

<b>Space Research Institute</b> Department of Experimental Space Research Austrian Academy of Sciences Schmiedlstraße 6 8042 Graz - Messendorf Austria	<b>Project:</b> <b>Rosetta – RPC-MAG</b> Sample Rate and Frequency Response Analysis RO-IWF-TR0001	Document: IWF 2002/01 Filename: RPC-MAG Author: hue@oeaw.ac.at Revision: January 2002 Date: 15.12.2015 Page: 1
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# Sample Rate and Frequency Response Analysis of Rosetta RPC-MAG

## Calibration Report RO-IWF-TR0001

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## Abstract

The Rosetta RPC-MAG Sample Rate and Frequency Response Analysis of the flight and flight-spare units are presented in this paper. We developed an approach for the AC-calibration that uses least square scheme for determining the calibration parameters. The technique is applied to all models and the results are outlined in the document. The paper closes with the summary of the results. Attempts are made to present all essential details.

## Keywords

Sample Rate and Frequency Response Analysis, AC-calibration, Rosetta RPC-MAG

## 1. Overview

The AC-calibration is one part of the calibration procedure. The goal is to determine the Frequency Response and the temporal resolution of the instrument with high accuracy. All possible combinations of flight and flight-spare parts are considered. The Braunbeck Coilsystem in Magnetsrode delivers the environment for such investigations.

### 1.1 Supplied amplitude and frequency range

#### 1.1.1 Amplitude

The magnetic field amplitudes at CoC (Center of coil) for the AC- calibration are shown in Table 1. Two ranges are chosen for RPC-MAG.

Name	Amplitude (nT peak-to-peak)
fd_h	22000
fd_l	500

Tab. 1: Supplied amplitudes

#### 1.1.2 Frequency

The frequencies for the 2 amplitude ranges are in logarithmic order, ranging from 0.1Hz up to 1kHz and zero field in between the data sequences. The exact values are outlined in Table 2.

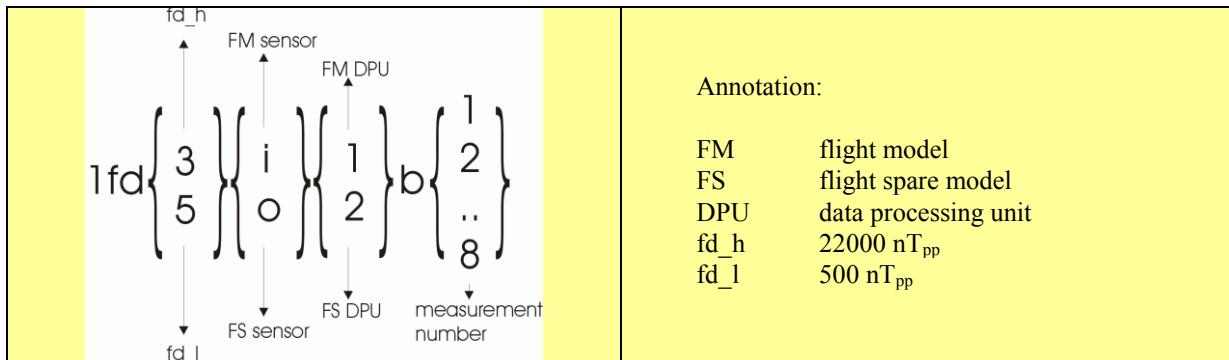
Frequencies (Hz) // 100mHz – 1kHz									
0.1000	0.1259	0.1585	0.1995	0.2512	0.3162	0.3981	0.5012	0.6310	0.7943
1.0000	1.2589	1.5849	1.9953	2.5119	3.1623	3.9811	5.0120	6.3097	7.9430
10.000	12.589	15.849	19.953	25.119	31.623	39.811	50.120	63.097	79.430
100.00	125.89	158.49	199.53	251.19	316.23	398.11	501.20	630.97	794.30
1000.0									

Tab. 2: Supplied frequencies

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## 1.2 IWF filename structure

All documented files have eight-character names, beginning with the sequence “1fd”. Note that the name is a mixture of letters and characters, e.g. 0 is the digit zero, not the letter O. The last digit of each name is always the measurement number. The following Table 3 shows the possible characters which contains information about the measurement for the Rosetta RPC-MAG AC calibration.



Tab. 3: IWF filename structure

## 1.3 Measurement data

The RPC-MAG AC-calibration consists of 22 CCD datasets (Complete Calibration Data), measured at Magnetsrode. Each CCD-file has a individual number and IWF-filename as shown in Table 4. A CCD-file has exactly 8 channels. Table 5 shows the combination of channels and frames. Inboard and outboard magnetic field vectors are from channel 0 to 5.

Number	CCD-File	Annotation	IWF-Name
01	01-04-05 // 10-53-16	fd_h // FM-Sensor // FS-DPU	1fd3i2b1
02	01-04-05 // 11-40-37	fd_l // FM-Sensor // FS-DPU	1fd5i2b1
03	01-04-20 // 09-01-12	fd_h // FM-Sensor // FM-DPU	1fd3i1b1
04	01-04-20 // 09-48-34	fd_l // FM-Sensor // FM-DPU	1fd5i1b1
05	01-04-23 // 07-07-01	fd_h // FS-Sensor // FM-DPU	1fd3o1b1
06	01-04-23 // 07-54-55	fd_l // FS-Sensor // FM-DPU	1fd5o1b1
07	01-04-25 // 14-46-10	fd_h // FS-Sensor // FS-DPU	1fd3o2b1
08	01-04-25 // 15-33-33	fd_l // FS-Sensor // FS-DPU	1fd5o2b1
09	01-04-25 // 16-20-57	fd_h // FS-Sensor // FS-DPU	1fd3o2b2
10	01-04-25 // 17-08-17	fd_l // FS-Sensor // FS-DPU	1fd5o2b2
11	01-04-25 // 17-55-38	fd_h // FS-Sensor // FS-DPU	1fd3o2b3
12	01-04-25 // 18-42-58	fd_l // FS-Sensor // FS-DPU	1fd5o2b3
13	01-04-25 // 19-30-18	fd_h // FS-Sensor // FS-DPU	1fd3o2b4
14	01-04-25 // 20-17-39	fd_l // FS-Sensor // FS-DPU	1fd5o2b4
15	01-04-25 // 21-04-59	fd_h // FS-Sensor // FS-DPU	1fd3o2b5
16	01-04-25 // 21-52-20	fd_l // FS-Sensor // FS-DPU	1fd5o2b5
17	01-04-25 // 22-39-41	fd_h // FS-Sensor // FS-DPU	1fd3o2b6
18	01-04-25 // 23-27-01	fd_l // FS-Sensor // FS-DPU	1fd5o2b6
19	01-04-26 // 00-14-21	fd_h // FS-Sensor // FS-DPU	1fd3o2b7
20	01-04-26 // 01-01-41	fd_l // FS-Sensor // FS-DPU	1fd5o2b7
21	01-04-26 // 01-49-02	fd_h // FS-Sensor // FS-DPU	1fd3o2b8
22	01-04-26 // 02-36-22	fd_l // FS-Sensor // FS-DPU	1fd5o2b8

Tab. 4: Rosetta RPC-MAG measurements

### CCD channels of the ADC-frames

CH 0	FGM-IB-x
CH 1	FGM-IB-y
CH 2	FGM-IB-z
CH 3	FGM-OB-x
CH 4	FGM-OB-y
CH 5	FGM-OB-z
CH 6	Temperature IB
CH 7	Temperature OB
CH 8	Framecounter

Tab. 5: Rawdata channels

## 1.4 Calibration

### 1.4.1 Calibration Setup

The main setup of the Digital Frequency Measurement is outlined in Figure 1 and in the picture Figure 2. The coilsystem is the Braunbeck-System at IGM/TUB. The coils are adequately supplied with the desired signals in frequency and amplitude. Strictly speaking, only one coil is impinged with the signal and the fluxgate sensor is in diagonal position in the center of the coil (CoC). The files themselves are summarized in the appendix.

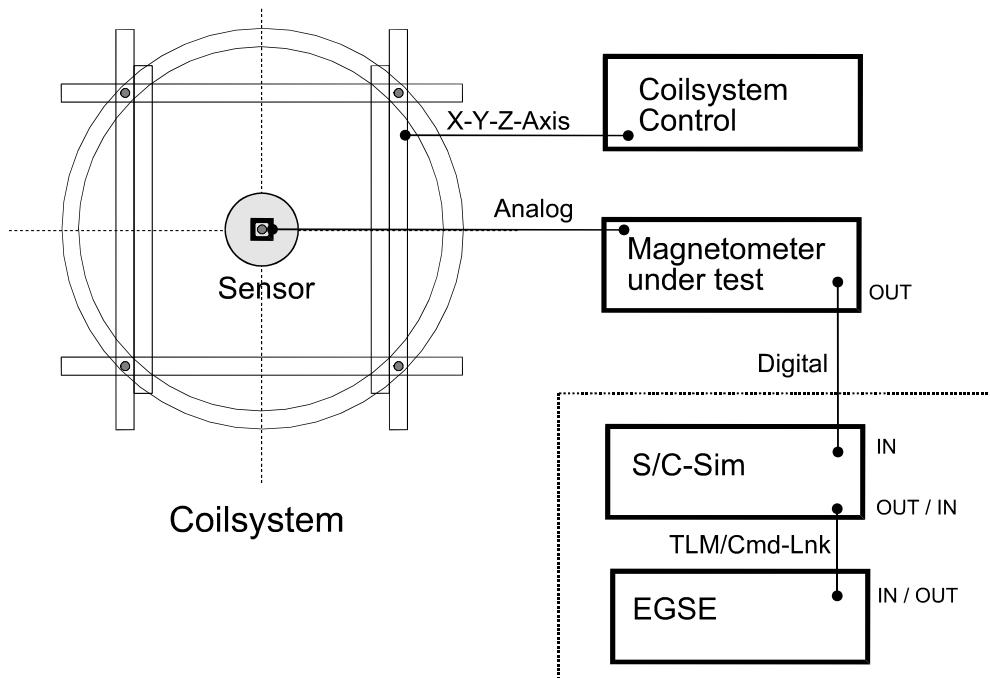


Fig. 1: Blockdiagram of the Calibration Setup for Digital Frequency Measurements

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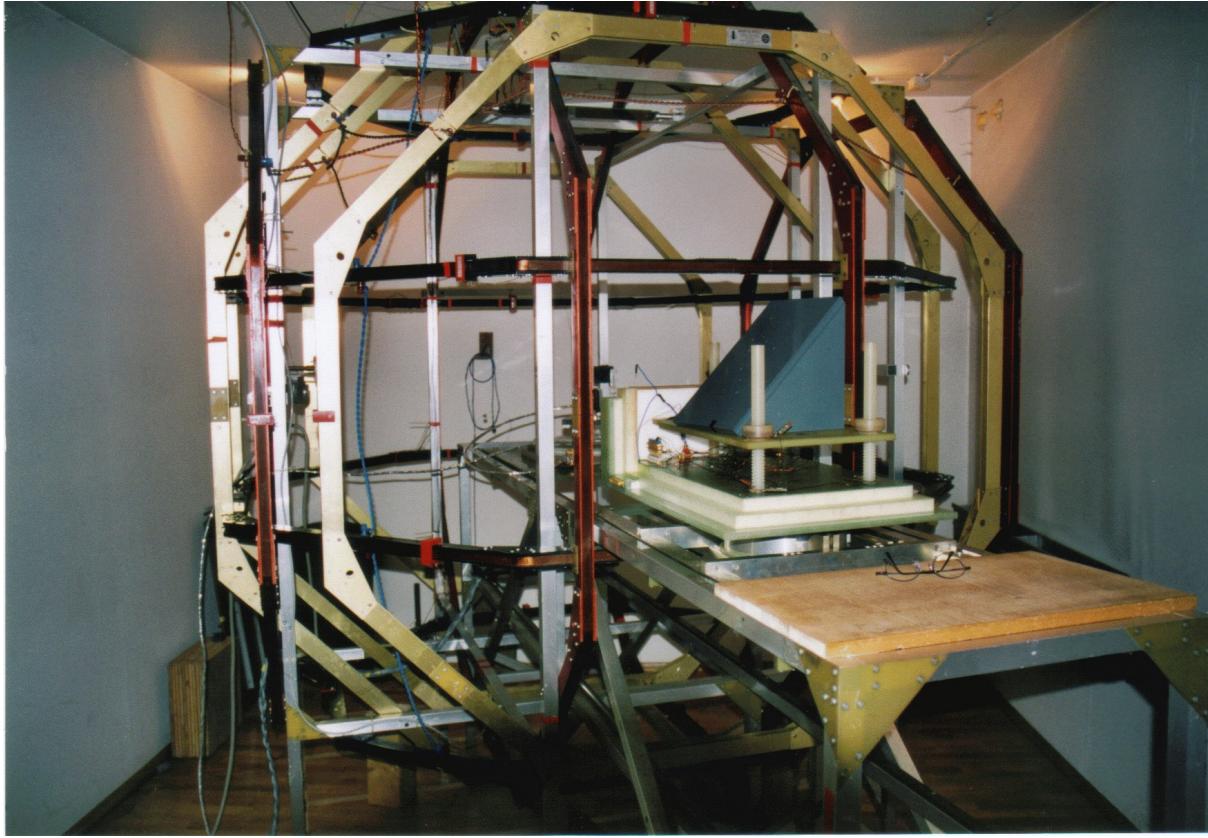


Fig. 2: Picture of the Braunbeck Coilsystem at IGM/TUB [Magnetsrode](#)

#### 1.4.2 Calibration Software

The approach for AC-calibration is a least square scheme for determining the calibration parameters. Correct calibration parameters are determined by requiring that the final data set must yield values of the residuals close to zero. The technique is extremely efficient provided input data are available from the CCD-Record (IGM/TUB) and is prove useful for Rosetta RPC-MAG Frequency Response Analysis. Figure 3 outlines the dataflow from the measured CCD-Records to the final outputs as file and/or graphic.

The Complete Calibration Data (CCD) Records are delivered from the coilsystem in Magnetsrode and includes the rawdata channels as shown in Table 5. The DOS program CCD2T extracts the channels and creates ASCII output. The pipeline continues with MATLAB moduls, first the data import followed by the rawdata inspection and the selection of the range belonging to one frequency (41 ranges; from 100mHz to 1kHz in logarithmic order) and as core module the optimization routines. After successful finishing all results are stored in a structure and some selected values are printed in the final ASCII file.

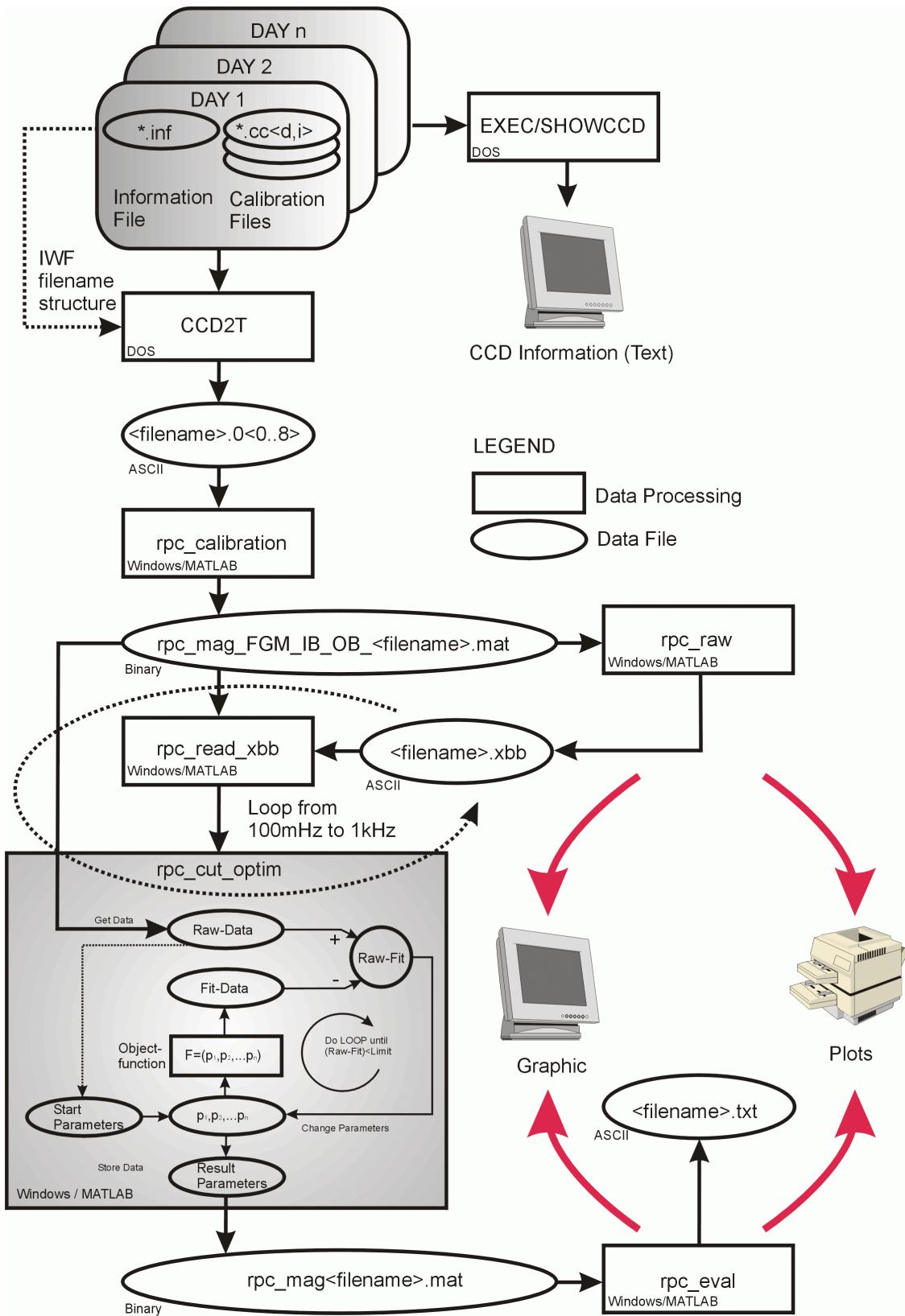


Fig. 3: RPC-MAG AC-calibration flow

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## 2. Results and Conclusions

Appendix A lists the results for each CCD file. Table 6 is the summary of the investigations of RPC-MAG AC-calibration for each combination of flight and flight-spare units. RPC-MAG has a samplefrequency with the FM-DPU of 19,9810 Hz and 19.9806 Hz with the FS-DPU, regardless of the sensor. The cornerfrequency is at 13.5 Hz.

FM-Sensor // FS-DPU	
Cornerfrequency –3 dB @ ...	Samplefrequency ...
13.5 ± 0.3 Hz	19.98070 ± 0.00002 Hz
FM-Sensor // FM-DPU	
Cornerfrequency –3 dB @ ...	Samplefrequency ...
13.5 ± 0.3 Hz	19.98103 ± 0.00005 Hz
FS-Sensor // FM-DPU	
Cornerfrequency –3 dB @ ...	Samplefrequency ...
13.5 ± 0.3 Hz	19.98103 ± 0.00002 Hz
FS-Sensor // FS-DPU	
Cornerfrequency –3 dB @ ...	Samplefrequency ...
13.5 ± 0.3 Hz	19.98060 ± 0.00002 Hz

Tab. 6: RPC-MAG Summary

## 3. References, Links and Acknowledgements

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### Links

Useful link for further information:

<http://sci.esa.int/rosetta/>  
<http://www.iwf.oeaw.ac.at>

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