CORK and BPR documentation Documentation

Release 0.2

Martin Heesemann

May 18, 2013

CONTENTS

The wiki http://www.corkobservatories.org/pmwiki/index.php

Unfortunately, the wiki site is not very well maintained in the moment.

I do maintain a version controlled software repository that contains all the programs that you need to deal with CORKs and the downloaded data: http://corkobservatory.svn.sourceforge.net/viewvc/corkobservatory/

This repository is used to keep the computers that are used to download data updated and in sync. It also contains all calibration and site information (see CalibrationFiles) and the details of the instrument configurations (see ParameterFiles). If you want to contribute to that information, you need to install subversion (svn) to stay up to date and push new updates to the software repository. Or you can ask me to make the modifications. I also use the repository the maintain some documentation of the software that you can access here: http://corkobservatory.sourceforge.net/

CHAPTER

ONE

BEFORE YOUO GO TO SEA

1.1 Make sure you have a working computer

A computer running Linux is the simplest platform to install and run the CORK software on.

1.1.1 Verify that your software is still current

[mheesema@sciserv C-tools]$ svn log -r base:head

CHAPTER

TWO

CORK AND BPR FIELD GUIDE

2.1 Crib sheets

2.1.1 Simple health check and download

1. Make sure laptop clock is synchronized (see *Sync to NTP*)
2. Create a working directory (see *Setup working directory*)
3. Connect instrument to computer (see *Connecting the Instrument*)
4. Turn on communication and power **after** connection is established make sure power and comms are off before ODI connector is removed from parking position
5. Run mlterm, making sure to use a reasonable log-file name (see *Starting mlterm*)
6. **Get instrument stats `F`**
    (a) Take note of clock drift (do **not** syncronize the clock, later on)
    (b) Take note of predicted download times
7. **Get basic logger settings `I`**
    (a) Take note of download baud-rate (115200 for NEPTUNE instruments)
    (b) Take note of control baud-rate (115200 for NEPTUNE instruments)
8. Consider to increase download speed (see *Increase download speed*)
9. Download data `D`, making sure to use a reasonable file name
10. Get instrument stats `F` again
11. **Deploy instrument and quit `Z`** PI might suggests real-time monitoring while following next steps
12. Backup data (*.raw) to USB key (see *Backup data*)
13. **Check data integrity**
    (a) **run `mlbin xxxx.raw`** strips off file system and generate xxxx.bin (there should be no errors)
    (b) **run `dumpBin.py -a -n -t -s xxxx.bin > xxxx.dmp`** Does some integrity checking and creates ASCII dump
    (c) **run `tail xxxxx.dmp` to see statistics** Discuss with PI
14. Contact PI and discuss whether to clear memory
15. Backup *.log files and sent *.log and *.raw files to PI

16. Make sure the communication and power lines are turned off **before** the under water mateable connector is disconnected.

2.2 Howto's

2.2.1 Linux

Working with the *HP-Mini* s that are used to download data from *CORK* s and *BPR* s requires some basic Linux skills. This section provides some recipes for common tasks.

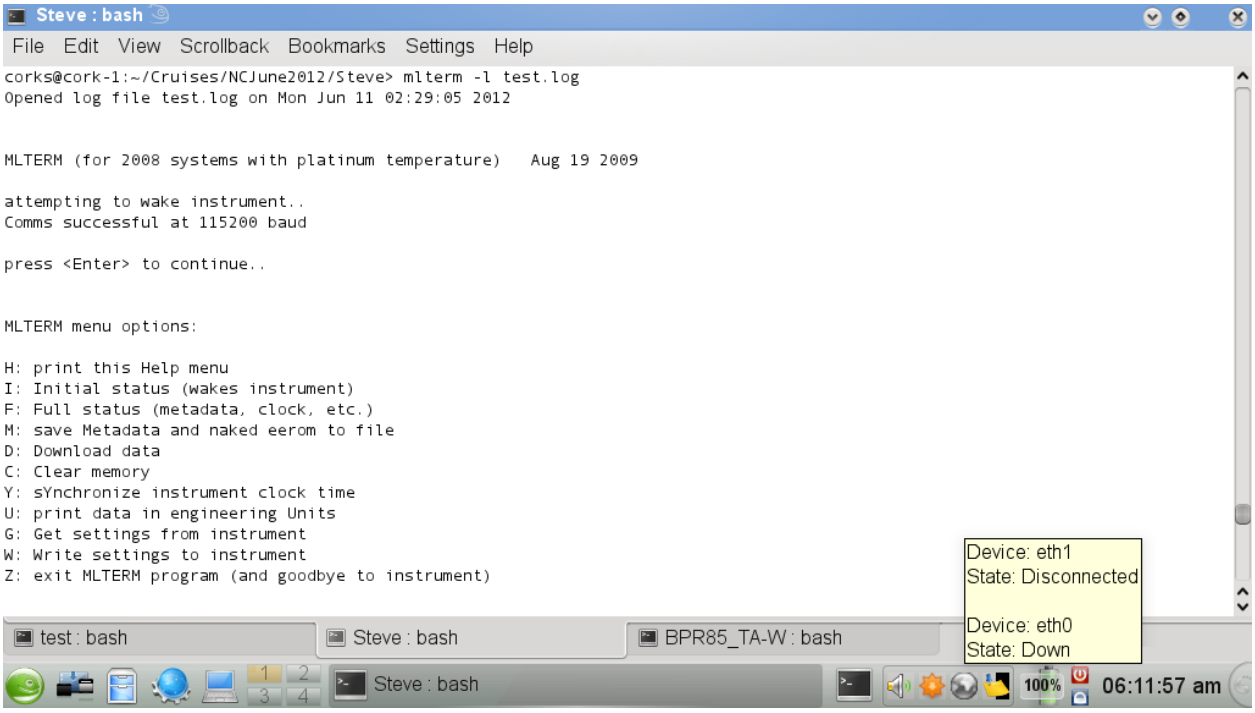


Figure 2.1: Linux session with terminal window.

Open a terminal window

Click on the terminal icon

to open a command-line terminal window. If needed you can create tabs with additional terminals from the `File` menu.

Basic Linux Commands

`pwd` Prints the current working directory

`ls` Lists the files in the current directory. Use `ls -lh` to get more details about the files.

`mkdir` Creates a new subdirectory (e.g. `mkdir TestDirectory`)

rm Deletes specified files. `rm -r` also deletes directories. **Careful**, there is no way back!!!

cd Change into specified directory. As with all other commands, pressing `Tab` does an auto-complete–try it!

Setup working directory

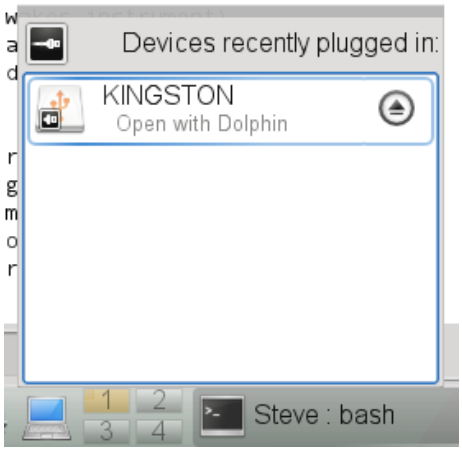
Before you start to communicate with a CORK or BPR, create a working directory under `/home/corks/Cruises` or `/home/corks/Tests`–what ever seems more appropriate. If you are on a cruise you might consider creating subdirectories for individual instruments. In a terminal window change the directory to the working directory and execute `cp /home/corks/corkobservatory/CalibrationFiles/\*.txt ./` to copy some calibration files into your working directory (see *mlterm calibration files*). Now, you're all set to begin communication with the logger, data download, and post-processing.

If all of this is not clear to you, you might want to read *Open a terminal window* and *Basic Linux Commands* first.

Backup data

After downloading data from an instrument and before clearing the memory, make sure that you make at least one backup copy of the data is on a USB key. To make a backup follow these steps:

1. Insert USB key (it will be mounted under /media)
2. Find out the name/directory of the drive (`ls /media`)
3. Copy files `cp file1.raw [file2.log ...] /media/nameOfUSB` (`cp -R` let's you copy directories recursively)
4. Unmount USB key (click computer icon, hover over device–e.g. KINGSTON, click eject symbol)



5. Now the eject symbol should have disappeared and you can safely remove the device

Sync to NTP

1. Boot up the *HP-Mini* and make sure that wireless networking is enabled (both LEDs on front are blue) if you do not have a cabled connection.
2. **Make sure you are connected to a network**
   (a) Hover over icon on the bottom tool bar (globe, or wireless signal) and check if eth0 (cable) or eth1 (wireless are connected)

(b) If no connection is up, click on the globe and connect to a network (e.g. TGT if you happen to be on the Thompson)

3. **Open a terminal window and monitor the NTP log file (`tail --follow /var/log/ntp` – `Ctrl-c` to quit)**

   (a) Look for `synchronized to xxx.xxx.xxx.xxx, stratum ?` that happened within the last 30 min or so.

   (b) If you do not see anything, try to restart NTP (`sudo /sbin/service ntp restart` – you will need the root password)

   (c) If after a few minutes you still do not see any signs of synchronization, you might have to *Setup NTP*

Setup NTP

Todo

Add section about NTP setup

2.2.2 Instrument setup

Connecting the Instrument

Most modern CORKs and BPR have an RS-422 serial interface. We found that *Moxa UPort* USB-to-RS422 converters provide the most reliable connections.

2.2.3 mlterm

Starting mlterm

Before running mlterm in a command-line terminal, make sure you are in a directory that is appropriately setup (see *Setup working directory*). If you simply run `mlterm`, the session will be logged (appended) to a logfile named after the current date. It is advisable to use the `-l myLogfile.log` command-line option, to choose a descriptive name. On startup, mlterm tries all possible baudrates to connecte to the instrument. If the baudrate is known (115200 for all NEPTUNE instruments) the `-b 115200` option provides a quicker initialization. As shown in *Linux session with terminal window.*, the instrument should wake up after a short period of time and after hitting `Enter` the high-level mlterm menu will be presented.

Increase download speed

Start mlterm (see *Starting mlterm*) and from high-level menu proceed as follows:

1. Enter low-level mode by pressing `P` and `Enter`

2. Bring up MT01 menu `Ctrl-s`
3. Choose option to change download baudrate `3`
4. Choose appropriate download speed (most likely `8` 230400)
5. Quit MT01 menu `Q`
6. Quit low-level interface `Esc`

Now, your are all set to start the download procedure.

Note, the download baudrate will automatically be set to it's default if you deploy the instrument by quitting mlterm with `Z` or after a timeout period of 30 minutes.

2.2.4 Data post-processing

After downloading raw data from an instrument (see *Simple health check and download*) the data has to post-processed.

First, mlbin has to be applied (`mlbin filename.raw`) to turn the *.raw file into a *.bin file. The *.raw files still contain the filesystem of the flash card and recovery information in case there were errors in the data transmission. mlbin strips off the filesystem and tries to fix any errors that might have occured. The *.bin file only contains data records in binary counts.

mldat9 (`mldat9 filename.bin`) is the standart utility to calibrate *.bin data and write the results into a *.dat ASCII file. In order to use mldat9 you have to cd into the directory with the *.bin file and make sure there is also a current set of calibration files in the directory (see *Setup working directory*). While running mldat9 you will be ask whether the temperatures are measured using a platinum sensor or a thermistor. Platinum sensors are mostly used in CORKs and BPRs installed past 2009 and have two-digit serial numbers, while themistors have one digit serial numbers. The serial numbers are shown in the sites.txt calibratrion file (see *mlterm calibration files*) and should be noted in the respective *.par file under `~/corkobservatory/ParameterFiles`. Furthermore, you are asked whether the Paroscientific gauge measures pressure and temperature or pressure only. If you do not know the answer you can lookup the gauge serial numbers that are mentionend in sites.txt in parosci.txt and check whether U0, Y1, Y2 are zero (pressure only) or non zeros (pressure and temperature). Then you have to select a data format (typically ‘‘ 4. Parosci temperature compensated pressure‘‘) and a site description which is a line from the site.txt calibration file. The site description has the following format:

number:	description_rtcID	deploymentMonth	temperatureSerial	parosciSerial	parosciSerial	...
3:	1027C_89	Jul10	98	120238	120239	...

mldat9 automatically removes spikes from the paros pressure and temperature channels that get sometimes generated by the measurement system and is convinient to use, but it has certain limitations:

1. mldat9 has problems with partial records that can sometimes occur especially on systems that occasionally switch between battery and cabled mode.
2. mldat9 cannot cope with instruments that have a mix between gauges that measure temperature and pressure and pressure only. These configurations exist especially for CORKs which have many gauges and are designed to operated in cabled mode.

To cope with these problems two Python programs were developed that can be used instead of mldat9 (see *Install dependencies for Python scripts*). The first script dumpBin.py can be used fix *.bin files by eliminating partial records, remove spikes, find problems, and dump the binary counts into an ASCII format that is human readable and can be calibrated using a calibrateLogfile.py.

A common workflow to process `filename.bin` using these scripts would be:

1. Fix data problems using `dumpBin.py -n -s -a -t -b filename_fixed.bin filename.bin > filename.dmp`
    - filename_fixed.bin will contain all complete data records

- filename.dmp will contain ASCII representation of binary data and debugging information

2. Dump despiked data (only works with clean data) for calibration "dumpBin.py -d filename_fixed.bin > filename_despiked.dmp
3. Calibrate the data `calibrateLogfile.py -c calibrationName filename_despiked.dmp > filename_despiked.dat`
   - calibrateLogfile.py also works with data from stdin, so the last two steps can be combined using a pipe: `dumpBin.py -d filename_fixed.bin | calibrateLogfile.py -c calibrationName > filename_despiked.dat`
   - Run `calibrateLogfile.py -l` to get a list of available calibrations. New calibrations can be defined in calibrateData.py.

Run `dumpBin.py --help` and `calibrateLogfile.py --help` to study all available the commandline options.

mlterm calibration files

There are three different calibration files:

parosci.txt Calibration coefficients for Paroscientific pressure gauges

platinum.txt Calibration coefficients for platinum housing temperature sensors

therms.txt Calibration coefficient housing temperature thermistors

sites.txt Data base that associates deployment locations and times, logger IDs, and sensor IDs. This information is used for calibration routines.

Note, mldat and mlterm only support only up to 30 lines in sites.txt.

Todo

Changed mldat (wrt2dat.c – DEFINE MAXSITES) to support sites.txt files with more than 30 lines. Add same functionality to mldat (formatdata.c) requires CORK simulator for testing...

2.3 Glossary

AWQ bulkhead connector CORK pressure cases usually have an 6 pie AWQ bulkhead connector, that connects to an 7-pin ODI or SEACON underwater mateable connector. BPR pressure cases usually have an 2 piece AWQ bulkhead connector, that connects to a 7-pin ODI connector.

ODI to two pie AWQ cable

BPR Bottom Pressure Recorder

CORK Circulation Obviation Retro-fit Kit

HP-Mini There are four HP-Minis setup to do CORK and BPR downloads around the world. It is also possible to compile the communication software for Mac and there is an image for VirtualBox that makes it possible to run the software on a Linux virtual machine under windows.

Moxa UPort The Moxa UPort USB-2-RS422 to adapter provides superior download speeds over other brands. Unfortunately, the driver only supports older versions of Linux. UPDATE: There is a new driver released in summer 2012. Also, Nic Scott mentioned wrapping Windows drivers under Linux

CHAPTER

THREE

CORK COMPUTER SETUP

3.1 Required software

A computer running Linux is the simplest platform to install and run the CORK software on. It is also known to run on Mac computers and most data data processing can be done on Windows machines, but mlterm the programm used to communicate with CORKs and download the data does not work under windows and the necessary development environment to compile various C-programs might be challenging to setup on Mac.

3.1.1 Check out the CORK software repository

CORK software, calibration and parameter files are maintainded at the CORK Observatory Software Repository.

It is best to have svn installed to check out the code. Check if svn is installed by running `svn --help`. If there is not help displayed you have to install svn e.g. by running `sodu yum install subversion`.

Now, go into the home directory of the cork user (`cd ~`) and run

```
svn co https://svn.code.sf.net/p/corkobservatory/code/ corkobservatory
```

Note: SourceForge changed their naming scheme. Do *not* use the following anymore: `svn co https://corkobservatory.svn.sourceforge.net/svnroot/corkobservatory corkobservatory`

If you are stuck at revision 65 after update Updated to revision 65.

`svn info` URL: https://corkobservatory.svn.sourceforge.net/svnroot/corkobservatory

```
svn switch --relocate https://corkobservatory.svn.sourceforge.net/svnroot/corkobservatory
https://svn.code.sf.net/p/corkobservatory/code/
```

After update revision should be greater than Revision: 73

This will create a `corkobservatory` directory that contains program source codes, calibration information, etc. To update these files to the latest version you can cd into the `corkobservatory` directory and run `svn update` at any time when you have an internet connection.

3.1.2 Compile and install mlterm, mlbin, mldat9

`mlterm`, `mlbin` and `mldat9` are the core utilities (programmed in C) to setup CORKs and download the data, strip unneccessary filesystem information from the downloaded *.raw files, and to calibrate the data contained in the *.bin

files, respectively. In some special cases, when there are problems with data consistency or with special instrument setups you need to use some Python scripts, that will be discussed later, instead of mldat9.

Since the core utilities are supplied as C source code, you need to have a C-compiler and basic development tools installed. cd into the `mlterm`, `mlbin`, and `mldat` directories under `~/corkobservatory/C-tools` and run

1. make
2. sudo make install

in each directory to compile and install the programs individually.

NOTE: there is also a variant of mlterm `mlterm_vpn` that gets automatically installed with mlterm that is for use with instruments connected over connections with high latency (e.g. TCP/IP, VPN,...).

3.1.3 Install RS-422 adapter driver if necessary

Many USB/RS-422 adapters run under Linux out of the box, but the *Moxa UPort*-1130, which we found is the most reliable adapter, requires the compilation/installation of a seperate driver. We had problems in the past, because the driver was not compatible with current Linux distributions, but fortunately, Moxa did update the driver in summer 2012.

So if you want to use a Moxa adapter make sure to download and install the latest diver either from their website or use the copy that is stored in the software repository (`~/corkobservatory/ComputerSetup/drivers/MoxaUPort`). Follow the instructions in the `readme.txt` file under "Module driver configuration".

If the driver install succeeded running `mlterm` with the Moxa UPort plugged into a USB port should start an mlterm session with mlterm trying to connect to the instrument. If the adapter is not recognized by the OS mlterm will fail with the following message:

```
/dev/ttyUSB0:  No such file or directory
```

3.1.4 Install dependencies for Python scripts

The Python scripts need

1. Python (tested with 2.6 and 2.7)
2. numpy
3. matplotlib (optionally for plotting)

So first check if Python is already installed `python --version` and install it with e.g. `sudo yum install python` if not. Now you can try to install the numpy and matplotlib packages of your distribution e.g.:

- `sudo yum install python-numpy`
- `sudo yum install python-matplotlib`

or install easy_install e.g. `sudo yum install python-setuptools` and then run:

- `sudo easy_install numpy`
- `sudo easy_install matplotlib`

Now, cd into the `~/corkobservatory/ComputerSetup/scripts` directory (see *Check out the CORK software repository* for how to set it up) and run `./createPythonToolsSymLinks.bash` to add symbolic links to the python scripts `dumpBin.py` and `calibrateLogfile.py` to your path. If everything worked out, running `dumpBin.py --help` and `calibrateLogfile.py --help` will display the respective help information.

CHAPTER

FOUR

MANPAGES

```
Usage: mlterm [OPTION] ... [DEVICE]

  Options:

    -b BAUDRATE     baudrate for terminal (should match instrument) deflt: 19200

    -C              Clear memory

    -d FILENAME     debug output file

    -D FILENAME     Download data to raw output file

    -p FILENAME     parameter error output file (companion to -W)

    -F              Full status report

    -G FILENAME     Get eerom and output to parameter file

    -h              display this help and exit

    -l FILENAME     log output file

    -M FILENAME     Metadata (and naked eerom) to  output file

    -n HOST[:PORT]  host (and optional network port; default is 4001) for

                    networked serial device

    -W FILENAME     Write parameter input file to instrument eerom

    -I              Initial status report

    -P              low level (Pass-thru) mlterm for advanced users

    -R              Recover communications

    -s SITENAME     name as in sites.txt to format data (companion to -U)

    -Y              sYnchronize instrument clock time

    -U COUNT        display data in engineering Units for COUNT samples

                    enter '' to display til ESC
```

```
    -v              verbose output to screen and log file
  DEVICE is the serial port device file; default is /dev/ttyUSB0
Usage: dumpBin.py [options] bin_files

This script processes ML-CORK bin files

Options:
  -h, --help            show this help message and exit
  -I RTC_ID, --RTC_ID=RTC_ID
                        Force RTC ID #. Supply id as hex integer (e.g. 0x8C).
                        Default: 5th byte in file
  -c NCHANNELS, --n_channels=NCHANNELS
                        Force number of paro channels
  -n, --no_stats        Skip stats--they can take some time and generate some
                        clutter
  -s, --spaces
  -a, --print_all
  -p, --plot_data       Plots the data. May not work if you do not have the
                        right libaries installed
  -i, --info_only       Just output statistics (and plot, optionally) and not
                        the actual data
  -o, --old_ML-CORK     Assume data is from an old ML-CORK where the readings
                        do not end with 0x00
  -t, --timestamps      Print calibrated timestamps on every line emulating NC
                        logfiles, at the same time.
  -f TIMESTAMPFMT, --timestampFMT=TIMESTAMPFMT
                        Modify timestamp format defaults is '%Y%m%d %H:%M:%S'.
                        Use -f '%Y%m%dT%H%M%S.000Z' to emulate NEPTUNE Canada
                        log files.
```

```
  -d, --despike         Remove detected spikes by inserting linear
                        interpolation.
  -b BINARYFILE, --binary_file=BINARYFILE
                        Safe a binary file skipping problematic records


Examples:

Usage: calibrateLogfile.py [options] logfile.log


This script find raw data in mlterm logfiles and calibrates it


Options:
  -h, --help            show this help message and exit
  -c CALIBRATION, --calibration=CALIBRATION
                        Name of calibration defined in calibrateData.py
                        (required)
  -s, --skip_length_check
                        Skip the check whether the number of calibrated value
                        equals the number of               binary input
                        fields. Use this e.g. for 1362B where one existing
                        channel               contains garbage and is not
                        used...
```

CHAPTER

FIVE

TODOS

Todo

Add section about NTP setup

(The *original entry* is located in C:\Users\Martin\Documents\Instruments\CORKs\corkobservatory\Documentation\src\FieldGuide.rst, line 156.)

Todo

Changed mldat (wrt2dat.c – DEFINE MAXSITES) to support sites.txt files with more than 30 lines. Add same functionality to mldat (formatdata.c) requires CORK simulator for testing...

(The *original entry* is located in C:\Users\Martin\Documents\Instruments\CORKs\corkobservatory\Documentation\src\FieldGuide.rst, line 281.)

CHAPTER

SIX

PYTHON MODULES

Basic functions needed to calibrate ML-CORK / BPR data.

More text to describe what's going on

calibrateData.**calibratePPCTime**(*xt=709763880*)

calibrateData.**calibrateParoP**(*xFP*, *Coeffs=None*, *xFT=None*, *Temp=None*)

calibrateData.**calibrateParoT**(*xFT*, *Coeffs=None*)
Calibrate temperatures from Paroscientifc Type-II gauges.

calibrateData.**calibratePlatinum**(*xT*, *Coeffs=None*, *ID=None*)
Calibrate temperatures from platinum chip sensors.

The conversion from A/D counts to temperatures in degC is a simple linear relation ship.

$$T = a \cdot x + b$$

calibrateData.**calibrateThermistor**(*xR*, *Coeffs=None*, *ID=None*)
Calibrate temperatures from thermistor.

calibrateData.**calibrate_1026B**(*Raw=[11994032, 1736812215, 1753391814]*)
Calibration for the NC 1026B CORK

calibrateData.**calibrate_1027C**(*Raw=[5925652, 2199430082L, 2163066709L]*)
Calibration for the setup (SR-2B with new gauges) deployed external to CORK in 1027C in Summer 2011, attached with umbilical

calibrateData.**calibrate_857D**(*Raw=[4547430, 2171517024L, 2182222185L]*)
Calibration for the 857D Middle Valley piggyback instrument

calibrateData.**calibrate_858G**(*Raw=[4547430, 708836726, 2161941373L, 708836726, 2161941373L]*)
Calibration for the 858G Middle Valley replacement reCORKed in May 2013. Output: T_Pt, P_S1, P_Sf, T_S1, T_Sf

calibrateData.**calibrate_Barkley_BPR78**(*Raw=[11627636, 743177769, 2060680196]*)

calibrateData.**calibrate_DoNet1**(*Raw=[6068887, 741081220, 2172977017L, 2172525574L, 2153115213L, 2121447476]*)
Calibration for NanTroSEIZE C02 CORK

calibrateData.**calibrate_DoNet2_OtherGauges**(*Raw=[6008878, 741271410, 2172985505L, 2172512813L, 2145168051, 2121430965]*)

calibrateData.**calibrate_Endeavour_BPR83**(*Raw=[6471937, 708836726, 2161941373L]*)

calibrateData.**calibrate_Folger_BPR201107**(*Raw=[5128065, 718440432, 2158355974L]*)

calibrateData.**calibrate_HeissCalib**(*Raw=[6159243, 692484443, 2131853000]*)

calibrateData.**calibrate_JFast**(*Raw=[5965668, 710927413, 2105924590, 720840165, 2167634962L, 707618831, 2170619802L]*)

Calibration for the 2012 JFast setup

calibrateData.**calibrate_KEMO_BPR06**(*Raw=[5269341, 2160603186L]*)

calibrateData.**calibrate_NCHR_BPR8C**(*Raw=[4917899, 2221701693L]*)

calibrateData.**calibrate_NT_C10_SmartPlug**(*Raw=[5111502, 710297371, 2165241587L, 2141217326]*)

calibrateData.**calibrate_U1362A**(*Raw=[5908710, 2159359656L, 2233473579L, 2112889090]*)

Calibration for the U1362A (SR2A) setup as it was in stalled on IODP Exp 327 in Jul 2010

calibrateData.**calibrate_U1362B**(*Raw=[4740228, 681524504, 2138749542, 2207002754L, 0, 2135957100]*)

Calibration for the U1362B (initially 1027C) setup as it was in stalled on IODP Exp 327 in Jul 2010. The Screen #3 gauge was just unplugged => crosstalk garbage.

calibrateData.**calibrate_U1364A**(*Raw=[5590666, 717083323, 2190506663L, 2166733706L, 2127403171, 2207142752L, 2128115585]*)

Calibration for IODP U1364A data.

Here are the results of an example calibration:

```
>>> calibrate_U1364A(Raw=[5590666, 717083323, 2190506663, 2166733706, 2127403171, 2207142752, 21
[23.626078129440003, 22.276150361949441, 11.103497907947677, 10.510306334848947, 522.67979987438
```

calibrateData.**getParoCoeffs**(*ID=None*)

calibrateData.**getParoIdList**()

calibrateData.**getPlatinumCoeffs**(*ID=None*)

calibrateData.**getThermistorCoeffs**(*ID=None*)

calibrateData.**readParoCoeffs**()

Read coeff from parosci.txt file.

These coeffs are used later on

calibrateData.**readPlatinumCoeffs**()

calibrateData.**readSites**()

Read information from sites.txt file.

calibrateData.**readThermistorCoeffs**()

calibrateLogfile.**parseCMDOpts**()

dumpBin.**calCoeffs**(*loggerID*)

dumpBin.**getStatistics**(*Data*, *loggerID=None*, *do_plots=False*, *interp_spikes=False*)

dumpBin.**parseCMDOpts**()

dumpBin.**readBinFile**(*binFileName='1027C_Weekend.bin'*)

dumpBin.**recordLength**(*Data*, *loggerID=None*)

dumpBin.**stripTrash**(*Data*)

CHAPTER

SEVEN

REFERENCES

genindex modindex search

INDEX