

L A C F R F S Y S T E M 解説書

Ver 1.1 1987 年 3月 5日 満田和久

L A C F R F (First Reduction File) S Y S T E M の解説書を、お届けします。
FRF とともに、ご愛用ください。

もくじ

1. LAC FRF (Ver. 1.2) ファイル構造 説明書
2. LAC FRF 作成プログラム(Ver. 2.1) 使用手引書
3. FRFREAD (LAC FRF読出し) サブルーチン群(Ver. 1.1) 使用手引書

関連文書

1. FRFSTATS使用手引書 (近日発売)
2. FRFPLOT 使用手引書 (近日発売)
3. FRFDSPLY 使用手引書 (近日発売)
4. LAC SRF (Second Reduction File) 使用手引書 (近日発売)

(スペクトル編)

ASTRO-C LAC First Reduction File

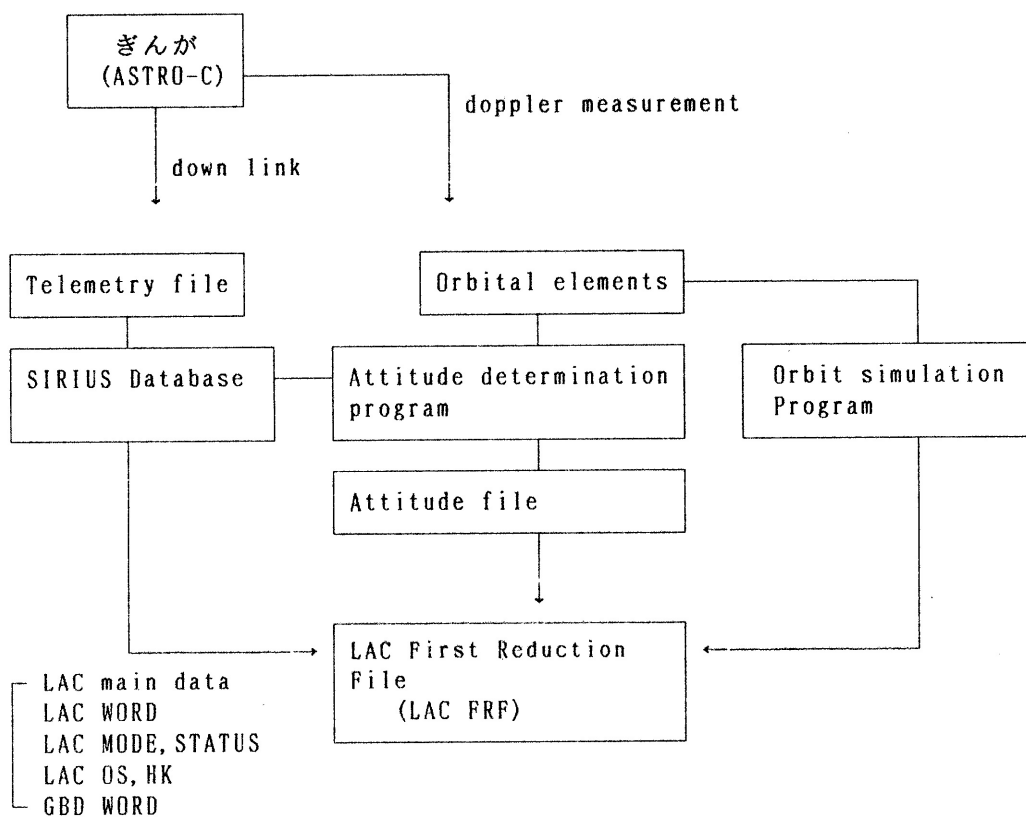
Version 1.2

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1. Introduction

A LAC FRF contains LAC data and auxiliary data derived from the SIRIUS database and results of attitude determination and orbit simulations. Every counting data maintains original time resolution. One LAC FRF corresponds to one file unit of the SIRIUS database.



2. File Contents

The file format is FB (Fixed-length blocked).

Each record consists of 1 byte of ID word and 96 bytes of data words. (Rec. length= 97 bytes)

A FRF contains following records.

ID	Data words(96 bytes)		
A	Header 1	path number, message etc.	Header records
B	Header 2	time of the data, observation objects	
C	Header 3	orbital elements, attitude file	
D	Header 4	average attitude, program version, date of creation	
J	OS 1	OS Header, OS of LAC 0 and LAC 1	OS records
K	OS 2	OS of LAC 2, LAC 3 and LAC 4	
L	OS 3	OS of LAC 5, LAC 6 and LAC 7	
.			
.	Records J-L repeat, if neccessary.		
.			
S	SF header 1	time, bitrate, status, mode, HK(HV,temp.) etc.	SF data 1 set of SF data
T	" 2	LAC words (L1, SUD)	
T	" 3	LAC words (R1, SUD)	
T	" 4	LAC words (S23, ANTI)	
T	" 5	LAC words (V1, ANTI)	
T	" 6	LAC words (V2) and PI-monitor word	
T	" 7	LAC words (EV)	
T	" 8	GBD words (background monitor)	
U	" 9	attitude and orbit	
.	(4 records of the attitude and orbit data (ID=U) for low bit rate.)		
..	Frame data		
..	1 frame of data = 2 record for PC mode.		
..	1 frame of data = 1 record for MPC modes.		
..	ID = HEX 00 ~80		
..	(If the data mode is non LAC mode, no frame data exist.)		
S	SF header of the next SF.		
T			
T			
T			

One set of SF data corresponds to one SF of data in the telemetry format.

3. Details of the records.

In the table below, data types used in the FRP are summerised.

Symbol	Data type
A	Character data, in EBCDIC code.
In	Integer data, in n characters of EBCDIC code. FORTRAN I editing.
Pn,m	Real data, in n characters of EBCDIC code. FORTRAN F editing.
Bn	Integer data, in n bytes of binaries. MSB 1st word 2nd word n-th word LSB
R4 R8	Real data, in FORTRAN internal representation (IBM format) of 4-or 8-byte real. MSB 1st word LSB MSB 2nd word 4or8-th word $\text{data} = (-1)^s \cdot 16^{E-64} \cdot \sum_{n=1}^{6or14} M_n / 16^n$

① Header records

Header 1

Word	Type	Size(bytes)	Contents
1	A	1	'A' or C1 (HEX) ID word.
2~ 9	A	8	Satelite code name.
10~19	A	10	Pass number.
20	I1	1	Real time data (0) or stored data (1).
21~24	I4	4	Day of the year of the data acquisition.
25~51	A	27	Message (put at the tracking stasjon).
52~60	3I2, I3	9	Epoch (hh,mm,ss,msec)when delay time is defined.
61~64	2I2	4	Values of satellite clocks(T1,T2) at the epoch.
65~69	I5	5	Time delay (msec) caused by the down link (*).

(*) For the stored data, all the SF time (SF Header 1 W5~27) hould be corrected by this value. For the real time data, the SF time near the epoch should be corrected by this value. All other SF times should have the same msec values for the real time data.

Header 2

Word	Type	Size(bytes)	Contents
1	A	1	'B' or C2 (HEX) ID word.
2~31	2(6I2, I3)	30	Begining and ending of the data (Y, M, D, h, m, s, ms).
32~41	A	10	Name of the observation target 1 .
42~57	F6.2	6	Right Ascension (deg, 1950 EQ.) of the target 1.
48~53	F6.2	6	Declination (deg, 1950 EQ.) of the target 1.
54~63	A	10	Name of the observation target 2.
64~69	F6.2	6	Ritht Ascension (deg, 1950 EQ.) of the target 2.
70~75	F6.2	6	Declination (deg, 1950 EQ.) of the target 2.
76~81	I6	6	Total amount of LAC data time (sec).
82~84	I3	3	Total number of OS changes.
85~87	I3	3	Total number of SF's in the file.

Header 3

Word	Type	Size(bytes)	Contents
1	A	1	'C' or C3 (HEX) ID word.
2~13	6B2	12	Epoch of the orbital elements (Y, M, D, h, m, s).
14~17	R4	4	Semimajor axis, a (km).
18~21	R4	4	Eccentricity, e .
22~25	R4	4	Inclination angle, i (deg).
26~29	R4	4	Angle from ascending node to perigee, ω (deg).
30~33	R4	4	Right ascension of the ascending node, Ω (deg).
34~37	R4	4	Mean anomaly, M (deg).
38~41	R4	4	Time derivative of ω (deg/day).
42~45	R4	4	Time derivative of Ω (deg/day).
46~49	R4	4	Time derivative of M (= mean motion, deg/min).
50~53	R4	4	Time derivative of a (km/day).
54~57	R4	4	Second time derivative of M (deg/min/min).
58~93	C36	36	ID of the attitude-determination file.

Header 4

Word	Type	Size(bytes)	Contents
1	A	1	'D' or C4 (HEX) ID word.
2~ 7	I6	6	Average attitude 1, duration (sec).
8~13	F6.2	6	" , right ascension of Y-ax. direction
14~19	F6.2	6	" , declination of Y-axis direction.
20~25	I6	6	Average attitude 2, duration (sec).
26~31	F6.2	6	" , right ascension of Y-ax. direction
32~37	F6.2	6	" , declination of Y-axis direction.
38~43	I6	6	Average attitude 3, duration (sec).
44~49	F6.2	6	" , right ascension of Y-ax. direction
50~55	F6.2	6	" , declination of Y-axis direction.
56~87	A	32	Program name & version by which the FRF was created.
88~97	512	10	Date & time of creation (Y, M, D, h, m).

OS 1

Word	Type	Size(bytes)	Contents
1	A	1	'J' or D1 (HEX) ID word.
2~4	I3	3	SF number when the OS data is defined. ♡
5~19	612, I3	15	Time (Y, M, D, h, m, s, ms) when the OS data is defined.
20~27	R8	8	MJD of the time when the OS data is defined.
28~33		6	Flags showing which OS data has changed.
28	B1	1	HV
29	B1	1	Inselect
30	B1	1	C gain
31	B1	1	F gain
32	B1	1	Discr level
33	B1	1	Anti matrix
34~65	♣	32	OS of LAC 0.
66~97	♣	32	OS of LAC 1.

MSB: LAC 7 --> LSB: LAC 0
 Change: BIT ON (1)
 No change: BIT OFF (0)

OS 2

Word	Type	Size(bytes)	Contents
1	A	1	'K' or D2 (HEX) ID word.
2~33	♣	32	OS of LAC 2.
34~65	♣	32	OS of LAC 3.
66~97	♣	32	OS of LAC 4.

OS 3

Word	Type	Size(bytes)	Contents
1	A	1	'L' or D3 (HEX) ID word.
2~33	♣	32	OS of LAC 5.
34~65	♣	32	OS of LAC 6.
66~97	♣	32	OS of LAC 7.

♡ SF number

SF's in the SIRIUS file are numbered with increasing numbers from 1. These numbers increase always by 1 even if there is time gap, or telemetry drop out.

☞ Contents of OS data of each sensor

Word	Type	Size(bytes)	Contents
X+ 1	B1	1	HV level (0 - 15).
2	B1	1	Input select L1 (0=off, 1=on).
3	"	"	" R1 (").
4	"	"	" S23 (").
5	"	"	" V1 (").
6	"	"	" V2 (").
7	"	"	" EV (").
8	B1	1	Coarse gain (0 - 1) .
9	B1	1	Fine gain L1 (0 - 7).
10	"	"	" R1 (").
11	"	"	" S23 (").
12	"	"	" V1 (0 - 3).
13	"	"	" V2 (").
14	"	"	" EV (0 - 7).
15	B1	1	Discri level L1 (0 - 1).
16	"	"	" R1 (").
17	"	"	" S23 (").
18	"	"	" V1, V2 (").
19	"	"	" EV (").
20	"	"	" Lower discri (").
21	"	"	" Middle discri (").
22	"	"	" Upper discri (").
23	B1	1	Anti-coinsidence L1 - R1 (0=off, 1=on).
24	"	"	" L1 - S23 (").
25	"	"	" R1 - S23 (").
26	"	"	" L1 - V1 (").
27	"	"	" R1 - V1 (").
28	"	"	" S23 - V1 (").
29	"	"	" L1+R1+S23+V1 - V2 (").
30	"	"	" L1+R1+S23+V2 - EV (").
31~32			null.

③ SF Header

SF Header 1 (Status and HK)

Word	Type	Size(bytes)	Contents
1	A	1	'S' or E2 (HEX) ID word.
2~ 4	I3	3	SF number.
5~19	6I2, I3	15	Time when the 8th Bit of Word 0, Frame 0 of the SF was received (for real-time data) or stored in the BDR (for stored data). (Y, M, D, h, m, s, ms)
20~27	R8	8	MJD of the above time.
28	B1	1	Bit rate (0=high, 1=middle, 2=low).
29	B1	1	Number of bad frames due to telemetry drop out.
30	B1	1	LAC status, E1 (0=off, 1=on).
31			" E2 (").
32			" Bypass (").
33			" Memory (").
34			" Cal system (").
35	B1	1	Cal-ON data exist in the SF (=1) or not (=0).
36	B1	1	HV status, LAC 0 (0=off, 1=on).
37			" 1 (").
38			" 2 (").
39			" 3 (").
40			" 4 (").
41			" 5 (").
42			" 6 (").
43			" 7 (").
44	B1	1	ACE power (0=off, 1=on).
45			Momentum wheel (0=stop, 1=CPU control, 2=backup control, 3=tacho mode).
46			Magnetic attitude control (0=close, 1=open).
47			Spin rate control (0=CPU/open, 1=down by X MTQ, 2=down by Y, 3=up by X, 4=up by Y).
48			Spin ANC (0=off, 1=on)
49			MTQ on/off (from LSB, X, Y, Z MTQ off/on).
50			ACE mode (0=open, 1=normal, 2=slew +, 3=slew -, 4=slew 360, 5=low spin, 6=maneuver, 7=safe hold, 8=standby).
51~56	6B1	6	GBD status. (power on/off, HVS, HVP, A, RBM, auto-C)
57	B1	1	RBM(radiation belt monitor) flag (0=off, 1=on).
58	B1	1	Initial data mode of the SF. 0= LAC PC 1= LAC MPC1 2= LAC MPC2 3= LAC MPC3 -1= ASM T -2= ASM PH -3= ACS -4= NSAS CAL -5= LAUNCH -6= PC CHECK -7=MEMORY CHECK -8= error

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Word	Type	Size(bytes)	Contents
59~74	8B2	16	HV HK (volt) $\times 10$ (LAC 0 => LAC 7).
75	B1	1	Temp. HK data ID (0=LAC 0-3, 1=LAC 4-7).
76~91	8B2	16	Temp. HK (°C) $\times 10$ 0A 0B 0C 1B 2A 2B 2C 3B when data ID = 0 4B 5A 5B 5C 6B 7A 7B 7C when data ID = 1

SF Header 2 ~ 8 (LAC words, PI monitor word and GBD word)

ID	$\leftrightarrow$ 8bytes	96 bytes of data
2	T	LAC WORD L1 LAC0 LAC1 LAC2 LAC3 LAC4 LAC5 LAC6 LAC7 LAC WORD SUB ANTI LAC0 LAC1 LAC2 LAC3
3	T	LAC WORD R1 LAC0 LAC1 LAC2 LAC3 LAC4 LAC5 LAC6 LAC7 LAC WORD SUB ANTI LAC4 LAC5 LAC6 LAC7
4	T	LAC WORD S23 LAC0 LAC1 LAC2 LAC3 LAC4 LAC5 LAC6 LAC7 LAC WORD ANTI SUD LAC0 LAC1 LAC2 LAC3
5	T	LAC WORD V1 LAC0 LAC1 LAC2 LAC3 LAC4 LAC5 LAC6 LAC7 LAC WORD ANTI SUD LAC4 LAC5 LAC6 LAC7
6	T	LAC WORD V2 LAC0 LAC1 LAC2 LAC3 LAC4 LAC5 LAC6 LAC7 PI MONI WORD 0 1 2 3 4 5 6 7
7	T	LAC WORD EV LAC0 LAC1 LAC2 LAC3 LAC4 LAC5 LAC6 LAC7 NULL
8	T	GBD WORD SC GBD WORD PC GBD WORD SOL 2 NULL

LAC WORD: 1 data = 1 byte (B1), 8 samplings per 1 SF for each layer and sensor.

PI MONI WORD: 1 data = 1 byte (B1), 4 samplings per 1 SF for each sensor.

GBD WORD, SC and PC: 1 data = 1 byte (B1), 32 samplings per 1 SF.

GBD WORD, SOL 2: 1 data = 2 bytes (B2), 8 sampling per 1 SF.

For the data measured with the non-reset counter, the differences between the former samplings are stored.

~~Correction for pre-scaler is performed.~~

SF Header 9 (Attitude and orbit)

<u>Word</u>	<u>Type</u>	<u>Size(bytes)</u>	<u>Contents</u>
1	A	1	'U' or E4 (HEX) ID word.
2~ 9	R8	8	MJD of the attitude data .
10~21	3R4	12	Z-Y-Z Euler angles defining the satellite attitude. (1950.0 EQ.) (deg)
22~33	3R4	12	Estimated error of the Euler angles (deg).
34~45	3R4	12	Satellite position referred to the Earth, height (km), longitude (deg), latitude (deg)
46~57	2R4	8	Earth-center direction seen from the satellite, right ascension and declination (deg, 1950EQ)
58~61	R4	4	Cut off rigidity (Gev/c).
62~69	2R4	8	Direction of the geomagnetic field, right ascension and declination(deg, 1950EQ)
70~77	2R4	8	Direction of the sun, right ascension and declination (deg, 1950EQ)
78	B1	1	The satellite is in sunshine (=1) or not (=0) . (NSAS data is used.)
79~82	R4	4	Elevation angle of the Y-axis direction from the earth horizon (deg).
83	B1	1	In the direction of Y-axis is, sky (=0), dark earth (=1) or bright earth (=2).

④ Frame data

(i) General format

ID	96 bytes of data words
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(ii) ID word

1bit sync	3 bits LAC mode	4 bits LAC group, sensor ID
MSB		LSB

sync : 0=no telemetry drop out, 1=some telemetry drops exist in the frame (△).
 LAC mode: 0=PC, 1=MPC1, 2=MPC2, 3=MPC2, 7=not LAC mode.
 LAC group, sensor ID: 0= group A (LAC0-3), 1= group B (LAC4-7) for PC mode
 LAC sensor number 0-7 for MPC 1 mode.
 0 for MPC 2,3 modes.

△ In MPC-1 mode, 8 frames of data make one set of sampling. In this mode, the data words are sorted within the 8 frames. However the sync bits are stored in the order of frames regardless of the sorting.

(iii) Data words

PC mode

ID	← 64 bytes →	← 32 bytes →
00	Group A PCL	Group A PCH
01	Group B PCL	Group B PCH

} 1 frame

(ID is added by HEX 80, if telemetry drop out exists.)

Differences from the previous samplings are stored (non-reset counter).

MPC 1 mode

ID	← 48 bytes →	← 48 bytes →
10	PH0... LAC 0 MID ...PH47	PH0... LAC 0 TOP ...PH47
11	PH0... LAC 1 MID ...PH47	PH0... LAC 1 TOP ...PH47
17	PH0... LAC 7 MID ...PH47	PH0... LAC 7 TOP ...PH47

} 8 frames

(ID is added by HEX 80, if telemetry drop out exists.)

MPC 2 mode

ID ←———— 48 bytes —————→ ←———— 48 bytes —————→

20	PH0... Group A ...PH47	PH0... Group B ...PH47	— 1 frame
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(ID is added by HEX 80, if telemetry drop out exists.)

MPC 3 mode

12 bytes (8 samplings per 1 frame)

ID ←————→

30	PH0 →12 PH0→12	PH0 →12 PH0→12	PH0 →12 PH0→12	PH0 →12 PH0→12	— 1 frame
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(ID is added by HEX 80, if telemetry drop out exists.)