ISEE-C MEDIUM ENERGY COSMIC RAY EXPERIMENT TELEMETRY DESCRIPTION

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ISEE-C TYH FORMAT

0	1	2	3	4	← VLET → PHA 5	6	RATES 7	← HET → RATES 8	9	PHA 10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55	56	57	ANA S/C 1 58	DIG S/C 59	M.F. COUNT 60	61	62	63
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
112	113	114	115	116	117	118	119	120	121	ANA S/C 2 122	123	124	125	126	127

DMU Telemetry Format Convolutional Mode

1 MINOR FRAME

ISEE-C TYH DATA FORMAT

MINOR FRAME WORD	PARAMETER
5	VLET PHA DATA
6	
7	VLET RATES, FLAGS & PHA STATUS BITS
8	HET RATES
9	
10	HET PHA DATA
11	
58	ANALOG SUBCOM #1
59	DIGITAL SUBCOM
122	ANALOG SUBCOM #2

ANALOG SUBCOM 1 (BY POSITIONS, = STEPS)

STEP #	
51	VLETS ANALOG HOUSEKEEPING
52	HETS POWER MONITOR
53	VLETS POWER MONITOR

ANALOG SUBCOM 2

STEP #	
17	HETS THERMISTOR
19	VLETS THERMISTOR

DIGITAL SUBCOM (BY POSITIONS, = STEPS)

STEP #	
43	
44	HET SUBCOM BITS
45	AND COMMAND STATUS
46	AS FOLLOWS:

ACCELERATED MODE SUBCOM FORMATS

COMMUTATOR	MINOR FR#	DATA	
ASC1 (WD58)	2 (MOD 64)	VLET	+12V
	10	"	+6V
	18	"	TEMP1
	26	"	TEMP2
	34	"	0V
	42	"	0V
	50	"	-6V
	58 (MOD 64)	VLET	-12V
	4 (MOD 8)	HET PWR MONITOR	
	5 (MOD 8)	VLET PWR MONITOR	
ASC 2 (WD122)	1 (MOD 8)	HET THERMISTOR	
	3	~~HET~~ THERMISTOR	
		VLET	
OSC1 (WD59)	3 (MOD 16)	S5 S4 S3 S2 S1=0 G1 G2 CN.	
	9	CD8	CD1
	5	CD16	CD9
	6	CD24	CD17
	11	S5 S4 S3 S2 S1=1 G1 G2 CN.	
	12	CD32	CD25
	13	CD40	CD33
	14 (MOD 16)	CD48	CD41
		B7 B6 B5 B4 B3 B2 B1 B0	

STEP #/Bit	7	6	5	4	3	2	1	0	
43	S5	S4	S3	S2	S1≡0	G1	G2	CAL	S1≡0
44	CD1	CD2	CD3	-	-	-	-	CD8	
45	CD9	CD10	-	-	-	-	-	CD16	
46	CD17	CD18	-	-	-	-	-	CD24	
43	S5	S4	S3	S2	S1≡1	G1	G2	CAL	S1≡1
44	CD25	CD26	-	-	-	-	-	CD32	
45	CD33	CD34	-	-	-	-	-	CD40	
46	CD41	CD42	-	-	-	-	-	CD48	

HET SUBCOM POSITION = (S4)(S3)(S2)(S1)

COMMAND BIT ASSIGNMENT IS A TBD

VLET DATA

Data for the VLET system includes:

1. Pulse height analysis data (PHA data)
2. Rates data
3. Analog housekeeping
4. Power monitor and temperature data

The positions in a minor frame where these are read out have been indicated on the preceeding pages. We will now discuss each in turn in more detail.

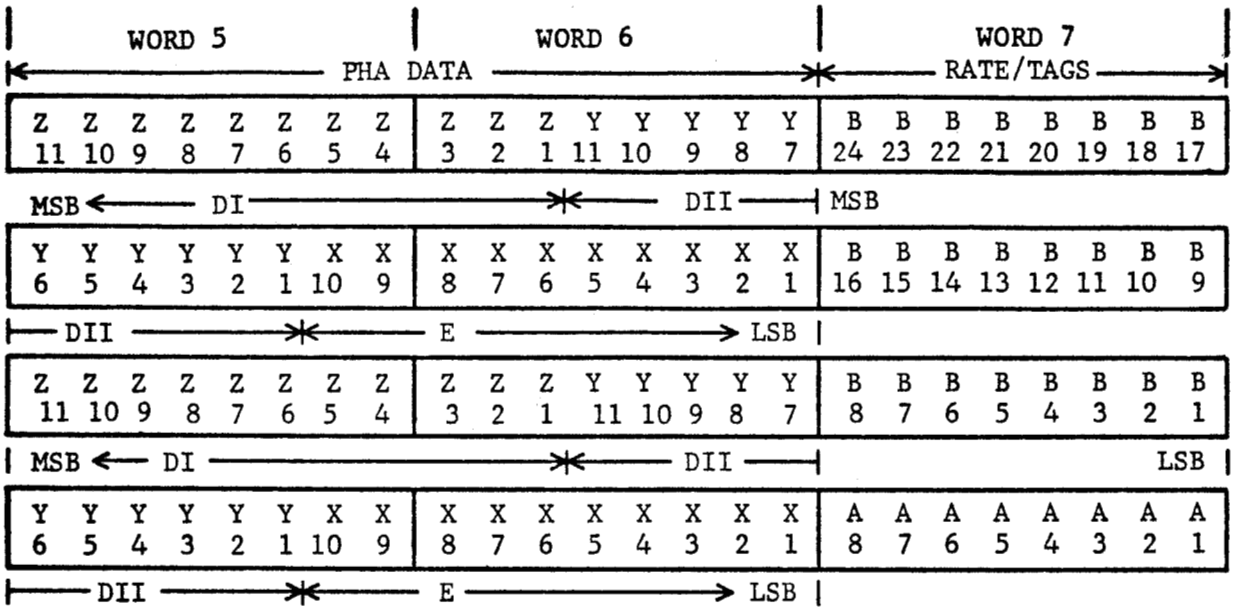
The pattern of PHA and rates data readouts is indicated on the next page. A single PHA event corresponds to a single particle entering one of the two VLET telescopes. The data for a single PHA event consists of a DI pulse-height (11 bits), a DII pulse-height (11 bits), an E pulse-height (10 bits) and event tag bits Po and P1. The three pulse-heights for a single event can be read out in 2 minor frames (words 5 and 6) as shown on the next page. However the Po and P1 tags are read out for two events at a time in word 7, frames 3, 7, 11, . . . as indicated. Thus the pulse height data and tag data for two PHA events is read out in four minor frames. The null event (no particle detected) is characterized by DI=0. P1 tells whether the event was detected in telescope 1 or in telescope 2; the state of the Po bit classifies the event as one of two different event types.

The VLET system contains 8 non-sectored rate counters and 8 sectored rate counters.

At the end of each block of 64 minor frames (minor frames 0-63) the contents of all 16 of these rate registers are transferred for read-out during the next block of 64 minor frames. The registers are then immediately cleared and any subcommutators are advanced in position. Non-sectored rate counters then immediately resume counting until the end of the new block of 64 minor frames. Each sectored rate counter counts a particular event rate only when the corresponding telescope is looking in a particular direction, i.e. the spin plane is divided into 8 different azimuthal sectors and to each sector corresponds one of the eight sector rate counters. After the end of one block of 64 minor frames, counting into the sector rate registers doesn't resume until the sun spike occurs. Events are then counted successively into the 8 different sector rate counters for 8, 16 or 32 complete spins depending upon whether the spacecraft bit-rate is 2048 IBPS, 1024 IBPS or 512 IBPS respectively. The nominal spin period is 3 seconds. Complete accumulation will therefore be finished by the end of the 64 minor frame block.

Each VLET rate register read-out (sectored and non-sectored) consists of 24 bits read out in word 7. Every fourth readout of word 7 contains tag/status information, however, so the contents of one rate register is read out every four minor frames and all 16 rate registers are read out in

BIT STRUCTURE, VLET PHA/RATE READOUTS



BIT CONTENTS

X = E PHA
Y = DII PHA
Z = DI PHA
B = RATE
A_i = TAGS AND STATUS

P_1 0 = TELESCOPE 1
1 = TELESCOPE 2

P_o 0 = EVENT TYPE 0
1 = EVENT TYPE 1

Frame # Modulo 16

A_1 = { 3 S2 (VLET); 7 S1 (VLET); 11 S0 (VLET); 15 CAL ALLOW }

A_2 = CAL START

A_3 = P_1, A_4 = P_o } TAGS FOR PHA EVENT IN FRAMES (2,3),(6,7), . . .

A_5 = TELESCOPE 2 PHA ENABLE

A_6 = TELESCOPE 1 PHA ENABLE

A_7 = P_1, A_8 = P_o } TAGS FOR PHA EVENT IN FRAMES (0,1),(4,5), . . .

VLET ANALOG SUBCOM POSITION = (S2)(S1)(S0)

VLET RATE FORMAT (REVISED 9/2/76)

S2 = 8x64W7		0	0	0	0	1	1	1	1
S1 = 4x64W7		0	0	1	1	0	0	1	1
S0 = 2x64W7		0	1	0	1	0	1	0	1
T1	R1	DΣ1	DΣ1	DΣ1	DΣ1	DΣ1	DΣ1	DΣ1	DΣ1
	R2	DΣ2	DΣ2	DΣ2	DΣ2	DΣ2	DΣ2	DΣ2	DΣ2
	R3	DΣ1E1	DΣ1E2	DΣ1E1~	DΣ1E2	DΣ1E1	DΣ1E2	DΣ1E1	DΣ1E2
T2	R4	DΣ1	DΣ1	DΣ1	DΣL	DΣ1	DΣ1	DΣ1	DΣ1
	R5	DΣ2	DΣ2	DΣ2	DΣ2	DΣ2	DΣ2	DΣ2	DΣ2
	R6	DΣ1E1	DΣ1E2	DΣ1E1	DΣ1E2	DΣ1E1	DΣ1E2	DΣ1E1	DΣ1E2
	R7	DT2	DT1	DT2	DT1	DT2	DT1	DT2	DT1
	R8	DIT1	DIIT1	ET1	FT1	DIT2	DIIT2	ET2	FT2
	RSE	DΣ1T1	DT1	DΣ1T2	DT2	DΣ1T1	DT1	DΣ1T2	DT2

D = DIDIIF̄ T1 = TELESCOPE 1, T2 = TELESCOPE 2

USE SUBCOM POSITION SAMPLE FROM PRECEDING 64 MINOR FRAME DATA BLOCK

[ ] = length of subcom cycle

64 minor frames (see page 5). Register R1 is read out first, R2 next and so on through R8, then sector rate register SR1 is read out followed by SR2, . . . SR8.

The rate counter subcommutation and rate coincidence conditions are indicated in the table on page 6 . For 8-level subcommutation, the subcommutator position ≡ $\lceil (S2)(S1)(S0) \rceil_{\text{octal}}$. The S2, S1 and S0 bits are obtained from word 7, frames 3, 7 and 11 (modulo 16) respectively as shown on page 5 .

NOTE: ALL RATES REGISTERS (HET & VLET) ACCUMULATE DATA FOR 64 MINOR FRAMES AND READ OUT THE RESULTS DURING THE NEXT 64 MINOR FRAMES; THUS RATE READOUTS IN ONE 64 MINOR FRAME BLOCK SHOULD BE ASSOCIATED WITH THE SUBCOM POSITIONS READ OUT IN THE PRECEDING 64 MINOR FRAME BLOCK. THE HET AND VLET SUBCOMS ARE INDEPENDENT OF EACH OTHER.

The VLET analog housekeeping (step 51 on the spacecraft analog subcom #1) is further subcommed by 8 inside the experiment using the same subcommutator clock (S2)S1)(S0) as used for the VLET rate registers:

PARAMETER	(S2)	(S1)	(S0)
+12 V	0	0	0
+6 V	0	0	1
Thermistor 3	0	1	0
Thermistor 4	0	1	1
Spare	1	0	0
Spare	1	0	1
-6 V	1	1	0
-12 V	1	1	1

The VLETS Power Monitor (analog subcom #1, step 53) nominally sits at 4.0 volts when the experiment is ON and at ground when the experiment is OFF.

HET DATA

The TYH High-Energy Telescope (HET) produces three types of digital data (rate data, PHA data and command status data), and 3 analog parameters. One complete data cycle requires 16 blocks of 64 minor frames, or 1024 minor frames. A single 64 minor frame block format is shown in Figure 1.* Word 8 contains all the HET rate data, consisting of 16 consecutive 22-bit rate counter readouts, followed by 8 additional 20-bit sectored rate counter readouts, for a total of 512 bits in the 64 8-bit words. The first bit in the sequence (i.e., the first bit readout in time) appears in minor frame #0 and is the MSB (2^{21}) of rate counter #1; this is designated $R1_{22}$. The succeeding bits ($R1_{21}$, $R1_{20}$, $R1_{19}$ . . . R_1) complete the readout of R1, followed by R2 ($R2_{22}$, $R2_{21}$ . . . $R2_1$) and so on until all 16 rate counters and the 8 sectored rate counters (SR1 through SR8) have been readout. This represents 1/16 of a complete rate data cycle and corresponds to a single position of the rate counter commutator. The commutator position is read out as the S4, S3, S2 and S1 bits in the digital subcom (S4 is MSB) of the preceding 64 minor frame block. The logical rates, i.e., the required coincidence anticoincidence conditions among various elements of each telescope, are shown in Fig. 2.+ Some rates are not commutated at all (R3, R4, R11 and R12, for example), and represent the same coincidence condition regardless of the state of the S1-S4 bits and the HG_i bits (high gain/low gain) for each telescope. Other rates may be commutated between two quantities using only the S1 bit (e.g., R5) or only the HG_i bit (R1). R2 and R10, however, are commutated using both HG_i and the S1, S2 bits as well. The singles rates from each telescope element are commutated modulo 16 in R8 and R16 using all the bits S1, S2, S3, S4.

PHA (pulse-height analysis) data for selected events appears as a 48-bit sequence starting in the MSB of Word 9 of even-numbered frames and ending with the LSB of Word 11 of odd-numbered frames. The first 12 bits read out (T12-T1 in Fig. 1) are tag bits which identify the event type (A STopping, B STopping, or PENetrating), the telescope, the sector orientation of the spacecraft at the time of the particle detection, the penetration range of the particle through the C stack, and other housekeeping parameters of that event. The remaining 36 bits contain three 12-bit numbers representing the amplitude of three selected detector signals. Fig. 1* illustrates the various PHA addresses and identifies which detector quantity is represented for each of the PHA event types.

Command status data is read out in the digital subcom. Eight subcom words, i.e., 128 minor frames, are required for a complete readout of all 48 status bits. Each block of 64 minor frames, however, contains one readout of the rate commutation position and the two gain bits, one for each telescope. See page 3.

*Drawing Labelled TYH High Energy Telescope, ISEE-C Telemetry Format

+Drawing Labelled ISEE HET Rate Table