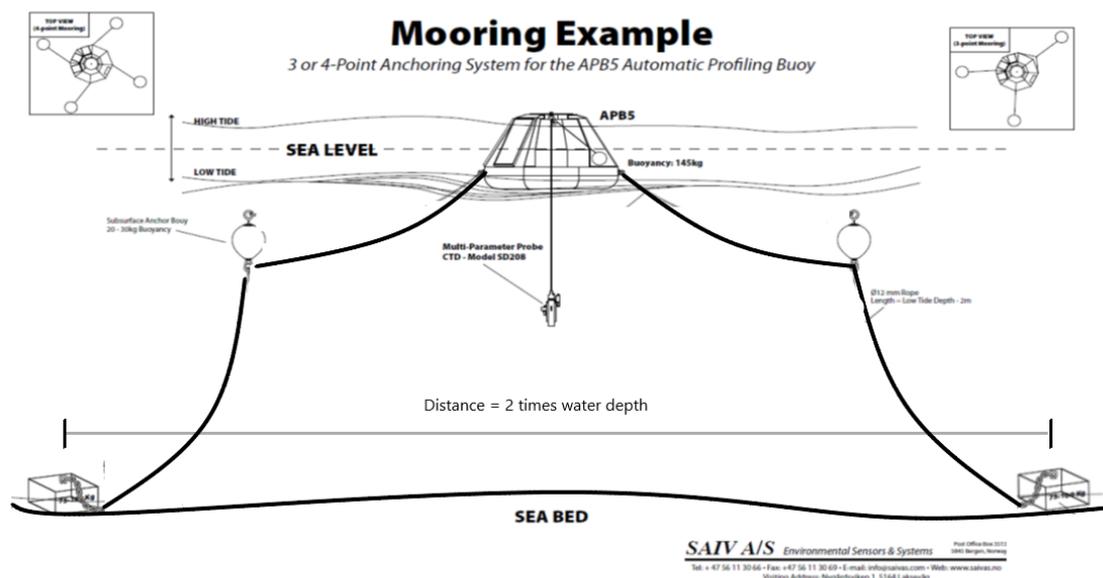
Bottom/seafloor, there should be 4 anchors with 12 mm chain connect directly and 12-14 mm rope to the APB5 or support-buoy, This is a common way to do the mooring. Anchors can be anchor rings or concrete blocks. Anchor rings can be lighter 40-70 kg. A concreate block must be heavier 100-200 kg. Weight of anchors is depended on placement of the APB5.

The chain at the bottom must be a length that correspond with tide and expected wave height. Distance between anchors is 2 times water depth. When APB5 is moored the chain should make a curve from anchor point up to the APB5. Where part of the chain rest on the seafloor. Chain length on seafloor has to correspond with tide and expected wave highs. The connection between chain and rope should always be above seafloor. This prevents damage of rope and connection point.

An APB5-HD version need at least **40-50 Kg** constant load from each anchor points on low tide too obtain stability in water. Standard APB5 will need extra under water buoys if anchors are too heavy. (Illustrated previous page) This is often the case if used on deep water. Therefore an APB5-HD is often recommended for deep water installations.

Mooring Example APB5-HD
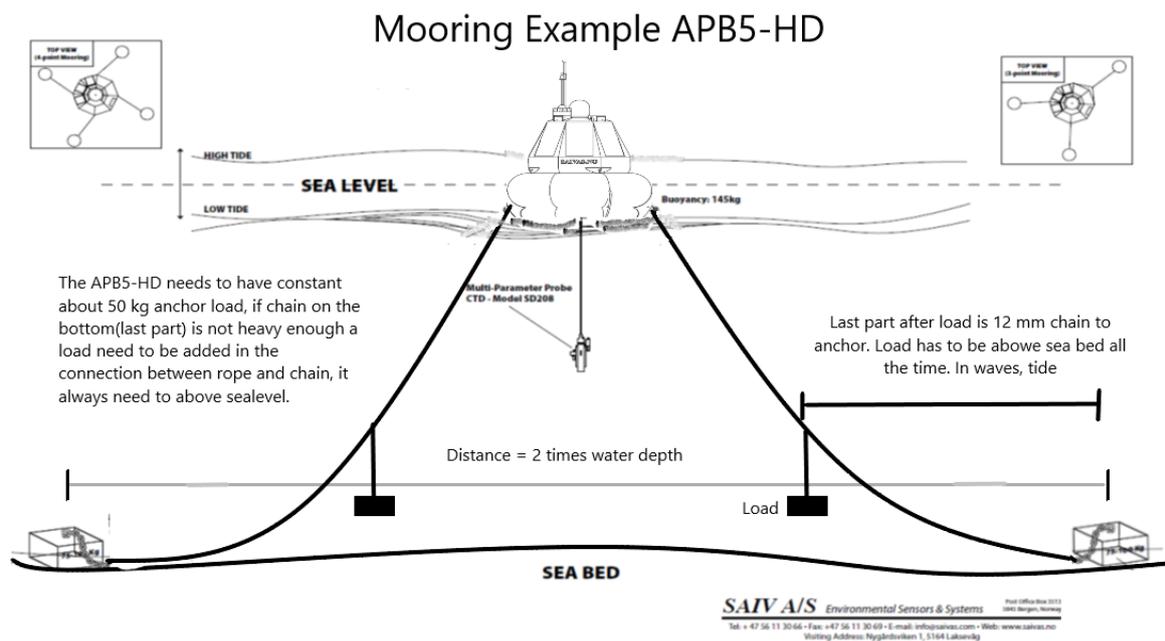
Again this mooring example is a suggestion and not a rule for all location. Therefor a local mooring company should be in charge. Things to consider: The sea floor must be checked, that it is plane. Tide, current and wave height must be in the planning.

Note: Especially with APB5 standard the biofouling growth must be monitored on APB5 body and the anchor point near surface, if heavy biofoulings the weight will drag the APB5 deeper in water. The Biofouling can cause damage to sun panels, winch and rope (sharp edges on biofouling (sea shell) can eventually cut the rope while profiling, this last part also applies to APB5-hd). The winch is **not** designed to stay permanently underwater.

The maximum wave height is a question that often appears when comes to using the APB5. There is no wave height limit for the APB5, in the end of the day it all comes to the anchoring and the planning that has been done. The APB5 is designed to go more or less under water in some seconds if that is the case, but anchoring must be able to hold it in place. Not too lose and not too tight.

Maintenance, if the APB5 is left alone for months and there have been heavy storms and waves, anchor can have been damaged from last storm and next it eventually brake. A visual check my prevent this.

The biofouling of algae and sea shells must be taken care of. Some places it is growing rapidly, only a couple of months and some places it take longer. The season is also important, it more growth in spring and summer, than autumn and winter. If the anchors are getting heavy because of sea shell it can make the APB5 float deeper and more shell can grow and eventually sun panels and winch is under water. The APB5-HD will handle a lot more algae and sea shell growth both on anchors and buoy body, but it will still need looking after when it comes to anchors.

Top- Server & Direct access:

The APB5 system can be controlled from a remote web page located on the Top-Server or direct access via the APB5 local web server on board the APB5 system. The manual will first explain the top-server and then direct access.

Top-Server accessable 24/7:

Top-server can be any computer server (NAS/Windows-Server/UNIX etc.) located in-house with cabled internet and cabled net power. The server needs to be online and available 24/7 and be connected to the internet via public static IP-address.
SAIV provide a free of charge server place for all APB5 system that is delivered from SAIV. This server (NAS) is located at SAIV office. SAIV have no responsibilities for data loss. Data can at any time be downloaded or exported from SAIV file server/database and stored at user. The user can also purchase a configured NAS server from SAIV (this server will only have request and FTP server) or setup their own server.
The Top-Server has the purpose of give the user opportunities to preset configuration when the APB5 system is offline and not connected. When the APB5-system is awakened it connects to the internet via the chosen network unit (mobile-LTE or satellite/Inmarsat) and will read these settings and operate according to them. The APB5 also use this establishes to verify that is has internet connection. If a top-server is not present the APB5 will event this as an internet connection fail.
When connection is establish an access log will note the time, date and IP number request came from. The log will record of there was done changes or not.

Change setting from Top-server.

The APB5 system always request for new settings on the top-server. Therefor the top-server must be online 24/7.
The APB5 system does this:
1. Every time it is finish with a profile.
2. At 0900 and 1500 during day if mode is passive = off.
3. If an interrupt from remote is performed.

The connection relies on an APB5 system having a working network connection via SIM card from a provider.

Access the SAIV APB5 Top-System:

In any browser type the URL:

Station.saivas.net

The Top-Server will look like this: The note: "not available" telling the user that this is the main Top-Server available for all. And the graph is from a random system.

The link "learn more" is a link to datasheets, manuals and videos.

For login on to user page: Type username/hardware no: in the field and type "View".

At this point: type username and password.
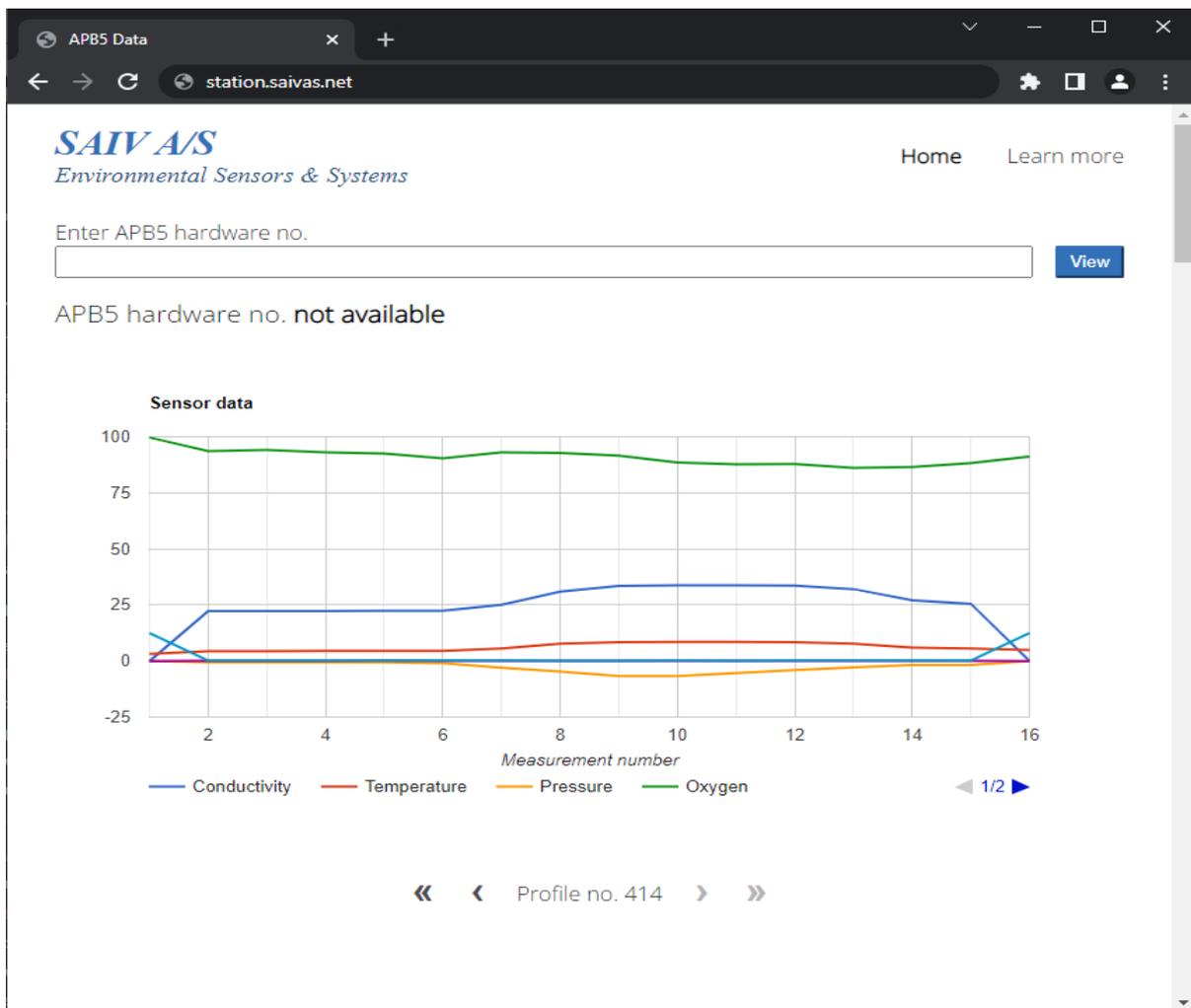
Getting familiar with SAIV APB5 Top-System server main page:

When a successfully login is preformed, the main page will look a bit different. The APB5 hardware "not available" has been changed to same as the login "username".
There is a few more links on the top right corner: «Status"," Export" and "Run settings".
The ⇐ Station.saivas.net" will return to login page.
Under the graph, which present a profile, is an option for scrolling back and forth in the profiles. The profiling number keep track.
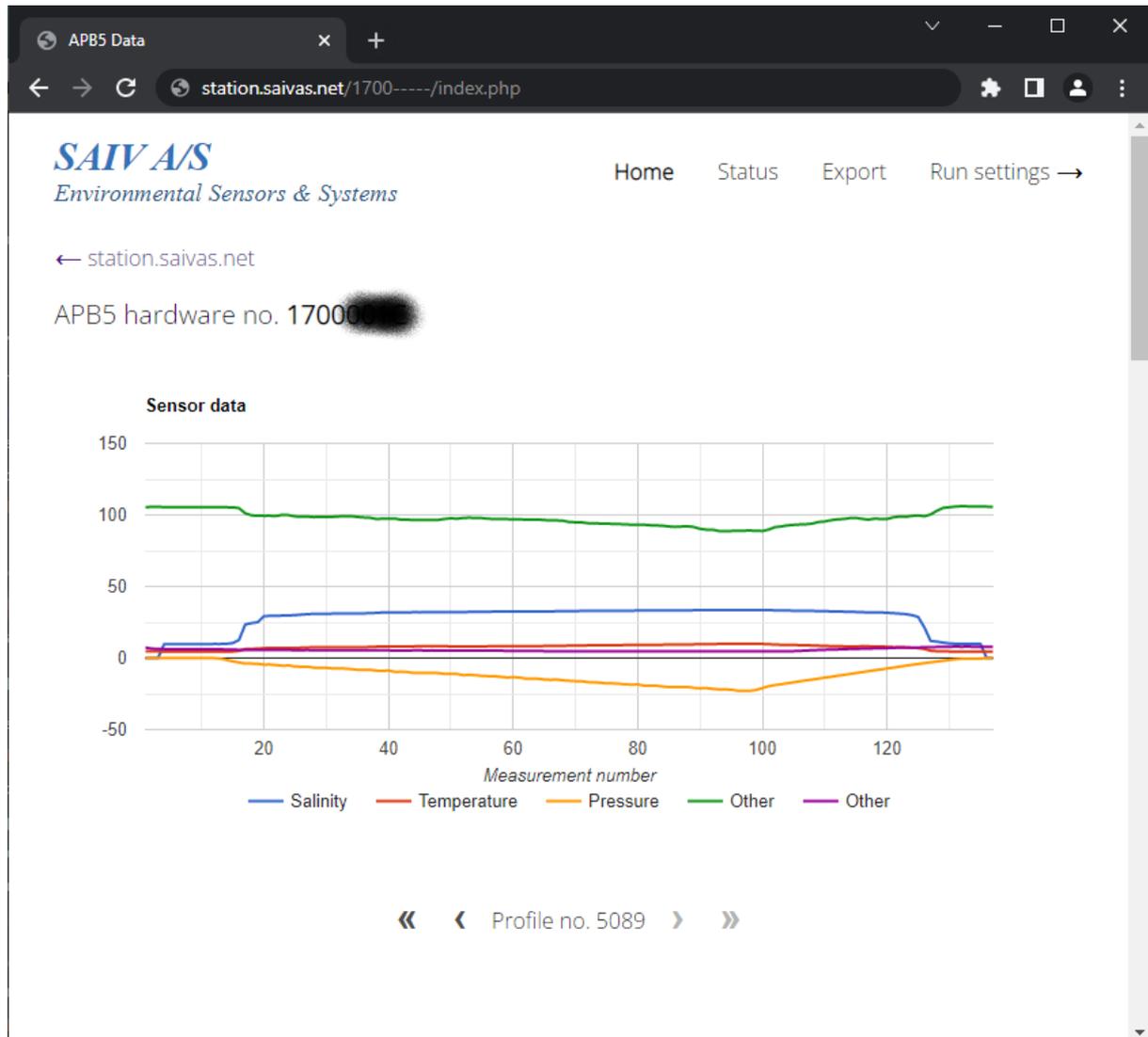
Further down on the page there is information about the profile settings, Instrument and sensors, various battery voltage and temperatures data from different units.
If optional weather station w/GPS and ADCP is active their data will also be present with values if not they will be marked N/A. (Not Applicable/Available).
Manufacturer information will be in the very end of the page.

Run settings page on Top-server:

Run settings is the where the user can set the APB5 next profile configuration. When Run is pressed a list of commands will be stored in a file, and as soon as APB5 system connects to the server it will read these settings. And preform profiles and Interval accordantly.

Why does the APB5 system need a top-server for pre-setting of commands?
When user is out of WIFI distance of the APB5-system and the APB5 system has no public IP. Or even it has public IP, but the APB5 system is in run mode = auto and network is in mode = offline/always off.
Then the only way to communicate and change settings is by preset new settings on a server (Top-server) that the APB5 system will connect to.

Press RUN from the top-system server:

When "RUN" is pressed it will return a confirmation page. On the top of the page there is a yellow mark note, telling user that the setting has not yet been read/received by the APB5 profiling system. This yellow mark will also be displayed on the main page and all other page that is connecting to the username/hardware no. User can at any time cancel the settings by click a link in the yellow mark. It will than disappear and the setting is cancel. If the yellow mark disappear without user has cancel, means that the APB5 has logged on and read the settings. This can be verified in the "status page": "recent access log entries"

In the confirmation page, settings have been presented with numbers. The numbers are explained on the page:

Run settings and what it the different setting does.

Note current settings will not be displayed when reopening the APB5 Top System. Only default values. You can always see the current settings under the profile graph or in stored profile files on the FTP server.

The configuration and run page consists of the following operation options:

Run Mode (options)***:***

Auto:	Continuous profiling according to set intervals.
Single run:	Performs one profile and then turns off. Often use with land test.
Off:	System will not run and all settings including interval does not apply.
Service:	Used for manual operation via remote control, maintenance, changing batteries in CTD or to change pulleys/rope See section on maintenance.
	Be careful: If depth is set to any value higher than 0, the system will drop the instrument to this depth, regardless if there is water or not. The instrument will then stay there until a new profile is being set or the remote is used to winch the instrument back into the APB5 buoy body.

Depth: Set the maximum depth of profiling (max 75 or 150 m depending on model).

Speed: Select between 3 profiling speeds: fast, middle or slow.
                The speed settings is configurable(speed settings page).

Stop every: Select stop intervals on the way down (there are no stops on the way up).
                If user chooses to stop the instrument every 3 meters during a profile to depth
                of 21 meters, the winch will stop on 3,6,9,12,15 and 18 meters before it reaches
                21 meter and eventually returns to docking position.

Time on stop: Time duration per stop (in seconds). Selected time will apply to
                all stops in the profile.

Initial Start time: Select the desired start time of profiling.
                "Now": will start the APB5 as soon as the APB5 system reads the settings.
                If a time and min is selected the APB5 will starts it first measurement at
                this time and minute. Then follow the interval. If the APB5 is connecting and
                reads the settings after the time and minutes has past, it will wait until next day
                too correspond with correct time and minute for start.

Interval: Selected interval time in minutes/hours between profiles. Is it important not to
                select a profiling interval that is shorter than the total time of one profile. Total
                time for one profile can be tested by running a "Single run" and the total time
                will then be available in the profile file or under the profile graph in main page.

Online start at:
                Always off: (Net= Offline) System communication mode is offline. This does

not mean that the system do not send files when finish profiling, it stills connect for some seconds for sending new files and check for new settings. This mode has lowest current consumption. And is the best option for long term use.

Always on: (Net= Online) means that the APB5 is always online. This is a power consuming option it should not be used over long period of time, unless there is external power. It will also require public IP or RMS active.
Online mode is used when maintenance is needed, often together with off and service mode and WIFI is in range.
APB5 will turn itself "Offline" if battery has less than 50% it will not return to online/always-on if battery increase again.

Window time: (i.e. 11):
For example selecting 11: the system will go online at 11 am and be online according to selected "Online duration" (hours).
This can be handy if the system has:
1. Public IP.
2. Remote management system (RMS) active in the mobile router.
 (RMS is covered by the Rut955 manual)

Online duration**:** Allows you select the time the system is online in "window time",
            i.e. 2 hours. In the APB5 profile data will this be displayed (Net 11-2).

Status page on Top-server:

The page starts with presenting the current profile settings based on last received profile information.
This page show amongst more, when the system is scheduled for new profile.

Recent events*:*
It also present the 20 latest events, these events have been extracted from the events file in event folder.

Recent access log entries:

The access log entries are when the APB5 system has done a request.
The list shows the 10 latest entries. Full list can be obtained by click on the
"current access log" = URL: station.saivas.net/username/apb5log.txt

"Read"	= 0, There are changes to be read from the APB5.
"Read"	= 1,2,3, APB5 no changes to be done.
"Set"	= 0, APB5 has got new settings and started to use them.
"IP"	= The IP address that the APB5 has been given when connected to internet, this will be different every time it is connecting to the net (internet) unless the SIM request static IP.

When there is no change (Read = 1,2,3):
```
2014/01/20 12:42:24 Europe/Oslo +0100GMT IP:46.66.182.153, Read:1
```
When there are changes SET=0, the log will look like this after APB5 has access it (Set = set:,,,,,,)
```
2014/01/24 10:01:20 Europe/Oslo +0100GMT IP:46.66.171.93,
Set:0,1,5,3,0,1,24,0,30,17,1
```
The APB5 also use access log to sync time with the server. It has options of adding GMT time to the server time. If used in different time zones.
The APB5 read the settings, by login with username and password and then preform the URL:
Station.saivas.net/username/ip.php

Explanation to set:

These are operation options presents as numbers.
```
Set:0,1,5,3,0,1,24,0,30,17,1
```

Set: pos.	Number	Explanation
1.pos:	0	**Changed!** Changes have been executed = Set:0
2.pos:	1	**Auto**, system will run continuously according to interval
	2	**Single run**, System will run 1 time.
	3	**Off**, System is requested to go passive.
	4	**Service**, System is requested to activate winch
3.pos:	0..150	**Depth** in meters
4.pos:	3	Speed **Fast**, The speed the winch will profile
	6	Speed **Middle**.
	9	Speed **Slow**
5.pos:	0..150	0 = no stops, i.e. = 3 The winch will **stop every** 3 meter.
6.pos:	0..30	Seconds the stop will last
7.pos:	24	Start profile immediately after access read is done.
	0..23	Start hour to start profile.
8.pos:	0..59	Start min to start profile, not used if start hour = 24.
9.pos:	0..1439	Interval between profiles in minutes.
10.pos	8	Online
	17	Offline
	9-16	Windows time start
11.pos	1..6	Duration of windows time.

Schedule from remote server:

The set functionally makes it possible to schedule the APB5 system from a remote system that can follow tide water diagram or other weather changes and set profiles exactly to specific hours of the day. This is a functionality that is not implemented in the SAIV's top-server, but any user with programming knowledge can make their own request server for the APB5 to link and read new settings.

Export page on Top- Server:

The export page on the Top-Server is a page where user can do database queries.
All files that are been sent to the server is fetched and stored in a database.
User gets all files in one file by simply select the start date.
The result can be displayed "preview" on the webpage or be retrieved as a CSV file with optional delimiter «Export». User can than easily import to excel or other presentation programs.
Note: Mode explains the cells.

Access APB5 internal web pages, "direct access".

Direct access is possible when user is in WIFI range or SIM has public IP.

Direct Access connects to APB5 internal/onboard webpages:

This is when user has direct contact with the APB5 systems internal web controller.
1. via WIFI network. (192.168.1.2) User needs to be less than 50 meter from the system.
2. via mobile-LTE/satellite-Inmarsat if public static/dynamic IP is active on active SIM. User can be anywhere in the world
Software for direct Access:
1. Any internet browser.
2. Minisoft-SD200w using TCP/IP connection 192.168.1.2: 10000 or public IP:10000. SD200w is a terminal based communication and it is possible communicate directly with all attached unit of APB5 system. This a good tool for making sure that all units are responding and also a tool for debugging.

Direct access is possible when:

1. The APB5 system is set to online or windows time by Top-system (require Public IP).
2. The APB5 is woken by remote.

When woken by remote the WIFI network from the APB5 will be available as SSID; the SSID will be the same as the APB5 systems hardware/Username. This SSID can be connected via any type of smart phone or PC. After connection is done use the internet browser on the connected unit and type in the URL field: "192.168.1.2" press enter or GO command (smart phones).
If public IP on SIM is available this IP can also be used for direct access, but WIFI will have better bandwidth (network speed) if user is close to the APB5.
An IRQ can make it easier to connect by smart phone.
If not already on the remote, make a copy of the IRQ and glue it the remote back side.
After connected to APB5 WIFI, use your smart phone camera and focus on the IRQ, it will then redirect you to the browser with URL: 192.168.1.2

Figure 25- IRQ: 192.168.1.2

Direct access from anywhere in the world

Public IP can be static and dynamic. Both can be linked with a dynamic name server DDNS. The difference between static and dynamic public IP is that the static is always the same compared to dynamic that changing each time the SIM is connected to internet. Dynamic IP must always work with a DDNS.
Public IP gives user the opportunity to access the APB5 internal webpage anywhere in the world if the APB5 is online. This public IP is very nice if user need help from manufacturer.

Direct access via WIFI:

This manual will from her base on WIFI access, the only difference with public IP will be the IP address. WIFI will always have 192.168.1.2 after user has connected to the APB5 WIFI networks SSID.
Assuming APB5 is online. The APB5 WIFI corresponds with its username. After accessing this WIFI net the index/home page is accessible via 192.168.1.2.

The version 5.49 and higher has link to all pages and files from index page/menu. Some older version does not have links from index page, Contact manufacturer and ask for upgrade (free of charge), Criteria for free upgrade is Public IP or user must ship the main electronic to manufacturer (shipping and 2 hour work will be billed on return). New version has always the latest changes and will be a great benefit for user and the stability of the APB system.

Links to older APB5 software version:

Here is a list how to access with older version, will not work with newer version.
1. Profile configuration and run (aprun.htm)
2. Getting the profile data (Dump.htm)
3. Set buoy (station) name and password (Config.htm)

In addition there are number of advanced configuration pages:

4. Status messages and total number of profiles (Status.htm)
5. FTP settings (Apftp.htm)
6. Time zone and DNS settings (Apdnp.htm)
7. Set profiling speeds (ApSpeed.htm)

Index/menu htm:

Contains links to all configurations pages internally in the APB5. From here on all links will be explained.

Status htm (status and):

Status contains latest info of the APB5 system. Critical status messages or events will also be stored in the event.log that is sent to top-server.
A typical status check is when a profile is being preform and user is curious of the progress. Refresh by F5 or link symbol "↻". Be aware that rapidly clicks may disturb the APB5 from working properly id in possess of profiling. Use menu link to return to index.
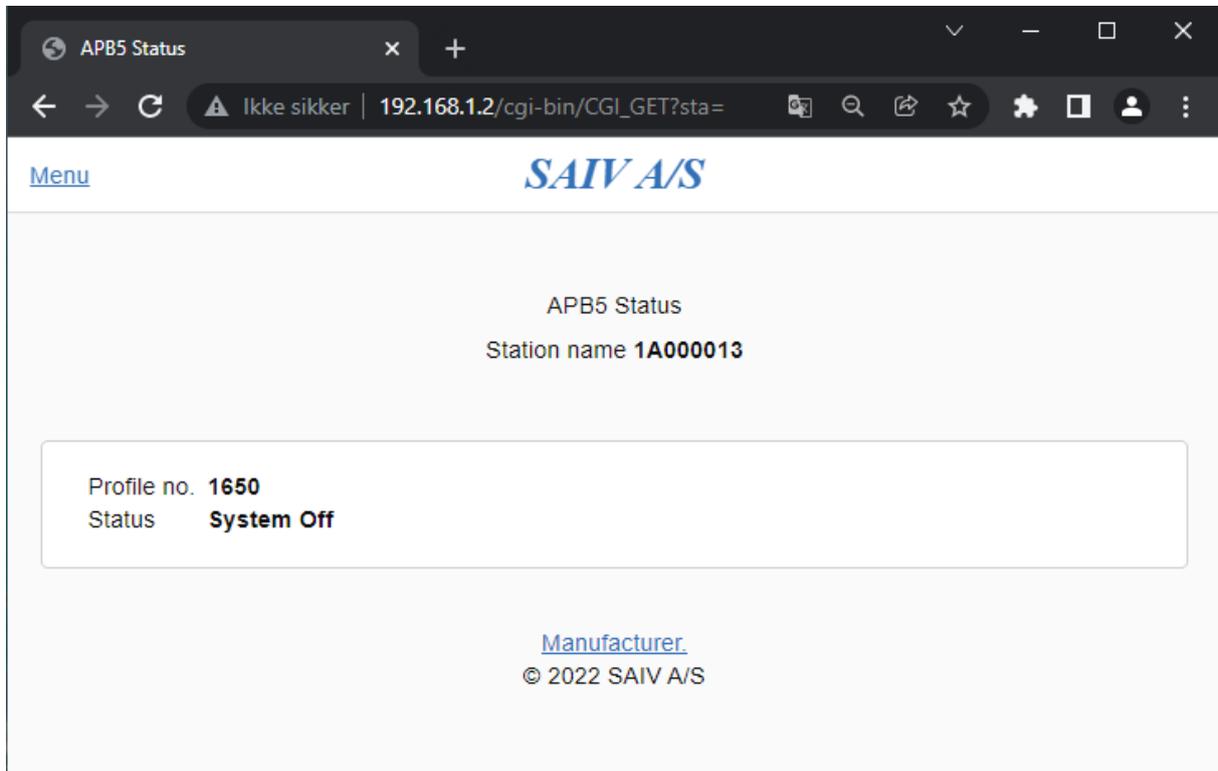
Data:

This is the page where data is being present after a finish profile is done. If system is placed in off this page will say no data and give user a link to status. The APB5 need to make a profile vi Run settings in order to get data present.
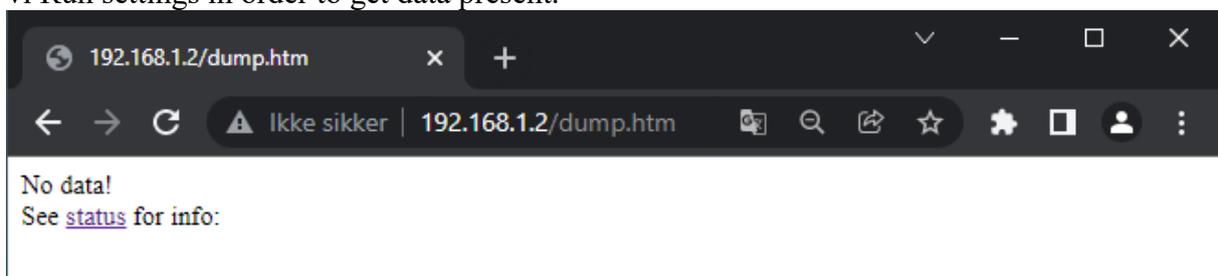
Run settings: Single-run & land-test

The command options on the internal web page run settings are the same as in the APB5 Top System above. The only difference is the "Test on land" option:

<u>Test on land</u>: If the system is to be tested while the buoy is on land this option should be set to [ON]. Normally while doing a profile the system would be under water and radio transmission would not be applicable. If this option is set to [OFF] while testing on land, the system will stop profiling and give an error message. Always prefor a land-test before deployment to insure that all parts of the APB5 system units work together.

When RUN is clicked a new webpage will confirm the settings: as shown with a single run:
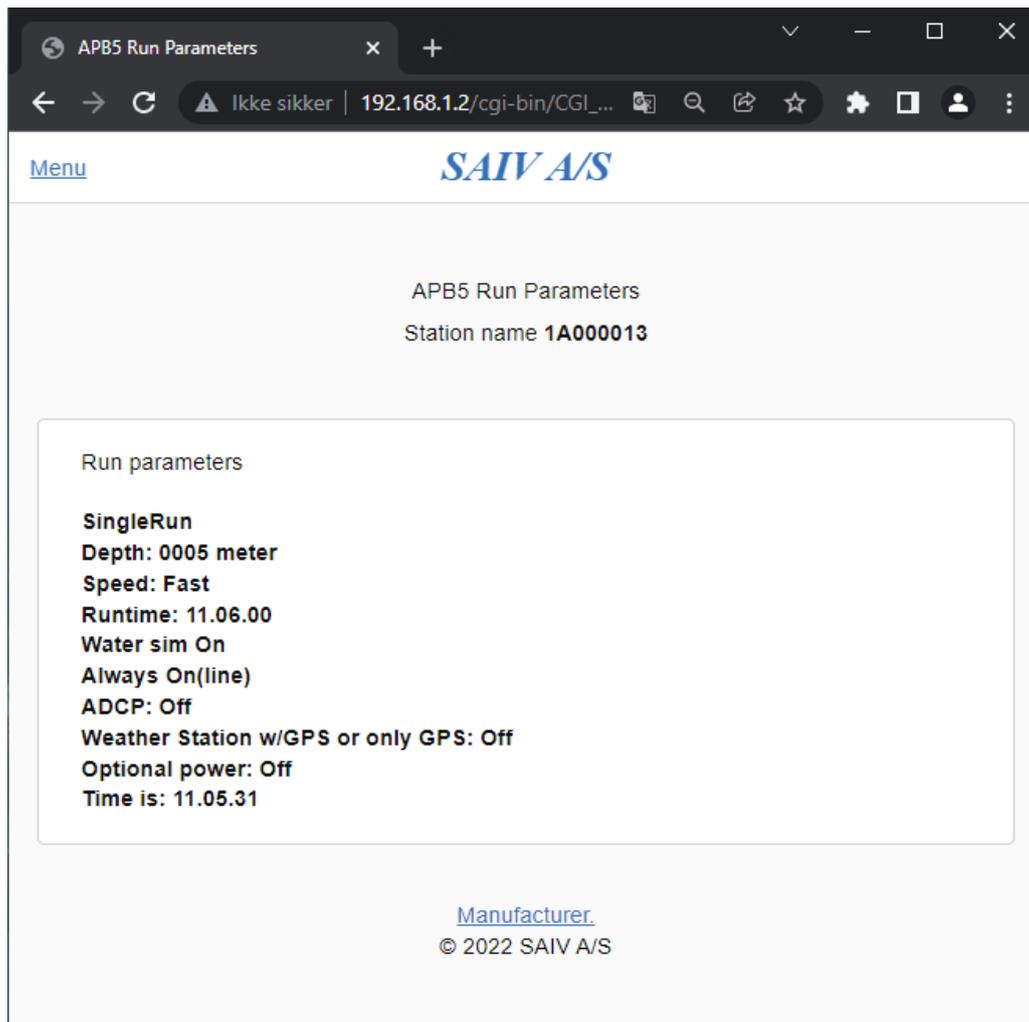
From the run parameter the water sim is on in this specific run case. This is than a land test and user must prepare to help instrument after it has rested in the climate zone for 30 seconds. This has been explained in start of this manual under "first time start up and land test" point 7.

Referring back to "Status" can at this point be used to give user some information about the future progress. The status will only give overview information about the current possess, like in possess of waking the instrument in numbers of try times and when profiling down and up. If user wants to see the whole possess. Debug on port 10001 is recommended. More about this in debug section.

Profile data after a run:

Text proceeded by a "#" gives multiple information about the system.

#Line 1:	Name:	of buoy, this can be changed on the website *config.htm*
	Network:	Online/Offline/window-time
	Profile no:	Total number of profiles the APB5 system has preform during its life.
#Line 2:	Depth:	The max depth it will profile to
	Mode:	Continuously or stop on the way down.
	Speed:	Fast, Middle & Slow
#Line 3:	Interval:	between profiles
	Start time:	When profile was started
	Finish time:	When profile was finish.
	Next:	When next profile will start or can say OFF if not in auto.
#Line 4:		Battery count in the instrument,
		Winch volt before and after profile.
		Voltage and temperature read by power card.
#Line 5:		Tilt in degree. Max registered tilt during profile.
		GPS position and weather station data, if active.

Rest of the data file is a direct dump of data from the CTD. No data treatment is performed.

Data is also sent to FTP server, internal and external if selected. Ref: FTP settings:

FTP settings*:*

Ftp: Password and User is the same login to web page. For computer logging from i.e. database system there is another user and password for this purpose. This user will have username with "_RO" (Read only) behind. Password will also be different.
This is for security reason.

The APB5 system can send data to any server around the world.
The criteria for the FTP server:
-    Public static IP.
-    Passive FTP mode.
-    Firewall: The ports 21 and high end ports must be open for the passive FTP.
-    The server must be set as to text/ASCII mode.

- The server cannot be a SFTP server (secure) if need security the communication must be done via VPN that is fully possible from the router in APB5, this is not covered in this manual. User need to setup a FTP server and make a VPN login from the APB5.
- In the root of CTD directory. Tree additional directories must be created:
    1. Batt
    2. Event
    3. Test
- The ADCP will need a ADCP directory in root together with the CTD folder

Battery file:

Battery file is a file that will give information about maximum, minimum and average current charging and discharging, battery voltage and charging voltage and temperature in the batteries. It will measure the total max, min and average battery usage between profiles and during profiles. Between profiles it samples every 10 second, during profile it samples every 2 seconds.

Event file/ event log:

The event log is a log that contains some info about the current settings of the APB5 system. This info is marked with # in front of the beginning of new line.

This information is self-explaining and can be useful if user is unsure of some settings and can easily verify this by open the event folder and take a look at last event that has come from the system. The system keep sending event logs even if in passive (0900 and 1500) and off course always with a new profile files. The only time event log is not sending is when FTP is turn off.

After the last #-line the event will be displayed. There are totally 10 events that can be created and send in one event log. The 10 event works as a FIFO system, first in list is fist out of the list. Often the event has the same info. This because there have not been any new events. The event will be sent over again until new events appear. Therefor date and time is added to the event. Make sure to read the date and time before concluding the error. The status on top-system will extract events, and present them in a 20 columns list.

The file that is being illustrated under is from a system that is in mode: "system off" therefor it will keep adding lines with current voltage level of the system. The voltage level is important information, when comes to the question if the system is ready to operate.

Test folder:

Test folder is where one test file is been sent if the user press SAVE.

External FTP:

When save is clicked a test file will be sent to /test of root folder CTD.
For accessing this folder: User will need a client FTP program or APP on smart phone.
The external FTP server is available 24/7 from any PC in the world.

FTP programs for PC:
Filezilla:
-   (https://filezilla-project.org/download.php?platform=win64) is commonly used.
Total commander 10:
-   (https://www.ghisler.com/download.htm)

Smart phone:
-   FTP client pro or Lite(can only store one connection)

Access external FTP free server at SAIV
-   Link: station.saivas.net.
-   Login: Username & password delivered separately from manufacturer or printed in manual. PS! User cannot change password on SAIV free server.

If a new test file is located in the TEST folder, the APB5 has internet access and will be able to send all files form a profile.

Local FTP :

If local FTP is selected YES a test file will be sent to a test folder in this. This local FTP has a purpose to work as a backup or if internet access is not available. Folders will contain the same as top-servers folders.
This server is only available when user is connected to APB5 systems WIFI network or the APB5 systems router SIM has public IP and the system is online or in windows time.

The local FTP is a 32 Gbyte USB pen attached to the router of the APB5.
The USB memory pen is mapped to "/mnt/sda1" and "root/usb" internally in the router.
The memory pen must contain 5 folders:
1. CTD
2. ADCP
3. Event
4. Batt
5. Test

Access local FTP server: (same program for access external is being used when connect local)
-   Link: 192.168.1.1
-   Login: Username: root & password as external FTP.

Speed settings:

Speed setting gives user option to set the initial speed for 3 types of speed that can be selected in run settings. Speed is how fast the drum is rotating. It also has to do with the force/how strong the winch can be. Up to 150 will the speed increase after 150 the winch will just get stronger. Normally there should not be of any use to change these settings. User has to keep in mind that the system has no net power and there is not a need to stress the system by profiling

fast.

For finding the correct speed, user must adjust and the make a test profile. Some sensors need more time than others, therefor is speed important, in up speed can be changed if event log often report that it have to adjust speed in up. This can be in case of high current or if the speed was too low in the first place.

Winch power source:

The winch get power source via buck booster. This buck booster will give the winch stable voltage regardless of the battery voltage. This buck has the too purpose. Give the winch higher voltage than the batteries can give and hold the voltage stable so that the speed is stable.

Out of water speed and current:

When the profile is done and the instrument has returned to the climate zone (just below the waterline) Than the APB5 system need more power to lift the instrument out of water. This is the speed and current that the APB5 than use. Again do not increase these setting just for doing so, it is better that the instrument get slow and controlled back into the APB5 buoy body than rapidly. This will save power and make the winch last longer.

Winch stuck – speed and current settings:

In normal profiling cycle the winch stuck speed and current is not used. Once the APB5 control system notice that the winch is not mowing it will increase the winch speed/force with 5, than sense again, if still not move it will repeat the 5 speed increase. It will do so every 3 seconds until it start moving or the value that is added in speed field is reached or the current is getting higher that the value that is added in the current field. On every speed adjust it will report an event to the log.

Once max speed or max current limit has been detected the winch will go the opposite way and try again, but this time with full force. If no success after 2 tries it will last add some slack on the rope and make a final event report that the winch is stuck. The system will be set to passive and then off. In this mode it will look for new command via request on the top-system at 0900 and 1500 during day time. If no change it will add its voltage to the log.
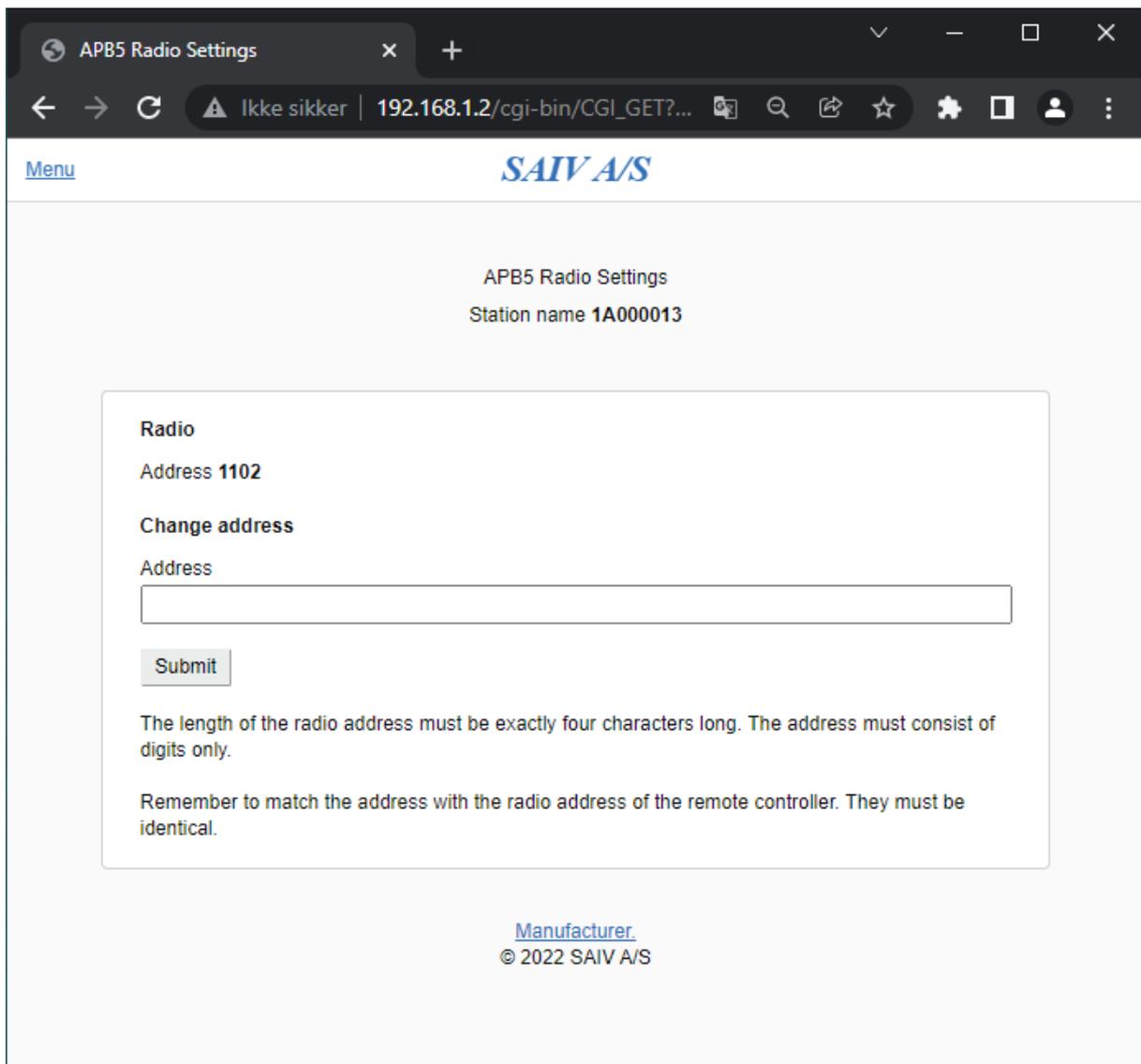
Radio settings:

Radio setting is the where address for the short range radio link between instrument and APB5 system controller is set. The current address is bolded number after Address on the page. New address can be typed in the empty field and then submit. New number will be displayed after page reload. Remember to change address of remote if address is changed. Event log will always write the current address if this should be forgotten.
The address id of the radio link is the same as the series number of the SD208/204. The S/N can be located on the titan ring on the instrument.

Station settings:

The station name can be changed her. Type in the name in the text window and click [submit]. The name will then be displayed after station name in heading.

It is possible to password protect the APB5 webpage. This has to be enable first before password can be customize. Password enabling must be done in hidden menu.
Once password is enabled the password can be changed. Type old and then new in second field and confirm with submit.
PS! There is a bug in current version. If browser is closed after login the controller must reset before being able to do a new logging. Reset can be done via debug terminal. It should be possible to use the system with this bug. The system always reset after a profile.
In most cased the password is not needed:
1. If public IP is not activated on SIM password is not need.
2. The system often runs in offline mode to save power.

Optional power settings:

It is possible to use external equipment as a raspberry PI, web-camera or similar that can use the APB5 internal WIFI and internet connection to send data.
Optional power webpage can activate and test the optional power output. Power on time will be optional from 1 – 10 minutes.
A waterproof box (type Fibox (PC 150/75 HG or PC 150/100 HG)) inner L=163mm x W=113mm x H=70mm/90mm, will be mounted inside the APB5 buoy. Inside will be a power connection that has a voltage that can variate from 11-25 volt (depended on battery level and charging). Max power out is limit by the BTS740 chip, that has short protection and overload protection.
Note:
If optional equipment has a high start current, it is also possible/advisable to add an NTC resistor of i.e., 5 ohm (6.4 Amp) in series with the optional power to prevent drop in system voltage. A drop in voltage can make the whole system to halt. If this occurs there will be registration as an uncontrolled restart in the event-log.

Request & Time sync settings, daylight savings and time zone.

Request:
Request server and login criteria are set her. It is very critical for the system to be able to contact the request server. If the system not able to contact the request server it will log this as a network error and not try to send FTP files. The request server is a web server with a server side PHP script running. The script must be placed in the login folder and be able to change a file that handle the request.

Time synchronizing:
The time synchronizing is a way of getting the top-server and the APB5 buoy be synchronized, time zone can be added to the synchronizing. User can enable and disable this option.

Summer & winter time:
It is possible to include summer time and winter time and setting the date for shifting from summer to winter and back again. Check the internet for more information. For example see http://www.timeanddate.com. Normally it is based on a week number and week day. Time zone has to be input as minutes from GMT.
Both Summer/winter and Time zone can be enabled or disabled.

Set manually: Time and Date:

Manual time and date settings can be used if user wants the system to follow a different time then the server. This option is most used for engineering, when testing an simulating the system.

The Raw time and date is a clean webpage showing APB5 system time, this is used if another system wants to synchronize its time with the APB5 system. For example a controller that is used in the optional power output box.

SD200W Direct communication

It is possible to have direct communication with all components attached to the APB5.

In order to communicate directly with the APB5 using the SD200W, use the address and port: 10000. With WIFI(Local Area Network address: 192.168.1.2)

Minisoft-SD200w is available for download at SAIV.no
The Mag-key that can start and stop the instrument also contains a USB memory pen, SD200w, manuals and drivers for the USB converter is stored on this.
The program needs only to be unpacked (zip). The unpacking is normally done by double click on the file.
If the file do not download automatically, user must check if its being blocked by the browser. The SD200w is an packed EXE file and some browser wants the user to verify that it's safe to download.

After unpacking, the SD200w can easily be installed by dragging the file in to the desktop. Than double click the file and the program should run.

Open APB5 communication in SD200W.

Start SD200W by clicking the 'instrument icon' followed by the [Setup] button to open the, Communications parameters' dialogue:
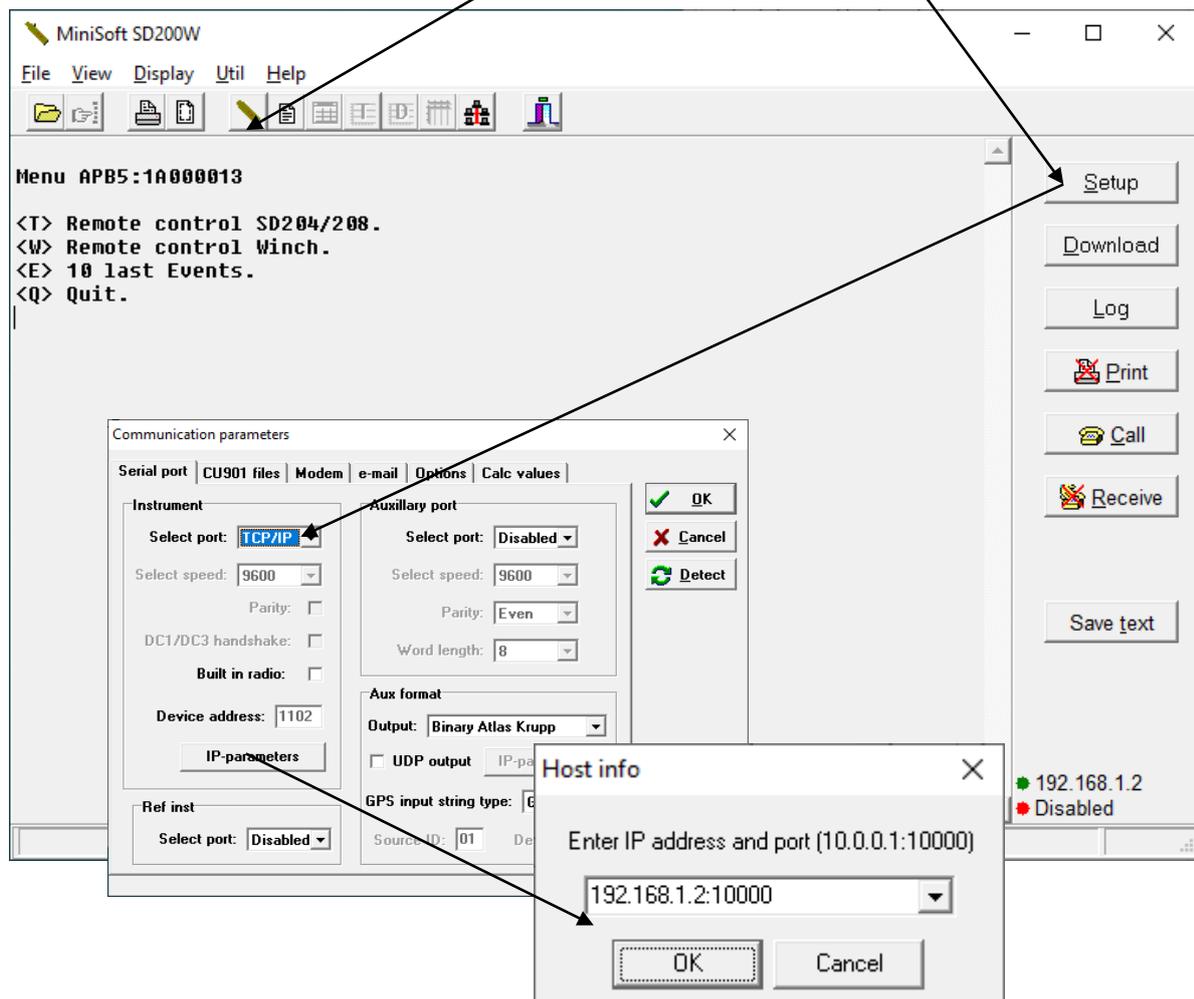
Use the menu to navigate. NB: If no selections are made APB5 will timeout after 2 minutes and close connection.

NB! In order to stop already started communication click <CTRL+T> or <Esc> to return to the start menu.

SD204/SD208 communication:

<T>: Communication with the instrument,

> NB! It can take up to 1 minute in order to wake up the radio unit inside SD204/SD208. Dots will indicate the wake up. After the instrument is awake the standard SD204/SD208 menu is shown. **See manual for SD204/SD208.**
> <ctrl+T> to end the communication with the instrument (SD204/SD208).

There are many different graphing possibilities; by right clicking the mouse one can chose the graph type that is most suitable. Ref: Graph section in the SD204/SD208 manual (chapter 5).

When connecting to the CTD (SD208/204)
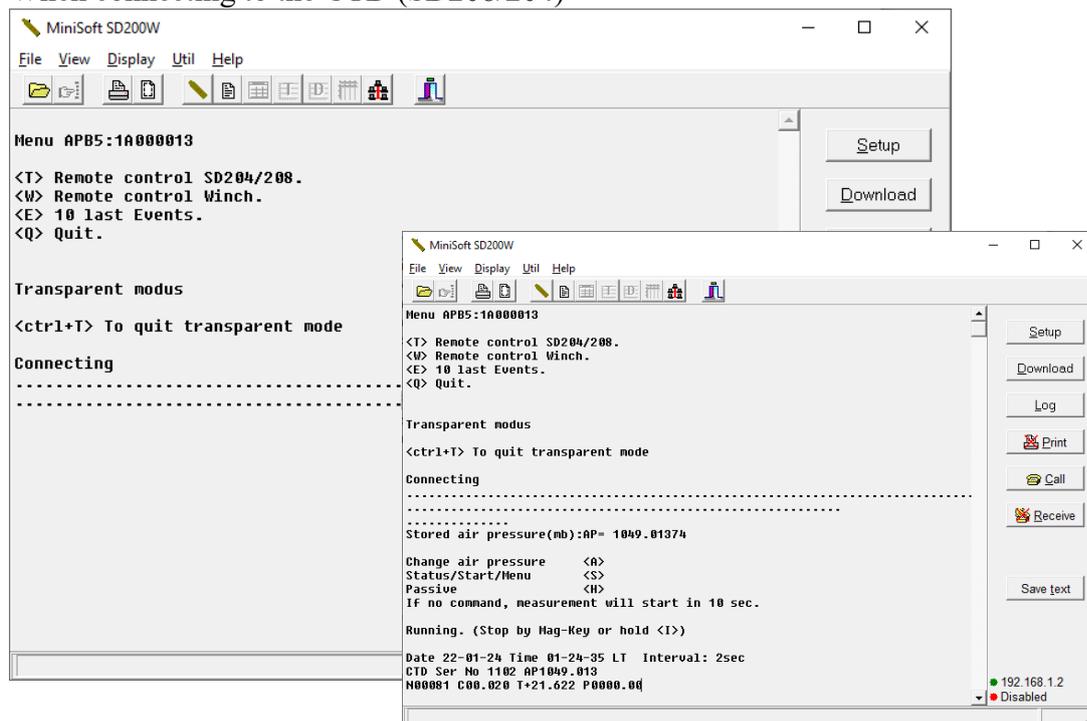
Radio unit communication:

It is possible to communicate directly with the radio unit. After clicking <T> to open the communication with the instrument, click <Q> to stop the wake up. Then you are able to click <CTRL+R> an then <M> and the radio unit menu will appear. This menu is not for use, only to show that the radio unit works during a troubleshooting process.

Winch communication:

<W>: Winch communication: menu for winch controller.

```
MiniSoft SD200W                                    —   □   ×

File  View  Display  Util  Help

Menu APB5:1700001C

<T> Remote control SD204/208.
<W> Remote control Winch.
<E> 10 last Events.
<Q> Quit.


Transparent Winch

<ctrl+T> To quit transparent mode

--MENU-- BLDC v:5.20
<U>p e.x U0100<ent>
<D>own e.x D0100<ent>
<S>tatus
<L>oBatt:21.0
<R>Vref:5000
<I>MaxI:4.50
<B>BottomLim:4400
<V>Speed:080
<F>Fall_limit:0017
<W>Store
<T>C.Status
<Z>Adj Tilt
<ESC>Reset all
```

(Buttons on right: Setup, Download, Log, Print, Call, Receive, Save text)
● 192.168.1.2
● Disabled

Winch commands:

Commands	Explanation	Result
U0000<enter>	Up	Up number is number of turn/10
D0000<enter>	Down	Down number is number of turn/10
S	Status	Printing status line. 1 time
L021<enter>	Low battery warning	Stopping winch if battery (Do not change)
R0000<enter>	Voltage calibration	(Do not change)
I450<enter>	Max current	Current protect max 900 (Do not change)
B4400<enter>	Max depth	Bottom limit
V000<enter>	Speed	Number between 004 to 255
F0017<enter>	Max fallout	Clime zone depth fallout in start(Do not change)
W	Save	Store new settings
T	Status	Continuous printing
Z	Tilt zero	Make sure that the buoy is in horizontal position
ESC	Reset	Reset of counter , running and errors

[S]tatus:
This displays the voltage, power consumption when running, temperature in winch controller, depth at current time, depth remaining, max depth, X-tilt, Y-tilt, speed and error messages.

Error:

Errxxx	Explanation	Results
000	No error	No change
001	Battery voltage under lowest level in Volt.	Stop immediately
002	Over max current in Amps	Stop immediately
004	Stuck, winch not move after a certain given time	Stop immediately
008	Rope warped. Rope is winched opposite way.	Stop immediately

Hidden menus:

Hidden menu can be reached via fist type <P> than.
<L> Menu for activate and deactivate units.
<S> Battery communication
<D> Watchdog and power control

Hidden menu<P> than <L>:
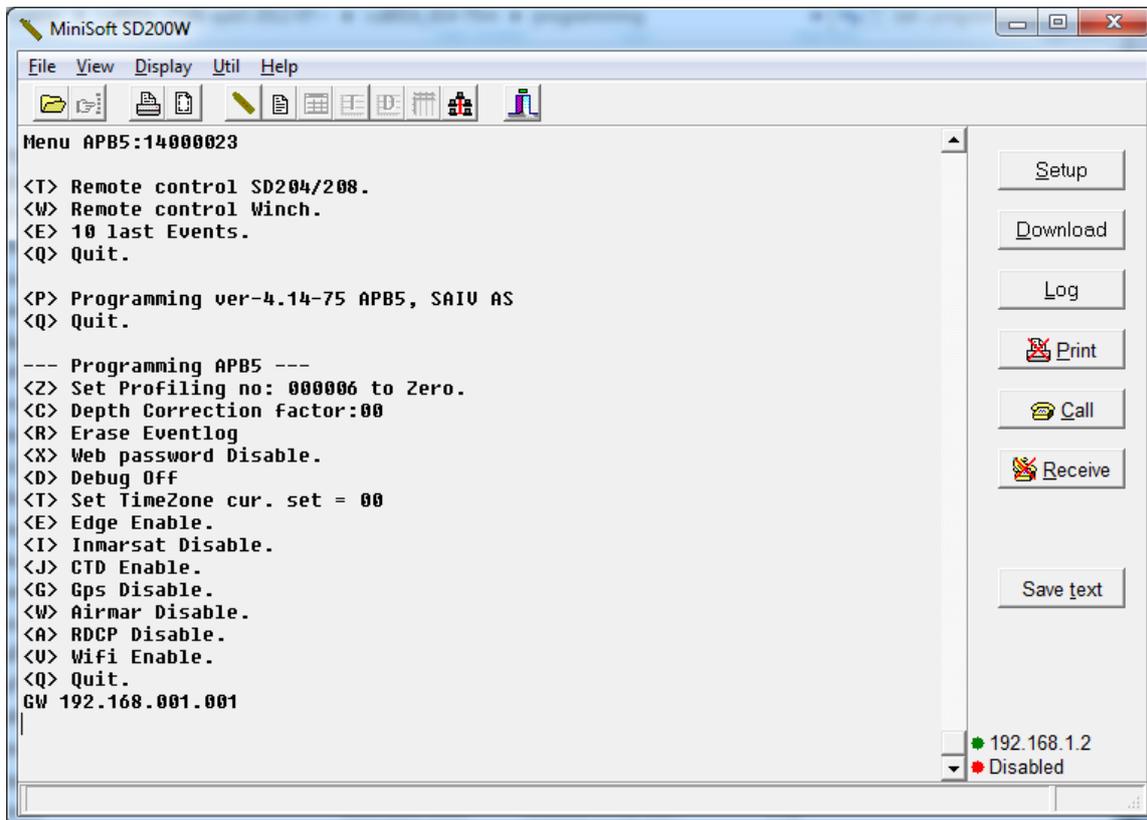
Inmarsat:

Change between mobile and Inmarsat can be done here. Not that the Gate way will be changed to 192.168.1.3
After enable Inmarsat, mobile router and WIFI are still active. The Inmarsat router webpage can be access by typing 192.168.1.3 in the URL field of any browser.
After changing the network router, the system will use this as the network connection until change is done form this menu. The event log file will tell that it uses satellite connection. Be aware that satellite uses 10 times the power of a mobile network. See appendix for more information.

Battery communication <P> than <S>:

Menu is displayed.
Any key will wake battery, system will do this by itself and present battery 1 menu.
<1 ?> Print battery 1 menu.
<2 ?> Print battery 2 menu.
Follow menu for usage.

Enable Airmar, GPS and ADCP.

After enabling other sensors in the APB5 system their menus will be displayed as a part of the main menu.

There is a build in menus for Airmar, GPS and ADCP that can be used to test the units.

ADCP:

If present its startup text will be displayed. In this screenshot ADCP is not connected.

Read more about ADCP in appendix.
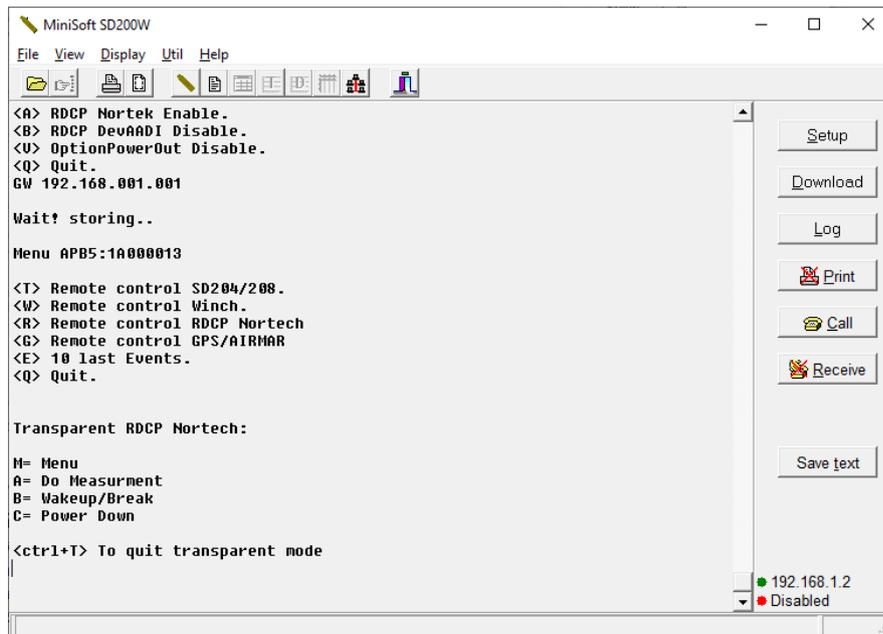
Airmar weather station:

If present its text will be displayed. In this screenshot Airmar is not connected.

Read more about Airmar in appendix.
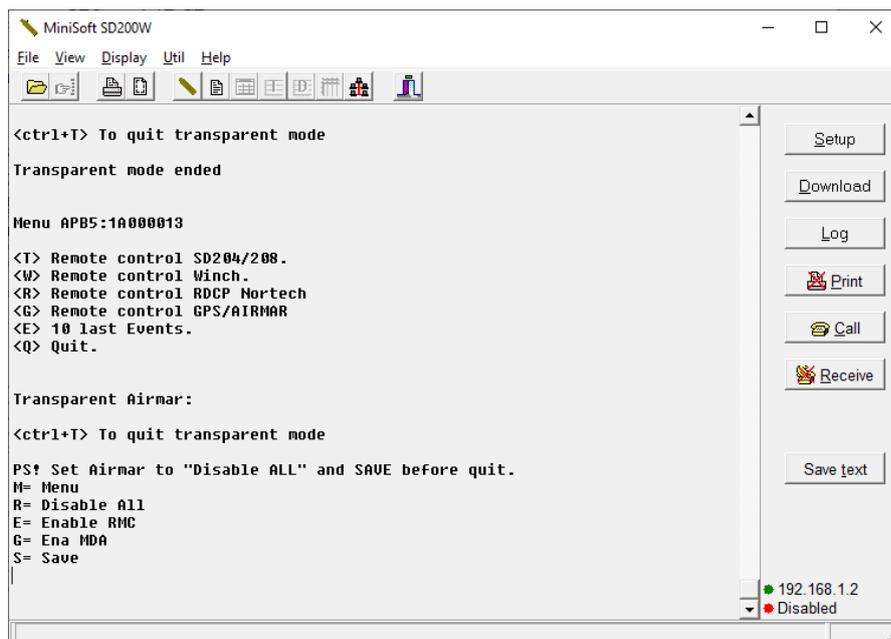
Debug:

When doing a test on land before deployment or when profile in when deployed. Is it possible to watch the ongoing process.

Make sure that WIFI connection is establish to the APB5. Open SD200w - via Instrument icon - > Setup. Select TCP/IP and type 192.168.1.1:10001. <ok>
Note: This is also possible to do remotely by Satellite and mobile if public IP is enabled on SIM.

Wait for green led in lower left corner in front of 192.168.1.2. If debug is not active no information is printed. Type <D> for activate debug mode. <D> toggles debug mode, press more than once will turn off and on debug mode.
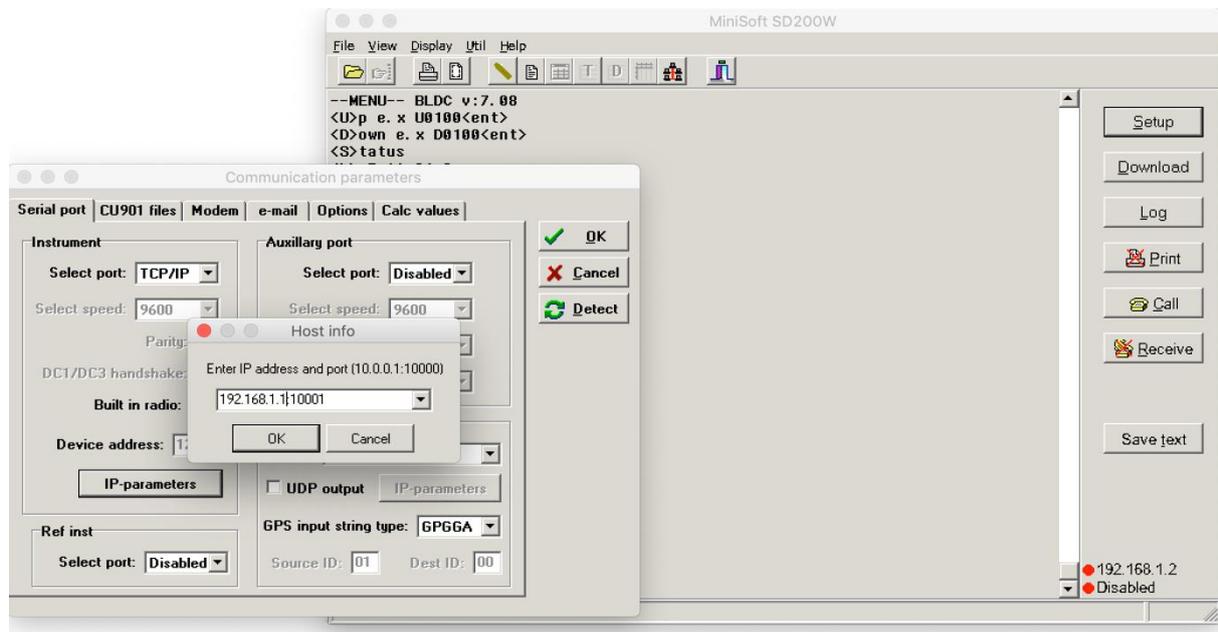
About:
Watchdog is being printed every 30 sec. There are many variable been printed there is no need to understand all this. The power variables D1-5 and P1-P6 are good to have some knowledge about. 1 = on and 0 = off.
D1 = Radio.
D2 = LTE mobile router and WIFI.
D3 = Satellite
D4 = Switch
D5 = Light only on between 1600-0900.

P1 = Adcp slow start
P2 = Winch slow start
P3 = Winch
P4 = Adcp
P5 = Weather station w/GPS or just GPS
P6 = Optional power output.

When a profile is set to run, debug mode will say profiling run:
It will first do some communication with batteries, and if weather station is selected it will be

turn on at this moment.

The controller will then send some settings to the winch and after this is OK. It will open communication with instrument via Radio.

Several <I> will be send repeatedly for up to one minutes at the time for every waking tries. The instrument only listen for <I> in 200 ms every 30 seconds. Eventually the instrument will wake and the menu of the instrument will be displayed when communication is up. Last command to instrument will be RUN.

From her on the winch communication begins. Every 3 sec winch status will be pulled. Some info will be displayed- Look at E0000 and D0000 is giving info of the winch rotation. The climate zone will be just below the waterline, the winch will not move in for 30 seconds. When climate -time as ended the profile begins. User can no observe i.e. speed settings that will correspond with selected speed Slow, middle and fast. in the winch status line after "v".

When desired depth is reached it will be print "depth reached", if weather station or GPS is enable data will be collected at this point. The last of the winch cycle will be the PARK. The instrument will be stopped by <I> and data will be dumped into the controller.

If there are more sensors like ADCP then this is next. The battery communication and collect of battery data is the last the controller do before restart. At this time all files are saved.

After restart FTP is next. First it will test network and then send files to FTP servers if enable. After all files are being sent. The profile ends and system turns of the network if in offline mode unless optional power is enabled, the system will then keep the network on until the optional power time is finish. Then the system turn of the network.

Turn of Debug with <D>. Close window.

Command: ESC = reset controller. This command will make an uncontrolled restart log in the event's FIFO log list. If user wants to stop during profile "X" can be used. User must after a reset go to run settings and give new commands. The system will try again later if changes is not made.

Warning it is possible to delete the program in this mode by typing special commands. So, typing be careful to type other chars. If you get delete Main Y/N: type N for No.

If you in some reason are able to delete the program, do not turn of the APB5 power (main switch). Leave it on and contact supplier. It possible to download new software as long as it has power and WIFI is up running.

Troubleshooting.

If something goes wrong during land test, check these points before contact manufacturer.
If hard to follow troubleshoot study manual for help before contact manufacturer.
Always check event log before digging into troubleshoot. For viewing the newest use
SD200w terminal program (TCP/IP 192.168.1.2:10000) <E>.

1. Not able to wake APB5 with remote:

1. Check that remote has correct address. (more info Remote).
2. Distance between remote and APB5 must not be longer than 30-40 meter and clear view between the APB5 and remote.
3. Check that the time is between 9-16. It might be that the APB5 has wrong time. To check this, cover the lantern light with a dark bag or similar. If not start blinking after 60-90 seconds it time is between 9-16. It also possible to measure the voltage in the main switch junction box, terminals nr 5 & 6 or (+ & -), Should be 0 volt if between 9-16.(main switch for more info)
4. Measure the system battery voltage (13.6-16 volt is fully charged), place ground probe terminal 6 = (-) and plus probe on either 7 & 8, depending of state of main switch. If switch being toggled to opposite state, voltage will move between 7 and 8. The voltage should be more or less the same in both states. If the voltage is lower than 11 volt if switch is in OFF state, battery must be charged. If charging does not help, there could be is a fault in the batteries. Try to disconnect secondary battery and check voltage. Disconnect the 2 pin plug from solar panel junction box and measure the voltage on each battery. Also measure in the 2 pin cable from solar panel junction box, should way over 12 volt, if bright day light.

2. Getting green light on remote, but no WIFI.

1. If WIFI SSID = username of the APB5 does not appears on PC or smart phones WIFI. The mobile router might be damaged. Check at least 2 smart phones or PC. Check if access log has got new record corresponding with waking time. Try to interrupt/wake the APB5 again with remote.
2. Check if winch can be manually run down and up. If still no WIFI SSID the routers most likely damaged and need to be replaced. Contact manufacturer.
3. If there are multiple WIFI net where the APB5 is being tested, there can be cross talking on same channel. Try to turn of the other WIFI net or move APB5 to different location. WIFI channel can be changed.

3. Winch is not able to lift the instrument, "screaming"

If winch struggling lifting Instrument, The winch drum might be stuck, the electronics in winch might be damaged, the battery source can be damaged. The DC/DC converter is damaged. Start by checking the event log.

1. The best way to determine the problem is to open direct communication with the winch and manual control it. Use appendix 3. This will explain how to open direct communication with winch. Use commands to free as many meter it will to hold the rope by hand. When having rope in your hand, start winching it In/UP with <U> up command and hold a little force on the rope. Look at the voltage. It should not drop more than 0.5 volt if current goes to 2.5 Amp. If drop more, like 5 volt. There is a problem with the source, DC/DC or battery.

2. Do the same tests as in 1, but this time measure the voltage in the main switch junction box Terminal 6(-) GND and 7 or 8. When having at stable battery voltage reading on the voltmeter, preform the winch up winching again. This time check if battery measure by voltmeter is dropping. If not, the batteries are fine, if yes, it is one of the batteries that are bad. Contact manufacturer.

4. The system do not start to winch the instrument

Check event log.
If event log says cannot start instrument
1. Check if batteries are ok in the instrument by swiping a magnet over start field of the Instrument. If both diodes are blinking in turns. Then the batteries need to be replaced.
2. If battery has been changed and still same problem, the battery change can have turned the radio off. Connect CTD with SD200w via pc cable make sure that the instrument has APB5 mode settings for radio.
3. It can also be the address of the radio. But this should not be the case unless the instrument has been changed. To verify address, check s/n on the instrument. Then the radio.htm for address in the APB5

5. Access log is not writing new lines when green led on remote is given (wait 3 min)

1. Check routers network status. (192.168.1.1)
2. Check password in the Request – time server page. After saving settings it should send a new access log line.

6. No data files at the external FTP server.

Check event log.
1. Look for FTP event.
2. Do manually FTP sending by simply press store on FTP settings page. At the same time check that FTP password is correct and FTP is enabled. There will be a FTPtest file in CTD folder or Test folder(on newer program version)
3. Log into router and check network status (SIM). 192.168.1.1

7. No data files at the internal FTP server.

Check event log
1. Look for FTP event (internal)
2. Check USB, by manually log in to local FTP(192.168.1.1:21) User: root, Password: (username). Open root folder and check that USB have CTD, event, batt and ADCP folders. If the USB is not present the USB might not be mounted (check start up script). The USB might be damaged. Open router box and test USB stick in a computer. If still problem, replace with similar USB 32Gbyte(any will do, if able to fit)

8. No data from ADCP

Check event log
1. Run direct communication via Sd200w terminal (192.168.1.2:10000). If ADCP is not part of the menu, then it is not active. Use hidden menu to change.
2. In direct communication, press menu for ADCP and after some seconds the ADCP should display its type and version number. If only menu showing. It can be no power.
3. Power problems. Use voltmeter to measure voltage pins on cable (use direct communication via SD200w for activate power out by pressing menu for ADCP.
4. If no power, it can be bad DC/DC converter in the main system el-tube.
5. If power ok, the ADCP can be damaged, Use ADCP ACUA pro and separate cable and power supply to check ADCP.
6. If no problem using AQUA pro to communicate with ADCP. Then there is something wrong with cable or communication in the main system el-tube.

9. No data from Weather station

Check event log
1. Run direct communication via Sd200w terminal (192.168.1.2:10000). If weather station is not part of the menu, then it is not active. Use hidden menu to change.
2. In direct communication, press menu for weather station and after some seconds the weather station should display its type and version number.
3. If only AIRMAR startup showing, the data output is disable, Enable both options via menu and save. Do not disable. Just quit when its running.
4. If only menu showing. It can be no power.
5. Power problems. Use voltmeter to measure voltage terminals (1 & 2) in main power switch junction box. (Use direct communication via SD200w for activates power out by pressing menu for weather station.
6. If no power, it can be error in the main system el-tube or the cable.
7. If power ok, the weather station can be damaged. Contact manufacturer.

10. Event log telling that the winch is stuck.

Open direct communication using the SD200w and open connection via IP 192.168.1.2 port 10000. Select communication with winch. By use of winch command winch the instrument up and down. Press <T> to give continuous status messages to the screen.
1. Voltage level:
   Look at the voltage level, should not drop more than 1-1.5 volt if current get about 3 Amp. If drop 5 volt the battery or buck booster can be damaged.
2. Error:
If error has different number than 000, check this with winch communication.
3. Stuck:
If there is reason to think that the winch is stuck. Try to fish with the winch commands. Up and down.

Maintenance and warranty

Maintenance

The APB5-system should work for 1 year continuously without any need for maintenance or battery replacement in the CTD. However, to achieve this, the following criteria must be observed:

Profiling intervals should not run too frequently and not too deep. The measuring interval of the instrument should not be too short, because this will limit the lifetime of the batteries in the SD204/SD208. With 2 hours interval, profiling depth of 40 meter and 10 seconds time interval, the lifetime of the battery in the SD204/SD208 should last for 12 months.

If there has been a storm, strong winds and/or violent sea the system needs to be checked to ensure that everything is working normal (instrument, anchoring points, ropes and pulleys i.e.) For this type of maintenance inspection, use service mode and the remote control.

After 1 year, anchor points, ropes and pulleys should always be inspected. Batteries should be replaced in the SD204/SD208. For normal use and warranty issue, the buoy needs to be kept clean from algae growth.

Biofouling/algae growth, heavy growth of algae can cause the buoy to sink deeper into the water (under normal waterline). The buoy then needs to be cleaned more often, some area in the world in growth season every 2-3 months.
Antibiofouling paint might be used to prevent this, but only local studies can give correct answer to this algae growth issue.

Warranty:

The APB5 system has (1) one year warranty or 5000 profiles for 75 meter version (selected depth in profiles not relevant for the 5000 profiles) 150 meter version has warranty limit of 3000 profiles.

Appendix:

CTD multisensor Suitcase:

The CTD-SD208 will always be delivered with the APB5 system in a suitcase,
Containing:
1. Manual for the SD208
2. Calibration sheet.
3. Rs232 PC cable for connecting the SD208 to the computer.
4. USB to rs232 converter.
5. A Mag-key for start and stop instrument.
6. A USB memory pen, as a part of the Mag-Key. Contains software and manuals
7. The remote for the APB5
8. Some O-rings.
9. Fluid and membranes for OX sensor (if present). Use the protect cap with moist sponge to keep the membrane moisture.
10. Always use the suitcase when shipped to SAIV for calibration. We recommend calibration after 1 year.

External net power:

The APB5 is ready for net power. If more than 6-8 profiles to 45 meter, during months that have less sun (i.e. Norway Des. and Jan.) Note: The APB5 will skip to profile if voltage is to low and try again when voltage is higher.
The external connector is mounted on one of the top brackets. The input must not be more than 15 VDC.
The Cap has a dummy plug on the opposite side storage when net power is inserted.
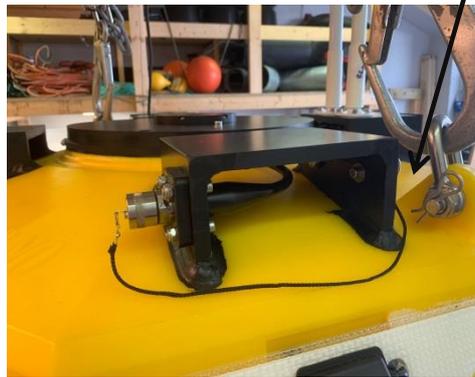
For using this, user has to order an X meter cable and a power supply. The power supply is in a water proof container with 2 plugs. The cable must have stretch relief and a security wire.

1. For connection to the APB5 15 VDC.
2. For connection to net power.(220/120 VAC)

The cable must also have float devices to ensure that the cable stays floating, a cable that sinks can easily be stuck in the bottom/anchor or other underwater units. Do not use the cable more than necessary in Norway middle December to end of January.

14.4 lifepo4 battery discharge diagram:

A lithium lifePo4 14.4 battery has a discharge table has shown under:

Voltage	Capacity
14.4V	100%
13.6V	100%
13.4V	99%
13.3V	90%
13.2V	70%
13.1V	40%
13.0V	30%
12.9V	20%
12.8V	17%
12.5V	14%
12.0V	9%
10.0V	0%

Pictures of making shackle knot:

Fireline knot! Remember to thread the end-stop on the rope before start.

1. Make a normal knot, thread the loop over the shakle.
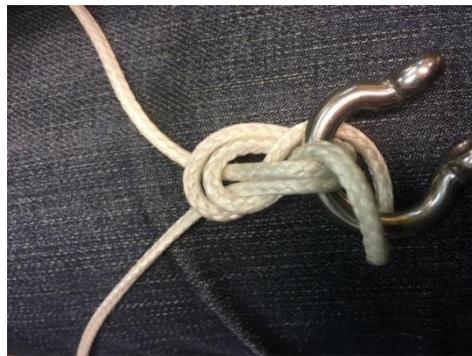
2. Then tighten in, do this in step, a lite water on the rope help.

3. Finish.

4. Three both rope ends through the end-stop. Then cut.
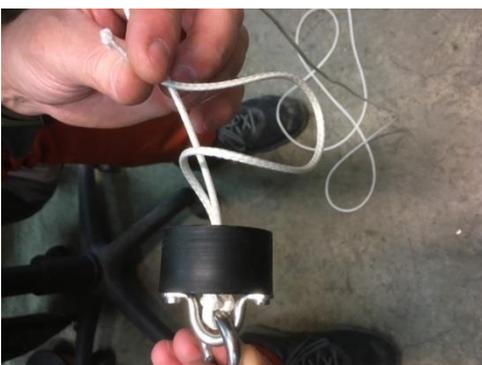
Physical change of SIM card in LR77-v2

For changing SIM card LR77-v2 first open gray box to the left of the on/off box.

Use a small screwdriver/or 2mm pin to press on the small eject button next to the SIM slot
Insert the new SIM.
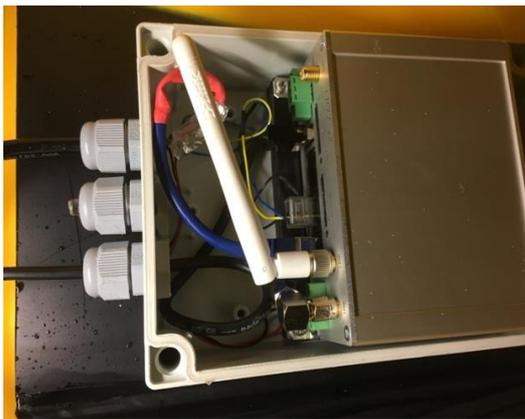
Most SIM will get there APN access point name from the mobile provider.
If special APN need to be used user must login to the LR77-v2 webpage.

Script settings:

The script will need 2 mount lines, for the USB memory pen. This is for FTP backup.
The mnt/sda1 is the where the controller writes files, the root/usb is for user.
mount /dev/sda1 /root/usb
mount /dev/sda1 /mnt/sda1

Change the APN

To access LR77-v2 is best done by WIFI. After activate APB5 and connected to APB5 WIFI network. Use address 192.168.1.1 in address line of a browser.
Username: root
Password: Same password for as for WIFI or top-system.
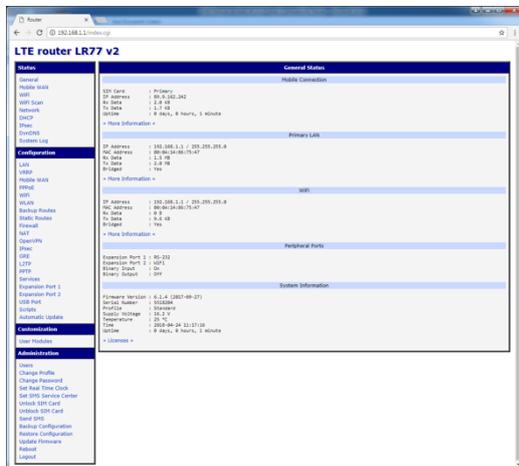
Click "Mobile Wan" link under configuration menu: APN and pin code can be added an changed here.
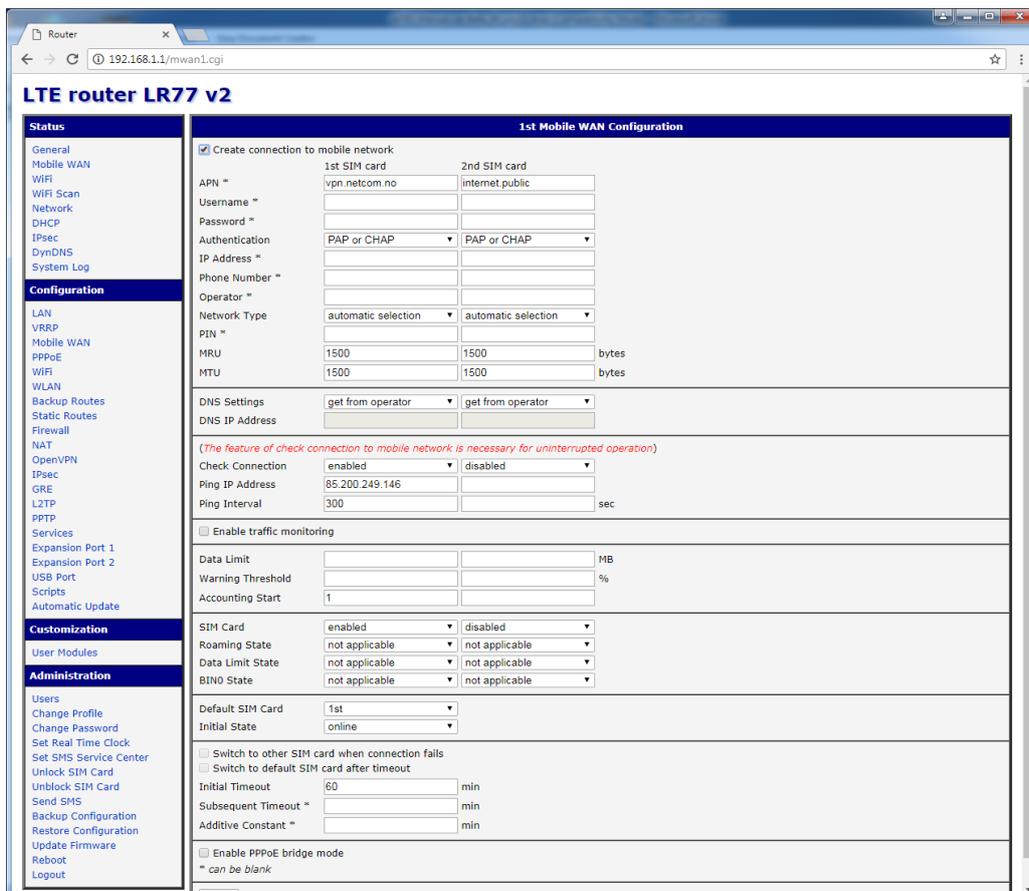
Change APN: Access point name to the name your SIM provider use, 1 st sim is default.

Physical change of SIM card in RUT955

The RUT955 is placed on top of the APB5. The container need to be open by unscrew 14, 4 mm umbraco screws. User can use a screw machine to unscrew, but do not tighten the screws with the machine in case of damage the treads (plastic treads). Be careful with the treads.

Use a 2 mm pin (like a drill or similar) to press the SIM eject button so that the SIM slot slide-out. Then change the SIM.

If the SIM has pin code, it is smart to unlock this before use it in the router. For adding APN or PIN code! Login to the routers web page and do the settings first. Do this by waking the APB5. After WIFI is access set it to online and OFF from the 192.168.1.2. Then login to the router page from 192.168.1.1.

User: Admin
Password : Same as WIFI password.
Use the RUT955 manual for further assistant.

RUT955 SIM Card - Teltonika Networks Wiki (teltonika-networks.com)

Login page RUT955.
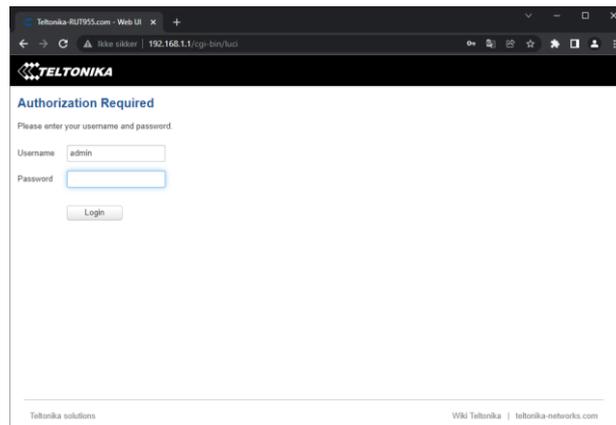
Script setting:

The script will need 1 mount line, for the USB memory pen. This is for FTP backup.'
The script settings is located under menu "system" – "User scripts"
The USB directory must be created in the root folder.
The Rut955 automatically make an sda1 folder in the "mnt/sda1" directory. Therefor is it not needed on this router. The mnt/sda1 is the folder that the controller use, the root/usb is for the user.
mount /mnt/sda1 /root/usb

Chang the APN:
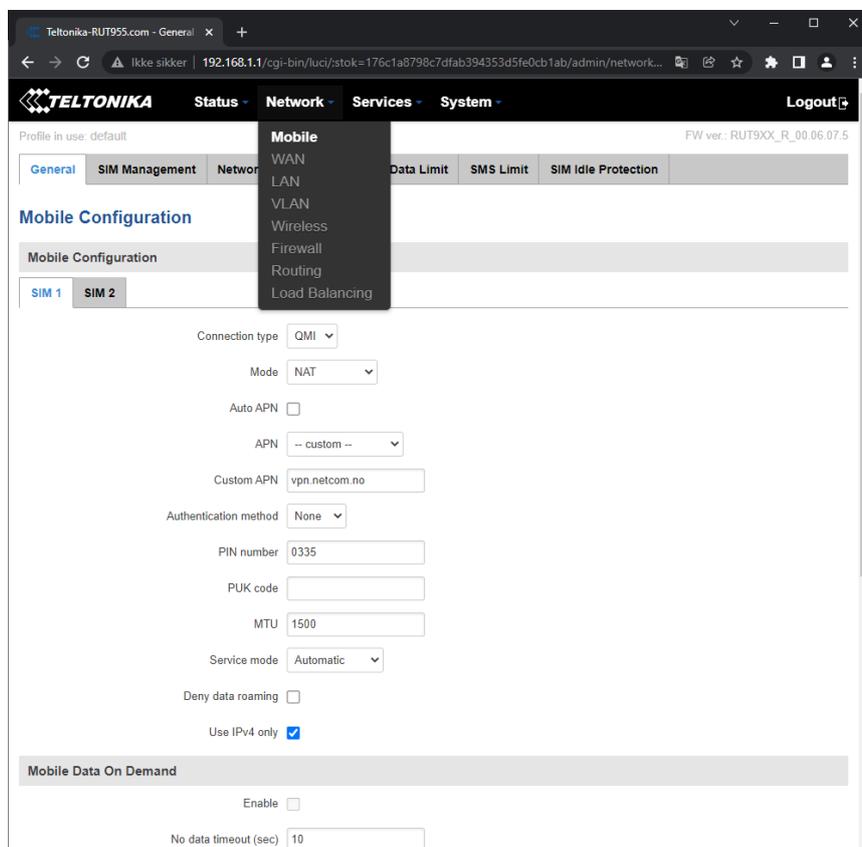
Inmarsat satellite communication:

SAIV is using Marlink as provider for the Inmarsat SIM cards, prices and can variate from when the manual was re-written in 2022.
The Inmarsat router is a Sailor FBB 250 from Cobham.
This is a device for connecting to WAN (Internet) via satellite. The Inmarsat consist of 11 geostationary satellites covering most of the globe. The Inmarsat is the most reliable satellite communication system in the world. Some use the system as a backup system to other satellite system since it very expensive in use, about 300 USD a mount for 25 Mbytes, but the reliability makes up for that. The APB5 system needs a reliable communication system and the messages are normally not any bigger than 5-10Kbytes. The benefit of using geostationary satellites is that is easy to maintain the communication and therefore public static IP can easily be used. Most of the time the APB5 system manages without public static IP, but the option is available if needed.

The Inmarsat system consists of an antenna and a router. More reading and manuals can be obtained via: Hard copy of manuals is sometime stored in the ADCP case.
https://sync.cobham.com/satcom/products/maritime/satcom/l-band-inmarsat/sailor-250-fleetbroadband/c-24/c-114/p-218

The router is placed in a water proof container inside the APB5 buoy body just beneath the main controller tube. For changing the SIM the main controller must be removed and the Inmarsat container must be taken out and open.
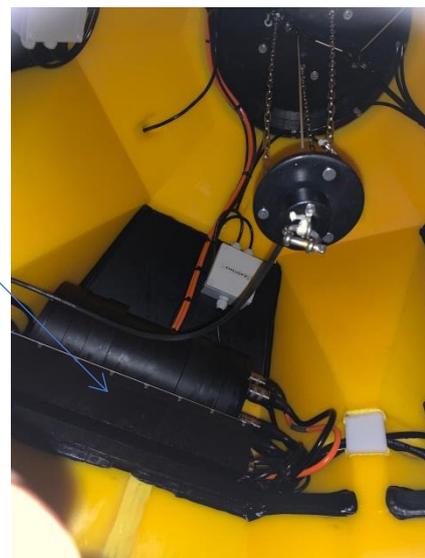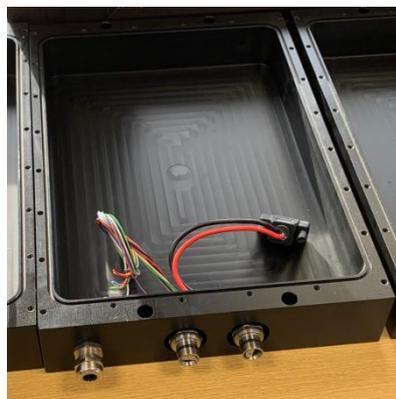
Access the Inmarsat routers web page:

After waking and connecting to the APB5 WIFI network the Inmarsat web pages can be accessed via IP: 192.168.1.3.

If not already activated!
The Inmarsat must first be selected as main communication unit (Inmarsat enabled) in hidden menu.
User: Admin
Password: 1234

This is the Inmarsat index and status page.

If Signal is good, more than 5 dots and Status is Ready is should be online. User can test the internet connection by sending a test FTP or even browse the internet from the computer that being use to view this page. Remember that surfing internet can easily use some megabytes. Usage can be seen behind standard data.
The router is set to start standard internet connection at start up. Do not change this.

If Marlink provider is being used, data can be monitored via: Require user and password.
https://datamanager.marlink.com/
After login to datamanager, add the SIM ICC-ID in the search field and information about data usage, firewall etc. will be available. Firewall is not needed if public static IP is not active. Even with public IP enabled, the APB5 should only have the router online for 1 hour or 2 during day (window time). If firewall is set enable be aware that FTP and other communication can be closed.
The current consumption of the Inmarsat is 10 times the mobile network router. (2-5 Amph).

Inmarsat uses APN with SIM.

This is already been setup by manufacturer if SIM was requested and sent to manufacturer before delivery.
The APN is used by the network user to establish the connection to the required destination network. This means that the terminal must know the APN in order to be able to connect to the destination network.

To set up the AP, click on "Settings" then on "LAN", "Network user groups" User must then go to "Edit group /APN / click defined and type Marlink's APN "marlink-usa.bgan.inmarsat.com"
Remember to mark "user defined".

Request for for Inmarsat public IP:

MARLINK

Public Static IP Address Request

☐ Activation   ☐ Deactivation

1. Service Provider (Customer) Details:

Company:			
First Name:		Surname:	
Address:			
E-mail:		Country:	
Telephone:		Fax:	
Marlink Key Account Manager:		Billing Entity:	

2. Service Type:

☐ Public.Static*

Please describe briefly the reason for the implementation of a public static IP address any why no other solution fits:

* Subject to availability and tehnical justification. Charged to the customer on a monthly basis

3. Inmarsat Broadband Service (select only one):

☐ BGAN ☐ FB ☐ SB   ICCID: IMSI:

Related APN:

4. Other Services (select only one):

☐ Thuraya IP ☐ Inmarsat MPDS*   ICCID/IMN: IMSI/FWDID:

* Only available on LES ID 004/011

5. Confirmation:

Service Provider Representative: Date:

**Please send this electronic form per email back to
Marlink Global Customer Care**

TO BE FILLED IN BY MARLINK

Allocated IP Address:

Associated Username: (BGAN/FB/SB Only)   Date:

EMEA
+33 (0)1 70 48 98 98   Version 3.0   Americas
Asia Pacific   www.marlink.com   +1 (310) 616 5594
+65 64 29 83 11   customercare@marlink.com   +1 855 769 39 59 (toll free)

ADCP Nortek

Data: From APB5:

The ADCP is preprogrammed with a 1 minute deployment plan, the ADCP do not need any changes to work with the APB5. Remember to back up the plan on a computer, if new changes made. Do not make longer plans than 3 minutes.

```
Lister - [C:\Users\baard\AppData\Local\Temp\_tc\22011013_13.16.25.txt]         —   □   ×

Fil  Rediger  Alternativer  Koding  Hjelp                                          100 %
#1A00007C,Profile no: 414,Date-time: 2022-01-10 13.11.33 , Next: 2022-01-10, 14.07.00

 11 30 2021 2 58 22 0 33 13.4 1467.2 198.9 1.3 -1.3 0.159 4.17 0 0
    0    433  787
    1   3584  902
    2   2140   34
    3   1516   24
    4   1164  290
    5   2874 3417
    6   1760  277
    7   1883  368
    8    679 3481
    9   2329 3508
   10   1333 3489
   11   1000 3540
   12    789  213
   13    943  244
   14   1763  264
   15    496 3381
   16    745  786
   17    168 3227
   18   1463   81
   19   1815 3481
```

The # line is data from the APB5 system.
The lines without # is direct output from the Nortek ADCP Z-cell 600Khz.
This unit has a max depth of 40 meter. The Z-cell 600 has an extra measuring head for measuring the current where it is placed.
Date time in the ADCP is depended on an internal battery. This is by default not installed from manufacturer. Power to the ADCP is given from the APB5 system during measurements. Therefor the time and date should not be used.

Explanation to the data can be obtained from the Nortek "system integrator manual - classic" page 56-57.
The format is as follows:
Header Line: Name - Units
Month (1-12), Day (1-31) , Year Hour (0-23) , Minute (0-59) , Second (0-59) , Error Code, Status Code, Battery voltage - V, Soundspeed - m/s, Heading - degrees, Pitch - degrees, Roll - degrees, Pressure - dbar, Temperature- degrees C, Analogue input 1 - Counts (0 - 65536), Analogue input 2- Counts (0 – 65536)
Data Line: Name - Units
CellNo (1-128), Speed - mm/s, Direction - tenth of degrees

For doing changes to the setup, the software from Nortek called AquaPro must be installed and used and the ADCP must be connected directly to the computer via rs232 to USB converter. All the equipment for this is in the blue case. There is also a USB pen with manuals and software.

Configure a deplyment plan with AquaPro.

Use pc-cable , power supply and USB converter to commnuicate.
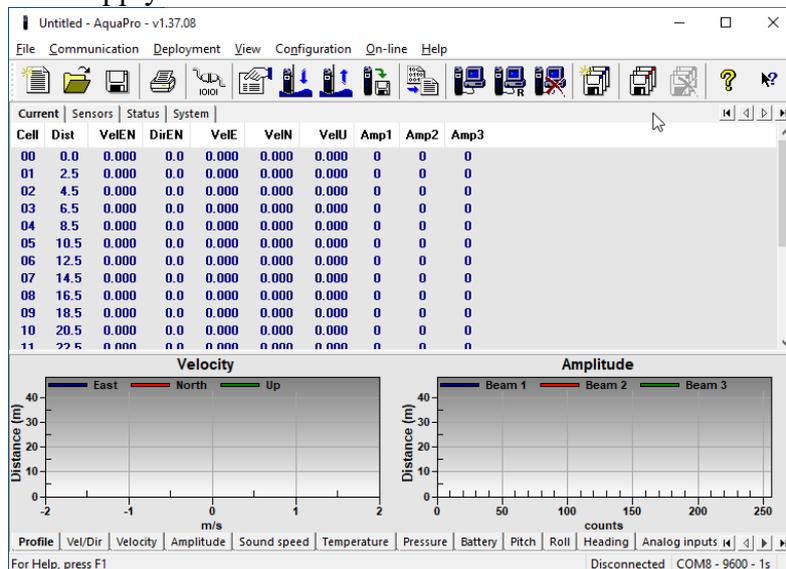
Under menu deplyment, is possible to make a deplyment plan. This plan will than ned to downloaded to the ADCP by update button.

The ADCP will follow this plan, everytime the APB5 wants it to make a measure.
The plan must not be longer than 3 minutes. Be aware that longer time than 1 minute of measure will use more power. Do not make the deplymant plan any longer than neasesary.
A copy of the stored plan is advice able to backup before doing any changes.

Deplymantplan:
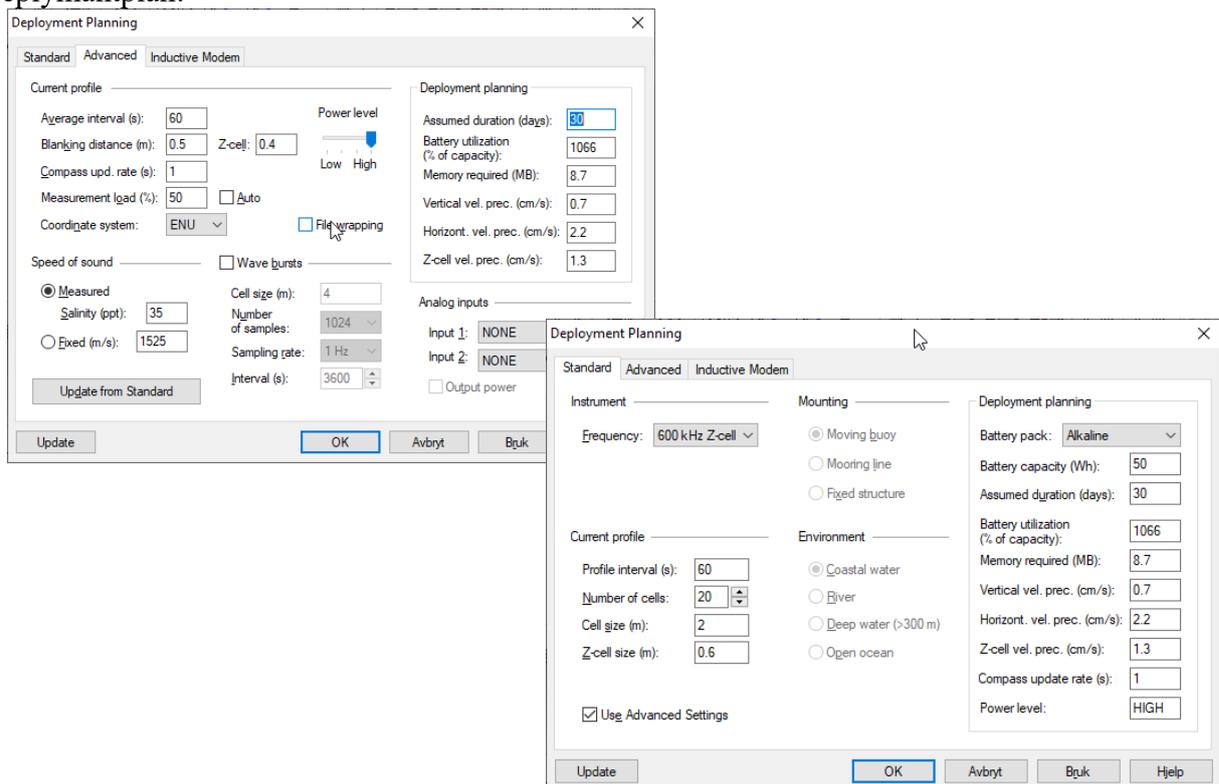
Deploy APB5-HD with ADCP:

Before deploy the APB5 the ADCP needs to be mounted on the side of the APB5-HD.

Water line

It is possible to adjust the height. It does not need to be as deep as the picture shows.
The ADCP Z cell 600, have the benefit of measuring current where the head is. Be aware that if it's mounted to high the can be some air bobbles in the water during high waves.
Water line of the APB5-HD is about middle of the ADCP bracket.

There is a cable cap for sealing the cable.
Use this when ADCP is disconnected.
The plug is a MCIL8m.
It cannot be connected the wrong way.
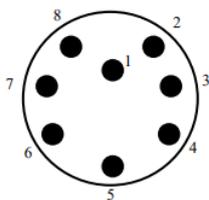
Pictures under is showing other ways of mounting the ADCP while doing land test or stored on land.

Note: The ADCP do not need to be in water for testing its functionality. The reading, will of-course give now meaning.

Inside the ADCP case:

1. Some antifouling protection pads. (if extra ordered)
2. RS232 PC cable.
3. Calibrations papers.
4. USB to rs232 converter.
5. USB pen with software and manuals.
6. Battery for standalone operations.
7. Power supply for usage with the PC cable.
8. A small maintenance kit.
9. The ADCP (under the wooden top box)
10. If Inmarsat is ordered with the APB5, manuals and CD for this might be placed here.
11. If Weather station is ordered it might be placed here with its calibration sheet.

Weather station:

The weather station is of type AIRMAR 150 WX.

The Airmar 150WX will present measurement on 5. Line of the APB5 information's lines that start with # and after the max tilt information:
GPS = NMEA format. (N/S)DDMM.MMMMM, (E/W) DDDMM.MMMMM
T =   Temperature in degree Celsius
P =   Air pressure in Bar
WD = Wind direction in degree
WS=   Wind speed in meter per seconds.

Weather Station presentation in APB5 system:

#M-Tilt, X:6,Y:5, GPS:N6023.6456 E00516.2462, T:-0.4C, P:0.9951B, WD:141.5T, WS:1.8m/s

Convert NMEA to digital format:

N/S = MM.MMMMM/60seconds + DD = 23.6456/60+ 60 = 60.3940933.
E/W= MM.MMMMM/60seconds + DDD = 16.2462/60 + 5 = 5.27077.
This can be used directly in google maps as: "60.3940933,5.27077"
Google will translate this to: 60°23'38.7"N 5°16'14.8"E
This is should be in the bay where SAIV is located.

For protection the weather station will be unmounted from the APB5 before shipping.
And the antenna is laid down. The antenna must be mounted with screws and then it is just to plug in the weather station. The plug cannot be connected the wrong way.

The weather sending data via NMEA protocol, Manufacturer will preprogram it to use MDA and RMC. The printing is set disable. The APB5 will poll it when ready. When connect to the Weather station via direct access, do not store any settings without any reason.

The weather station is using Airmar's cable that is connected to the terminals in the main switch box.

Top-Server

Setting up a Top-Server, this part for skilled personnel only:

It is possible to make a simple top server that the APB5 can do request and send files to.
Important: The APB5 system do not handle DDNS request, therefor must the server have static public IP.
Additionally to public static IP the server need a FTP server installed and a webserver installed. The webserver must handle a PHP driven script that is used to preset settings for the APB5-system to read when it request for new settings and also log this as an access request from the APB5 system. The PHP script is free of charge if user decides to set up a server. SAIV will not give support to unskilled personnel, and some cost will be required if need help with the script, but this last part should not be needed if personnel is skilled in IT such as having good knowledge of code-programming, setting up servers and understanding of the TCP/IP protocol.

Run setting page: apr.php
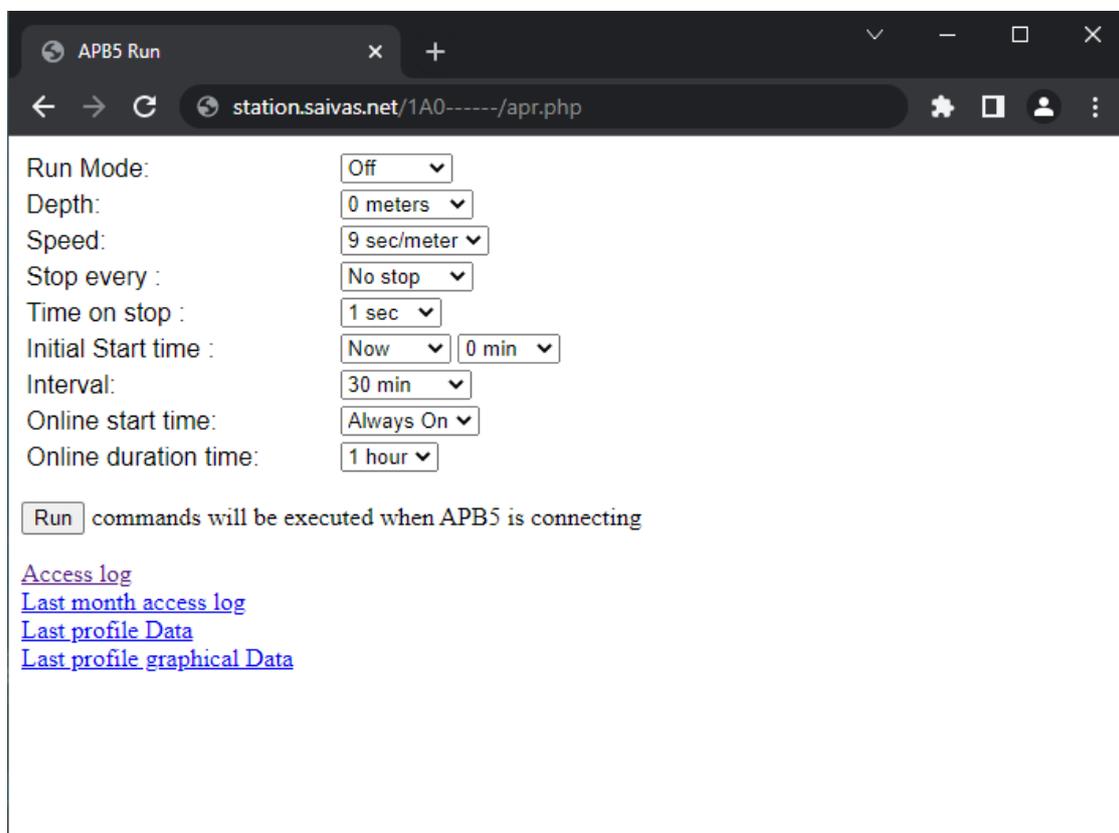
The page is generated by the file apr.php.
When run is pressed a file is created. This file is read by the ip.php.
After this is done the file is marked read = 1
The file ip.php must not be changed, because the APB5 will request with this file name.
The APB5 used .htaccess for as security. This can be added to the web folder.

Data collections and collaboration systems:

Clarify:

Clarify.io is a data collection system that manage many system it on single data collection system. It is free to sign up and play with some data from the database. The system is ready for APB5 systems. Calify.io is also available as APP for smart phones.
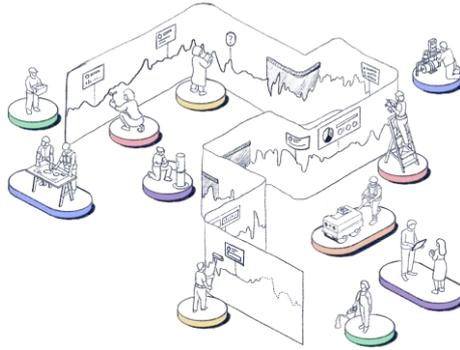
User can invite other to join and share data. Analytic approach can easily be done by selecting query for specific data and compare them with other data from different periods. User can get notes if sensors measures data goes over specific thresholds. The result can be shared and visual for other science.

Export and many more features are available. Read more from «How it work" on from the main page. Clarify.io
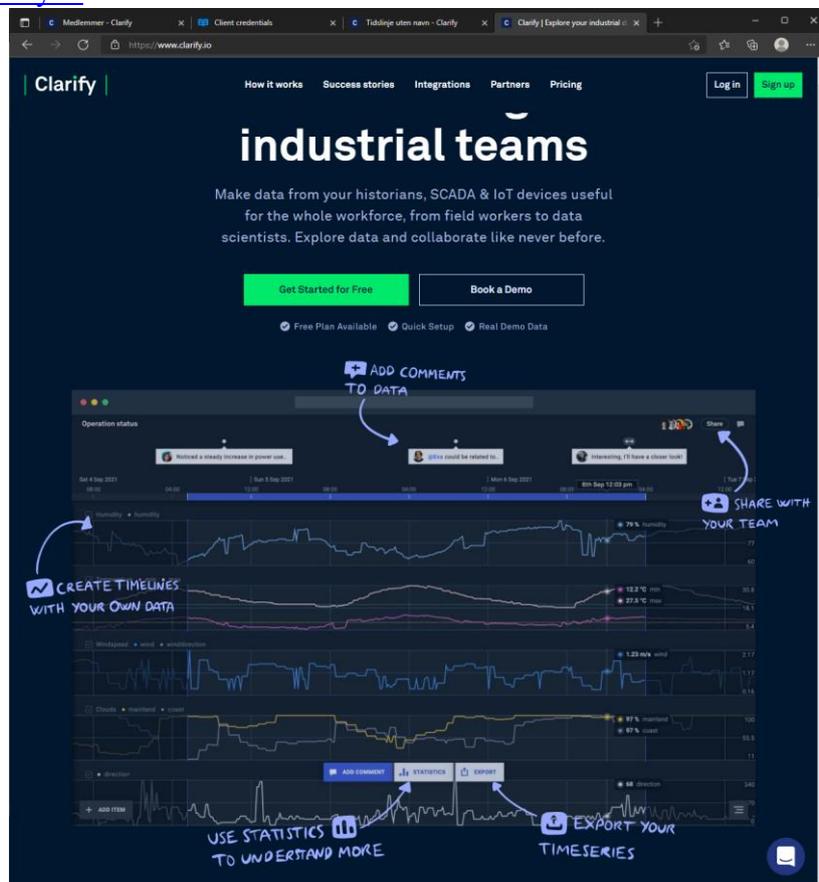
To add data can easily be done by select data from a list and add it to the time graph.
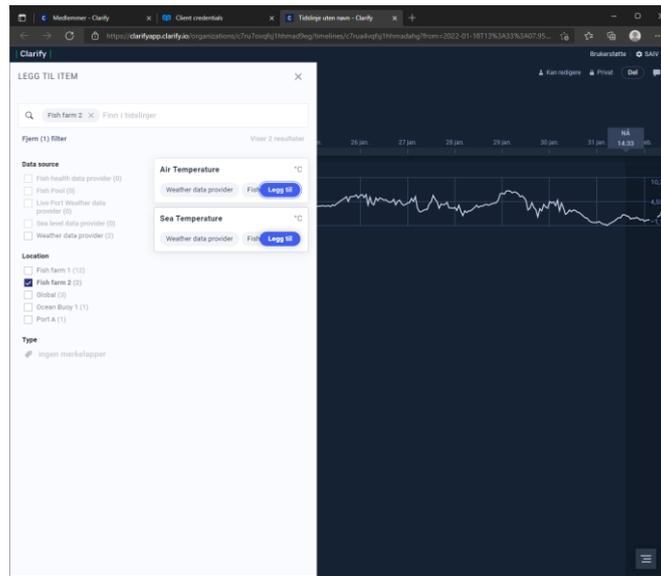
Compare data with current tide water.
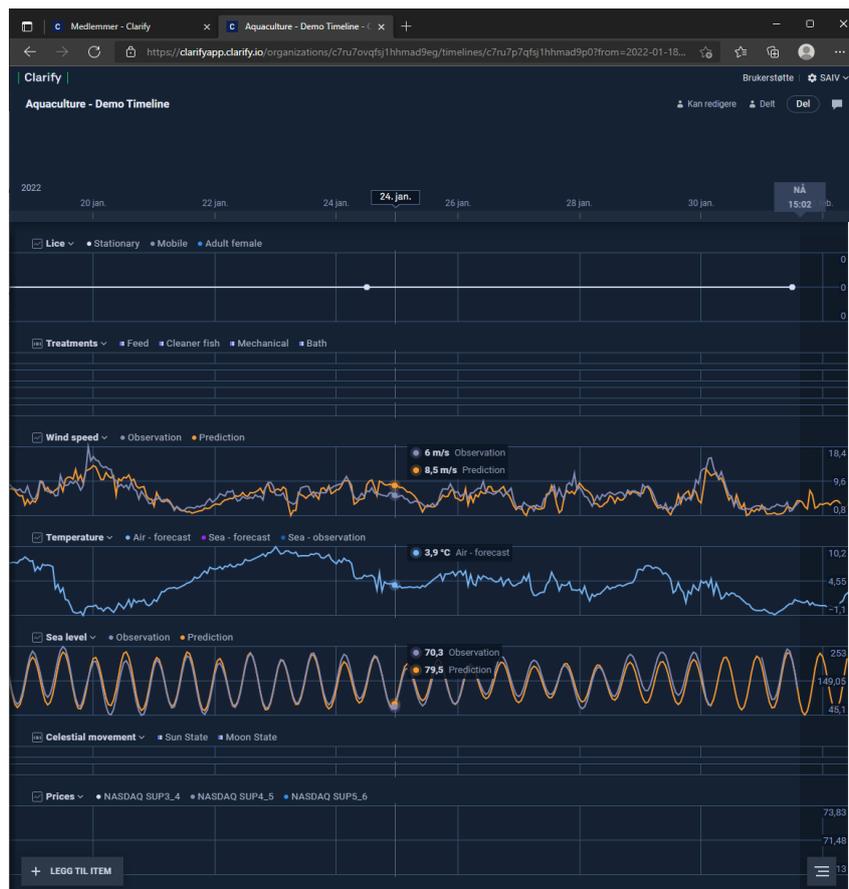
IMR welfare meter (Institute of Marine Research, Bergen, Norway)

(*http://www.imr.no/welfaremeter/index.htm*)

The system polls data from the FTP server in to a local database it can be displayed as shown under. The Welfare-meter is used by Institute of Marine Research, Bergen. The system was the first analytic system that was used with the APB5 system (2008).
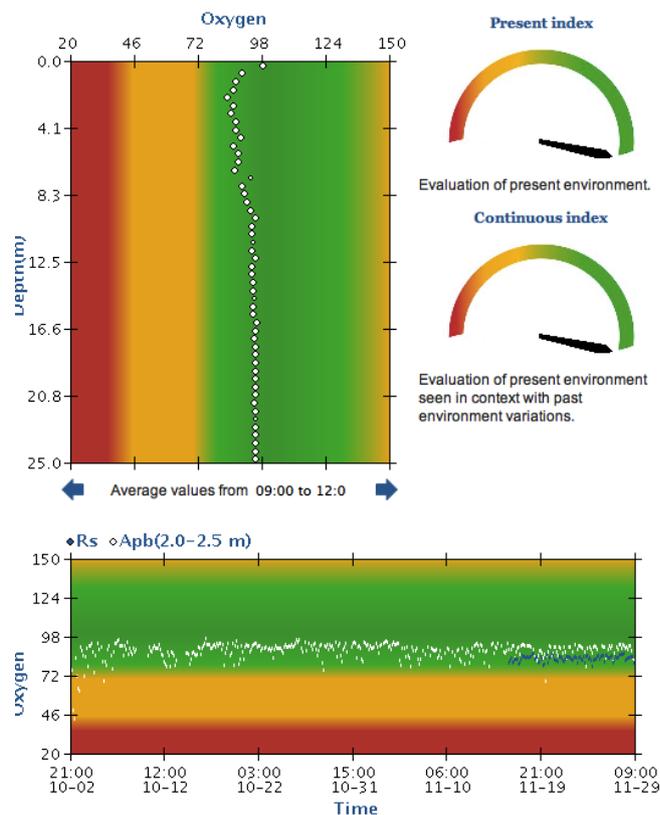
Fig Appendix . Example of graphical display of profile data using the IMR Welfaremeter.

The Welfaremeter is an expert system for assessing fish welfare in aquaculture. The system consists of a buoy (APB5) with profiling probe (CTD,SD204/SD208) placed in the centre of a sea cage, a reference probe (CTD, SD204/SD208) placed at a distance from the fish farm, a database, an expert software program and an internet webpage. The profiling probe measures temperature, oxygen, salinity, fluorescence and turbidity for each half meter downwards in the cage. The buoy's control unit determines how often the probe profiles the water column and present data on an internal webpage. The Welfaremeter polls these data via the mobile phone network (GPRS) and stores it in the database. The data are then analysed by the expert software which gives an evaluation of the environmental conditions in the cage as either very good, fair or potentially harmful for the fish. The software also calculates a welfare index from 0 (terrible welfare) to 100 (excellent welfare). This index is based on modelling of metabolic scope (the salmon's capacity to extract oxygen beyond its basic needs from the water under the current environmental conditions) and factorial scope which reflects the salmon's robustness for stress and environmental perturbations under the current environmental conditions). The results are shown on the internet webpage (requires login).