JET PROPULSION LABORATORY

INTEROFFICE MEMORANDUM
Voyager-DH-79-36

November 28, 1979

TO: Radio Science Team

FROM: D. Holmes

SUBJECT: REDR DESCRIPTION

The following description of the REDR format is organized by the OBUF WORDS of each logical record, as shown in Table 1. Refer to that table in the discussion. The timing relationships presented in this memo are correct according to Mr. Bob Tappan, and a memo is forthcoming on the origin of these relationships by the same authority.

General: All words are integer, right-hand justified, zero filled if unsigned or positive, and one filled if signed. (The OBUF format is based on eight bit blocks.) The exception is OBUF words 852 through 855. These are ASCII characters representing the PREDIK Set ID. (Refer to REDR LOGICAL RECORDS FORMAT, Table 1, and Logical Record Status Block, Figure 1.)

1. OBUF Words 1 through 5: Record day, year, hour, minute, and second for the first A/D data sample for each of the receivers within the logical record. Timing relationships between the first data sample and the time tag will be discussed later in Paragraph 17.

2. OBUF Word 6: Data Validity Flag; The data validity flag occurs on the ODR to indicate valid time and status information. On the ODR, this information is recorded on the tape once at the beginning of each integer second. Records that fall in between integer seconds will not contain valid time and status and are indicated by a flag bit equal to zero. On the REDR, each record should contain a valid flag because the stripper program calculates the appropriate time and repeats the status for each record that does not start on the integer second.

3. OBUF Word 7: Sample Rate; This is an interger binary number indicating the number of samples per second per A/D converter.

4. OBUF Words 808 through 819: ODS Configuration; These items are user supplied inputs to the stripper program. Knowledge of the ODA configuration must be known by the user, there are no fields within the ODR which contain this information. Items 808 through 818 determine the port to which each A/D is connected. Items 812 through 813 indicate the receiver mode, S or X band or unused.

5. OBUF Words 820 and 821: Commanded Frequency; The commanded frequency number is read from the POCA (Synthesizer Controller) and electronically written on to the ODR in two parts. The first part (High Part) is a 24 bit binary integer which myst be multiplied by

10 to arrive at the first part of the decimal value. The second part (Low Part) is a 24 bit binary integer which must be divided by 10^6 to put the decimal point to the right of the first digit. The two parts are added together as displayed in the example below.

Commanded Frequency Example

(High Part)	(Low Part)
4156421	9374600
Item 820	Item 821

41564219.374600

See Figure 2

6. OBUF Words 822 and 823: Synthesizer Count; The synthesizer count is a two part number which conforms to the same rules as the commanded frequency number. The count is a measure of the phase to fractions of a cycle of the output of the DANA synthesizer, heterodyned down by 40 MHz, electronically written on to the ODR on the integer second. The count continues from one second to the next until the counter rolls over. The modules of the occultation counter is 167772160.000000. See Figure 1 and Paragraph 16 on the relationship between commanded frequency and POCA sweep rate and Paragraph 17 on A/D sample timing relationships with the frequency readouts.

7. OBUF Words 824 and 825: Ramp Start Frequency; The ramp start frequency is a two part number which conforms to the same rules as the commanded frequency number. The ramp start frequency is electronically written on an ODR each time the ODA is initialized or started from an idle mode. The number remains unchanged until the ODA is halted and re-started. The first ramp start frequency written on an ODR has the same timing relationship as the commanded frequency.

8. OBUF Word 826: POCA Sweep Rate; The POCA sweep rate is a one's complement integer which must be divided by 10^5 to arrive at the sweep rate in Hertz. See Paragraph 16 for the relationship between sweep rate, synthesizer count, and commanded frequency.

9. OBUF Word 827: POCA Status; The POCA status is an eight bit binary integer which describes the condition of the POCA. The following table describes the bit configuration.

POCA Status

	Function	1_2	0_2
0	Sweep	On*	Off
1	Acquisition	On	Off*
2	Track	On*	Off
3	Limit Enable	On	Off*
4	Synthesizer In-Lock	In-Lock*	Out-of-Lock
5	Synthesizer Power	On*	Off
6	Control	Ready*	Not Ready
7	Control	Manual	Computer

10. OBUF Word 828: Time Offset; The time offset is the delay through the an A/D converter in the ODA and the associated logic circuitry. This offset is a part of the total offset between the first A/D sample on the logical record and the record time. The time offset word is a binary integer describing the offset in nanoseconds according to the following algorithm:

$$\text{Time Offset} = 1/20 \text{ sample rate} \times 10^9 + 460 \text{ nanoseconds}$$

11. OBUF Word 829: Sample Size; The A/D sample size is eigher 8 or 12 bits.

12. OBUF Words 835 through 839: File Creation Date, Time; The date and time this REDR was created from the ODR.

13. OBUF Words 840 through 841: Spacecraft ID and DDS; Binary integer for the spacecraft ID number and station number.

14. OBUF Words 842 through 846: File Start Date Time; Same as the first logical record on the REDR tape.

15. OBUF Words 852 through 853: PREDIK Set ID; PREDIK ID using four ASCII characters.

16. Commanded Frequency, Synthesizer Count, and Sweep Rate relationship.
    a. The record time and the commanded frequency have an exact relationship.
    b. To check the commanded frequency from the synthesizer count, the following algorithm should be used:

$$Cf_t = 40 \times 10^6 + \left[\frac{O_{t+n} - O_t - 1/2 \, SR \, (n)^2}{(n)} \right]$$

Where: Cf_t = Command frequency at time t.

O_{t+n} = Count as t + n seconds

SR = ~~Sample~~ Sweep Rate in Hertz/second

n = time in seconds between sample O_{t+n} and O_t

c. The error between the count and the commanded frequency is on the order of tenths of Hertz at the S-band level.

17. Timing Relationship between the record time and the first A/D sample of a logical record.

To align the first A/D sample with the record time, one must ADD the following offset to the record time.

Actual Sample Time = Record Time + 1 second + 1 sample interval + hardware offset (OBUF Word 828).

Table 1. REDR LOGICAL RECORDS FORMAT

Item Number	Bit Number	Length (Bits)	IBM Word	Description
1	1-8	8	1	Last Two Digits of Record Year
2	9-24	16		Record Day-of-Year
3	25-32	8		Record Hour
4	33-40	8	2	Record Minute
5	41-56	16		Record Second (times 100)
6	57-64	8		Data Validity Flag 0 = Good 1 = Bad
7	65-96	32	3	Sample Rate
8	97-112	16	4	1st AD-1 Sample (two's complement)
9	113-128	16		1st AD-2 Sample (two's complement)
10	129-144	16	5	1st AD-3 Sample (two's complement)
11	145-160	16		1st AD-4 Sample (two's complement)
12	161-176	16	6	2nd AD-1 Sample (two's complement)
13	177-192	16		2nd AD-2 Sample (two's complement)
14	193-208	16	7	2nd AD-3 Sample (two's complement)
15	209-224	16		2nd AD-4 Sample (two's complement)
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
804	12833-12848	16	402	200th AD-1 Sample (two's complement)
805	12849-12864	16		200th AD-2 Sample (two's complement)
806	12865-12880	16	403	200th AD-3 Sample (two's complement)
807	12881-12896	16		200th AD-4 Sample (two's complement)
808	12897-12898	2	404	AD-1 Receiver Number 0 = Receiver Number 1 1 = Receiver Number 2 2 = Receiver Number 3 3 = Receiver Number 4
809	12899-12900	2		AD-2 Receiver Number (0, 1, 2, or 3)
810	12901-12902	2		AD-3 Receiver Number (0, 1, 2, or 3)
811	12903-12904	2		AD-4 Receiver Number (0, 1, 2, or 3)
812	12905-12906	2		Receiver Number 1 Mode 0 = Not In Use 1 = S-Band 2 = X-Band.
813	12907-12908	2		Receiver Number 2 Mode (0, 1, or 2)
814	12909-12910	2		Receiver Number 3 Mode (0, 1, or 2)
815	12911-12912	2		Receiver Number 4 Mode (0, 1, or 2)
816	12913-12920	8		Receiver Number 1 Filter (0 to 127)
817	12921-12928	8		Receiver Number 2 Filter (0 to 127)
818	12929-12936	8	405	Receiver Number 3 Filter (0 to 127)
819	12937-12944	8		Receiver Number 4 Filter (0 to 127)
820	12945-12960	16		Commanded Frequency - H/P*
	12961-12968	8	406	
821	12969-12992	24		Commanded Frequency - L/P*

* H/P = High Part = Variable / 10
L/P = Low Part = (Variable modulo 10) x 10^6

Table 1. REDR LOGICAL RECORDS FORMAT (cont'd)

Item Number	Bit Number	Length (Bits)	IBM Word	Description
822	12993-13016	24	407	Synthesizer Count - H/P*
823	13017-13024	8		
	13025-13040	16	408	Synthesizer Count - L/P*
824	13041-13056	16		
	13057-13064	8	409	Ramp Start Frequency - H/P*
825	13065-13088	24		Ramp Start,Frequency - L/P*
826	13089-13120	32	410	POCA Sweep Rate (two's comp. x 10^5)
827	13121-13128	8	411	POCA Status (see 820-13, RSC-11-3)
828	13129-13152	24		Time Offset (nanoseconds)#
829	13153-13184	32	412	HSDB Sample Size (8 or 12 bits)
830	13185-13216	32	413	0 (not used)
831	13217-13248	32	414	0 (not used)
832	13249-13280	32	415	0 (not used)
833	13281-13312	32	416	0 (not used)
834	13313-13344	32	417	0 (not used)
835	13345-13352	8	418	Last Two Digits of File Creation Year
836	13353-13368	16		File Creation Day-of-Year
837	13369-13376	8		File Creation Hour
838	13377-13384	8	419	File Creation Minute
839	13385-13392	8		File Creation Second
840	13393-13400	8		File Spacecraft ID Number
841	13401-13408	8		File Station Number
842	13409-13416	8	420	Last Two Digits of File Start Year
843	13417-13432	16		File Start Day-of-Year
844	13433-13440	8		File Start Hour
845	13441-13448	8	421	File Start Minute
846	13449-13456	8		File Start Second
847	13457-13464	8		Last Two Digits of File Stop Year
848	13465-13472	8		
	13473-13480	8	422	File Stop Day-of-Year
849	13481-13488	8		File Stop Hour
850	13489-13496	8		File Stop Minute
851	13497-13504	8		File Stop Second
852	13505-13512	8	423	1st PREDIK Set ID ASCII Character
853	13513-13520	8		2nd PREDIK Set ID ASCII Character
854	13521-13528	8		3rd PREDIK Set ID ASCII Character
855	13529-13536	8		4th PREDIK Set ID ASCII Character

Time Offset = [1 / (20 x Sample Rate)] x 10^9 + 460 nanoseconds

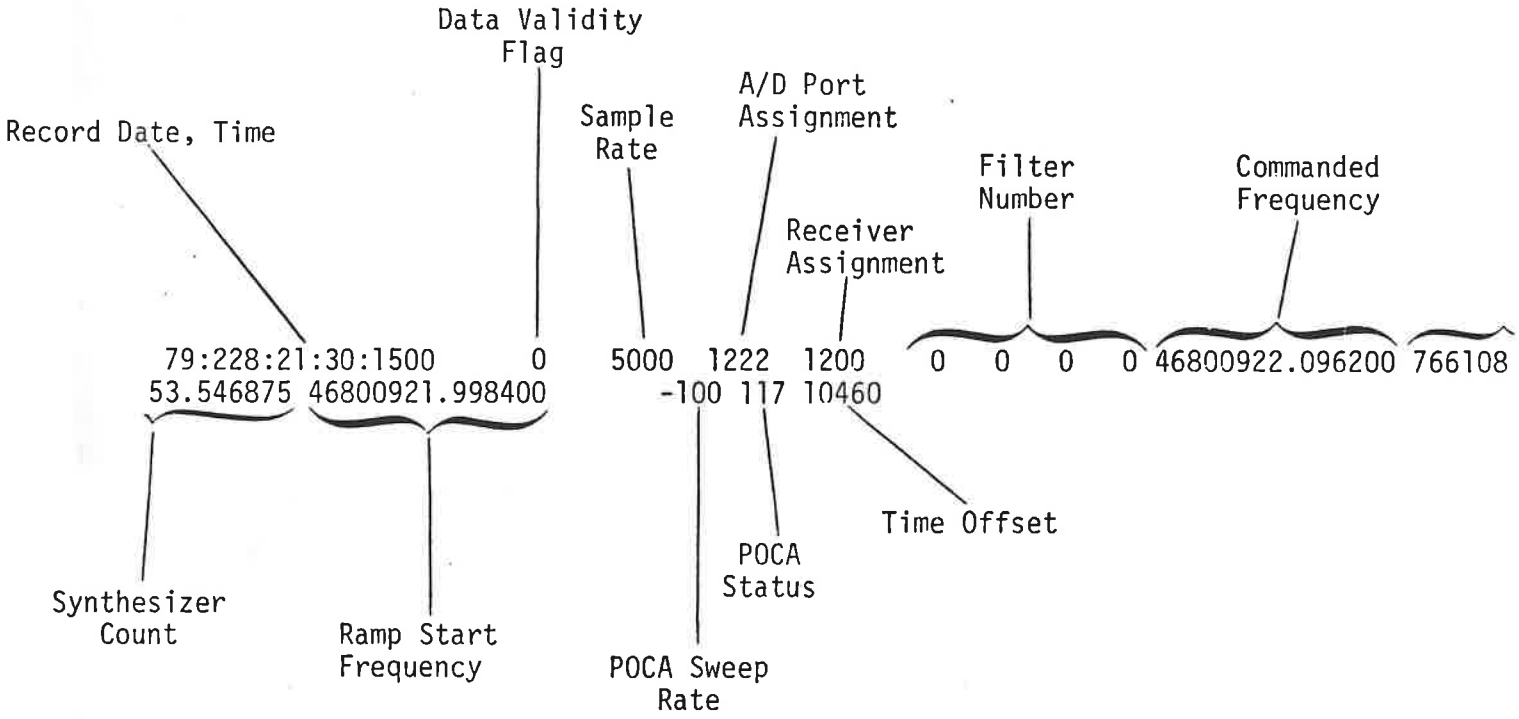

Figure 1, REDR Logical Record Status Blocks

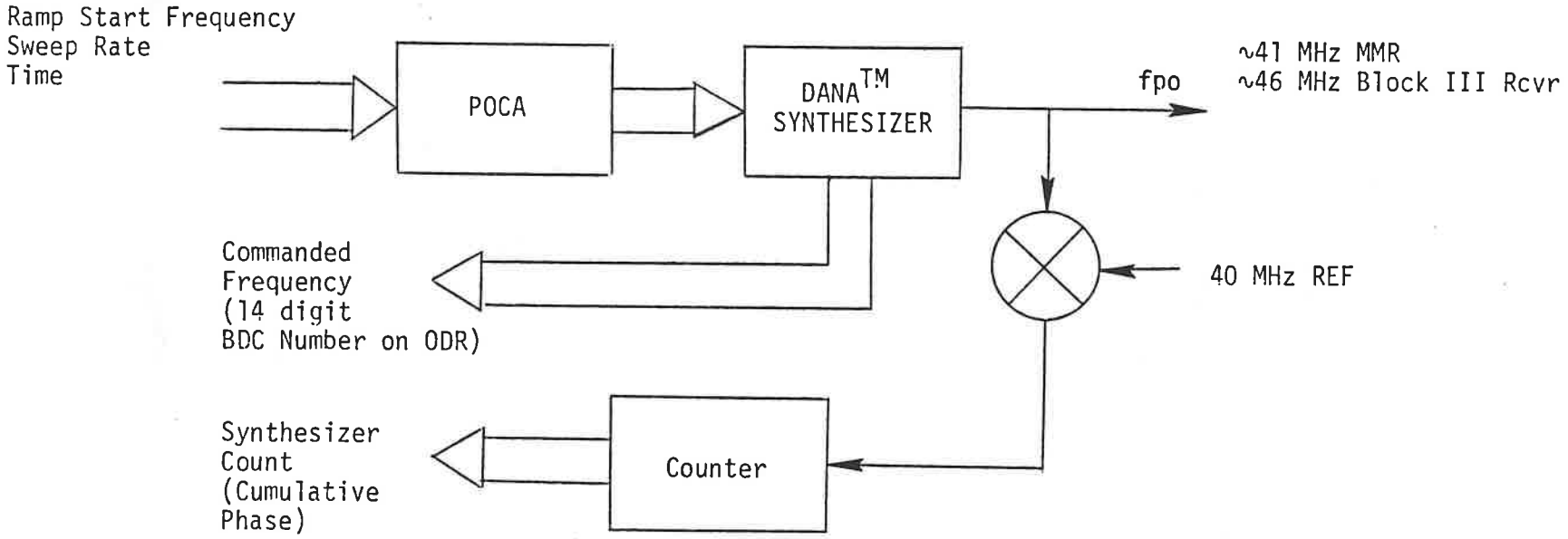

Figure 2, POCA Frequency Flow