Multi-channel Analog to Digital Recorder (MADRE)

User Manual

This document presents the output the data streaming format. We also briefly list the upcoming features.

Description:

- MADRE can receive analog signals from a daughter board (Multi channel Analog Prototype,MAP).

- MADRE can read up to 10 analog channels through its 7 analog to digital converters (AD7124-24bits).

- MADRE have 2 ways of recording data: Streaming the data and storing the data on an SD card.

- MADRE uses a 40 MHz clock. A 625 kHz timer drives the ADCs. The ADCs sample at 320 Hz. The sample frequency is set up by a sinc^4 filter. The gain of the ADCs is 1.

The ADCs are configured in unipolar mode. The Counts/Volts conversion is :

$Counts = (2\char94 N \times AIN \times Gain)/VREF$
$with\ Gain =1, N=24\ bits, VREF= 2.5\ Volts$

The data are organized as such:
- a analog sample is 3 bytes
- a EPSIsample is 2 temperature channels, 2 shear channels, 3 Accelerometer channels. The length of an EPSIsample is 7 * 3 bytes= 21 bytes. The length of an EPSIsample will change in the future because we will add a micro-conductivity sensor and other sensors.
- a block is defined as 160 EPSIsamples (.5 second)

Data Streaming and Data Storage :

Data Streaming:

The data are streamed by block of 160 samples (.5 second). Each block starts with an ASCII header followed 0,1 or 2 blocks of ASCII samples from auxiliary devices and 1 block of 160 binary ESPSIsamples.

If no devices are plugged to the MADRE board, there will be no ASCII blocks.

Header:
The Header is a 63 bytes word:
`"\r\n$MADRE00000000,00000000,00000000,00000000,00000000,00000000\r\n"`

- It starts with "\r\n" to visualize a new block.
- "$MADRE" start the MADRE Header.
- 8 bytes + "," : Number of EPSIsamples since power up
- 8 bytes + "," : Number of 32.768 kHz RTC since power up
- 8 bytes + "," : first auxiliary device checksum   (Stand alone EPSI: checksum =0)
- 8 bytes + "," : Second auxiliary device checksum (Stand alone EPSI: checksum =0)
- 8 bytes + "," : EPSIsample checksum (uint8_t)
- "\r\n"   : end of the header.

Auxiliary devices blocks:
The length depends on the length of the length of one auxiliary sample and the streaming frequency. A block from the first auxiliary devices is composed by:

- a header: "$AUX1".
- an EPSIsamples stamp (EPSI sample counts)
- ","
- the actual device sample (in ASCII).

The EPSi sample block:

- a header: "$EPSI".
- the 160 EPSIsample in binary (3360 bytes)

We do provide a python script that open a serial port and read the output of the MADRE board.
https://github.com/aleboyer/EPSI_git.git

SD card recording:

The data are stored in a file that includes:

- 1 main file header with variable length. This main header contains the date, the mission name, the vehicle name, the deployment number, the file number, the serial number of the MADRE board, the serial number of the MAP board, the recording method, the sampling frequency, the name of the ftdi device if streaming, the duration of a block in second, the number of block in the file, the number of EPSI samples per block, the baud rate if streaming, the power type, the kind of vehicle and the number of auxiliary sensors

- 1 EPSI header with variable length. The EPSI header corresponds to the information describing the analog board plugged on the MADRE. This header contains the number of sensors, the serial number of the sensors, the calibration number of the sensors, the Sensor order, the number of bytes per analog to digital convertor.

- 1 or 2 auxiliary device headers with variable length. The number of headers is defined in the main header file. It includes the serial number of the auxiliary instrument, the baud rate of the communication, the calibration of the instruments, the format of the instrument sample.

- Data blocks. It includes a block header defining the block number, the number of auxiliary sample and error flags

Structure of a header:

"$MADRE_nbytes\r\n" :

- "$MADRE_" Chain of characters identifying the beginning of a header or a block.
- "nbytes" number of bytes to the end of the header.
- "\n\r" new line carriage return.

"Key Value=Value;\r\n":

- "Key Value = " name of the value, blank space = blank space.
- "Value;" Value ended with semi-column. When Value is a string, we add simple quotes .
- "\n\r" new line carriage return.

Structure of a Data block:

"$MADRE_nbytes\r\n" :

      -"$MADRE_" Chain of characters identifying the beginning of a header or a block.
      -"nbytes" number of bytes to the end of the block.
      - "\n\r" new line carriage return.
      -16 or 20 bytes:4bytes for the block number, 4bytes for voltage description,4 or 8 bytes corresponding to the number of auxiliary sample (4 bytes for aux1 and 4 bytes for aux2).
      - 4bytes: error flags.

      -AUX block:
            - 4 + n bytes: 4 bytes EPSIsample count + n bytes for the auxiliary sample
                      (defined in AUX header).
            - etc (number of AUX samples).
      -EPSI block:
            - n bytes: 3 bytes per ADC * number of sensors (define in EPSI header)
            - n bytes: 3 bytes per ADC * number of sensors (define in EPSI header)
            - etc (number of EPSI samples)

Command	action
stop	Stop the current run of the MADRE board
start	Start a new run of the MADRE board
madre	send the the MADRE header to the user
map	send the the MAP header to the user
aux1	send the the AUX1 to the user
aux2	send the the AUX2 header to the user
$MADRE_keyvalue=value;	change the value of the key value in the MADRE set up structure. Terminated with semicolon.
$MAP_keyvalue=value;	change the value of the key value in the MAP set up structure. Terminated with semicolon.
$AUX1_keyvalue=value;	change the value of the key value in the AUX1 set up structure. Terminated with semicolon.
$AUX2_keyvalue=value;	change the value of the key value in the AUX2 set up structure. Terminated with semicolon.
$MADRE_date=unixtime;	change the date on the madre board