

pHFET-SOS (MFET MPHox NANOFET) v4.1.6 Release Notes

Release v4.1.6 is released for lab testing 7 Dec 2022. MpHOX rev B, MFET rev C, and NanoFET rev A are supported.

It is expected that v4.1.7 will follow with fixes / mods found in lab testing.

Not Fixed:

>>>> Bug Aug 24 2022 <<<< Thom
QA file is written to microSD card with length = 0.

>>>> BUG <<<< JLong 29 April 2022
Conductivity data were skipped in file:
ProjectLib/mpHOx/board_tests/4_1_1_mpHOx_test/10266010.txt

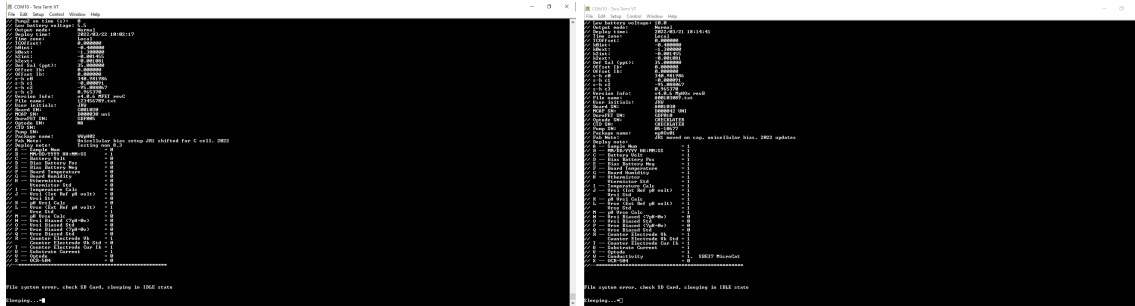
Note from Thom: Need access to the datafile and some clarification. Is this due to the header having two fields swapped?

```
"TC_MCat\tCond\tPres\tpSal\tDate_MC\tTime_MC\t"); }  
// bug fix 19May2022 swapped pSal/Press for microCAT SBE37  
"TC_MCat\tCond\tpSal\tPres\tDate_MC\tTime_MC\t"); }
```

>>>> BUG <<<< JLong 29 April 2022
Update start-of-line character? Currently #

>>>> BUG <<<< Thom 20220311
Implement experiment duty cycle (number of sample periods on, number of sample periods off)

>>>> BUG /REQUEST<<<< 20220321 JKW: filenaming bug v 4.0.6 mphox/mfet
A file name longer than "12345678.txt" will break deployment loop and put sensor to sleep:
"File system error, check SD Card, sleeping in IDLE state
Sleeping..."
Would be better if the incorrect filename could be truncated to 8.3, or if an error could be thrown in the menu. Examples from mFET and Mphox below:



>>>> BUG <<<< Thom/Jacki

Postpend a space when printing data to log and console

>>>> BUG <<<< Thom 20210818

At the end of the sample, 0x0d 0x0a is the terminator. Suggest making an app config for 0x0d (Unix) or 0x0d 0x0a (Windows)

>>>> BUG <<<<

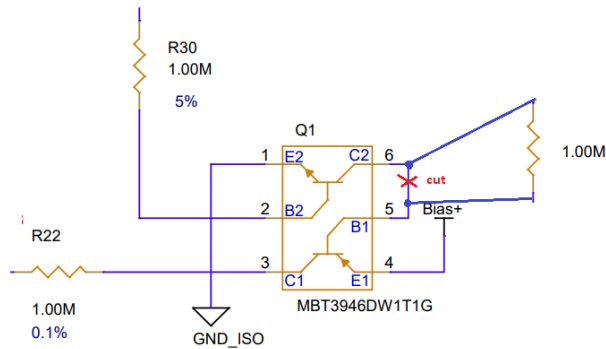
Should there be a way to change temperature source from Durafet to CTD or Optode when calculating pH?

>>>> BUG <<<<

Slope and offset correction for Temperature

New Features:

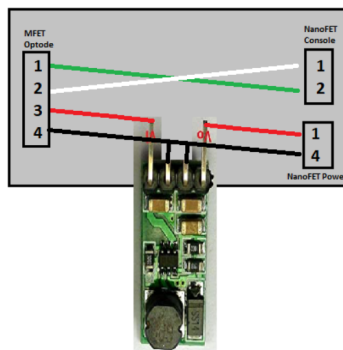
- Support for nanoFET 'Rev A'
 - ISFET pH and temperature for deep sea durafet
 - BME280 housing environment. Temperature and Humidity are available for deployment config and pressure is available by test menu.
 - Logging to onboard flash is not supported in this release.
 - Requires a blue wire on ADS1248 pin 6 to pin 16 for single ended bias bat measurement and a trace cut and addition of 1Mohm resistor on Q1
 - NanoFET schematic snippet:



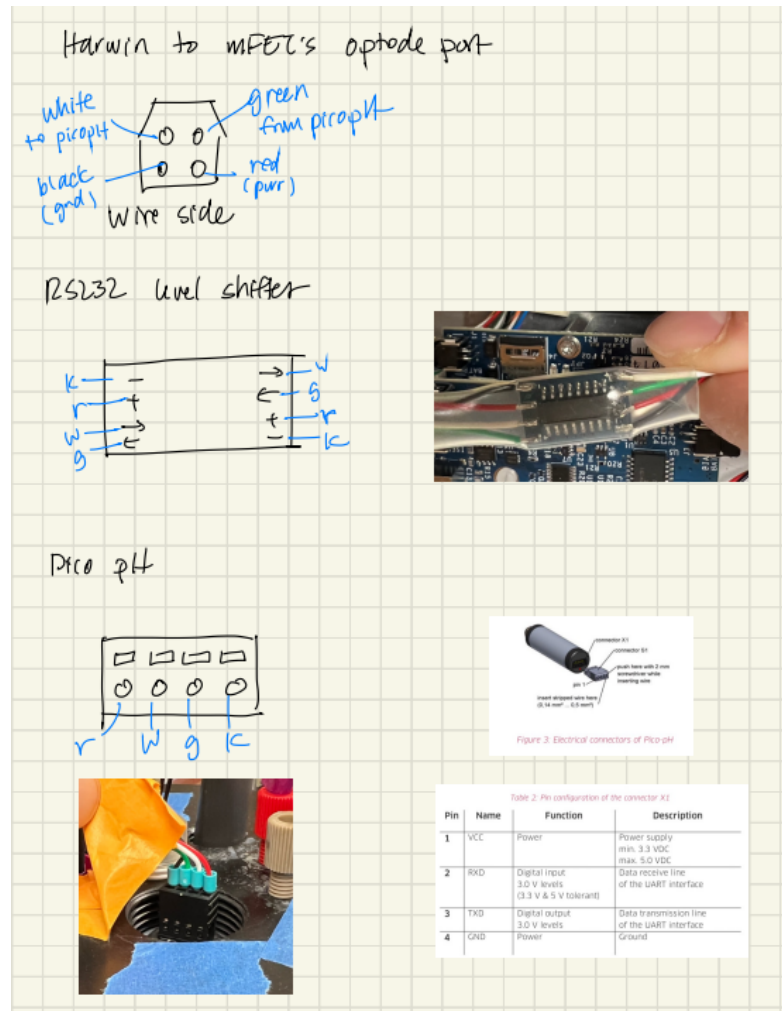
- MFET drivers:
 - NanoFET as a pH instrument attached to MFET optode port. NanoFET cable requires a 5v to 12v boost converter.
 - Integration of Irene Hu's Pico-pH driver for MFET optode port. Pico-pH cable requires rs232 level shifter.
 - OCR-504 driver for MFET optode port is available, not yet tested.
- MFET Wirewalker fast sampling, aka 'databar' mode. This is configured thru the menu system: 1 -- Configure, Y -- Advanced, A -- App Config, then enter 2 for EXEC_FAST_SAMP. In deployment, back to back sampling with no processor sleep between samples.

MFET Optode port Cable Diagrams:

- NanoFET as a pH instrument for MFET. 5v to 12v Boost converter is available on Amazon, <https://www.amazon.com/dp/B07T7FWVP8>
- Diagram:



- Pico-pH cable:



Bug fixes and new features:

- Wirewalker fast sampling use case with Databarf feature. No sleep between samples. Sample period is 0.5 sec.
- Merge Irene's pico-ph driver. Update to new driver model and config framework.
- FRAM storage of samplenum not working on NanoFET attached to MFET optode port. When NanoFET is used as a pH instrument on the MFET, the sample number is stuck at 3. FIXED. This was due to statemachine turning off power to nanoFET to quickly.
- Create a 'dump fram' utility, put it under the Advanced menu under Config. Useful diagnostic.
- Change main menu to match the user workflow. 1) Configure, 2) Test, 3) Sleep, 4) Deploy. This helps new users. Justification: since the menu system was being reworked to hide 'advanced' features, it was thought this is the time to make the change.

- Re-tool serial driver interfaces for both UART3 / Optode Port and UART4 / CTD Port to simplify driver integration on Optode and CTD port. In uart3.c, steps are outlined for adding a new driver to pHFET-SOS
- Add a menu item to 'assign defaults' for sys_data after a firmware update. This separates the init of sys_data from QA data. QA data should be preserved for diagnosis of hardware issues. Warning that pops up when firmware is updated reflects the new procedure.
- Merge Irene's pico-ph driver. Update to new serial driver framework.
- Merge Irene's code for Eddy covariance. Files have been added, however the merge was not completed. Code is commented out in this release.
- NanoFET as a peripheral instrument for the MFET on the Spray Glider. Connect the nanoFET to the MFET for two pH sensors on the Spray.
- Wirewalker databarf mode. Select via App config (available under 1-Config, Y-Advanced)

```

Enter Selection [9]: y
A -- App Config Fields
D -- assign Default values to EEPROM sys_data and sys_samp structures
E -- Edit/Copy EEPROM sys_data structure
S -- Print EEPROM Sys_data structure
Z -- ADC 24bit Sampling Parameters
M -- MetaData
R -- print QA Report
Q -- QA and setup after board manufacture
9 -- Exit to Main Menu

Enter Selection [9]: a

...

EXEC_DEPLOY is 0
EXEC_EDDY_COVARIANCE is 1
EXEC_FASTSAMP is 2

```

- Fix EEPROM burn out. This is a bug in all previous releases. Onchip EEPROM is rated for 500K samples. The fix was in place but due to a bug, the fix was not activated. Found during back to back sampling, trying to fill up microsd card. After downloading firmware, could not stop the sampling. Had to modify the code to re-init the sysData defaults just after init(). The fix is to not write the sys_data prior to sleep unless sys_data struct has changed....

Error.txt shows:

```

Cat error.txt
...
2022/09/19 21:52:27 Error storing system data (sleep.c).

```

```

2022/09/19 21:52:30 Error storing system data (sleep.c).
2022/09/19 21:52:33 Error storing system data (sleep.c).
2022/09/19 21:52:36 Error storing system data (sleep.c).
2022/09/19 21:52:39 Error storing system data (sleep.c).
2022/0
9/19 21:52:42 Error storing system data (sleep.c).
2022/09/19 21:52:45 Error s
/> ls

----A 2022/08/25 19:42      227  BOM.TXT
----A 2022/08/25 19:44    22597  LICENSE.TXT
----A 2022/09/05 17:24   42949602  THOMTEST.TXT
----A 2022/10/06 17:19 159541012  MFETTST2.TXT
----A 2022/10/06 17:19  27680094  ERROR.TXT

  5 File(s)
  0 Dir(s)
 7528832K bytes free

----A 2022/10/06 17:19 159541012  MFETTST2.TXT >> 159,541,012 159 Megabytes

```

- RC17 datalogger with MFET 147 has ymodem failure. Analysis shows this is due to `f_read()` error on the first data packet. Command 'ls' shows the directory and file size, however all the files fail command 'cat' and 'ys'. MicroSD card removed and Windows does not recognize the card. The FIX is to move to industrial grade microSD cards.
- Reported by CeNCOOS. On v4.1.1 mpHOx RevB (using mpHOx controller). Optode, SBE37, pH all connected and deployed on the Monterey Warf. Controller crashed when they went to the main menu -> config -> data headers. Recovering sensor and will have controller back for more detailed config settings. 8/22/2022. Fixed.
- Write app config state in metadata (microsd logging, uart echo, app exec). The metadata should represent a full reproducible config / setup of the MFET/NanoFet/MpHOx. Updated the metadata print function.
- Add a password or other means to prevent inadvertent access to system config options by 'new users'. Fix provided as an 'Advanced' menu item.

```

Main Menu -- v4.1.6 MFET revC -- Will sleep in 30 seconds
1 -- Configure
2 -- Test
3 -- Sleep
4 -- Deploy
5 -- Files
H -- Help
Enter Selection: 1

```

```

Configuration Menu:
1 -- Set Clock
2 -- Change File Name

```

```

3 -- Set Deployment Parameters
4 -- Enter pH Sensor Calibration Coefficients
5 -- Calculate pH Sensor Calibration Coefficients
6 -- Change Baud Rate
7 -- Config Data Fields
8 -- Metadata Settings

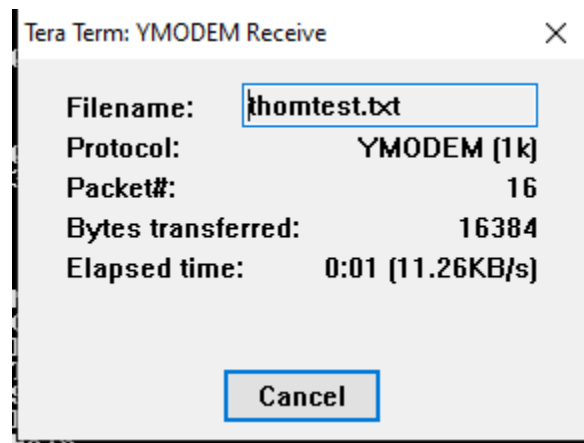
D -- Data Header, Sample Data, Sample Timing
M -- Metadata
Y -- Advanced Setup Menu

9 -- Exit to Main Menu

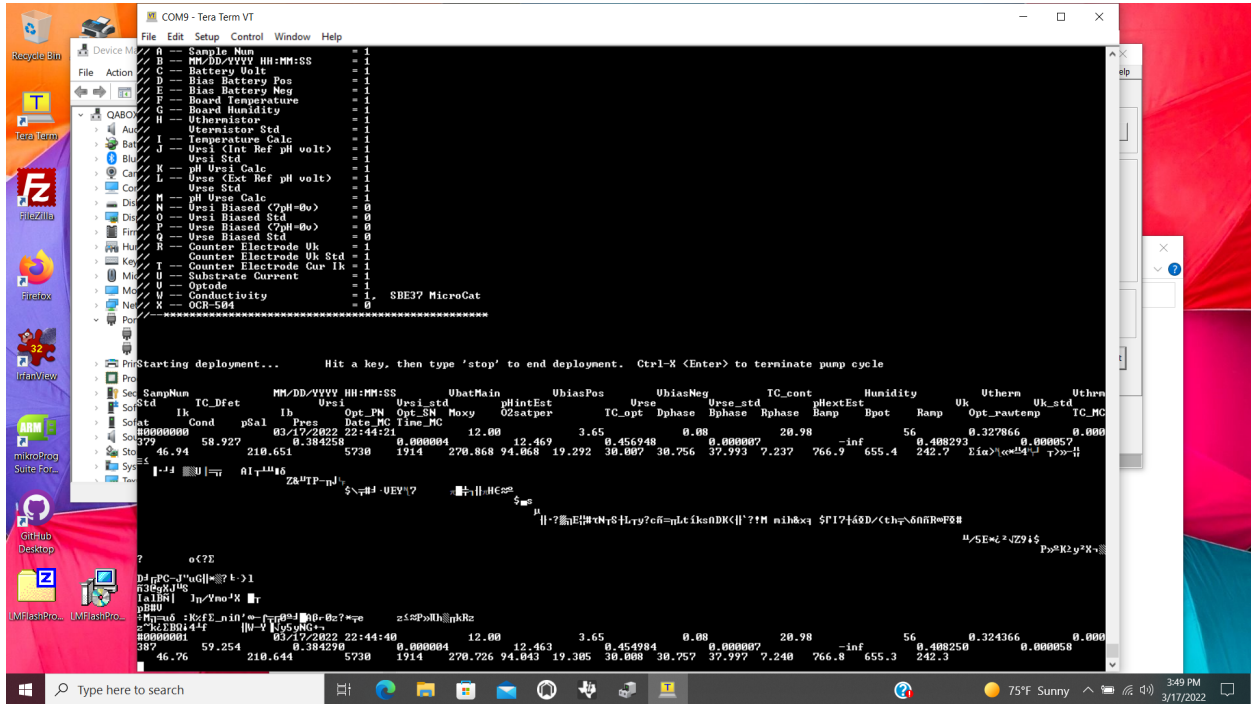
Enter Selection [9]: y
A -- App Config Fields
D -- assign Default values to EEPROM sys_data and FRAM sys_samp structures
E -- Edit/Copy EEPROM sys_data structure
S -- Print EEPROM Sys_data structure
T -- Print FRAM sys_samp sampling and pump sequence data structure
I -- Init FRAM sys_samp data structure
Z -- ADC 24bit Sampling Parameters
M -- MetaData
R -- print QA Report
Q -- QA and setup after board manufacture
9 -- Exit to Main Menu

```

- From connect with instrument menu, if you select “5”, it kicks you back to previous menu, if you go through and try again it will work. Fixed.
- Add ‘d’ to configuration menu options for testing config of data fields.
- Teraterm stops at 16384 bytes transferred. Root cause appears to be a bad command packet sent from Teraterm. After asking for assistance, Irene and Yui were able to transfer large files without problems. This was fixed by removing Teraterm and re-installing the latest Teraterm version 4.106



- Sampling in the 3, D loop, or deploying w/o an SBE37SI attached results in no output of the SBE data into the TS response. When testing via 3,5,1 menu and polling the microcat directly, a proper response can be seen.
- Sampling in the 3, D loop, or deploying w/o an SBE37SI attached results in junk characters being presented. Can be fixed by attaching CTD to port and redeploying. Sometimes even while plugging CTD in during deployment loop.



- Sample period = 3, results in sampling every 2 seconds

```
//+***** Deployment Settings *****
// Firmware version: v4.0.6 MpHox revB
// Sampling period (s) 3
// Samples hour align: Yes
// Vrsi sps, trials: 20, 10
// Vrse sps, trials: 20, 5
// Vtherm sps, trials: 20, 5
// Ik sps, trials: 160, 1
// Vk sps, trials: 160, 1
// Ib sps, trials: 160, 1
// Vb sps, trials: 20, 5
// Vbias sps, trials: 40, 1
// Pump on time (s): 0
// Pump1 on time (s): 0
// Pump2 on time (s): 2
// Low battery voltage: 10.5
// Output mode: Normal
// Deploy time: 2022/03/17 10:42:08
// Time zone: Local
// TCOffset: 0.000000
// k0int: -0.400000
// k0ext: -1.300000
// k2int: -0.001455
// k2ext: -0.001081
// Def Sal (ppt): 35.000000
// Offset Ik: 0.000000
// Offset Ib: 0.000000
// s-h c0: 340.981986
// s-h c1: -0.000091
// s-h c2: -95.088067
```

```
// s-h c3 0.965370
// Version Info: v4.0.6 MpHOx revB
// File name: thomtest.txt
// User initials: tgm
// Board SN: a001039
// MCAp SN: 39
// DuraFET SN: 64545454
// Optode SN: 5254245245
// CTD SN: this is the story of a
// Pump SN: 44lthom
// Package name: thomz dev mphox
// Fab Note: fab'd mid-2020 in the great pandemic
// Deploy note:
// A -- Sample Num = 0
// B -- MM/DD/YYYY HH:MM:SS = 1
// C -- Battery Volt = 0
// D -- Bias Battery Pos = 0
// E -- Bias Battery Neg = 0
// F -- Board Temperature = 0
// G -- Board Humidity = 0
// H -- Vtermistor = 0
// I -- Vtermistor Std = 0
// J -- Temperature Calc = 0
// K -- Vrsi (Int Ref pH volt) = 0
// L -- Vrsi Std = 0
// M -- pH Vrsi Calc = 0
// N -- Vrsi (Ext Ref pH volt) = 1
// O -- Vrsi Std = 1
// P -- pH Vrsi Calc = 0
// Q -- Vrsi Biased (7pH=0v) = 0
// R -- Vrsi Biased Std = 0
// S -- Vrsi Biased (7pH=0v) = 0
// T -- Vrsi Biased Std = 0
// U -- Counter Electrode Vk = 1
// V -- Counter Electrode Vk Std = 0
// W -- Counter Electrode Cur Ik = 1
// X -- Substrate Current = 1
// Y -- Optode = 0
// Z -- Conductivity = 0
// AA -- OCR-504 = 0
//--*****
```

Starting deployment... Hit a key, then type 'stop' to end deployment.

MM/DD/YYYY HH:MM:SS	Vrse	Vrse_std	Vk	Ik	Ib
03/17/2022 10:42:10	0.016750	0.008239	0.413801	-62.24	252.311
03/17/2022 10:42:12	0.016542	0.008332	0.413810	-62.76	221.350
03/17/2022 10:42:14	0.016555	0.008337	0.413816	-62.74	221.370
03/17/2022 10:42:16	0.016547	0.008342	0.413813	-61.64	221.267
03/17/2022 10:42:18	0.016521	0.008356	0.413811	-62.81	221.306

- Test_mode gets forced to 0 in Deploy() START - looks like a bug

```
void deploy(deploy_state state)
{
    uint32_t retVal;
    time_t current_time, usersTime;

    char input, buff[100];
    int response;
    uint32_t temp;

    switch(state)
    {
        case START:
            sys_data.test_mode = 0; // SBE pump will run if not in test
mode

            // Set custom start time, test mode, removed before 2018...
```

```
// Start immediately
current_time = ROM_HibernateRTCGet();
```

- Sensor salinity should not be in sys_data, move to sys_samp (FRAM)
- NanoFET ADS1248, 3 mux inputs need to be configured as ADC instead of GPIO
- Wirewalker MFET test case, add a profile for fast sampling.
- When mFET is in 'datalogger' mode and deployed (i.e. take sample every second), it doesn't keep it's 'deployed' state when power is toggled. For example, if it is deployed and logging data, and then power is toggled, it will go back to its main menu rather than going back into deployment mode. This isn't the case for 'polled' mode, like we operate for the Spray.
 - Fixed in v4.0.6. When wake event associated with power on, (sleep_handler (should be called wake_handler) HIBERNATE_INT_WR_COMPLETE, modified the wakesource to pretend it's an RTC wake event, this causes a sample to be taken and next wakeup to be programmed. I thought about adding a note to the sample indicating a power event, but this was additional work that I thought should come from 'user request'. As it is, the timestamp tells the tale.
 - Tested in both aligned and not aligned. Tested with power off for several hours.
 - Note: there is a risk if power is cut during a uSD card write (tiny chance, but possible) that card corruption can occur so don't be thinking you can just cut power at any old time....
- Add support for OCR-504 to MFET for Glider deployment (requires modified mfet for 6v out on optode port).
- Ymodem crash on MFET after a glider deployment ss,sl. Note: this was due to a nearly dead battery. In v4.0.6 a warning is printed at the main menu indicating low Vin
- PROGRAMMING PROCEDURE: 2 parts

uSD card QA check doesn't seem to work on first pass with any previously used microSD card. The workaround for this is to go through 3-Q test menu procedure, put board to sleep, then run 3-Q QA again and it works. Very Strange.

Also had one board that had an issue measuring the amount of free space left on its uSD, even though it was a fresh card. This was rectified by going into file menu a second time, which resulted in free space being shown.

FIXED. Logic gap associated with enable/disable of uSD occurs when state of flash is 0xff

FIXED by checking insertion state of microSD and insuring that proper filesystem init is called before use.

1. Attempted to program several mphox mcap boards. Almost all were below 3.8.4, some had not been programed previously

2. For boards that had been programmed previously, going to 3.9.1 resulted in an EEPROM error that resulted in the Timestamp check crashing out, often resulting in “test timestamp...” or “timestamp loc” Before locking up (image below).

[illegible]

3. I believe that James had been running EEPROM data procedure, 1→E, as any board that had gone through the EETECH QA/programming procedure had this game breaking bug. I do not use this step, but check the eeprom later, as I was under the assumption that running the 3-Q QA procedure flashed the EEPROM properly.

[illegible]

4. Another image of the error below.

- Init.c, allow reset default GPIO state as input rather than programming unused pins as outputs for slightly lower power. Corrected a couple of errors including SDpresent (input) that was programmed as output. Re-ordered init.c
- Verify 'Sleeping*' termination on MFET for glider use case. Seems like Brent needed a special character and another 'bug' fix possibly broke that. Need to verify v3.9.x on Glider.
- Change API in optode and ctd to use UART3 and UART4
- Remove line termination filtering in ISR. Add /r/n to uprintf strings.
- Simplify state machines for parsing ctd and optode byte streams
- AUX-PWR (aka AUX1.c) API structure to allow for multiple instrument drivers (HyperOCR, ADV, etc.). Menu selections, etc.
- uSD cards incoming QA procedure. Was recommending Format as FAT32 (full erasure) on a Win10 Pro or Ubuntu PC and stop relying on factory format... If this is done, it needs to be done with the microSD card association utility and not with Windows formatting. Latest recommendation after talking with Scripps is to use 1GB industrial grade microSD cards and use 'as shipped' without formatting.
- Slope and offset correction for pH. k0 and k1 are used for this