AcSense-8CH-CAM User Manual

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For Payload Configuration: 8CH hydrophone array, GPS, BAR100 pressure/temp, external switch, external console cable, SD logging, Arducam
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System Overview, Note, and Warnings

The *AcSense-8CH-CAM* logs up to 8-channel hydrophone array and Arducam with RTC and underwater pressure/temperature for use in underwater sensing applications. Based on the AcSense-8CH-OEM board stack, this system logs from up to 8 CH hydrophones for collection of acoustic data sampled at 52 kHz with 16 bit resolution. Additional sensors include internal IMU, GPS RTC, and external pressure/temperature sensor. Expected battery life is 24-48 hours with the included Talentcell 99Wh battery, exact time dependent on camera sampling rate.

Preflight Checklist:

- ☐ Recharge batteries
- ☐ Clear and insert SD card
- ☐ Inspect bore seal o-rings, feel each penetrator in the endcap (it it moved when twisted, tighten with a wrench before continuing)
- ☐ Seal enclosure
- ☐ Make sure 8-pin dummy plug is in 8-pin underwater connector for console connector
- ☐ Remove red cap from pressure/temp sensor
- ☐ Turn on, observe LED to confirm that it is recording
- ☐ Deploy!

WARNINGS:

- ☐ **DO NOT grab or twist connectors when opening/closing the enclosure.**
- ☐ **Switch is only “ON” when entirely screwed in: make sure the light comes on!**
- ☐ **O-rings: whenever the system is opened/closed, inspect o-rings for damage or dirt. If dirty, remove, clean, and re-grease prior to re-assembly. If damaged, replace.**

- ☐ **Remove red cap from pressure/temperature sensor before deployment**
- ☐ **Do not touch, tap or puncture the metal diaphragm on the pressure sensor**

System Overview

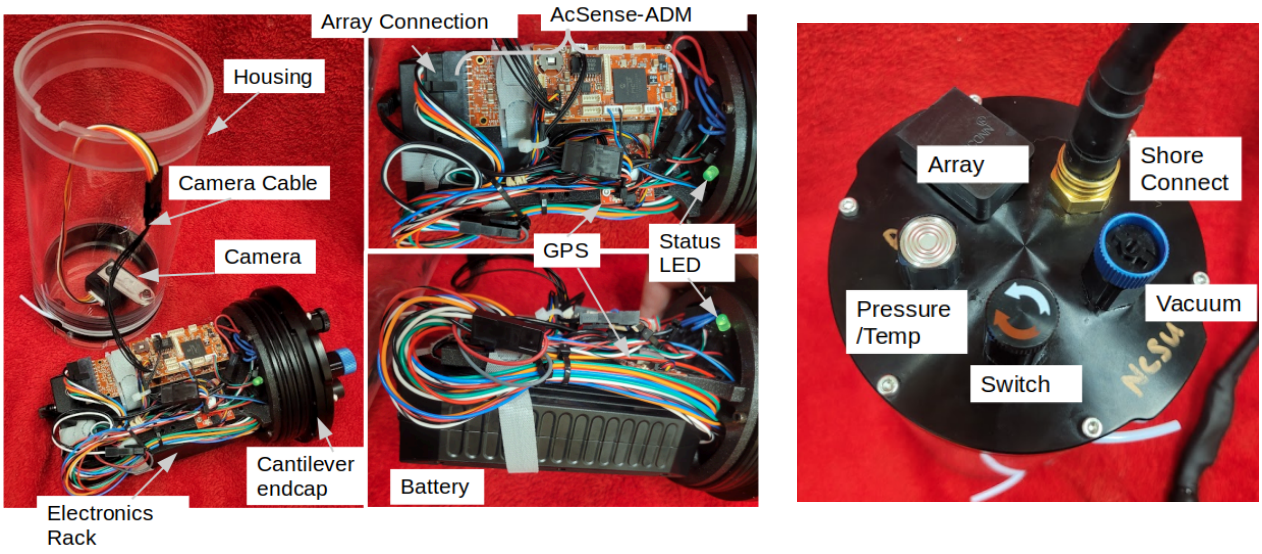


Figure 1: Electronics rack and payload components, including housing and camera, cantilever endcap with electronics rack, battery, and endcap penetrators. NOTE: Red cap should be kept on pressure/temperature sensor until immediately before deployment to avoid damage.

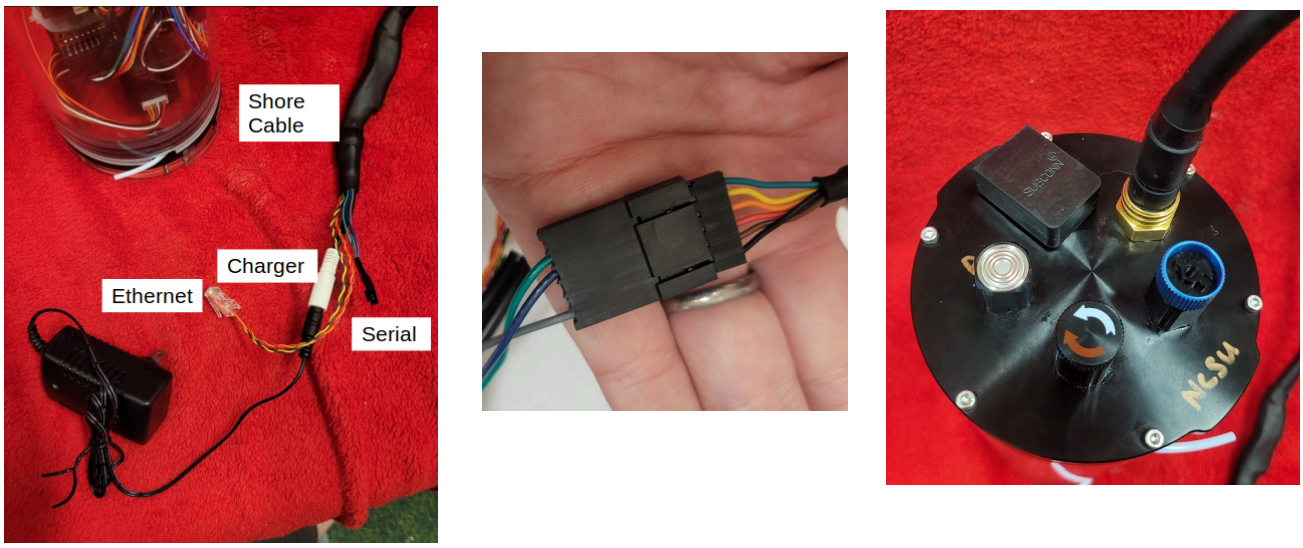


Figure 2: Shore cable call-out of components, Serial cable connection to TTL -> USB cable, shore cable connection to the endcap

Typical Use

The typical use of this system includes turning the system on, system deployment, battery changes, and data offload. The system on startup will begin logging to an SD card in the AcSense-ADM system.

Powering On

To power the system on, turn the On/OFF switch clockwise until the blue LED comes on.

Observing Logging State

There are two internal LEDs, one on the GPS and the other coming off the AcSense (green). The Blue LED in the GPS flashes to indicate GPS fix/PPS; the green LED on the AcSense has three states:

- OFF: AcSense system is not running/logging data
- AcSense is logging but not logging: solid blue LED
- Recording: flashing blue LED, 2 s on, blink off, 2 s on

If the green light is ON but not blinking, that indicates the system is configured but the SD card is missing. If the light is OFF it indicates the AcSense is not running. Check that the SD card is full inserted; this can also indicate that the config file contains an error. Open the config file in ghex and ensure each config line starts at the beginning of the line.

Console

1. Connect shore cable to 8-pin connector
2. Connect USB to Serial converter to Serial port
3. Power ON using switch: Green LED should be lit
4. Log in via Minicom or other terminal (Baud rate 115200, flow control off):
   > minicom -D /dev/ttyUSB0
   (Navigate menus to adjust baud rate, flow control)
5. Verify sensor values using serial console:
   ➔ ?
   ➔ LOG+

The system will begin giving you heartbeats. To enable internal pressure/temperature streamed logging:

➔ PTS+

To stop streaming PTS over serial or to get a single data entry:

➔ PTS

In general, a command and + will stream; a command without plus will give a single return and stop. The options for data queries for the default config are:
LOG STS CFG ADC EPT_100 GPS PTS IMU
SDCARD

See console service section below for full details.

Verify communications and sensor state.

In-bottle or with system on the bench:

1. Connect shore cable
2. Connect USB to Serial converter to Serial port
3. Power ON using switch: Green LED should begin blinking
4. Log in via Minicom or other terminal (Baud rate 115200, flow control off)
5. Verify sensor values using serial console (see “Console” above)
6. Verify SD card installed
7. Observe battery charge (LEDS lit on talentcell battery)

Pre-Deployment: Seal and get flat IMU orientation

1. Insert cantilever endcap into bottle on array system; rotationally align key.
2. Insert ortman key into slot.
3. Turn on if still off, plug in shore cable.
4. Check RTC using the RTC commend v. actual date, adjust if needed using commands from Console Service section.
5. Make a note of IMU values on a flat surface (IMU+ command to stream):
    a. Pitch =
    b. Roll =?
    c. Acc X =
    d. Acc Y =
    e. Acc Z =
6. Rotate the system on its side:
    a. Pitch =
    b. Roll =
    c. Acc X =
    d. Acc Y =
    e. Acc Z =
    (Accelerometer is on the bottom of the board)(x is across the short dimension, y is along the long dimension, z is through the rack)
7. If you want to pull a vacuum (optional):
    a. Screw red vacuum connector into vacuum port.
    b. Observe vacuum via PTS+ command via serial console; at atmospheric it should read about 1000.

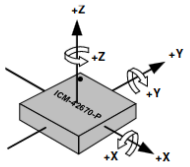
c. Pull vacuum, then quickly unscrew red vacuum connector; If you succeeded, the pressure will be below 1000 and will remain constant-ish (contingent on temperature).

Final Check: (before throwing in water)

1. Vacuum port closed: Blue plug in place, fully screwed in.
2. Dummy plug in shore cable connector (8-pin)
3. Remove red cap on pressure sensor
4. Hydrophones placed as desired, locations measured
5. Hydrophone array connected to 9-pin connector
6. Powered on with switch
7. Green LED blinking internally (look through the acrylic hull)
8. GPS has fix (Blue flashing LED)

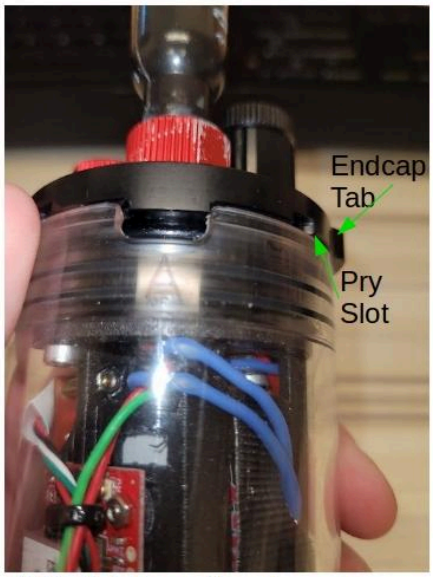
Other notes:

(Accelerometer is on the bottom of the AcSense-Digital board)(x is across the short dimension, y is along the long dimension, z is through the rack)



Opening the housing

1) Remove Locking Cord



2) Push tabs until endcap pops out (pry in pry slot if needed)

3) Gently push until orings are fully dis-engaged; remove rack from housing.

1. Remove the locking cord from the cantilever end of the housing (indicated by orange locking cord)
2. Push up on the black endcap until the orings on the cantilevered sensor payload endcap disengage from the bottle. Occasionally, you may need to gently pry it open with a flat-head screwdriver.
3. Continue to pull until the rack is removed from the housing

Sealing the housing

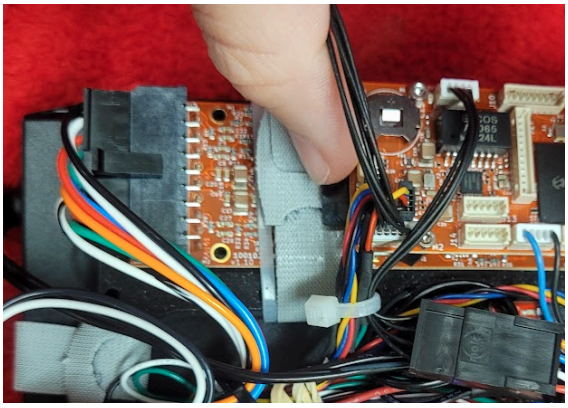
1. Inspect bore seal o-rings for damage; regrease using molykote, replace is needed
2. Ensure velcro battery straps are in place, SD card is in its slot, and switch is OFF
3. Check for loose wires along the sides of the cantilevered sensor payload; reposition if needed. Plug in any connectors to front endcap that go through the bottle.
4. Test each connector in the cantilevered sensor payload endcap by lightly twisting; if it moves, re-tighten using a wrench.
5. Slide cantilevered sensor payload into tube, aligning male tab on the outer edge of the endcap with female groove on the housing
6. Push until the enclosure is fully closed.
7. Insert nylon cord to lock.

Charging the battery

The battery may be charged either through the console cable or by opening the bottle and plugging in the battery charge cable to the battery. A 12 V charging cable is provided.

Offloading Data

The AcSense firmware creates a series of folders; every time the system turns on, it writes to the next sequential folder. The most recent folder with data in it contains the most recent run; occasionally a file system refresh is required to have the new files show up. Note that if files are initially created before the GPS RTC is set, the dates of creation on the folders will reflect that rather than the correct time.



SD Card location: to remove, push in and then gently extract. Tweezers can be helpful!

1. Open the housing as described above
2. Locate SD card on end of the electronics rack away from the sensor endcap under the Digital board.
3. Press the SD card to “pop” out, remove SD card
4. Put SD card into reader, connected to a computer, copy data to known location
5. Run parser as described below, in “Data Parsing”.

NOTE: a pair of tweezers can be useful for inserting/removing the SD card if you are struggling with it.

Note: The last directory will contain the latest data; in general, data should be contained within a single directory but it sometimes gets split either due to too many files being created in a single directory or due to system reset due to an overflow state. A new directory is entered on longer runs every 5-6 hours. We suggest you use the timestamps and expected duration to check, and clear the SD card of D* directories prior to each use.

Data Parsing

Data may now be parsed into .csv files using a gui that runs in python. When you are ready to parse data, we can provide either source code, a .exe for windows, or a linux bash script.

To parse an individual file, select the “External ADC” Radio button, then File -> Open -> Open File. Next, select Parse -> Parse Loaded File or Directory. Finally, select Export -> Export Data to CSV.

To parse an entire directory, select the “External ADC” Radio button, then File -> Open -> Open, parse, and export directory ; select the desired directory path. Another file menu will open to ask where you want to output the data, you can put it in the same place. Once you click “Open” on

the second directory selection, it will begin parsing the files within the directory. This may take a LONG time depending on how many files are in the directory; it is parsing all the .dat files to .csv.

You can then plot your .csv files. Note that the time data will be saved as a separate csv from the sensor data; to plot on the same time base, use an interpolation function on the time csv and apply it to the sample points in the sensor data file.

Data Plotting (Example Code)

Example plotting code is provided as a python file generic_plotter_script_folderexport.py; feel free to reuse any of this code in your own plotters, it is intended as demo code.

Run as follows:
> python3 generic_plotter_script_folderexport.py --dir <outdir for folder export> --cam <0 or 1> --ac <0 or 1>

Example on my computer:
>python3 generic_plotter_script_folderexport.py --dir /home/efischell/Desktop/SDcard/CFF_turtle2024/Benchtest/CFF2/D2/parsed1/ --cam 0 --ac 1

This will plot all SENS data in the folder, as well as each AC file with associated SENS data and the camera images as frames for export to a movie. If --cam 1, it will export .jpg files with the camera images and snaps of the other data to a directory; if --ac 1 it will plot and save acoustic data along with associated other sensor data.

NOTE: the script assumes camera images are back a directory from the directory you specify with --dir: it is configured so that you copy your data to, e.g. myfolder/D4/, then export it to myfolder/D4/ which will create the directory myfolder/D4/parsed1/ with the .csv files then it would look for image files in myfolder/D4/IMG4_1/ etc.

microSD Card Config

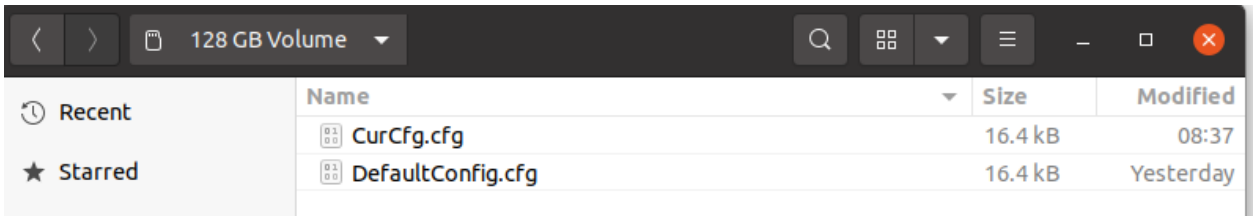
The provided microSD card should have a file called “DefaultConfig.cfg”. This file sets which data streams are turned on and off, what is logged, and what is used as the clock for the system.

```
ACBOTICS CONFIG ON
CONSCFG ON
SDCFG ON
CONS ON
SDCARD ON HB_STAT=OFF WDT_STAT=OFF WDT_AC=ON HB_AC=ON
ENET OFF
IMU ON READINT=100
PTS ON
PTS READINT=1000
ADC ON CHAN=8  RBELEMS=12
CTD OFF ER_BAUD=9600 SER_CON=J14
EPT_100 ON READINT=100 DNAME=J7
RTC OFF
TIMEMGR SRC=GPS
MAG OFF DNAME=J25 DTYPE=MM56x3
GPS ON  DNAME=J25
SDCARD ACH=SPIADC CH=GPS CH=EPT CH=IMU CH=PTS CCH=IMG CH=IMG_MD
STAT ON SD_GPIO=F1  WDT=ON
CAM ON RES=HD READINT=2500
SPIRB OFF
```

To change the default config, do the following:

1. Locate and remove SD card. Plug into computer.

2. Find binary .cfg file on SD card, DefaultConfig.cfg



3. Open file in ghex or other binary file editor. (instructions below are for ghex) (for ghex, it is really helpful to stretch the screen horizontally until the lines all start where the hex ends as shown below before attempting to edit)

4. Edit as needed
5. Save file
6. Eject card, put back into AcSense-Digital board

Install ghex on linux:
> sudo apt-get install ghex

For more information on config file customization, see **Configuration Setup** below.

Two config examples are available in your customer google drive: an ethernet streaming example and a SD card logging example. The SD card logging example is DefaultConfig.cfg; the ethernet streaming example is 8chethDefaultConfig.cfg.

External Cables

Shore Cable

Bulkhead connector: MCBH8F
Cable Connection: MCIL8M/shore cable
Dummy Plug: MCIL8M
The shore cable (8-pin Subconn micro-circular MCIL8M) is terminated with a barrel plug for charging, a serial port with USB-to-serial converter, and a Ethernet cable (Ethernet streaming is not enabled in the config file of the shipped system, but may be configured as indicated in the MicroSD Card Config section).

Connector/Cable Pin (color)	EXT Connection (Geophone)	INT Connection (Microfit 3.0 2x4 Male	Connect To:

		connector)	
1 (Black)	Shore GND	Microfit 1x 3 : 1	Barrel GND
2 (White)	Shore CHARGE (12 V)	Microfit 1x 3 : 3	Barrel 12V
3 (Red)	Serial Shore Tx	Microfit 1 x 5 M: 2	AcSense Digital J20
4 (Green)	Serial Shore Rx	Microfit 1 x 5 M: 3	AcSense Digital J20
5 (Orange)*	Rx-	Microfit 1 x 4: 1	Picoblade 1x4 1 (to AcSense Digital J4 Rx-)
6 (Blue)*	Rx+	Microfit 1 x 4: 2	Picoblade 1x4 2 (to J4 Rx+)
7 (White/black)*	Tx-	Microfit 1 x 4: 3	Picoblade 1x4 3 (to J4 Tx-)
8 (Red/black)*	Tx+	Microfit 1 x 4: 4	Picoblade 1x4 4 (to J4 Tx+)

* = internal and shore cable wiring complete for future feature, software option not enabled in default config on SD card

Hydrophone Array Cable

Bulkhead connector: MLPBH-9-F
Cable Connection: MLPIL-9-M to hydrophone array
Dummy Plug: MLPDC-9-M
NOTE: assembled INT connector with reduced-force mating pins to make connecting/disconnecting easier.
10 pin cable- length = 6 m

Pin Number (LPBH-9 -F)	Color- MLPIL-9-M cable	Connect: EXT Hydrophone	Connect: INT (Microfit 3.0 2 x 9 connector)
1	Black	H0 Green	18 (CH0 IN)
2	White	H1 Green	17 (CH1 IN)
3	Red	H2 Green	16 (CH2 IN)
4	Green	H3 Green	15 (CH3 IN)
5	Orange	12V common, all hydrophones	5 (12 V)
6	Blue	H4 Green	14 (CH4 IN)

7	White/Black	H5 Green	13 (CH5 IN)
8	Red/Black	H6 Green	12 (CH6 IN)
9	Green/black	H7 Green	11 (CH7 IN)

NOTE: INT connector uses low-force pins

Shore Cable

Connector 9: BAR100 (temperature/pressure sensor)
Manufacturer documentation:
https://bluerobotics.com/store/sensors-sonars-cameras/sensors/bar100-sensor-r2-rp/

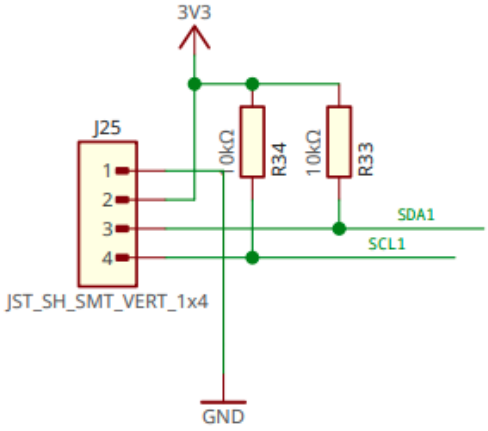
Manufacturer Warnings:

Because of the PEEK body, the Bar100 has a lower installation torque than our other M10 bulkheads made of aluminum. Please refer to the technical details below for the recommended installation torque.

The metal diaphragm on the Bar100 is very thin, and can easily be damaged if unevenly loaded, or touched by something hard or sharp. Test functionality only in water, not by pushing with a finger or small object.

Sensor wire Color	Connect: INT micro-fit	AcSense-Digital
Black	1	I2C- GND (1)
Red	2	I2C- 3.3V (2)
White	3	I2C- SDA (3)
Green	4	I2C-SCL1 (4)

Board end:
AcSense-Digital-PIC32



Data Notes

Timestamps

The output from the parser is one or more .csv files per data type, with columns for each data stream within the sensor. All of the .csv files have a common column called “timestamp”: this timestamp column is the common time tick for the entire AcSense system, with a timestamp increment of 1 equivalent to 10 ns (i.e. 10^-8 s). This ensures that regardless of whether the global time is incorrect or variable in accuracy, the data integrity is guaranteed.

To go from timestamp to seconds into the log with no global time offset, simply multiply the timestamp value by 10^-8:

```
time_seconds = (
       data[“timestamp”].to_numpy() * 10**-8
   )
```

To get a global timestamp, the plotter code uses the .csv associated with the RTC or GPS RTC, finds the first valid global time in the file, and uses that value to map the timestamps in all other sensor csv files to a global time in seconds:

```
   offset = 0
   if RTC_data is not None:

       # use RTC data to look up timestamps:
       # print(RTC_data[0])
       try:
           rtc_start = RTC_data.iloc[0]["timestr"]
           offset = RTC_data.iloc[0]["timestamp"]
       except:
           rtc_start = ""
           offset = 0

       xlabeln = "s since " + rtc_start

   else:
       print("RTC data is None?")
       xlabeln = "s"
   if type(sensor_data["timestamp"]) == type([]) or type(
       sensor_data["timestamp"]
   ) == type(np.array([])):
       tstamp_array = np.array(sensor_data["timestamp"]) - offset

   else:
       try:
           tstamp_array = sensor_data["timestamp"].to_numpy() - offset
       except:
           tstamp_array = np.array([sensor_data["timestamp"]]) - offset
   tstamps = tstamp_array * TICK
```

```
    return [tstamps, xlabeln]
```

Files and Folders

The system automatically creates a series of directories, D1 -> D31, in the SD card. On boot, the system will write to SD card in those directories; for long logging intervals, new directories will be entered approximately every 5-6 hours. It is highly recommended to copy off and then remove all directories from the SD card for each extended run.

Folders created on the SD card

Within a given directory, e.g. D1/, there will be the following files and folders:

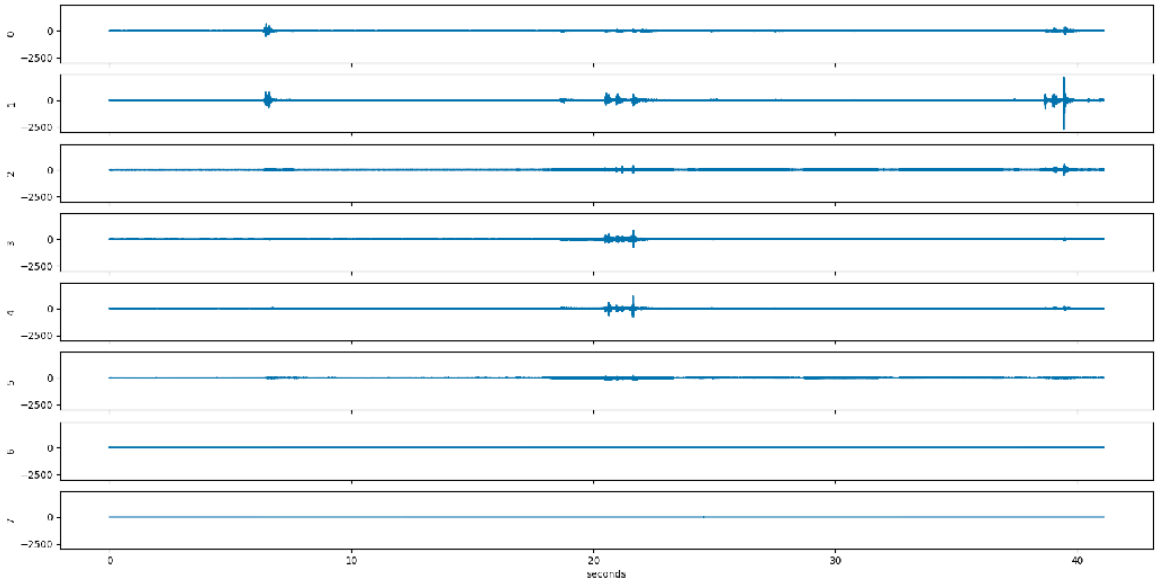
1. Image directories: e.g. IMG1_0/, IMG1_1/ etc.
2. SENS file(s): e.g. SENS_1_1.dat
3. Acoustic files: e.g. AC1_0.dat, AC1_1.dat etc.
4. Config files stored for reference (binary and text): CC_1_1.cfg, CC_1_1.txt

The image directories are indexed to the acoustic files, such that IMG1_0/ contains the images collected during the acoustic acoustic file AC1_0.dat.

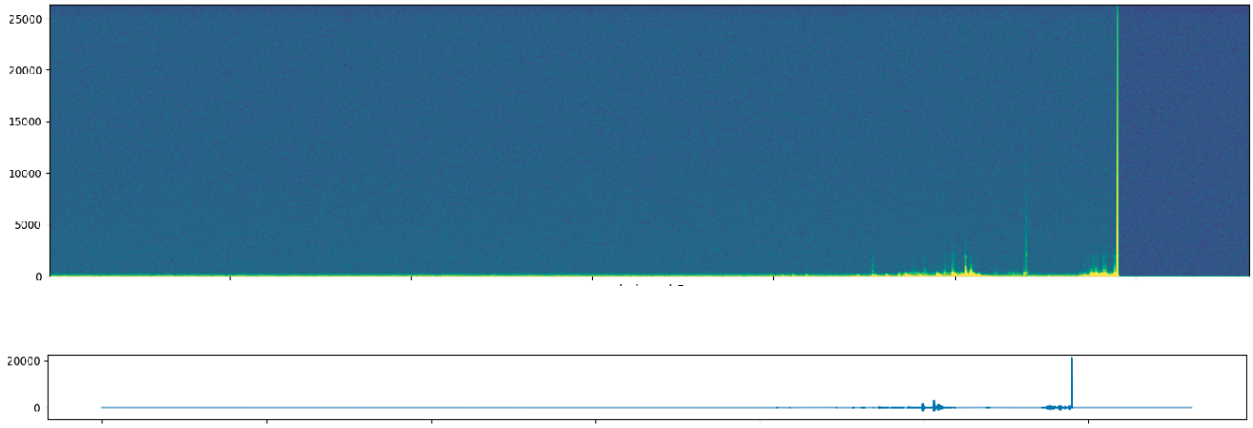
Image metadata is stored in the SENS file as well, and exported to .csv with the other SENS data structures; this makes it easy to reference specific images to timestamps.

Acoustic Data Notes

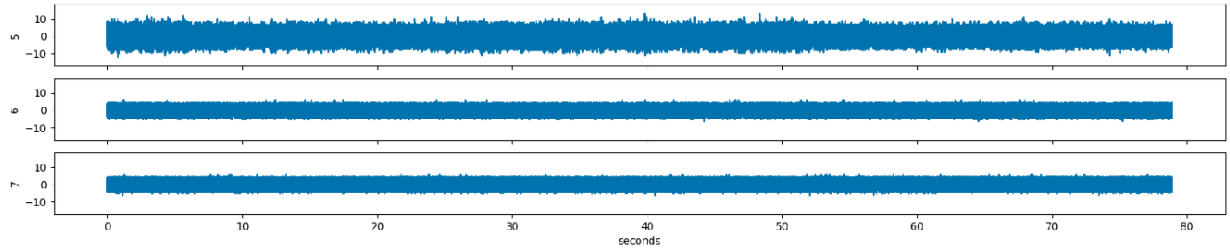
For 16 bit systems, the conversion between



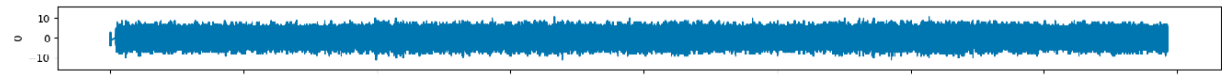
Systems that do not have multiple of 8 channels currently need to specify the nearest multiple of 8 for channel number in configuration; this means when you plot your data, you will see 8-N disconnected channels, where N is the actual number of hydrophones. In the above example, a 6-channel array is used, so that CH6 and 7 show up as low voltage/disconnected compared to the signal-rich time series show for CH0-5.



When the hydrophone array is disconnected, the spectrogram and time series plots will show a sharp spike following by a general reduction in sound level with no more high level data.



A disconnected channel will typically show values between -5 and 5 of a constant in integer space, with no peaks above that. Above, CH 5 is connected and CH 6 and 7 are disconnected while recording in a quiet room; the difference is obvious even when there is little noise.

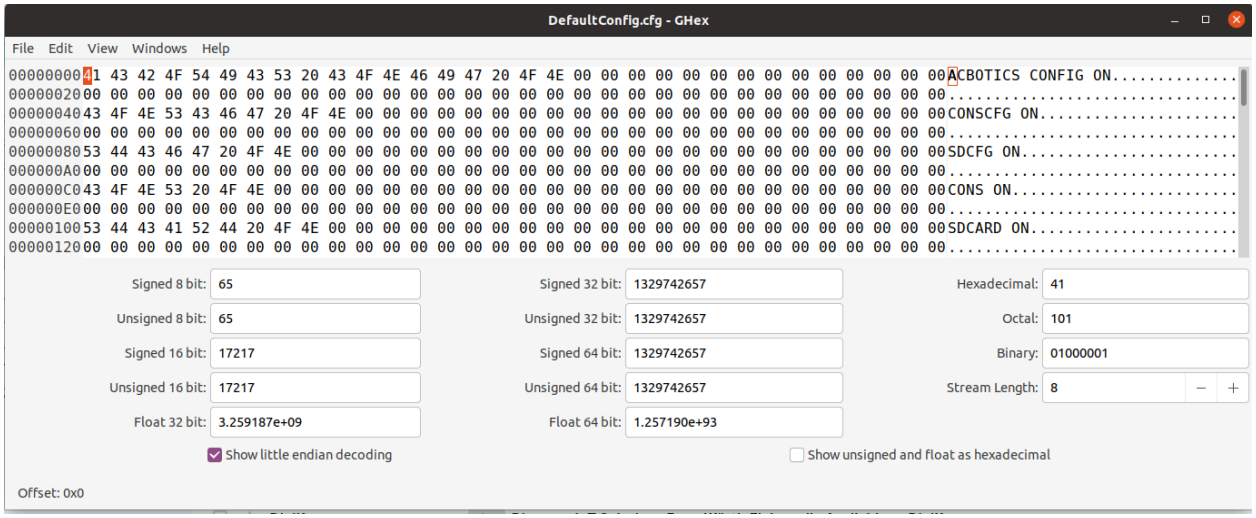


Short data gaps in the acoustic files do occur occasionally, typically due to write latency on the microSD card while writing images; if this issue becomes substantial, we recommend slowing down the camera write or decreasing the image quality. Future firmware versions are planned that address this via memory supplementation.

Configuration Setup

The AcSense onboard software may be configured via a binary file with configuration data; if the file DefaultConfig.cfg is on root of the SD card, the AcSense will automatically load it as the initial configuration on boot. To create a new configuration file: use a hex editor such as ghex, open a new file. This will allow you to edit human-readable text, then export to a file called DefaultConfig.cfg.

NOTE: Ensure there is a line break between each line, and each new line starts at the beginning of the line with no spaces ahead of it. If there is something wrong with your DefaultConfig.cfg, the AcSense blue record LED will not blink on startup, which is always a clue to go look again. If you are having trouble getting this to work, contact support@acbotics.com with the config file you are trying to run and we can help you figure out where something is misaligned.



If you name your file FactoryOverwrite.cfg it will load that into the non-volatile RAM as the config, and then if you later boot without the SD card that will be stored.

The configuration is run once at startup. It is possible to define configs that allocate more memory than are available on the device, in which case it will fail. Unless you need something different, it is highly recommended you use Acbotics provided config files.

Required configuration variables:

Required on line	Text	Description
1	ACBOTICS CONFIG ON	Turns it on; this line must be present
2	CONSCFG ON	Can be configured; this line must be present
3	SDCFG ON	Can be configured by the SD card; this line must be present

General configuration variables:
MODULENAME PASSEDVALS

NOTE: All bool type variables can take ON, OFF, TRUE, FALSE, 0 or 1.

Config Names

Module	**Config Name**
Console module	CONS
SD logging	SDCARD
Ethernet streaming/eth parameters	ENET
Internal IMU	IMU
Internal pressure/temp sensor	PTS
Ac-ADM	ADC
DS RTC	RTC
Bar 100 pressure sensor	EPT_100
Bar 30 pressure sensor	EPT_30
Ping Echosounder	PING
Internal ADCs	INTADC
Time manager	TIMEMGR
GPS (currently that specific module)	GPS
Status process	STAT
NAU driver	NAU7802
Magnetometer driver	MAG
Watchdog driver	ACW
Heartbeat	HB_STAT=ON
Camera	CAM

CONS

Options: ON/OFF

Command	Result	Notes

CONS ON	Turns on console	
CONS OFF	Turns off console	Default

Default: OFF

SDCARD

Options:
ON, OFF
CH=<str> [adds a channel to be logged][can be run as many times as you want]
ACH=<str> [ring buffer name for primary ADC][only set to one thing]
Note: new channels to record must be added here and also turned ON. E.g to add a magnetometer, you would need a "MAG ON" line and also to add CH=MAG on this line. If you only do one or the other, your sensor will not log.

Command	Result	Notes
SDCARD ON	Turn on	
SDCARD OFF	Turn off	Default
CH=<str>	Add a channel to log on SD Card, e.g. CH=GPS	Can have as many as will fit in the 32 byte line, space delimited
ACH=<str>	Ring buffer name for primary ADC (name needs to match what your ADC is outputting on) E.g ACH=SPIADC ACH=INTADC	
HB_STAT=ON	Turn on heartbeat based on STAT variable	
HB_AC=ON	Turn on heartbeat based on acoustic file creation	
WDT_STAT=ON	Watchdog on STAT variable; reset if it stops	
WDT_AC=ON	Watchdog on AC files; reset if they stop being written	

ENET

Command	Result	Notes
ENET ON	On	
ENET OFF	Off	Default
ENET IP=<str>	Set target IP address for main data stream. E.g. if you are sending data to IP 195.168.1.5, you would put: ENET IP=195.168.1.5	Default 224.1.1.1
ENET PORT=<str>	Set target port	Default 9760
ENET DAQ_IP=<str>	Set own IP address	Default 192.168.1.56
ENET DAQ_SM=<str>	Set own netmask	Default 255.255.255.0
ENET SEN_ON	Turn on sending sensor (i.e. non-ADC) data (e.g. GPS, IMU, PTS etc.)	
ENET SEN_OFF	Turn off sending sensor (i.e. non-ADC) data (e.g. GPS, IMU, PTS etc.)	Default
ENET SEN_IP=<str> ENET SEN_PORT=<str>	IP address and port to send the sensor (non-ADC) data to. Let you send sensor and ADC data to different places	Default SEN_IP=224.1.1.2 Default SEN_PORT=9770
CH=<str>	Add a channel to Ethernet stream, e.g. CH=GPS	Can have as many as will fit in the 32 byte line, space delimited e.g. ENET CH=GPS CH=PTS CH=ADC CH=IMU Or as as many lines as you want Default none
ACH=<str>	Ring buffer name for primary ADC (name needs to match what your ADC is outputting on)	Sets once Default ACH=SPIADC

SER_ON	Turn on serial stream	
SER_OFF	Turn off serial stream	Default
SER_IP=<str>	IP address to send serial data to	Default 192.168.1.115
SER_TX_PORT	Port send serial data to over ethernet	Default 9780
SER_RX_PORT	Port to listen to for ethernet data to send to the serial port (gives you a ability to control a serial device via ethernet)	Default 9781
SER_BAUD	Baud rate for eth-modulated serial connection	Default 15200
SER_INV True SER_INV False	Configures whether the serial port inverts its logic (needed for some TTL level w/ RS232 logic serial devices)	Default False
SER_CON=<str> SER_CON=J20 SER_CON=J19 SER_CON=J14 SER_CON=J13 SER_CON=J12	Connector for serial device referencing the UART connectors on the AcSense-Digital board	Default J19
NTP_IP=<str>	Configure where to get NTP data from	Default 192.168.1.115

IMU

Command	**Result**	**Notes**
IMU ON IMU OFF	Turn on/off	Default OFF
IMU READINT=100 IMU READINT=1000	Sample interval in IMU in ms	Default 100

PTS

Command	Result	Notes
PTS ON PTS OFF	Turn on/off	Default OFF
PTS READINT=10000 PTS READINT=1000	Sample interval in ms	Default 10000 (.1 Hz)

ADC

Command	Result	Notes
ADC ON ADC OFF	On/off	
ADC CANON ADC CANOFF	Turn fake input on/off	Not generally used except by Sam
ADC CHAN=<str>	Configure number of channels for ADC, e.g. ADC CHAN=8 ADC CHAN=16	Default ADC CHAN=16 Match to 8x number of ADM boards
ADC FS=<str>	Set desired sample rate	Currently placehold
ADC RBELEMS=<number>	How many elements are going to be in the ADC ring buffer (memory trade-off) (most users won't need to mess with this)	Default 48, if doing something requiring lots of memory may need to drop down

RTC

Command	Result	Notes
RTC ON RTC OFF	On/off	
RTC DNAME=<str>	Port name, e.g. J25, J7, J9 etc. that I2C RTC is plugged into	Must be explicitly defined if ON

EPT_100

Command	Result	Notes
EPT_100 ON EPT_100 OFF	On/off	
EPT_100 DNAME=<str>	Port name, e.g. J25, J7, J9 etc. that I2C RTC is plugged into	Must be explicitly defined if ON
EPT_100 READINT=<ms>	Read interval in milliseconds for EPT	Default 100

EPT_30

Command	Result	Notes
EPT-30 ON EPT-30 OFF	On/off	
EPT_30 DNAME=<str>	Port name, e.g. J25, J7, J9 etc. that I2C RTC is plugged into	Must be explicitly defined if ON
EPT_30 READINT=<ms>	Read interval in milliseconds for EPT	Default 100

PING

Command	Result	Notes
PING ON PING OFF	On/off	
		* below from rev.
PING SER_BAUD=<baud rate>	Baud rate for the ping	(probably don't need to change this) Default 115200
PING SER_CON=<UART Port>	Port argument for which serial port (J14, J21, J19,	

	J20) that the ping is plugged into	
PING MODE_AUTO=ON PING MODE_AUTO=OFF	Set auto mode ping echosounder (see BlueRobotics Ping documentation)	Default OFF
PING SCAN_START=<mm> PING SCAN_LENGTH=<mm>	Range scan start distance and scan length settings for ping if not using AUTO mode, set in mm (see BlueRobotics Ping Documentation).	Minimum scan start value 0, SCAN_LENGTH must be at least 1 m (1000 mm) Default SCAN_START=1000 Default SCAN_LENGTH=25000
PING INTERVAL=<ms>	Time interval between transmissions; INTERVAL=0 as fast as possible given scan start and scan length. Interval set in ms.	Default INTERVAL=0
PING GAIN=<number>	Gain for PING system, see Ping documentation for details; 0: 0.6, 1: 1.8, 2: 5.5, 3: 12.9, 4: 30.2, 5: 66.1, 6: 144 Higher gain = more sensitivity to water column, may saturate; lower gain = may not detect smaller scatterers in the water column	Default GAIN=3

INTADC

Command	**Result**	**Notes**
INTADC ON INTADC OFF	On/off	
INTADC CH=<number from 0 to 4>	Turns on indicated channel (0 to 4)	May appear more than once, e.g. to run CH 0 and CH 1 you would have: INTADC CH=0 INTADC CH=1
INTADC FS=<sample rate in HZ)	Integer in Hz for desired sample rate	Exact sample rate may differ slightly from setting, will pick

		nearest the clock can do. We recommend verifying using a function generator as input at a known frequency, or ask us for validation.
INTADC DIFF=ON INTADC DIFF=OFF	On/off of differential mode or single-ended input mode	Default ON
INTADC SIGN=ON INTADC SIGN=OFF	Signed or unsigned ADC data	Default ON (signed)
INTADC RBELEMS	Ring Buffer lines	(if you are having issues with dropped acoustic data, try adding RBELEMS=400 to your INTADC config) Rec: RBSIZE=400
INTADC RBSIZE	Length for each line in ring buffer	Rec: RBSIZE=400

TIMEMGR

Command	**Result**	**Notes**
TIMEMGR SRC=<str>	Channel name of a source it can get the time from, e.g. GPS or RTC to get timestamps for files	Currently only supports GPS or RTC
		Future: add NTP as option

GPS

Command	**Result**	**Notes**
GPS ON GPS OFF	ON/OFF	
GPS DNAME=<port>	Port for GPS	NOTE: DO NOT PUT THE GPS ON J8 as the IMU is on J8 and they REALLY don't play nicely together. I typically put the GPS on J7 and chain

		other I2C devices on J25

STAT

Command	**Result**	**Notes**
STAT SD_GPIO=<str> STAT SD_GPIO	Sets which GPIO pin blinks an LED when running <A to H><number> E.g. STAT SD_GPIO=A5	Default None
		Future: set blink rate etc.
STAT WDT=ON STAT WDT=OFF	Turn watchdog timer on/off; watchdog resets if it doesn't get fed.	
STAT ON STAT OFF	Control whether STATUS process runs (turn off to save memory)	

NAU7802

Command	**Result**	**Notes**
NAU7802 ON NAU7802 OFF	ON/OFF	Typ used for load cell interface
NAU7802 DNAME=<port>	Port for NAU7802	
NAU7802 GAIN=<number>	Gain values 1,2,4,8,... 128 (powers of 2 up to 128)	Default 1
NAU7802 READINT=<ms>	READINT is how fast it will attempt to read from the ADC.	The ADC clocks itself, so there is also a SR=?? Which sets the ADC's internal sample rate, if READINT is faster it will default to internal sample rate

NAU7802 SR=<sample/s>	Options: 10, 20, 40, 80, 320	Default 10

ACW (AcWatchdog interface)

Command	**Result**	**Notes**
ACW ON ACW OFF	ON/OFF	
ACW ALARM=MM/DD/YY HH:MM:SS	Alarm wake time for watchdog timer to wake the system back up	E.g. ACW ALARM=04/30/24 10:58:00
		LATER: will add duty cycle, initial wake interval, dname

MAG

Command	**Result**	**Notes**
MAG ON MAG OFF	ON/OFF	
MAG DNAME=<port>	Port for Magnetometer	
MAG READINT=<ms>	Millisecond read interval	

CAM

Command	**Result**	**Notes**
CAM ON CAM OFF	ON/OFF	
CAM RES=<resolution>	Set resolution for the Arducam; resolution options in resolution table below	The frame rate will adjust DOWN if it can't write fast enough for a given selected frame rate. If you go above HD, do a trial run to ensure

		you are getting sufficient frame rate for your application. (HD w/ frame rate 1 verified)
FR=<Hz>	Framerate in Hz	The frame rate will adjust DOWN if it can't write fast enough for a given selected frame rate. If you go above VGA FR=4 or HD FR=1, do a trial run to ensure you are getting sufficient frame rate for your application.

Camera Resolution Options:

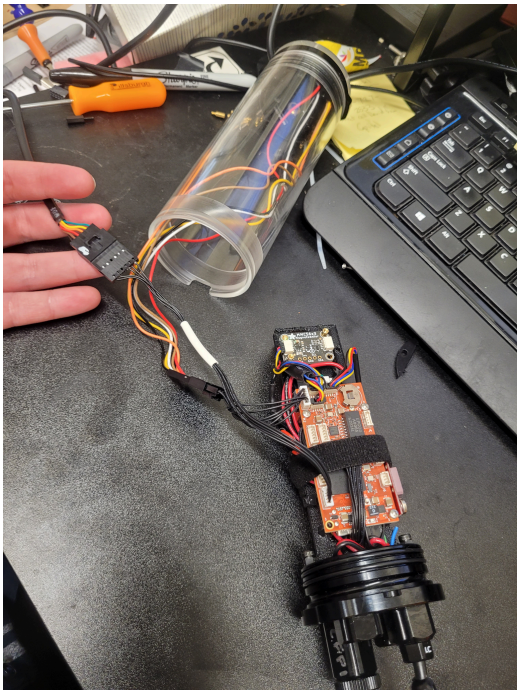
<resolution>	**Suggested Line in DefaultConfig.cfg**	**Resolution (pixels)**
QVGA	CAM ON RES=QVGA FR=16	320x240
VGA	CAM ON RES=VGA FR=4	640x480
HD	CAM ON RES=HD FR=1	1280x720
FHD	CAM ON RES=FHD FR=0.25	1920x1080
WXGA2	CAM ON RES=WXGA2 FR=0.1	2592x1944

NOTE: You can set a higher frame rate, but you are not guaranteed to get that frame rate. Above is a best guess at the fasted it will run, but exact performance will depend on how fast the SD card you choose can write data.

Serial Console

Serial console

The cable kit includes a console cable to plug into J20; this cable mates to a USB to serial converter (avail on digikey: https://www.digikey.com/en/products/detail/ftdi-future-technology-devices-international-ltd/TTL-232R-3V3/1836393). Using a console is useful if you need to debug the system, but may not be required during general use.



Plugging in the console cable to the AcSense-Mini-Cam system

1. Connect console cable to USB to serial converter cable (provided)
2. Power on
3. Log in via Minicom or other terminal (Baud rate 115200, flow control off):
   > minicom -D /dev/ttyUSB0
   (Navigate menus to adjust baud rate, flow control)
4. Activate serial console and heartbeat:
   ➔ ?
   ➔ LOG+
   (The system should begin giving you heartbeats)

NOTE: if you query too soon after startup, you will get a message "Password?". If that happens, unpower/power the unit and try again with a longer wait.

5. Query the GPS:
   ➔ GPS
6. If the RTC on the GPS is correct, continue to step 8
7. To manually set the RTC:
   ➔ > ?
   ➔ > CFG
   ➔ >> RTC
   ➔ >> RTC MM/DD/YY HH:MM:SS
   ➔ >> EXIT
   ➔ To confirm: (it may take a few seconds to update)
   ➔ > RTC
8. Verify sensor values using serial console:
   ➔ ?

➔ LOG+

The system will begin giving you heartbeats. To view IMU data:

➔ IMU+

To observe IMU settings:

➔ IMU PRT

To get IMU at a rate of 1 sample every 10 ms:

➔ IMU READINT=10

To slow back down to every second:

➔ IMU READINT=1000

(READINT is set in ms)

To stop streaming IMU over serial console or to get a single data entry:

➔ IMU

9. Verify data is logging:

➔ ?

➔ SDCARD

SDCARD Space: 29.711GB, Free: 29.677GB, Ovfl: 0, Next: D2/AC2_2.dat
SDCARD Sensor File: D2/SENS_2_1.dat, size: 0.582MB

Repeat the command, and observe if the file size is growing (it should be, indicating logging is indeed taking place.

In general, a command and + will stream; a command without plus will give a single return and stop. Examples for data queries are:

LOG STS CFG PING RTC
PTS IMU SDCARD EPT GPS MAG

Console Service

(Version 0.99.1, June 16, 2023)

1. Configuration

The Console Service is currently defined as Uart 1, baudrate 115200, data bits 8, parity none, stop bits 1.

<CRLF> refers to the line ending character(s) generated when the Return or Enter key is pressed.

2. General Operation

The Console Service comes up in Logging Mode, looking for a request to enter Command Mode.

? ? enters Command Mode and pauses Logging Mode for 30 seconds. This is to make it easier to enter commands in the face of streaming log data. When Command Mode is entered, the Command Menu is displayed, followed by the Command Prompt (>) , for example:

```
LOG   STS   CFG   GEO   ADC   ECHO   EPT   RTC
PTS   IMU   SDCARD NAU7802
>
```

The list of Commands may be different, depending on the device configuration. Most Commands will be described in Section 3, below, but CFG (Configuration Mode) is special:

> CFG<CRLF> - this enters Configuration Mode, the Configuration Command Menu is displayed, followed by the Configuration Prompt (>>), for example:

```
EXIT   RTC
>>
```

The list of Configuration Commands may be different, depending on the device configuration. Most Configuration Commands will be described in Section 4, below, but EXIT (Configuration Mode) is special:

>> EXIT<CRLF> - this Command exits Configuration Mode and returns to Command Mode. When Command Mode is re-entered, the Command Menu is displayed, followed by the Command Prompt (>).

When in Command or Configuration Mode, ? may be entered, to pause Logging Mode for 30 seconds, redisplay the current Menu (Command or Configuration), and redisplay the current prompt (> or >>).

Commands and Configuration Commands (except for ?) must be followed by <CRLF>. To make corrections, backspace is allowed until the <CRLF> is entered.

3. Commands

The current list of Commands and parameters are listed in Table 1, below.

Table 1, Command Description

Command	Parameters	Operation
LOG	none	Displays LOG Help
LOG	+	Restarts Logging mode
LOG	-	Pauses Logging mode indefinitely
STS	none	Requests devices to output their Status
STS	Device	Requests a particular device (GEO, ADC, ECO, etc. to output its Status)
CFG	none	Enter Configuration mode
GEO	none	Request Geophone device to output one sample for each channel in xx,xxx,xxxx format, comma separated hex values (no 0x prefix)
GEO	#	Request Geophone device to output 1024 samples for channel # (0,1,2) in xx,xxx,xxxx,… format comma separated hex values (no 0x prefix)
ADC	none	Request External ADC device to output one sample for each channel in xx,xxx,xxxx format, comma separated hex values (no 0x prefix)
ADC	#	Request External ADC device to output max samples for channel # (0,1,2,3,4,5,6,7) channel in xx,xxx,xxxx format, comma separated hex values (no 0x prefix). max samples currently 5120

ECHO	none	Request Echo Sounder device to output latest PING_PROFILE in xxXXxxXXxx… format, unseparated 2 digit hex values (no 0x prefix) PING_PROFILE currently 226 bytes.
EPT	none	Displays EPT Help message
EPT	#	Displays periodic External Pressure / Temperature data # times
EPT	+	Displays periodic EPT data forever, or until a new EPT command is entered (use EPT 1 to turn periodic data display off after next period).
RTC	none	
PTS	none	Displays PTS Help message
PTS	#	Displays periodic internal Pressure / Temperature Sensor data # times
PTS	+	Displays periodic PTS data forever, or until a new PTS command is entered (use PTS 1 to turn periodic data display off after next period).
PTS	FAST	Set PTS periodic rate to fast value (currently every 1 second)
PTS	SLOW	Set PTS periodic rate to slow value (currently every 10 seconds)
IMU	none	Displays IMU Help message
IMU	#	Displays periodic IMU data # times
IMU	+	Displays periodic IMU data forever, or until a new IMU command is entered (use IMU 1 to turn periodic data display off after next period).
IMU	FAST	Set IMU periodic rate to fast value (currently every 10 times per second)
IMU	SLOW	Set PTS periodic rate to slow value (currently every 1 second)
SDCARD	none	Displays current SDCARD information

4. Configuration Commands

The current list of Configuration Commands and parameters are listed in Table 1, below.

Table 2, Configuration Command Descriptions

Command	Parameters	Operation
EXIT	none	Exit Configuration Mode, return to Command Mode
RTC	DD/MM/YY HH:MM:SS	Set Real Time Clock to time specified in Parameters, numbers only

5. Paused Log Nuances

(In the next release)

The output of these commands will be displayed even when LOG is paused.

RTC and IMU PTS EPT (with # parameter set to 1)

These commands will restart the log

IMU PTS EPT (with + or # parameter set to > 1)

These “Dump” commands will pause the log until done then return it to its previous state

ADC, ADC #, GEO, GEO #, ECHO

Data output as a result of STS commands will be displayed even when LOG is paused.

Serial Connection

Below is an example of how to connect to the console via serial, using minicom.

Dialout

First, check if the current use is in the dialout group:

```
> groups
efischell adm tty uucp dialout cdrom sudo dip plugdev lpadmin lxd sambashare
```

“Dialout” should appear in the list. If it does not, you need to add yourself to the dialout group:

```
> sudo adduser $USER dialout
```

Where $USER is the username you log in with (for the above example, efischell). You need to do this so that python etc. can access the serial port.

Minicom

Next, plug in the USB connector on the shore cable. This should show up as something like /dev/ttyUSB0:

```
> ls /dev/ttyU*
/dev/ttyUSB0
```

To run/use minicom:

```
> minicom -D $PORT
```

Replacing $PORT with the above USB port.

In minicom, navigate the menus:
CTL-A
O
Set flow control to “OFF”, ensure baud rate is 115200. You should start to see