Cluster Active Archive:

Interface Control Document for WHISPER

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Issue	RID/Ref	Details
1.3		▪ Completed Electron Densities section ▪ Added Sounding Times section ▪ Added Appendix A
1.4		▪ Added EFW recalibration method in appendix A ▪ Added Appendix B
1.5		▪ Update of the “Points of contact” section ▪ Added FPtool software description (part 6.4)
1.6		▪ Update of the “Points of contact” section ▪ Added Electron density metafile description in part 5.a and 5.a.1.12 ▪ Update parts 5.4 and 6.
1.7		▪ Update WHISPER products description following new format definition ▪ Remove density extraction algorithms (details are provided in the WHISPER calibration report)
1.8		▪ Section 2 (Points of contact) updated ▪ Section 5.14 updated
1.9		Revised following CAA team recommendations
1.10		Revised, following CAA team recommendations made during the 2013 CAA/WHISPER progress meeting
1.11		Update sections 5.2.6, 5.4.6, 5.5.6, 5.6.6, 5.8.6
1.12		Updated following CAA/CSA recommendations
1.13		Update Section 2 (Contacts), 4.3.5 (Caveats production), Section 3.2.3 (Technical realisation)

TABLE OF CONTENTS

1 PURPOSE

The purpose of this document is to provide a broad outline of the archiving of the data from the WHISPER instrument on CLUSTER in the ESA Cluster Active Archive (CAA) and to define the agreement of the CAA and PI of WHISPER on this broad outline.

The scientific rationale underpinning the CAA activities, subsequently taken over by the CSA (Cluster Science Archive) is as follows:

- Maximise the scientific return from the mission by making all CLUSTER data available to the worldwide scientific community;
- Ensure that the unique data set returned by the CLUSTER mission is preserved in a stable, long-term archive for scientific analysis beyond the end of the mission;
- Provide this archive as a major contribution by ESA and the CLUSTER science community to the International Living With a Star (ILWS) programme.

In the case of WHISPER the main responsibilities will be:

- Delivery of high resolution WHISPER data in an agreed format at the best possible quality level. Additional value added products will also be delivered, on the best effort basis, as well as graphical displays.

2 POINTS OF CONTACT

For the operation of archiving the high-resolution data from WHISPER the following contacts have been agreed:

- As scientific correspondents:
  - for the CAA: C. P. Escoubet, A. Masson
  - for WHISPER: P. Henri, P. Canu

- As technical correspondents:
  - for the CAA: C. P. Escoubet, C. Perry
  - for WHISPER: X. Vallières

- As managerial correspondents:
  - for the CAA: C. P. Escoubet
  - for WHISPER: P. Henri, X. Vallières

3 INSTRUMENT DESCRIPTION

3.1 Science Objectives

The WHISPER instrument provides two functions:

1) the continuous survey of the natural plasma emissions in the 2-80 kHz frequency band
2) the measurement of the electron density of the plasma, (a) from the measurements of the relaxation sounder, an active radio frequency technique which aims at identifying the electron plasma frequency in the 4-82 kHz range, or (b) from natural plasma emissions

The primary objective of the CLUSTER mission is the study in three dimensions of small-scale plasma structures in key regions of the Earth's environment. The specific contribution of WHISPER is to serve the general objectives of wave and turbulence studies to be carried out on CLUSTER, as part of the Wave Experiment Consortium WEC (Pedersen *et al*, 1997). A description of the specific role of WHISPER within WEC is given in Décréau *et al.* (1997).

Measurements in **Natural mode** address the following objectives:

- to study energy and mass transfers, using electrostatic waves as local tracers of small structures, and more generally investigating the role of turbulence;
- to identify the mode and source mechanism of high-frequency emissions, electrostatic or electromagnetic;
- to identify the spatio-temporal properties of electrostatic or electromagnetic high-frequency emissions, as well as their directivities (orientations of wave vector, in the spin frame), in order to identify source dimensions and position, and derive some properties of the medium along the ray path.

Measurements in Active operation of the sounder (**Sounding mode**) address the following objectives:

- to identify regions in space and mass transport processes, via measurement of the absolute density;
- to identify high-frequency wave modes, via precise measurement of characteristics electron frequencies;
- to estimate the cold-to total-electron density ratio.

Measurements combining **Natural mode and Sounding modes** address the following objectives:

- to study the spatial extension and drift speed of key structures;
- to observe density fluctuations for value-added analysis of low-frequency waves.

3.2 Hardware Overview

3.2.1 Sounding mode: technique of the relaxation sounder

The principle of a relaxation sounder is similar to that of classical radar flown in plasma. Inside the active period of a frequency step of total duration ΔT, a radio wave transmitter sends a wave train over a limited time period T, at a fixed frequency f. This corresponds, in the frequency domain, to a distribution of the signal centred at f, with a full width at half maximum of $1/T$. Such a burst will eventually trigger natural resonances of the plasma in the frequency range it covers. Shortly after this active period, a radio receiver connected to an electric sensor (an EFW double-sphere dipole in the case of WHISPER) listens to the signal around f until the end of the time ΔT. Then, the frequency is translated and the process is repeated at a new frequency step. A succession of these steps, constituting a sweep, allows the properties of the neighbouring plasma to be explored over the range of interest. The values of T and ΔT depend of the operating mode, selected by telecommand. Possible values for T are 0.512 ms or 1.024 ms, ΔT is a multiple of 13.3 ms.

This technique is suitable for observing with a high spectral resolution the slow (mainly electrostatic) waves which are able to propagate near the characteristic frequencies of the plasma. These low-group-velocity waves, after excitation by the transmitted pulse, travel either together with the satellite (accompanying waves), or away and back to it because of the curvature of the ray path by the density and/or magnetic field gradients (oblique echoes). The very-narrow-bandwidth (almost monochromatic) plasma-resonance signals received provide accurate density measurements thanks to the direct or indirect (via other resonances) identification of the electron plasma frequency F_{pe}.

A resonance is identified by two main features:

- the presence of a decay in the received signal following the active period;
- a signal level higher than the natural emissions at the same frequency.

The comparison of the **Active** echoes (received immediately after a transmitted burst) with **Natural** emissions (received before or a long time after an eventual transmission at the same frequency) is a mandatory step in conducting a sounding experiment. In the case of the WHISPER experiment, a dedicated data product (corresponding to the acquisition of a natural spectrum mode just before a transmission and acquired with the same construction pattern than active spectra) is sometimes available (depending on the operating mode) to ease this

comparison. It is referred as a **Passive** spectrum. This technique does not work in all plasma environments. Hence, density recognition is not possible everywhere.

3.2.2 Natural emissions analyzer: technique

AC electric signal from EFW sensors are fed to WHISPER, which derives differential signal along one of the electric field double sphere long antennas (Ez or Ey)[1], then performs on-board a spectral analysis via FFT.

3.2.3 Technical realisation

The relaxation sounder instrument on CLUSTER consists of three main parts (Figure 1):

a) a sensitive double-sphere antenna, part of the EFW experiment;
b) a transmitter and a receiver including a spectrum analyser, which form the WHISPER experiment proper;
c) a data-acquisition and a data-processing system, which are part of the DWP experiment.

The latter device also ensures the control of telecommand and telemetry for the entire WEC. The WHISPER power supply is part of the complete WEC setting, described in Pedersen *et al.*, 1997.

[1] The angles between Ey and Ez with respect to the Z-axis of the satellite reference frame are 45 and 135 degrees, respectively.

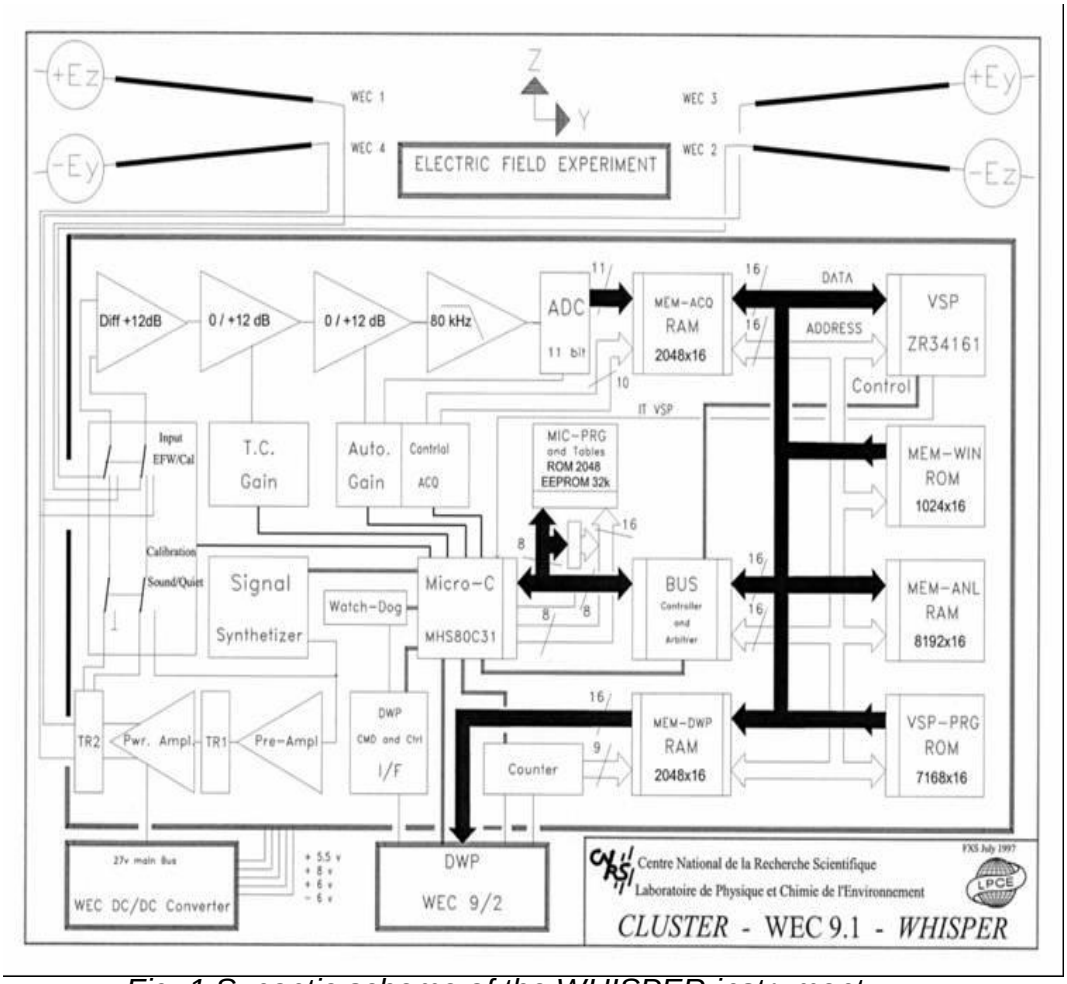

Fig. 1 Synoptic scheme of the WHISPER instrument

Transmitter:

The WHISPER transmitter is connected to the shields of one electric wire boom pair (always *Ey*) through the EFW experiment module. In Natural (N) mode operations, it remains inactive. In Sounding (S) mode (also called Active mode), a signal synthesiser delivers a pulse of sine waves, of either 1 ms or 0.5 ms duration at a frequency set by a microcontroller according to a command word transmitted via DWP. Different levels can be selected. The sequencing of WHISPER transmissions is ensured by a blanking signal transmitted to WHISPER by DWP. The time lag between two pulse occurrences (i.e. the step duration) is variable. The successive frequency values in a sweep follow a table chosen by telecommand among about 256 options (Whisper EID, Sené, 1998). The selected table, adapted to the pulse

duration, can cover various frequency ranges and various patterns in the succession of triggered frequencies. In planned nominal operations, the sweep is not explored uniformly, but according to a pattern which ensures that two frequency steps triggered successively in time are sufficiently apart from each other in frequency. Indeed, the frequency slice stimulated by a transmission is not strictly limited to 1 or 2 kHz (6 frequency bins), hence the adjoining frequency slices are prompted to be stimulated too, at a lower level. The frequency pattern is designed to prevent the 'passive' information recorded before a pulse transmission being corrupted by the preceding sounding. In addition, the frequency range can be swept in its upper part with 0.5 ms wide pulses, whereas 1 ms pulses are chosen in the lower part, in order to run two sweeps within 3 s of a total sounding time interval.

Receiver:

The receiver is connected to one of the double sphere dipole probe *Ez* (placed at right angles to the *Ey* boom pair) or *Ey* (choice by telecommand) through the electric field module. It is operated in each 13.3 ms listening step (internal WHISPER clock, synchronized with the general WEC 900 Hz clock, the DWP master clock), after the possible transmission of the pulse (the receiver is inhibited during the pulse), during the acquisition slot of duration 3.2 or 6.4ms (necessary to acquire 512 or 1024 FFT points for 256 or 512 frequency bins at 166 kHz sampling rate). The signal is amplified by a gain amplifier including three stages. The total gain can take three different values (12, 24, and 36 dB), with an exact ratio of four in between any two consecutive ones. Different options can be selected by telecommand. The gain is either fixed or automatically controlled. In the automatic control mode, the gain is selected among two consecutive stepped gains (either between 12 dB and 24 dB or between 24 dB and 36 dB). It responds to the characteristics (number of overflows) of a short sampling (64 samples) taken before the real acquisition, placed in the second part of the 13.3 ms basic time structure (this is done in order to optimize the gain and to minimize the overflow events in the measurements in real time). The number of overflows occurring during the actual acquisition is recorded and transmitted as a status parameter. After an 11-bit analogue-to-digital (A/D) conversion, corresponding to a 66 dB dynamic range (ratio between the saturation level and the quantification level), each signal sample is placed in the Most Significant Bit (MSB) part of a 16-bit word when the gain receiver value has a fixed value. When the automatic gain control option is chosen, the 11 bits issued from the converter are placed according to the actual gain value, either in the MSB part of the 16-bit word of the acquisition memory, or 2 bits below to take account of the factor of 4 difference in gains. The next operation is the frequency analysis. The device used is a Zoran Vector Signal Processor (VSP) (Vasiljevic, 1990) which performs an FFT, and delivers 64 to 512 useful bins in the 0-83 kHz range. Each bin is a complex value. In the WHISPER application, the VSP calculates the modulus and the result is placed in a 16-bit word. The 512 bins option is always chosen in (S) modes, which require a good frequency resolution. The A/D converter and VSP combination yields

to a dynamic range for the bin values larger than the 66 dB available for the time samples. In order to control the calculation noise over the complete frequency range, windowing of the time signal is necessary. The chosen window is the three terms Blackmann-Harris window.

The total duration of basic operations covers three time structures of 13.3 ms: one for the acquisition, one for the FFT calculation, and one for the transfer of FFT frames to DWP. This requires several RAM memories, referred to in Figure 1 as MEM-ACQ for the acquired time samples, MEM-ANL for the FFT analysis, and MEM-DWP for buffering the results to be transferred to DWP. The details of operations are managed by the microcontroller. In sounding operations, when the medium reacts dynamically, no accumulation of spectra is foreseen. In (N) modes, on the contrary, a number of successive individual spectra are accumulated by the DWP software which treats the WHISPER data. This number is selected by telecommand. The microcontroller marks each individual spectrum placed in MEM-DWP by its rank in the series to be accumulated.

In the case of automatic gain control, the number of gain switches during the accumulation phase is transmitted as a status parameter. It is generally not possible to retrieve the actual gain value used during the accumulation process because the gain for each individual spectrum acquired during this phase is lost. However, there are two exceptions:

- when the number of automatic gain changes is zero: all spectra have been acquired with the lowest gain (out of the two possible commanded automatic gains)
- when the number of automatic gain changes is equal to the number of accumulated spectra: all spectra have been acquired with the highest gain (out of the two possible commanded automatic gains)

3.3 Data Processing Chain

This section essentially revisits the processing chain indicated above, such as each product described below (section 3.4) can be related to it: from electric field signal supplied by EFW to the WHISPER science data stream entering in the TM stream prepared by WEC. It will not describe the on-board TM packetisation and the first step of ground decommutation which are both under DWP responsibility. It should nevertheless give enough explanation for interested scientists to understand which information is contained in each WHISPER data word, at which precision, and with which degree of confidence.

On-Board control and data processing:

The WHISPER instrument includes two sets of on-board software. One of them is used by the VSP (Zoran) for performing the calculation of:

1) the average power E_{pow};
2) the various FFTs;
3) the modulus of the complex bin data delivered by the FFT; and
4) the bin-to-bin accumulation of spectra when a WHISPER internal data compression is requested and the instrument is in (N) mode.

The other software is used by the microcontroller. Its main functions are:

1) to set-up the experiment according to the WHISPER command mode word;
2) to load the needed FFT program into the VSP internal RAM;
3) to generate and control the transmitted wave;
4) to run a 'watchdog' program against the radiation effects;
5) to reshape the data output from the analyser before transferring them in MEM-DWP by adding status, sequencing, and E_{pow} information.

The onboard data compression implemented by DWP is described in Woolliscroft *et al.,* 1997. Each bin level information extracted from the MEM-DWP buffer is equivalent to a 24-bit word. This size is reduced to 6 or 8 per word via a quasi-logarithmic compression. In (S) modes, two spectra are built after a sweep: the Active spectrum, i.e. bin levels calculated from a post-pulse acquisition, and the Passive one, i.e. bin levels calculated from a pre-pulse acquisition. All or part of this information is transmitted to the ground, according to a chosen strategy. In (N) modes, bin-to-bin accumulated spectra are built. All of them, or only a sample of them, are transmitted to the ground, according to one of the selection rate possibilities (Table II). The spectrum selection rate, combined with the number of accumulations in each spectrum, leads to the overall time resolution, driven by telemetry constraints. The internal WHISPER data compression (less efficient) is available in option, in case a back-up is needed. It reconstructs the Active spectrum in (S) mode and accumulates successive spectra bin-to-bin in (N) mode.

3.4 Instrument Data Products

For a detailed description of data generated by the WHISPER instrument, see Appendix C.

4 DATA PROVISION – GENERAL CONVENTIONS

4.1 Formats

All WHISPER digital data products are delivered in the Cluster Exchange Format (CEF) version 2. Files are named with the **.cef** extension to assist identification.

4.2 Standards

Each record contains the same major field: time. The time will be Universal Time (UT), i.e. the Greenwich Mean Time. Time is represented as a string in the ISO format adopted by the CSDS, following the form: *yyyy-mm-ddThh:mm:ss.sssZ.*

Another main unit is $V_{rms}^2.m^{-2}.Hz^{-1}$. This unit applies to:

- the “Active” files spectra (see section 5.4 below);
- the “Passive” files spectra (see section 5.5 below);
- the “Natural” files spectra (see section 5.2 below);
- the “Energy” files values unit (see section 5.3 below).

All the Frequencies are in kHz unit (see section 5.6 “House Keeping” files).

4.3 Production Procedures

4.3.1 Mass archives production

Eight WHISPER CAA products (see list below) are produced using a dedicated software developed by the WHISPER team. Once produced, the files are validated by the WHISPER team before delivery. The production was handled by CNES (Centre National d’Etudes Spatiales, Toulouse, France) for data up to October 2012 and was then transferred to LPC2E.

Input files:
The input files for the WHISPER archive software are the files obtained after the de-commutation.
Several files are required:

- Ci_HK_WHI_yyyymmdd_Vnn.bin
- Ci_DE_WHI_yyyymmdd_Vnn.bin
- Ci_DU_WHI_yyyymmdd_Vnn.bin
- Ci_CA_WHI_yyyymmdd_Vnn.bin
- Ci_VR_WHI_yyyymmdd_Vnn.bin
- Ci_ID_WHI_yyyymmdd_Vnn.bin

where *Ci* represents the spacecraft, *yyyymmdd* the date and *Vnn* the file version. The two letters code identifies the input file, with HK for House Keeping WEC data, DE for WHISPER science data, DU for Dump data, CA for onboard calibration data, VR for coherency criteria data. ID file contains an index for fast data access.

Output files:
The WHISPER archive software produces the following files, for each spacecraft Ci:

- Ci_CP_WHI_HK__yyyymmdd_Vnn.cef
- Ci_CT_WHI_ACTIVE_EVENT__yyyymmdd_Vnn.cef
- Ci_CT_WHI_NATURAL_EVENT__ yyyymmdd _Vnn.cef
- Ci_CP_WHI_ACTIVE_TO_PASSIVE_RATIO__ yyyymmdd _Vnn.cef
- Ci_CP_WHI_ACTIVE__ yyyymmdd _Vnn.cef
- Ci_CP_WHI_WAVE_FORM_ENERGY__ yyyymmdd _Vnn.cef
- Ci_CP_WHI_NATURAL__ yyyymmdd _Vnn.cef
- Ci_CP_WHI_PASSIVE_ACTIVE__ yyyymmdd _Vnn.cef

Furthermore, for each archived date, a log file is created, containing some information about the name of the input files, the name of the output files, the compression rate of the files, some warning and error messages.

NOTE: *if some input files do not exist, empty output files are created and delivered to CAA.*

4.3.2 Electron density production

The production procedure for electron density files is separated from the other datasets. It is done routinely at LPC2E but requires human intervention and scientific expertise and is therefore performed on a best effort basis. A detailed description of the processes related to the production of density is given in the WHISPER calibration report.

Input files:
The input files are the WHISPER CAA products containing the ACTIVE and NATURAL spectra. External date can be used to assist the determination as, for instance, the magnetic field magnitude from the FGM experiment or the spacecraft potential from the EFW experiment.

Output files:
One daily file is produced for each spacecraft Ci:

- Ci_CP_WHI_ELECTRON_DENSITY__yyyymmdd_Vnn.cef.

When no density can be extracted, an empty file is provided.

4.3.3 Sounding times production

The Sounding Times files were created to deliver a product that is easier to use than HK files. The purpose is to provide flags indicating times of possible perturbations for other instruments.

Input files:
This product is directly produced from the WHISPER ACTIVE product. The production procedure consists in applying a script to the already produced ACTIVE file. A header is created, and then the relevant data is extracted from the ACTIVE file and copied in the SOUNDING_TIMES file.

Output files:
One daily file is produced for each spacecraft Ci:

- Ci_CP_WHI_SOUNDING_TIMES__yyyymmdd_Vnn.cef

4.3.4 Electron gyrofrequency production

Results of FGM/WHISPER cross-calibration studies have been archived at CAA as a dedicated product. The electron gyrofrequency product contains values of electron gyrofrequencies in the plasmasphere, obtained from WHISPER active measurements using an ad-hoc algorithm. Under a local linear approximation of the electron gyrofrequency, harmonic resonant signatures are extracted from the spectrogram. This dataset contains data only from the 2001-2005 period.

Output files:
One yearly file is produced for each spacecraft Ci:

- Ci_CP_WHI_ELECTRON_GYROFREQUENCY_yyyy0101_yyyy1231_Vnn.cef

4.3.5 Caveats production

The caveats dataset produced at LPC2E lists time periods where overflows and/or interferences can affect the measurements quality. Corrupted spectra are also listed. These files are produced manually, on the basis of one file per spacecraft per year.

Output files:
One yearly file is produced for each spacecraft Ci:

- Ci_CQ_WHI_CAVEATS__yyyy0101_000000_yyyy1231_235959_Vnn.cef

4.3.6 Quicklooks production

Quicklooks are images produced at LPC2E and provided to the CAA/CSA user for browsing purposes. Two kinds of quicklooks are available: one for the Active mode and one for the Natural mode. Each quicklook represents the electric field spectrograms for the 4 spacecraft, for 6 hours of data, as well as several supporting parameters. Quicklooks are delivered in POSTSCRIPT (ps) format as well as in JPEG for previsualisation purpose on the CAA website.

Output files:

- Four quicklooks per day for **Active mode, POSTSCRIPT** format
  - CM_CG_WHI_QL_ACT__yyyymmdd_0000_ yyyymmdd_0600_Vnn.ps
  - CM_CG_WHI_QL_ACT__yyyymmdd_0600_ yyyymmdd _1200_Vnn.ps
  - CM_CG_WHI_QL_ACT__yyyymmdd_1200_ yyyymmdd _1800_Vnn.ps
  - CM_CG_WHI_QL_ACT__yyyymmdd_1800_ yyyymmdd _2400_Vnn.ps
- Four quicklooks per day for **Active mode, JPEG** format
  - CM_CG_WHI_QL_ACT__yyyymmdd_0000_yyyymmdd_0600_Vnn.jpeg
  - CM_CG_WHI_QL_ACT__yyyymmdd_0600_yyyymmdd _1200_Vnn.jpeg
  - CM_CG_WHI_QL_ACT__yyyymmdd_1200_yyyymmdd _1800_Vnn.jpeg
  - CM_CG_WHI_QL_ACT__yyyymmdd_1800_yyyymmdd _2400_Vnn.jpeg
- Four quicklooks per day for **Natural mode, POSTSCRIPT** format
  - CM_CG_WHI_QL_NAT__yyyymmdd_0000_ yyyymmdd _0600_Vnn.ps
  - CM_CG_WHI_QL_NAT__yyyymmdd_0600_ yyyymmdd _1200_Vnn.ps
  - CM_CG_WHI_QL_NAT__yyyymmdd_1200_ yyyymmdd _1800_Vnn.ps
  - CM_CG_WHI_QL_NAT__yyyymmdd_1800_ yyyymmdd _2400_Vnn.ps
- Four quicklooks per day for **Natural mode, JPEG** format
  - CM_CG_WHI_QL_NAT__yyyymmdd_0000_ yyyymmdd _0600_Vnn.jpeg
  - CM_CG_WHI_QL_NAT__yyyymmdd_0600_ yyyymmdd _1200_Vnn.jpeg
  - CM_CG_WHI_QL_NAT__yyyymmdd_1200_ yyyymmdd _1800_Vnn.jpeg
  - CM_CG_WHI_QL_NAT__yyyymmdd_1800_ yyyymmdd _2400_Vnn.jpeg

4.3.7 Prime Parameters production

The PP (Prime Parameters) dataset contains preliminary spin resolution measurements of the electron density and plasma wave spectral density from the WHISPER experiment on C1. These data have been converted into Cluster Exchange Format from the original Cluster Science Data System Common Data Format (CDF) Prime Parameter files that were made available through the Cluster Science Data System. The metadata has been updated from the CSDS/CDF standard to the CAA to aid compatibility with tools developed for the Cluster Active Archive.

Graphical products and cross-Calibration plots available at CAA are produced directly at CAA.

4.4 Quality Control Procedures

The intrinsic quality of the main WHISPER data products (high resolution electric-field power spectral density) is considered to be good, except when:

- Data gaps are affecting data files of one or several spacecraft during orbit elements where data coverage had been planned (as indicated in the Master Plan). Several causes can result in data gaps. Some gaps affect large compact time intervals, other are irregular and random.
- WHISPER data are corrupted, on one or several spacecraft. Several possible causes can induce corruption (DWP/EFW/WHISPER problem).
- EDI is ON, hence perturbs WHISPER data. EDI Event files indicate which time intervals are potentially affected, and at which level (start and stop of EDI functioning, and EDI mode). For an example of interference, see the WHISPER user guide.

WHISPER ELECTRON_DENSITY product:

- each provided density value is considered to be good. The quality control is performed during the density extraction. The accuracy of the density is reflected by two parameters: CONTRAST and UNCERTAINTY (see section 5.10).
- specific manual processing may be performed for dedicated cross-calibration studies. Corresponding density values are considered as high-quality values. This will be reflected by the value of the QUALITY flag.

4.5 Delivery Procedures

Mass archives are delivered to CAA as daily zip files containing:

- NATURAL files (see section **5.2**);
- ACTIVE files (see section **5.4**);
- PASSIVE files (see section **5.5**);
- ACTIVE_TO_PASSIVE_RATIO files (see section **5.6**);
- WAVE_FORM_ENERGY files (see section **5.3**);
- ACTIVE_EVENT files (see section **5.8**);
- NATURAL_EVENT files (see section **5.9**);
- HK (House Keeping) files (see section **5.7**).

Other archives are delivered to CAA independently (eventually by batch, zipped if needed):

- ELECTRON_DENSITY (see section **5.10**)

- ELECTRON_GYROFREQUENCY (see section **5.11**)
- SOUNDING_TIMES (see section **5.12**)
- CAVEATS (see section **5.15** and **5.16**).
- QUICKLOOKS (see section **5.17**)

5 DATA PROVISION – SPECIFIC DESCRIPTIONS

In this section, we describe the WHISPER products as they are named and formatted for CAA.

5.1 Global Metadata

Several global metadata files are included within the different files:

- CL_CH_MISSION.ceh
- Ci_CH_CL_OBS.ceh where i=1,2,3,4 (spacecraft id)
- CL_CH_WHI_EXP.ceh
- Ci_CH_WHI_INST.ceh where i=1,2,3,4 (spacecraft id)

5.1.1 CL_CH_MISSION.ceh

The mission level metadata are given in the file called ”CL_CH_MISSION.ceh”. It is provided and maintained by the CAA team at ESTEC.

5.1.2 Ci_CH_OBS.ceh

The observatory level metadata are given in the files Ci_CH_OBS.ceh, where i is spacecraft id. There is one file for each spacecraft, and they are provided/maintained by the CAA team at ESTEC.

5.1.3 CL_CH_WHI_EXP.ceh

This ceh file contains:

```
!
!  CL_CH_WHI_EXP.ceh
!  WHISPER experiment metadata
!

START_META = EXPERIMENT
   ENTRY = "WHISPER"
END_META = EXPERIMENT

START_META = EXPERIMENT_DESCRIPTION
   ENTRY = "The Wave of HIgh frequency and Sounder for Probing of Electron density"
   ENTRY = "by Relaxation (WHISPER) performs the measurement of the electron density"
   ENTRY = "on the four satellites of the CLUSTER project. The two main purposes of"
   ENTRY = "the WHISPER experiment are to record the natural waves and to make a"
   ENTRY = "diagnostic of the electron density using the sounding technique."
   ENTRY = "The various working modes and the fourier transforms calculated on board"
   ENTRY = "provide a good frequency resolution obtained in the bandwidth 2-83 kHz."
   ENTRY = "Onboard data compression by the Digital Wave Processing (DWP) intrument"
```

```
   ENTRY = "allows a good dynamic and level resolution of the electric signal amplitude."
END_META = EXPERIMENT_DESCRIPTION

START_META = INVESTIGATOR_COORDINATES
           ENTRY = "Pierre Henri>PI>Pierre.Henri@cnrs.fr"
           ENTRY = "Jean-Louis Rauch>Former PI (2012 - 2021)"
           ENTRY = "Jean-Gabriel Trotignon>Former PI (2007 - 2012)"
           ENTRY = "Pierrette Decreau>Former PI (1987 - 2007)"
END_META = INVESTIGATOR_COORDINATES

START_META = EXPERIMENT_KEY_PERSONNEL
           ENTRY = "Patrick Canu>Deputy-PI>patrick.canu@lpp.polytechnique.fr"
           ENTRY = "Xavier Vallieres>Data Manager>Xavier.Vallieres@cnrs.fr"
END_META = EXPERIMENT_KEY_PERSONNEL

START_META = EXPERIMENT_REFERENCES
           ENTRY = "Decreau, P. M. E., et al., Early results from the WHISPER instrument on Cluster: an overview,
                    Ann. Geophysicae, 19, 1241, 2001."
           ENTRY = "Decreau, P. M. E., et al., WHISPER, a resonance sounder and wave analyser: performances
                    and perspectives for the CLUSTER mission,Space Sci.Rev.,79,157,1997."
           ENTRY = "User Guide to the WHISPER measurements in the Cluster Active Archive, CAA-EST-UG-WHI,
                    ESA"
           ENTRY = "Calibration Report of the WHISPER measurements in the Cluster Active Archive, CAA-EST-CR-
                    WHI, ESA"
           ENTRY = "Cluster Active Archive: Interface Control Document for WHISPER, CAA-WHI-ICD, ESA"
           ENTRY = "Digital Object Identifier for the WHISPER archive: https://doi.org/10.5270/esa-6stdo07"
END_META = EXPERIMENT_REFERENCES
```

5.1.4 CM_CH_WHI_INST.ceh

This ceh file contains:

```
!
!  CM_CH_WHI_INST.ceh
!  Multiple instrument level header
!

START_META = INSTRUMENT_NAME
   ENTRY = "MULTIPLE"
           ENTRY = "WHISPER1"
           ENTRY = "WHISPER2"
           ENTRY = "WHISPER3"
           ENTRY = "WHISPER4"
END_META = INSTRUMENT_NAME

START_META = INSTRUMENT_DESCRIPTION
           ENTRY = "WHISPER Experiment on all Cluster spacecraft"
END_META = INSTRUMENT_DESCRIPTION
```

```
START_META = INSTRUMENT_TYPE
            ENTRY = "Antenna"
            ENTRY = "Double_Sphere"
            ENTRY = "Spectral_Power_Receiver"
            ENTRY = "Resonance_Sounder"
END_META = INSTRUMENT_TYPE

START_META = MEASUREMENT_TYPE
            ENTRY = "Electric_Field"
            ENTRY = "Radio_and_Plasma_Waves"
            ENTRY = "Radio_Soundings"
END_META = MEASUREMENT_TYPE
```

5.1.5 Ci_CH_WHI_INST.ceh

This ceh file contains (example given for spacecraft 1):

```
!
!  C1_CH_WHI_INST.ceh
!  WHISPER1 instrument metadata
!

START_META = INSTRUMENT_NAME
            ENTRY = "WHISPER1"
END_META = INSTRUMENT_NAME

START_META = INSTRUMENT_DESCRIPTION
   ENTRY = "WHISPER Experiment on Cluster C1"
   ENTRY = "WHISPER measures the potential difference between two EFW sensors located at the boom of the
            Cluster electric antennas (Ey or Ez)."
   ENTRY = "The received signal is then band-pass filtered, digitised and analysed in frequency by an on-board
            processor to compute electric power spectral density."
   ENTRY = "Measurement is performed on Ey or Ez antenna depending on the instrument telecommand."
   ENTRY = "In the event of an EFW probe failure, reception is performed between the probe in operation and
            the body of the satellite, thus receiving on half on the electric antenna."
   ENTRY = "Caveats:"
   ENTRY = "2000-08-22T00:00:00.000Z/2001-12-28T03:02:57.999Z, reception on Ez antenna requested by
            telecommand."
   ENTRY = "2001-12-28T03:02:58.000Z/2002-01-17T23:38:27.999Z, reception on half Ez antenna after EFW
            probe 1 failure on Ez antenna."
   ENTRY = "2002-01-17T23:38:28.000Z/2009-10-14T06:59:59.999Z, reception on Ey antenna requested by
            telecommand."
   ENTRY = "2009-10-14T07:00:00.000Z/2009-12-05T14:05:34.999Z, reception on half Ey antenna after EFW
            probe 4 failure on Ez antenna."
   ENTRY = "2009-12-05T14:05:35.000Z/2024-09-30T23:59:59.999Z, reception on half Ez antenna requested by
            telecommand."
END_META = INSTRUMENT_DESCRIPTION

START_META = INSTRUMENT_TYPE
```

```
        ENTRY = "Antenna"
        ENTRY = "Double_Sphere"
        ENTRY = "Spectral_Power_Receiver"
        ENTRY = "Resonance_Sounder"
END_META = INSTRUMENT_TYPE

START_META = MEASUREMENT_TYPE
        ENTRY = "Electric_Field"
        ENTRY = "Radio_and_Plasma_Waves"
        ENTRY = "Radio_Soundings"
END_META = MEASUREMENT_TYPE

START_META = INSTRUMENT_CAVEATS
        ENTRY = "*C1_CQ_WHI_CAVEATS"
END_META = INSTRUMENT_CAVEATS
```

5.2 Natural Files: CP_WHI_NATURAL

This dataset contains electric spectral power density under NATURAL mode from the WHISPER experiment.

5.2.1 Format

As described in section 4.1

5.2.2 Standard

As described in section 4.2

5.2.3 Production Procedure

As described in section 4.3

5.2.4 Quality Control Procedure

As described in section 4.4

5.2.5 Delivery Procedure

As described in section 4.5

5.2.6 Product Specification

Filename format: Ci_CP_WHI_NATURAL___yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each NATURAL file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh

- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_NATURAL_DATASET.ceh
- parameters: Ci_CH_WHI_NATURAL_PARAMETERS.ceh

Each NATURAL file contains eleven variables. Ten of them are record varying, so that one single record in the file is composed of the following variables:

time_tags	time (ISO) of the spectrum, centred on the accumulation time
Delta	gives the DELTA_PLUS and DELTA_MINUS values (in s) of the time_tags metadata which are half the number of seconds corresponding to the sampling interval + the uncertainty of the time_tags. Its value depends on the metadata called Average_Number (see below): Average_Number = • 1, then Delta= 0.01333/2+0.003 • 2, then Delta= 2*0.01333/2+0.003 • 4, then Delta= 4*0.01333/2+0.003 • 8, then Delta= 8*0.01333/2+0.003 • 16, then Delta= 16*0.01333/2+0.003 • 32, then Delta= 32*0.01333/2+0.003 • 64, then Delta=64*0.01333/2+0.003
fft_size	number of points on which we make a Fast Fourier Transform. Four FFT dimensions are available on WHISPER: 512, 256, 128, and 64 bins
Receiving_Antenna	receiving antenna (Ey or Ez). The emission is always performed by Ey
Electric_Spectral_Power_Density	512 values (in $Vrms^2.m^{-2}.Hz^{-1}$) of the spectrum. In practice, only up to 480 values are useful and the others are -1
Overflow_Code	this data gives an idea of the overflow influence during the acquisition (see below for the definition of the metadata Average_Number): Overflow_Code = nb_overflow / (128*Average_Number) where:

<table>
<tr><td></td><td>● nb_overflow is the number of overflow that occurred during the acquisition of the Average_Number spectra

● 128=256/2 and 256 is the maximum overflow value that can be obtained during the acquisition of a spectrum, We must divide by 2 because after the compression of the overflow value (see section 3.4.1.3) the minimum value of the range is taken.

<table><tr><th>Overflow value</th></tr><tr><td>0</td></tr><tr><td>1</td></tr><tr><td>2-3</td></tr><tr><td>4-7</td></tr><tr><td>8-15</td></tr><tr><td>16-31</td></tr><tr><td>32-63</td></tr><tr><td>64-127</td></tr><tr><td>128-255</td></tr><tr><td>256-511</td></tr><tr><td>512-1023</td></tr><tr><td>1024-2047</td></tr><tr><td>2048-4095</td></tr><tr><td>4096-8191</td></tr><tr><td>8192-16383</td></tr></table>
For example if we have 600 overflows during the acquisition, the output value of the overflow will be 512 not 600.</td></tr>
<tr><td>Average_Number</td><td>in natural mode, Average_Number corresponds to the number of averaged spectra. There are different possibilities:

Average_Number =
● 1, then 1 spectrum is averaged
● 2, then 2 spectra are averaged
● 4, then 4 spectra are averaged
● 8, then 8 spectra are averaged
● 16, then 16 spectra are averaged
● 32, then 32 spectra are averaged
● 64, then 64 spectra are averaged</td></tr>
<tr><td>Gain_Change_Number</td><td>number corresponding to the number of times the gain changed during the acquisition.</td></tr>
</table>

Mantissa	first part (the second is exponent, see below) of the compressed value which is a fixed point integer before the compression algorithm. After the compression, the integer gets a floating point representation, and the compressed data size is the mantissa size plus the fraction size
Exponent	second part of the compressed value

A NATURAL file also contains one non record varying variable whose values are given in the parameters definition file (see 5.2.7.6).

Spectral_Frequencies	512 values (in kHz) corresponding to the acquisition frequencies of the spectrum (480 values between 1.953 kHz and 79.915 kHz, and 32 fill values)

Example of a NATURAL file:

```
FILE_NAME = "C1_CP_WHI_NATURAL__20071001_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
        ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_NATURAL_DATASET.ceh"
INCLUDE = "C1_CH_WHI_NATURAL_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
        ENTRY = "C1_CP_WHI_NATURAL__20071001_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
        ENTRY = "1"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
        ENTRY = "03"
END_META = DATASET_VERSION

START_META = FILE_TIME_SPAN
```

```
          VALUE_TYPE = ISO_TIME_RANGE
          ENTRY = 2007-10-01T00:00:00.000Z/2007-10-01T23:59:59.999Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
          VALUE_TYPE = ISO_TIME
          ENTRY = 2009-12-15T08:13:06Z
END_META = GENERATION_DATE

DATA_UNTIL= "End"
2007-10-01T00:00:09.973Z,0.216333,512,"Y",1.647276E-13,1.024392E-13,9.388281E-14,… ,-1.000000E+00,-
1.000000E+00,-1.000000E+00,-1.000000E+00,0.000000,32,0,2,-7 $
End
```

5.2.7 Metadata Specification

5.2.7.1 Mission

See section 5.1.1

5.2.7.2 Observatory

See section 5.1.2

5.2.7.3 Experiment

See section 5.1.3

5.2.7.4 Instrument

See section 5.1.4

5.2.7.5 Dataset

The file Ci_CH_WHI_NATURAL_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_NATURAL_DATASET.ceh
!  Header file for WHISPER1 NATURAL dataset
!

START_META = DATASET_ID
          ENTRY = "C1_CP_WHI_NATURAL"
END_META = DATASET_ID

START_META = DATA_TYPE
          ENTRY = "CP>CAA_Parameter"
```

```
END_META = DATA_TYPE

START_META = DATASET_TITLE
          ENTRY = "Electric Spectral Power Density"
END_META = DATASET_TITLE


START_META = DATASET_DESCRIPTION
          ENTRY = "This dataset contains electric spectral power density under natural mode from Whisper on
          spacecraft 1"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
          ENTRY = "DATASET VERSION HISTORY"
          ENTRY = "VERSION 01: first version of dataset"
          ENTRY = "VERSION 02: correction of the Spectral Frequencies parameter description"
          ENTRY = "VERSION 03: dataset headers update"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
          ENTRY =  "2.14"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
          ENTRY = "0.1"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
          ENTRY = "5"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
          ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
          ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
          ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
          data"
END_META = ACKNOWLEDGEMENT

START_META = FILE_TYPE
          ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
          ENTRY = "CAA"
```

```
END_META = METADATA_TYPE
```

5.2.7.6 Parameters

The file Ci_CH_WHI_NATURAL_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

Each value in the record is comma-separated.
Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_NATURAL_PARAMETERS.ceh
!  Parameters description for WHISPER1 NATURAL dataset
!

START_VARIABLE = time_tags__C1_CP_WHI_NATURAL
            CATDESC = "Interval centred time tag"
            UNITS = "s"
            SIZES = 1
            VALUE_TYPE = ISO_TIME
            SIGNIFICANT_DIGITS = 24
            FILLVAL = 9999-12-31T23:59:59.999Z
            DELTA_PLUS = Delta__C1_CP_WHI_NATURAL
            DELTA_MINUS = Delta__C1_CP_WHI_NATURAL
            LABLAXIS = "UT"
            FIELDNAM = "Universal Time"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = time_tags__C1_CP_WHI_NATURAL

START_VARIABLE = Delta__C1_CP_WHI_NATURAL
             SIZES = 1
             VALUE_TYPE = FLOAT
             FILLVAL = -1
             LABLAXIS = "D"
             FIELDNAM = "Delta"
             UNITS = "s"
             SI_CONVERSION = "1>s"
             CATDESC = " half the sampling duration + uncertainty of time tags (in seconds)"
             DEPEND_0 = time_tags__C1_CP_WHI_NATURAL
             LABEL_1 = "Delta"
             SIGNIFICANT_DIGITS = 8
             PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Delta__C1_CP_WHI_NATURAL

START_VARIABLE = fft_size__C1_CP_WHI_NATURAL
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "F_F_T"
            FIELDNAM = "Fast Fourier Transform Size"
```

```
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Number of bin frequency points of the Fast Fourier Transform"
            DEPEND_0 = time_tags__C1_CP_WHI_NATURAL
            LABEL_1 = "Fast_Fourier_Transform_Size"
            SIGNIFICANT_DIGITS = 3
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = fft_size__C1_CP_WHI_NATURAL

START_VARIABLE = Receiving_Antenna__C1_CP_WHI_NATURAL
            SIZES = 1
            VALUE_TYPE = CHAR
            FILLVAL = "?"
            LABLAXIS = "R_A"
            FIELDNAM = "Receiving Antenna"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Receiving antenna Ey or Ez"
            DEPEND_0 = time_tags__C1_CP_WHI_NATURAL
            LABEL_1 = "Receiving_Antenna"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Receiving_Antenna__C1_CP_WHI_NATURAL

START_VARIABLE = Electric_Spectral_Power_Density__C1_CP_WHI_NATURAL
            SIZES = 512
            VALUE_TYPE = FLOAT
            ENTITY = "Electric_Field"
            PROPERTY = "Magnitude"
            FLUCTUATIONS = "Fourier_spectrum"
            LABLAXIS = "E-SPD"
           FIELDNAM = "E-Spectral Power Density"
           SI_CONVERSION = "1.0>Vrms^2*m^-2*Hz^-1"
           UNITS = "Vrms^2*m^-2*Hz^-1"
           FILLVAL = -1
           CATDESC = "Electric Spectral Power Density in Natural Mode"
           DEPEND_0 = time_tags__C1_CP_WHI_NATURAL
           DEPEND_1 = Spectral_Frequencies__C1_CP_WHI_NATURAL
           SIGNIFICANT_DIGITS = 13
           PARAMETER_TYPE = "Data"
           QUALITY = 3
END_VARIABLE = Electric_Spectral_Power_Density__C1_CP_WHI_NATURAL

START_VARIABLE = Spectral_Frequencies__C1_CP_WHI_NATURAL
           SIZES = 512
           VALUE_TYPE = FLOAT
           LABLAXIS = "S_F"
           FIELDNAM = "Spectral Frequencies"
           SI_CONVERSION = "1.0E3>Hz"
           UNITS = "kHz"
           FILLVAL = -1
```

```
            DELTA_PLUS = 0.0815
            DELTA_MINUS = 0.0815
            SCALETYP = "Linear"
            CATDESC = "frequencies of the 512 elements of the fixed size spectrum"
             DATA =
            1.953,2.116,2.279,2.441,2.604,2.767,2.930,3.092,3.255,3.418,3.581,3.743,3.906,4.069,4.232,4.395,4.5
            57,4.720,4.883,5.046,5.208,5.371,5.534,5.697,5.859,6.022,6.185,6.348,6.510,6.673,6.836,6.999,7.161,
            7.324,7.487,7.650,7.812,7.975,8.138,8.301,8.464,8.626,8.789,8.952,9.115,9.277,9.440,9.603,9.766,9.9
            28,10.091,10.254,10.417,10.579,10.742,10.905,11.068,11.230,11.393,11.556,11.719,11.882,12.044,12
            .207,12.370,12.533,12.695,12.858,13.021,13.184,13.346,13.509,13.672,13.835,13.997,14.160,14.323,
            14.486,14.648,14.811,14.974,15.137,15.299,15.462,15.625,15.788,15.951,16.113,16.276,16.439,16.60
            2,16.764,16.927,17.090,17.253,17.415,17.578,17.741,17.904,18.066,18.229,18.392,18.555,18.717,18.
            880,19.043,19.206,19.368,19.531,19.694,19.857,20.020,20.182,20.345,20.508,20.671,20.833,20.996,2
            1.159,21.322,21.484,21.647,21.810,21.973,22.135,22.298,22.461,22.624,22.786,22.949,23.112,23.275
            ,23.438,23.600,23.763,23.926,24.089,24.251,24.414,24.577,24.740,24.902,25.065,25.228,25.391,25.5
            53,25.716,25.879,26.042,26.204,26.367,26.530,26.693,26.855,27.018,27.181,27.344,27.507,27.669,27
            .832,27.995,28.158,28.320,28.483,28.646,28.809,28.971,29.134,29.297,29.460,29.622,29.785,29.948,
            30.111,30.273,30.436,30.599,30.762,30.924,31.087,31.250,31.413,31.576,31.738,31.901,32.064,32.22
            7,32.389,32.552,32.715,32.878,33.040,33.203,33.366,33.529,33.691,33.854,34.017,34.180,34.342,34.
            505,34.668,34.831,34.993,35.156,35.319,35.482,35.645,35.807,35.970,36.133,36.296,36.458,36.621,3
            6.784,36.947,37.109,37.272,37.435,37.598,37.760,37.923,38.086,38.249,38.411,38.574,38.737,38.900
            ,39.062,39.225,39.388,39.551,39.714,39.876,40.039,40.202,40.365,40.527,40.690,40.853,41.016,41.1
            78,41.341,41.504,41.667,41.829,41.992,42.155,42.318,42.480,42.643,42.806,42.969,43.132,43.294,43
            .457,43.620,43.783,43.945,44.108,44.271,44.434,44.596,44.759,44.922,45.085,45.247,45.410,45.573,
            45.736,45.898,46.061,46.224,46.387,46.549,46.712,46.875,47.038,47.201,47.363,47.526,47.689,47.85
            2,48.014,48.177,48.340,48.503,48.665,48.828,48.991,49.154,49.316,49.479,49.642,49.805,49.967,50.
            130,50.293,50.456,50.618,50.781,50.944,51.107,51.270,51.432,51.595,51.758,51.921,52.083,52.246,5
            2.409,52.572,52.734,52.897,53.060,53.223,53.385,53.548,53.711,53.874,54.036,54.199,54.362,54.525
            ,54.688,54.850,55.013,55.176,55.339,55.501,55.664,55.827,55.990,56.152,56.315,56.478,56.641,56.8
            03,56.966,57.129,57.292,57.454,57.617,57.780,57.943,58.105,58.268,58.431,58.594,58.757,58.919,59
            .082,59.245,59.408,59.570,59.733,59.896,60.059,60.221,60.384,60.547,60.710,60.872,61.035,61.198,
            61.361,61.523,61.686,61.849,62.012,62.174,62.337,62.500,62.663,62.826,62.988,63.151,63.314,63.47
            7,63.639,63.802,63.965,64.128,64.290,64.453,64.616,64.779,64.941,65.104,65.267,65.430,65.592,65.
            755,65.918,66.081,66.243,66.406,66.569,66.732,66.895,67.057,67.220,67.383,67.546,67.708,67.871,6
            8.034,68.197,68.359,68.522,68.685,68.848,69.010,69.173,69.336,69.499,69.661,69.824,69.987,70.150
            ,70.312,70.475,70.638,70.801,70.964,71.126,71.289,71.452,71.615,71.777,71.940,72.103,72.266,72.4
            28,72.591,72.764,72.917,73.079,73.242,73.405,73.568,73.730,73.893,74.056,74.219,74.382,74.544,74
            .707,74.870,75.033,75.195,75.358,75.521,75.684,75.846,76.009,76.172,76.335,76.497,76.660,76.823,
            76.986,77.148,77.311,77.474,77.637,77.799,77.962,78.125,78.288,78.451,78.613,78.776,78.939,79.10
            2,79.264,79.427,79.590,79.753,79.915,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-
            1,-1,-1,-1,-1,-1,-1,-1
             SIGNIFICANT_DIGITS = 6
             PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Spectral_Frequencies__C1_CP_WHI_NATURAL

START_VARIABLE = Overflow_Code__C1_CP_WHI_NATURAL
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "Ov"
```

```
            FIELDNAM = "Overflow Code Value"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "coded overflow information, from 0 (clean) to 1 (saturation)"
            DEPEND_0 = time_tags__C1_CP_WHI_NATURAL
            LABEL_1 = "Overflow_Code_Value"
            SIGNIFICANT_DIGITS = 12
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Overflow_Code__C1_CP_WHI_NATURAL

START_VARIABLE = Average_Number__C1_CP_WHI_NATURAL
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "A_N"
            FIELDNAM = "Average Number"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Number of averaged spectra"
            DEPEND_0 = time_tags__C1_CP_WHI_NATURAL
            LABEL_1 = "Average_Number"
            SIGNIFICANT_DIGITS = 2
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Average_Number__C1_CP_WHI_NATURAL

START_VARIABLE = Gain_Change_Number__C1_CP_WHI_NATURAL
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "G_C_N"
            FIELDNAM = "Gain Change Number"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Number of gain changes during the acquisition"
            DEPEND_0 = time_tags__C1_CP_WHI_NATURAL
            LABEL_1 = "Gain_Change_Number"
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Gain_Change_Number__C1_CP_WHI_NATURAL

START_VARIABLE = Mantissa__C1_CP_WHI_NATURAL
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = 99
            LABLAXIS = "M"
            FIELDNAM = "Mantissa"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "First part of the compressed value which is a fixed point integer defined in the
            compression algorithm"
```

```
            DEPEND_0 = time_tags__C1_CP_WHI_NATURAL
            LABEL_1 = "Mantissa"
            SIGNIFICANT_DIGITS = 2
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Mantissa__C1_CP_WHI_NATURAL

START_VARIABLE = Exponent__C1_CP_WHI_NATURAL
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = 99
            LABLAXIS = "E"
            FIELDNAM = "Exponent"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Second part of the compressed value"
            DEPEND_0 = time_tags__C1_CP_WHI_NATURAL
            LABEL_1 = "Exponent"
            SIGNIFICANT_DIGITS = 2
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Exponent__C1_CP_WHI_NATURAL
```

5.3 Energy File: CP_WHI_WAVE_FORM_ENERGY

This dataset contains the Electric Wave Form Power Density under natural mode from the WHISPER experiment.

5.3.1 Format

As described in section 4.1

5.3.2 Standard

As described in section 4.2

5.3.3 Production Procedure

As described in section 4.3

5.3.4 Quality Control Procedure

As described in section 4.4

5.3.5 Delivery Procedure

As described in section 4.5

5.3.6 Product Specification

Filename format: Ci_CP_WHI_WAVE_FORM_ENERGY__yyyymmdd_Vnn.cef
where i = 1,2,3,4 (spacecraft id), nn = version number.

Each WAVE_FORM_ENERGY file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_WAVE_FORM_ENERGY_DATASET.ceh
- parameters: Ci_CH_WHI_WAVE_FORM_ENERGY_PARAMETERS.ceh

Each WAVE_FORM_ENERGY file contains the following six variables whose description is the same as in section 5.2.6:

- time_tags
- Delta
- Electric_Wave_Form_Power_Density
- Spectrum_Code
- Average_Number
- Overflow_Code

Example of a WAVE_FORM_ENERGY file:

```
FILE_NAME = "C1_CP_WHI_WAVE_FORM_ENERGY__20071001_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
          ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_WAVE_FORM_ENERGY_DATASET.ceh"
INCLUDE = "C1_CH_WHI_WAVE_FORM_ENERGY_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
          ENTRY = "C1_CP_WHI_WAVE_FORM_ENERGY__20071001_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
          ENTRY = "1"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
          ENTRY = "02"
END_META = DATASET_VERSION
```

```
START_META = FILE_TIME_SPAN
          VALUE_TYPE = ISO_TIME_RANGE
          ENTRY = 2007-10-01T00:00:00.000Z/2007-10-01T23:59:59.999Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
          VALUE_TYPE = ISO_TIME
          ENTRY = 2009-12-15T08:13:06Z
END_META = GENERATION_DATE

START_META = FILE_CAVEATS
          ENTRY = "Warning: Chronology error after 05:53:54.248"
END_META = FILE_CAVEATS

DATA_UNTIL= "End"
2007-10-01T00:00:04.853Z,0.006084,8.417433E-15,0,32,0.000000 $
2007-10-01T00:00:05.280Z,0.006084,6.839164E-15,0,32,0.000000 $
End
```

5.3.7 Metadata Specification

5.3.7.1 Mission

See section 5.1.1

5.3.7.2 Observatory

See section 5.1.2

5.3.7.3 Experiment

See section 5.1.3

5.3.7.4 Instrument

See section 5.1.4

5.3.7.5 Dataset

The file Ci_CH_WHI_WAVE_FORM_ENERGY_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
! C1_CH_WHI_WAVE_FORM_ENERGY_DATASET.ceh
! Header file for WHISPER1 WAVE FORM ENERGY dataset
!

START_META = DATASET_ID
          ENTRY = "C1_CP_WHI_WAVE_FORM_ENERGY"
END_META = DATASET_ID
```

```
START_META = DATA_TYPE
          ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE

START_META = DATASET_TITLE
          ENTRY = "Electric Wave Form Power Density"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
          ENTRY = "This dataset contains the Electric Wave Form Power Density under natural mode from
          Whisper on spacecraft 1"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
          ENTRY = "DATASET VERSION HISTORY"
          ENTRY = "VERSION 01: first version of dataset"
          ENTRY = "VERSION 02: dataset headers update"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
          ENTRY = "0.2"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
          ENTRY = "0.013"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
          ENTRY = "0.8"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
          ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
          ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
          ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
          data"
END_META = ACKNOWLEDGEMENT

START_META = FILE_TYPE
          ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
```

```
          ENTRY = "CAA"
END_META = METADATA_TYPE
```

5.3.7.6 Parameters

The file Ci_CH_WHI_WAVE_FORM_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

Each value in the record is comma-separated.
Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_WAVE_FORM_ENERGY_PARAMETERS.ceh
!  Parameters description for WHISPER1 WAVE FORM ENERGY dataset
!

START_VARIABLE = time_tags__C1_CP_WHI_WAVE_FORM_ENERGY
           CATDESC = "Interval centred time tag"
            UNITS = "s"
            SIZES = 1
            VALUE_TYPE = ISO_TIME
            SIGNIFICANT_DIGITS = 24
            FILLVAL = 9999-12-31T23:59:59.999Z
            DELTA_PLUS = delta__C1_CP_WHI_WAVE_FORM_ENERGY
            DELTA_MINUS = delta__C1_CP_WHI_WAVE_FORM_ENERGY
            LABLAXIS = "UT"
            FIELDNAM = "Universal Time"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = time_tags__C1_CP_WHI_WAVE_FORM_ENERGY

START_VARIABLE = Delta__C1_CP_WHI_WAVE_FORM_ENERGY
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "D"
            FIELDNAM = "Delta"
            UNITS = "s"
            SI_CONVERSION = "1>s"
            CATDESC = " half the sampling duration + uncertainty of time tags (in seconds)"
            DEPEND_0 = time_tags__C1_CP_WHI_WAVE_FORM_ENERGY
            LABEL_1 = "Delta"
            SIGNIFICANT_DIGITS = 8
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Delta__C1_CP_WHI_WAVE_FORM_ENERGY

START_VARIABLE = Electric_Wave_Form_Power_Density__C1_CP_WHI_WAVE_FORM_ENERGY
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            ENTITY = "Electric_Field"
```

```
            PROPERTY = "Magnitude"
            FLUCTUATIONS = "Mean_Square_Level"
            LABLAXIS = "E_W_F_P_D"
            FIELDNAM = "Energy Value"
            SI_CONVERSION = "1.0>Vrms^2*m^-2*Hz^-1"
            UNITS = "Vrms^2*m^-2*Hz^-1"
            CATDESC = "Electric Wave Form Power Density"
            DEPEND_0 = time_tags__C1_CP_WHI_WAVE_FORM_ENERGY
            LABEL_1 = "Energy_Value"
            SIGNIFICANT_DIGITS = 13
            PARAMETER_TYPE = "Data"
            QUALITY = 3
END_VARIABLE = Electric_Wave_Form_Power_Density__C1_CP_WHI_WAVE_FORM_ENERGY

START_VARIABLE = Spectrum_Code__C1_CP_WHI_WAVE_FORM_ENERGY
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "S_C"
            FIELDNAM = "Presence of Spectrum Code"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Equals to 1 if the record corresponds to a natural spectrum and 0 otherwise"
            DEPEND_0 = time_tags__C1_CP_WHI_WAVE_FORM_ENERGY
            LABEL_1 = "Presence_of_Spectrum_Code"
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Spectrum_Code__C1_CP_WHI_WAVE_FORM_ENERGY

START_VARIABLE = Average_Number__C1_CP_WHI_WAVE_FORM_ENERGY
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "A_N"
            FIELDNAM = "Average Number"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Number of averaged individual spectra (formed every 13.33 ms)"
            DEPEND_0 = time_tags__C1_CP_WHI_WAVE_FORM_ENERGY
            LABEL_1 = "Average_Number"
            SIGNIFICANT_DIGITS = 2
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Average_Number__C1_CP_WHI_WAVE_FORM_ENERGY

START_VARIABLE = OverFlow_Code__C1_CP_WHI_WAVE_FORM_ENERGY
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "Ov"
            FIELDNAM = "Overflow Code Value"
```

```
        UNITS = "unitless"
        SI_CONVERSION = "1>unitless"
        CATDESC = " coded overflow information, from 0 (clean) to 1 (saturation)"
        DEPEND_0 = time_tags__C1_CP_WHI_WAVE_FORM_ENERGY
        LABEL_1 = "Overflow_Code_Value"
        SIGNIFICANT_DIGITS = 9
        PARAMETER_TYPE = "Support_Data"
END_VARIABLE = OverFlow_Code__C1_CP_WHI_WAVE_FORM_ENERGY
```

5.4 Active File: CP_WHI_ACTIVE

This dataset contains ACTIVE electric spectral power density under sounding mode from the WHISPER experiment.

5.4.1 Format

As described in section 4.1

5.4.2 Standard

As described in section 4.2

5.4.3 Production Procedure

As described in section 4.3

5.4.4 Quality Control Procedure

As described in section 4.4

5.4.5 Delivery Procedure

As described in section 4.5

5.4.6 Product Specification

Filename format: Ci_CP_WHI_ACTIVE__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each ACTIVE file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_ACTIVE_DATASET.ceh
- parameters: Ci_CH_WHI_ACTIVE_PARAMETERS.ceh

Each ACTIVE file contains eleven variables. Ten of them are record varying, so that one single record in the file is composed of the following variables:

time_tags	same as in section 5.2.6
Delta	gives the DELTA_PLUS and DELTA_MINUS values (in s) of the time_tags metadata which are half the number of seconds corresponding to the sampling interval + the uncertainty of the time_tags. This value depends on the number of step in the frequency Scan Table swept and of the metadata named Sounding_Interval (see below). It is equal to (step_number-1)*Sounding_Interval/2000+0.003.
Receiving_Antenna	same as in section 5.2.6
Electric_Spectral_Power_Density	same as in section 5.2.6
Table_Number	Corresponds to the fst (frequency scan table) number. There are 128 frequency scan tables and each of these gives us a group of frequency values which will give the level of the environment excitement (see WEC user manual) For example, the table number 76 gives the following values: {33, 197, 191, 185, 179, 173, 167, 161, 155, 149, 143, 137, 195, 189, 183, 177, 171, 165, 159, 153, 147, 141, 135, 193, 187, 181, 175, 169, 163, 157, 151, 145, 139, 133, 0} The first value gives the number of steps. There are two different kinds of tables: fixed tables and algorithmic tables. The fixed tables have predefined values contrary to the algorithmic tables which have values calculated by an algorithm.
Sounding_Interval	duration (in ms) of the emission-reception(s). There are different modes depending of the Average_Number (see above, Natural file Section a.): Average_Number = ●32: 1 Emission is followed by 1 Reception and the duration is 13.33 ms.

	●16: 1 Emission is followed by 2 Receptions (or by 3 Receptions) and the duration is 26.66 ms (or the duration is 40ms). ●8: 1 Emission is followed by 5 Receptions and the duration is 66.66 ms. ●4: 1 Emission is followed by 8 Receptions and the duration is 106.66 ms. ●2: 40 * (1 Emission followed by 1 Reception) + waiting time + 256 * 1 Reception + waiting time. The total duration time is 8.5 s. ●64: 1 Emission is followed by 5 Receptions + waiting time. The total duration is 125 ms. ●1: 1 Emission is followed by 13 Receptions + waiting time. The total duration is 250 ms.
Emission/Reception_Delay	equals to 18.8666666 ms if we have a delay of 13.333333 ms between the Emission and the Reception and to 5.5333333 ms otherwise.
Gain_Change_Number	number of times the gain changed during the acquisition.
Mantissa	first part (the second is exponent, see below) of the compressed value which is a fixed-point integer before the compression algorithm. After the compression, the integer gets a floating-point representation, and the compressed data size is the mantissa size plus the fraction size
Exponent	second part of the compressed value

An ACTIVE file also contains one non record varying variable whose values are given in the parameters definition file (see 5.4.7.6).

Spectral_Frequencies	512 values (in kHz) corresponding to the acquisition frequencies of the spectrum (480 values between 1.953 kHz and 79.915 kHz, and 32 fill values)

Example of an ACTIVE file:

```
FILE_NAME = "C1_CP_WHI_ACTIVE__20071001_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
```

```
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
           ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_ACTIVE_DATASET.ceh"
INCLUDE = "C1_CH_WHI_ACTIVE_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
           ENTRY = "C1_CP_WHI_ACTIVE__20071001_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
           ENTRY = "1"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
           ENTRY = "03"
END_META = DATASET_VERSION

START_META = FILE_TIME_SPAN
           VALUE_TYPE = ISO_TIME_RANGE
           ENTRY = 2007-10-01T00:00:00.000Z/2007-10-01T23:59:59.999Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
           VALUE_TYPE = ISO_TIME
           ENTRY = 2009-12-15T08:13:06Z
END_META = GENERATION_DATE

DATA_UNTIL= "End"
2007-10-01T00:00:02.182Z,0.523000,"Y",-1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-
1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,1.090455E-
14,3.289766E-14,-1.000000E+00,2.005840E-15,-1.000000E+00,-1.000000E+00,1.600792E-14,6.369614E-14…,-
1.000000E+00,-1.000000E+00,29,26.666666,5.533333,0,2,0 $
End
```

5.4.7 Metadata Specification

5.4.7.1 Mission

See section 5.1.1

5.4.7.2 Observatory

See section 5.1.2

5.4.7.3 Experiment

See section 5.1.3

5.4.7.4 Instrument

See section 5.1.4

5.4.7.5 Dataset

The file Ci_CH_WHI_ACTIVE_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_ACTIVE_DATASET.ceh
!  Header file for WHISPER1 ACTIVE dataset
!

START_META = DATASET_ID
           ENTRY = "C1_CP_WHI_ACTIVE"
END_META = DATASET_ID

START_META = DATA_TYPE
           ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE

START_META = DATASET_TITLE
           ENTRY = "Electric Spectral Power Density"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
           ENTRY = "This dataset contains electric spectral power density under Sounding Mode from Whisper on
spacecraft 1"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
           ENTRY = "DATASET VERSION HISTORY"
           ENTRY = "VERSION 01: first version of dataset"
           ENTRY = "VERSION 02: correction of the Spectral Frequencies parameter description"
           ENTRY = "VERSION 03: dataset headers update"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
           ENTRY =  "52"
END_META = TIME_RESOLUTION
```

```
START_META = MIN_TIME_RESOLUTION
            ENTRY = "1.5"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
            ENTRY = "104"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
            ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
            ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
            ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
data"
END_META = ACKNOWLEDGEMENT

START_META = FILE_TYPE
            ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
            ENTRY = "CAA"
END_META = METADATA_TYPE
```

5.4.7.6 Parameters

The file Ci_CH_WHI_ACTIVE_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_ACTIVE_PARAMETERS.ceh
!  Parameters description for WHISPER1 ACTIVE dataset
!

START_VARIABLE = time_tags__C1_CP_WHI_ACTIVE
            CATDESC = "Interval centred time tag"
            UNITS = "s"
            SIZES = 1
            VALUE_TYPE = ISO_TIME
            SIGNIFICANT_DIGITS = 24
            FILLVAL = 9999-12-31T23:59:59.999Z
            DELTA_PLUS = Delta__C1_CP_WHI_ACTIVE
            DELTA_MINUS = Delta__C1_CP_WHI_ACTIVE
```

```
            LABLAXIS = "UT"
            FIELDNAM = "Universal Time"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = time_tags__C1_CP_WHI_ACTIVE

START_VARIABLE = Delta__C1_CP_WHI_ACTIVE
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "D"
            FIELDNAM = "Delta"
            UNITS = "s"
            SI_CONVERSION = "1>s"
            CATDESC = "half the sampling duration + uncertainty of time tags (in seconds)"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE
            LABEL_1 = "Delta"
            SIGNIFICANT_DIGITS = 8
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Delta__C1_CP_WHI_ACTIVE

START_VARIABLE = Receiving_Antenna__C1_CP_WHI_ACTIVE
            SIZES = 1
            VALUE_TYPE = CHAR
            FILLVAL = "?"
            LABLAXIS = "R_A"
            FIELDNAM = "Receiving Antenna"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Receiving antenna Ey or Ez"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE
            LABEL_1 = "Receiving_Antenna"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Receiving_Antenna__C1_CP_WHI_ACTIVE

START_VARIABLE = Electric_Spectral_Power_Density__C1_CP_WHI_ACTIVE
            SIZES = 512
            VALUE_TYPE = FLOAT
            ENTITY = "Electric_Field"
            PROPERTY = "Magnitude"
            FLUCTUATIONS = "Fourier_spectrum"
            LABLAXIS = "E-SPD"
            FIELDNAM = "Electric Spectral Power Density"
            SI_CONVERSION = "1.0>Vrms^2*m^-2*Hz^-1"
            UNITS = "Vrms^2*m^-2*Hz^-1"
            FILLVAL = -1
            CATDESC = "Electric Spectral Power Density"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE
            DEPEND_1 = Spectral_Frequencies__C1_CP_WHI_ACTIVE
            SIGNIFICANT_DIGITS = 13
            PARAMETER_TYPE = "Data"
```

```
            QUALITY = 3
END_VARIABLE = Electric_Spectral_Power_Density__C1_CP_WHI_ACTIVE

START_VARIABLE = Spectral_Frequencies__C1_CP_WHI_ACTIVE
            SIZES = 512
             VALUE_TYPE = FLOAT
             LABLAXIS = "S_F"
             FIELDNAM = "Spectral Frequencies"
             SI_CONVERSION = "1.0E3>Hz"
             UNITS = "kHz"
             FILLVAL = -1
             DELTA_PLUS = 0.0815
             DELTA_MINUS = 0.0815
             SCALETYP = "Linear"
             CATDESC = "frequencies of the 512 elements of the fixed size spectrum"
             DATA =
            1.953,2.116,2.279,2.441,2.604,2.767,2.930,3.092,3.255,3.418,3.581,3.743,3.906,4.069,4.232,
            4.395,4.557,4.720,4.883,5.046,5.208,5.371,5.534,5.697,5.859,6.022,6.185,6.348,6.510,6.673,
            6.836,6.999,7.161,7.324,7.487,7.650,7.812,7.975,8.138,8.301,8.464,8.626,8.789,8.952,9.115,
            9.277,9.440,9.603,9.766,9.928,10.091,10.254,10.417,10.579,10.742,10.905,11.068,11.230,11
            .393,11.556,11.719,11.882,12.044,12.207,12.370,12.533,12.695,12.858,13.021,13.184,13.34
            6,13.509,13.672,13.835,13.997,14.160,14.323,14.486,14.648,14.811,14.974,15.137,15.299,1
            5.462,15.625,15.788,15.951,16.113,16.276,16.439,16.602,16.764,16.927,17.090,17.253,17.4
            15,17.578,17.741,17.904,18.066,18.229,18.392,18.555,18.717,18.880,19.043,19.206,19.368,
            19.531,19.694,19.857,20.020,20.182,20.345,20.508,20.671,20.833,20.996,21.159,21.322,21.
            484,21.647,21.810,21.973,22.135,22.298,22.461,22.624,22.786,22.949,23.112,23.275,23.438
            ,23.600,23.763,23.926,24.089,24.251,24.414,24.577,24.740,24.902,25.065,25.228,25.391,25.
            553,25.716,25.879,26.042,26.204,26.367,26.530,26.693,26.855,27.018,27.181,27.344,27.507
            ,27.669,27.832,27.995,28.158,28.320,28.483,28.646,28.809,28.971,29.134,29.297,29.460,29.
            622,29.785,29.948,30.111,30.273,30.436,30.599,30.762,30.924,31.087,31.250,31.413,31.576
            ,31.738,31.901,32.064,32.227,32.389,32.552,32.715,32.878,33.040,33.203,33.366,33.529,33.
            691,33.854,34.017,34.180,34.342,34.505,34.668,34.831,34.993,35.156,35.319,35.482,35.645
            ,35.807,35.970,36.133,36.296,36.458,36.621,36.784,36.947,37.109,37.272,37.435,37.598,37.
            760,37.923,38.086,38.249,38.411,38.574,38.737,38.900,39.062,39.225,39.388,39.551,39.714
            ,39.876,40.039,40.202,40.365,40.527,40.690,40.853,41.016,41.178,41.341,41.504,41.667,41.
            829,41.992,42.155,42.318,42.480,42.643,42.806,42.969,43.132,43.294,43.457,43.620,43.783
            ,43.945,44.108,44.271,44.434,44.596,44.759,44.922,45.085,45.247,45.410,45.573,45.736,45.
            898,46.061,46.224,46.387,46.549,46.712,46.875,47.038,47.201,47.363,47.526,47.689,47.852
            ,48.014,48.177,48.340,48.503,48.665,48.828,48.991,49.154,49.316,49.479,49.642,49.805,49.
            967,50.130,50.293,50.456,50.618,50.781,50.944,51.107,51.270,51.432,51.595,51.758,51.921
            ,52.083,52.246,52.409,52.572,52.734,52.897,53.060,53.223,53.385,53.548,53.711,53.874,54.
            036,54.199,54.362,54.525,54.688,54.850,55.013,55.176,55.339,55.501,55.664,55.827,55.990
            ,56.152,56.315,56.478,56.641,56.803,56.966,57.129,57.292,57.454,57.617,57.780,57.943,58.
            105,58.268,58.431,58.594,58.757,58.919,59.082,59.245,59.408,59.570,59.733,59.896,60.059
            60.221,60.384,60.547,60.710,60.872,61.035,61.198,61.361,61.523,61.686,61.849,62.012,62.
            174,62.337,62.500,62.663,62.826,62.988,63.151,63.314,63.477,63.639,63.802,63.965,64.128
            ,64.290,64.453,64.616,64.779,64.941,65.104,65.267,65.430,65.592,65.755,65.918,66.081,66.
            243,66.406,66.569,66.732,66.895,67.057,67.220,67.383,67.546,67.708,67.871,68.034,68.197
            ,68.359,68.522,68.685,68.848,69.010,69.173,69.336,69.499,69.661,69.824,69.987,70.150,70.
            312,70.475,70.638,70.801,70.964,71.126,71.289,71.452,71.615,71.777,71.940,72.103,72.266
```

```
          ,72.428,72.591,72.764,72.917,73.079,73.242,73.405,73.568,73.730,73.893,74.056,74.219,74.
          382,74.544,74.707,74.870,75.033,75.195,75.358,75.521,75.684,75.846,76.009,76.172,76.335
          ,76.497,76.660,76.823,76.986,77.148,77.311,77.474,77.637,77.799,77.962,78.125,78.288,78.
          451,78.613,78.776,78.939,79.102,79.264,79.427,79.590,79.753,79.915,-1,-1,-1,-1,-1,-1,-1,-
          1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1
           SIGNIFICANT_DIGITS = 6
           PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Spectral_Frequencies__C1_CP_WHI_ACTIVE

START_VARIABLE = Table_Number__C1_CP_WHI_ACTIVE
           SIZES = 1
           VALUE_TYPE = INT
           FILLVAL = -1
           LABLAXIS = "T_N"
           FIELDNAM = "Table Number"
           UNITS = "unitless"
           SI_CONVERSION = "1>unitless"
           CATDESC = "Frequency Swept Table Number between 0 and 127"
           DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE
           LABEL_1 = "Table_Number"
           SIGNIFICANT_DIGITS = 3
           PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Table_Number__C1_CP_WHI_ACTIVE

START_VARIABLE = Sounding_Interval__C1_CP_WHI_ACTIVE
           SIZES = 1
           VALUE_TYPE = FLOAT
           FILLVAL = -1
           LABLAXIS = "S_I"
           FIELDNAM = "Sounding Interval"
           UNITS = "ms"
           SI_CONVERSION = "1.0E-3>s"
           CATDESC = "coded time interval between 2 emission pulses in unit of (40/3=13.3)ms”
           DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE
           LABEL_1 = "Sounding_Interval"
           SIGNIFICANT_DIGITS = 10
           PARAMETER_TYPE = "Support_Data"
          PARAMETER_CAVEATS = "0: 1 unit (13.3 ms); 1: 2 units (26.6 ms); 2: 3 units (40 ms); 3: 5 units (66.6
          ms); 4: 8 units (106.6 ms); 5: 40 units+2106.66 ms waiting+256 units+2446.66 ms waiting (8.5 s);
          6: 6 units+45 ms waiting (125 ms); 7: 14 units+63.34 ms waiting (250 ms)"
END_VARIABLE = Sounding_Interval__C1_CP_WHI_ACTIVE

START_VARIABLE = Emission_Reception_Delay__C1_CP_WHI_ACTIVE
           SIZES = 1
           VALUE_TYPE = FLOAT
           FILLVAL = -1
           LABLAXIS = "E/R_D"
           FIELDNAM = "Emission/Reception Delay"
           SI_CONVERSION = "1.0E-3>s"
           UNITS = "ms"
```

```
            CATDESC = "acquisition time interval"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE
            LABEL_1 = "Emission/Reception_Delay"
            SIGNIFICANT_DIGITS = 9
            PARAMETER_TYPE = "Support_Data"
           PARAMETER_CAVEATS = "acquisition time is defined as the delay between the leading edge of
           the emission pulse and the starting edge of the associated reception"
END_VARIABLE = Emission_Reception_Delay__C1_CP_WHI_ACTIVE

START_VARIABLE = Gain_Change_Number__C1_CP_WHI_ACTIVE
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "G_C_N"
            FIELDNAM = "Gain Change Number"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Number of gain changes during the acquisition"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE
            LABEL_1 = "Gain_Change_Number"
            SIGNIFICANT_DIGITS = 3
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Gain_Change_Number__C1_CP_WHI_ACTIVE

START_VARIABLE = Mantissa__C1_CP_WHI_ACTIVE
           SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = 99
            LABLAXIS = "M"
            FIELDNAM = "Mantissa"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "First part of the compressed value which is a fixed point integer defined in the
           compression algorithm"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE
            LABEL_1 = "Mantissa"
            SIGNIFICANT_DIGITS = 2
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Mantissa__C1_CP_WHI_ACTIVE

START_VARIABLE = Exponent__C1_CP_WHI_ACTIVE
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = 99
            LABLAXIS = "E"
            FIELDNAM = "Exponent"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Second part of the compressed value"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE
```

```
        LABEL_1 = "Exponent"
        SIGNIFICANT_DIGITS = 2
        PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Exponent__C1_CP_WHI_ACTIVE
```

5.5 Passive File: CP_WHI_PASSIVE_ACTIVE

This dataset contains PASSIVE electric spectral power density under sounding mode from the WHISPER experiment (see user guide for a more detailed description). The presence of this data depends on the onboard compression strategy (see Appendix C).

5.5.1 Format

As described in section 4.1

5.5.2 Standard

As described in section 4.2

5.5.3 Production Procedure

As described in section 4.3

5.5.4 Quality Control Procedure

As described in section 4.4

5.5.5 Delivery Procedure

As described in section 4.5

5.5.6 Product Specification

Filename format: Ci_CP_WHI_PASSIVE_ACTIVE__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each ACTIVE file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_PASSIVE_ACTIVE_DATASET.ceh
- parameters: Ci_CH_WHI_PASSIVE_ACTIVE_PARAMETERS.ceh

Each PASSIVE_ACTIVE file contains eleven variables that are the same as for the dataset in section 5.4.6 except for one parameter. Ten of them are record varying, so that one single record in the file is composed of the following variables:

time_tags	
Delta	
Receiving_Antenna	
Electric_Spectral_Power_Density	
Table_Number	
Sounding_Interval	
Passive/Active_Delay	equals 13.33 ms if there is no delay between the emission and the reception and equals 26.66 ms if there is a delay between the emission and the reception.
Gain_Change_Number	
Mantissa	
Exponent	

A PASSIVE_ACTIVE file also contains one non record varying variable whose values are given in the parameters definition file (see 5.5.7.6).

Spectral_Frequencies	512 values (in kHz) corresponding to the acquisition frequencies of the spectrum (480 values between 1.953 kHz and 79.915 kHz, and 32 fill values)

Example of a PASSIVE_ACTIVE file:

```
FILE_NAME = "C1_CP_WHI_PASSIVE_ACTIVE__20071001_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
          ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_PASSIVE_ACTIVE_DATASET.ceh"
INCLUDE = "C1_CH_WHI_PASSIVE_ACTIVE_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
          ENTRY = "C1_CP_WHI_PASSIVE_ACTIVE__20071001_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
          ENTRY = "1"
```

```
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
           ENTRY = "03"
END_META = DATASET_VERSION

START_META = FILE_TIME_SPAN
           VALUE_TYPE = ISO_TIME_RANGE
           ENTRY = 2007-10-01T00:00:00.000Z/2007-10-01T23:59:59.999Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
           VALUE_TYPE = ISO_TIME
           ENTRY = 2009-12-15T08:13:06Z
END_META = GENERATION_DATE

DATA_UNTIL= "End"
2007-10-01T01:54:15.012Z,0.683000,"Z",-1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-
1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,6.169048E-17,...,-
1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-1.000000E+00,-
1.000000E+00,14,26.666666,13.333333,0,4,4 $
End
```

5.5.7 Metadata Specification

5.5.7.1 Mission

See section 5.1.1

5.5.7.2 Observatory

See section 5.1.2

5.5.7.3 Experiment

See section 5.1.3

5.5.7.4 Instrument

See section 5.1.4

5.5.7.5 Dataset

The file Ci_CH_WHI_PASSIVE_ACTIVE_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
! C1_CH_WHI_PASSIVE_ACTIVE_DATASET.ceh
! Header file for WHISPER1 PASSIVE ACTIVE dataset
!
```

```
START_META = DATASET_ID
          ENTRY = "C1_CP_WHI_PASSIVE_ACTIVE"
END_META = DATASET_ID

START_META = DATA_TYPE
          ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE

START_META = DATASET_TITLE
          ENTRY = "Passive Of Active Electric Spectral Power Density"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
          ENTRY = "This dataset contains passive electric spectral power density under sounding mode from
Whisper on spacecraft 1"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
          ENTRY = "DATASET VERSION HISTORY"
          ENTRY = "VERSION 01: first version of dataset"
          ENTRY = "VERSION 02: correction of the Spectral Frequencies parameter description"
          ENTRY = "VERSION 03: dataset headers update"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
          ENTRY =  "52"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
          ENTRY = "1.5"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
          ENTRY = "104"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
          ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
          ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"END_META =
CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
          ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
data"
END_META = ACKNOWLEDGEMENT

START_META = FILE_TYPE
```

```
        ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
        ENTRY = "CAA"
END_META = METADATA_TYPE
```

5.5.7.6 Parameters

The file Ci_CH_WHI_PASSIVE_ACTIVE_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_PASSIVE_ACTIVE_PARAMETERS.ceh
!  Parameters description for WHISPER1 PASSIVE ACTIVE dataset
!

START_VARIABLE = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
        CATDESC = "Interval centred time tag"
        UNITS = "s"
        SIZES = 1
        VALUE_TYPE = ISO_TIME
        SIGNIFICANT_DIGITS = 24
        FILLVAL = 9999-12-31T23:59:59.999Z
        DELTA_PLUS = Delta__C1_CP_WHI_PASSIVE_ACTIVE
        DELTA_MINUS = Delta__C1_CP_WHI_PASSIVE_ACTIVE
        LABLAXIS = "UT"
        FIELDNAM = "Universal Time"
        PARAMETER_TYPE = "Support_Data"
END_VARIABLE = time_tags__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Delta__C1_CP_WHI_PASSIVE_ACTIVE
        SIZES = 1
        VALUE_TYPE = FLOAT
        FILLVAL = -1
        LABLAXIS = "D"
        FIELDNAM = "Delta"
        UNITS = "s"
        SI_CONVERSION = "1>s"
        CATDESC = "half the sampling duration + uncertainty of time tags (in seconds)"
         DEPEND_0 = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
         LABEL_1 = "Delta"
         SIGNIFICANT_DIGITS = 8
         PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Delta__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Receiving_Antenna__C1_CP_WHI_PASSIVE_ACTIVE
         SIZES = 1
```

```
            VALUE_TYPE = CHAR
            FILLVAL = "?"
            LABLAXIS = "R_A"
            FIELDNAM = "Receiving Antenna"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Receiving antenna Ey or Ez"
            DEPEND_0 = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
            LABEL_1 = "Receiving_Antenna"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Receiving_Antenna__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Electric_Spectral_Power_Density__C1_CP_WHI_PASSIVE_ACTIVE
            SIZES = 512
            VALUE_TYPE = FLOAT
            ENTITY = "Electric_Field"
            PROPERTY = "Magnitude"
            FLUCTUATIONS = "Fourier_spectrum"
            LABLAXIS = "E-SPD"
            FIELDNAM = "E-Spectral Power Density"
            SI_CONVERSION = "1.0>Vrms^2*m^-2*Hz^-1"
            UNITS = "Vrms^2*m^-2*Hz^-1"
            FILLVAL = -1
            CATDESC = "Electric Spectral Power Density"
            DEPEND_0 = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
            DEPEND_1 = Spectral_Frequencies__C1_CP_WHI_PASSIVE_ACTIVE
            SIGNIFICANT_DIGITS = 13
            PARAMETER_TYPE = "Data"
            QUALITY = 3
END_VARIABLE = Electric_Spectral_Power_Density__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Spectral_Frequencies__C1_CP_WHI_PASSIVE_ACTIVE
            SIZES = 512
            VALUE_TYPE = FLOAT
            LABLAXIS = "SF"
            FIELDNAM = "Spectral Frequencies"
            SI_CONVERSION = "1.0E3>Hz"
            UNITS = "kHz"
            FILLVAL = -1
            DELTA_PLUS = 0.0815
            DELTA_MINUS = 0.0815
            SCALETYP = "Linear"
            CATDESC = "frequencies of the 512 elements of the fixed size spectrum"
            DATA =
           1.953,2.116,2.279,2.441,2.604,2.767,2.930,3.092,3.255,3.418,3.581,3.743,3.906,4.069,4.232,4.395,4.5
           57,4.720,4.883,5.046,5.208,5.371,5.534,5.697,5.859,6.022,6.185,6.348,6.510,6.673,6.836,6.999,7.161,
           7.324,7.487,7.650,7.812,7.975,8.138,8.301,8.464,8.626,8.789,8.952,9.115,9.277,9.440,9.603,9.766,9.9
           28,10.091,10.254,10.417,10.579,10.742,10.905,11.068,11.230,11.393,11.556,11.719,11.882,12.044,12
           .207,12.370,12.533,12.695,12.858,13.021,13.184,13.346,13.509,13.672,13.835,13.997,14.160,14.323,
           14.486,14.648,14.811,14.974,15.137,15.299,15.462,15.625,15.788,15.951,16.113,16.276,16.439,16.60
```

```
            2,16.764,16.927,17.090,17.253,17.415,17.578,17.741,17.904,18.066,18.229,18.392,18.555,18.717,18.
            880,19.043,19.206,19.368,19.531,19.694,19.857,20.020,20.182,20.345,20.508,20.671,20.833,20.996,2
            1.159,21.322,21.484,21.647,21.810,21.973,22.135,22.298,22.461,22.624,22.786,22.949,23.112,23.275
            ,23.438,23.600,23.763,23.926,24.089,24.251,24.414,24.577,24.740,24.902,25.065,25.228,25.391,25.5
            53,25.716,25.879,26.042,26.204,26.367,26.530,26.693,26.855,27.018,27.181,27.344,27.507,27.669,27
            .832,27.995,28.158,28.320,28.483,28.646,28.809,28.971,29.134,29.297,29.460,29.622,29.785,29.948,
            30.111,30.273,30.436,30.599,30.762,30.924,31.087,31.250,31.413,31.576,31.738,31.901,32.064,32.22
            7,32.389,32.552,32.715,32.878,33.040,33.203,33.366,33.529,33.691,33.854,34.017,34.180,34.342,34.
            505,34.668,34.831,34.993,35.156,35.319,35.482,35.645,35.807,35.970,36.133,36.296,36.458,36.621,3
            6.784,36.947,37.109,37.272,37.435,37.598,37.760,37.923,38.086,38.249,38.411,38.574,38.737,38.900
            ,39.062,39.225,39.388,39.551,39.714,39.876,40.039,40.202,40.365,40.527,40.690,40.853,41.016,41.1
            78,41.341,41.504,41.667,41.829,41.992,42.155,42.318,42.480,42.643,42.806,42.969,43.132,43.294,43
            .457,43.620,43.783,43.945,44.108,44.271,44.434,44.596,44.759,44.922,45.085,45.247,45.410,45.573,
            45.736,45.898,46.061,46.224,46.387,46.549,46.712,46.875,47.038,47.201,47.363,47.526,47.689,47.85
            2,48.014,48.177,48.340,48.503,48.665,48.828,48.991,49.154,49.316,49.479,49.642,49.805,49.967,50.
            130,50.293,50.456,50.618,50.781,50.944,51.107,51.270,51.432,51.595,51.758,51.921,52.083,52.246,5
            2.409,52.572,52.734,52.897,53.060,53.223,53.385,53.548,53.711,53.874,54.036,54.199,54.362,54.525
            ,54.688,54.850,55.013,55.176,55.339,55.501,55.664,55.827,55.990,56.152,56.315,56.478,56.641,56.8
            03,56.966,57.129,57.292,57.454,57.617,57.780,57.943,58.105,58.268,58.431,58.594,58.757,58.919,59
            .082,59.245,59.408,59.570,59.733,59.896,60.059,60.221,60.384,60.547,60.710,60.872,61.035,61.198,
            61.361,61.523,61.686,61.849,62.012,62.174,62.337,62.500,62.663,62.826,62.988,63.151,63.314,63.47
            7,63.639,63.802,63.965,64.128,64.290,64.453,64.616,64.779,64.941,65.104,65.267,65.430,65.592,65.
            755,65.918,66.081,66.243,66.406,66.569,66.732,66.895,67.057,67.220,67.383,67.546,67.708,67.871,6
            8.034,68.197,68.359,68.522,68.685,68.848,69.010,69.173,69.336,69.499,69.661,69.824,69.987,70.150
            ,70.312,70.475,70.638,70.801,70.964,71.126,71.289,71.452,71.615,71.777,71.940,72.103,72.266,72.4
            28,72.591,72.764,72.917,73.079,73.242,73.405,73.568,73.730,73.893,74.056,74.219,74.382,74.544,74
            .707,74.870,75.033,75.195,75.358,75.521,75.684,75.846,76.009,76.172,76.335,76.497,76.660,76.823,
            76.986,77.148,77.311,77.474,77.637,77.799,77.962,78.125,78.288,78.451,78.613,78.776,78.939,79.10
            2,79.264,79.427,79.590,79.753,79.915,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-
            1,-1,-1,-1,-1,-1,-1,-1
            SIGNIFICANT_DIGITS = 6
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Spectral_Frequencies__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Table_Number__C1_CP_WHI_PASSIVE_ACTIVE
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "T_N"
            FIELDNAM = "Table Number"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Frequency Table Number between 0 and 127"
            DEPEND_0 = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
            LABEL_1 = "Table_Number"
            SIGNIFICANT_DIGITS = 3
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Table_Number__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Sounding_Interval__C1_CP_WHI_PASSIVE_ACTIVE
```

```
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "S_I"
            FIELDNAM = "Sounding Interval"
            SI_CONVERSION = "1.0E-3>s"
            UNITS = "ms"
            CATDESC = "coded time interval between 2 emission pulses in unit of (40/3=13.3)ms"
            DEPEND_0 = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
            LABEL_1 = "Sounding_Interval"
            SIGNIFICANT_DIGITS = 10
            PARAMETER_TYPE = "Support_Data"
           PARAMETER_CAVEATS = "0: 1 unit (13.3 ms); 1: 2 units (26.6 ms); 2: 3 units (40 ms);
           3: 5 units (66.6 ms); 4: 8 units (106.6 ms);
           5: 40 units+2106.66 ms waiting+256 units+2446.66 ms waiting (8.5 s);
           6: 6 units+45 ms waiting (125 ms);
           7: 14 units+63.34 ms waiting (250 ms)"
END_VARIABLE = Sounding_Interval__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Passive_Active_Delay__C1_CP_WHI_PASSIVE_ACTIVE
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "P/A_D"
            FIELDNAM = "Passive/Active Delay"
            SI_CONVERSION = "1.0E-3>s"
            UNITS = "ms"
            CATDESC = "Delay between passive spectrum and active spectrum acquisition intervals"
            DEPEND_0 = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
            LABEL_1 = "Passive/Active_Delay"
            SIGNIFICANT_DIGITS = 9
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Passive_Active_Delay__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Gain_Change_Number__C1_CP_WHI_PASSIVE_ACTIVE
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "G_C_N"
            FIELDNAM = "Gain Change Number"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Number of gain changes during the acquisition"
            DEPEND_0 = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
            LABEL_1 = "Gain_Change_Number"
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Gain_Change_Number__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Mantissa__C1_CP_WHI_PASSIVE_ACTIVE
```

```
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = 99
            LABLAXIS = "M"
            FIELDNAM = "Mantissa"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "First part of the compressed value which is a fixed point integer defined in the
           compression algorithm"
            DEPEND_0 = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
            LABEL_1 = "Mantissa"
            SIGNIFICANT_DIGITS = 2
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Mantissa__C1_CP_WHI_PASSIVE_ACTIVE

START_VARIABLE = Exponent__C1_CP_WHI_PASSIVE_ACTIVE
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = 99
            LABLAXIS = "E"
            FIELDNAM = "Exponent"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Second part of the compressed value"
            DEPEND_0 = time_tags__C1_CP_WHI_PASSIVE_ACTIVE
            LABEL_1 = "Exponent"
            SIGNIFICANT_DIGITS = 2
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Exponent__C1_CP_WHI_PASSIVE_ACTIVE
```

5.6 Active to Passive Ratio File: CP_WHI_ACTIVE_TO_PASSIVE_RATIO

This dataset contains ACTIVE to PASSIVE spectral power density ratio under sounding mode from the WHISPER experiment (see user guide for a more detailed description).

5.6.1 Format

As described in section 4.1

5.6.2 Standard

As described in section 4.2

5.6.3 Production Procedure

As described in section 4.3

5.6.4 Quality Control Procedure

As described in section 4.4

5.6.5 Delivery Procedure

As described in section 4.5

5.6.6 Product Specification

Filename format: Ci_CP_WHI_ ACTIVE_TO_PASSIVE_RATIO__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each ACTIVE_TO_PASSIVE_RATIO file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_ACTIVE_TO_PASSIVE_RATIO_DATASET.ceh
- parameters: Ci_CH_WHI_ACTIVE_TO_PASSIVE_RATIO_PARAMETERS.ceh

Each ACTIVE_TO_PASSIVE_RATIO file contains five variables that are the same as for the dataset in section 5.4.6 except for one parameter. Four of them are record varying, so that one single record in the file is composed of the following variables:

time_tags	
Delta	
Receiving_Antenna	
Active_to_Passive_SPD_Coded_Ratio	512 values (in practice, only 490 values are useful and the others are -1) coding the Active to Passive ratio for each frequency. For each of these values we have 4 possible values: ● 0 if the Active/Passive ratio is ≤ 2 ● 1 if the Active/Passive ratio is > 2 and ≤ 4 ● 2 if the Active/Passive ratio is > 4 and ≤ 16 ● 3 if the Active/Passive ratio is > 16.

An ACTIVE_TO_PASSIVE_RATIO file also contains one non record varying variable whose values are given in the parameters definition file (see 5.6.7.6).

Spectral_Frequencies	512 values (in kHz) corresponding to the acquisition frequencies of the spectrum (480 values between 1.953 kHz and 79.915 kHz, and 32 fill values)

Example of ACTIVE_TO_PASSIVE_RATIO file:

```
FILE_NAME = "C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO__20071001_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
          ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_ACTIVE_TO_PASSIVE_RATIO_DATASET.ceh"
INCLUDE = "C1_CH_WHI_ACTIVE_TO_PASSIVE_RATIO_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
          ENTRY = "C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO__20071001_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
          ENTRY = "1"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
          ENTRY = "03"
END_META = DATASET_VERSION

START_META = FILE_TIME_SPAN
          VALUE_TYPE = ISO_TIME_RANGE
          ENTRY = 2007-10-01T00:00:00.000Z/2007-10-01T23:59:59.999Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
          VALUE_TYPE = ISO_TIME
          ENTRY = 2009-12-15T08:13:06Z
END_META = GENERATION_DATE

DATA_UNTIL= "End"
2007-10-01T00:00:02.182Z,0.523000,"Y",-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,0,0,-1,0,-1,-1,3,... ,-1,-1,-1 $
End
```

5.6.7 Metadata Specification

5.6.7.1 Mission

See section 5.1.1

5.6.7.2 Observatory

See section 5.1.2

5.6.7.3 Experiment

See section 5.1.3

5.6.7.4 Instrument

See section 5.1.4

5.6.7.5 Dataset

The file Ci_CH_WHI_ACTIVE_TO_PASSIVE_RATIO_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
! C1_CH_WHI_ACTIVE_TO_PASSIVE_RATIO_DATASET.ceh
! Header file for WHISPER1 ACTIVE TO PASSIVE RATIO dataset
!

START_META = DATASET_ID
          ENTRY = "C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO"
END_META = DATASET_ID

START_META = DATA_TYPE
          ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE

START_META = DATASET_TITLE
          ENTRY = "Active to Passive Spectral Power Density Coded Ratio"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
          ENTRY = "This dataset contains Active to Passive Spectral Power Density Ratio under sounding mode
from Whisper on spacecraft 1"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
          ENTRY = "DATASET VERSION HISTORY"
          ENTRY = "VERSION 01: first version of dataset"
          ENTRY = "VERSION 02: correction of the Spectral Frequencies parameter description"
          ENTRY = "VERSION 03: dataset headers update"
```

```
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
          ENTRY =  "52"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
          ENTRY = "1.5"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
          ENTRY = "104"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
          ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
          ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
          ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
data"
END_META = ACKNOWLEDGEMENT

START_META = FILE_TYPE
          ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
          ENTRY = "CAA"
END_META = METADATA_TYPE
```

5.6.7.6 Parameters

The file Ci_CH_WHI_ACTIVE_TO_PASSIVE_RATIO_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_ACTIVE_TO_PASSIVE_RATIO_PARAMETERS.ceh
!  Parameters description for WHISPER1 ACTIVE TO PASSIVE RATIO dataset
!

START_VARIABLE = time_tags__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
          CATDESC = "Interval centred time tag"
           UNITS = "s"
```

```
            SIZES = 1
            VALUE_TYPE = ISO_TIME
            SIGNIFICANT_DIGITS = 24
            FILLVAL = 9999-12-31T23:59:59.999Z
            DELTA_PLUS = Delta__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
            DELTA_MINUS = Delta__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
            LABLAXIS = "UT"
            FIELDNAM = "Universal Time"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = time_tags__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO

START_VARIABLE = Delta__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "D"
            FIELDNAM = "Delta"
            UNITS = "s"
            SI_CONVERSION = "1>s"
            CATDESC = "half the sampling duration + uncertainty of time tags (in seconds)"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
            LABEL_1 = "Delta"
            SIGNIFICANT_DIGITS = 8
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Delta__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO

START_VARIABLE = Receiving_Antenna__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
            SIZES = 1
            VALUE_TYPE = CHAR
            FILLVAL = "?"
            LABLAXIS = "R_A"
            FIELDNAM = "Receiving Antenna"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Receiving antenna Ey or Ez"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
            LABEL_1 = "Receiving_Antenna"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Receiving_Antenna__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO

START_VARIABLE = Active_to_Passive_SPD_Coded_Ratio__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
            SIZES = 512
            VALUE_TYPE = INT
            LABLAXIS = "A/P"
            FIELDNAM = "Active to Passive SPD Coded Ratio"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            FILLVAL = -1
            CATDESC = "Active to Passive coded ratio"
            DEPEND_0 = time_tags__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
```

```
            DEPEND_1 = Spectral_Frequencies__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
           PARAMETER_CAVEATS = "0: Actif/Passive <= 2; 1: Active/Passive > 2 and <= 4;
           2: Active/Passive > 4 and <= 16; 3: Active/Passive > 16"
END_VARIABLE = Active_to_Passive_SPD_Coded_Ratio__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO

START_VARIABLE = Spectral_Frequencies__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
            SIZES = 512
            VALUE_TYPE = FLOAT
            LABLAXIS = "S_F"
            FIELDNAM = "Spectral Frequencies"
            SI_CONVERSION = "1.0e3>Hz"
            UNITS = "kHz"
            FILLVAL = -1
            DELTA_PLUS = 0.0815
            DELTA_MINUS = 0.0815
            SCALETYP = "Linear"
            CATDESC = "frequencies of the 512 elements of the fixed size spectrum"
            DATA=
           1.953,2.116,2.279,2.441,2.604,2.767,2.930,3.092,3.255,3.418,3.581,3.743,3.906,4.069,4.232,4.395,4.5
           57,4.720,4.883,5.046,5.208,5.371,5.534,5.697,5.859,6.022,6.185,6.348,6.510,6.673,6.836,6.999,7.161,
           7.324,7.487,7.650,7.812,7.975,8.138,8.301,8.464,8.626,8.789,8.952,9.115,9.277,9.440,9.603,9.766,9.9
           28,10.091,10.254,10.417,10.579,10.742,10.905,11.068,11.230,11.393,11.556,11.719,11.882,12.044,12
           .207,12.370,12.533,12.695,12.858,13.021,13.184,13.346,13.509,13.672,13.835,13.997,14.160,14.323,
           14.486,14.648,14.811,14.974,15.137,15.299,15.462,15.625,15.788,15.951,16.113,16.276,16.439,16.60
           2,16.764,16.927,17.090,17.253,17.415,17.578,17.741,17.904,18.066,18.229,18.392,18.555,18.717,18.
           880,19.043,19.206,19.368,19.531,19.694,19.857,20.020,20.182,20.345,20.508,20.671,20.833,20.996,21
           1.159,21.322,21.484,21.647,21.810,21.973,22.135,22.298,22.461,22.624,22.786,22.949,23.112,23.275
           ,23.438,23.600,23.763,23.926,24.089,24.251,24.414,24.577,24.740,24.902,25.065,25.228,25.391,25.5
           53,25.716,25.879,26.042,26.204,26.367,26.530,26.693,26.855,27.018,27.181,27.344,27.507,27.669,27
           .832,27.995,28.158,28.320,28.483,28.646,28.809,28.971,29.134,29.297,29.460,29.622,29.785,29.948,
           30.111,30.273,30.436,30.599,30.762,30.924,31.087,31.250,31.413,31.576,31.738,31.901,32.064,32.22
           7,32.389,32.552,32.715,32.878,33.040,33.203,33.366,33.529,33.691,33.854,34.017,34.180,34.342,34.
           505,34.668,34.831,34.993,35.156,35.319,35.482,35.645,35.807,35.970,36.133,36.296,36.458,36.621,3
           6.784,36.947,37.109,37.272,37.435,37.598,37.760,37.923,38.086,38.249,38.411,38.574,38.737,38.900
           ,39.062,39.225,39.388,39.551,39.714,39.876,40.039,40.202,40.365,40.527,40.690,40.853,41.016,41.1
           78,41.341,41.504,41.667,41.829,41.992,42.155,42.318,42.480,42.643,42.806,42.969,43.132,43.294,43
           .457,43.620,43.783,43.945,44.108,44.271,44.434,44.596,44.759,44.922,45.085,45.247,45.410,45.573,
           45.736,45.898,46.061,46.224,46.387,46.549,46.712,46.875,47.038,47.201,47.363,47.526,47.689,47.85
           2,48.014,48.177,48.340,48.503,48.665,48.828,48.991,49.154,49.316,49.479,49.642,49.805,49.967,50.
           130,50.293,50.456,50.618,50.781,50.944,51.107,51.270,51.432,51.595,51.758,51.921,52.083,52.246,5
           2.409,52.572,52.734,52.897,53.060,53.223,53.385,53.548,53.711,53.874,54.036,54.199,54.362,54.525
           ,54.688,54.850,55.013,55.176,55.339,55.501,55.664,55.827,55.990,56.152,56.315,56.478,56.641,56.8
           03,56.966,57.129,57.292,57.454,57.617,57.780,57.943,58.105,58.268,58.431,58.594,58.757,58.919,59
           .082,59.245,59.408,59.570,59.733,59.896,60.059,60.221,60.384,60.547,60.710,60.872,61.035,61.198,
           61.361,61.523,61.686,61.849,62.012,62.174,62.337,62.500,62.663,62.826,62.988,63.151,63.314,63.47
           7,63.639,63.802,63.965,64.128,64.290,64.453,64.616,64.779,64.941,65.104,65.267,65.430,65.592,65.
           755,65.918,66.081,66.243,66.406,66.569,66.732,66.895,67.057,67.220,67.383,67.546,67.708,67.871,6
           8.034,68.197,68.359,68.522,68.685,68.848,69.010,69.173,69.336,69.499,69.661,69.824,69.987,70.150
```

```
        ,70.312,70.475,70.638,70.801,70.964,71.126,71.289,71.452,71.615,71.777,71.940,72.103,72.266,72.4
        28,72.591,72.764,72.917,73.079,73.242,73.405,73.568,73.730,73.893,74.056,74.219,74.382,74.544,74
        .707,74.870,75.033,75.195,75.358,75.521,75.684,75.846,76.009,76.172,76.335,76.497,76.660,76.823,
        76.986,77.148,77.311,77.474,77.637,77.799,77.962,78.125,78.288,78.451,78.613,78.776,78.939,79.10
        2,79.264,79.427,79.590,79.753,79.915,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-
        1,-1,-1,-1,-1,-1,-1,-1
        SIGNIFICANT_DIGITS = 6
        PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Spectral_Frequencies__C1_CP_WHI_ACTIVE_TO_PASSIVE_RATIO
```

5.7 House Keeping File: CP_WHI_HK

This dataset contains information about pulse emission under sounding mode from the WHISPER experiment.

5.7.1 Format

As described in section 4.1

5.7.2 Standard

As described in section 4.2

5.7.3 Production Procedure

As described in section 4.3

5.7.4 Quality Control Procedure

As described in section 4.4

5.7.5 Delivery Procedure

As described in section 4.5

5.7.6 Product Specification

Filename format: Ci_CP_WHI_HK__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each HK file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_HK_DATASET.ceh
- parameters: Ci_CH_WHI_HK_PARAMETERS.ceh

Each HK file contains five variables:

time_tags	time (ISO) of the elementary Sounding pulse or a 13.33 ms separated supposed pulse times value if we are not be able to know the real processing mode of the instrument.
Pulse_Frequency	frequency value (in kHz) corresponding to the pulse emission (-1 is the default value).
Pulse_level	output voltage (in V) of the transmitter. Four values are available: 0 Volt (no emission); 50 Volts; 100 Volts and 200 Volts (-1 is the default value).
Pulse_Length	duration (in ms) of the emission. Two values are possible: 1.024 ms and 0.512 ms (-1 is the default value).
Confidence_Flag	flag: equal to 1 if the mode is Sounding Mode and equal to 0 if the mode is Natural Mode.

Example of a HK file:

```
FILE_NAME = "C1_CP_WHI_HK__20071001_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
          ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_HK_DATASET.ceh"
INCLUDE = "C1_CH_WHI_HK_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
          ENTRY = "C1_CP_WHI_HK__20071001_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
          ENTRY = "1"
END_META = VERSION_NUMBER
```

```
START_META = DATASET_VERSION
          ENTRY = "02"
END_META = DATASET_VERSION

START_META = FILE_TIME_SPAN
          VALUE_TYPE = ISO_TIME_RANGE
          ENTRY = 2007-10-01T00:00:00.000Z/2007-10-01T23:59:59.999Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
          VALUE_TYPE = ISO_TIME
          ENTRY = 2009-12-15T08:13:02Z
END_META = GENERATION_DATE

START_META = FILE_CAVEATS
          ENTRY = "Warning: Chronology error after 05:53:45.115"
END_META = FILE_CAVEATS

DATA_UNTIL="End"
2007-10-01T00:00:01.641Z,62,200,0.512,1 $
2007-10-01T00:00:01.667Z,50,200,0.512,1 $
End
```

5.7.7 Metadata Specification

5.7.7.1 Mission

See section 5.1.1

5.7.7.2 Observatory

See section 5.1.2

5.7.7.3 Experiment

See section 5.1.3

5.7.7.4 Instrument

See section 5.1.4

5.7.7.5 Dataset

The file Ci_CH_WHI_HK_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_HK_DATASET.ceh
!  Header file for WHISPER1 HOUSE KEEPING dataset
```

```
!

START_META = DATASET_ID
           ENTRY = "C1_CP_WHI_HK"
END_META = DATASET_ID

START_META = DATA_TYPE
           ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE

START_META = DATASET_TITLE
           ENTRY = "House Keeping"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
           ENTRY = "This dataset contains information about pulse emission under sounding mode from Whisper
           on spacecraft 1"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
           ENTRY = "DATASET VERSION HISTORY"
           ENTRY = "VERSION 01: first version of dataset"
           ENTRY = "VERSION 02: dataset headers update"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
           ENTRY =  "0.013"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
           ENTRY = "0.013"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
           ENTRY = "0.250"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
           ENTRY = "Auxiliary"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
           ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
           ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
           data"
END_META = ACKNOWLEDGEMENT
```

```
START_META = FILE_TYPE
           ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
           ENTRY = "CAA"
END_META = METADATA_TYPE
```

5.7.7.6 Parameters

The file Ci_CH_WHI_HK_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_HK_PARAMETERS.ceh
!  Parameters description for WHISPER1 House Keeping dataset
!

START_VARIABLE = time_tags__C1_CP_WHI_HK
           CATDESC = "Sounding Pulse time tag"
           UNITS = "s"
           SIZES = 1
           VALUE_TYPE = ISO_TIME
           SIGNIFICANT_DIGITS = 24
           FILLVAL = 9999-12-31T23:59:59.999Z
           DELTA_PLUS = 0.005
           DELTA_MINUS = 0.005
           LABLAXIS = "UT"
           FIELDNAM = "Universal Time"
           PARAMETER_TYPE = "Support_Data"
END_VARIABLE = time_tags__C1_CP_WHI_HK

START_VARIABLE = Pulse_Frequency__C1_CP_WHI_HK
           VALUE_TYPE = INT
           LABLAXIS = "F"
           FIELDNAM = "Pulse Frequency"
           SI_CONVERSION = "1.0E3>Hz"
           SIZES = 1
           UNITS = "kHz"
           FILLVAL = -1
           CATDESC = "Frequency value (kHz) of the sine wave train emitted"
           DEPEND_0 = time_tags__C1_CP_WHI_HK
           LABEL_1 = Pulse_Frequency
           SIGNIFICANT_DIGITS = 2
           PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Pulse_Frequency__C1_CP_WHI_HK
```

```
START_VARIABLE = Pulse_Level__C1_CP_WHI_HK
            VALUE_TYPE = INT
            LABLAXIS = "L"
            FIELDNAM = "Pulse Level"
            SIZES = 1
            UNITS = "V"
            SI_CONVERSION = "1>V"
            FILLVAL = -1
            CATDESC = "Peak to peak value of the emission pulse (V)"
            DEPEND_0 = time_tags__C1_CP_WHI_HK
            LABEL_1 = Pulse_Levely
            SIGNIFICANT_DIGITS = 3
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Pulse_Level__C1_CP_WHI_HK

START_VARIABLE = Pulse_Length__C1_CP_WHI_HK
           VALUE_TYPE = FLOAT
            LABLAXIS = "P_L"
            FIELDNAM = "Pulse Length"
            SI_CONVERSION = "1.0E-3>s"
            SIZES = 1
            UNITS = "ms"
            FILLVAL = -1
            CATDESC = "Duration of the emission (ms)"
            DEPEND_0 = time_tags__C1_CP_WHI_HK
            LABEL_1 = Pulse_Length
            SIGNIFICANT_DIGITS = 5
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Pulse_Length__C1_CP_WHI_HK

START_VARIABLE = Confidence_Flag__C1_CP_WHI_HK
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "C_F"
            FIELDNAM = "Confidence Flag"
            SIZES = 1
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "status of instantaneous Whisper mode (1: Sounding; 0: Natural) "
            DEPEND_0 = time_tags__C1_CP_WHI_HK
            LABEL_1 = Confidence_Flag
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Confidence_Flag__C1_CP_WHI_HK
```

5.8 Active Event File: CT_WHI_ACTIVE_EVENT

This dataset contains event information under sounding mode from the WHISPER experiment.

5.8.1 Format

As described in section 4.1

5.8.2 Standard

As described in section 4.2

5.8.3 Production Procedure

As described in section 4.3

5.8.4 Quality Control Procedure

As described in section 4.4

5.8.5 Delivery Procedure

As described in section 4.5

5.8.6 Product Specification

Filename format: Ci_CT_WHI_ACTIVE_EVENT__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each ACTIVE_EVENT file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_ACTIVE_EVENT_DATASET.ceh
- parameters: Ci_CH_WHI_ACTIVE_EVENT_PARAMETERS.ceh

Each ACTIVE_EVENT file contains fifteen variables. Fourteen of them are record varying, so that one single record in the file is composed of the following variables:

time_tags	Time range T1/T2 where T1 is the first sounding pulse time (ISO) tag in the Active spectrum and T2 is the first sounding pulse time tag of the next (but different) Sounding Mode , except for the last record, which is the time of the last sounding pulse of the day.
Table_Number	Frequency Table Number between 0 and 127

Gain_Command	number between 0 and 7. The signal is amplified by a gain amplifier including three stages. The total gain can take three different values (12, 24, and 36 dB), with an exact ratio of four in between any two consecutive ones. Different options can be selected by telecommand. The gain is either fixed (values 0, 1, 2, 3) or automatically controlled (values 4, 5, 6, 7). The automatic control selects one of two consecutive stepped gains. It responds to the characteristics (number of overflows) of a short sampling (64 samples) taken before the real acquisition, placed in the second part of the 13.3ms basic time structure. Gain_Command= • 0, the gain is fixed and its value is +12 dB • 1, the gain is fixed and its value is +24 dB • 2, the gain is fixed and its value is +36 dB • 3, the gain is fixed and its value is +36 dB • 4, the gain is automatic and its value is between +24 / +12 dB • 5, the gain is automatic and its value is between +24 / +12 dB • 6 then the gain is automatic and its value is between +36 / +24 dB • 7 then the gain is automatic and its value is between +36 / +12 dB.
Level	output voltage (in V) of the transmitter. Four values are available: 0 Volts (no emission); 50 Volts; 100 Volts and 200 Volts.
Receiving_Antenna	receiving antenna (Ey or Ez). The emission is always performed by Ey
Smode_Average	Emission-Reception values. We have different possibilities: Smode_Average = • 0, 1 Emission is followed by 1 Reception • 1, 1 Emission is followed by 2 Receptions • 2, 1 Emission is followed by 3 Receptions • 3, 1 Emission is followed by 5 Receptions

	• 4, 1 Emission is followed by 8 Receptions • 5, 40* (1 Emission 1 Reception) + a waiting time (158 ms) + 256 Receptions • 6, 1 Emission is followed by 5 Receptions • 7, 1 Emission is followed by 13 Receptions
Whisper_Processing	equal to 1 if Whisper is ON and equal to 0 if DWP is ON.
Emission_Reception_Delay	equal to 18.8666666 ms if we have a delay of 13.333333 ms between the Emission and the Reception and to 5.5333333 ms otherwise
Form_Passive_Reduced_Flag	this variable can only take two values: • 0: means reduced form, i.e. spectrum is added on 6 bins • 1: means standard form (idem Active spectra).
Sounding_Processing_Option	compression strategy (see **3.4.2.1.2**): • A: strategy A • B: strategy B • C: strategy C • D: strategy D
Compression_Method_Required	for the exponent size: • 0: adjusted size • 1: size fixed to 5
Compressed_Data_Size	• 0: 8 bits • 1: 6 bits
Pulse_Table	80 values. Possible values are 0 (corresponding to a pulse duration of 1.024 ms), 1 (corresponding to a pulse duration of 0.512 ms), and -1 (corresponding to a not defined pulse).
time_delay	512 values. Each value corresponds to the time difference (positive or negative) in s between the pulse time and the swept table central time. The swept table central time corresponds to the time when half the processing frequency scan table has been done and does not correspond to a pulse time.

An ACTIVE_EVENT file also contains one non record varying variable whose values are given in the parameters definition file (see 5.8.7.6).

Spectral_Frequencies	512 values (in kHz) corresponding to the acquisition frequencies of the spectrum (480 values between 1.953 kHz and 79.915 kHz, and 32 fill values)

Example of an ACTIVE_EVENT file:

```
FILE_NAME = "C1_CT_WHI_ACTIVE_EVENT__20071001_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
        ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_ACTIVE_EVENT_DATASET.ceh"
INCLUDE = "C1_CH_WHI_ACTIVE_EVENT_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
        ENTRY = "C1_CT_WHI_ACTIVE_EVENT__20071001_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
        ENTRY = "1"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
        ENTRY = "03"
END_META = DATASET_VERSION

START_META = FILE_TIME_SPAN
        VALUE_TYPE = ISO_TIME_RANGE
        ENTRY = 2007-10-01T00:00:00.000Z/2007-10-01T23:59:59.999Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
        VALUE_TYPE = ISO_TIME
        ENTRY = 2009-12-15T08:13:02Z
END_META = GENERATION_DATE

DATA_UNTIL="End"
```

```
2007-10-01T00:00:01.646Z/2007-10-01T01:54:14.331Z, 29, 5, 200, "Y", 1, 0, 5.533333, 1, "A", 0, 1, 1, 1, 1, …,
99.000000, 99.000000, 99.000000 $
End
```

5.8.7 Metadata Specification

5.8.7.1 Mission

See section 5.1.1

5.8.7.2 Observatory

See section 5.1.2

5.8.7.3 Experiment

See section 5.1.3

5.8.7.4 Instrument

See section 5.1.4

5.8.7.5 Dataset

The file Ci_CH_WHI_ACTIVE_EVENT_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
! C1_CH_WHI_ACTIVE_EVENT_DATASET.ceh
! Header file for WHISPER1 ACTIVE EVENT dataset
!

START_META = DATASET_ID
          ENTRY = "C1_CT_WHI_ACTIVE_EVENT"
END_META = DATASET_ID

START_META = DATA_TYPE
          ENTRY = "CT>CAA_Event_Data"
END_META = DATA_TYPE

START_META = DATASET_TITLE
          ENTRY = "Active Event"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
          ENTRY = "This dataset contains event information under sounding mode from Whisper on spacecraft
1"
END_META = DATASET_DESCRIPTION
```

```
START_META = DATASET_CAVEATS
          ENTRY = "This table provides the functionning mode of the instrument in Sounding Mode and the"
          ENTRY = "time between the Pulse emission and the central time of the Frequency Swept Table"
          ENTRY = "DATASET VERSION HISTORY"
          ENTRY = "VERSION 01: first version of dataset"
          ENTRY = "VERSION 02: correction of the Spectral Frequencies parameter description"
          ENTRY = "VERSION 03: dataset headers update"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
          ENTRY =  "0"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
          ENTRY = "0.1"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
          ENTRY = "86400"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
          ENTRY = "Auxiliary"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
          ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
          ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
data"
END_META = ACKNOWLEDGEMENT

START_META = FILE_TYPE
          ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
          ENTRY = "CAA"
END_META = METADATA_TYPE
```

5.8.7.6 Parameters

The file Ci_CH_WHI_ACTIVE_EVENT_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
```

```
! C1_CH_WHI_ACTIVE_EVENT_PARAMETERS.ceh
! Parameters description for WHISPER1 ACTIVE EVENT dataset
!

START_VARIABLE = time_tags__C1_CT_WHI_ACTIVE_EVENT
            CATDESC = "duration of the sounding mode event"
             UNITS = "s"
             SIZES = 1
             VALUE_TYPE = ISO_TIME_RANGE
             SIGNIFICANT_DIGITS = 49
             FILLVAL = 9999-12-31T23:59:59.999Z/9999-12-31T23:59:59.999Z
             LABLAXIS = "UTR"
             FIELDNAM = "Universal Time Range"
             PARAMETER_TYPE = "Support_Data"
             DELTA_PLUS = 0.003
             DELTA_MINUS = 0.003
            PARAMETER_CAVEATS = "duration of the sounding mode event is the time interval t1-t2 where t1 is
            the time of the first pulse in a given state of Whisper sounder commanding and t2 is the time of the
            first pulse of the next state of Whisper sounder commanding (or of the last sounding pulse of the
            day)"
END_VARIABLE = time_tags__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Table_Number__C1_CT_WHI_ACTIVE_EVENT
             SIZES = 1
             VALUE_TYPE = INT
             FILLVAL = 999
             LABLAXIS = "FST"
             FIELDNAM = "Frequency Scan Table"
             UNITS = "unitless"
             SI_CONVERSION = "1>unitless"
             CATDESC = "Frequency Table Number between 0 and 127"
             DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
             LABEL_1 = Frequency_Scan_Table
             SIGNIFICANT_DIGITS = 3
             PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Table_Number__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Gain_Command__C1_CT_WHI_ACTIVE_EVENT
             SIZES = 1
             VALUE_TYPE = INT
             FILLVAL = -1
             LABLAXIS = "G_C"
             FIELDNAM = "Gain Command"
             UNITS = "unitless"
             SI_CONVERSION = "1>unitless"
             CATDESC = " gain command number"
             DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
             LABEL_1 = Gain_Command
             SIGNIFICANT_DIGITS = 1
             PARAMETER_TYPE = "Support_Data"
```

```
        PARAMETER_CAVEATS = "0:fixed gain +12dB ; 1:fixed gain +24dB; 2:fixed gain +36dB; 3:fixed gain
+36dB; 4:automatic gain +24/+12 dB; 5:automatic gain +24/+12;
        6:automatic gain +36/+24; 7:automatic gain +36/+24 dB"
END_VARIABLE = Gain_Command__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Level__C1_CT_WHI_ACTIVE_EVENT
        SIZES = 1
        VALUE_TYPE = INT
        FILLVAL = -1
        LABLAXIS = "L"
        FIELDNAM = "Level"
        UNITS = "V"
        SI_CONVERSION = "1>V"
        CATDESC = "Peak to peak value of the emission pulse (V)"
        DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
        LABEL_1 = Level
        SIGNIFICANT_DIGITS = 3
        PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Level__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Receiving_Antenna__C1_CT_WHI_ACTIVE_EVENT
        SIZES = 1
        VALUE_TYPE = CHAR
        FILLVAL = "?"
        LABLAXIS = "R_A"
        FIELDNAM = "Receiving Antenna"
        UNITS = "unitless"
        SI_CONVERSION = "1>unitless"
        CATDESC = "Receiving antenna Ey or Ez"
        DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
        LABEL_1 = Receiving_Antenna
        PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Receiving_Antenna__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Smode_average__C1_CT_WHI_ACTIVE_EVENT
        SIZES = 1
        VALUE_TYPE = INT
        FILLVAL = -1
        LABLAXIS = "A_M"
        FIELDNAM = "Average Mode"
        UNITS = "unitless"
        SI_CONVERSION = "1>unitless"
        CATDESC = "coded time interval between 2 emission pulses in unit of (40/3=13.3)ms"
        DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
        LABEL_1 = Average_Mode
        SIGNIFICANT_DIGITS = 1
        PARAMETER_TYPE = "Support_Data"
        PARAMETER_CAVEATS = "0: 1 unit (13.3 ms); 1: 2 units (26.6 ms); 2: 3 units (40 ms);
        3: 5 units (66.6 ms); 4: 8 units (106.6 ms);
        5: 40 units+2106.66 ms waiting+256 units+2446.66 ms waiting (8.5 s);
```

```
            6: 6 units+45 ms waiting (125 ms); 7: 14 units+63.34 ms waiting (250 ms)"
END_VARIABLE = Smode_average__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Whisper_Processing__C1_CT_WHI_ACTIVE_EVENT
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "W_P"
            FIELDNAM = "Whisper Processing"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "1: WHISPER processing; 0: DWP compression of WHISPER data""
            DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
            LABEL_1 = Whisper_Processing
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
           PARAMETER_CAVEATS = "case of WHISPER processing is unfrequent (or inexistant)"
END_VARIABLE = Whisper_Processing__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Emission_Reception_Delay__C1_CT_WHI_ACTIVE_EVENT
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "E/R_D"
            FIELDNAM = "Emission/Reception Delay"
            SI_CONVERSION = "1.0E-3>s"
            UNITS = "ms"
            CATDESC = "acquisition time interval"
            DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
            LABEL_1 = Emission/Reception_Delay
            SIGNIFICANT_DIGITS = 9
            PARAMETER_TYPE = "Support_Data"
           PARAMETER_CAVEATS = "acquisition time is defined as the delay between the leading edge of the
           emission pulse and the starting edge of the associated reception"
END_VARIABLE = Emission_Reception_Delay__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Form_Passive_Reduced_Flag__C1_CT_WHI_ACTIVE_EVENT
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "F_P_R_F"
            FIELDNAM = "Form Passive Reduced Flag"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "0: do form; 1: don't form"
            DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
            LABEL_1 = Form_Passive_Reduced_Flag
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
           PARAMETER_CAVEATS = "to form reduced spectrum means to add 6 successive frequency bins"
```

```
END_VARIABLE = Form_Passive_Reduced_Flag__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Sounding_Processing_Option__C1_CT_WHI_ACTIVE_EVENT
            SIZES = 1
            VALUE_TYPE = CHAR
            FILLVAL = "?"
            LABLAXIS = "S_P_O"
            FIELDNAM = "Sounding Processing Option"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Compression strategy (A,B,C,D)"
            DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
            LABEL_1 = Sounding_Processing_Option
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Sounding_Processing_Option__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Compression_Method_Required__C1_CT_WHI_ACTIVE_EVENT
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "C_M_R"
            FIELDNAM = "Quasi-log Compression Method Required"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "0: exponent size adjusted; 1: exponent size fixed to 5"
            DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
            LABEL_1 = Compression_Method_Required
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Compression_Method_Required__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Compressed_Data_Size__C1_CT_WHI_ACTIVE_EVENT
           SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "C_D_S"
            FIELDNAM = "Compressed Data Size"
            UNITS = "unitless"
           SI_CONVERSION = "1>unitless"
            CATDESC = "0: 8-bits data compression; 1: 6-bits data compression"
            DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
            LABEL_1 = Compressed_Data_Size
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Compressed_Data_Size__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Pulse_Table__C1_CT_WHI_ACTIVE_EVENT
            SIZES = 80
            VALUE_TYPE = INT
            LABLAXIS = "PT"
```

```
            FIELDNAM = "Pulse Table"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            FILLVAL = -1
            CATDESC = "duration of each pulse during the sounding sweep (0: 1.024ms; 1: 0.512ms; -1: no pulse)"
            DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
            LABEL_1 =
           "Pulse_1","Pulse_2","Pulse_3","Pulse_4","Pulse_5","Pulse_6","Pulse_7","Pulse_8","Pulse_9","Pulse_1
           0","Pulse_11","Pulse_12","Pulse_13","Pulse_14","Pulse_15","Pulse_16","Pulse_17","Pulse_18","Pulse
           _19","Pulse_2","Pulse_21","Pulse_22","Pulse_23","Pulse_24","Pulse_25","Pulse_26","Pulse_27","Puls
           e_28","Pulse_29","Pulse_30","Pulse_31","Pulse_32","Pulse_33","Pulse_34","Pulse_35","Pulse_36","P
           ulse_37","Pulse_38","Pulse_39","Pulse_40","Pulse_41","Pulse_42","Pulse_43","Pulse_44","Pulse_45",
           "Pulse_46","Pulse_47","Pulse_48","Pulse_49","Pulse_50","Pulse_51","Pulse_52","Pulse_53","Pulse_5
           4","Pulse_55","Pulse_56","Pulse_57","Pulse_58","Pulse_59","Pulse_60","Pulse_61","Pulse_62","Pulse
           _63","Pulse_64","Pulse_65","Pulse_66","Pulse_67","Pulse_68","Pulse_69","Pulse_70","Pulse_71","Pul
           se_72","Pulse_73","Pulse_74","Pulse_75","Pulse_76","Pulse_77","Pulse_78","Pulse_79","Pulse_80"
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Pulse_Table__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Time_Delay__C1_CT_WHI_ACTIVE_EVENT
            SIZES = 512
            VALUE_TYPE = FLOAT
            LABLAXIS = "TD"
            FIELDNAM = "Time Delay"
            UNITS = "s"
            SI_CONVERSION = "1>s"
            FILLVAL = 99
            CATDESC = "time differences between pulse time and swept table interval centred time"
            DEPEND_0 = time_tags__C1_CT_WHI_ACTIVE_EVENT
            DEPEND_1 = Spectral_Frequencies__C1_CT_WHI_ACTIVE_EVENT
            SIGNIFICANT_DIGITS = 10
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Time_Delay__C1_CT_WHI_ACTIVE_EVENT

START_VARIABLE = Spectral_Frequencies__C1_CT_WHI_ACTIVE_EVENT
            SIZES = 512
            VALUE_TYPE = FLOAT
            LABLAXIS = "SF"
            FIELDNAM = "Spectral Frequencies"
            SI_CONVERSION = "1.0E3>Hz"
            UNITS = "kHz"
            FILLVAL = -1
            DELTA_PLUS = 0.0815
            DELTA_MINUS = 0.0815
            SCALETYP = "Linear"
            CATDESC = "frequencies of the 512 elements of the fixed size spectrum
           "
            DATA =
           1.953,2.116,2.279,2.441,2.604,2.767,2.930,3.092,3.255,3.418,3.581,3.743,3.906,4.069,4.232,4.395,4.5
```

```
            57,4.720,4.883,5.046,5.208,5.371,5.534,5.697,5.859,6.022,6.185,6.348,6.510,6.673,6.836,6.999,7.161,
            7.324,7.487,7.650,7.812,7.975,8.138,8.301,8.464,8.626,8.789,8.952,9.115,9.277,9.440,9.603,9.766,9.9
            28,10.091,10.254,10.417,10.579,10.742,10.905,11.068,11.230,11.393,11.556,11.719,11.882,12.044,12
            .207,12.370,12.533,12.695,12.858,13.021,13.184,13.346,13.509,13.672,13.835,13.997,14.160,14.323,
            14.486,14.648,14.811,14.974,15.137,15.299,15.462,15.625,15.788,15.951,16.113,16.276,16.439,16.60
            2,16.764,16.927,17.090,17.253,17.415,17.578,17.741,17.904,18.066,18.229,18.392,18.555,18.717,18.
            880,19.043,19.206,19.368,19.531,19.694,19.857,20.020,20.182,20.345,20.508,20.671,20.833,20.996,2
            1.159,21.322,21.484,21.647,21.810,21.973,22.135,22.298,22.461,22.624,22.786,22.949,23.112,23.275
            ,23.438,23.600,23.763,23.926,24.089,24.251,24.414,24.577,24.740,24.902,25.065,25.228,25.391,25.5
            53,25.716,25.879,26.042,26.204,26.367,26.530,26.693,26.855,27.018,27.181,27.344,27.507,27.669,27
            .832,27.995,28.158,28.320,28.483,28.646,28.809,28.971,29.134,29.297,29.460,29.622,29.785,29.948,
            30.111,30.273,30.436,30.599,30.762,30.924,31.087,31.250,31.413,31.576,31.738,31.901,32.064,32.22
            7,32.389,32.552,32.715,32.878,33.040,33.203,33.366,33.529,33.691,33.854,34.017,34.180,34.342,34.
            505,34.668,34.831,34.993,35.156,35.319,35.482,35.645,35.807,35.970,36.133,36.296,36.458,36.621,3
            6.784,36.947,37.109,37.272,37.435,37.598,37.760,37.923,38.086,38.249,38.411,38.574,38.737,38.900
            ,39.062,39.225,39.388,39.551,39.714,39.876,40.039,40.202,40.365,40.527,40.690,40.853,41.016,41.1
            78,41.341,41.504,41.667,41.829,41.992,42.155,42.318,42.480,42.643,42.806,42.969,43.132,43.294,43
            .457,43.620,43.783,43.945,44.108,44.271,44.434,44.596,44.759,44.922,45.085,45.247,45.410,45.573,
            45.736,45.898,46.061,46.224,46.387,46.549,46.712,46.875,47.038,47.201,47.363,47.526,47.689,47.85
            2,48.014,48.177,48.340,48.503,48.665,48.828,48.991,49.154,49.316,49.479,49.642,49.805,49.967,50.
            130,50.293,50.456,50.618,50.781,50.944,51.107,51.270,51.432,51.595,51.758,51.921,52.083,52.246,5
            2.409,52.572,52.734,52.897,53.060,53.223,53.385,53.548,53.711,53.874,54.036,54.199,54.362,54.525
            ,54.688,54.850,55.013,55.176,55.339,55.501,55.664,55.827,55.990,56.152,56.315,56.478,56.641,56.8
            03,56.966,57.129,57.292,57.454,57.617,57.780,57.943,58.105,58.268,58.431,58.594,58.757,58.919,59
            .082,59.245,59.408,59.570,59.733,59.896,60.059,60.221,60.384,60.547,60.710,60.872,61.035,61.198,
            61.361,61.523,61.686,61.849,62.012,62.174,62.337,62.500,62.663,62.826,62.988,63.151,63.314,63.47
            7,63.639,63.802,63.965,64.128,64.290,64.453,64.616,64.779,64.941,65.104,65.267,65.430,65.592,65.
            755,65.918,66.081,66.243,66.406,66.569,66.732,66.895,67.057,67.220,67.383,67.546,67.708,67.871,6
            8.034,68.197,68.359,68.522,68.685,68.848,69.010,69.173,69.336,69.499,69.661,69.824,69.987,70.150
            ,70.312,70.475,70.638,70.801,70.964,71.126,71.289,71.452,71.615,71.777,71.940,72.103,72.266,72.4
            28,72.591,72.764,72.917,73.079,73.242,73.405,73.568,73.730,73.893,74.056,74.219,74.382,74.544,74
            .707,74.870,75.033,75.195,75.358,75.521,75.684,75.846,76.009,76.172,76.335,76.497,76.660,76.823,
            76.986,77.148,77.311,77.474,77.637,77.799,77.962,78.125,78.288,78.451,78.613,78.776,78.939,79.10
            2,79.264,79.427,79.590,79.753,79.915,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-
            1,-1,-1,-1,-1,-1,-1,-1
             SIGNIFICANT_DIGITS = 6
             PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Spectral_Frequencies__C1_CT_WHI_ACTIVE_EVENT
```

5.9 Natural Event File: CT_WHI_NATURAL_EVENT

This dataset contains event information under natural mode from the WHISPER experiment.

5.9.1 Format

As described in section 4.1

5.9.2 Standard

As described in section 4.2

5.9.3 Production Procedure

As described in section 4.3

5.9.4 Quality Control Procedure

As described in section 4.4

5.9.5 Delivery Procedure

As described in section 4.5

5.9.6 Product Specification

Filename format: Ci_CT_WHI_NATURAL_EVENT__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each NATURAL_EVENT file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_NATURAL_EVENT_DATASET.ceh
- parameters: Ci_CH_WHI_NATURAL_EVENT_PARAMETERS.ceh

Each NATURAL_EVENT file contains nine variables:

time_tags	beginning of the Natural spectrum acquisition time tag / Next record (in a different natural Mode) beginning of the Natural spectrum acquisition time tag, except for the last record, which is the time of the last acquisition (Natural or Sounding) of the day
fft_size	number of points on which the Fast Fourier Transform is performed. Four FFT dimensions are available on WHISPER: 512, 256, 128, and 64 bins.
Receiving_Antenna	receiving antenna (Ey or Ez). The emission is always performed by Ey
Average_Number	in natural mode, Average_Number corresponds to the number of averaged spectra. There are

	different possibilities: Average_Number = ● 1, then 1 spectrum is averaged ● 2, then 2 spectra are averaged ● 4, then 4 spectra are averaged ● 8, then 8 spectra are averaged ● 16, then 16 spectra are averaged ● 32, then 32 spectra are averaged ● 64, then 64 spectra are averaged
Gain_Command	number between 0 and 7. The signal is amplified by a gain amplifier including three stages. The total gain can take three different values (12, 24, and 36 dB), with an exact ratio of four in between any two consecutive ones. Different options can be selected by telecommand. The gain is either fixed (values 0, 1, 2, 3) or automatically controlled (values 4, 5, 6, 7). The automatic control selects one of two consecutive stepped gains. It responds to the characteristics (number of overflows) of a short sampling (64 samples) taken before the real acquisition, placed in the second part of the 13.3ms basic time structure. Gain_Command = • 0, the gain is fixed and its value is +12 dB • 1, the gain is fixed and its value is +24 dB • 2, the gain is fixed and its value is +36 dB • 3, the gain is fixed and its value is +36 dB • 4, the gain is automatic and its value is between +24 / +12 dB • 5, the gain is automatic and its value is between +24 / +12 dB • 6, the gain is automatic and its value is between +36 / +24 dB • 7, the gain is automatic and its value is between +36 / +12 dB
Averaged_Spectrum_Select_Rate	output rate of the accumulated spectra: • 0: all →spectra 1, 2, 3, 4… • 1: 2/3 →spectra 2, 3, 5, 6… • 2: 1/2 →spectra 2, 4, 6, 8…

	• 3: 1/3 →spectra 2, 5, 8… • 4: 1/4 →spectra 3, 7, 11… • 5: 1/6 →spectra 4, 10, 16… • 6: 1/8 →spectra 5, 13, 21… • 7: 1/10 →spectra 6, 16, 26…
Energy_Overflow_Averaging_Flag	This variable can only take 2 values: • 0: averaging OFF • 1: averaging ON
Compression_Method_Required	This variable can only take 2 values: • 0: adjusted size for the exponent size, • 1: size fixed to 5 for the exponent size.
Compressed_Data_Size	This variable can only take 2 values: • 0: 8 bits, • 1: 6 bits.

Example of a "Natural Event" File:

```
FILE_NAME = "C1_CT_WHI_NATURAL_EVENT__20071001_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
        ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_NATURAL_EVENT_DATASET.ceh"
INCLUDE = "C1_CH_WHI_NATURAL_EVENT_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
        ENTRY = "C1_CT_WHI_NATURAL_EVENT__20071001_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
        ENTRY = "1"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
        ENTRY = "02"
END_META = DATASET_VERSION
```

```
START_META = FILE_TIME_SPAN
          VALUE_TYPE = ISO_TIME_RANGE
          ENTRY = 2007-10-01T00:00:00.000Z/2007-10-01T23:59:59.999Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
          VALUE_TYPE = ISO_TIME
          ENTRY = 2009-12-15T08:13:06Z
END_META = GENERATION_DATE

DATA_UNTIL= "End"
2007-10-01T00:00:06.343Z/2007-10-01T01:54:18.387Z,512,"Y",32,6,6,1,0,1 $
2007-10-01T01:54:18.387Z/2007-10-01T02:14:31.146Z,256,"Z",16,6,7,1,0,1 $
2007-10-01T02:14:31.146Z/2007-10-01T23:59:53.472Z,256,"Y",16,5,6,1,0,1 $
End
```

5.9.7 Metadata Specification

5.9.7.1 Mission

See section 5.1.1

5.9.7.2 Observatory

See section 5.1.2

5.9.7.3 Experiment

See section 5.1.3

5.9.7.4 Instrument

See section 5.1.4

5.9.7.5 Dataset

The file Ci_CH_WHI_NATURAL_EVENT_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_NATURAL_EVENT_DATASET.ceh
!  Header file for WHISPER1 NATURAL EVENT dataset
!

START_META = DATASET_ID
          ENTRY = "C1_CT_WHI_NATURAL_EVENT"
END_META = DATASET_ID

START_META = DATA_TYPE
```

```
          ENTRY = "CT>CAA_EVENT_DATA"
END_META = DATA_TYPE

START_META = DATASET_TITLE
          ENTRY = "Natural Event"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
          ENTRY = "This dataset contains event information under Natural Mode from Whisper on spacecraft 1"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
          ENTRY = "This table provide the functionning mode of the instrument in Natural Mode"
          ENTRY = "DATASET VERSION HISTORY"
          ENTRY = "VERSION 01: first version of dataset"
          ENTRY = "VERSION 02: dataset headers update"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
          ENTRY =  "0"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
          ENTRY = "0.1"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
          ENTRY = "86400"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
          ENTRY = "Auxiliary"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
          ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
          ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
data"
END_META = ACKNOWLEDGEMENT

START_META = FILE_TYPE
          ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
          ENTRY = "CAA"
END_META = METADATA_TYPE
```

5.9.7.6 Parameters

The file Ci_CH_WHI_NATURAL_EVENT_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
! C1_CH_WHI_NATURAL_EVENT_PARAMETERS.ceh
! Parameters description for WHISPER1 NATURAL EVENT dataset
!

START_VARIABLE = time_tags__C1_CT_WHI_NATURAL_EVENT
            CATDESC = "Universal Time Range"
            UNITS = "s"
            SIZES = 1
            VALUE_TYPE = ISO_TIME_RANGE
            SIGNIFICANT_DIGITS = 49
            FILLVAL = 9999-12-31T23:59:59.999Z/9999-12-31T23:59:59.999Z
            LABLAXIS = "UTR"
            FIELDNAM = "Universal Time Range"
            PARAMETER_TYPE = "Support_Data"
            DELTA_PLUS = 0.003
            DELTA_MINUS = 0.003
           PARAMETER_CAVEATS = "duration of the natural mode event is the time interval t1-t2 where t1 is the
           time of the leading edge of the first acquisition and t2 is the time of the leading edge of the first
           acquisition of the next state of Whisper natural commanding (or of the last acquisition of the day)"
END_VARIABLE = time_tags__C1_CT_WHI_NATURAL_EVENT

START_VARIABLE = fft_size__C1_CT_WHI_NATURAL_EVENT
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "F_F_T"
            FIELDNAM = "Fast Fourier Transform Size"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Number of bin frequency points of the Fast Fourier Transform"
            DEPEND_0 = time_tags__C1_CT_WHI_NATURAL_EVENT
            LABEL_1 = "Fast_Fourier_Transform_Size"
            SIGNIFICANT_DIGITS = 3
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = fft_size__C1_CT_WHI_NATURAL_EVENT

START_VARIABLE = Receiving_Antenna__C1_CT_WHI_NATURAL_EVENT
            SIZES = 1
            VALUE_TYPE = CHAR
            FILLVAL = "?"
            LABLAXIS = "R_A"
            FIELDNAM = "Receiving Antenna"
            UNITS = "unitless"
```

```
            SI_CONVERSION = "1>unitless"
            CATDESC = "Receiving antenna Ey or Ez"
            DEPEND_0 = time_tags__C1_CT_WHI_NATURAL_EVENT
            LABEL_1 = "Receiving_Antenna"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Receiving_Antenna__C1_CT_WHI_NATURAL_EVENT

START_VARIABLE = Average_Number__C1_CT_WHI_NATURAL_EVENT
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "A_N"
            FIELDNAM = "Average Number"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Number of averaged individual spectra (formed every 13.33 ms)"
            DEPEND_0 = time_tags__C1_CT_WHI_NATURAL_EVENT
            LABEL_1 = "Average_Number"
            SIGNIFICANT_DIGITS = 2
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Average_Number__C1_CT_WHI_NATURAL_EVENT

START_VARIABLE = Gain_Command__C1_CT_WHI_NATURAL_EVENT
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "G_C"
            FIELDNAM = "Gain Command"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "gain command number"
            DEPEND_0 = time_tags__C1_CT_WHI_NATURAL_EVENT
            LABEL_1 = "Gain_Command"
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
           PARAMETER_CAVEATS = "0:fixed gain +12dB ; 1:fixed gain +24dB; 2:fixed gain +36dB;
           3:fixed gain +36dB; 4:automatic gain +24/+12 dB; 5:automatic gain +24/+12;
           6:automatic gain +36/+24; 7:automatic gain +36/+24 dB)"
END_VARIABLE = Gain_Command__C1_CT_WHI_NATURAL_EVENT

START_VARIABLE = Averaged_Spectrum_Select_Rate__C1_CT_WHI_NATURAL_EVENT
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "A_S_S_R"
            FIELDNAM = "Averaged Spectrum Select Rate"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Output rate of the averaged spectra"
            DEPEND_0 = time_tags__C1_CT_WHI_NATURAL_EVENT
```

```
            LABEL_1 = "Averaged_Spectrum_Select_Rate"
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Averaged_Spectrum_Select_Rate__C1_CT_WHI_NATURAL_EVENT

START_VARIABLE = Energy_Overflow_Averaging_Flag__C1_CT_WHI_NATURAL_EVENT
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "E/O_A_F"
            FIELDNAM = "Energy/Overflow Averaging Flag"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Averaging status: ON (1) or OFF (0)"
            DEPEND_0 = time_tags__C1_CT_WHI_NATURAL_EVENT
            LABEL_1 = "Energy/Overflow_Averaging_Flag"
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Energy_Overflow_Averaging_Flag__C1_CT_WHI_NATURAL_EVENT

START_VARIABLE = Compression_Methode_Required__C1_CT_WHI_NATURAL_EVENT
           SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "C_M_R"
            FIELDNAM = "Quasi-log Compression Methode Required"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "0 : exponent size adjusted; 1: exponent size fixed to 5"
            DEPEND_0 = time_tags__C1_CT_WHI_NATURAL_EVENT
            LABEL_1 = "Compression_Methode_Required"
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Compression_Methode_Required__C1_CT_WHI_NATURAL_EVENT

START_VARIABLE = Compressed_Data_Size__C1_CT_WHI_NATURAL_EVENT
            SIZES = 1
            VALUE_TYPE = INT
            FILLVAL = -1
            LABLAXIS = "C_D_S"
            FIELDNAM = "Compressed Data Size"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Compressed data size: 0 means 8 bits, 1 means 6 bits"
            DEPEND_0 = time_tags__C1_CT_WHI_NATURAL_EVENT
            LABEL_1 = "Compressed_Data_Size"
            SIGNIFICANT_DIGITS = 1
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Compressed_Data_Size__C1_CT_WHI_NATURAL_EVENT
```

5.10 Electron Density File: CP_WHI_ELECTRON_DENSITY

This dataset contains electron density from the WHISPER experiment.

5.10.1 Format

As described in section 4.1

5.10.2 Standard

As described in section 4.2

5.10.3 Production Procedure

As described in section 4.3

5.10.4 Quality Control Procedure

As described in section 4.4

5.10.5 Delivery Procedure

As described in section 4.5

5.10.6 Product Specification

Filename format: Ci_CT_WHI_ELECTRON_DENSITY__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each ELECTRON_DENSITY file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_ELECTRON_DENSITY_DATASET.ceh
- parameters: Ci_CH_WHI_ELECTRON_DENSITY_PARAMETERS.ceh

Each ELECTRON_DENSITY file contains ten variables:

time_tags	central time (ISO) of the spectrum on which the electron density was computed.
Delta	half the number of seconds corresponding to the uncertainty of the time tag of the corresponding spectrum + the spectrum acquisition time
Spectrum_type	nature of the spectrum the density was computed on • “N” for Natural

	• “A” for Active
Computation method	The first digit corresponds to the computation (algorithm) method to obtain the plasma frequency. The second corresponds to the possible variant used.
External_data	Indicates if the EFW potential was used in the computation of the density (“E”), if the FGM fce was used (“F”), or no external data (“-“).
Human_Validation	Type of validation: • “V” when validated • “C” when corrected or added manually • “-“ for none
Electron_density	density value (in cm^{-3})
Uncertainty	uncertainty value of the density (in cm^{-3}). Its computation depends on the plasma determination algorithm.
Contrast	local contrast of the cut-off or the peak around the computed electron density, indicating the reliability of the determined plasma frequency, depending on the method.
Quality	quality flag • 3 = semi-automatic derivation • 4 = manual derivation

Example of an ELECTRON_DENSITY file:

```
FILE_NAME = "C1_CP_WHI_ELECTRON_DENSITY__20050201_V08.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
           ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_ELECTRON_DENSITY_DATASET.ceh"
INCLUDE = "C1_CH_WHI_ELECTRON_DENSITY_PARAMETERS.ceh"
```

```
START_META = LOGICAL_FILE_ID
          ENTRY = "C1_CP_WHI_ELECTRON_DENSITY__20050201_V08"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
          ENTRY = "08"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
          ENTRY = "02"
END_META = DATASET_VERSION

START_META = FILE_TIME_SPAN
          VALUE_TYPE = ISO_TIME_RANGE
          ENTRY = 2005-02-01T00:00:00.000Z/2005-02-01T23:59:59.999Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
          VALUE_TYPE = ISO_TIME
          ENTRY = 2009-12-15T14:21:01Z
END_META = GENERATION_DATE

DATA_UNTIL= "End"
2005-02-01T04:30:02.551Z,0.683000,"A","11","-","V",0.094420,0.011096,1.00,3 $
2005-02-01T04:30:03.991Z,0.683000,"A","11","-","V",0.117916,0.012400,1.00,3 $
End
```

5.10.7 Metadata Specification

5.10.7.1 Mission

See section 5.1.1

5.10.7.2 Observatory

See section 5.1.2

5.10.7.3 Experiment

See section 5.1.3

5.10.7.4 Instrument

See section 5.1.4

5.10.7.5 Dataset

The file Ci_CH_WHI_ELECTRON_DENSITY_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_ELECTRON_DENSITY_DATASET.ceh
!  Header file for WHISPER1 ELECTRON DENSITY dataset
!

START_META = DATASET_ID
           ENTRY = "C1_CP_WHI_ELECTRON_DENSITY"
END_META = DATASET_ID

START_META = DATA_TYPE
           ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE

START_META = DATASET_TITLE
           ENTRY = "Electron Density"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
           ENTRY = "This dataset contains plasma frequencies from Whisper on spacecraft 1"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
           ENTRY = "DATASET VERSION HISTORY"
           ENTRY = "VERSION 01: first version of dataset"
           ENTRY = "VERSION 02: dataset headers update, QUALITY changed to CONTRAST, addition of a new
QUALITY variable"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
           ENTRY =  "52"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
           ENTRY = "1.5"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
           ENTRY = "104"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
           ENTRY = "Derived"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
           ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
```

```
        ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
                data"
END_META = ACKNOWLEDGEMENT

START_META = FILE_TYPE
        ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
        ENTRY = "CAA"
END_META = METADATA_TYPE
```

5.10.7.6 Parameters

The file Ci_CH_WHI_ELECTRON_DENSITY_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

Each variable is described by a metadata. An example is given for spacecraft 1:

```
!
!  C1_CH_WHI_ELECTRON_DENSITY_PARAMETERS.ceh
!  Parameters description for WHISPER1 ELECTRON DENSITY dataset
!

START_VARIABLE = time_tags__C1_CP_WHI_ELECTRON_DENSITY
        CATDESC = "Interval centred time tag"
        UNITS = "s"
        SIZES = 1
        VALUE_TYPE = ISO_TIME
        SIGNIFICANT_DIGITS = 24
        FILLVAL = 9999-12-31T23:59:59Z
        DELTA_PLUS = Delta_Time__C1_CP_WHI_ELECTRON_DENSITY
        DELTA_MINUS = Delta_Time__C1_CP_WHI_ELECTRON_DENSITY
        LABLAXIS = "UT"
        FIELDNAM = "Universal Time"
        PARAMETER_TYPE = "Support_Data"
END_VARIABLE = time_tags__C1_CP_WHI_ELECTRON_DENSITY

START_VARIABLE = Delta_Time__C1_CP_WHI_ELECTRON_DENSITY
        SIZES = 1
        VALUE_TYPE = FLOAT
        FILLVAL = -1
        LABLAXIS = "D"
        FIELDNAM = "Delta"
        UNITS = "s"
        CATDESC = "Half of the number of seconds corresponding the uncertainty of the time tags"
        DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_DENSITY
        SIGNIFICANT_DIGITS = 8
        PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Delta_Time__C1_CP_WHI_ELECTRON_DENSITY
```

```
START_VARIABLE = Spectrum_Type__C1_CP_WHI_ELECTRON_DENSITY
            SIZES = 1
            VALUE_TYPE = CHAR
            FILLVAL = "-"
            LABLAXIS = "S_T"
            FIELDNAM = "Spectrum Type"
            UNITS = "unitless"
            CATDESC = "spectrum type (A: Active; N:Natural) from which the electron density is derived"
            DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_DENSITY
            PARAMETER_TYPE = "Support_Data"
            SIGNIFICANT_DIGITS = 1
END_VARIABLE = Spectrum_Type__C1_CP_WHI_ELECTRON_DENSITY

START_VARIABLE = Computation_Method__C1_CP_WHI_ELECTRON_DENSITY
            SIZES = 1
            VALUE_TYPE = CHAR
            FILLVAL = "XX"
            LABLAXIS = "Meth"
            FIELDNAM = "Computation Method"
            UNITS = "unitless"
            CATDESC = "Method used for the computation of the density – see CAA-EST-CR-WHI"
            DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_DENSITY
            PARAMETER_TYPE = "Support_Data"
            SIGNIFICANT_DIGITS = 2
END_VARIABLE = Computation_Method__C1_CP_WHI_ELECTRON_DENSITY

START_VARIABLE = External_Data__C1_CP_WHI_ELECTRON_DENSITY
            SIZES = 1
            VALUE_TYPE = CHAR
            FILLVAL = "-"
            LABLAXIS = "E_D"
            FIELDNAM = "External Data"
            UNITS = "unitless"
            CATDESC = "use of external data (-:  none; E:  EFW s/c potential)"
            DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_DENSITY
            PARAMETER_TYPE = "Support_Data"
            SIGNIFICANT_DIGITS = 1
END_VARIABLE = External_Data__C1_CP_WHI_ELECTRON_DENSITY

START_VARIABLE = Human_Validation__C1_CP_WHI_ELECTRON_DENSITY
            SIZES = 1
            VALUE_TYPE = CHAR
            FILLVAL = "-"
            LABLAXIS = "Val"
            FIELDNAM = "Human Validation"
            UNITS = "unitless"
            CATDESC = "human validation (V:viewed and accepted; C:corrected manually; -:none)"
            DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_DENSITY
            PARAMETER_TYPE = "Support_Data"
```

```
            SIGNIFICANT_DIGITS = 1
END_VARIABLE = Human_Validation__C1_CP_WHI_ELECTRON_DENSITY

START_VARIABLE = Electron_Density__C1_CP_WHI_ELECTRON_DENSITY
            SIZES = 1
            VALUE_TYPE = FLOAT
            ENTITY = "Electron"
            PROPERTY = "Number_Density"
            LABLAXIS = "E-D"
            FIELDNAM = "Electron Density"
            SI_CONVERSION = "1.0e6>m^-3"
            UNITS = "cm^-3"
            FILLVAL = -1
            ERROR_PLUS = Uncertainty __C1_CP_WHI_ELECTRON_DENSITY
            ERROR_MINUS = Uncertainty __C1_CP_WHI_ELECTRON_DENSITY
            CATDESC = "Electron Density"
            DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_DENSITY
            SIGNIFICANT_DIGITS = 9
            PARAMETER_TYPE = "Data"
            QUALITY = Quality__C1_CP_WHI_ELECTRON_DENSITY
END_VARIABLE = Electron_Density__C1_CP_WHI_ELECTRON_DENSITY

START_VARIABLE = Uncertainty__C1_CP_WHI_ELECTRON_DENSITY
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "Unc"
            FIELDNAM = "Uncertainty"
            UNITS = "cm^-3"
            SI_CONVERSION = "1.0e6>m^-3"
            CATDESC = "Uncertainty of the computed electron density"
            DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_DENSITY
            SIGNIFICANT_DIGITS = 3
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Uncertainty__C1_CP_WHI_ELECTRON_DENSITY

START_VARIABLE = Contrast__C1_CP_WHI_ELECTRON_DENSITY
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "Contr"
            FIELDNAM = "Contrast"
            UNITS = "unitless"
            SI_CONVERSION = "1>unitless"
            CATDESC = "Local contrast for the computed density - see CAA-EST-CR-WHI"
            DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_DENSITY
            SIGNIFICANT_DIGITS = 2
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Contrast__C1_CP_WHI_ELECTRON_DENSITY
```

```
START_VARIABLE = QUALITY__C1_CP_WHI_ELECTRON_DENSITY
        SIZES = 1
        VALUE_TYPE = INT
        FILLVAL = -1
        LABLAXIS = "Qual"
        FIELDNAM = "Quality"
        UNITS = "unitless"
        SI_CONVERSION = "1>unitless"
        CATDESC = "quality flag (3= semi-automatic derivation, 4= manual derivation)"
        DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_DENSITY
        SIGNIFICANT_DIGITS = 2
        PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Quality__C1_CP_WHI_ELECTRON_DENSITY
```

5.11 Electron Gyrofrequency Files: CP_WHI_ELECTRON_GYROFREQUENCY

This dataset contains electron gyrofrequency in the plasmasphere, derived from WHISPER active measurements. This dataset is limited to the 2001-2005 period.

5.11.1 Format

As described in section 4.1

5.11.2 Standard

As described in section 4.2

5.11.3 Production Procedure

As described in section 4.3

5.11.4 Quality Control Procedure

As described in section 4.4

5.11.5 Delivery Procedure

As described in section 4.5

5.11.6 Product Specification

Filename format: Ci_CP_WHI_ELECTRON_GYROFREQUENCY__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each ELECTRON_GYROFREQUENCY file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh

- dataset: Ci_CH_WHI_ELECTRON_GYROFREQUENCY_DATASET.ceh
- parameters: Ci_CH_WHI_ ELECTRON_GYROFREQUENCY_PARAMETERS.ceh

Each ELECTRON_GYROFREQUENCY file contains four variables:

time_tags	central time (ISO) of the spectrum on which the electron density was computed.
Delta_Time	half the number of seconds corresponding to the uncertainty of the time tag of the corresponding spectrum + the spectrum acquisition time
Electron_Gyrofrequency	Electron gyrofrequency value (in kHz)
Uncertainty	uncertainty value of the gyrofrequency (in kHz)

Example of a SOUNDING_TIMES file:

```
FILE_NAME = "C1_CP_WHI_ELECTRON_GYROFREQUENCY__20010206_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
  ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_ELECTRON_GYROFREQUENCY_DATASET.ceh"
INCLUDE = "C1_CH_WHI_ELECTRON_GYROFREQUENCY_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
  ENTRY = "C1_CP_WHI_ELECTRON_GYROFREQUENCY__20010206_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
  ENTRY = "01"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
  ENTRY = "01"
END_META = DATASET_VERSION

START_META = FILE_TIME_SPAN
  VALUE_TYPE = ISO_TIME_RANGE
  ENTRY = 2001-02-06T23:18:10.168Z/2001-02-06T23:59:42.112Z
```

```
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
  VALUE_TYPE = ISO_TIME
  ENTRY = 2010-05-03T09:13:50Z
END_META = GENERATION_DATE

DATA_UNTIL= "End"
2001-02-06T23:18:10.168Z,0.683000,14.135617, 0.08150 $
2001-02-06T23:18:36.728Z,0.683000,14.187700, 0.04075 $
2001-02-06T23:18:38.168Z,0.683000,14.190955, 0.04075 $
2001-02-06T23:19:04.728Z,0.683000,14.238156, 0.04075 $
End
```

5.11.7 Metadata Specification

5.11.7.1 Mission

See section 5.1.1

5.11.7.2 Observatory

See section 5.1.2

5.11.7.3 Experiment

See section 5.1.3

5.11.7.4 Instrument

See section 5.1.4

5.11.7.5 Dataset

The file Ci_CH_WHI_ELECTRON_GYROFREQUENCY_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

```
!
!  C1_CH_WHI_ELECTRON_GYROFREQUENCY_DATASET.ceh
!  Header file for WHISPER1 ELECTRON GYROFREQUENCY dataset
!

START_META = DATASET_ID
          ENTRY = "C1_CP_WHI_ELECTRON_GYROFREQUENCY"
END_META = DATASET_ID

START_META = DATA_TYPE
          ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE

START_META = DATASET_TITLE
```

```
            ENTRY = "Electron gyrofrequency in plasmasphere"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
            ENTRY = "This dataset contains electron gyrofrequencies from Whisper on spacecraft 1 in
plasmasphere"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
            ENTRY = "DATASET VERSION HISTORY"
            ENTRY = "VERSION 01: first version of dataset"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
            ENTRY =  "52"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
            ENTRY = "1.5"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
            ENTRY = "104"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
            ENTRY = "Derived"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
            ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
            ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
data"
END_META = ACKNOWLEDGEMENT

START_META = FILE_TYPE
            ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
            ENTRY = "CAA"
END_META = METADATA_TYPE
```

5.11.7.6 Parameters

The file Ci_CH_WHI_ELECTRON_GYROFREQUENCY_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

```
!
!  C1_CH_WHI_ELECTRON_GYROFREQUENCY_PARAMETERS.ceh
!  Parameters description for WHISPER1 ELECTRON GYROFREQUENCY dataset
!

START_VARIABLE = time_tags__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 CATDESC = "Interval centred time tag"
 UNITS = "s"
 SIZES = 1
 VALUE_TYPE = ISO_TIME
 SIGNIFICANT_DIGITS = 24
 FILLVAL = 9999-12-31T23:59:59Z
 DELTA_PLUS = Delta_Time__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 DELTA_MINUS = Delta_Time__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 LABLAXIS = "UT"
 FIELDNAM = "Universal Time"
 PARAMETER_TYPE = "Support_Data"
END_VARIABLE = time_tags__C1_CP_WHI_ELECTRON_GYROFREQUENCY

START_VARIABLE = Delta_Time__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 SIZES = 1
 VALUE_TYPE = FLOAT
 FILLVAL = -1
 LABLAXIS = "D"
 FIELDNAM = "Delta"
 UNITS = "s"
 CATDESC = "Half of the number of seconds corresponding the uncertainty of the time tags"
 DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 SIGNIFICANT_DIGITS = 8
 PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Delta_Time__C1_CP_WHI_ELECTRON_GYROFREQUENCY

START_VARIABLE = Electron_Gyrofrequency__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 SIZES = 1
 VALUE_TYPE = FLOAT
 ENTITY = "Electron"
 PROPERTY = "Magnitude"
 LABLAXIS = "Fce"
 FIELDNAM = "Electron Gyrofrequency"
 SI_CONVERSION = "1.0E3>Hz"
 UNITS = "kHz"
 FILLVAL = -1
 ERROR_PLUS = Uncertainty__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 ERROR_MINUS = Uncertainty__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 CATDESC = "Electron Gyrofrequency"
 DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_GYROFREQUENCY
```

```
 SIGNIFICANT_DIGITS = 9
 PARAMETER_TYPE = "Data"
 QUALITY = 3
END_VARIABLE = Electron_Gyrofrequency__C1_CP_WHI_ELECTRON_GYROFREQUENCY

START_VARIABLE = Uncertainty__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 SIZES = 1
 VALUE_TYPE = FLOAT
 FILLVAL = -1
 LABLAXIS = "Unc"
 FIELDNAM = "Uncertainty"
 UNITS = "kHz"
 SI_CONVERSION = "1.0E3>Hz"
 CATDESC = "Uncertainty of the derived electron gyrofrequency"
 DEPEND_0 = time_tags__C1_CP_WHI_ELECTRON_GYROFREQUENCY
 SIGNIFICANT_DIGITS = 8
 PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Uncertainty__C1_CP_WHI_ELECTRON_GYROFREQUENCY
```

5.12 Sounding Times File: CP_WHI_SOUNDING_TIMES

This dataset contains the central time tags of WHISPER soundings followed by half the number of seconds corresponding to the sampling time interval.

5.12.1 Format

As described in section 4.1

5.12.2 Standard

As described in section 4.2

5.12.3 Production Procedure

As described in section 4.3

5.12.4 Quality Control Procedure

As described in section 4.4

5.12.5 Delivery Procedure

As described in section 4.5

5.12.6 Product Specification

Filename format: Ci_CP_WHI_SOUNDING_TIMES__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each SOUNDING_TIMES file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_SOUNDING_TIMES_DATASET.ceh
- parameters: Ci_CH_WHI_SOUNDING_TIMES_PARAMETERS.ceh

Each SOUNDING_TIMES file contains two variables:

time_tags	central time (ISO) of the sounding event
Delta	half the duration (in s) of the sounding length + the uncertainty.

Example of a SOUNDING_TIMES file:

```
FILE_NAME = "C1_CP_WHI_SOUNDING_TIMES__20070101_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

START_META = METADATA_VERSION
          ENTRY = "2.0"
END_META = METADATA_VERSION

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_SOUNDING_TIMES_DATASET.ceh"
INCLUDE = "C1_CH_WHI_SOUNDING_TIMES_PARAMETERS.ceh"

START_META = LOGICAL_FILE_ID
          ENTRY = "C1_CP_WHI_SOUNDING_TIMES__20070101_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
          ENTRY = "1"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
          ENTRY = "02"
END_META = DATASET_VERSION

START_META = FILE_TIME_SPAN
          VALUE_TYPE = ISO_TIME_RANGE
          ENTRY = 2007-01-01T00:00:00.000Z/2007-01-01T23:59:59.999Z
END_META = FILE_TIME_SPAN
```

```
START_META = GENERATION_DATE
          VALUE_TYPE = ISO_TIME
          ENTRY = 2010-01-05T10:12:22Z
END_META = GENERATION_DATE

DATA_UNTIL= "End"
2007-01-01T00:00:02.662Z,0.683000 $
2007-01-01T00:00:04.102Z,0.683000 $
End
```

5.12.7 Metadata Specification

5.12.7.1 Mission

See section 5.1.1

5.12.7.2 Observatory

See section 5.1.2

5.12.7.3 Experiment

See section 5.1.3

5.12.7.4 Instrument

See section 5.1.4

5.12.7.5 Dataset

The file Ci_CH_WHI_SOUNDING_TIMES_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset description:

```
!
!  C1_CH_WHI_SOUNDING_TIMES_DATASET.ceh
!  Header file for WHISPER1 SOUNDING TIMES dataset
!

START_META = DATASET_ID
          ENTRY = "C1_CP_WHI_SOUNDING_TIMES"
END_META = DATASET_ID

START_META = DATA_TYPE
          ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE

START_META = DATASET_TITLE
          ENTRY = "Timings of WHISPER soundings"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
          ENTRY = "This dataset contains the central time tags of WHISPER soundings on Cluster 1 followed by
```

```
            half the number of seconds corresponding to the sampling time interval"
END_META = DATASET_DESCRIPTION

START_META = DATASET_CAVEATS
            ENTRY = "DATASET VERSION HISTORY"
            ENTRY = "VERSION 01: first version of dataset"
            ENTRY = "VERSION 02: dataset headers update"
END_META = DATASET_CAVEATS

START_META = TIME_RESOLUTION
            ENTRY = "52"
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
            ENTRY = "1.5"
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
            ENTRY = "104"
END_META = MAX_TIME_RESOLUTION

START_META = PROCESSING_LEVEL
            ENTRY = "Auxiliary"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
            ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
            ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
            data"
END_META = ACKNOWLEDGEMENT
```

5.12.7.6 Parameters

The file Ci_CH_WHI_SOUNDING_TIMES_PARAMETERS.ceh (i=1,2,3,4 spacecraft id) contains the parameters description:

```
!
!  C1_CH_WHI_SOUNDING_TIMES_PARAMETERS.ceh
!  Parameters description for WHISPER1 SOUNDING_TIMES dataset
!

START_VARIABLE = time_tags__C1_CP_WHI_SOUNDING_TIMES
            CATDESC = "Interval centred time tag"
            UNITS = "s"
            SIZES = 1
            VALUE_TYPE = ISO_TIME
            SIGNIFICANT_DIGITS = 24
```

```
            FILLVAL = 9999-12-31T23:59:59.999Z
            DELTA_PLUS = Delta__C1_CP_WHI_SOUNDING_TIMES
            DELTA_MINUS = Delta__C1_CP_WHI_SOUNDING_TIMES
            LABLAXIS = "UT"
            FIELDNAM = "Universal Time"
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = time_tags__C1_CP_WHI_SOUNDING_TIMES

START_VARIABLE = Delta__C1_CP_WHI_SOUNDING_TIMES
            SIZES = 1
            VALUE_TYPE = FLOAT
            FILLVAL = -1
            LABLAXIS = "D"
            FIELDNAM = "Delta"
            UNITS = "s"
            SI_CONVERSION = "1>s"
            CATDESC = "half the sampling duration + uncertainty of time tags (in seconds)"
            DEPEND_0 = time_tags__C1_CP_WHI_SOUNDING_TIMES
            LABEL_1 = "Delta"
            SIGNIFICANT_DIGITS = 8
            PARAMETER_TYPE = "Support_Data"
END_VARIABLE = Delta__C1_CP_WHI_SOUNDING_TIMES
```

5.13 Prime Parameters (PP) Files: PP_WHI

This dataset contains preliminary spin resolution measurements of the electron density and plasma wave spectral density from the WHISPER experiment. These data have been converted into Cluster Exchange Format from the original Cluster Science Data System Common Data Format (CDF) Prime Parameter files that were made available through the Cluster Science Data System.

5.13.1 Format

As described in section 4.1

5.13.2 Standard

As described in section 4.2

5.13.3 Production Procedure

As described in section 4.3

5.13.4 Quality Control Procedure

As described in section 4.4

5.13.5 Delivery Procedure

As described in section 4.5

5.13.6 Product Specification

Filename format: Ci_PP_WHI__yyyymmdd_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

PP production is directly handled at CAA.

5.14 Summary Parameters (SP) Files: SP_WHI

This dataset contains 1-minute averaged measurements of the electron density and plasma wave spectral density from the WHISPER experiment on the Cluster C3 spacecraft. These data have been converted into Cluster Exchange Format from the original Cluster Science Data System Common Data Format (CDF) Prime Parameter files that were made available through the Cluster Science Data System.

5.14.1 Format

As described in section 4.1

5.14.2 Standard

As described in section 4.2

5.14.3 Production Procedure

As described in section 4.3

5.14.4 Quality Control Procedure

As described in section 4.4

5.14.5 Delivery Procedure

As described in section 4.5

5.14.6 Product Specification

Filename format: CL_SP_WHI__yyyymmdd_Vnn.cef where nn = version number.

SP production is directly handled at CAA.

5.15 Measurement quality caveat: CQ_WHI_CAVEATS

This dataset contains information relative to caveats affecting measurements quality (interferences, overflows, corrupted data, on-ground processing bugs) for the WHISPER experiment.

5.15.1 Format

As described in section 4.1

5.15.2 Standard

As described in section 4.2

5.15.3 Production Procedure

Caveats are produced directly at LPC2E on a manual basis.

5.15.4 Quality Control Procedure

N/A

5.15.5 Delivery Procedure

Caveats are delivered at CAA by LPC2E.

5.15.6 Product Specification

Filename format: Ci_CQ_WHI_CAVEATS__yyyymmdd_hhmm_yyyymmdd_hhmm_Vnn.cef where i = 1,2,3,4 (spacecraft id), nn = version number.

Each SOUNDING_TIMES file includes metadata for:

- mission: CL_CH_MISSION.ceh
- observatory: Ci_CH_OBS.ceh
- experiment: CL_CH_WHI_EXP.ceh
- instrument: Ci_CH_WHI_INST.ceh
- dataset: Ci_CH_WHI_CAVEATS_DATASET.ceh

Each CAVEATS file contains two variables:

time_range	validity time range (ISO) of the specified caveat
caveat_text	caveat information in relation with interferences, overflows, corrupted data and on-ground processing issues

Example of a CAVEATS file:

```
FILE_NAME = "C1_CQ_WHI_CAVEATS__20030101_0000_20031231_0000_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = $

INCLUDE = "CL_CH_MISSION.ceh"
```

```
INCLUDE = "C1_CH_OBS.ceh"
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "C1_CH_WHI_INST.ceh"
INCLUDE = "C1_CH_WHI_CAVEATS_DATASET.ceh"

START_META = LOGICAL_FILE_ID
           ENTRY = "C1_CQ_WHI_CAVEATS__20030101_0000_20031231_0000_V01"
END_META = LOGICAL_FILE_ID

START_META = VERSION_NUMBER
           ENTRY = "1"
END_META = VERSION_NUMBER

START_META = DATASET_VERSION
           ENTRY = "01"
END_META = DATASET_VERSION

START_META = FILE_TYPE
           ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
           ENTRY = "CAA"
END_META = METADATA_TYPE

START_META = METADATA_VERSION
           ENTRY = "2.0"
END_META = METADATA_VERSION

START_META = FILE_TIME_SPAN
           VALUE_TYPE = ISO_TIME_RANGE
           ENTRY      = 2003-01-01T00:00:00.000Z/2003-12-31T23:59:59.000Z
END_META = FILE_TIME_SPAN

START_META = GENERATION_DATE
           VALUE_TYPE = ISO_TIME
           ENTRY = 2009-12-02T15:30:24Z
END_META = GENERATION_DATE

DATA_UNTIL = "End"
 2003-10-04T00:00:00.000Z/2003-10-05T00:00:00.000Z,"corrupted spectra" $
End
```

5.15.7 Metadata Specification

5.15.7.1 Mission

See section 5.1.1

5.15.7.2 Observatory

See section 5.1.2

5.15.7.3 Experiment

See section 5.1.3

5.15.7.4 Instrument

See section 5.1.4

5.15.7.5 Dataset

The file Ci_CH_WHI_CAVEATS_DATASET.ceh (i=1,2,3,4 spacecraft id) contains the dataset and parameters description:

```
!
!  C1_CH_WHI_CAVEATS_DATASET.ceh
!  Header file for WHISPER1 CAVEATS dataset (data quality caveats dataset)
!

START_META = DATASET_ID
           ENTRY = "C1_CQ_WHI_CAVEATS"
END_META = DATASET_ID

START_META = DATA_TYPE
           ENTRY = "CQ>CAA_Quality/Caveats"
END_META = DATA_TYPE

START_META = DATASET_TITLE
           ENTRY = "WHISPER1 data quality caveats dataset"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
           ENTRY = "This dataset contains data quality caveats information from WHISPER on spacecraft
           1"
END_META = DATASET_DESCRIPTION

START_META = PROCESSING_LEVEL
           ENTRY = "Auxiliary"
END_META = PROCESSING_LEVEL

START_META = CONTACT_COORDINATES
           ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
           ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
           data"
END_META = ACKNOWLEDGEMENT
```

```
START_META = FILE_TYPE
          ENTRY = "cef"
END_META = FILE_TYPE

START_META = METADATA_TYPE
          ENTRY = "CAA"
END_META = METADATA_TYPE

START_VARIABLE = Time_range__C1_CQ_WHI_CAVEATS
          PARAMETER_TYPE = "Support_Data"
          CATDESC = "Validity time range of a specified caveat"
          VALUE_TYPE = ISO_TIME_RANGE
          FILLVAL = 9999-12-31T23:59:59.999Z/9999-12-31T23:59:59.999Z
          UNITS = "s"
          SI_CONVERSION = "1.0>s"
          SIGNIFICANT_DIGITS = 49
          FIELDNAM = "Universal Time Range"
END_VARIABLE = Time_range__C1_CQ_WHI_CAVEATS

START_VARIABLE = Caveat_text__C1_CQ_WHI_CAVEATS
          PARAMETER_TYPE     = "Support_Data"
          CATDESC = "Caveats"
          ENTITY = "Instrument"
          SIGNIFICANT_DIGITS = 80
          VALUE_TYPE = CHAR
          FILLVAL = "NA"
          UNITS = "unitless"
          SI_CONVERSION = "1>unitless"
          PROPERTY = "Status"
          FIELDNAM = "Caveats"
          DEPEND_0 = Time_range__C1_CQ_WHI_CAVEATS
END_VARIABLE = Caveat_text__C1_CQ_WHI_CAVEATS
```

5.16

5.16 Quicklook in Natural mode: CG_WHI_QL_NAT_PS and CG_WHI_QL_NAT_JPEG

These datasets are quicklooks, produced for browsing purpose, containing the Electric Wave Form Power Density spectrograms under natural mode from the WHISPER experiment, for all spacecraft.

5.16.1 Format

Quicklooks are images provided in Postscript format and Jpeg format (for previsualisation on the CAA website).

5.16.2 Standard

As described in section 4.2

5.16.3 Production Procedure

Quicklooks are produced routinely at LPC2E. Files are generated for 6 hours of data

5.16.4 Delivery Procedure

Quicklooks are delivered at CAA by LPC2E.

5.16.5 Product Specification

Filenames format:
CM_CG_WHI_QL_NAT_PS__yyyymmdd_hhmm_yyyymmdd__hhmm_Vnn.cef
CM_CG_WHI_QL_NAT_JPEG__yyyymmdd_hhmm_yyyymmdd__hhmm_Vnn.cef

Content:

- one view per S/C, each view contains (from top to bottom):
  1) a color-coded bar giving information on the overflow level
  2) a color-coded bar giving the S/C telemetry mode
  3) a color-coded bar giving information on the receiving antenna
  4) a color-coded bar giving information on the FFT size used onboard
  5) the total energy in dB (integrated signal computed on board and from spectrum)
  6) the color-coded spectrogram in dB
- Ephemeris values are provided for C3, they are given at the bottom of the page, below the time labels on the horizontal axis:
  1) distance to Earth in Earth radii
  2) latitude in degrees in the Geocentric Solar Ecliptic coordinate system
  3) longitude in degrees in the Geocentric Solar Ecliptic coordinate system
  4) magnetic latitude in degrees
  5) magnetic local time in hours

5.16.6 Metadata Specification

The files CM_CG_WHI_QL_NAT_PS.ceh and CM_CG_WHI_QL_NAT_JPEG.ceh contain the dataset description. Example for the Postscript format is given below:

```
!
!  CM_CH_WHI_QL_NAT_PS.ceh
!  Header file for NATURAL WHISPER quicklook (PS)
!

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "CM_CH_OBS.ceh"
```

```
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "CM_CH_WHI_INST.ceh"

!================================
! Dataset Level Metadata
!================================

START_META = DATASET_ID
           ENTRY = "CM_CG_WHI_QL_NAT_PS"
END_META = DATASET_ID

START_META = DATA_TYPE
           ENTRY = "CG>CAA_Graphic"
END_META = DATA_TYPE

START_META = DATASET_TITLE
           ENTRY = "WHISPER quicklooks in Natural mode (PS)"
END_META = DATASET_TITLE

START_META = CONTACT_COORDINATES
           ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
           ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
                    data"
END_META = ACKNOWLEDGEMENT

START_META    =  PROCESSING_LEVEL
  ENTRY     =  "Calibrated"
END_META     =  PROCESSING_LEVEL

START_META    =  DATASET_DESCRIPTION
  ENTRY     =  "WHISPER experiment wave spectrograms in natural mode ; 6 hours per plot "
  ENTRY     =  ""
  ENTRY     =  "There is one view per S/C, each view contains (from top to bottom):"
  ENTRY     =  "1) a color-coded bar giving information on the overflow level"
  ENTRY     =  "2) a color-coded bar giving the S/C telemetry mode"
  ENTRY     =  "2) a color-coded bar giving information on the receiving antenna"
  ENTRY     =  "3) a color-coded bar giving information on the transmitted level"
  ENTRY     =  "4) the total energy in dB (integrated signal computed on board and from spectrum)"
  ENTRY     =  "5) the color-coded spectrogram in dB"
  ENTRY     =  ""
  ENTRY     =  "Ephemeris values are provided for C3."
  ENTRY     =  "They are given at the bottom of the page, below the time labels on the horizontal axis:"
  ENTRY     =  "1) distance to Earth in Earth radii"
  ENTRY     =  "2) latitude in degrees in the Geocentric Solar Ecliptic coordinate system"
  ENTRY     =  "3) longitude in degrees in the Geocentric Solar Ecliptic coordinate system"
  ENTRY     =  "4) magnetic latitude in degrees"
  ENTRY     =  "5) magnetic local time in hours"
```

```
END_META    =  DATASET_DESCRIPTION

START_META   =  TIME_RESOLUTION
  ENTRY     =  21600
END_META    =  TIME_RESOLUTION

START_META   =  MIN_TIME_RESOLUTION
  ENTRY     =  21600
END_META    =  MIN_TIME_RESOLUTION

START_META   =  MAX_TIME_RESOLUTION
  ENTRY     =  21600
END_META    =  MAX_TIME_RESOLUTION

START_META   =  FILE_TYPE
  ENTRY     =  "ps"
END_META    =  FILE_TYPE

START_META   =  DATASET_VERSION
  ENTRY     =  "V01"
END_META    =  DATASET_VERSION

START_META   =  METADATA_VERSION
  ENTRY     =  "2.0"
END_META    =  METADATA_VERSION

START_META   =  METADATA_TYPE
  ENTRY     =  "CAA"
END_META    =  METADATA_TYPE

START_META   =  DATASET_CAVEATS
  ENTRY     =  "See User Guide for caveats"
END_META    =  DATASET_CAVEATS
```

5.17 Quicklook in Active mode: CG_WHI_QL_ACT_PS and CG_WHI_QL_ACT_JPEG

These datasets are quicklooks, produced for browsing purpose, containing the Electric Wave Form Power Density spectrograms under active mode from the WHISPER experiment, for all spacecraft.

5.17.1 Format

Quicklooks are images provided in Postscript format and Jpeg format (for previsualisation on the CAA website).

5.17.2 Standard

As described in section 4.2

5.17.3 Production Procedure

Quicklooks are produced routinely at LPC2E. Files are generated for 6 hours of data

5.17.4 Quality Control Procedure

N/A

5.17.5 Delivery Procedure

Quicklooks are delivered at CAA by LPC2E.

5.17.6 Product Specification

Filenames format:
CM_CG_WHI_QL_ACT_PS__yyyymmdd_hhmm_yyyymmdd__hhmm_Vnn.cef
CM_CG_WHI_QL_ACT_JPEG__yyyymmdd_hhmm_yyyymmdd__hhmm_Vnn.cef

Content:

- one view per S/C, each view contains (from top to bottom):
  1) a color-coded bar giving the S/C telemetry mode
  2) a color-coded bar giving information on the receiving antenna
  3) a color-coded bar giving information on the transmitted level
  4) the color-coded spectrogram in dB
- position information, provided for C3, is given at the bottom of the page, below the time labels on the horizontal axis:
  1) distance to Earth in Earth radii
  2) latitude in degrees in the Geocentric Solar Ecliptic coordinate system
  3) longitude in degrees in the Geocentric Solar Ecliptic coordinate system
  4) magnetic latitude in degrees
  5) magnetic local time in hours

5.17.7 Metadata Specification

The files CM_CG_WHI_QL_ACT_PS and CM_CG_WHI_QL_ACT_JPEG.ceh contain the dataset description. Example for the Postscript format is given below:

```
!
!  CM_CH_WHI_QL_ACT_PS.ceh
!  Header file for ACTIVE WHISPER quicklook (PS)
!

INCLUDE = "CL_CH_MISSION.ceh"
INCLUDE = "CM_CH_OBS.ceh"
```

```
INCLUDE = "CL_CH_WHI_EXP.ceh"
INCLUDE = "CM _CH_WHI_INST.ceh"

!================================
! Dataset Level Metadata
!================================

START_META = DATASET_ID
           ENTRY = "CM_CG_WHI_QL_ACT (PS)"
END_META = DATASET_ID

START_META = DATA_TYPE
           ENTRY = "CG>CAA_Graphic"
END_META = DATA_TYPE

START_META = DATASET_TITLE
           ENTRY = "WHISPER quicklooks in Active mode"
END_META = DATASET_TITLE

START_META = CONTACT_COORDINATES
           ENTRY = "Jean-Louis Rauch>PI>Jean-Louis.Rauch@cnrs-orleans.fr"
END_META = CONTACT_COORDINATES

START_META = ACKNOWLEDGEMENT
           ENTRY = "Please acknowledge the instrument team and ESA Cluster Active Archive when using this
                    data"
END_META = ACKNOWLEDGEMENT

START_META    =  PROCESSING_LEVEL
  ENTRY     =  "Calibrated"
END_META     =  PROCESSING_LEVEL

START_META    =  DATASET_DESCRIPTION
  ENTRY     =  "WHISPER experiment wave spectrograms in natural mode ; 6 hours per plot "
  ENTRY     =  ""
  ENTRY     =  "There is one view per S/C, each view contains (from top to bottom):"
  ENTRY     =  "1) a color-coded bar giving the S/C telemetry mode"
  ENTRY     =  "2) a color-coded bar giving information on the receiving antenna"
  ENTRY     =  "3) a color-coded bar giving information on the transmitted level"
  ENTRY     =  "4) the color-coded spectrogram in dB"
  ENTRY     =  ""
  ENTRY     =  "Ephemeris values are provided for C3."
  ENTRY     =  "They are given at the bottom of the page, below the time labels on the horizontal axis:"
  ENTRY     =  "1) distance to Earth in Earth radii"
  ENTRY     =  "2) latitude in degrees in the Geocentric Solar Ecliptic coordinate system"
  ENTRY     =  "3) longitude in degrees in the Geocentric Solar Ecliptic coordinate system"
  ENTRY     =  "4) magnetic latitude in degrees"
  ENTRY     =  "5) magnetic local time in hours"
END_META     =  DATASET_DESCRIPTION
```

```
START_META    =  TIME_RESOLUTION
  ENTRY       =  21600
END_META      =  TIME_RESOLUTION

START_META    =  MIN_TIME_RESOLUTION
  ENTRY       =  21600
END_META      =  MIN_TIME_RESOLUTION

START_META    =  MAX_TIME_RESOLUTION
  ENTRY       =  21600
END_META      =  MAX_TIME_RESOLUTION

START_META    =  FILE_TYPE
  ENTRY       =  "ps"
END_META      =  FILE_TYPE

START_META    =  DATASET_VERSION
  ENTRY       =  "V01"
END_META      =  DATASET_VERSION

START_META    =  METADATA_VERSION
  ENTRY       =  "2.0"
END_META      =  METADATA_VERSION

START_META    =  METADATA_TYPE
  ENTRY       =  "CAA"
END_META      =  METADATA_TYPE

START_META    =  DATASET_CAVEATS
  ENTRY       =  "See User Guide for caveats"
END_META      =  DATASET_CAVEATS
```

APPENDIX A – REFERENCES

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APPENDIX B – LIST OF ACRONYMS

CAA	Cluster Active Archive
CDF	Common Data Format
CEF	Cluster Exchange Format
CNES	Centre National d'Etudes Spatiales
CSA	Cluster Science Archive
CSDS	Cluster Science Data System
DWP	Digital Wave Processor
EDI	Electron Drift Instrument
EFW	Electric Field and Wave experiment
ESA	European Space Agency
FGM	Flux Gate Magnetometer
FFT	Fast Fourier Transform
ILWS	International Living With a Star
LPC2E	Laboratoire de Physique et Chimie de l'Environnement et de l'Espace
MSB	Most Significant Bit
N/A	Non Applicable / Non Available
OBDH	On-Board Data Handling
PI	Principal Investigator
RAM	Random Access Memory
TM	TeleMetry
UT	Universal Time
VSP	Vector Signal Processing
WAMW	WHISPER Actual Mode Words
WCMW	WHISPER Command Mode Word
WEC	Wave Experiment Consortium
WHISPER	Waves of High frequency and Sounder for Probing the Electron density by Relaxation
WPW	WHISPER Processing Word

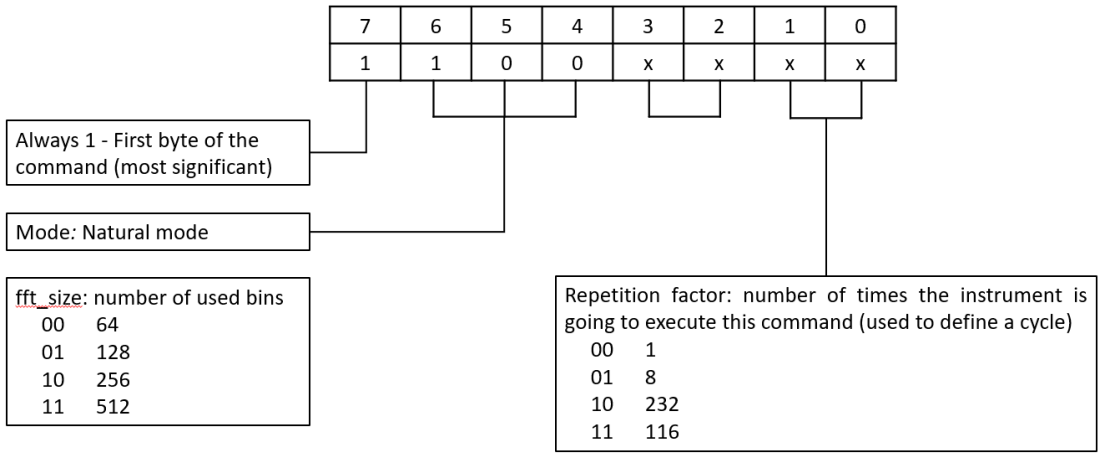
APPENDIX C – INSTRUMENT DATA PRODUCTS

C.1 WHISPER in natural Mode (mode 4)

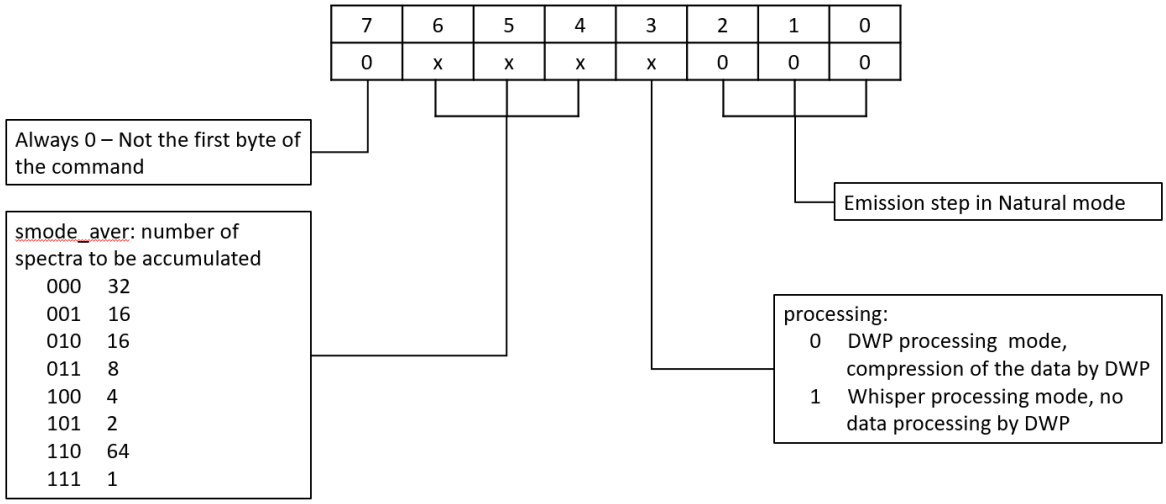
C.1.1 The WHISPER Command Mode Word (WCMW)

DWP controls the WHISPER instrument by using a 4-byte long command word called WCMW.
In DWP, the 4 bytes are stored in a buffer initialized to default values when the instrument is turned on. The onboard telemetry system allows DWP to refresh one or many of these bytes before each transmission of the WCMW to WHISPER.
The most significant bit of each of these bytes has to take respectively the value 1,0,0,0.

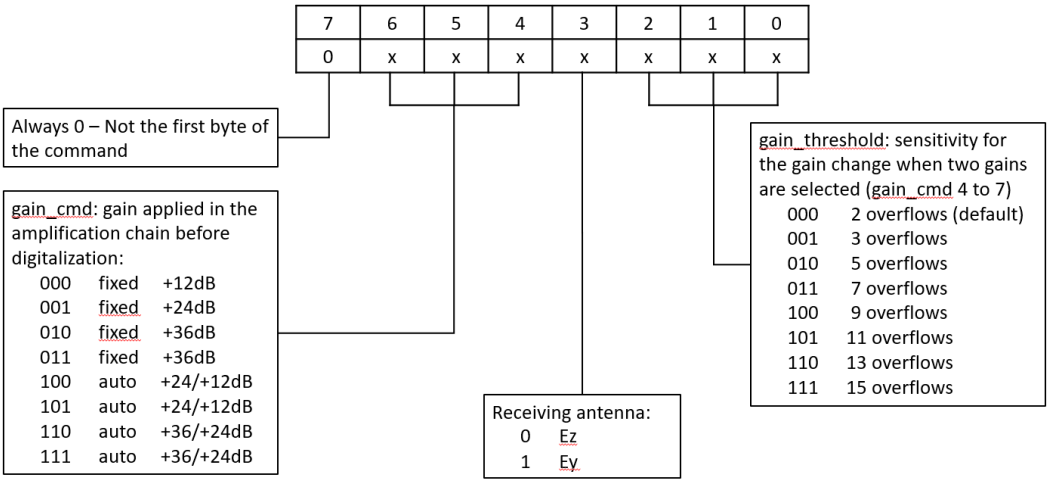
WCMW 0:



WCMW 1:



WCMW 2:



Concerning the gain command, when an automatic gain change is chosen, the higher value is selected. If too much saturation occurs, the gain is switched to the lower one.

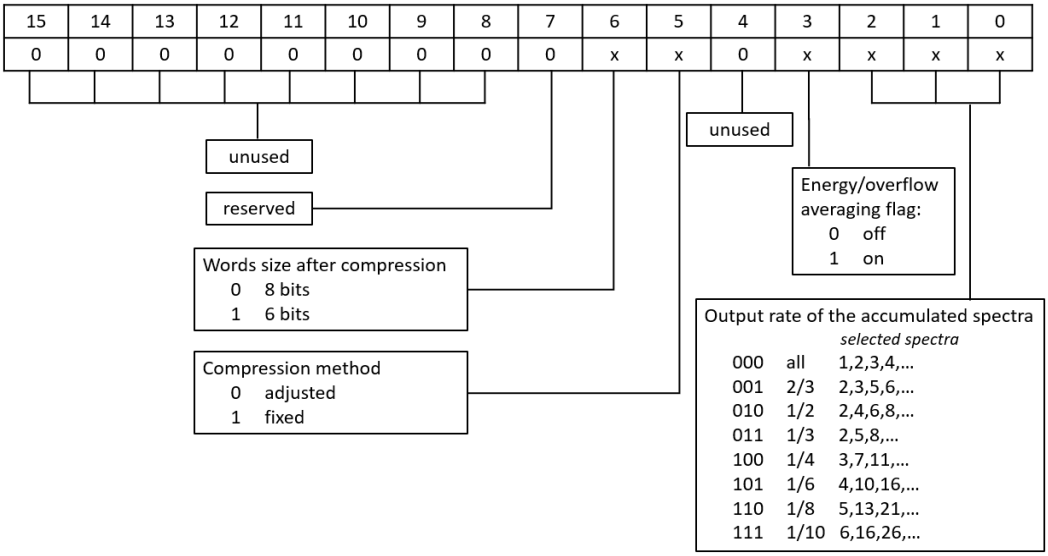
WCMW 3:

7	6	5	4	3	2	1	0
0	x	x	x	x	x	x	x

In a telemetry command, this byte can contain information concerning other non-natural modes.

C.1.2 The WHISPER Processing Word (WPW)

This word, which is destined to DWP only, is used to give various parameters to the WHISPER application executed by DWP.
In the telemetry commands, a single byte is sent (except in Gliding mode), but two bytes appear in the DWP output data block.



C.1.3 DWP-Processed Natural Mode

In DWP-processed Natural mode, DWP receives one WHISPER packet every 13.33 ms. The processing of these data relies on the notion of averaging intervals, which are badly named for historical reasons, as a certain number of FFT magnitudes (defined by smode_aver, WCMW1) are summed rather than averaged during these intervals.

Another parameter affecting the processing is the averaged spectrum select rate, which establishes the amount (percentage) of intervals for which the accumulated FFT data will be output.

If the FFT spectra contain 256 (resp. 512) bins, the values over 80 kHz are not processed, which corresponds to the last 2 (resp. last 10) bins.

Output format of the WHISPER application data:

In Natural mode, the emitted data are structured as follows:

- 5 16-bit state words;
- the energy and overflow information;
- FFT data.

DWP associates to this data block the time tag of the latest WHISPER packet used to form it. This time is when DWP reads this packet in the WHISPER output buffer, which is a little after the time WHISPER outputs it (emitting the FrameReady signal).

The state Words:

word #	bits	Contents
1	0-7 8-15	WCMW1 WCMW0
2	0-7 8-15	NatGainCounter WCMW2
3	0-13 14 15	bits 0-13 of WPW Dummy last byte flag for FFT data 0 = Natural Mode
4	0-7 8-15	Energy values number Overflow information length (word number)
5	0-14 15	Length (in words) of the FFT data, including FFT header if present. IntervalEndFlag

NatGainCounter counts the automatic gain changes performed by WHISPER during an averaging interval (see averaged spectrum select rate). For such averaging intervals, the WHISPER application (DWP) checks for every received spectrum whether the automatic gain changed and, if so, increments NatGainCounter.
The gain changes when the real gain is the lower of the two possible values.

Dummy last byte flag indicates if the master processor added a completion byte to obtain an even number of bytes.

IntervalEndFlag this flag is set if, during the processing, the WHISPER instrument reached the end of the averaging interval before the WHISPER application (DWP), meaning the WHISPER

instrument sent as many spectra as defined by smode_aver, whereas the DWP application did not process as many. Such a situation can happen when a loss of data occurred between the instrument and the application for some reason. It can be indicated by a DWP Application Overflow flag in the HouseKeeping data in such a case. This flag allows the application and the instrument to be synchronized (at the start of a new averaging interval or of a new command).

Energy and Overflow information:

A total energy value (amount of energy between 2 and 80 kHz computed from the waveform signal) and an overflow counter are computed for each FFT output by WHISPER.

The output data depend on the value of the bit 3 of WPW: the energy/overflow averaging flag:

- Off: in this case, the output contains the total energy values and the overflow counters for all the FFT produced by WHISPER during the averaging interval,
- On: in this case, the total energy values and the overflows are accumulated throughout the averaging interval. If the number of accumulated spectra (smode_aver) is 64, the energy values are divided by 2 before being added to the total to avoid an overflow in the accumulation variable. Furthermore, whatever the length of the averaging interval, the totals are also divided by 2 before compression.

The energy values (32 bits) are compressed on 8 bits using the DynLog32n algorithm (Sumner 1993) with the fixed dynamic range option (5 bits for the exponent and 3 bits for the mantissa).

The overflow values are compressed using the FindPos function (Sumner 1993). This function returns the position of the most significant bit of an input 32-bit word (base 2 logarithms). For an overflow value n, the compressed value is FindPos(n)+1= $\log_2$ (n) + 1. If n=0, the compressed value is 0.

Overflow value	compressed value
0	0
1	1
2-3	2
4-7	3
8-15	4
16-31	5
32-63	6
64-127	7
128-255	8
256-511	9
512-1023	10
1024-2047	11
2048-4095	12
4096-8191	13
8192-16383	14

The compressed energy values are stored as 2 by 16-bit word and the overflow values as 4 by 16-bit word. In the output block, these 16-bit words are written starting with the least significant byte.

- If the number of energy values is odd, an extra dummy value (equal to 0) is added.
- If the number of overflow values is not multiple of 4, the last word is completed with at most 3 values 15 (F hexa) (value unused by the compression).

The energy and overflow values are processed and accumulated according to the averaged spectrum select rate, on possibly various averaging intervals, until the averaging interval corresponds to one for which the data must be emitted. For example, if smode_aver equals 16 and the averaged spectrum select rate is 1/4, we obtain:

Rank of the emitted accumulated spectra:		3	7	11	15	…
Number of energy values = number of overflow values	averaging OFF	48	64	64	64	…
	averaging ON	3	4	4	4	…

When the averaging of energy and overflow is not selected, some combinations of averaging interval lengths and averaged spectrum select rates provoke an overtaking of the output packet size (511 words): this happens when more than 200 FFT are read before an output packet is emitted.
In such a combination, the energy/overflow averaging option is automatically imposed and the copy of WPW in the output block is modified consequently. Normally, these cases correspond to an averaging interval of 64 FFT and an averaged spectrum select rate ≤ 1/4 (1/4, 1/6, 1/8, 1/10) or to an averaging interval of 32 FFT and an averaged spectrum select rate ≤1/8 (1/8, 1/10).

FFT Data:

If the current averaging interval is one of those for which a data packet is emitted (according to the averaged spectrum select rate), the FFT data (bins) for this interval are bit-shifted to the left according to the Zoran VSP scale factor and accumulated bin to bin.
Otherwise only the energy and overflow data are processed.

After accumulation, the FFT data are compressed according to the compression options defined in WPW.
If the data are compressed on 6 bits, the resulting values are stored at the rate of 4 values on 3 bytes as follows:

Byte 1								Byte 2								Byte 3							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
5	4	first value						3	2	second value						1	0	third value					

The bits of the 4th value are underlined

If the number of values treated by the processor is not divisible by 4, the last values are stored at the rate of a value by byte. If the number of stored bytes is odd, we add a dummy last byte at the end to finish on a border of a 16-bit word.

In the output block, the FFT data are preceded by a header, the FFT header, which contains:

- The size of the mantissa and the initial value of the exponent in the case of compression with the adjusted dynamic range option;
- If the compression is on 6 bits, the number of resulting values placed simply in bytes, after the groups of 4 values;
- A flag to indicate if a dummy last byte was added to obtain an even number of bytes.

The FFT header is coded on 16 bits as follows:

bits	***value***
0-2	mantissa size - 1
3-8	exponent offset + 30
9-10	number of values in complete bytes
11	dummy last byte flag
12-15	unused

If the compression is on 8 bits with fixed dynamic range, the processor does not add this header before writing its data.

NOTE: *there is never a dummy last byte in that case.*

As for energy and overflow values, the FFT data must be read by 16-bit words, by swapping the most significant and least significant bytes.

C.1.4 WHISPER-Processed Natural Mode

This processing mode, indicated by the bit 3 of WCMW1, is a mode in which DWP is transparent. It is only passing on the data emitted by WHISPER directly in the OBDH. All the feasible modes in DWP mode are also in WHISPER mode. The only constraint is the output rate, which is limited to 650 bits/s, except for 2 dedicated modes.

Data output format:

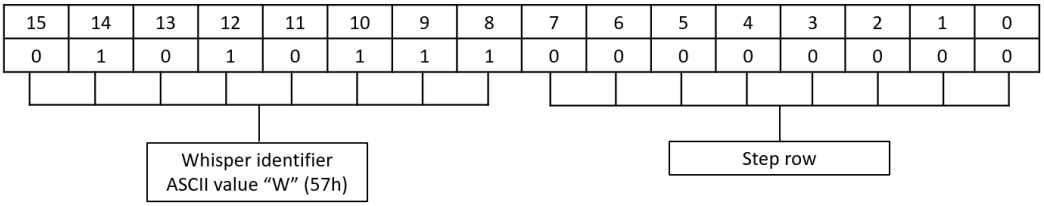
In non-dedicated WHISPER mode, the data output format is that of the data transferred by the WHISPER instrument to DWP in DWP processing mode.

The data are structured as follows:

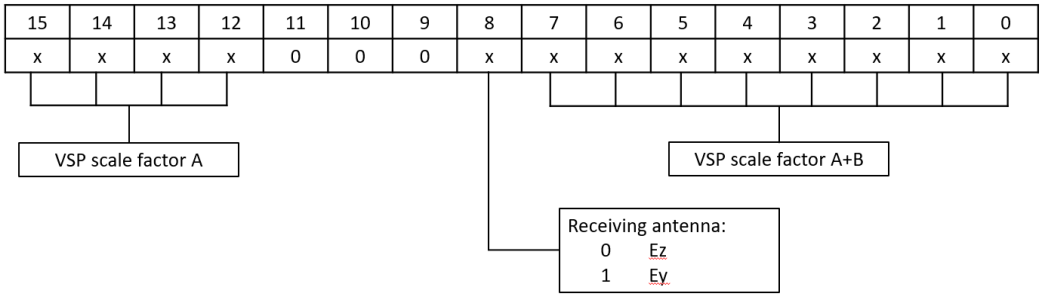
- 4 state words, WHISPER Actual Mode Words (WAMW), describing the current mode;
- 2 words containing a copy of WCMW;
- WHISPER Data Main Words (WDMW) containing the energy values;
- the FFT data.

DWP associates to this block a time tag corresponding to the time when it read the packet in the WHISPER output buffer. This time is slightly greater than the time WHISPER outputs the packet (emitting the FrameReady signal).

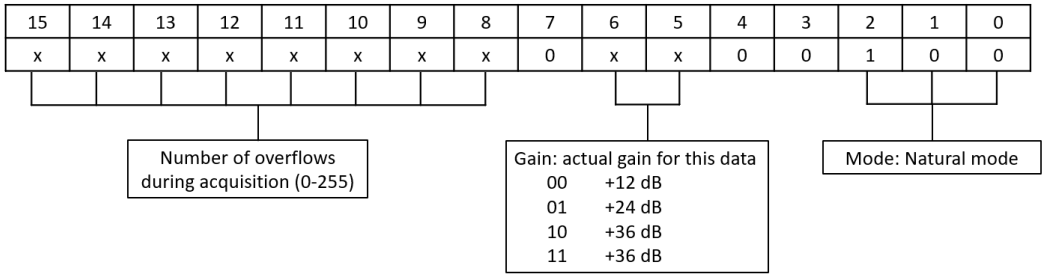
WAMW0:



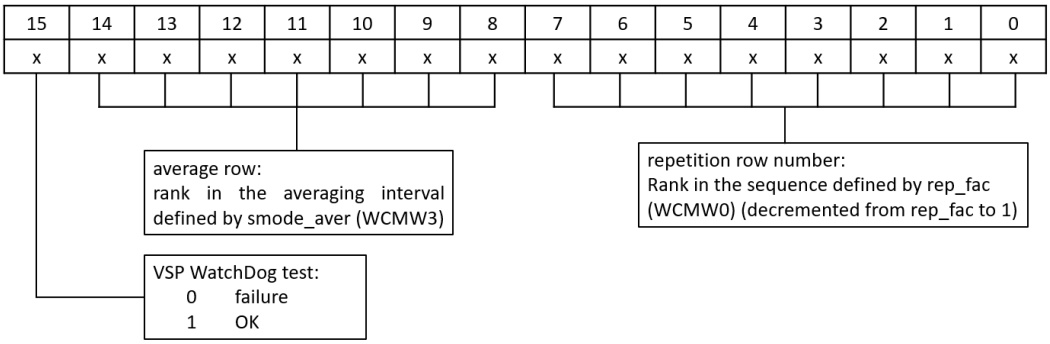
WAMW1:



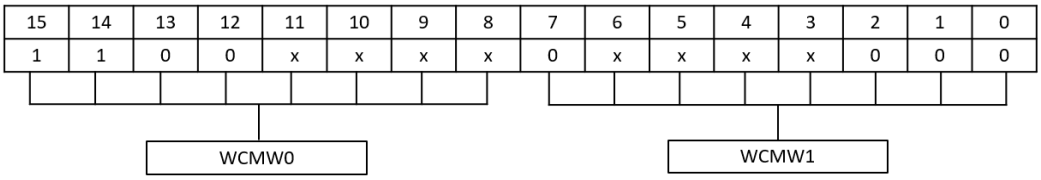
WAMW2:



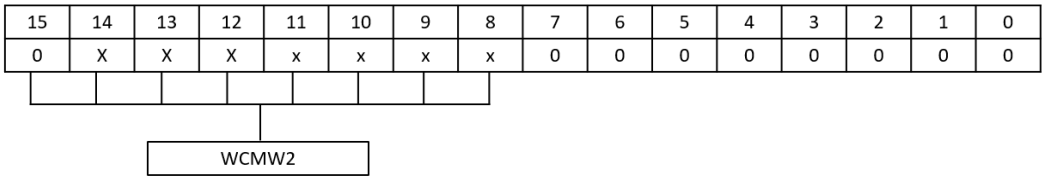
WAMW3:



WAMW4:



WAMW5:



Then energy values follow. Depending on the FFT size (64, 128, 256, 512 bins), these 32-bit values are stored on 2, 4, 8 or 16 16-bit words, respectively corresponding to the 1, 2, 4 or 8 128-sample blocks on which they are computed.

Then the FFT data follow.

WHISPER Internal dedicated modes:

Contrary to the previously described modes, the processing performed in these two modes is an actual averaging rather than an accumulation. The energy and overflow values are also averaged.

The only adjustable parameters are the repetition factor (rep_fac), the gain and the gain threshold (WCMW2).

These two modes are:

a) an averaging of 16 128-bin FFT, duration = 74 ms[1] + 1240 ms by cycle, command: C (4..7) 18 xx 00;

b) an average of 8 256-bin FFT, duration = 74 ms[1] + 1133.33 ms by cycle, command: C (8..B) 38 xx 00.

In these modes only one WHISPER packet is produced by cycle, with a format similar to the one produced by WHISPER in standard Natural mode, with the following exceptions:

- Step row (WAMW0 byte 0) is set to 0;
- VSP scale factor A (WAMW1 byte 1 bits 4-7) is set to 0;
- VSP scale factor A+B (WAMW1 byte 0) corresponds to the greatest scale factor found during a cycle;
- The number of overflows (WAMW2 byte 1) is the average number of overflows during a cycle (total number of overflows / number of spectra);
- The gain (WAMW2 byte 0) is the gain of the last spectrum of the cycle;
- VSP watch dog test (WAMW3 byte 1 bit 7) is the VSP watch dog test of the last spectrum of the cycle;
- Listen row (WAMW3 byte 1 bits 0-6) is put to 1;

- Repetition row (WAMW3 byte 0) is put to the value of the current rank;
- The words 6 and 7 (energy 0) contain the quadratic sum averaged by samples collected during a cycle, (coded in an unsigned 32-bit integer);
- The words 8 and 9 (energy 1) (128 bins) and the words 8 - 13 (energy 1 in 3) (256 bins) are 0;
- The FFT data (bins) are the averaged values; these values are bit-shifted according to the greatest VSP scale factor found during the cycle.

[1] Initialisation Time: time between the moment when DWP sends the command and the moment when we obtain the first averaged spectrum.

C.2 WHISPER in Sounding Mode (mode 2)

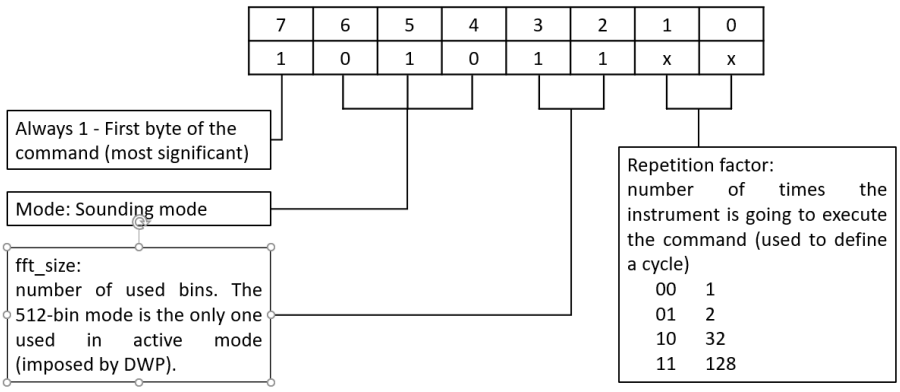
C.2.1 DWP processing Mode

In this mode, operations such as Compression, Computation of "ratios", etc. may be performed to increase the amount of information transmitted without having to change the transmission rate.

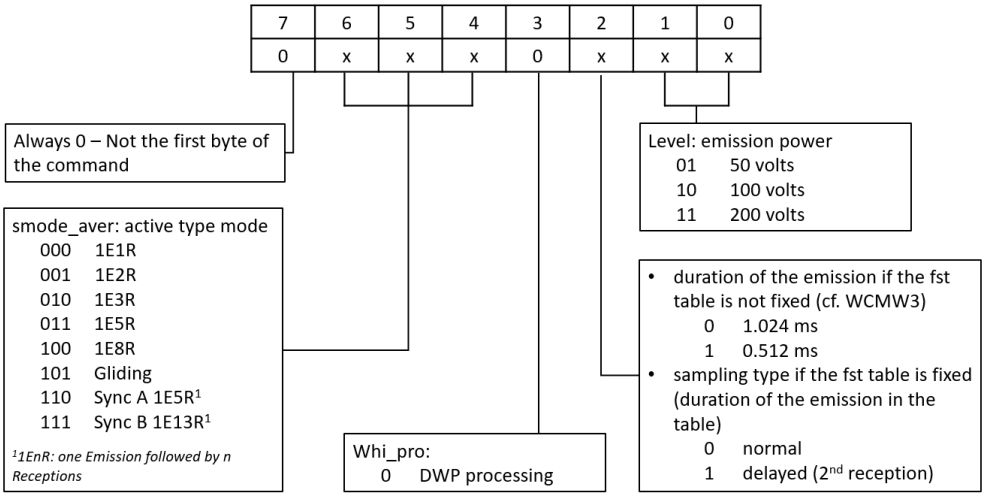
C.2.1.1 The WHISPER Command Mode Word (WCMW)

This mode offers a wide variety of combinations.

The byte 0 (**WCMW0**) of the command contains the following information:

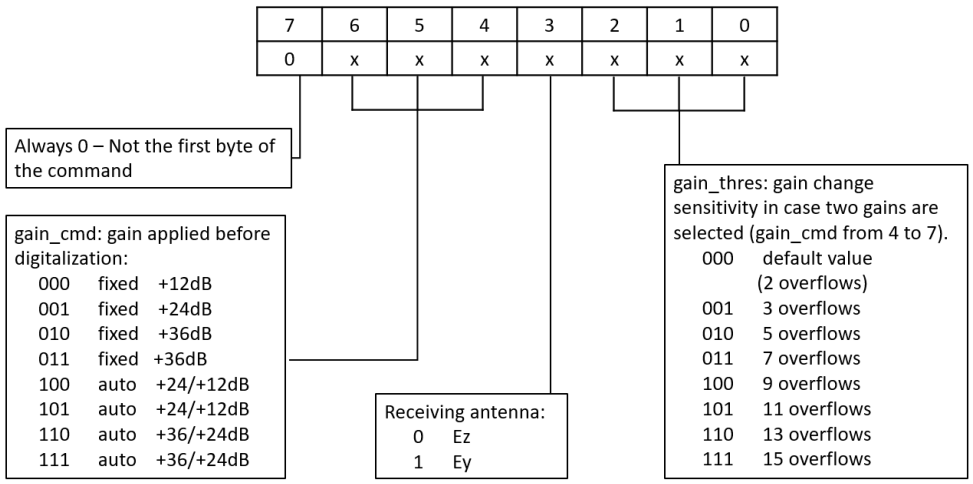


The byte 1 (**WCMW1**) of the command is as follows:

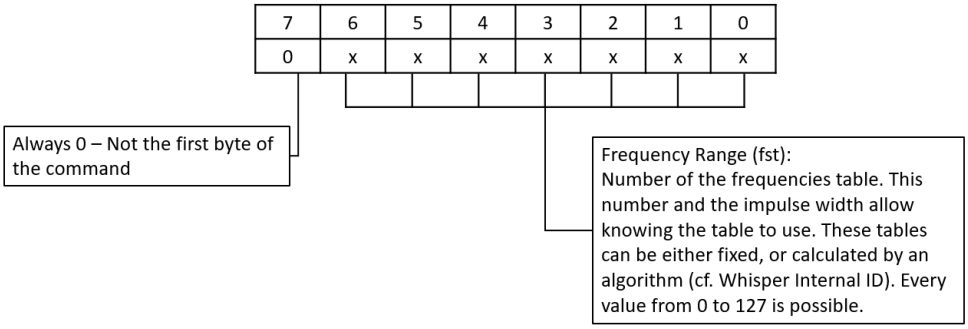


[1] These modes are characterized by a supplementary wait (45 ms for Sync A and 63.34 ms for Sync B) between every frame to synchronize WHISPER with the other experiments.

The byte 2 (**WCMW2**) of the command is as follows:

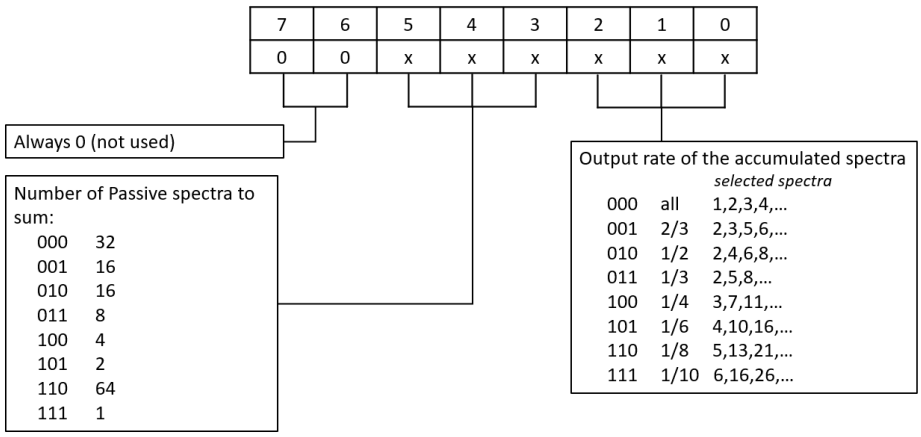


The byte 3 (**WCMW3**) of the command is as follows:

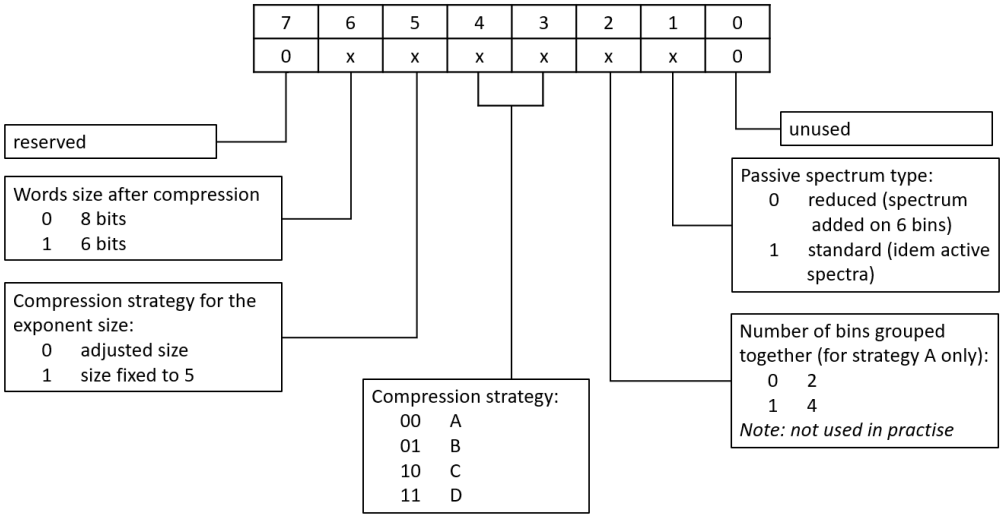


C.2.1.2 The WHISPER Processing Word (WPW)

It is a one-byte word except when the Gliding mode is selected (smode_aver equals to 5). In that case, it is a 16-bit word structured as follows:



The second byte of the Gliding processing word has the same structure as the unique byte of the other sounders modes. That is:



NOTE: *bits 6 and 5 are used in the same way as for the N phases of the Gliding mode.*

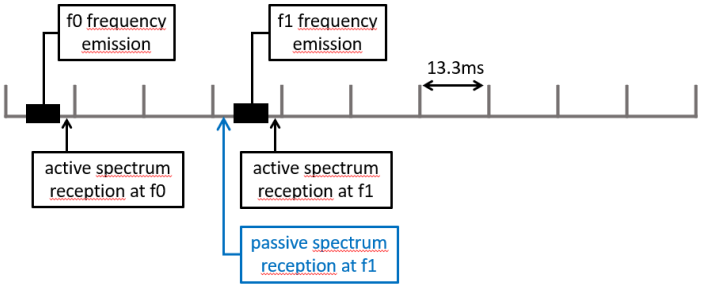
C.2.1.3 The Output Format

Particular case of the Gliding mode:

This mode allows WHISPER to be synchronized with the rotation of the satellite to prevent from hampering the other experiments which work in parallel during the WHISPER non-active phases. It is characterized by a sounding phase (S) followed by a long-term listening phase (N) (1E1R Active mode (40 steps) + a 2106.66 ms waiting time + 256 passive listenings + a variable waiting time to ensure a complete cycle duration of 2.125 times the spin duration). During the S phases, the output frames have the same size as those in non-gliding sounding modes. During the N phases, the output format is identical to that of the normal N mode except that the WCMW and the WPW are those of the S phase. In this last case, the flag indicating if the energies and the saturations are summed does not appear: it is simply forced to 1 by the software. The output format for the natural mode is described in the section corresponding to this mode. It is however necessary to note that both N and S phases take place independently, so an S phase does not reset the N mode.

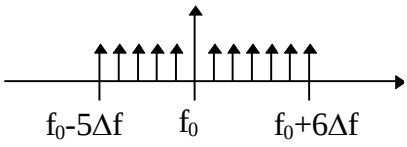
Compression strategy:
In the following, we will deal with so-called Active and Passive spectra obtained in S mode. They correspond respectively to the spectra obtained in the listening consecutive to the emission and to the spectra obtained before the emission for the implied frequency.

Ex : in 1E3R Mode:

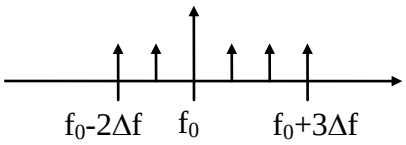


In any case, only the bins around the investigated frequency are kept. The number of bins kept depends on the duration of the emission.

- Emission of 0.512 ms: 12 bins kept (because $12\Delta f = \frac{1}{\Delta t}$)

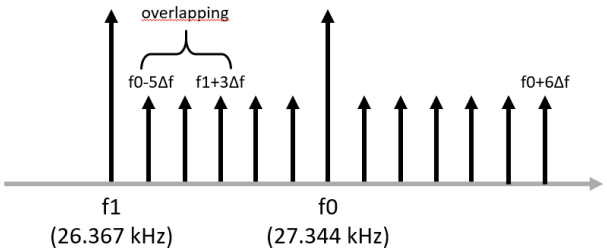


- Emission of 1.024 ms: 6 bins kept (because $6\Delta f = \frac{1}{\Delta t}$)



WARNING: Depending on the distance between the investigated frequencies, overlapping can occur. Thus, working on the Fourier tables should take into account the frequencies exploration sequence, to determine in a sure way to which spectrum and which date belongs each bin.

Example for frequency table #14: there is overlapping for frequency bins 26.530 kHz, 26.693 kHz, and 26.855 kHz.



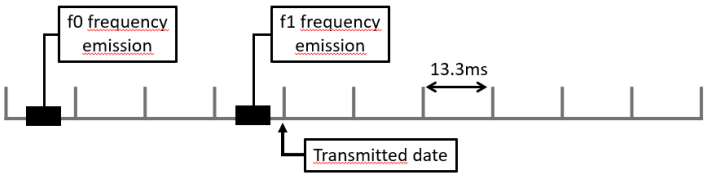
The output format in active mode depends on the selected strategy. In the following, the output format is described byte by byte for each strategy, in the order of

appearance in the output. However, some information is coded on many bytes forming 16-bit or more words. The headers are coded as follows: in the 16-bit words, the most significant bytes appear first; in DWP mode, all the data bytes (FFT, indicators,…) are switched: byte 1, byte 0, byte 3, byte 2, byte 5, byte 4… It is thus necessary to re-order them. In WHISPER mode, the data are either on 16-bit or on 32-bit words. The 16-bit words are coded as in the header. In the 32-bit words, the least significant bits appear first: word 0 (bits 15-0) then word 1 (bits 31-16).

(i) Output format for strategy A

In this strategy, the amount of data for the spectra is reduced by a factor 2 or 4 depending on the value of bit 2 in WPW. This lessening is performed in order to keep only the most significant information in every group of 2 or 4 bins. In such a group, only the bin of highest intensity is kept.
So, the information appearing in output are: a description header, an indicators table allowing to know which bin was kept for each group, a ratios table containing information on the Active / Passive ratio for the selected bins, the table of selected bins, and –if bit 1 of WPW is set- the table of passive bins grouped by 6 and summed.
DWP dates every output block with the date of the last used WHISPER packet time.

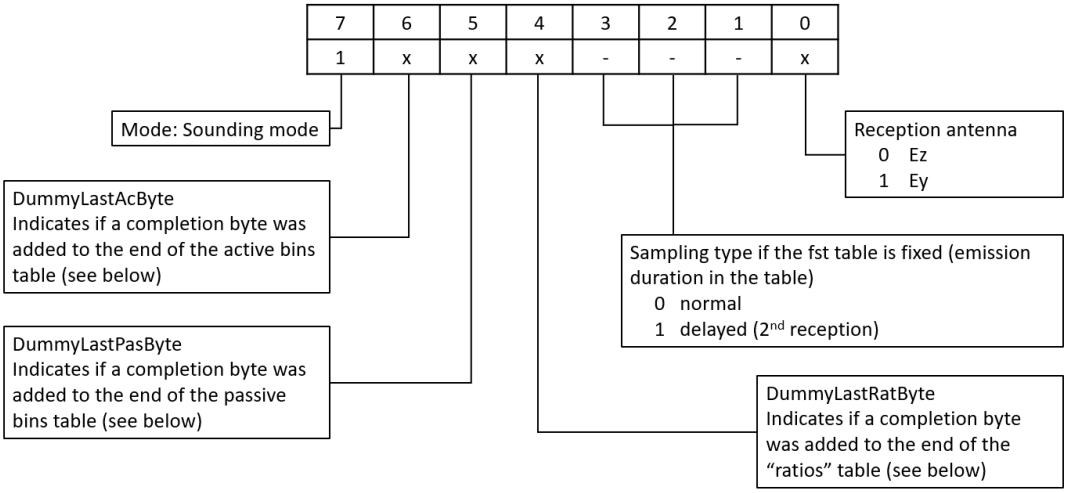
Example: table of two steps of frequency, 1E3R.



Header Description:

This header is composed of 8 16-bit words:

- Byte 0: WCMW0. Byte 0 of the WHISPER command word appearing in the WHISPER header. Its format is identical to the format described for the command.
- Byte 1: WCMW1. Byte 1 of the WHISPER command word appearing in the WHISPER header. Its format is identical to the format described for the command.
- Byte 2: WCMW2. Byte 2 of the WHISPER command word appearing in the WHISPER header. Its format is identical to the format described for the command.
- Byte 3: AcGainCounter. Byte indicating the gain change number for acquisitions having contributed to the Active spectrum.
- Byte 4: this byte contains a series of bits as follows:



- Byte 5: It is the WPW least significant bits. The bits not represented are not important for the emission phase S of the gliding mode. For other active modes, these missing bits do not contain information.
- Byte 6: IndicatorByteSize. Contains the number of bytes of the indicators table (see the description of this table below).
- Byte 7: IndRatSize. Contains the number of 16-bit words of the indicators table, the ratios and the possible completion byte.
- Bytes 8 et 9: This 16-bit word contains the following two pieces of information:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SweepStart: start index of the bins treated in the WHISPER table minus 19 (shift of the 512 bins table by 10 and divergence of the start index -0 rather than 1- when compared to the shift of 30 units specified in (Sumner 1993)							ActiveResultSize: Length in 16-bit words of the active bins, including the FFT headers if required.								

- Bytes 10 and 11: this 16-bit word contains:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SweepLength: Number of memorized bins with the hypothesis that there is no hole. (Owed to an "application overflow": loss of a WHISPER block).									PasGainCounter: Number of gain changes for the Passive spectra.						

- Byte 12: AcOverflows. Number of saturations + 1 for the Active spectra. This value is compressed with the DynLog32n algorithm described in (Sumner 1993) (exponent+mantissa: 3+5 bits).
- Byte 13: PasOverflows. Number of saturations + 1 for the Passive spectra. This value is compressed like AcOverflows.

WARNING: In a few cases, incoherencies appear between DummyLastAcByte, ActiveResultSize, and SweepLength. As there is in fact redundancy between these parameters, it will be enough to consider only the value of SweepLength.

Indicators Description:

The indicators specify the position of the bin of highest value in the 2 or 4-bin subsets depending on bit 2 of WPW. When the grouping is incomplete (number of bins not multiple of 2 or 4), the first group (lowest frequency) is incompletely constituted. The coding of indicators requires either 1 or 2 bits. They are concatenated in bytes.

Example for 4-bin groups:

7	6	5	4	3	2	1	0
I_{n+3}		I_{n+2}		I_{n+1}		I_n	

When the number of groups is not multiple of 4 or 8, the last byte is incomplete: the most significant bytes are meaningless. The total byte length of the indicators table is given by IndicatorByteSize. The indicators coding does not necessarily require aligning on 16-bit words. If this coding requires an odd number of bytes (IndicatorByteSize is odd), no dummy completion byte is used. The following table is directly concatenated without loss of bytes.

Description of the "ratios":

In sounding modes, the Active to Passive ratios are coded on two bits. A value between 0 and 3 is thus returned according to the following rule:

0 if *(Active/2 ≤ Passive)*, else
1 if *(Active/4 ≤ Passive)*, else
2 if *(Active/16 ≤ Passive)*, else
3

Four "ratios" are coded by byte:

7	6	5	4	3	2	1	0
R_{n+3}		R_{n+2}		R_{n+1}		R_n	

As for indicators, if the number of groups is not divisible by 4, the last byte is incomplete: the most significant bits are meaningless.

Description of the active FFT table:

The selected active bins follow the ratios. These data are compressed on 6 or 8 bits each depending on the value of bit 6 in WPW. The compression algorithm is described in the reference document (Sumner 1993). The structure of the table is the

same as that in Natural mode, except that there is only one FFT table. So, as in normal mode, there may be a 16-bit header.

NOTE*: in the case of an automatic gain, the data obtained with the strong gain are shifted of two bits, hence the ratio between both gains. Such cases thus require using the weakest gain to get back the data.*

If the bit 1 of WPW is set, a passive bins table is added to the end. In the other case, the block ends at this level.

Description of the passive FFT table:

This table consists of the complete table of Passive spectra. Groups of 6 bins are formed and their values are summed. Traditional compression is performed. The data is then stored in the same way as the active FFT table, possibly with a FFT header.

If the number of bins is not divisible by 6, the first block (low frequency) is the only one without 6 bins.

At this point, the Passive spectrum is not complete. In the first output block, for a sequence connected to the repetition factor, the passive part corresponding to the first step of frequency is not present. In the following blocks in the same sequence, the same passive piece of information is obtained from the information of the previous block as normally, however a wait period passes before starting the following repetition, thus the difference of time is not identical.

(ii) Output format for strategy B

In comparison with the previous strategy A, all the active bins are transmitted.

So the information in output is: a description header, a ratios table containing information on the Active / Passive ratios for all the bins, and, if bit 1 of WPW is set, the passive bins table grouped by 6 and summed.

Description of the header:

The header has the same format as for strategy A. Only IndicatorByteSize is forced to zero, because it does not have meaning anymore.

Description of the "ratios":

The "ratios" are coded in the same way as for the strategy A. Only their number differs, because no grouping is made.

Description of the active FFT table:

The active bins follow the ratios. These data are compressed and coded as in strategy A.

If bit 1 of WPW is set, a passive bins table is added to the end. Else, the block ends at this level.

Description of the passive FFT table:

This table is constituted in the same way as for strategy A.

(iii) Output format for strategy C

In this strategy, no calculation or grouping is made by DWP. So the "ratios" do not appear in output. Thus the information in output is: a description header, the active bins table, the passive bins table.

Description of the header:

The header has the same format as for strategy A. Only IndicatorByteSize and IndRatSize are forced to zero.

Description of the active FFT table:

The active bins follow immediately the header. These data are compressed and coded as for strategy A.

Description of the passive FFT table:

If bit 1 of WPW is set, the passive bins table is constituted as for strategy A.
Otherwise, the passive bins are not added, but compressed then coded as for the Active spectrum.

(iv) Output format for strategy D

This strategy is quite similar to the strategy C, except that the passive bins table appears only if bit 1 of WPW is set and, in that case, the passive bins are grouped by 6 and added as in strategy A.

C.2.2 WHISPER processing Mode

This mode allows processing while DWP is out of order. It is mainly a help mode. However, all the possible active modes in DWP processing are possible. The only constraint is the limited output rate. Dedicated WHISPER modes use a quite particular processing.

C.2.2.1 The WHISPER dedicated mode

(v) WHISPER Command Mode Word (WCMW)

The structure is identical to that described in § C.2.1.1 The WHISPER Command Mode Word (WCMW). Certain values are simply imposed.

- Byte 0 can take the same values (Mode 2, 512 bins):

7	6	5	4	3	2	1	0
1	0	1	0	1	1	x	x

- Byte 1 is different: the WHISPER processing mode is imposed, the mode (smode_aver) is 1E1R, and the emission length is fixed to 1.024ms, i.e.:

7	6	5	4	3	2	1	0
0	0	0	0	1	0	x	x

- Byte 2 is the same: all the gains are possible:

7	6	5	4	3	2	1	0
0	x	x	x	x	x	x	x

- Byte 3 is imposed, so it fixes the frequencies sweeping table to the fixed table number 11:

7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	1

In hexadecimal, the mode command is: A(C..F) 0(8..F) (0..7)x 0B.

(vi) The WHISPER Processing Word (WPW)

The WHISPER Processing Word is not significant in WHISPER processing mode. Indeed, its purpose is to specify to DWP the processing to perform.

(vii) The Output Format

This mode is characterized by intensive processing from WHISPER: each step of the frequency table is examined, and for each step, only a little information is kept to create the single output block.

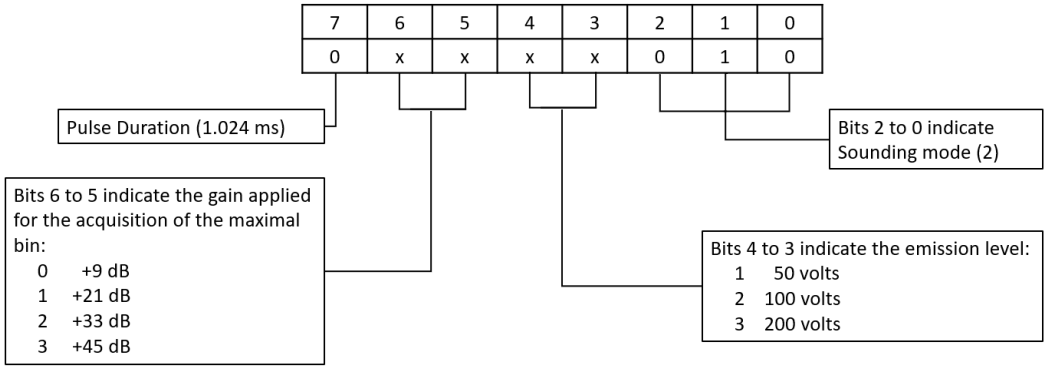
The output packet consists in the WHISPER data header and the active FFT table.

Contrary to what happens is DWP mode, the WHISPER packet is dated at the time of the transfer towards DWP, i.e. after reception of all the blocks, and after the required computations performed by WHISPER. Considering the several operations made by WHISPER in this mode, the blocks of intermediate FFT where some useful bins are extracted are spaced out of 40 ms against the third part in normal mode.

Description of the WHISPER header:

- Byte 0: this byte is simply a WHISPER identifier, its value is ' W ' (57h).
- Bytes 1 and 2: these two bytes should be put to zero according to the WHISPER Internal EID. However, it is not the case. These values are useful only for the coherence of the block:
  - Byte 1: Always 1.
  - Byte 2: The sum of the 4 least significant bits and the 4 most significant bits has to give the value of the byte 3.
- Byte 3: this byte gives the scale factor of the values in the active bins table.
- Byte 4: this byte indicates the number of saturations during the acquisition of the spectrum having the largest bin.

- Byte 5: the byte is decomposed as follows:



- Byte 6: only the most significant bit is interesting: it indicates if the WatchDog was triggered (0) or not (1). Other bits are 0.
- Byte 7: it is the repetition factor. This value is decreased down to 1 for the last frame.
- Byte 8: WCMW0. Byte 0 of the WHISPER command mode word. Its format is identical to that described for the command.
- Byte 9: WCMW1. Byte 1 of the WHISPER command mode word. Its format is identical to that described for the command.
- Byte 10: WCMW2. Byte 2 of the WHISPER command mode word. Its format is identical to that described for the command.
- Byte 11: this byte indicates the frequency step of the strongest intensity bin.
- Bytes 12 - 43: the following 32 bytes are decomposed into 8 32-bit words. Globally, this group of words indicates the signal energy for the strongest bin frequency step. This energy is stored like this:
    - Bytes 12 - 15: energy 0. This value represents the energy of the first 128 samples.
    - Bytes 16 - 19: energy 1. This value represents the energy of samples 129 to 256.
    - Bytes 20 - 23: energy 2. This value represents the energy of samples 257 to 384.
    - Bytes 24 - 27: energy 3. Samples 385 to 512.
    - Bytes 28 - 31: energy 4. Samples 512 to 640.
    - Bytes 32 - 35: energy 5. Samples 641 to 768.
    - Bytes 36 - 39: energy 6. Samples 769 to 896.
    - Bytes 40 - 43: energy 7. Samples 897 to 1024.

Description of the active FFT table:

This table contains the active bins. As in DWP processing mode, 6 bins are kept for each frequency step. Every value is coded on 16 bits, and passed on without any encoding.

C.2.2.2 The WHISPER not dedicated modes

This mode differs from the previous one as the WHISPER processing is the same as in DWP mode. However, DWP is transparent, and only a wait between each frequency step occurs to respect the transmission rate constraint. The break between every frame is 120*n WHSS with n is 8, 4, 2, and 1 respectively for the FFT sizes 512, 256, 128, 64.

(i) The WHISPER Command Mode Word (WCMW)

Excluding the WHISPER dedicated modes, this command word can take the same values as those specified in section C.2.1.1: only the bit 3 of the byte 1 (WCMW1) of the command is set to 1 to get in WHISPER processing mode.

(ii) The WHISPER Processing Word (WPW)

The WHISPER processing word is not significant in WHISPER processing mode. Indeed, its purpose is to specify to DWP the processing to perform.

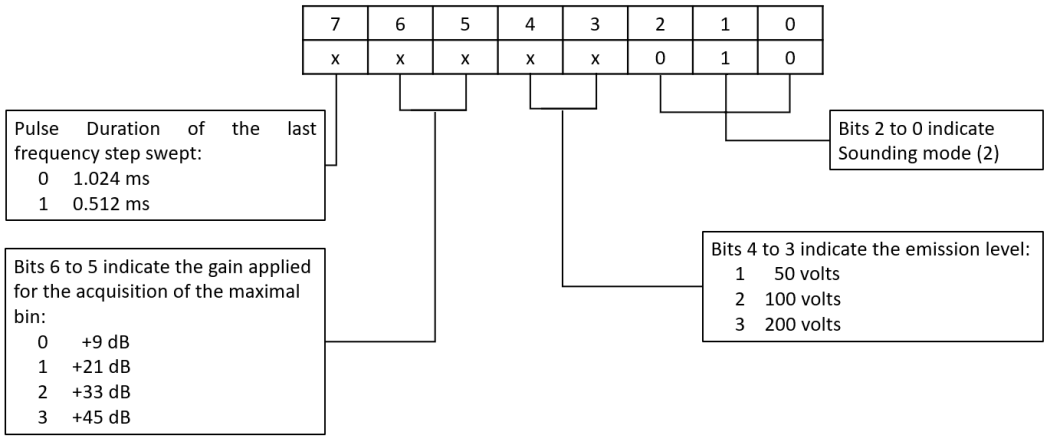
(iii) The Output Format

The output packet is constituted by the WHISPER data header, and by the active FFT table.

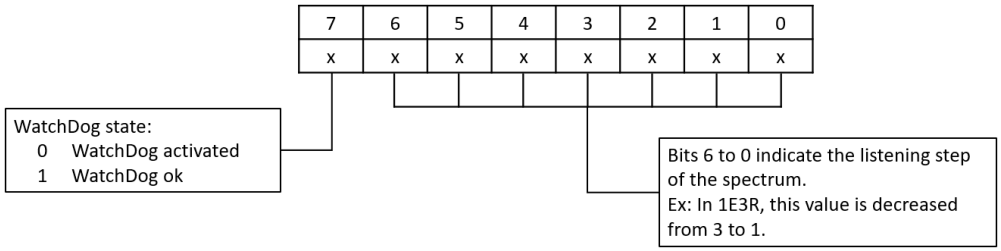
Description of the WHISPER Header:

- Byte 0: the first byte is simply a WHISPER identifier, its value is ' W ' (57h).
- Byte 1: this byte is the frequency step counter. It is decreased of the number of steps in the selected frequency table down to 1.
- Byte 2: the sum of the 4 least significant bits and the 4 most significant bits has to give the value of the byte 3.
- Byte 3: this byte gives the scale factor of values in the active bins table.
- Byte 4: this byte indicates the number of saturations during the acquisition of the spectrum.

- Byte 5: this byte is decomposed as follows:



- Byte 6: this byte is decomposed as follows:



- Byte 7: it is the repetition factor. This value is decreased down to 1 for the last frame.
- Byte 8: WCMW0. Byte 0 of the WHISPER command mode word. Its format is identical to that described for the command.
- Byte 9: WCMW1. Byte 1 of the WHISPER command mode word. Its format is identical to that described for the command.
- Byte 10: WCMW2. Byte 2 of the WHISPER command mode word. Its format is identical to that described for the command.
- Byte 11: this byte indicates the spectrum frequency step.

- Bytes 12 - 43: the following 32 bytes are decomposed into 8 32-bit words. Globally, this group of word indicates the signal energy. This energy is stored like this:
  - Bytes 12 - 15: energy 0. This value represents the energy of the first 128 samples.
  - Bytes 16 - 19: energy 1. This value represents the energy of samples 129 to 256.
  - Bytes 20 - 23: energy 2. This value represents the energy of samples 257 to 384.
  - Bytes 24 - 27: energy 3. Samples 385 to 512.
  - Bytes 28 - 31: energy 4. Samples 512 to 640.
  - Bytes 32 - 35: energy 5. Samples 641 to 768.
  - Bytes 36 - 39: energy 6. Samples 769 to 896.
  - Bytes 40 - 43: energy 7. Samples 897 to 1024.

Description of the active FFT table:

This table contains all the spectrum bins. Each value is coded on 16 bits, and transmitted without any encoding.

C.2.2.3 Differences between these two modes

To be able to decommute the data, it is important to be able to differentiate these two modes. Regrettably, no decision can be taken when looking at a WHISPER block. It is necessary to take into account the sequence and to watch the byte 1 (frequencies step counter):

- If the value is different from 1, it is a not dedicated WHISPER mode.
- If the value is equal to 1, and the previous value is superior to 1, it is a not dedicated WHISPER mode.
- If the value is equal to 1, and the previous value was 1, it is a dedicated WHISPER mode.

Such a decision is sure, if there is no transmission error, or loss of blocks. In the cases where these problems exist, we cannot be sure of the decision, it will thus be necessary to consider this piece of information with caution.