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USER'S GUIDE FOR THE PIONEER - F/G
SECTORED RATE DISPLAY PROGRAM

The sector display program provides printed summaries and/or microfilm plots of PIONEER-F/G sectored rates accumulated on either a time or readout basis. Rates tapes and parameter cards are input to the program, and a printed summary and/or an SD-4060 plot tape are the output. If a plot tape is produced, the number of frames generated is printed at the conclusion of the run.

The program currently (as of 4 April 1974) exists in two versions. The first (henceforth referred to as Version 6) plots 6 sector plots per frame. The second (Version 12) plots 12 sector plots per frame and, as an option, attempts to fit a function of the form

$$N = A_0 + A_1 \cos(\theta - \theta_1) + A_2 \cos(2\theta + \theta_2)$$

to the data. Differences between the use of the two versions will be noted in the following discussion.

When rates are accumulated by cycles, the actual number of readouts accumulated is determined by which rates are requested. The LET-II rate cycle requires 8 pages to complete while the HET/LET-I cycle requires 4 pages to complete. Therefore, if only HET/LET-I or only LET-II rates are requested, one cycle consists of one readout of each rate. However, if both HET/LET-I and LET-II rates are requested, one cycle consists of one readout of each of the LET-II rates and two readouts of each of the HET/LET-I rates.

Each set of parameter cards consists of a time card, an input tape card (optional), and a set of rate cards - one for each rate to be processed. If the tape card is omitted, the volume serial numbers for the input rates tapes will be obtained from the catalog defined by the JCL. Each set except the last one must be followed by an END card (a card with END in columns 1-3). The parameter cards are described in detail in the following Tables:

TIME CARD

VARIABLE NAME	COLUMN(S)	FORMAT	DESCRIPTION	
APC	1	A1	Spacecraft name = 'F' for PIONEER F = 'G' for PIONEER G	
NMM1	3-4	I2	START MONTH	DATE AND TIME OF START OF PERIOD ~~INTERVAL~~ ~~FOR~~ TO BE PLOTTED.
NDD1	5-6	I2	START DAY	
NYY1	7-8	I2	START YEAR (LAST 2 DIGITS)	
NHH1	10-11	I2	START HOUR	
NMIN1	12-13	I2	START MINUTE	
NMM2	15-16	I2	STOP MONTH	DATE AND TIME OF END OF PERIOD ~~INTERVAL~~ TO BE PLOTTED.
NDD2	17-18	I2	STOP DAY	
NYY2	19-20	I2	STOP YEAR	
NHH2	22-23	I2	STOP HOUR	
HMIN2	24-25	I2	STOP MINUTE	
INT	27-31	I5	LENGTH OF ACCUMULATION INTERVAL FOR EACH PLOT IN SECONDS (ACYCLE=F) OR CYCLES (ACYCLE=T)	

TIME CARD (CONTINUED)

VARIABLE NAME	COLUMN(S)	FORMAT	DESCRIPTION
QCYCLE	33	L1	FLAG FOR ACCUMULATING OVER CYCLES = F TO ACCUMULATE BY TIME ("INT" SECONDS) = T TO ACCUMULATE BY CYCLES ("INT" CYCLES)
QCPRT	34	L1	FLAG FOR PRINTING RATE SUMMARY = F FOR NO PRINTING = T FOR PRINTING.
QCPLT	35	L1	FLAG FOR GENERATING PLOTS = F FOR NO PLOTS = T FOR PLOTS (IF QCPRT = F AND QCPLT = F, no ouput will be produced.)
QTRNDR	36	L1	TREND CHECK REJECTION FLAG = F TO ACCUMULATED ALL DATA = T TO REJECT READOUTS THAT FAILED THE TREND CHECK.
QTMREJ	37	L1	FLAG FOR ACCUMULATING INHIBIT MODE DATA = F TO ONLY ACCUMULATE ~~ONLY~~ READOUTS FOR WHICH SECTORING IS NOT INHIBITED (OA MODE) = T TO ONLY ACCUMULATE ~~ONLY~~ READOUTS FOR WHICH SECTORING IS INHIBITED.

TIME CARD (CONTINUED)

VARIABLE NAME	COLUMN(S)	FORMAT	DESCRIPTION
PCFULL	39-43	F5.2	FULL SCALE FOR SECTORED RATE PLOTS (PERCENT). IF 0, EACH PLOT WILL BE SCALED ACCORDING TO THE MAXIMUM PERCENTAGE OF ITS SECTORS (EITHER 25, 50, OR 100%).
QTAPES	44	L1	FLAG FOR USING INPUT TAPES SPECIFIED ON THE FOLLOWING CARD (TAPE CARD): = F TO OBTAIN THE VOLUME SERIAL NUMBERS FROM THE TAPE CATALOG. = T TO READ THE NEXT CARD AS A TAPE CARD AND TO USE THE RATES TAPES SPECIFIED THEREON AS INPUT.
QNFIT	45	L1	FLAG FOR *SUPPRESSING* FIT OF COSINE FUNCTION TO THE DATA (*VERSION 12 ONLY* – VERSION 6 NEVER PERFORMS FIT). = F (OR BLANK) TO ATTEMPT TO FIT COSINE FUNCTION. = T TO *NOT* FIT COSINE FUNCTION.

TIME CARD (CONTINUED)

VARIABLE NAME	COLUMN(S)	FORMAT	DESCRIPTION
IDEBUG	46	I1	CONTROLS THE PRINTING OF INTERMEDIATE VALUES IN THE COSINE FUNCTION FIT SUBROUTINE (VERSION 12 ONLY): =0 FOR NO DEBUG PRINTOUT =1 TO PRINT INITIAL AND ~~FIN~~ FINAL ITERATIONS. =2 TO PRINT EACH ITERATION.

TAPE CARD (OPTIONAL) – READ ONLY IF QTAPES = T ON PREVIOUS TIME CARD.

THIS CARD MAY CONTAIN THE VOLUME SERIAL NUMBERS OF FROM 1 TO 10 INPUT RATES TAPES. THE TAPES MUST BE IN TIME SEQUENTIAL ORDER AND THE VOLUME SERIAL NUMBERS SPECIFIED MUST ~~BE~~ EXACTLY MATCH THOSE ON THE RATES TAPES STANDARD LABELS.

TAPE CARD (continued)

NAME		COLUMNS	FORMAT	DESCRIPTION						
DINTAP	(1)	1-6	A6	Volume	serial	number	of	1st	Raster	tape
"	(2)	9-14	"	"	"	"	"	2nd	"	"
"	(3)	17-22	"	"	"	"	"	3rd	"	"
"	(4)	25-30	"	"	"	"	"	4th	"	"
"	(5)	33-38	"	"	"	"	"	5th	"	"
"	(6)	41-46	"	"	"	"	"	6th	"	"
"	(7)	49-54	"	"	"	"	"	7th	"	"
"	(8)	57-62	"	"	"	"	"	8th	"	"
"	(9)	65-70	"	"	"	"	"	9th	"	"
"	(10)	73-78	"	"	"	"	"	10th	"	"

RATE CARDS

One rate card must be included for each rate to be processed. If a Tape card is present, the Rate cards must immediately follow it. Otherwise, they must immediately follow the Time card. If another set of parameter cards is to be read, the last Rate card must be followed by an ~~on~~ END card. The following are the ~~only valid~~ Rate cards for each sectored rate:

	Rate	↓ column 1 RATE CARD
SR a	$A_1\overline{A_2}BCI\overline{CIII}$	A1△¬A2△B△CI△¬CIII
SR1-b	$A_2BK_1\overline{CIII}$	A2△B△K1△¬CIII
SR1-c	$DIDII\overline{F}$	DI△DII△¬F
SR1-d	$DIDIIE_1\overline{F}$	DI△DII△E1△¬F
SR2-a	$SI_5\overline{SII}\,\overline{SII}_a\,\overline{SIII}$	SI5△¬SII△¬SIIA△¬SIII
SR2-b	$SI_6\overline{SII}\,\overline{SII}_a\,\overline{SIII}$	SI6△¬SII△¬SIIA△¬SIII
SR2-c	$SI_7\overline{SII}\,\overline{SII}_a\,\overline{SIII}$	SI7△¬SII△¬SIIA△¬SIII
SR2-d	$SI_8\overline{SII}\,\overline{SII}_a\,\overline{SIII}$	SI8△¬SII△¬SIIA△¬SIII
SR2-e	$\overline{SI}\,SII_5\,\overline{SII}_a\,\overline{SIII}$	¬SI△SII5△¬SIIA△¬SIII
SR2-f	$\overline{SI}\,SII_6\,\overline{SII}_a\,\overline{SIII}$	¬SI△SII6△¬SIIA△¬SIII
SR2-g	$\overline{SI}\,SII_7\,\overline{SII}_a\,\overline{SIII}$	¬SI△SII7△¬SIIA△¬SIII
SR2-h	$\overline{SI}\,SII_8\,\overline{SII}_a\,\overline{SIII}$	¬SI△SII8△¬SIIA△¬SIII

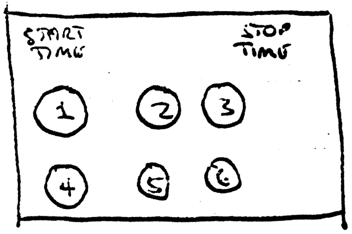
If a rate card does not match one of the above, a message will be printed and it will be skipped.

PLOT FORMAT (VERSION 6)

Each microfilm plot frame may contain up to 6 plots. If only one rate is being plotted, each frame ~~co~~ will contain six plots for that rate - one for each of ~~[illegible]~~ six intervals. The start and stop times on the frame will reflect the start ~~and stop~~ time for the first plot interval and the stop time for the last plot ~~[illegible]~~ interval respectively.

If from 2 to 6 rates are being plotted, each frame will contain one plot for each of the rates for one interval. If ~~[illegible]~~ more than 6 rates are being plotted, each plot interval will require two frames, the first containing the first six rates and the second containing the rest.

The placement of the ~~plo~~ rates is determined by the order in which the Rate cards are read:



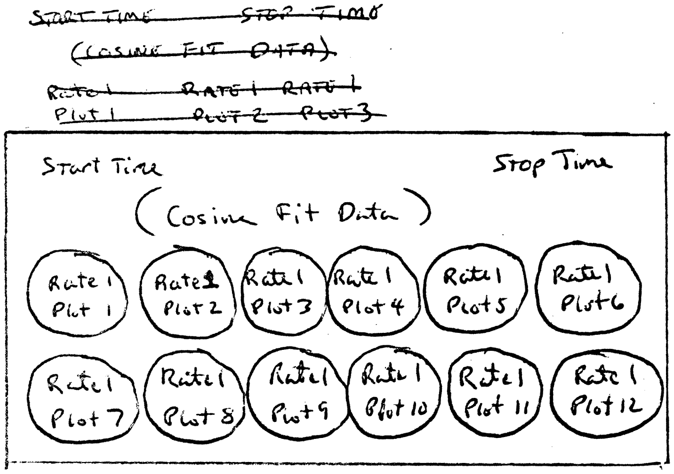
The i^{th} rate read appears on the i^{th} plot.

PLOT FORMAT (VERSION 12)

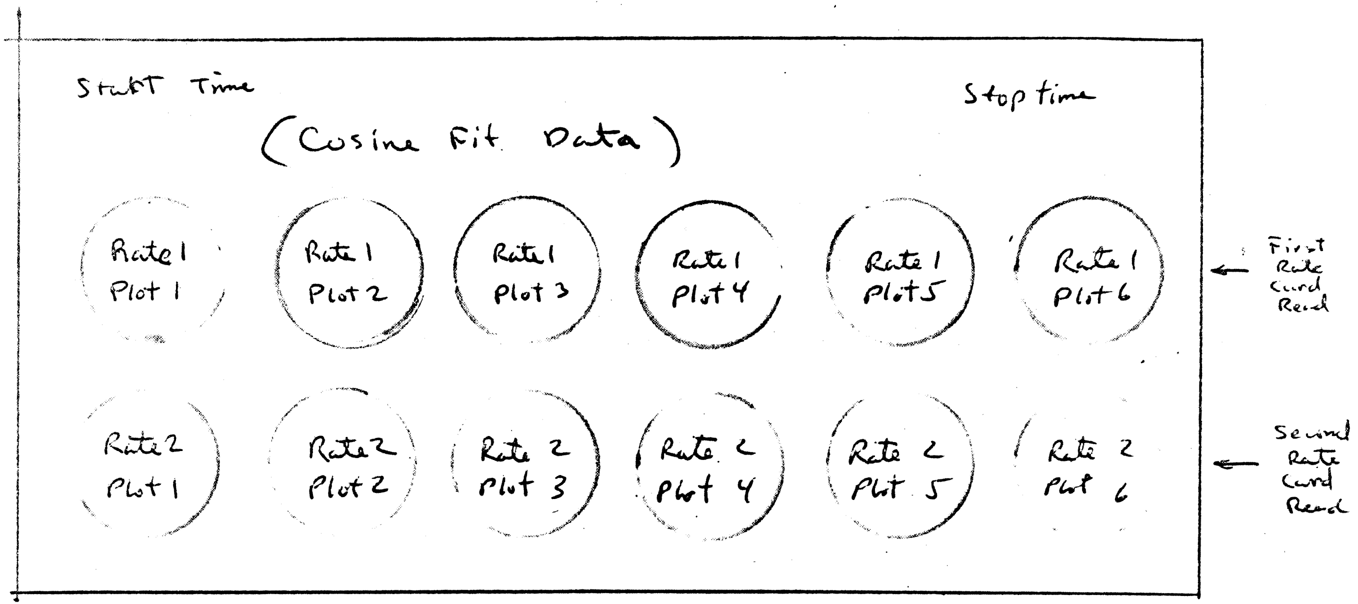
Each microfilm plot frame may contain up to 12 plots. If only one rate is being plotted each ~~frame~~ frame will contain 12 plots for that rate – one for each of 12 averaging intervals – increasing in time in the numerical order shown in the figure below. The start ~~time~~ ~~for the~~ and stop times on the frame will reflect the start time for the first ~~plot~~ averaging interval and the stop time for the last averaging interval.

If two rates are being plotted, each frame will contain 6 plots for each rate, with the first rate appearing on the top row and ~~to~~ the second rate on the bottom ~~row~~ row.

If more than two rates are being plotted, each frame will contain one plot for each rate for the same averaging interval



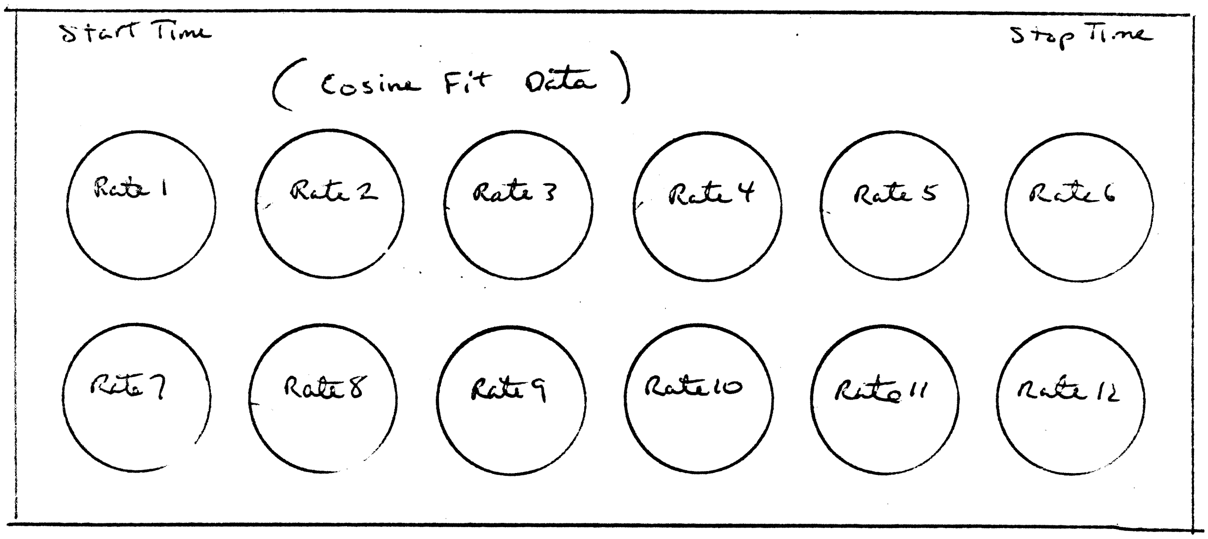
One Rate Plotted



Two Rates Plotted

Start time indicates start of these plots.

Stop Time indicates end of these plots.



MORE THAN 2 RATES PLOTTED

The i^{th} rate card read indicates the rate on the i^{th} plot.

Parameter Card Examples: (VERSION 6)

EXAMPLE 1: Plot and print non-inhibit mode data for PIONEER-F for ~~[illegible]~~ DI DII F for every readout from 00:00 TO 2:00 ~~[illegible]~~ on March 28, 1972. Use 25% full scale for all plots and accept all data regardless of trend check. Obtain rates tapes from catalog.

Column 1

(Time card) F△032872△0000△032872△0200△00001△TTTFF△25.00

(Rate card) DI△DII△¬F

EXAMPLE 2: Plot and print non-inhibit mode data for PIONEER-F for DIDIIF, $A_1\overline{A}_2$BCI$\overline{CIII}$, and $\overline{SI}\,\overline{SII}_8\,\overline{SII}_a\,\overline{SIII}$ for every half hour from 0100 ~~to~~ ~~[illegible]~~ on April 4, 1972 to 1400 on April 5, 1972, Scale each plot to maximum percentage and reject data ~~from~~ that failed the trend check, Use tapes E00569 and E00570 for input.

Also, plot and print inhibit mode data for PIONEER-F for DI DII E_1, $\overline{F}$ and A_2 BK_1, $\overline{CIII}$ for every hour on April 10, 1972 Use 50% full scale for all plots and accept all data regardless of trend check. Obtain rates tapes from catalog

```
                        Column 1
                        ↓
      (Time Card)       FΔ040472Δ0100Δ040572Δ1400Δ01800ΔFTTTFΔ00.00T
      (Tape Card)       E00569ΔΔE00570
Set   (RATE             DIΔDIIΔ¬F
 1     CARDS)           A1Δ¬A2ΔBΔCIΔ¬CIII
                        ¬SIΔSII8Δ¬SIIAΔ¬SIII
      (END CARD)        END
      (TIME CARD)       FΔ041072Δ0000Δ041072Δ2400Δ03600ΔFTTFTΔ50.00
Set   (Rate             DIΔDIIΔE1Δ¬F
 2     cards)           A2ΔBΔK1Δ¬CIII
```

TIME ESTIMATES: (VERSION 6)

The time required is a function of the length of the time period to be plotted, the number of rates to be plotted, and the length of the accumulation interval. The following table gives a few examples:

Length of Time period (Hours)	No. of Rates	Accumulation Interval	Execution Time (min) CPU	Execution Time (min) I/O	No. of Frames
6	7	10 cycles	.13	.12	13
6	3	1/2 hour	.14	.13	13
2	5	1 cycle	.16	.13	21
2	3	1 cycle	.13	.12	21
37	3	1/2 hour	1.05	.49	124
24	12	1 hour			

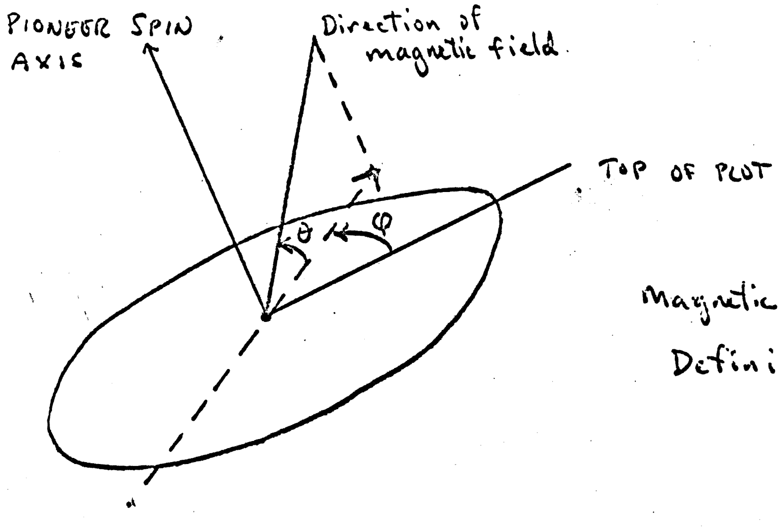
JCL FOR RUNNING VERSION 12

```
//      JOB        (JOBCARD)
//    EXEC   LINKGO,REGION.GO = 300K
//LINK.SYSLIB   DD   DSN = K3.SBCID.SB001.OPIOTEMP,DISP=SHR
//   DD   DSN = K3.SBCID.SB001.OPIONEER,DISP=SHR
//   DD
//   DD
//   DD   DSN = K3.AIJTD.SB008.OIMPLIB,DISP=SHR
//   DD   DSN = SYS2.SD4060,DISP=SHR
//LINK.SYSLIN   DD  *
 INCLUDE  SYSLIB (PISDMN,ALL)
 ENTRY  PISDMN
/*
      [   RATES TAPE CATALOG DD CARDS.   ]
 //GO.PIOFRATE  DD  UNIT=(2400-7,,DEFER),DISP=SHR,DSN=AIJTD.SBCID,
 //   LABEL=(,SL,,IN),VOL=SER=DUMMY,DCB=EROPT=SKP
*[//GO.SC4060ZZ  DD  DSN=T4060,UNIT=7TRACK,LABEL=(1,BLP),DISP=(NEW,KEEP),
 [//   DCB=(DEN=1,TRTCH=C,RECFM=F,BLKSIZE=1024),VOL=SER = ______
 //GO.SYSUDUMP   DD   SYSOUT=A
 //GO.DATA5   DD   *
      [    DATA CARDS    ]
```

* NOT REQUIRED IF QCPLT=F ON ALL TIME CARDS.

MAGNETIC FIELD DATA DISPLAY OPTION FOR THE PIONEER-F/G SECTORED RATE DISPLAY PROGRAM

As of 16 December 1974, an option has been added to version 12 of the PIONEER sector display program which allows magnetic field data to be merged and a dashed arrow to be displayed on each plot in the direction of the magnetic field in the plane of the plot. The angles of the magnetic field vector (as defined below) are printed with the rate summary (when QCPRT = T) and are displayed in the "cosine function fit table" at the top of each frame (when QNFIT = F). In addition, whenever the cosine function fit has been successfully performed, an arrow is ~~drawn~~ plotted in the direction of the first-order anisotropy with the length of the arrow being proportional to the magnitude of the first order anisotropy (100% anisotropy = full scale on the plot). This anisotropy arrow is drawn regardless of whether or not the magnetic field data is being merged.



Magnetic Field Angle (θ, φ) Definitions

Additional Input Parameters for Magnetic Field Data Display

If magnetic field data is to be displayed, the volume-serial number of the magnetic field tape (only one may be used per time card) must be entered in columns 48 – 53 (A6 format) of the time card.

A more complete listing of the magnetic field data used may be obtained by [illegible] utilizing the "debug" flag (MAGDBG) in column 55 (I1 format) of the time card.

MAGDBG = 1 causes the header information for each day from the magnetic field tape to be listed and the sums of the (x, y, z) components in S-J coordinates to be printed for each plot accumulation interval.

MAGDBG = 2 causes each magnetic field minute average to be printed for each plot accumulation interval in addition to the information provided by MAGDBG = 1.

JCL Changes

As a result of the addition of the magnetic field display option the following changes must be made to the JCL for Version 12:

1) The following must be added after // DD DSN=SYS2.SD4060,.. in the SYSLIB concatenation:

```
//   DD   DSN = K3.SBCID.ØHELIØSA, DISP=SHR
```

2) The following must be added when magnetic field data is to be used:

```
//GØ.FT10F001 DD UNIT=(2400-9,,DEFER), DSN = PIØMAG, DISP=S
//   LABEL= (,SL,,IN), VØL =SER= MAGTAP
```

An updated listing of the JCL required for Version 12 is given below:

```
//     JØB    (JØBCARD)
//     EXEC   LINKGØ, REGIØN.GØ=300K
// LINK.SYSLIB   DD   DSN=K3.SBCID.SB001.ØPIØTEMP, DISP=SHR
//    DD   DSN=K3.SBCID.SB001.ØPIØNEER, DISP=SHR
//    DD
//    DD
//    DD   DSN=K3.AIJTD.SB008.ØIMPLIB, DISP=SHR
//    DD   DSN=SYS2.SD4060, DISP=SHR
//    DD   DSN=K3.SBCID.ØHELIØSA, DISP=SHR
// LINK.SYSLIN  DD *
△INCLUDE   SYSLIB (PISDMN, ALL)
△ENTRY  PISDMN
/*
          [ Rates tape Catalog DD cards. ]
// GØ.PIØFRATE   DD   UNIT=(2400-7,,DEFER), DISP=SHR, DSN=RATES.TAPE,
//   LABEL=(,SL,,IN), VØL=SER=DUMMY, DCB=ERØPT=SKP
① // GØ.SC4060ZZ   DD   DSN=T4060, UNIT=7TRACK, LABEL=(1,BLP), DISP=(NEW,KEE
   //   DCB=(DEN=1,TRTCH=C,RECFM=F,BLKSIZE=1024), VØL=SER=------
② // GØ.FT10F001  DD   UNIT=(2400-9,,DEFER), DSN=PIØMAG, DISP=SHR,
   //   LABEL=(,SL,,IN), VØL=SER=MAGTAP
// GØ.SYSUDUMP   DD  SYSØUT=A
// GØ.DATAS  DD  *
        [ Data Cards ]
```

① Not required if QCPLT=F on all time cards.

② Not required if magnetic-field tape not specified on any time card.

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The GSFC experiment on the Pioneer spacecraft consists of the "Cosmic Ray Telescopes" and their associated electronics.

1. High Energy Telescope (HET)
2. Low Energy Telescope 1 (LET-1)
3. Low Energy Telescope 2 (LET-2)

The data derived from these telescopes are of two basic forms:

1. Pulse Height Analysis (PHA)
2. Events per second (rates)

The solid state detectors comprising each of the three telescopes are shown in table 1.

HET	LET-1	LET-2
A	DI	SI
B	DII	SII
CI	E	SIIa
CII	F	SIII
CIII		

Table #1 Solid State Detectors Names

The charge liberated, in the detector, by the passage of particle is [illegible] in a charge sensative preamplifier which produces an output voltage [illegible] whose height is linearly related to the incident particle energy loss [illegible] detector.

The output of the preamplifier is then passed through a post amp where it is given the optimum realizable shape for discrimination and analysis while preserving the amplitude-energy relationship.

The pulses out of the amplifier are fed to their associated linear electronics card where they are differentially buffered and applied to a host of amplitude discriminators. The nominal detection threshold for each of the discriminators is shown in Table 2.

HET		LET-1		LET-2	
Discrim.	Threshold (MeV)	Discrim.	Threshold	Discrim.	Threshold
A1	0.2	DI	.2	SI	.15
A2	2.0	DI_1	.2 .3 .43 .64	SI_1	.15 .7 1.2 2.5
		•	.94	•	.05
		•	1.4	•	.5
		•	2.0	•	1.0
B	0.2	DI_8	3.0	SI_8	1.5
CI	1.0	DII	.2	SII	.06
CII	1.0	ΣD	54.	SII_1	2.0 5.0 15
				•	2.5
				•	.05
				•	.70 35
CIII	0.2	E1	2.0	SII_8	1.0
*K1	$13.6<T<36$	E2	9.0	SIIa	.2

Table 2 (cont.)

HET		LET-1		LET-2	
Discrim.	Threshold (MeV)	Discrim.	Threshold	Discrim.	Threshold
*K2	$57 < T < 150$	E3	9.0	SIII	.1
		E4	40.0		
		F	.2		

*K = A+B+1.8 (CI+CII)

It can be seen that A1, A2, E1 ....E4 are separate and simultaneous discriminations while DI1...DI8, SI_1....SI8, and SII_1...SI8 are programmable discriminators. These programmable discriminators are slaved either to the telemetry frame rate or to the spacecraft roll rate.

In order to examine as large a portion of the Cosmic Ray Spectrum as possible, and to distinguish between the various species therein, the experiment has built in an elaborate scheme to share it's 32 available rate counting channels and six PHA channels. This is done by imposing coincidence/anticoincidence requirements upon the pulses appearing in any telescope. These requirements are now discussed on an individual telescope basis.

HET SYSTEM

PHA Data

There are four separate coincidence conditions which will initiate a pulse height analysis. They are:

1) $(A_2K_1$ or $A_1CI)$ $\overline{BCIII}$

2) A_1BK_2 $\overline{C\overline{I}\,\overline{I}I}$

3) $A_1\overline{A}_2$ BCIII

4) A_2 BCIII

Since there are five detectors to be analyzed and the experiment has only three channels, call them A, B, and C, the available channels are shared as follows: If either of the first two coincidence conditions cause the analysis, CIII has no pulse, therefore; channel A contains the analysis of detector A's pulse, channel B the analysis of detector B's pulse, while channel C contains the analysis of the sum of the pulses appearing in detectors CI and CII two coincidence conditions which cause the analysis, CIII has a pulse Channel A is switched to analyze this CIII pulse. The other channels produce the same analysis.

The PHA's are of the linear, capacitive discharge type, using a gated delay line oscillator to produce a string of pulses whose frequency is 666 KHz and length (Channel #) is related to incident particle energy as follows:

A'	0.2 MeV/Channel
B	0.2 MeV/Channel
CI & CII	1.0 MeV/Channel
CIII	0.2 MeV/Channel

In order to enhance the number of rare particles analyzed, a priority system is built into the HET system. The priority assigned to the four event types is a function of the telemetry frame and is changed every 64 frames as shown in Table III.

[illegible] ID BITS		EXTERNAL ID BITS		INTERNAL ID BIT	REMARKS
S1	S2	I_1	I_2	I_3	
0	0	0	0	0	SYSTEM WILL ACCEPT $A_1\overline{A_2}BC\overline{III}$ FOR ANALYSIS.
0	0	0	0	1	ACCEPT $A_2BC\overline{III}$
0	0	1	0	1	ACCEPT $A_2BC\overline{III}$ AS MANY TIMES AS IT APPEARS OR $(A_2K_1+A_1C_1)BC\overline{III}$
0		0	1	1	ACCEPT $(A_2K_1+A_1CI)BC\overline{III}$ AS MANY TIMES AS IT APPEARS OR $A_1BK_2\overline{CIII}$
		1	1	1	I.D. BITS INDICATE $A_1BK_2\overline{CIII}$ WAS ACCEPTED FOR ANALYSIS BUT NO MORE OF THESE EVENTS WILL BE ACCEPTED. PHA'S REMAIN INACTIVE UNTIL COMPLETION OF THE NEXT READ-OUT.
1	0	0	0	0	ACCEPT $A_1\overline{A_2}BC\overline{III}$
1	0	0	0	1	ACCEPT $A_2BC\overline{III}$
1	0	1	0	1	ACCEPT $A_2BC\overline{III}$ AS MANY TIMES AS IT APPEARS OR $A_1BK_2\overline{CIII}$
1	0	1	1	1	ACCEPT $A_1BK_2\overline{CIII}$ AS MANY TIMES AS IT APPEARS OR $(A_2K_1+A_1C_1)BC\overline{III}$
1	0	0	1	1	ACCEPT $(A_2K_1+A_1CI)BC\overline{III}$ AS MANY TIMES AS IT APPEARS
	1	0	0	0	ACCEPT $A_1\overline{A_2}BC\overline{III}$
	1	0	0	1	ACCEPT $(A_2K_1+A_1CI)BC\overline{III}$
0	1	0	1	1	ACCEPT $(A_2K_1+A_1CI)BC\overline{III}$ AS MANY TIMES AS IT APPEARS OR $A_1BK_2\overline{CIII}$
0	1	1	1	1	ACCEPT $A_1BK_2\overline{CIII}$ AS MANY TIMES AS IT APPEARS OR $A_2BC\overline{III}$
0	1	1	0	1	ACCEPT $A_2BC\overline{III}$ AS MANY TIMES AS IT APPEARS
1	1	0	0	0	ACCEPT $A_2BC\overline{III}$
1	1	1	0	1	ACCEPT $(A_2K_1+A_1CI)BC\overline{III}$
	1	0	1	1	ACCEPT $A_1BK_2\overline{CIII}$
	1	1	1	1	ACCEPT $A_1BK_2\overline{CIII}$ AS MANY TIMES AS IT APPEARS OR $A_1\overline{A_2}BC\overline{III}$
	1	0	0	1	ACCEPT $A_1\overline{A_2}BC\overline{III}$ AS MANY TIMES AS IT APPEARS

To uniquely "tag" a PHA event it is necessary to readout the "Seq. I.D." and "External I.D. bits" shown in table 1H. "Internal ID bits" is not read out but this does not produce an ambiquity. Referring to table 1H for S1=S2=0: If I_1=1 and I_2=0 (lowest Priority) the event is the last A2BCIII event encountered (note that the system will continue to accept new A2BCIII events without shanging ID bits). If I_1=0, I_1=1 the event is the last (A_1BK_2CI) $\overline{BCIII}$ event encountered. If I_1=I2=1, (highest priority) the PHA's contain the first $A_1BK2\overline{CIII}$ event encountered. Table 1H may be read in similar fashion for the other three combination of S1 and S2 where, it is seen, the priorities are reorder for each combination.

As a further aid in determining the species of particle analyzed the HET electronic produces a 1 bit of the CII threshold has been exceeded which is also read out in the associated tag word.

To meet the scientific objective of the CRT some indication of the direction of the incoming particle is also necessary. Therefore, for each PHA event an indication of the orientation of the spacecraft (one of eight possible sectors is also placed in the tag word of PHA event.

Rate Data

The HET system has assigned to it, 9 accumulators (R_1-R_9) exculsively and shares 8 accumulators (SR1) on a fifty-fifty basis with the LET-1 system. (See Table 2H.

Table 2H.

STATE OUTPUT	GATE EQUATION	A/B	S1	S2	SS_1	SS_2	SS_3
R1	$A_2 A_1 + A_1 CI + A_1 CIII$						
R2A	$A_2 A_1 B\ CIII$	0					
" B	$A_1 B K_2 \overline{CII}$	1					
R3A	$A_2 B\ CIII$	0					
" B	$A_2 B K_2 \overline{CI}$						
R4A	$A_2 B K_1 CI \overline{CII}$	0					
" B	A_1	1					
R5A	$A_2 B K_2 CI\ CII \overline{CIII}$	0					
" B	A_2	1					
R6A	$A_1 \overline{A_2} B\ CI$	0					
" B	$A_1 \overline{A_2} B\ CI \overline{CII}$	1					
R7A	$A_1 \overline{A_2} B\ CI\ CII \overline{CIII}$	0					
" B	$A_2 B K_1 \overline{CI}$	1					
R8A	$A_2 B K_1 CI \overline{CII}$	0					
" B	$A_2 B K_1 CI\ CII \overline{CIII}$	1					
R9A	B	0	0				
" B	CI	1	0				
" C	CII	0	1				
" D	CIII	1	1				
SR11	$A_1 \overline{A_2} B\ CI \overline{CIII}$				0	0	
" B	$A_2 B K_1 \overline{CIII}$				1	0	

Table 2H - HET Rates

Referring to Table 2H it is seen that: only rate 1 is not commutated, rate 9 is commutated between four rate equations by the bit labeled A/B, and SR1 is commutated between two rate equations by the bits SS1 and SS2. All other rates are toggled equally between the two rate equations shown in Table 2H by bit A/B except rate SR1 which is controlled by bits SS1 and SS2.

Bits A/B, S1, and S2 are derived in the experiment data system and their periods are bit rate and format dependent i.e. A/B changes every 32 S/C frames in format A, every 64 frames in format B and A/D, and every 128 S/C frame in format B/D. S1 changes every other A/B and S2 every other S1. (Standard binary ripple through counter)

Bits SS1, SS2, and SS3 also come from the data system but in normal operation are simultaneously bit rate, format, and S/C spin rate dependent. See data system section for operation of Sector Synchronizer. For the present only note that in normal operation the SS1, SS2, and SS3 bits may only change after an integral number of S/C revolutions. Again SS1, SS2, and SS3 are generated in a binary ripple counter.

LET-1 SYSTEM

PHA Data

There are two separate coincidence conditions which will initiate a pulse height analysis. They are:

1) DI DII $\overline{F}$
2) DI DII ΣD $\overline{F}$

In LET-1 there are four detectors. Since only three channels (again A, B, and C) are available they are assigned to detectors DI, DII, and E respectively. Since the above PHA equations require detector F to have no pulse nothing is lost. The LET-1 PHA's, like the HET PHA's are the linear, capacitive descharge type using the fated delay line oscillator to produce 66 KHz channel address advance pulses. The channel number is related to incident particle energy loss in each detector as follows:

DI - 0.1 MeV/Channel
DII - 0.1 MeV/Channel
E - 1.0 MeV/Channel

The LET-1 PHA system is, like the HET system, priority oriented. The LET-1 system operates in response to the S1 bit as follows:

S1=0 Analyze either type of event as often as they occur.
S1=1 Analyze DI DII $\overline{F}$ type events as often as they occur until a DI DII ΣD event occurs, then analyze only the ΣD events until data is readout.

The S1 bit is the same bit that was applied to the HET linear electronics and hence, changes every 64 S/C frames.

Rate Data

The LET-1 system is assigned four rate accumulators exclusively and shares 8 accumulators with the HET system on a fifty-fifty basis and 1 accumulator is shared with the LET-2 system on an equal basis.

RATE OUTPUT	RATE EQUATION	A/B	S1	S2	SS_1	SS_2
R1A	DI_1	0	0	0		
" B	DI_2	1	0	0		
" C	DI_3	0	1	0		
" D	DI_4	1	1	0		
" E	DI_5	0	0	1		
" F	DI_6	1	0	1		
" G	DI_7	0	1	1		
" H	DI_8	1	1	1		
R11A	$DI\,DII\,\bar{F}$	0				
" B	$DI\,DII\,\Sigma D\,\bar{F}$	1				
R12A	$DI\,DII\,E_1\,\bar{F}$	0				
" B	$DI\,DII\,\Sigma D\,E_3\,\bar{F}$	1				
R13A	$DI\,DII\,E_2\,\bar{F}$	0				
" B	$DI\,DII\,\Sigma D\,E_4\,\bar{F}$	1				
R14A	DI	1	0	0		
" B	DII	1	0	0		
" C	E_1	0	1	0		
" D	F	1	1	0		
SR1C	$DI\,DII\,\bar{F}$				0	1
" D	$DI\,DII\,E_1\,\bar{F}$				1	1

Table 1L1

Table 1L1 shows that rate 10 is the accumulation of an integral analyzer which is commutated through eight levels by bits A/B, S1 and S2, 11, 12, and 13 are commutated two ways between the indicated rate equations by bit A/B. Rate 14 has 4 levels of communication in the LET-1 system and another four in the LET-2 system for a total of 8 levels of commutation controlled by bits A/B, S1, and S2. SR1 is commutated through the last two, of four levels, by bits SS1, and SS2. The other two comutator positions are assigned to the HET system.

LET-2 SYSTEM

PHA Data

There are no pulse height analyses associated with the LET-2 telescope.

Rate Data

Three rate accumulators are dedicated to LET-2 data while one accumulator is shared with the LET-1 system on a fifty-fifty basis. (See Table 1L2.)

Table 1L2 shows that R14 is assigned to LET-2 for the last four of it's eight levels of commutation. The commutation of R14 is controlled by bits A/B, S1, and S2 from the experiment data system.

R15 and R16 are commutated through four levels each, as shown in table 1L2, by bits A/B and S1.

The sectored accumulator SR2 is switched between eight rate equations by bits SS1, SS2, SS3, from the data system.

Sectored Rate Accumulators.

SR1 and SR2, in addition to being commutated through their respective energy levels, are directionally resolved into eight equal sectors of 45°. The sectors are generated as the spacecraft spins with the first beginning at the time fo the roll index pulse. Each sector is assigned a separate accumulator.

Table II2

RATE OUTPUT	RATE EQUATION	A/B	S1	S2	SS_1	SS_2	SS_3
R1A	SI 5	0	0	1			
" B	SII 6	1	0	1			
" C	$SIII$ 7	0	1	1			
" D	SII_a 8	1	1	1			
R1SA	$SI_1\,\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	0	0				
" B	$SI_2\,\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	1	0				
" C	$SI_3\,\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	0	1				
" D	$SI_4\,\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	1	1				
R1ZA	$SI\,SII_1\,\overline{SII_a}\,\overline{SIII}$	0	0				
" B	$SI\,SII_2\,\overline{SII_a}\,\overline{SIII}$	1	0				
" C	$SI\,SII_3\,\overline{SII_a}\,\overline{SIII}$	0	1				
" D	$SI\,SII_4\,\overline{SII_a}\,\overline{SIII}$	1	1				
SR2A	$SI_5\,\overline{SII}\,\overline{SII_a}\,\overline{SIII}$				0	0	0
" B	$SI_6\,\overline{SII}\,\overline{SII_a}\,\overline{SIII}$				1	0	0
" C	$SI_7\,\overline{SII}\,\overline{SII_a}\,\overline{SIII}$				0	1	0
" D	$SI_8\,\overline{SII}\,\overline{SII_a}\,\overline{SIII}$				1	1	0
" E	$\overline{SI}\,SII_5\,\overline{SII_a}\,\overline{SIII}$				0	0	1
" F	$\overline{SI}\,SII_6\,\overline{SII_a}\,\overline{SIII}$				1	0	1
" G	$\overline{SI}\,SII_7\,\overline{SII_a}\,\overline{SIII}$				0	1	1
" H	$\overline{SI}\,SII_8\,\overline{SII}\,\overline{SIII}$				1	1	1

Data Format

The Pioneer spacecraft data formats for format A and format B are shown in Figs. D1 and D2.

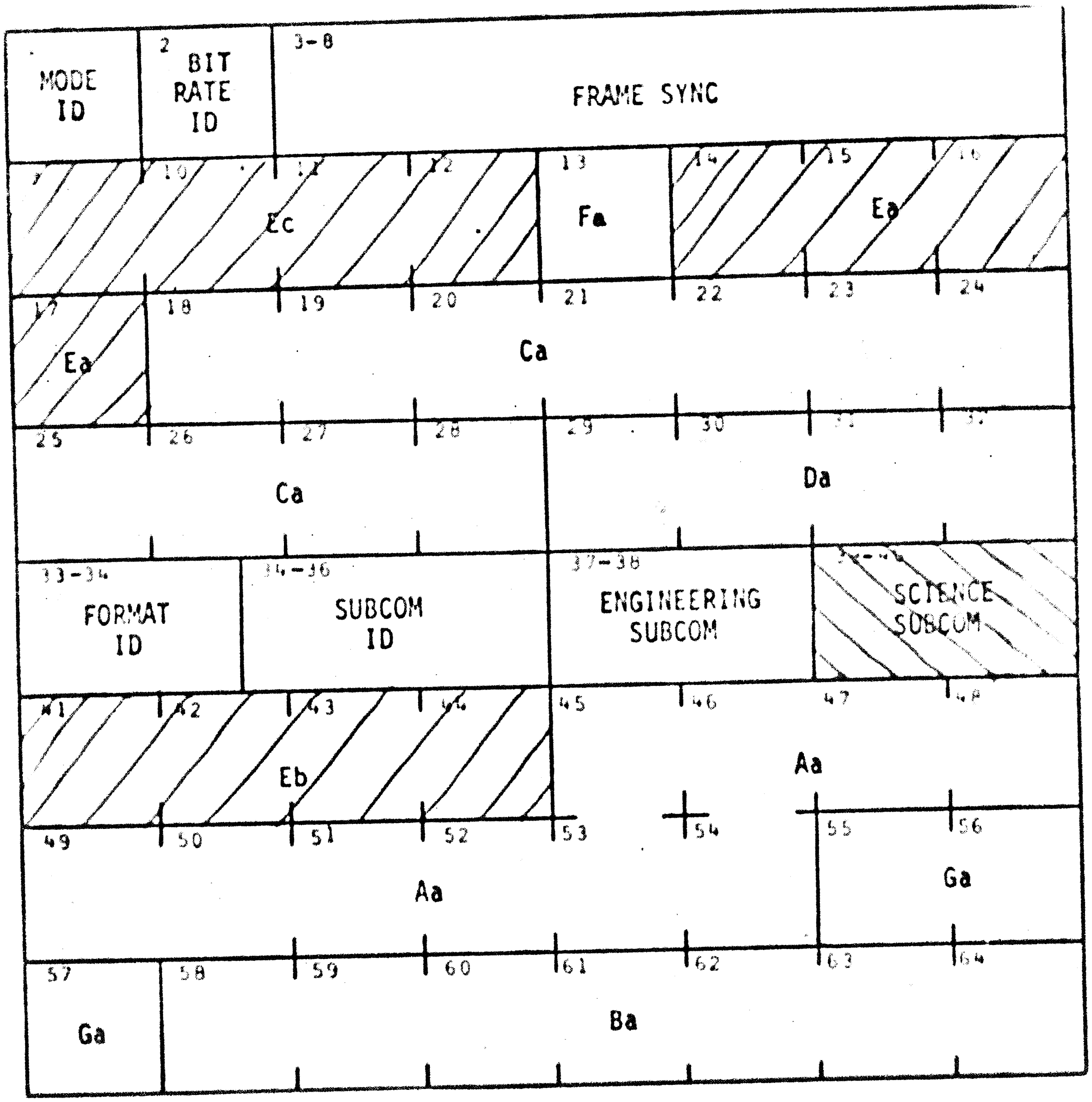


Fig. D1 S/C Mainframe format A

Data Format

The Pioneer spacecraft data formats for format A and format B are shown in Figs. D1 and D2.

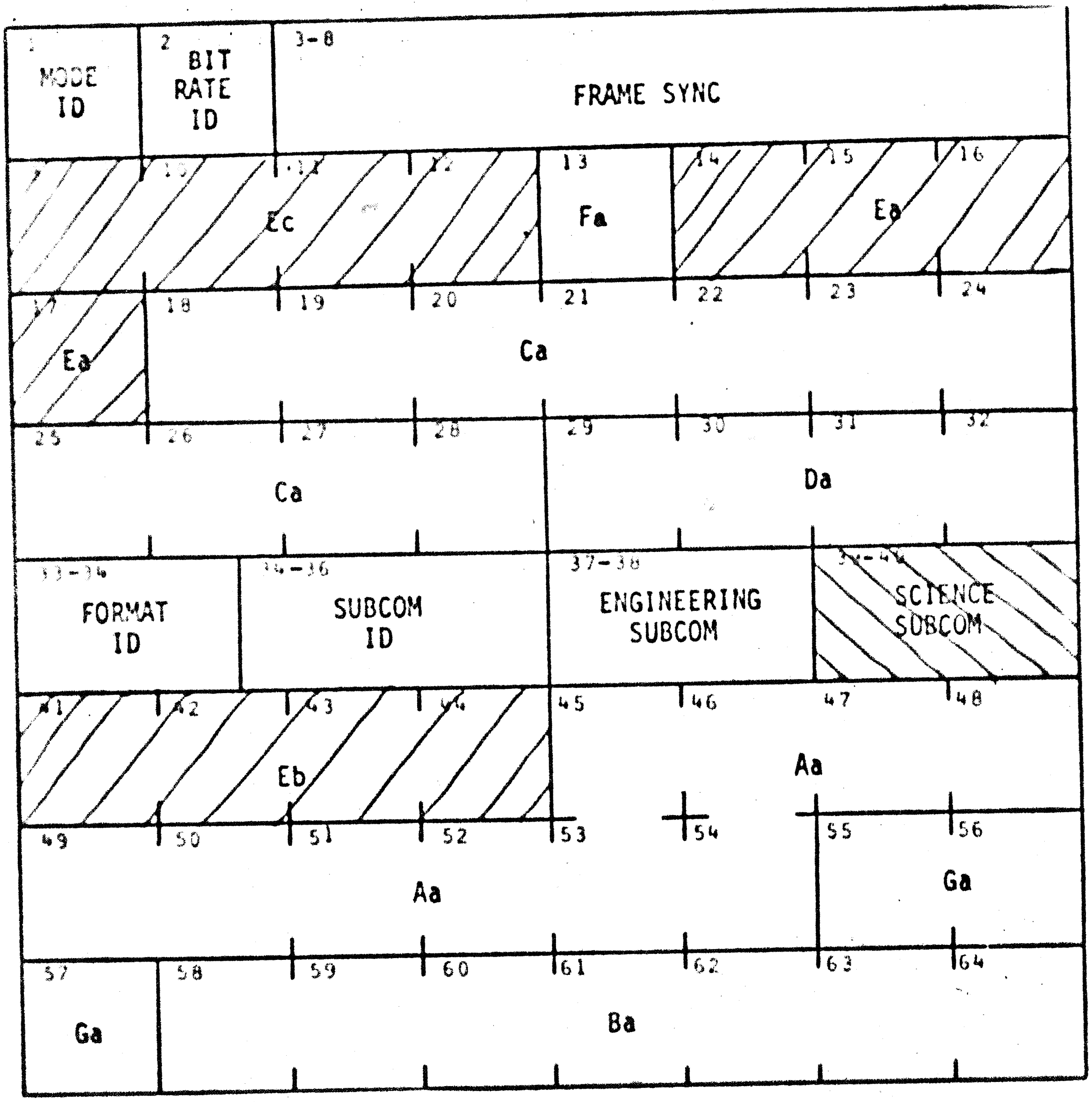
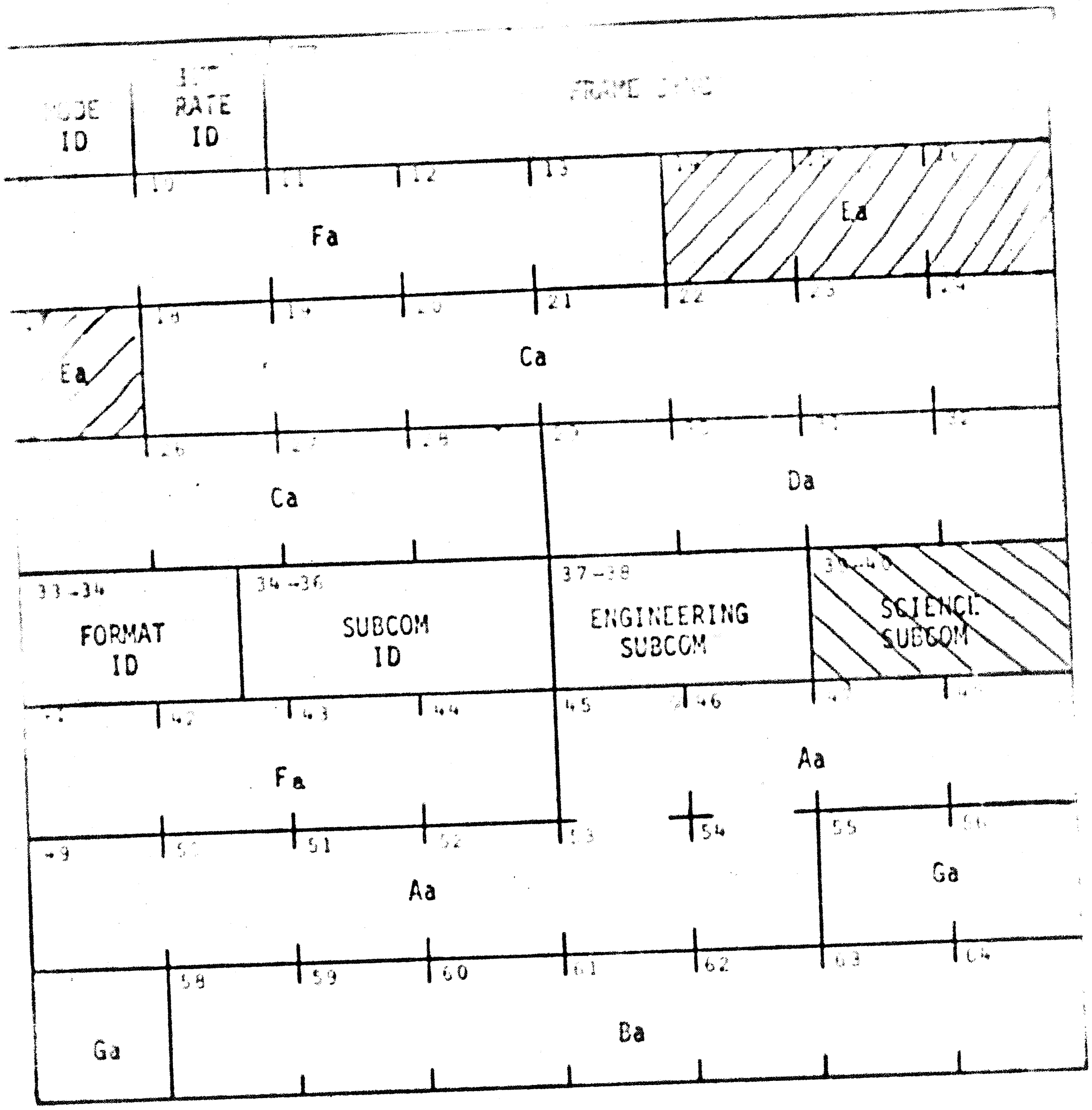


Fig. D1 S/C Mainframe format A



Formats A and B are only operating modes in which experiment data is outputed to the spacecraft. The words shown crosshatched are allotted to the GSFC experiment. It is seen that the CRT receives three M/F 12 bit words in format A and one S/SC 6 bit word. In format B there is one 12 bit M/F word and on S/SC 6 bit word the S/SC word is only present (to the CRT) in one of each 64 mainframes and will be used as a starting point and synchronization check in interpreting the output data.

Format A

As shown in Figure D3 below the experiment is assigned three M/F data words Ec, Eg, and Eb. Further, Fig. D3 shows how the data is assigned to these words within the instrument.

S SEQ ID = SECTORED RATE SEQUENCE ID
R SEC ID = UNSECTORED RATE SEQUENCE ID

☐ RATE WORDS ARE 24 BIT LOG COMPRESSED TO 12 BITS.

:: SEE FIGURE 3.1.1-2

		Ec	EA	EB	E-1, 30	
	S/C WORDS	MF, [illegible]	MF, 14-17	MF, 41-44	2^2 2^1 2^0	2^2 2^1 2^0
	WEIGHTING	11 10 _ 1 0	2^{11} 2^{10} - 2^1 2^0	☐	RSEQ ID	SSEQ ID
	TYPE DATA	PHA	PHA	RATE		
8	n	LET-B	LET-C	R16	0 0 0	X X X
1	n+1 C	::HET-TAG	HET-A	S1		
	n+2	HET-B	HET-C	S1		
	n+3 2	::LET-TAG	LET-A	S1		
	n+4 3	LET-B	LET-C	S2		
	n+5	::HET-TAG	HET-A	S1		
	n+8	LET-B	LET-C	S1		
	n+9	::HET-TAG	HET-A	S2		
	n+10	HET-B	HET-C	S2		
	n+15	::LET-TAG	LET-A	S2		
	n+16	LET-B	LET-C	S2		
	n+17	::HET-TAG	HET-A	R1		
	n+31	::LET-TAG	LET-A	R15		
	n+32	LET-B	LET-C	R16		
2	n+33	::HET-TAG	HET-A	S1		
	n+64	LET-B	LET-C	R16	0 1 0	X X X
3	n+65	::HET-TAG	HET-A	S1		
4	n+128	LET-B	HET-C	R16	1 0 0	X X X

FRAME NUMBER

Figure D3-Data to Word Assignments GSFC/CRT

If frame number N is arbitrarily assigned to the one frame in 64 which the CRT is assigned the SSC Wd (Wd 30 FMT E-1), we shall let the data frame begin with the next frame. i.e., N+1 in Fig. D3.

In Frame N+1, Fig. D3 shows that word Ec contains HET tag data, word Ea contains HET-A (A=DetA of Det CIII. See HET PHA section.) PHA data and word Eb contains sectored rate 1-sector 1 (SR1-1) data. In frame N+2 word Ec contains HET -B (Det B), word Ea contains HET-C (ΣDETCI+DETCII), and Eb contains SR1-2.

In frame N+3 LET-1 PHA tag data is read out in word Ec. Word Ea contains LET-A (Det DI), while word Eb continues the rate data: SR1-3. In frame N+4 LET-1 PHA data is continued in word Ec, LET-B (Det DII), and word Ea, LET-C (Det E), while word Eb has SR1-4.

In frame N+5 words Ec and Ea return to HET tags and HET-A and the frame sequence continues in the manner modulo four. Word Eb, however, continues to sequence through SR1 (-5, 6, 7, and 8), SR 2 (-1, 2, 3, 4, 5, 6, 7, 8) and unsectored rates 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16. (See sections on HET and LET rates for the rate equation of these rates in terms of detector outputs). At frame N+33 word Eb reads out SR1-1 again and the rate data has come full cycle in 32 frames. At this time the A/B bit is changed and the unsectored rate accumulators step to count on the next, in its particular rate equation sequence. The cycle continues, this way for 31 more frames at which time (N+64) the S SC Wd is again applied to the CRT experiment and the complete data cycle is begun anew with the next (N+65) frame. In this new cycle (64 frames) the PHS priorities have been changed (See HET and LET PHA sections) and the rate accumulators are once again advanced to the next rate equation.

The experiment continues in this manner as long as the spacecraft is in format A.

A description of how to extract the exact rate equation for each word Eb readout and how to establish the exact source of the PHA readouts will be given following the Format B section.

Format B

Since the CRT experiment now receives only one M/F word and it was not desired to sacrifice one type of data for another it was necessary to readout both types of data in word Ea. This was accomplished by alternating the 32 rate readouts with 8 PHA event readouts. NOTE: 1 PHA event is readout in 4 words therefore 8 events take 32 frames.

Figure D4 shows the word assignments in Format B.

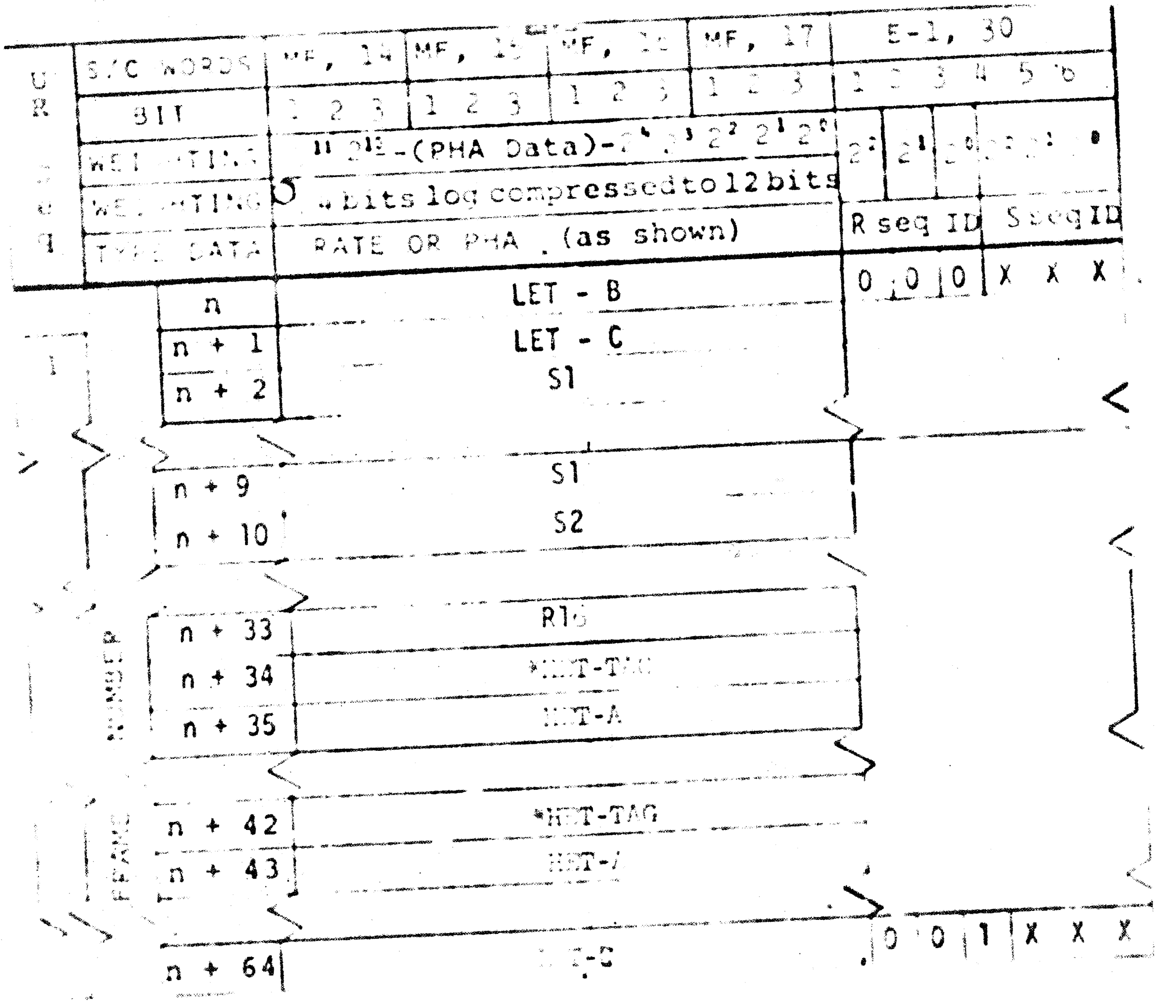


Figure D4 Data to Word Assignments Format B GSFC/CRT

LET B SUBCOM
LET C
S1
:
S2
:
R1
:
R16
HET TAG
HET A
" B
" C
LET TAG
LET A

The sequence of rate data readout is chronologically the same as for format A, however, it should be noted that cycle begins one frame late with respect to the SSC Wd, i.e., SR1-1 now is read out in the second frame following the SSC Wd. (frame W+2). Following the rate data come 32 frames of PHA data, N+34 to N+65 and the SSC Wd is once again received from the S/C and the experiment begins into cycle once again with SR1-1.

Form **A/D B/D:**

Data Synchronization

As was seen in the HET and LET descriptions the bits which control rate equation a given rate readout was accumulated under is controlled by the bits A/B, S1, and S2 for unsectored rates and SS1, SS2, and SS3 for sectored rates. These bits are readout once each 64 frames by the SSC Wd (Wd 30, E-2) in the format shown below:

S2-S1-A/B-SS3-SS2-SS1

The unsectored rate counter is advanced each 32 frames on Format A and each 64 frames in format B. In addition, in format A the unsectored rate counter LSB is reset by the SSC Wd and will therefore be equal to zero at readout time. The number readout in bits (S2, S1, A/B) will always advance by two and be an even number (i.e., A/B≠1). In format B this flip-flop is not reset and will, therefore, advance by one each SSC Wd readout.

The bits SS1, SS2, and SS3, of the sectored rate counter are dependent upon the S/C spin rate and therefore may change asychronously with the S2, S1, A/B bits. Therefore in order to give a closer indication of when the counter was advanced the SS1 bit ot the counter is readout as bit #7 (LSB+S) of the HET-tag word (See Figure D5). The criteria applied to determine which rate equation a read out sectored rate was accumulated under is dependent on whether or not the experiment has its sector synchronizer on or off. The status of the s.s. is found by examining bit 8 (LSB+4) of the HET-tag word.

Sector Sync Inhibited

The sectored rate data should be treated in the same manner as the unsectored rate data, i.e. the S seg ID readout in Wd 30 (SSC Wd) indicates the rate equation under which the following 16 sectored rate readouts were accumulated. E.G. If the S seg ID in Wd 30 were 3 this would indicate that the following sectored rate data were accumulated as follows:

Sectored Rate 1 = SID = DIDIIE $\overline{\text{F}}$

Sectored Rate 2 = S2D= SI_3 $\overline{\text{SII}}$ $\overline{\text{SIIa}}$ $\overline{\text{SIII}}$

The sectored SEQ counter is advanced every 32 frames, therefore, the next sectored rate data readout were accumulated under S SEQ ID-4. It is NOT possible to have redundant readouts with sector sync inhibited.

Sector Sync Not Inhibited

In this mode the internal sectored SEQ counter can only be updated at the time in the telemetry frame when unsectored rates are being readout and a prescribed number of S/C rolls have been completed.

To obtain sync with the sectored rate data one proceeds as follows: Note the reading of the SSEQ ID previously noted in Wd 30 (SSC Wd) if bit 7 does not change state the data in the following sectored rate readouts is redundant and should be discarded). Bit 7 of HET-tag Wd should be continuously monitored for state changes and S SEQ ID mentally increased by one for each change noted. A check may be had at each Wd 30 by comparing S SEQ's ID.

As an example suppose the S SEQ ID in Wd 30 were found to be 6 and during the next 32 frames examination of bit 7 of HET-tag Wd showed no state changes. The following data in the sectored rate words whould be rejected as redundant. SEQ. ID 5 Data if in the next 32 frames bit 7 changes state, (change the mental S SEQ ID to 7) sectored rate data this following readout would be fresh data and it accumulated under S SEQ ID = 6. Sectored rate - 1= S1C=DIDIIF sectored rate 2 = S2G=SI SII3 SIIa SIII. At the following word 30 (SSC Wd) the S SEQ ID should be verified: It should read 7.

In order to know the type of event (See HET and LET PHA sections) readout in the PHA words the event is modified by its accompanying tag word. Figure D5 shows the format meaning of both the HET and LET tag words.

BIT	1	2	3	4	5	6	7	8	9	10	11	12
WEIGHTING	2^2	2^1	2^0	2^0	2^1	2^0	2^0	2^0	2^3	2^2	2^1	2^0
HET-TAGS	SEC. ID			R	★	☐	S	SS	Δ			
WEIGHTING	2^2	2^1	2^0	2^0	2^0	2^0	2^0	2^0	2^0	2^0	2^0	2^0
LET-TAGS	SEC. ID			ΣD ●	1	1	1	1	1	1	1	1

NOTES:-

A) ★ WHEN BIT = 0: HET-A = DETECTOR A
WHEN BIT = 1: HET-A = DETECTOR CIII

B) Δ HIGH/LOW POWER
1 1 1 1 = LOW-POWER High Power
0 0 0 0 = ~~HIGH-POWER~~ Low Power

C) ☐ ANALYSIS CONDITION

D) R = RANGE (0/1) = [illegible] 0: CI threshold not exceeded
1: CII " is exceeded

E) S = LEAST SIGNIFICANT BIT OF SECTORED RATE SEQUENCE ID.

F) SS = SECTOR SYNC
1 = INHIBITED if S toggles
0 = NOT INHIBITED

G) ΣD = 1 if event contains ΣD

Fig. D5 HET & LET Tag Words

The sector in which the event was encountered is found in bits 1, 2, and 3 of the tag words. For a LET event the type of event (ΣD of $\overline{\Sigma D}$) is revealed in bit 4 (the rest of the LET tag word is filled with ones). For a HET event an indication of the contribution of the CII detector to the channel number readout in the HET-C (ΣCI+CII) is found in bit 4 of the HET tag word. If the CII threshold (MeV) is exceeded the bits is 1 if not, a zero.

The type of event that triggered the HET analysis is contained in bits 5 and 6 of the HET tag word. If bit 5=1 the HET A detector CIII is output. If a zero' HET-A is related to detector A's output. Bits 4 and 5 provide more information as to the coincidence conditions resulting in the analysis when modified by the S1 bit readout in SSC Wd (see HET PHA section for priority description).

Bits 7-8-9 of the HET-tag contain information on whether the sector sync is on or off (bit 8), when the bit SS1 toggles (bit 7) and whther the experiment is in the high power mode or not. (bit 9=1 for high power) Bits 10-12 of HET tag word are unused.

ANALOG DATA SYSTEMS

The analog outputs of the CRT experiment together with the experiment connector (0854-J1) pin number are shown in Fig. AD1 below.

Pin Number	SC WORD (FMT. E-1)	Data
24	Wd 25	Power Supply Mon (Temp)
26	Wd 28	DET Temp (ARC-Therm)
27	Wd 26	Power Supply Mon. (Voltage)
28	Wd 27	Calib on/off
29	Wd 29	+RV Mon
30	Bit Wd 24	CRT Status

These analog output on pin 27 is an eight level commutation of sevén voltage outputs of the experiment power supply and a ground position. The voltages in order of commutation are:

1) OV
2) +12V
3) +7.75V
4) +6.25V
5) +4.6V
6) -2V
7) -6.25V
8) -12V

All voltages are converted to the range 0.0 $\leq V \leq$3.0 before they are sent to the spacecraft quantizer.

The out-put on pin 28 indicates whether the CRT is being stimulated by it's internal calibrator. (OV=NO; 3V=yes)

The output on pin 30 supplies confirmation of the format in which the CRT is operating and, of course, should agree with that of the S/C. Pin 30=OV for format A and +3V for format B.

The output on Pin 24 comes from a thermister mounted directly on the power supply-input regulator-series transistor and serves as an indication of the dissipation of that device.

The output on Pin 26 comes from the Project Office supplied thermister which is mounted directly to LET-1 telescope housing.

DATA SYSTEM

The data system of the CRT may be broken up into two major areas: The "COSMIC RAY INTEGRATED MOSFET PROCESSOR" (CRIMP) and the INTERFACE DATA SYSTEM (IDS)

Crimp

The Crimp system is a design using LSI MOS technology to produce a logical building block normally referred to as a "bug." Some of the "bugs" used in the Crimp are:

1. Universal 4 bit MOS commutator C-1074
2. 10 channels of switch C-1070
3. Tree Bug
4. Mars bug
5. ATX, most bug C-1276

The hearts of the Crimp system are the Mars bugs which each contain a 24 bit accumutator, a 24 bit to 12 bit logarithmic compressor, readout gates which with suitable control produce the 12 bit compressed word as 3 bytes of 4 bits each. The compressed word is generated on command by disconnecting the accumulator input, transferring the contents to a 25 bit shift registers, shifting right until a "1" is found in the MSB of the register or 31 shifts have been made; counting the number of shifts required in a 5 bit counter, reading out the counter as the first five bits (characteristic) and the 7 MSB's of the shift register (after discarding the "1" in the MSB) as the last seven bits (Mantissa). It is seen that if the numbers accumulated is greater than 255 there will be some uncertainty in the number due to truncation from the left. Appendix A contains a listing of all possible outputs of rate data together with the uncertainty in the number read out. Included are octal and decimal representations of the rate number read out - neglecting the fact that it is compressed.

The Crimp also contains 6 PHA data accumulators of 12 bits and associated with each accumulator are 12 bits of interim storage, 12 bits of read out storage and necessary gating to sequentially produce, on application of control signals, the 12 bit PHA word as 3 bytes of 4 bits each. The PHA data is straight binary number representing the number of pulses produced by the HET or LET pulse height analyzers. Each LET or HET event has also a "tag" word associated with it which is formed in the IDS and shifted into readout storage with the 3 PHA words it modifies.

The Crimp contains circuitry necessary to produce the data format of the CRT. In a 6 stage binary counter, which is reset to all "1's" the the SSCWd (Wd 30 E-1), the Crimp keeps track of which frame it is in and sets up linkage to; the proper words (format A), or word (fromat B) to be read out in that frame. In format A the CRT receives three 12 bit words per frame making it is necessary to know where in the frame you are. For this purpose the Crimp has a sub counter (3 bit-set to all "1's" by the SSC Wd) which modifies the coarse address generated by the 6 bit counter reading out the 8 words of PHA data. Sectored rate (SR1 and SR2) accumulators are selected on the basis of 3 binary weighted lines from IDS which are decoded to one of eight lines by a "tree" bug in the Crimp. These lines in conjunction with a low "go" signal from IDS enable the Crimp to sequentially select the eight available accumulators are frozen.

INTERFACE DATA SYSTEM

The functions of the IDS are fourfold:

1. Provide specified impidence matching at the S/C-Experiment interface.
2. Provide interface between the MOS of the Crimp and the T^2L of the IDS.
3. Generate all necessary timing and control signals for operation of the experiment in gathering data.
4. Generate necessary timing signals to output data to the spacecraft date system.

S/C Experiment Interface

The IDS meets the required interface specification through the use of discrete amplifier on the input signals and discrete passive components output signals.

Crimp-IDS Interface

The IDS makes the voltage level shifts necessary between the MOS logic levels of the Crimp and its own transistor-transistor logic through discrete component inverting amplifier on all lines crossing the interface.

Timing and Control Signals

The IDS provides signals to both the linear system for PHA, control and rate commutation, and to the Crimp for accessing and fetching data for readout to the S/C.

The PHA's, their respective counters and tag registers in Crimp and IDS, and the control signals operate as shown the simplified block diagrams and timing diagram, figures IDS 1 and IDS 2.

Energy loss data from each PHA, only one of which is shown, consists of number N of logical pulses, (denoted GPT) which are counted in the 12 bit MOS counter. One additional dignal from each group of three PHA, designated' HET BUSY or LET BUSY is a pulse whose width is at least as long as the N pulses and therefore brackets all pulses to be counted. This signal indicates when the analyzers are busy and is used to inhibit any other analysis from overlapping the one in process. The TE of BUSY also initiates the transfer and reset pulse which moves data from the counters to intermediate storage and prepares the counters and PHA's for future analysis. The identifying tag bits associated with each event are strobed into the tag bit register in IDS shortly after the LE of BUSY. Subsequent events may be analyzed and written into intermediate storage, erasing all previous data. This is controlled by the priority system discussed above.

Once each 4 frames in format A or each 8 frames in format B, immediately prior to a PHA event readout. The PHA's are inhibited so that no analysis can take place, and the STU 32 KHz colck (after being divided by 2 to produce 16 KHz) is used to serially shift all data for both HET and LET events into readout storage. This data is fetched by Crimp under control of IDS in exactly the same way as rate data, i.e. by addressing each register sequentially and causing its data to be gated onto the output data bus. This is discussed in more detail later.

IDS also contains two counters, each with a capacity of 3 bits, which control commutation or rate data within the linear system. This allows the 32 rate counters of Crimp to be used for counting many more discrete coincidence rates from the various detector systems. Since the rates are basically of two types, sectored rates and unsectored rates, these two counters are called the sectored rate sequence counter (SRS) and the unsectored rate sequence counter (URS). The commutatuion sequence of each has already been described above. Operation and timing of each is described here.

The unsectored rate sequence counter is advanced by one count at the end of each unsectored rate accumulation interval as defined by the telemetry format in use. In format A, this occurs once each 32 main frames on the LE of the first Main Frame Word 14-17 (Ea) <u>following</u> the occurance of the subcom word E1-30 (SSC Wd) and 32 frames thereafter. The advance pulse also initiates log conversion of all unsectored rate counters so that, on the TE of Ea, new rate data is converted and ready to be fetched for readout in MFWd 41-44 (Eb). The URS is always advanced every 32 frames in format A. In format B URS is advanced every 64 frames, also on the first main frame word Ea following the subcom word E1-30. The unsectored rate data is thus converted and ready to be fetched on the TE of Ea for readout. The rate data readout cannot commence on MFWd 41-44, as it did in format A, however, because Ea is the only word present. Thus, in format B readout of rate data commences on the second Ea after E1-30.

In contrast to the above, the sectored rate sequence counter (SRS) can advance on one of two signals, either synchronously with the URS as described above, or in accordance with the Roll Index Pulse (RIP). In the former case, advance of SRS is synchronize with telemetry and has been fully described above. In the latter case, advance is synchronized with the S/C spin. One of these two signals is specified by the sector synchronizer command flip-flop and is indicated in the HET-tag word.

When the sector synchronizer is enabled, the sectored counters are allowed to accumulate for an integral number of complete S/C revolutions. The number of rolls is dependent upon the bit rate in use and present into the roll counter at the beginning of each accumulate interval. The roll counter increments by one on each RIP until the specified number of rolls has been completed. On the last roll pulse of each accumulate interval, a flip flop is set which enables the next Main Frame Word Ea in frames 17 through 32 or 49 through 64 initiate sectored accumulator datatransfer and log compression. The next accumulate interval begins on the first RIP following data transfer.

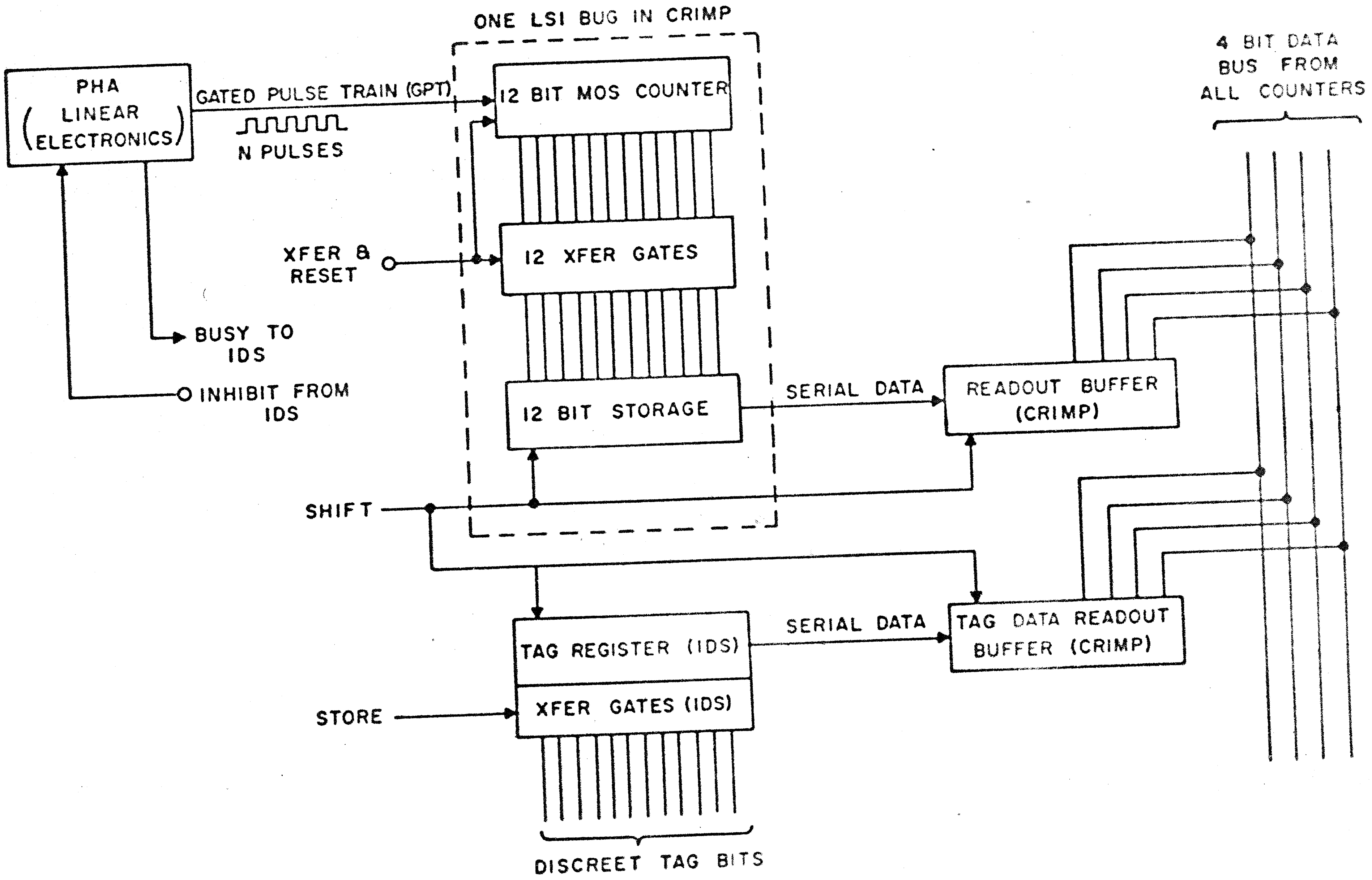
Data transfer is not allowed during frames 1-16 or 33-48 (Mode A) because sectored rate data in readout storage is being shifted out to the S/C. If transfer to readout storage was allowed during a sectored rate readout sequence. Two sources of error might arise. First, suppose the last RIP of an accumulate internal occured in frame 7. If transfer were allowed, the data transmitted to the ground in frames 1-7 would correspond to a different accumulate interval than that readout in frames 8-16. Recall that the sectored accumulators are commutated between several different rates, hence, adjacent accumulate intervals do not correspond to the same rate inputs. Allowing transfer as supposed above would intermaingle two intirelydifferent coincidence rates in the data.

Secondly, if transfer were allowed during sectored rate readout, if if possible that a complete set of 16 readouts would be interrupted if the last RIP occured during the first readout of the sectored data. This can happen if the prescribed number of rolls for a high bit rate (size 1024 or 2048 bps, in which case m=31 is preset into the rolls counter, and the S/C is subsequently commanded into a lower bit rate in which the readout sequence is very long compared to one roll period.

Format B, shows sectored data trnsfer is also inhibited furing those frames in which rate data is being readout to telemetry. The frame numbers when transfer is inhibited are m to m+32, which is different than in format A.

One last feature should be noted. It is very likely, indeed it is desired, that the accumulate interval for sectored rate data will be longer than the readout interval, hence data for a given intervals will be repeated in the telemetry. This redundant data may be used for bit error checks in the processing system, but cannot be included in the rate averages. It is easy to identify which data is a repeat of old data and which is new data by use of the LSB of the sectored rate sequence counter (SRS) which is readout every four frames in HET-tag. This bit will change state every time SRS is incremented.

The contents of the two 3-bit counters, are readout fully in the subcom word E1-30. On the leading edge of E1-30, the state of each bit is stribed into a six bit shift register and immediately readout by the S/C. Advance of either counter must be at the time of Main F ame Word.Ea, hence, no error due to strobing during counter transition is possible. (See Data Format Section for information on how to obtain data synchronization.)


ONE LSI BUG IN CRIMP
PHA
(LINEAR ELECTRONICS)
GATED PULSE TRAIN (GPT)
N PULSES
12 BIT MOS COUNTER
XFER & RESET
12 XFER GATES
BUSY TO IDS
INHIBIT FROM IDS
12 BIT STORAGE
SERIAL DATA
READOUT BUFFER (CRIMP)
4 BIT DATA BUS FROM ALL COUNTERS
SHIFT
TAG REGISTER (IDS)
XFER GATES (IDS)
STORE
SERIAL DATA
TAG DATA READOUT BUFFER (CRIMP)
DISCREET TAG BITS

IDS 1

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3.0 ENGINEERING DATA

The CRS outputs 26 Engineering Data Parameters (see Table 3.1) into the Engineering section of the GS&E data stream. They contain analog housekeeping data for the instrument. It is required to display their initial values and provide them full capability of standard processing and display.

TABLE 3.1 CRS ENGINEERING CHANNELS

CHANNEL NUMBER	CHANNEL TYPE	TITLE	DESCRIPTION
TBD	A	CRS TTEMP	CRS Telescope Temperature. 0.5 - 0.6 VDC Analog Signal. Deck TBD.
TBD	A	CRS ETEMP	CRS Electronics Temperature. 0.5 - 0.6 VDC Analog Signal. Deck TBD.
TBD	TBD	TBD	TBD - Multiplexed Instrument Engineering Data, Approx. 24 Different Parameters. 0 - 3 VDC Analog Data, Multiplexed. Deck TBD.

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IBM

International Business Machines Corporation

6611 Kenilworth Avenue
Riverdale, Maryland 20840

January 24, 1972

Pioneer

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Mr. Peter Bracken

Subject: Pioneer Data Processing System

Gentlemen:

The attached memoranda describe our understanding of the current requirements for the Pioneer Data Processing System.

Very truly yours,

G. J. Palfi

G. J. Palfi

Date: January 19, 1972
From (location or U.S. mail address): Scientific Data Analysis
Dept. & Bldg.: KE-2/Goddard
Telephone Ext.:

Subject: Meeting with Dr. Teegarden concerning the Pioneer Data Processing System

Reference:

To: G. J. Palfi

Attendees:
Mr. Pete Bracken (NASA)
Mr. Talcott Brooks
Mr. Ted Smith
Dr. Bonnard Teegarden (NASA)

A meeting was held with Dr. Bonnard Teegarden on January 14, 1972 to resolve some issues concerning the PHA Summarizer and the PHA Summary Plot program of the Pioneer Data Processing System. As a result of the meeting and subsequent telephone conversations, the following decisions were made:

PHA Summarizer

1. Each file on a Summary tape will contain data from a time interval that will be constant for the entire flight. The begin and end time of the interval will be rounded to the nearest quarter of an experiment cycle (64 frames). It was not decided what the time interval would be (perhaps 5 - 20 days), but Dr. Teegarden said he would decide that at a later date.

2. Each file on a Summary tape will consist of a header record followed by one or more data records. The first record (header record) of each file will contain at least the following information:

   a. Start and End time of Summary

   b. Attitude information to be used in conjunction with the sector identification. Dr. Teegarden said he would later decide what attitude information was required.

   c. Number of events and total time (excluding the time during data dropout) for each event type during the summarized interval.

3. The second and remaining records of the file (the data records) will consist of entries that contain the frequencies, in each of 4 priority modes, of events that have the same event type, amplitudes, R value, and sector values. It should be noted that these entries are determined by:

(a) sorting all events from the PHA tape according to the following fields in decending order and from left to right:

ETTA--- AB--- BC---CRSSSPP

where E = 1 for HET
= 0 for LET
TT = 00 for $A_1 \overline{A_2} BC III$
= 01 for $A_2 BCIII$
= 10 for $(A_2 K_1 + A_1 CI) \overline{BC III}$
= 11 for $A_1 BK_2 \overline{C III}$
A, B, C = Amplitudes for detectors A, B and C respectively
R = 0 CII threshold not exceeded
= 1 CII threshold is exceeded
SSS = 0-7 Sectors 1-8 respectively
PP = 0-3 Priorities 1-4 respectively

and (b)

summing events with identical E thru S fields according to the 4 priority modes. These 4 frequencies along with fields E thru S will comprise an entry in the data record.

4. Summaries generated for a time interval other than the constant time interval mentioned in 1 above will be written on a unique tape. The format of this unique tape will be identical to the normal Summary tape.

PHA Summary Plots

1. The PHA Summary Plots will be produced on a 128 by 128 grid. They will express the frequency of occurrence of the various data point readouts of two Pulse Height Analyzers for a range of possible readouts of the third Pulse Height Analyzer. The plots will be generated using compression factors which will allow the plotting range of Pulse Height Analyzer readouts to be increased at the expense of the resolution of individual readouts. The following table shows the correspondence of compression factor with range of readouts plotted. The ability to plot all possible combinations of two Pulse Height Analyzers within a detector will be incorporated.

Compression Factor	Range of PHA Readouts Plotted	Resolution Readouts/Plotted Point
1	0 - 127	1
2	0 - 255	2
4	0 - 511	4
8	0 - 1023	8
16	0 - 2047	16
32	0 - 4095	32

2. The program will have the ability to plot the data for one or more event types, either in separate plots or on the same plot. When plots are desired from only one summary period, any or all of the possible plots can be produced by performing multiple passes through the data for the summary period. When plots are desired from multiple summary periods, only a limited number of plots can be produced in one pass through the summary data due to main core storage limitations. The program can plot multiple summary periods either all on one plot or each on a separate plot.

3. The plot data can be screened before entering the plot grid. This screening can be based on the range at the third Pulse Height Analyzer readout, the sector information associated with each data point, or the priority mode in effect during data occurrence. In the case of the HET data, the status of the CI-CII threshold bit will provide an additional screening criteria.

In addition, screening can be performed through the correlation of readouts from two Pulse Height Analyzers. This can be accomplished by checking one PHA value against that derived from a function based on its correspondence with another PHA value. The incorporation of this technique might become so involved as to eliminate its feasibility within the time period at the PHA Summary Plot Program.

Unresolved Issues

In order for the Pioneer Summarizer Specifications to be completed the following items must be resolved by Dr. Teegarden:

1. The time interval to be summed during normal production.
2. The attitude information required in the header record on the Summary tape.
3. The procedure required to verify that the equipment counting the events/second (rates) is working correctly. To verify this, the PHA readouts will be analyzed to approximate the number of particles counted and then compared to the rates readout. It is not clear at this time whether such a procedure can be defined and thus may not be included in the PHA Summarizer.

Prepared by: Talcott K. Brooks
T. K. Brooks

Ted P. Smith
T. Smith

Date: January 20, 1972
From (location or U.S. mail address): Scientific Data Analysis
Dept. & Bldg.: KE 2/Goddard
Telephone Ext.:

IBM

Subject: Meeting with Dr. Teegarden concerning the Pioneer Data Processing System

Reference: Memo dated January 19, 1972 -- Same subject

To: George Palfi

Attendees: Dr. Bonnard Teegarden (NASA)
Mr. Ted Smith

A meeting was held with Dr. Teegarden on January 20, 1972 to discuss the unresolved issues mentioned in the memo referenced above. The objective was to obtain a "best guess" as to what general statistics and attitude information was required in the header record on the summary tape and to further define the time interval to be used during normal production of the Pioneer PHA Summarizer. As a result of the meeting the following decisions were made:

1. The time interval to be summed for a normal production run (hereafter referred to simply as the "summary interval") will be an even multiple of full days beginning at the first second of a day. The summary interval is expected to be between 5 and 20 days and will be changed infrequently (i.e., once or twice) during the life of the satellite. A summary interval will not overlap with any other summary interval in the production data base.

2. The header record will contain at least the following information:

   a. The start and end time of the summary interval.

   b. The attitude information to be used in conjunction with the sector identification. This information will be copied from the first record (i.e., experiment cycle) of the summary interval on the Pioneer PHA tapes and will include:

      1.) Roll attitude timer
      2.) Spin Period

  3.) Roll pulse/roll index phase error
  4.) Roll attitude time

c. The total of the rates data (i.e., the number of events that occurred) during the summary interval as a function of the event type.

d. The total time that the rates data was accumulated for during the summary interval as a function of the event type.

e. The total time that the PHA data (includes both good and null events) was accumulated for during the summary interval.

f. The total number of PHA readouts that resulted in null events as a function of the priority.

3. The information that will be printed by the Pioneer PHA Summarizer for the summary interval will include the following:

a. The number of events that occurred per second as a function of the event type.

b. The possible error in events/second described in a. above. This will be printed as a function of the event type where:

$$\text{error} = \pm \frac{\text{events/second}}{\sqrt{\text{number of events}}}$$

c. The number of rates readouts as a function of the event type.

Prepared by: Ted P. Smith
T. P. Smith

Date: January 20, 1972
From (location
or U.S. mail address):
Dept. & Bldg.: KE4/Goddard
Telephone Ext.:

IBM

Subject: Specifications for the Pioneer Data Reduction System

Reference:

To: File

Attendees:
Dr. Bonnard J. Teegarden
Mr. Pete Bracken
Mr. Don Stillwell
Mr. Charles Dickman
Mr. George Palfi
Mr. Joseph Novitsky
Mr. Talcott Brooks
Mr. Ted Smith

A meeting was held to discuss the design specifications for the Pioneer Data Reduction System. The following items were discussed:

1) The specifications for the Pioneer D. R. S. should include a discussion of the various operational modes for creating the PHA and RATES data bases and the utilization of only three tape drives for a single production run.

2) The Daily Data Quality Summary Report should include the following additional information:

   (a) Hourly averages of the PHA Event Rates data
   (b) Times associated with bit rate and format changes and the corresponding bit rate and format indicators.
   (c) Null events (all three detector readouts equal zero) will not be included in the number of event types for priority mode.

3) Don Stillwell will contact JPL or ARC concerning data overlap elimination.

4) The time assigned to the data on the PHA and RATES tape will be the actual sampling time.

J A Novitsky
J. A. Novitsky

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C.D. Dickman

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MR. TOM WONG
PIONEER PROJECT OFFICE N244-8
NASA/AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA 94303

THE CRITERIA APPLIED TO DETERMINE WHICH RATE EQUATION (SEE TABLE 1) A READOUT SECTORED RATE WAS ACCUMULATED UNDER IS DEPENDENT ON WHETHER OR NOT THE EXPERIMENT HAS ITS SECTOR SYNCHRONIZER ON OR OFF. THE STATUS OF THE S.S. IS FOUND BY EXAMINING BIT 8 (LSB+4) OF THE HET-TAG WORD (SEE FIGURE 3.1.1-2 NOTE F)

SECTOR SYNC INHIBITED: THE SECTORED RATE DATA SHOULD BE TREATED IN THE SAME MANNER AS THE UNSECTORED RATE DATA, I.E. THE S SEQ ID READOUT IN WD 30 (SSCWD) INDICATES THE RATE EQUATION UNDER WHICH THE FOLLOWING 16 SECTORED RATE READOUTS WERE ACCUMULATED. E.G. IF THE S SEQ ID IN WD 30 WERE 3 THIS WOULD INDICATE THAT THE FOLLOWING SECTORED RATE DATA WERE ACCUMUTATED AS FOLLOWS: (REF. TABLE I).

SECTORED RATE 1 = S1D = $\mathrm{DIDIIE}_1\overline{\mathrm{F}}$

SECTORED RATE 2 * S2D * $\mathrm{SI}_3\,\overline{\mathrm{SII}}\,\overline{\mathrm{SII}_a}\,\overline{\mathrm{SIII}}$

THE SECTORED SEQ COUNTER IS ADVANCED EVERY 32 FRAMES, THEREFORE, THE NEXT SECTORED RATE DATA READOUT WERE ACCUMULATED UNDER S SEQ ID=4. IT IS NOT POSSIBLE TO HAVE REDUNDANT READOUTS WITH SECTOR SYNC INHIBITED.

SECTOR SYNC NOT INHIBITED. IN THIS MODE THE INTERNAL SECTORED SEQ

(CONTINUED)

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ORIGINATOR'S TEL. NO.
XX 6837

DATE AND TIME PREPARED
9/16/71 3:00 p.m.

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COUNTER CAN ONLY BE UPDATED AT THE TIME IN THE TELEMETRY FRAME WHEN UNSECTORED RATES ARE BEING READOUT AND A PRESCRIBED NUMBER OF S/C ROLLS HAVE BEEN COMPLETED.

TO OBTAIN SYNC WITH THE SECTORED RATE DATA ONE PROCEEDS AS FOLLOWS: NOTE THE READING OF THE SSEQ ID READOUT IN WD 30 (SSCWD) EXAMINE BIT 7 (LSB+5) OF THE HET-TAG WORD. (SEE FIG 3.1.1-2 NOTE E). IF THIS BIT CHANGES STATE THE DATA TO BE READ OUT IN THE FOLLOWING SECTORED RATE READOUTS IS FRESH DATA AND WAS ACCUMULATED UNDER. SSEQ I.D. PREVIOUSLY NOTED IN WD 30 (SSCWD) (IF BIT 7 DOES NOT CHANGE STATE THE DATA IN THE FOLLOWING SECTORED RATE READOUTS IS REDUNDANT AND SHOULD BE DISCARDED). BIT 7 OF HET-TAG WD SHOULD BE CONTINUOUSLY MONITORED FOR STATE CHANGES AND S SEQ ID MENTALLY INCREASED BY ONE FOR EACH CHANGE NOTED. A CHECK MAY BE HAD AT EACH WD 30 BY COMPRING S SEQ ID'S.

AS AN EXAMPLE SUPPOSE THE SSEQ ID IN WD. 30 WERE FOUND TO BE [illegible] AND DURING THE NEXT 32 FRAMES EXAMINATION OF BIT 7 of HET-TAG WD SHOWED NO STATE CHANGES. THE FOLLOWING DATA IN THE SECTORED RATE WORDS WOULD BE REJECTED AS REDUNDANT, XXXXXXXXXXXX IF IN THE NEXT 32 FRAMES BIT 7 CHANGES STATE, CHANGE THE MENTAL SSEQ ID TO 7 SECTORED RATE DATA WOULD BE FRESH DATA AND [redacted] ACCUMULATED

(CONTINUED)

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UNDER SSEQ ID = 6. WITH REFERENCE TO TABLE I:

SECTORED RATE 1 = S1C = DIDII$\overline{F}$

SECTORED RATE 2 = ~~S~~X S2G = $\overline{SI}$ SII_3 $\overline{SII_a}$ $\overline{SIII}$

AT THE FOLLOWING WORD 30 (SSCWD) THE S SEQ ID SHOULD BE VERIFIED: IT SHOULD READ 7

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3	3

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GSFC 11-11 (4/69) GPO 643—16—80056-1 347-735

TABLE I

RATE DATA	DETECTOR COINCIDENCE	(SECTORED RATE SEQUENCE NUMBER) *UNSECTORED RATE SEQUENCE NUMBER
1 S1A	$A_1\overline{A_2}BCI\overline{CIII}$	(1,5)
2 S1B	$A_2BK_1\overline{CIII}$	(2,6)
3 S1C	$DIDII\overline{F}$	(3,7)
4 S1D	$DIDIIE_1\overline{F}$	(4,8)
5 S2A	$SI_1\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	(1)
6 S2B	$SI_2\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	(2)
7 S2C	$SI_3\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	(3)
8 S2D	$SI_4\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	(4)
9 S2E	$\overline{SI}SII_1\overline{SII_a}\,\overline{SIII}$	(5)
10 S2F	$\overline{SI}SII_2\overline{SII_a}\,\overline{SIII}$	(6)
11 S2G	$\overline{SI}SII_3\overline{SII_a}\,\overline{SIII}$	(7)
12 S2H	$\overline{SI}SII_4\overline{SII_a}\,\overline{SIII}$	(8)
13 R1	$(A_2+A_1CI)B\overline{CIII}$	*1-8
14 R2A	A_1BCIII	*1,3,5,7 x
15 R2B	$A_1BK_2\overline{CIII}$	*2,4,6,8 x
16 R3A	A_2BCIII	*1,3,5,7 x
17 R3B	$A_2BK_2\overline{CI}$	*2,4,6,8 x
18 R4A	$A_2BK_2CI\overline{CII}$	*1,3,5,7 x
19 R4B	A_1	*2,4,6,8 x
20 R5A	$A_2BK_2CICII\overline{CIII}$	*1,3,5,7 ✓

TABLE I

RATE DATA	DETECTOR COINCIDENCE	(SECTORED RATE SEQUENCE NUMBER) *UNSECTORED RATE SEQUENCE NUMBER
21 R5B	A_2	*2,4,6,8
22 R6A	$A_1\bar{A}_2B\overline{CI}$	*1,3,5,7
23 R6B	$A_1\bar{A}_2BCI\overline{CII}$	*2,4,6,8
24 R7A	$A_1\bar{A}_2BCICII\overline{CIII}$	*1,3,5,7
25 R7B	$A_2BK_1\overline{CI}$	*2,4,6,8
26 R8A	$A_2BK_1CI\overline{CII}$	*1,3,5,7
27 R8B	$A_2BK_1CICII\overline{CIII}$	*2,4,6,8
28 R9A	B	*1,5
29 R9B	CII	*2,6
30 R9C	CI	*3,7
31 R9D	CIII	*4,8
32 R10A	DI_1	*1
33 R10B	DI_2	*2
34 R10C	DI_3	*3
35 R10D	DI_4	*4
36 R10E	DI_5	*5
37 R10F	DI_6	*6
38 R10G	DI_7	*7
39 R10H	DI_8	*8

TABLE I

RATE DATA	DETECTOR COINCIDENCE	(SECTORED RATE SEQUENCE NUMBER) *UNSECTORED RATE SEQUENCE NUMBER
40 R11A	$DIDII\overline{F}$	*1,3,5,7
41 R11B	$DIDII\Sigma D\overline{F}$	*2,4,6,8
42 R12A	$DIDIIE_1\overline{F}$	*1,3,5,7
43 R12B	$DIDII\Sigma DE_3\overline{F}$	*2,4,6,8
44 R13A	$DIDIIE_2\overline{F}$	*1,3,5,7
45 R13B	$DIDII\Sigma DE_4\overline{F}$	*2,4,6,8
46 R14A	DI	*1
47 R14B	E	*2
48 R14C	DII	*3
49 R14D	F	*4
50 R14E	SI	*5
51 R14F	SIII	*6
52 R14G	SII	*7
53 R14H	SII_a	*8
54 R15A	$SI_1\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	*1,5
55 R15B	$SI_2\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	*2,6
56 R15C	$SI_3\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	*3,7
57 R15D	$SI_4\overline{SII}\,\overline{SII_a}\,\overline{SIII}$	*4,8

TABLE I

RATE DATA	DETECTOR COINCIDENCE	(SECTORED RATE SEQUENCE NUMBER) *UNSECTORED RATE SEQUENCE NUMBER
58 R16A	$SISII_1\overline{SII}_a\overline{SIII}$	*1,5
59 R16B	$SISII_2\overline{SII}_a\overline{SIII}$	*2,6
60 R16C	$SISII_3\overline{SII}_a\overline{SIII}$	*3,7
61 R16D	$SISII_4\overline{SII}_a\overline{SIII}$	*4,8

S SEQ ID = SECTORED RATE SEQUENCE ID
R SEC ID = UNSECTORED RATE SEQUENCE ID

☐ RATE WORDS ARE 24 BIT LOG COMPRESSED TO 12 BITS.

⁑ SEE FIGURE 3.1.1-2

URSeq	S/C WORDS	MF, 9-12	MF, 14-17	MF, 41-44	E-1, 30	
	WEIGHTING	$2^{11} 2^{10} - 2^1 2^0$	$2^{11} 2^{10} - 2^1 2^0$	☐	$2^2\ 2^1\ 2^0$	$2^2\ 2^1\ 2^0$
	TYPE DATA	PHA	PHA	RATE	RSEQ ID	SSEQ ID
8	3 n	LET-B D2	LET-C E	R16	000	XXX
1	4 n+1 U	⁑HET-TAG	HET-A A or C3	S1		
	1 n+2 1	HET-B B	HET-C C1+C2	S1		
	2 n+3 2	⁑LET-TAG	LET-A D1	S1		
	3 n+4 3	LET-B C	LET-C	S1 C		
	n+5	⁑HET-TAG	HET-A	S1	(6—9)	
	n+8	LET-B	LET-C	S1		
	n+9	⁑HET-TAG	HET-A	S2		
	n+10	HET-B	HET-C	S2		
	n+15	⁑LET-TAG	LET-A	S2		
	n+16	LET-B	LET-C	S2		
	n+17	⁑HET-TAG	HET-A	R1		
	n+31	⁑LET-TAG	LET-A	R15		
	n+32	LET-B	LET-C	R16		
2	n+33	⁑HET-TAG	HET-A	S1		
	n+64	LET-B	LET-C	R16	010	XXX
3	n+65	⁑HET-TAG	HET-A	S1		
4	n+120	LET-B	HET-C	R16	100	XXX

FRAME NUMBER

REPRODUCED FROM

TITLE
GSFC/CRT TELEMETRY
FORMAT PLAN
FORMATS A & E-1
DIGITAL DATA

PIONEER PROGRAM
NASA
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA

DOC. NO. PC-260.05

FIG. 3.1.1-1

REV. NO. 5

DATE 5-25-70

SHEET 1 OF 1

FORMAT B

FORMAT A

S/C WORD (FORMAT A)	9			10			11			12		
S/C WORD (FORMAT B)	14			15			16			17		
BIT	1	2	3	1	2	3	1	②	3	1	2	3
WEIGHTING	2^2	2^1	2^0	2^0	2^1	2^0	2^0	2^0	2^3	2^2	2^1	2^0
HET-TAGS	SEC. ID			R	* □		* S	SS	Δ 0	0	0	0
WEIGHTING	2^2	2^1	2^0	2^0	2^0	2^0	2^0	2^0	2^0	2^0	2^0	2^0
LET-TAGS	SEC. ID			□	1	1	1	1	1	1	1	1

5

NOTES:

A) * WHEN BIT = 0: HET-A = DETECTOR A
WHEN BIT = 1: HET-A = DETECTOR CIII

B) Δ HIGH/LOW POWER 1 1 1 1 = ~~LOW POWER~~ High Power
0 0 0 0 = ~~HIGH POWER~~ Low Power

C) □ ANALYSIS CONDITION

D) R = RANGE (0/1) = TBS

→ E) S = LEAST SIGNIFICANT BIT OF SECTORED RATE SEQUENCE ID.

F) SS = SECTOR SYNC 1 = INHIBITED 1 = 'S' toggles
0 = NOT INHIBITED

REPRODUCED FROM

TITLE
GSFC/CRT TAG BIT
IDENTIFICATION
FIRNATS A & B

PIONEER PROGRAM
NASA
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA

DOC. NO PC-260.05

FIG. 3.1.1-2

REV. NO. 5

DATE 5-25-70

SHEET 1 OF 1

TABLE 1H

Event Type	Particle	Event $I2=2^1$	Code $I1=2^0$	Relative Priority (1=highest) 0 S1=S2=0	 1 S1=1,S2=0	 2 S1=0,S2=1	 3 S1=S2=1
3 $A_1BK_2\overline{CIII}$	Stopping particles $Z \geq 2$	1	1	1*	2	2	2
2 $(A_2K_1 + A_1CI)\ B\overline{CIII}$	Stopping e⁻, or stopping p+ and heavier	1	0	2	1	3	3*
1 A_2B CIII	Penetrating particles $Z \geq 2$	0	1	3	3	1	4*
0 $A_1\overline{A_2}$ B CIII	Penetrating e⁻	0	0	4*	4*	4*	1

* Each event is analyzed as often as it occurs unless marked with *, in which case that event type is analyzed only once per readout.

LET

TYPE	PRIORITY	$S_1 = 0$	$S_1 = 1$
1	HIGH	$D1\ D11\ \overline{F}$	$D1\ D11\ \Sigma D\ \overline{F}$
0	LOW	$D1\ D11\ \Sigma D\ \overline{F}$	$D1\ D2\ \overline{F}$
		1	0

$S_2\ S_1\ A/B$

	DTU-A ON				DTU-B ON			
	Bit 1		Bit 3		Bit 1		Bit 3	
Real Time	0	0	0	0	0	0	1	1
Memory Readout	0	1	0	2	0	1	1	3
Telemetry Store	1	0	0	4	1	0	1	5

c) Bit Rate Identification. The DTU operating data bit rate is identified in bits 4 through 6 of each mainframe as follows:

	Bit 4		Bit 6	
16 BPS	0	0	0	0
32 BPS	0	0	1	1
64 BPS	0	1	0	2
128 BPS	0	1	1	3
256 BPS	1	0	0	4
512 BPS	1	0	1	5
1024 BPS	1	1	0	6
2048 BPS	1	1	1	7

d) Format Identification. The formats are identified in bits 97 through 101 of each mainframe as follows:

Format	Bit 97				Bit 101	
A	0	1	0	0	0	8
A	0	1	0	0	1	9
B	0	0	0	0	0	0
B	0	0	0	0	1	1
C-1	0	0	1	0	0	4
C-1	0	1	1	0	0	12
C-2	0	0	1	0	1	5
C-2	0	1	1	0	1	13
C-3	0	0	1	1	0	6
C-3	0	1	1	1	0	14
C-4	0	0	1	1	1	7
C-4	0	1	1	1	1	15
A/D-1	1	1	0	0	0	24
A/D-2	1	1	0	0	1	25
A/D-3	1	1	0	1	0	26
B/D-1	1	0	0	0	0	16
B/D-2	1	0	0	0	1	17
B/D-3	1	0	0	1	0	18

11100

4
5
16
28

Format ID for the C format is identical to the format ID for C-1 through C-4. That is, bit Nos. 100 and 101 will sequence through the binary count 00 through 11 as the C format sequences through formats C-1 through C-4.

Although the DTU is implemented to operate in Formats A/D-1 through A/D-8 and B/D-1 through B/D-8, only formats D-1 through D-3 are being used on the Pioneer F mission. The format identification codes are derived from the format commands. The five bit format ID code corresponds directly bit by bit, with the least significant five bits of each format command number.

e) Subcommutator Identification. The subcommutator position is identified by bits 102 through 108 of each mainframe. The total of 7 bits is derived from a divide-by-128 subframe counter, which is advanced by one count per subframe for a 128 word subcommutator. Bit 102 is the most significant bit for the 128 word engineering subcommutator. Bits 103 through 108 also identify the 64 word science subcommutator with the most significant bit first.

3.5.2.15 Engineering Subcommutator. The DTU provides in each mainframe an engineering subcommutator consisting of 128-6 bit words. The engineering subcommutator appears in bits 109 through 114 of the mainframe. Information telemetered in this subcommutator is obtained from various spacecraft engineering instrumentation such as thermistors, voltage and current monitors, switch positions, etc. Analog, digital, and status (bi-level) information is accepted by the DTU for telemetering in the engineering subcom. The assignment of analog, digital, and bi-level channels within the subcom is shown in Figure 3.5-12. The word slots marked by an X are permanently assigned (hard wired) to measurements made within the DTU. Bi-level bit 1 of word 32 is also internally wired. The word assignment for the engineering subcomm is listed in Figure 3.5-13 sheets 1 through 11.

3.5.2.16 Roll Attitude Timing. The DTU contains a redundant 12-bit counter which is driven by a 128 BPS clock and controlled by the roll reference pulse. The 12 bits of the counter are read out with the most significant bit first during engineering subcomm words C-112 and C-116. The counter is reset with each occurrence of the roll reference pulse, except during telemetry readout, and advanced by the 128 BPS clock. The clock is inhibited until the end of subcomm word C-125. The count stops on word C-112, is reset on the first roll pulse after the end of word gate C-125. Counting is then resumed. The 12-bit count represents the time between the occurrence of a roll reference pulse and the start of word C-112 of the engineering subcomm. This telemetered time will permit correlating the attitude of the roll-index reference line with given telemetered science and engineering data. The redundant roll attitude timer can be used only by commanding the redundant DTU. Whenever Format C or C1 are commanded, this information is telemetered at the mainframe rate only and engineering subcomm words C-112 and C-116 will contain zeros. Each count within the register represents 0.0078125 seconds.

3.5.2.17 Definition of Specific Telemetry Words within Engineering Subcomm.

a) Stored Command Identification. Engineering words C-305, C-306, and C-307 contain the stored execute delay time and the command number of one of five stored commands within the CDU. To identify which of the five commands and its delay time are being telemetered in any given engineering subcom bits 4, 5, and 6 of word C-307 are coded to represent the five commands.

Word	Bit	Measurement	Type
E-101		ARC/PA Detectors Temperature	A
E-102		ARC/PA Electronics Temperature	A
E-103		JPL/HVM Spectrum Analyzer/X-Axis Output	A
E-104		JPL/HVM Spectrum Analyzer/Y-Axis Output	A
E-105		JPL/HVM Spectrum Analyzer/Z-Axis Output	A
E-106		JPL/HVM Status	D
E-107		LaRC/MD Event Count	D
E-108	1	UC/CPI Detector D1 Status	B
	2	UC/CPI Detector D2 Status	B
	3	UC/CPI Detector D7 Status	B
	4	UC/CPI Priority Mode Status	B
	5	UC/CPI Calibrate Status	B
	6	UC/CPI Calibrate Status	B
E-109		USC/UV Electronics Temperature	A
E-110		UC/CPI Electronics Temperature	A
E-111		UC/CPI Egg Current Range 1	A
E-112		UC/CPI Egg Current Range 2	A
E-113		UC/CPI Egg Current Range 3	A
E-114		UC/CPI Fission Detector	D
E-115		UC/CPI Fission Detector	D
E-116		UC/CPI Fission Detector	D
E-117		CIT/IR Low Range Temperature	A
E-118		GE/AMD Preamp Temperature	A
E-119		GE/AMD Secondary Voltage	A
E-120			A
E-121			A
E-122		GE/AMD Event Data	D
E-123		GE/AMD Event Data	D
E-124	1	UI/GTT Logic Status	B
	2	GSFC/CRT Status	B
	3	GE/AMD Star Exclusion Status	B
	4	GE/AMD Data Readout Status	B
	5	USC/UV Channel Status	B
	6	USC/UV Roll Status	B
E-125		GSFC/CRT Electronics Temperature 1	A 24
E-126		GSFC/CRT Analog Data D1 2	A 25
E-127		GSFC/CRT Analog Data D2 3	A 26
E-128		GSFC/CRT Detector Temperature 4	A 27
E-129		GSFC/CRT Secondary Voltage 5	A 28
E-130		GSFC/CRT Identification Data 6	D 29
E-131		CIT/IR Command Register--Part 1	D
E-132		CIT/IR Command Register--Part 2	D
E-201		CIT/IR High Range Temperature	A
E-202		JPL/HVM Commutated Housekeeping Data	A

Figure 3.5-14. Science Subcomm Word Assignment (Sheet 1 of 2)

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IBM

International Business Machines Corporation

6611 Kenilworth Avenue
Riverdale, Maryland 20840

Pioneer

January 24, 1972

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Mr. Peter Bracken

Subject: Pioneer Data Processing System

Gentlemen:

The attached memoranda describe our understanding of the current requirements for the Pioneer Data Processing System.

Very truly yours,

G. J. Palfi

G. J. Palfi

Date: January 19, 1972
From (location
U.S. mail address): Scientific Data Analysis
Dept. & Bldg.: KE-2/Goddard
Telephone Ext.:

IBM

Subject: Meeting with Dr. Teegarden concerning the Pioneer Data Processing System

Reference:

To: G. J. Palfi

Attendees:	Mr. Pete Bracken (NASA)
	Mr. Talcott Brooks
	Mr. Ted Smith
	Dr. Bonnard Teegarden (NASA)

A meeting was held with Dr. Bonnard Teegarden on January 14, 1972 to resolve some issues concerning the PHA Summarizer and the PHA Summary Plot program of the Pioneer Data Processing System. As a result of the meeting and subsequent telephone conversations, the following decisions were made:

PHA Summarizer

1. Each file on a Summary tape will contain data from a time interval that will be constant for the entire flight. The begin and end time of the interval will be rounded to the nearest quarter of an experiment cycle (64 frames). It was not decided what the time interval would be (perhaps 5 – 20 days), but Dr. Teegarden said he would decide that at a later date.

2. Each file on a Summary tape will consist of a header record followed by one or more data records. The first record (header record) of each file will contain at least the following information:

    a. Start and End time of Summary

    b. Attitude information to be used in conjunction with the sector identification. Dr. Teegarden said he would later decide what attitude information was required.

    c. Number of events and total time (excluding the time during data dropout) for each event type during the summarized interval.

3. The second and remaining records of the file (the data records) will consist of entries that contain the frequencies, in each of 4 priority modes, of events that have the same event type, amplitudes, R value, and sector values. It should be noted that these entries are determined by:

(a) sorting all events from the PHA tape according to the following fields in decending order and from left to right:

ETTA--- AB--- BC---CRSSSPP

where E = 1 for HET
= 0 for LET
TT = 00 for $A_1 \overline{A_2} BC III$
= 01 for $A_2 BCIII$
= 10 for $(A_2 K_1 + A_1 CI) \overline{BC III}$
= 11 for $A_1 BK_2 \overline{C III}$
A, B, C = Amplitudes for detectors A, B and C respectively
R = 0 CII threshold not exceeded
= 1 CII threshold is exceeded
SSS = 0-7 Sectors 1-8 respectively
PP = 0-3 Priorities 1-4 respectively

and (b)

summing events with identical E thru S fields according to the 4 priority modes. These 4 frequencies along with fields E thru S will comprise an entry in the data record.

4. Summaries generated for a time interval other than the constant time interval mentioned in 1. above will be written on a unique tape. The format of this unique tape will be identical to the normal Summary tape.

PHA Summary Plots

1. The PHA Summary Plots will be produced on a 128 by 128 grid. They will express the frequency of occurrence of the various data point readouts of two Pulse Height Analyzers for a range of possible readouts of the third Pulse Height Analyzer. The plots will be generated using compression factors which will allow the plotting range of Pulse Height Analyzer readouts to be increased at the expense of the resolution of individual readouts. The following table shows the correspondence of compression factor with range of readouts plotted. The ability to plot all possible combinations of two Pulse Height Analyzers within a detector will be incorporated.

Compression Factor	Range of PHA Readouts Plotted	Resolution Readouts/Plotted Point
1	0 - 127	1
2	0 - 255	2
4	0 - 511	4
8	0 - 1023	8
16	0 - 2047	16
32	0 - 4095	32

2. The program will have the ability to plot the data for one or more event types, either in separate plots or on the same plot. When plots are desired from only one summary period, any or all of the possible plots can be produced by performing multiple passes through the data for the summary period. When plots are desired from multiple summary periods, only a limited number of plots can be produced in one pass through the summary data due to main core storage limitations. The program can plot multiple summary periods either all on one plot or each on a separate plot.

3. The plot data can be screened before entering the plot grid. This screening can be based on the range at the third Pulse Height Analyzer readout, the sector information associated with each data point, or the priority mode in effect during data occurrence. In the case of the HET data, the status of the CI-CII threshold bit will provide an additional screening criteria.

In addition, screening can be performed through the correlation of readouts from two Pulse Height Analyzers. This can be accomplished by checking one PHA value against that derived from a function based on its correspondence with another PHA value. The incorporation of this technique might become so involved as to eliminate its feasibility within the time period at the PHA Summary Plot Program.

Unresolved Issues

In order for the Pioneer Summarizer Specifications to be completed the following items must be resolved by Dr. Teegarden:

1. The time interval to be summed during normal production.
2. The attitude information required in the header record on the Summary tape.
3. The procedure required to verify that the equipment counting the events/second (rates) is working correctly. To verify this, the PHA readouts will be analyzed to approximate the number of particles counted and then compared to the rates readout. It is not clear at this time whether such a procedure can be defined and thus may not be included in the PHA Summarizer.

Prepared by: Talcott K. Brooks
T. K. Brooks

Ted R. Smith
T. Smith

Date: January 20, 1972
From (location or U.S. mail address): Scientific Data Analysis
Dept. & Bldg.: KE 2/Goddard
Telephone Ext.:

IBM

Subject: Meeting with Dr. Teegarden concerning the Pioneer Data Processing System

Reference: Memo dated January 19, 1972 — Same subject

To: George Palfi

Attendees: Dr. Bonnard Teegarden (NASA)
Mr. Ted Smith

A meeting was held with Dr. Teegarden on January 20, 1972 to discuss the unresolved issues mentioned in the memo referenced above. The objective was to obtain a "best guess" as to what general statistics and attitude information was required in the header record on the summary tape and to further define the time interval to be used during normal production of the Pioneer PHA Summarizer. As a result of the meeting the following decisions were made:

1. The time interval to be summed for a normal production run (hereafter referred to simply as the "summary interval") will be an even multiple of full days beginning at the first second of a day. The summary interval is expected to be between 5 and 20 days and will be changed infrequently (i.e., once or twice) during the life of the satellite. A summary interval will not overlap with any other summary interval in the production data base.

2. The header record will contain at least the following information:

   a. The start and end time of the summary interval.

   b. The attitude information to be used in conjunction with the sector identification. This information will be copied from the first record (i.e., experiment cycle) of the summary interval on the Pioneer PHA tapes and will include:

      1.) Roll attitude timer
      2.) Spin Period

3.) Roll pulse/roll index phase error
4.) Roll attitude time

c. The total of the rates data (i.e., the number of events that occurred) during the summary interval as a function of the event type.

d. The total time that the rates data was accumulated for during the summary interval as a function of the event type.

e. The total time that the PHA data (includes both good and null events) was accumulated for during the summary interval.

f. The total number of PHA readouts that resulted in null events as a function of the priority.

3. The information that will be printed by the Pioneer PHA Summarizer for the summary interval will include the following:

a. The number of events that occurred per second as a function of the event type.

b. The possible error in events/second described in a. above. This will be printed as a function of the event type where:

$$\text{error} = \pm \frac{\text{events/second}}{\sqrt{\text{number of events}}}$$

c. The number of rates readouts as a function of the event type.

Prepared by: Ted P. Smith
T. P. Smith

Date: January 20, 1972
From (location or U.S. mail address):
Dept. & Bldg.: KE4/Goddard
Telephone Ext.:

IBM

Subject: **Specifications for the Pioneer Data Reduction System**

Reference:

To: File

Attendees:
Dr. Bonnard J. Teegarden
Mr. Pete Bracken
Mr. Don Stillwell
Mr. Charles Dickman
Mr. George Palfi
Mr. Joseph Novitsky
Mr. Talcott Brooks
Mr. Ted Smith

A meeting was held to discuss the design specifications for the Pioneer Data Reduction System. The following items were discussed:

1) The specifications for the Pioneer D.R.S. should include a discussion of the various operational modes for creating the PHA and RATES data bases and the utilization of only three tape drives for a single production run.

2) The Daily Data Quality Summary Report should include the following additional information:
   (a) Hourly averages of the PHA Event Rates data
   (b) Times associated with bit rate and format changes and the corresponding bit rate and format indicators.
   (c) Null events (all three detector readouts equal zero) will not be included in the number of event types for priority mode.

3) Don Stillwell will contact JPL or ARC concerning data overlap elimination.

4) The time assigned to the data on the PHA and RATES tape will be the actual sampling time.

J A Novitsky
J. A. Novitsky

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Pio

Date: March 13, 1972

From: Scientific Data Analysis

Dept. KD3/Goddard

Subject: Meeting concerning the Pioneer Data Processing System

To: G. J. Palfi

Attendees:

Mr. Peter Bracken (NASA)
Mr. Talcott Brooks
Mr. Charles Dickman (NASA)
Mr. Joseph Novitsky
Mr. George Palfi
Mr. Ted Smith
Dr. Bonnard Teegarden (NASA)

A meeting was held to discuss the design specifications for the Pioneer PHA Summarizer System and other topics related to the Pioneer Data Processing System. As a result of the meeting and subsequent discussions, the following decisions were made:

Pioneer Data Reduction System

1. All PHA events will be checked by the Pioneer Data Reduction Program (PIODRP) to determine whether they are null events or valid events. A null event is one in which all three detector readouts are zero. Each of the three detector readouts for a valid event will be incremented by one unless the readout reset condition is present (i.e., all twelve bits of the readout equal one). If this condition exists, the readout value will be set to zero.

2. Due to the apparent problem with the HET rate R_1 -($A_2 K_1$ +A_1 CI) $B\overline{CIII}$, PIODRP will compute a substitute HET R_1 rate by summing the following rates:

   R6A – $A_1 \overline{A}_2 B \overline{CI}$
   R7A – $A_1 \overline{A}_2 B\ CI\ CII\ \overline{CIII}$
   R7B – $A_2 BK_1 \overline{CI}$
   R8A – $A_2 BK_1\ CI\ \overline{CII}$
   R8B – $A_2 BK_1\ CI\ CII\ \overline{CIII}$

   This computed rate will appear on the PHA tape for each page (1/4 experiment cycle) in addition to the 6 rates previously defined.

3. The format of the PHA tape will be changed to simplify coding and to decrease the time required to store and retrieve data in a record. The new format will be similar to the format described in the Pioneer PHA Summarizer System specifications except that the Subcom data, the Rates data, and the PHA data will be grouped according to pages.

Pioneer PHA Summarizer System

4. To simplify coding and to reduce the amount of execution time, the Pioneer PHA Summarizer Program (PPHASP) will not allow summaries to be replaced. Instead, the Pioneer Summary Catalog Maintenance Program (PSUMCM) will provide the means to delete one or more summaries. The data for these summaries can then be reprocessed by PPHASP using a different time interval as desired.

5. A new function, referred to as "Trend Checking", will be provided by PPHASP. This will require each type of Rates data (R_i to be compared to a previous Rates data (R_{i-1}) of the same type. If the data are not within a specified tolerance of each other, R_i will be discarded. The discarded data will, however, be used during the comparision of R_{i+1}. The formulas given below describe this function.

$$R'_i = R_i \text{ if } R_i > 0$$

$$R'_i = 1 \text{ if } R_i = 0$$

$$\sigma = \sqrt{R'_i}$$

$$X = 20 \text{ if } \sigma > 3$$

$$X = 10 \text{ if } \sigma \leq 3$$

R_i will be kept if: $R'_{i-1} - X\sqrt{R'_{i-1}} < R'_i < R'_{i-1} + X\sqrt{R'_{i-1}}$

The number of Rates readouts rejected because of the Trend Checking will be totaled as a function of the event type and printed in the PHA Summary Report.

6. The format of the header record on a PHA Summary tape will be changed to allow a function referred to as Dead Time Correction", to be performed by a succeeding program (perhaps the Pioneer PHA Summary Plot Program). Instead of storing the total number

of null events as a function of the priority mode, PPHASP will store them as a function of the priority mode and the bit rate. Likewise instead of storing the total number of non-null events as a function of the event type and priority mode, they will be stored as a function of the event type, the priority mode and the bit rate.

7. At the present it is not feasible to rewrite the PSORT routine since the maximum savings to be realized per summary are in terms of seconds (perhaps 10 seconds). Also the current design requires only minor modifications to be made to an existing sort routine. Redesign would delay completion of the system. At some later point, redesign of the PSORT routine will again be considered in light of actual (rather than estimated) execution times.

Pioneer PHA Summary Plot Program

8. The PHA Summary Plot Program will incorporate the ability to produce one dimensional histograms of the channel frequencies for multiple ranges of any of the detectors.

9. The label of each plot will contain the following:

   a) Satellite identification

   b) Start and stop time of the summary data plotted

   c) The number of events that occurred per second for those event types pictured in the plot.

   d) The possible error in events/second for those event types pictured in the plot where:

$$\text{Error} = \pm \frac{\text{Events/Second}}{\sqrt{\text{Number of events}}}$$

e) The total number of PHA events both plotted and total for those event types pictured in the plot.

Prepared by: T. K. Brooks
T. K. Brooks

J A Novitsky
J. A. Novitsky

Ted P. Smith
T. P. Smith

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PFG.293.300

USER MANUAL

Pioneer F/G Integration and Test Software

[illegible]

Signal Processing Department

lrecl = 32
blksize = 384

Approved by:

AW Jones
A. W. Jones, Head
Pioneer F/G Software Section

R. A. DeKimpe
R. A. DeKimpe, Manager
Signal Processing Department

RABeach
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TRW SYSTEMS GROUP

TRW SYSTEMS GROUP OF TRW, INC., Redondo Beach, California

February 15, 1971

Revised September 1971

E. MAGNETIC TAPE OUTPUT

If telemetry and command data are to be recorded on magnetic tape, the tape is mounted on the tape control unit with a logical unit address of 3. The tape unit should be in a ready state prior to requesting the actual recording of data.

Data recording on the magnetic tape is controlled by breakpoint switch 9.

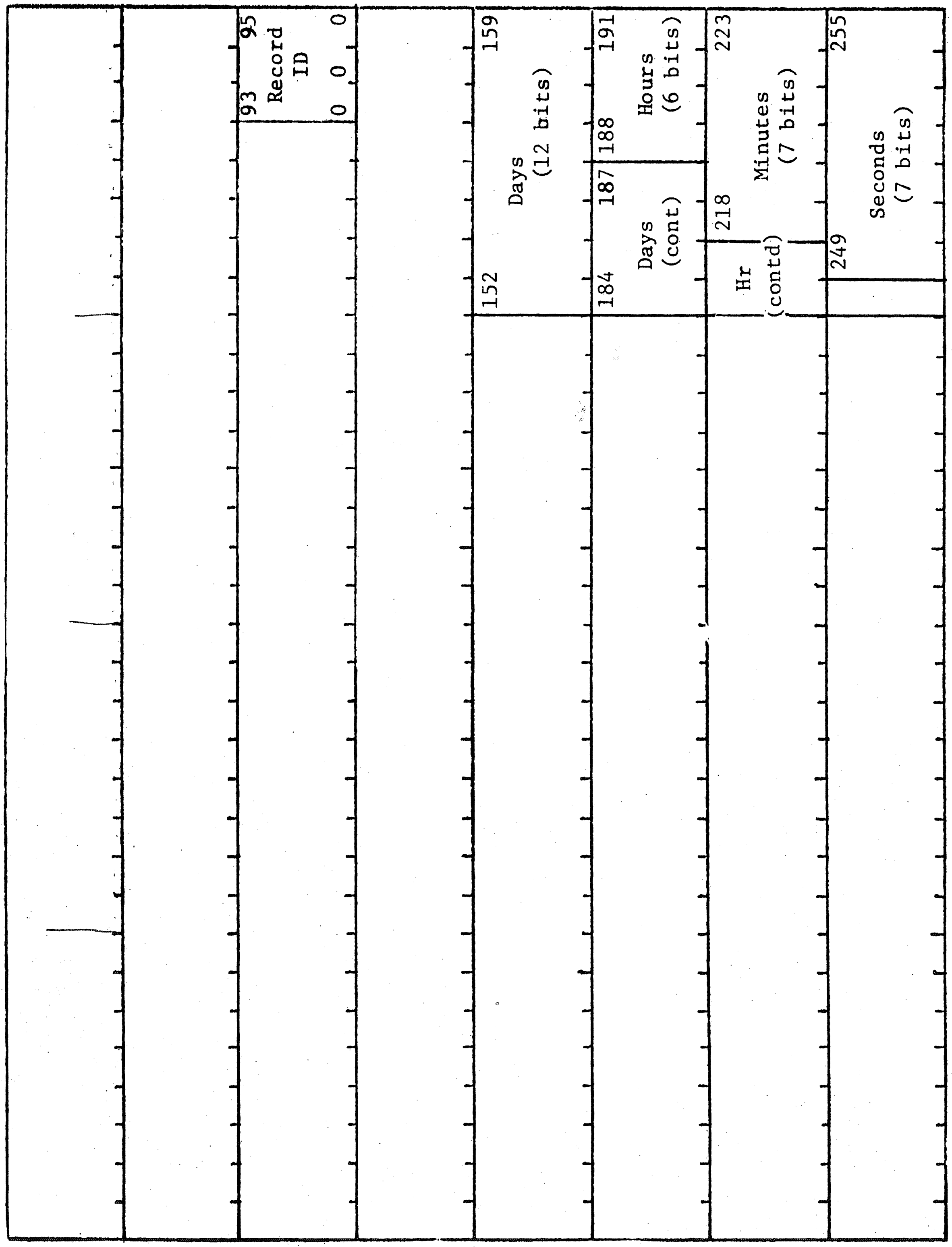
Each logical record is 32 bytes; 12 logical records are blocked to form a physical tape record. A record count is maintained by the program.

The count is maintained to provide means of copying a 9-track tape onto a 7-track tape without the use of multiple reels. One reel of 7-track tape can hold about three fourths of a reel of 9-track information. Therefore, if the above mentioned recording scheme is used, the maximum number of records is about 1700. To allow for contingencies, the count is set at 1200. A MAG TAPE FULL message is output to the teletype to inform the operator when this number of records is reached.

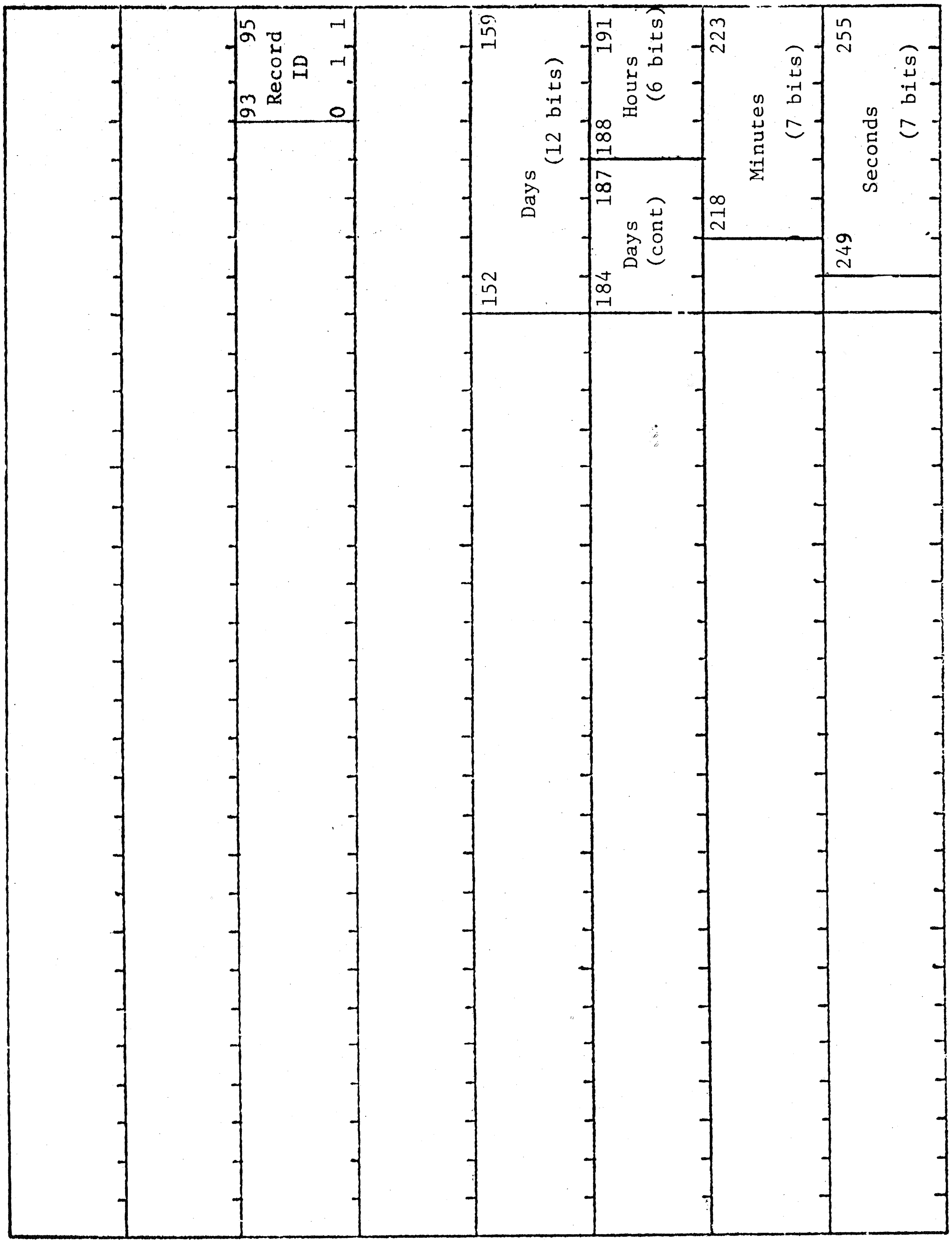
Layouts of data records on tape are shown on the following pages. In addition to the information shown, an end-of-file is written each time BPS 9 is turned off, and an additional end-of-file is written at the end of the data on the tape.

1. MAGNETIC TAPE HEADER

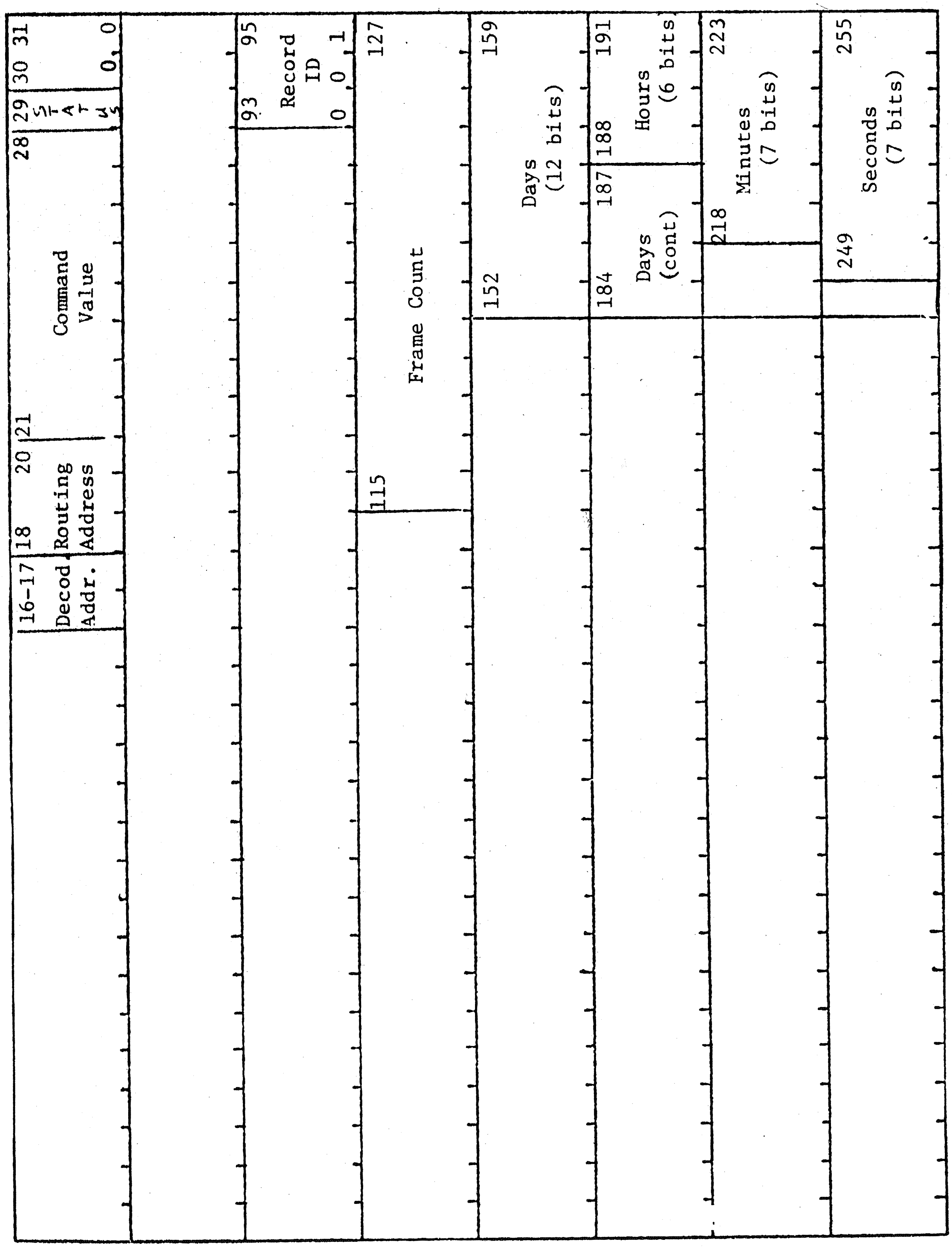
The header record is output when the magnetic tape output breakpoint switch goes from an <u>off</u> state to an <u>on</u> state.



2. MAGNETIC TAPE TELEMETRY LOSS-OF-SYNC RECORD

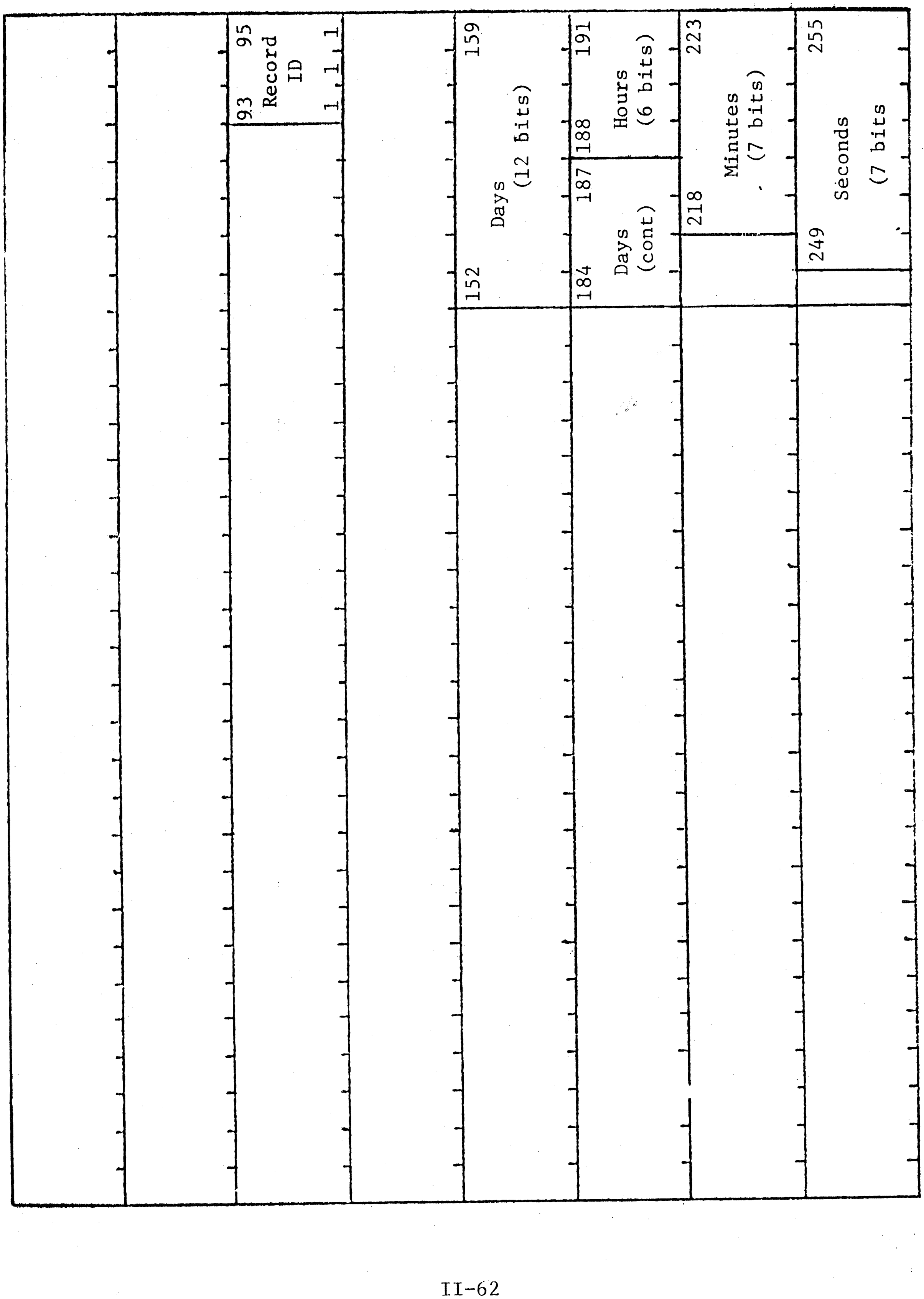


3. MAGNETIC TAPE COMMAND RECORD



4. MAGNETIC TAPE END-OF-DATA RECORD

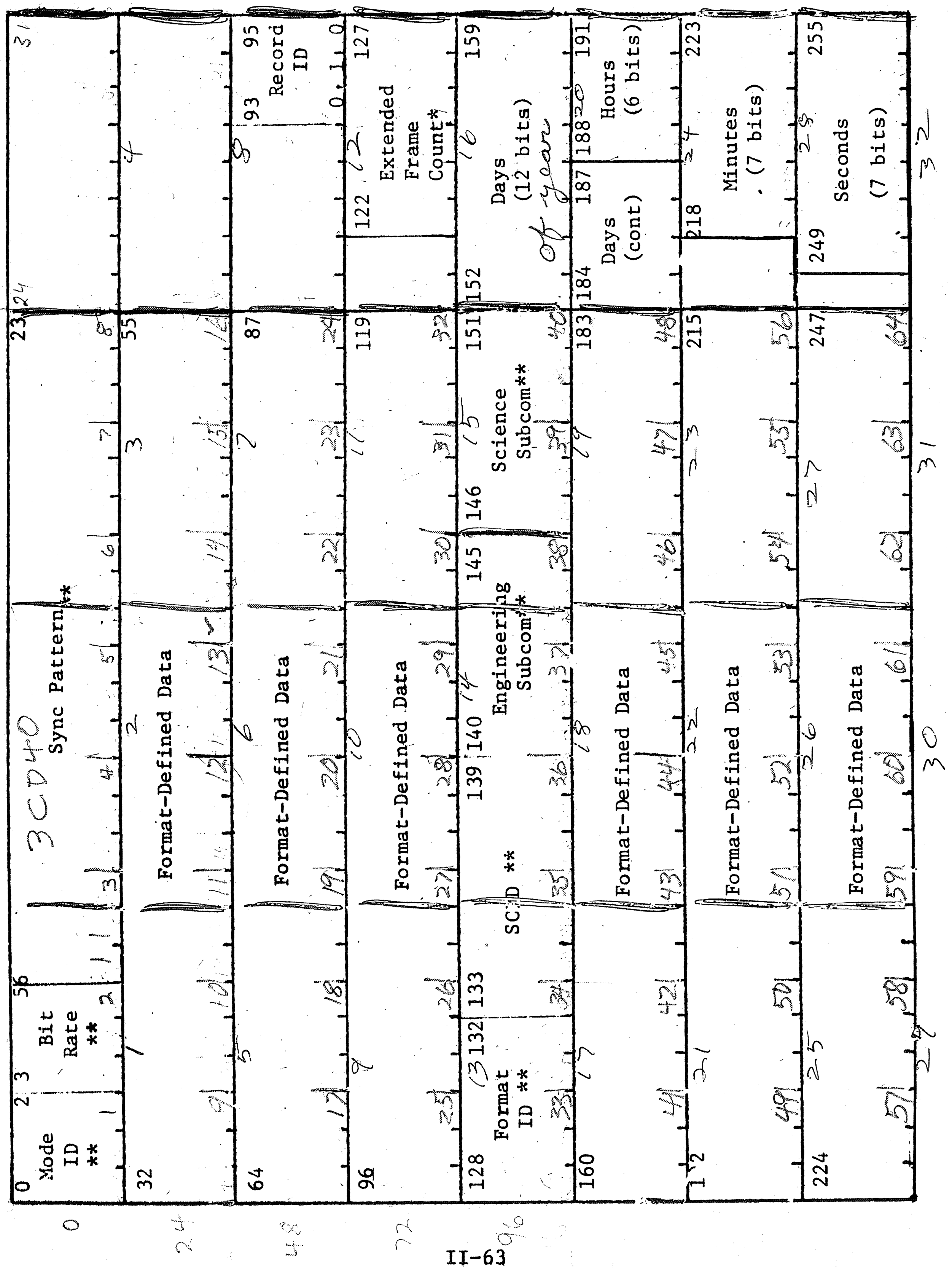
The following output occurs when the magnetic tape breakpoint switch goes from an <u>on</u> to an <u>off</u> state.

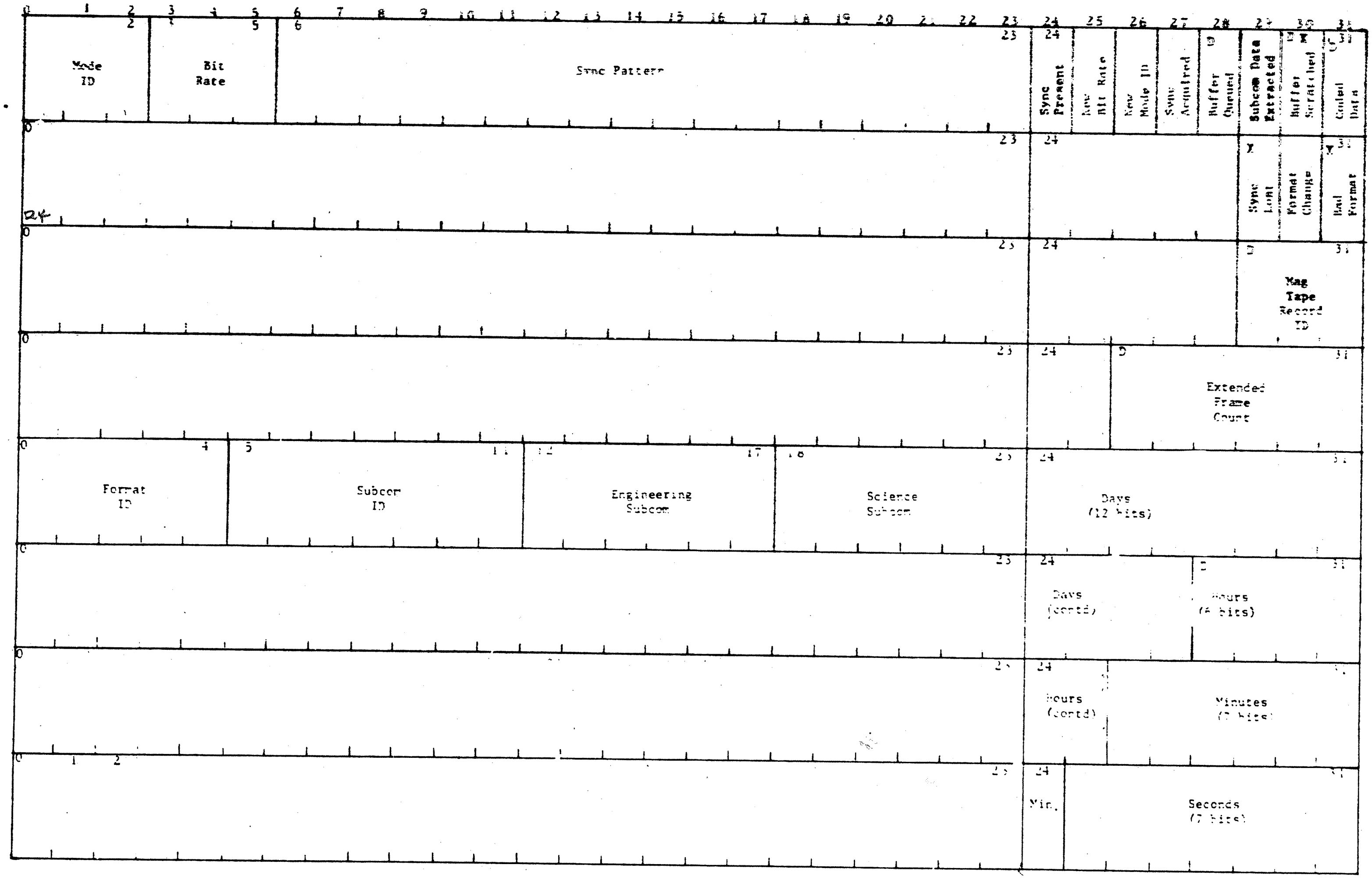


5. MAGNETIC TAPE TELEMETRY DATA RECORD

In the diagram, the fields marked with ** are replaced by format-defined data in a D mainframe. The fields marked with * are not available in a D mainframe.

Richard Zimmel
8-415-961-2804





D indicates those flags which are available in the D frame

X indicates those flags which will not be set in any queued-for-processing mainframe

Figure II-20. Mainframe Contents

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Dickhal

Pio

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA 94035

REPLY TO ATTN OF: PAM-4-63:244-8

December 30, 1974

TO: Distribution

Subject: Correction to Reference Axis Phase Error for Pioneer 10

Reference: Ames letter PAM-4-61:244-8, dated November 26, 1974

The purpose of this letter is to clarify and correct certain statements made in reference letter. The enclosure provides information on the roll sensor error that is to be substituted for that provided in the reference letter.

Roll pulse error data for Pioneer 10 provided in Figure 10 of the enclosure is to be used to correct the subject reference axis phase error (RAPE) in previously received experiment data records (EDRs). The Pioneer 10 experiment data records produced at ARC after January 1, 1975, will incorporate these values of roll pulse error in the sun clock angle parameter in order to minimize the effort required at each principal investigator's processing facility.

As stated previously, a similar report will be issued containing the results of analyses on the Pioneer 11 sun sensor assembly roll pulse error. Preliminary analyses indicated that the roll pulse error is very small at the sun cone angles experienced by this spacecraft during the Jupiter encounter period.

Charles F. Hall

Charles F. Hall
Manager, Pioneer Project

Enclosures:
1. Distribution list
2. As stated above

Enclosure 1

NASA - Ames

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Enclosure 2
December 17, 1974

NASA - Ames

PIONEER 10 ROLL PULSE ERROR ANALYSIS

INTRODUCTION

1. Sun Sensor Description. The sun sensor assembly (SSA) is a single assembly mounted at the edge of the high gain antenna dish along the +Y axis as shown in figure 1. It is designed to operate from 0.9 to 6.0 AU from the sun over a spin rate range of from 2-85 RPM and produces one roll pulse per revolution. As the apparent sun passes through the Z, +Y plane, the sun sensor produces a pulse. The sensor consists of three channels with overlapping fields of view as indicated in figure 1. Each channel of the sensor is designed using two detectors behind a slit as shown in figure 2. The sun pulse is derived using the differential photocurrent of the two detectors and is produced when the solar image formed by the optical slit and a lens passes over the detectors such that the differential signal exceeds a positive threshold. The individual and differential signal outputs are shown in figure 3. The width of the sensor field of view is nominally that determined by accuracy. This corresponds to the angular width of the detector signal responses shown in figure 3. The roll angular error, θe, is shown on the differential signal output curve of this same figure.

2. Summary. At the Pioneer Quarterly Review of August 9, 1972, the Pioneer 10/11 Roll Attitude Equations, Notation, and

Definitions (See enclosure A) were presented and agreed to for preparation of the Experimenter Data Records (EDRs). In this presentation, it was noted that the roll index pulse phase error was the electronically generated phase error measurement between the sun pulse (SUP) and the roll index pulse (RIP) and that no correction had been made for possible roll index pulse phase errors attributable to sun sensor characteristics such as misalignment, jitter, or bias. Thus, in the August 9th presentation the sun pulse was considered to be coincident with the sun crossing.

Subsequent to the launch of Pioneer 10 in an attempt to refine the roll attitude data, measurements and analyses were made to determine the magnitude of sun sensor errors. This investigation indicated that the sun pulse occurred prior to the passage of the sun by the reference axis resulting in a roll pulse error, ε (see figure 4). This roll pulse error, ε, was determined to vary as a function of sun aspect or cone angle. Thus, the equation for reference axis phase error (RAPE) shown in Enclosure A must be modified as follows:

$$\text{RAPE} = \text{CKAH} + \text{SPGR} + \text{RIPE} - \varepsilon$$

and previously calculated values of RAPE must be reduced by values of roll pulse error, ε, provided herein.

In order to eliminate changes to the investigator's computer programs to account for the roll pulse error, the Pioneer 10 Experiment Data Records produced after January 1, 1975, will incorporate the value of the roll pulse error, ε, in the column containing CKAH in File 3 such that this item will now be designated $CKAH_C$;and $CKAH_C$ = CKAH $-\varepsilon$.

ANALYSIS

1. Sun Sensor Error Sources. There are three primary error sources considered in this analysis:

    a. Jitter (pulse timing repeatability)

    b. Bias

    c. Misalignment

The jitter and bias error measurements were performed at the Honeywell Radio Center, Boston, Mass. The jitter errors were found to be constant at 0.83 milliseconds in the signal output at a 5 rpm spin rate. This measurement was transformed into an equivalent roll error in spacecraft attitude at a spin rate of 4.8 rpm. The jitter error is inversely proportional to the sine of the sun cone angle as shown in figure 5. The bias error measurements were made to demonstrate that the assembly meets all accuracy requirements. The bias measurements range shown in figure 5 is the range of values found for all tests; post thermal, post thermal/vacuum, post vibration, post magnetic and post environmental test measurements.

There are no test data available from alignment tests; however, curves that were presented in an early TRW proposal document are reproduced in figure 6 to show expected roll error for several values of alignment error. Evaluation of these plots would indicate that the roll error appears to be inversely proportional to the sine of the sun cone angle similar to the functional relationship for the jitter error.

Figure 7 represents the total error from all three error sources where the magnitudes of the jitter, bias, and a misalignment error of 0.2^o were combined algebraically. (The magnitude of the misalignment error is representative of a one sigma value of the total alignment tolerance specified in the TRW document Components Alignment Requirements and Allocations Interface Control Pioneer F/G C 311654.)

2. Error Measurement. Two basic independent methods were used to measure the roll pulse error (ε) for on orbit operation. Method 1 used the IPP instrument in a mode 4 configuration. A mode 4 threshold scan was made until lock was obtained on Jupiter. Then, without altering the instrument configuration, the sun sensor and star sensor were alternately commanded. The resultant shift in the roll position of Jupiter adjusted for position and attitude with respect to the ecliptic plane indicated the relative offset for the two sensors. This method assumed that neither the stellar reference assembly nor the IPP instrument has a significant systematic error in clock angle.
Method 2 measured the difference in S/C spin period when the sun sensor and star sensor were commanded alternately. The difference between the nominal and actual spin period was adjusted to account for the S/C position and attitude with respect to the ecliptic plane and the resultant value then represented the roll pulse error (ε).

RESULTS

1. Error Plots. Figure 8 shows the results of a number of measurements made using the approach described in method 1. Figure 9 shows the results of a greater number of measurements made using the approach described in method 2. Figure 10 shows a comparison

of predicted and observed error (using both methods) in roll position as a function of sun cone angle.

It is the Project Office opinion that the Method 2 results are indicative of the actual error that exists in roll pulse and therefore should be used for correcting past errors and will be used by the Project Office to provide $CKAH_c$ as previously discussed.

	FIELD-OF-VIEW	
CHANNEL	FROM X-Z PLANE	FROM Z-AXIS
1	-	±12° CONE
2	1/2°	10° TO 90°
3	1/2°	90° TO 170°

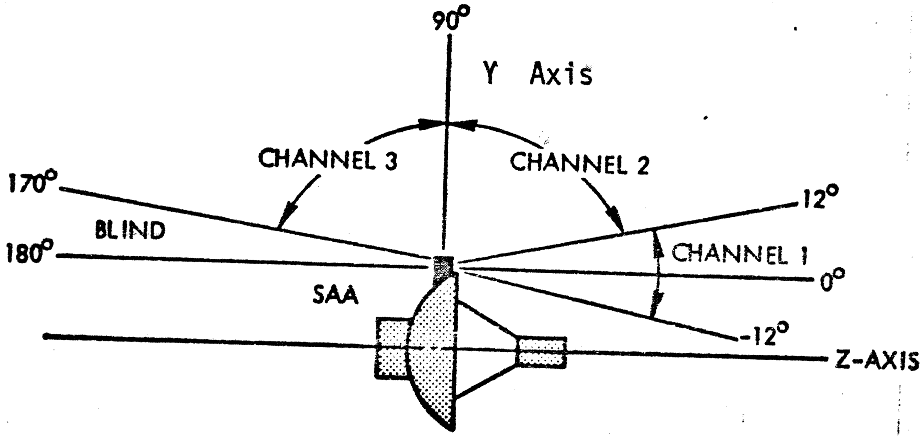


Figure 1 Sun Sensor Assembly (SSA) Mounting and Field-of-view.

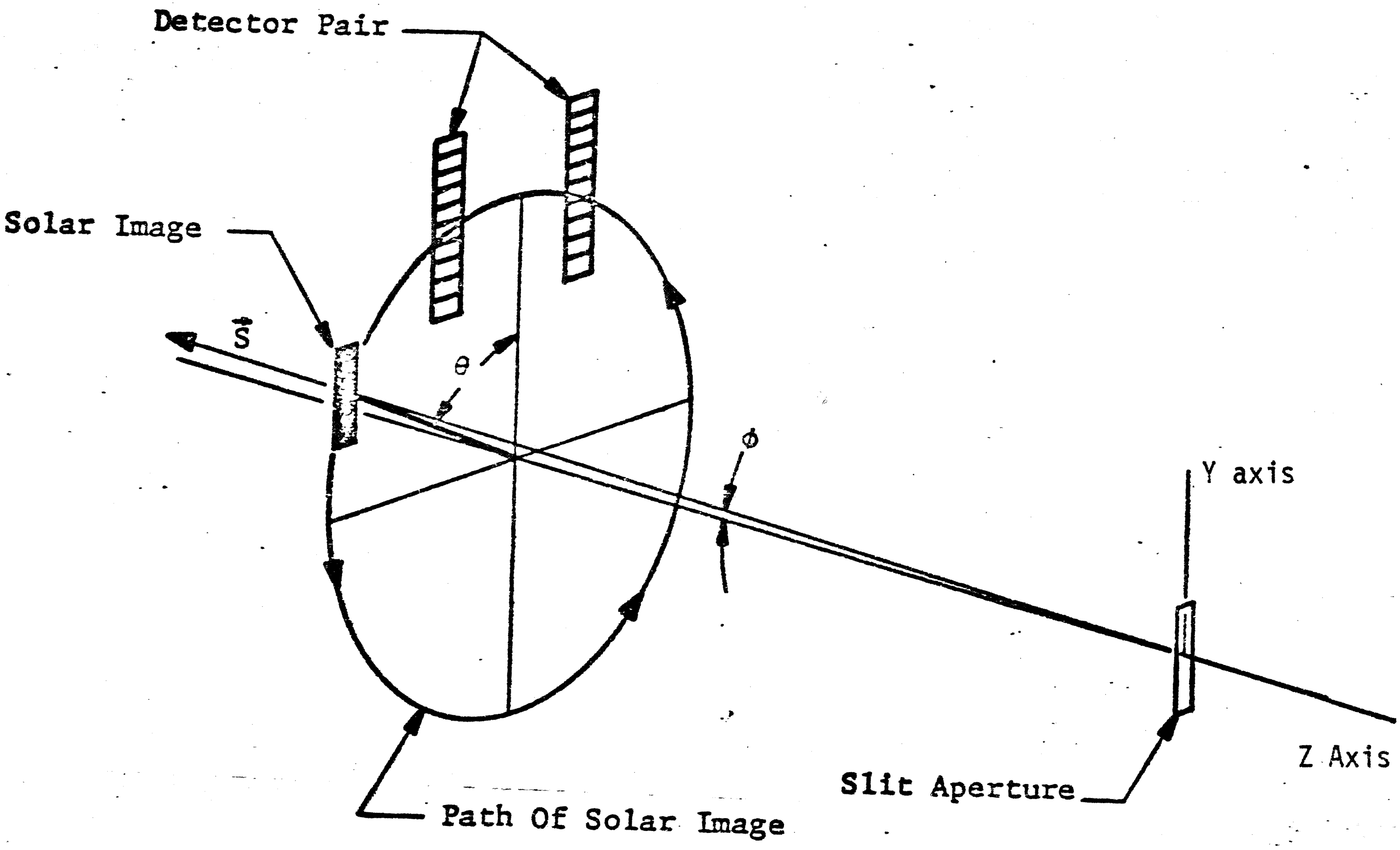
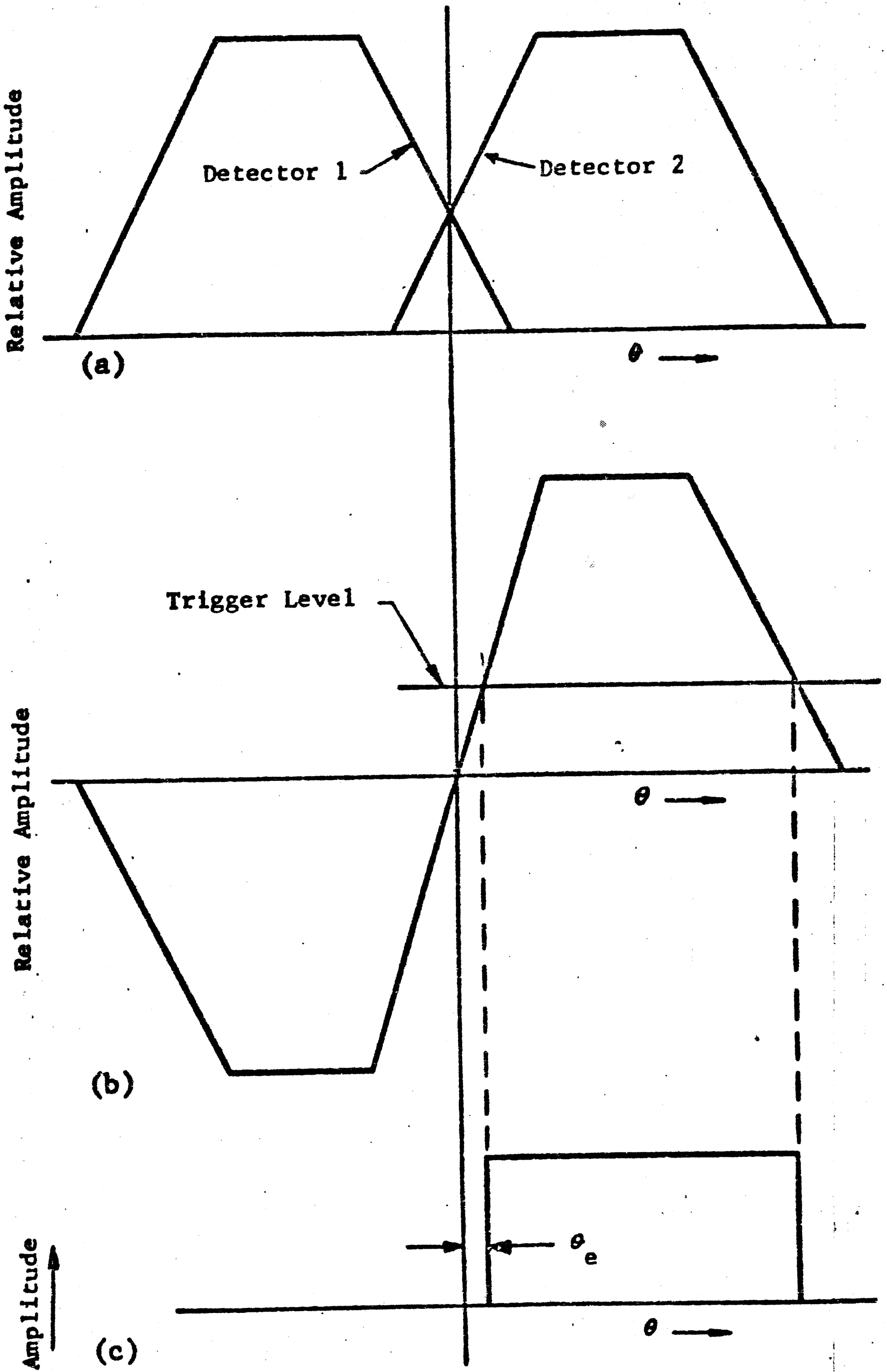


Figure 2 Idealized Representation of (SSA) Optical Principle

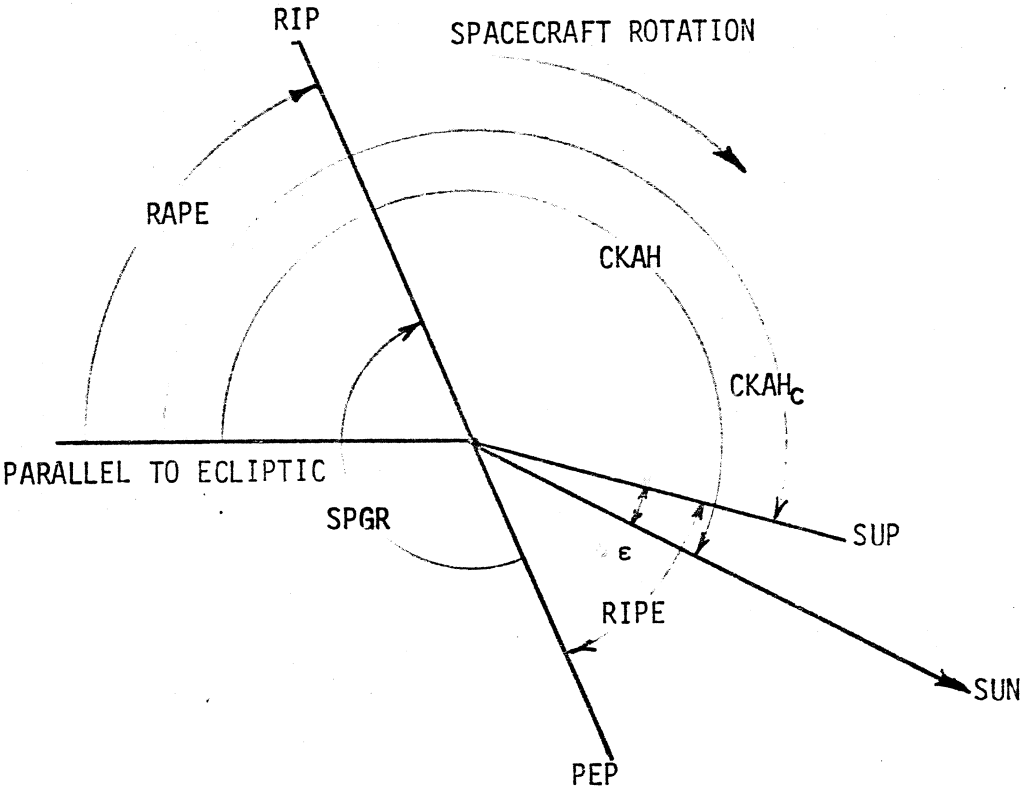


(a) INDIVIDUAL DETECTOR OUTPUTS
(b) DIFFERENTIAL OUTPUTS
(c) NET OUTPUT PULSE

Figure 3 Sun Sensor Assembly Detector Outputs.

Figure 4

ROLL PULSE DEFINITIONS



CKAH	CLOCK ANGLE OF SUN, UNCORRECTED FOR ERRORS, DEG.
ε	ROLL PULSE ERROR (plus for sun pulse (SUP) occurring prior to defined sun passage (SUN))
PEP	PHASE ERROR PULSE, DEG.
RAPE	REFERENCE AXIS PHASE ERROR, DEG.
RIP	ROLL INDEX PULSE
RIPE	ROLL INDEX PULSE PHASE ERROR, DEG.
SPSG	SPIN PERIOD SECTOR GENERATOR, 0^{o} or 180^{o}
SUP	SUN PULSE

$$CKAH_c = CKAH - \varepsilon$$

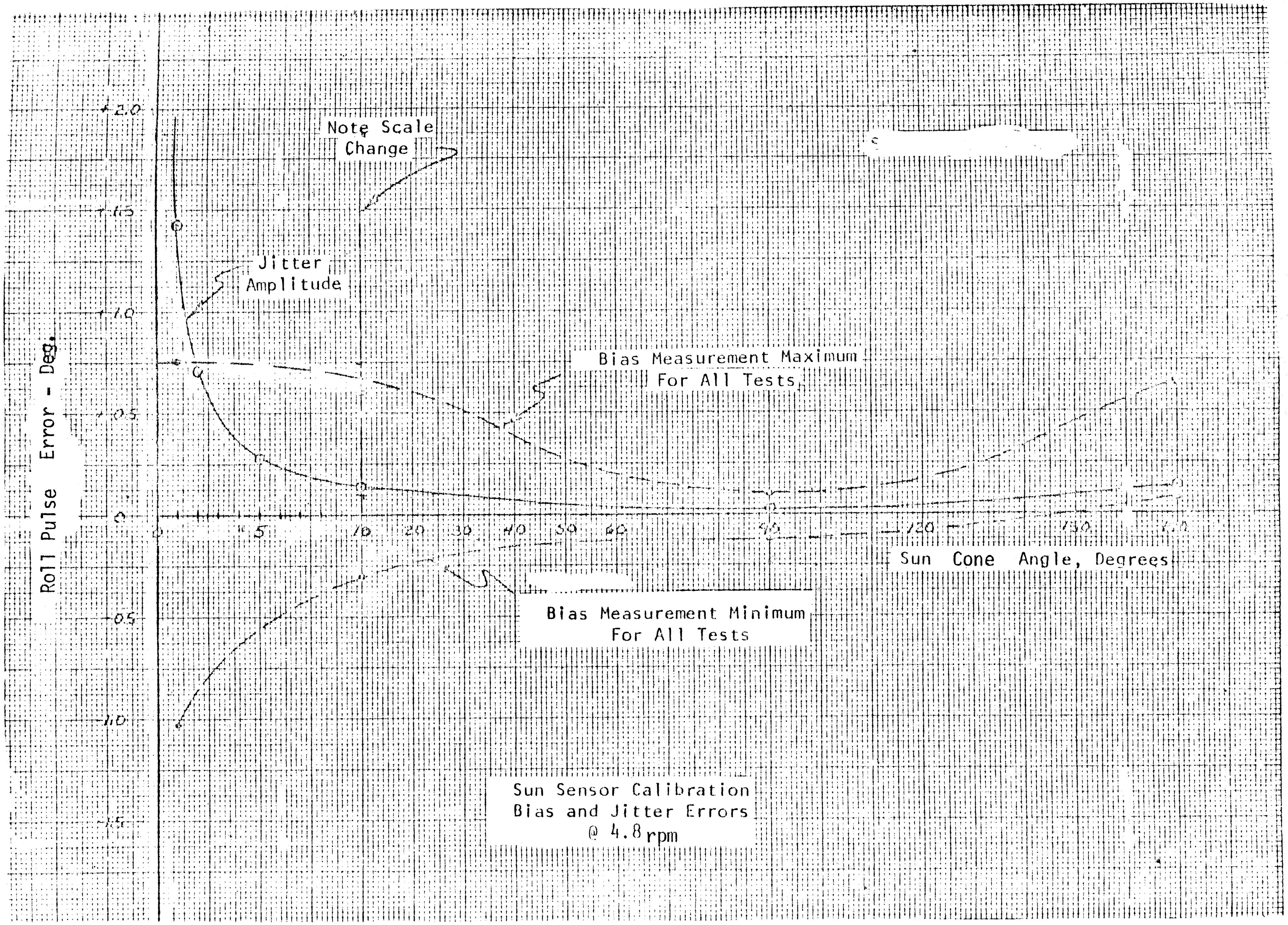


Figure 5 Roll Pulse Error as a Function of Sun Cone Angle Due to Sun Sensor Jitter and Bias Errors

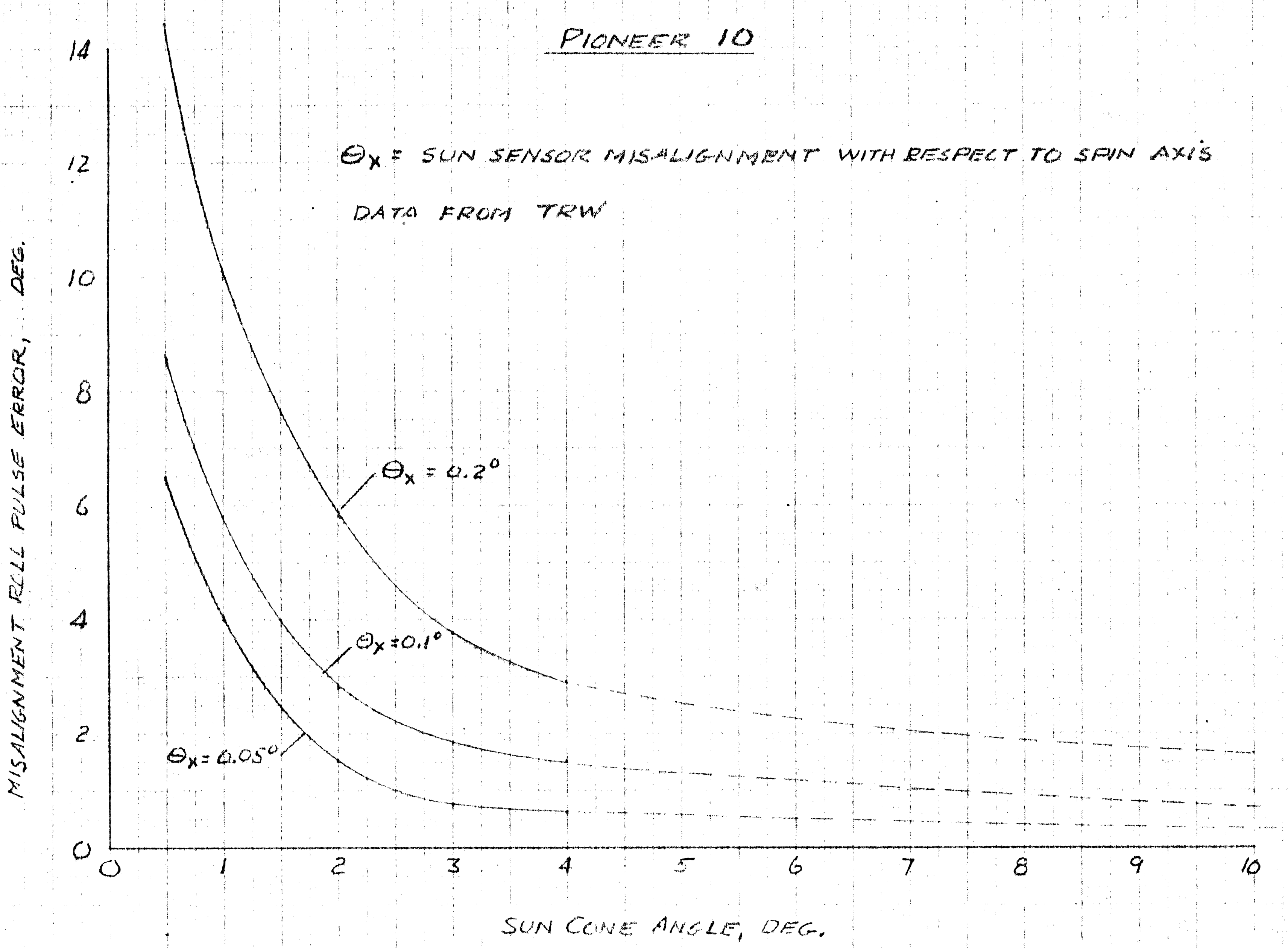


FIGURE 6 - ROLL PULSE ERROR AS A FUNCTION OF SUN CONE ANGLE DUE TO SUN SENSOR MISALIGNMENT.

8/29/74

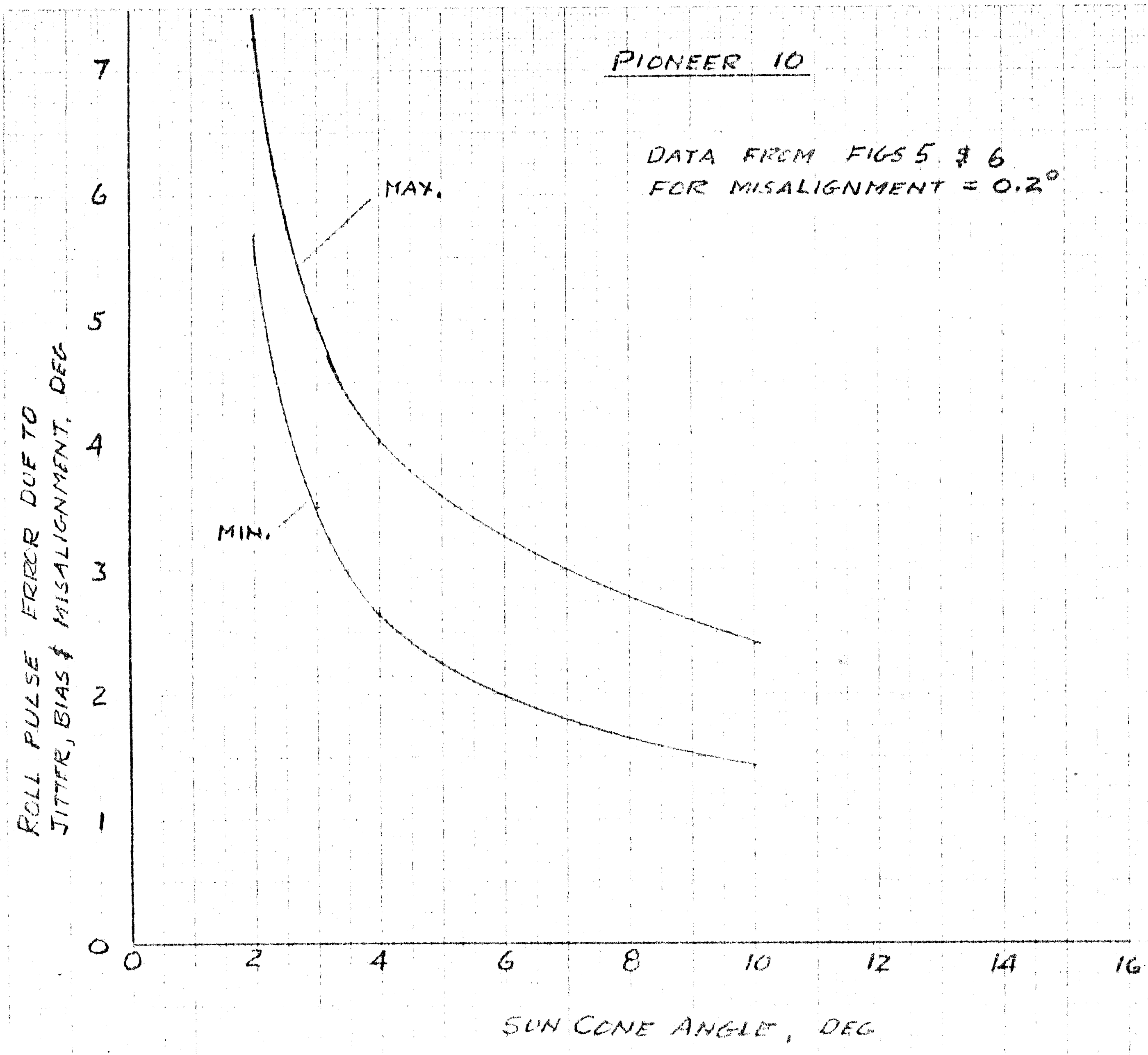


FIGURE 7 - ROLL PULSE ERROR AS A FUNCTION OF SUN CONE ANGLE DUE TO SUN SENSOR JITTER PLUS BIAS PLUS MISALIGNMENT

8-29-74

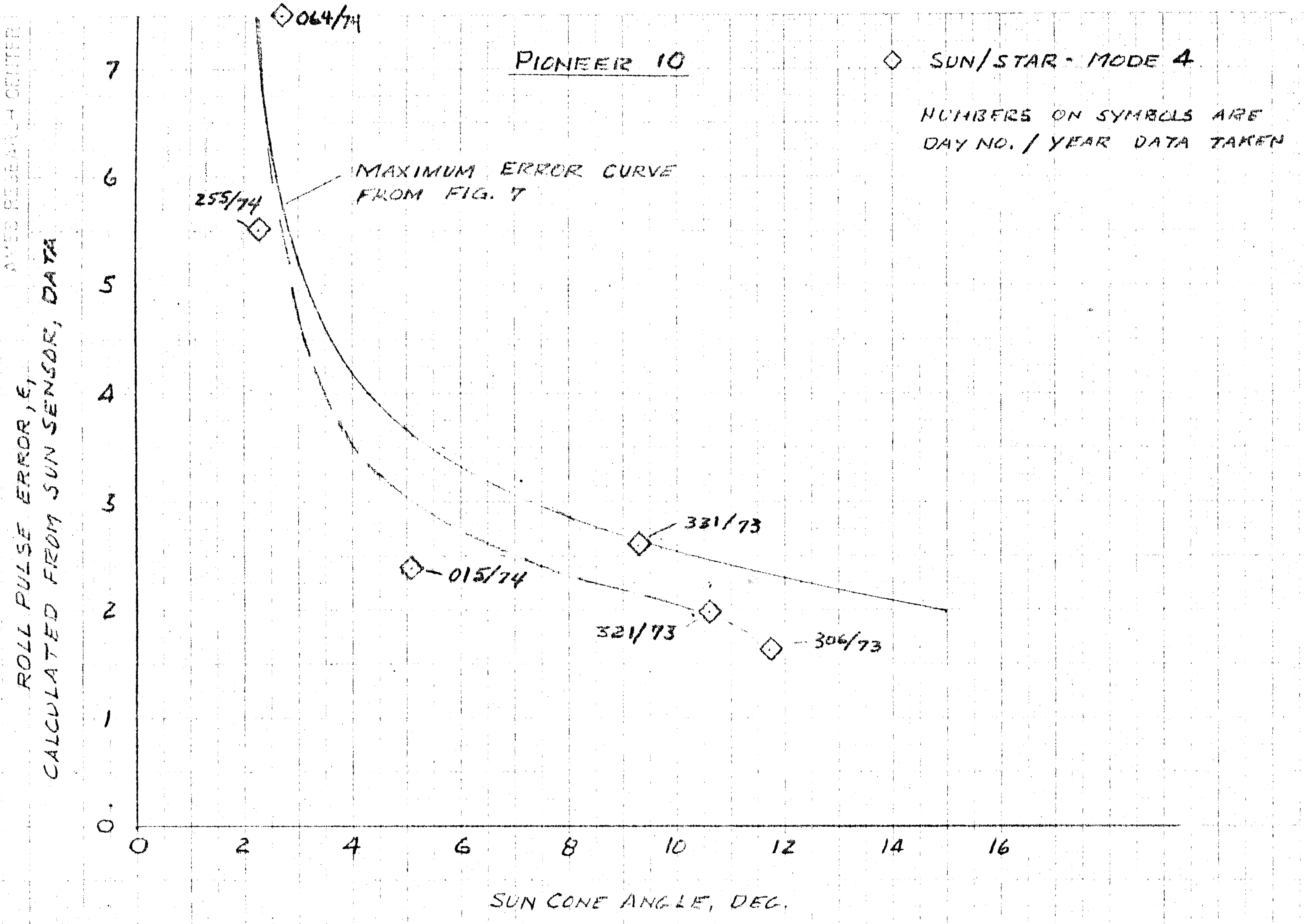


FIGURE 8 - COMPARISON OF ROLL PULSE ERROR FROM FIG. 7 WITH ROLL PULSE ERROR FROM MODE 4 DATA

8-29-74

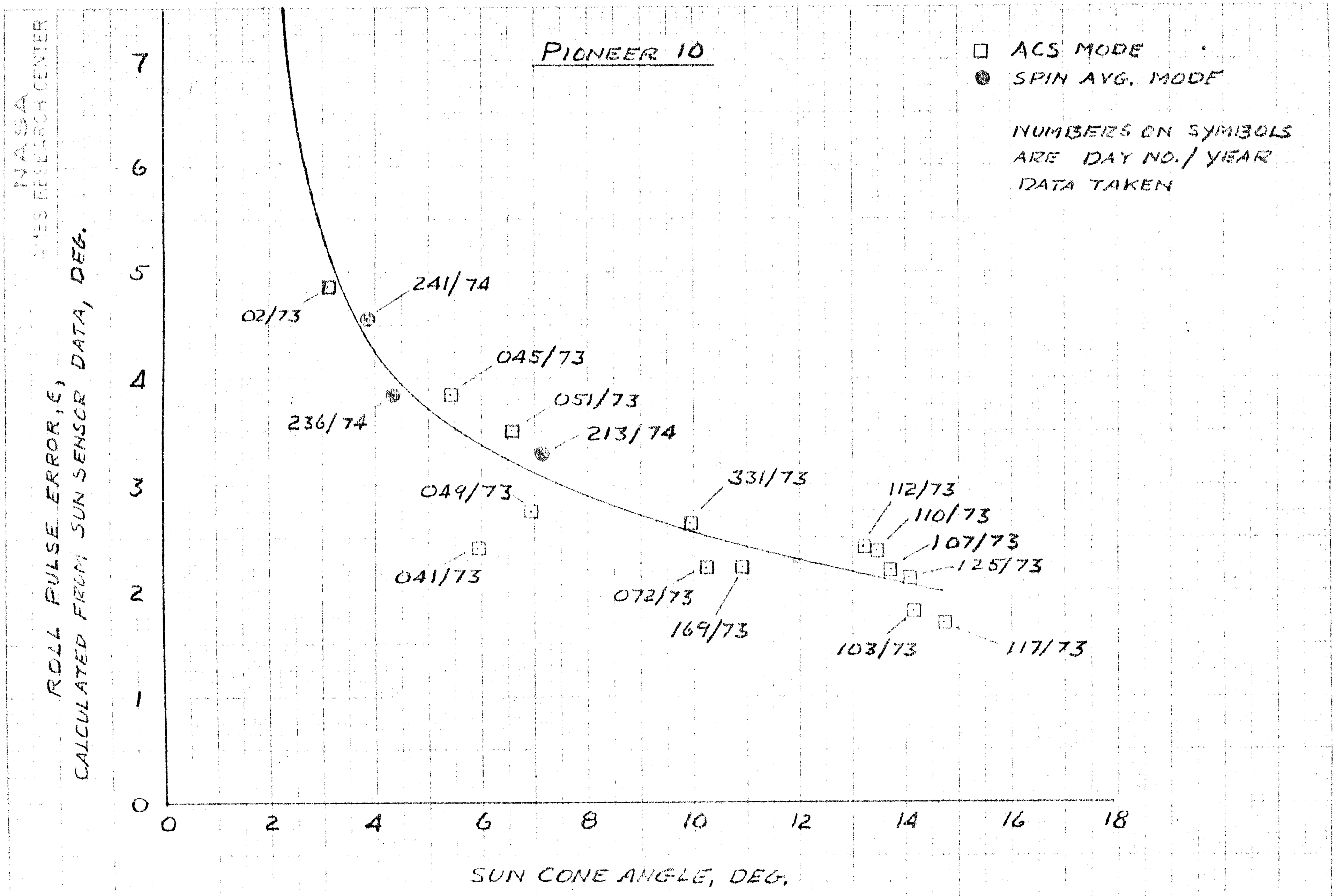


FIGURE 9 - ERROR IN ROLL PULSE CALCULATED FROM CHANGE OF SPIN PERIOD WITH CHANGE OF REFERENCE SENSOR.   8-29-74

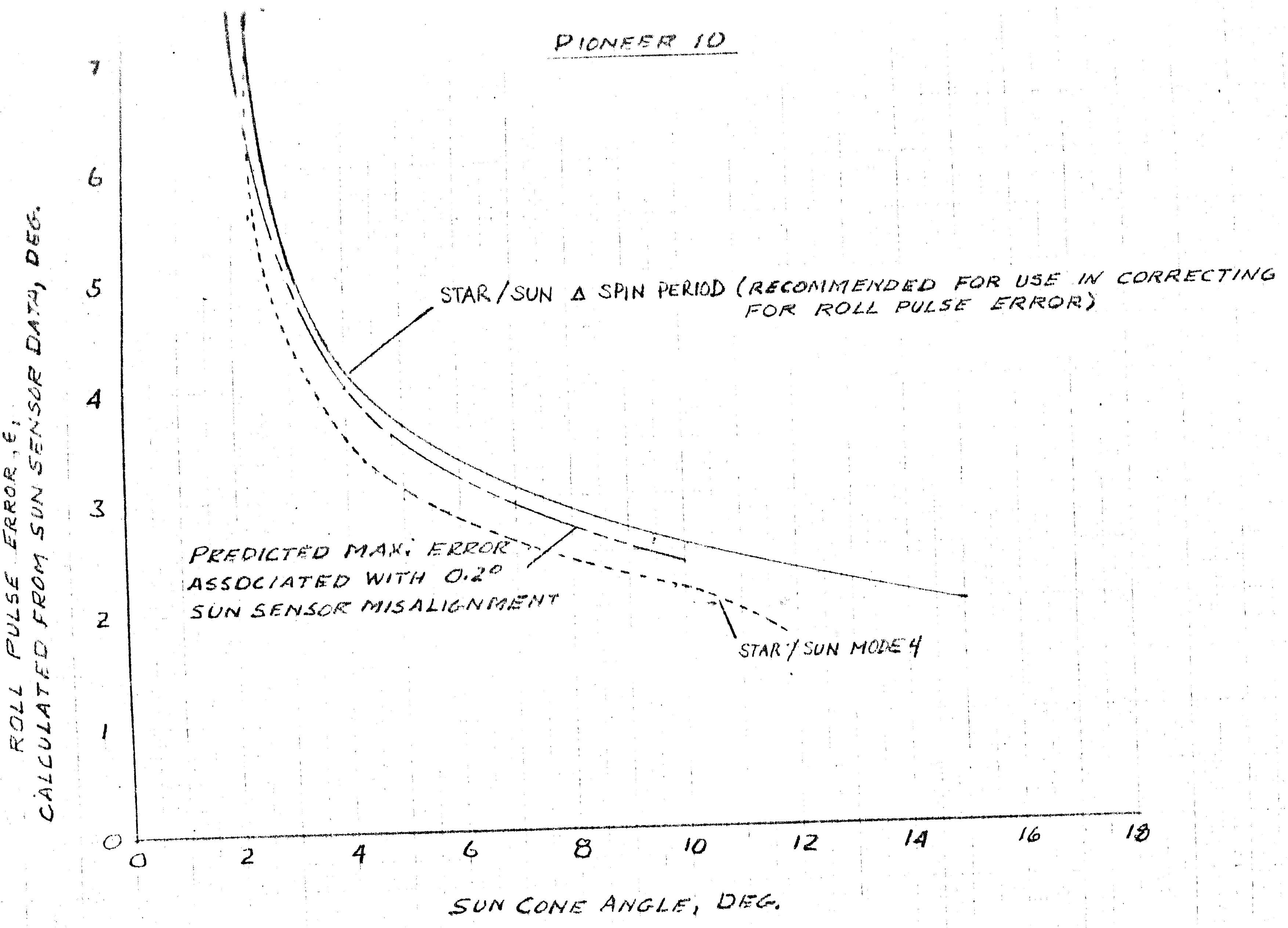


FIGURE 10 - COMPARISON OF PREDICTED AND OBSERVED ERROR IN ROLL PULSE WHEN CALCULATED FROM SUN SENSOR DATA AS A FUNCTION OF SUN CONE ANGLE

Enclosure A

PIONEER 10 ROLL ATTITUDE EQUATIONS

RAPE = CKAH + SPGR + RIPE (FOR SUN)

RAPE = CKAS + 25 + STD + RIPE + SPGR (FOR STAR)

USING SCID

$$RAAB = \frac{360}{SPP}\left[RAT + \frac{C+n}{BIT} + \frac{K(\Delta SCID)}{BIT}\right] + RAPE$$

$$RAAF = \frac{360}{SPP}\left[RAT + \frac{C+1}{BIT} + \frac{K(\Delta SCID)}{BIT}\right] + RAPE$$

(NOTE: USE ONLY FIRST NEW VALUE FOR RAT)

FORMAT	C	K
C-1; C-5	-67	192
C-2, C-3, C-4, A, B	+659	192
A/D, A/B	+659	384

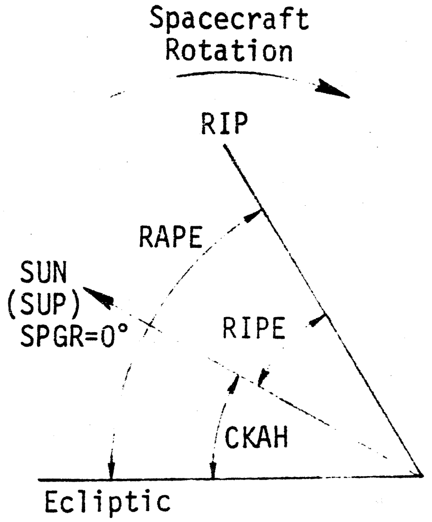
USING GMT

$$RAAB = \frac{360}{SPP}\left[RAT - GMTT + \frac{n-1}{BIT} + GMTF\right] + RAPE$$

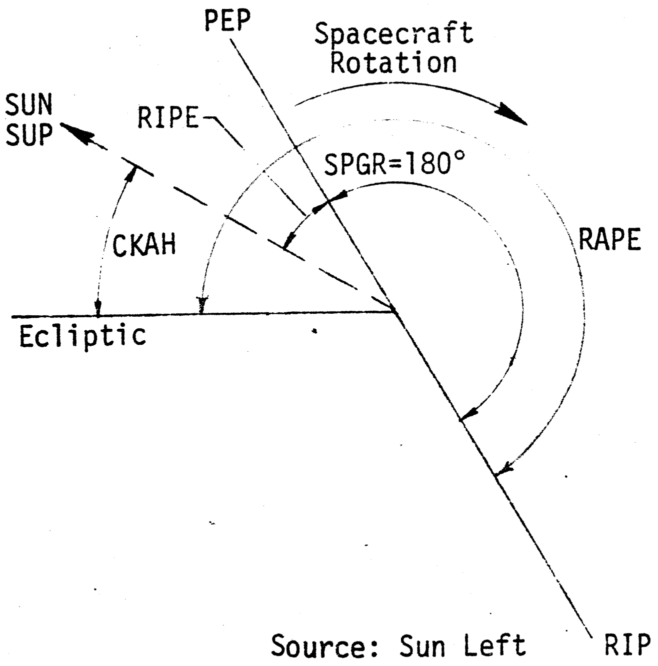
$$RAAF = \frac{360}{SPP}\left[RAT - GMTT + GMTF\right] + RAPE$$

PPO/20-2.03c
PPO/21-2.01c
PPO/22-2.6-4

ROLL PULSE DEFINITIONS

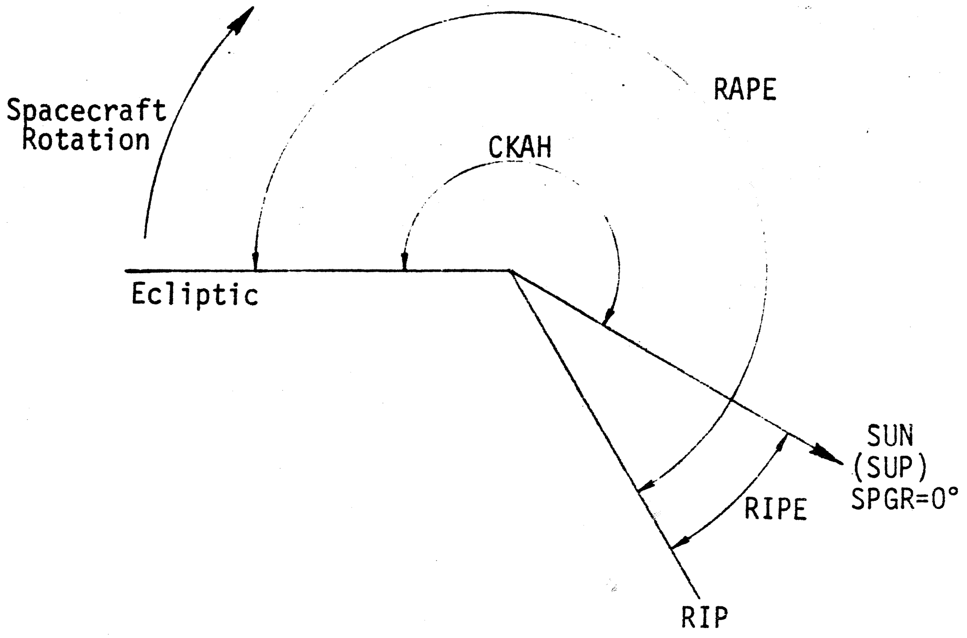


Source: Sun Left
SPGR: 0°

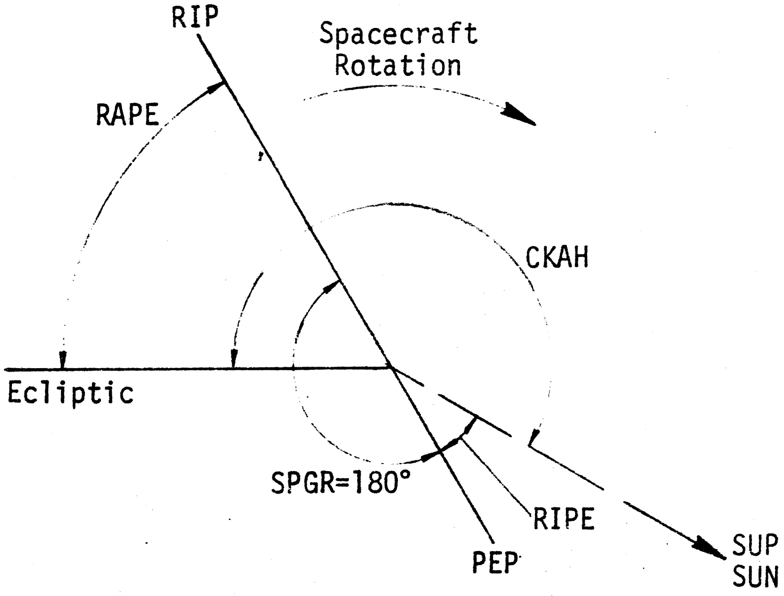


Source: Sun Left
SPGR: 180°

ROLL PULSE DEFINITIONS

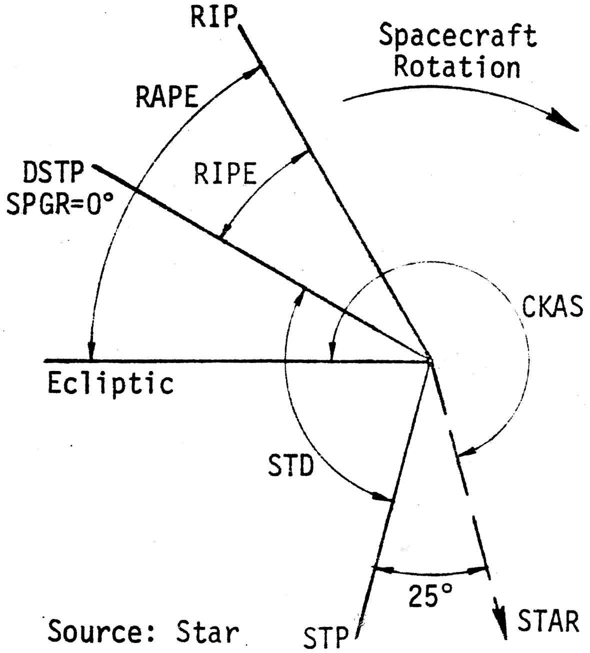


Source: Sun Right
SPGR: 0°

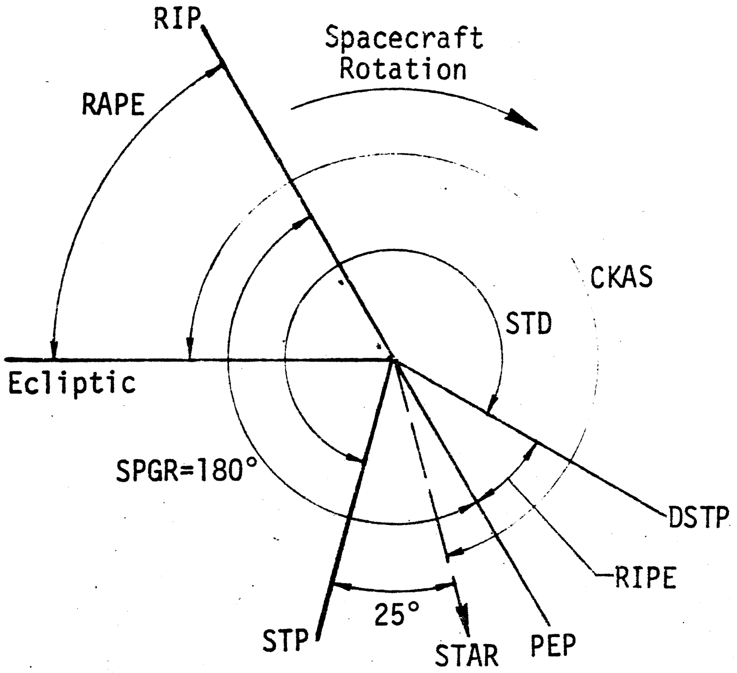


Source: Sun Right
SPGR: 180°

ROLL PULSE DEFINITIONS



Source: Star
SPGR: 0°



Source: Star
SPGR: 180°

PIONEER 10 ROLL ATTITUDE

NOTATION

PEP	PHASE ERROR PULSE
BIT	BIT RATE, BITS PER SEC
CKAH	CLOCK ANGLE OF SUN, DEG
CKAS	CLOCK ANGLE OF STAR, DEG
c,k	CONSTANTS
GMTF	GMT AT BEGINNING OF TLM DATA FRAME FOR WHICH RAAB OR RAAF IS BEING CALCULATED
n	BIT NUMBER IN FRAME
RAA	REFERENCE - AXIS ANGLE, DEG (MEASURED RELATIVE TO ASCENDING NODE OF S/C EQUATOR)
RAAB	RAA AT BEGINNING OF BIT "n", DEG
RAAF	RAA AT BEGINNING OF TLM DATA FRAME, DEG
RAPE	REFERENCE - AXIS PHASE ERROR (RAA AT TIME OF RIP)
RAT	ROLL - ATTITUDE - TIMER, SEC (TIME FROM RIP TO RAT TLM READOUT)
RIP	ROLL - INDEX PULSE
RIPE	ROLL - INDEX PULSE PHASE ERROR
RP	ROLL PULSE
SCID	SUBCOMMUTATOR IDENTIFICATION NUMBER, TLM DATA FRAME NUMBER
ΔSCID	DIFFERENCE BETWEEN SCID OF FRAME FOR WHICH RAAB OR RAAF IS BEING CALCULATED AND FRAME CONTAINING TLM WORD C-116 OF FIRST NEW VALUE OF RAT
SPP	SPIN PERIOD, SECS
SPGR	SPIN - PERIOD - SECTOR - GENERATOR ROLL REFERENCE
STD	STAR DELAY, DEG
STP	STAR PULSE
SUP	SUN PULSE
GMTT	GMT AT FIRST BIT OF TLM WORD C-112 OF FIRST NEW VALUE OF RAT

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3101-02000-02TN

APPENDIX B

(ERDLST MODIFICATIONS)

Prepared by
M. W. Scott

COMPUTER SCIENCES CORPORATION

For

GODDARD SPACE FLIGHT CENTER

Under

Contract No. NAS 5-11790
Task No. 3101-02000

March 1973

EDRLST MODIFICATIONS

The Pioneer F/G Tape List Program has been modified for the following purposes: to print the subcom data in octal and to copy the EDR tape by option.

Deck Setup

Added to the JCL is the following set of DD cards:

```
//GO.FT11F001 DD DSN=EDRIN,UNIT=(2400-9,,DEFER),DISP=(NEW,KEEP),
// DCB=(RECFM=U,BLKSIZE=5204,DEN=2),LABEL=(,BLP,,OUT),VOL=SER=DUM2
```

The purpose of this data set is:

DD Name	Purpose of Data Set	Input/ Output	Device Type	Code
FT11F001	Backup EDR tape	Output	Tape	C

The meaning of the code is as follows:

C - Copy EDR tape onto backup tape

```
//PEDR EXEC LINKGO,REGION.GO=100K
//LINK.SYSLIB DD DSN=K3.ZIART.OGENERAL,DISP=SHR
//             DD DSN=K3.ZBRXB.SB001.OPIONEER,DISP=SHR
//GO.FT06F001 DD DCB=(BUFNO=4)
//GO.FT10F001 DD DSN=EDRIN,UNIT=(2400-9,,DEFER),DISP=(OLD,KEEP),
// DCB=(RECFM=U,BLKSIZE=5204,DEN=2),LABEL=(,BLP,,IN),VOL=SER=DUM1
//GO.FT11F001 DD DSN=EDRIN,UNIT=(2400-9,,DEFER),DISP=(NEW,KEEP),
// DCB=(RECFM=U,BLKSIZE=5204,DEN=2),LABEL=(,BLP,,OUT),VOL=SER=DUM2
//GO.SYSUDUMP DD SYSOUT=A
//GO.DATA5 DD *
 &INPUT DTAPE='E02102',QATT=T,LIMITS=1,1,QCOPY=T,DBUTP='Z-169'  &END
```

(Note the example of the additional parameters to NAMELIST. In this example, the decom tape residing in slot E02102 is copied onto the tape residing in slot Z-169.)

Figure 1. General Deck Setup for Executing the Pioneer F/G EDR Tape List Program (EDRLST)

Input/Output Tape

The backup EDR tape is formatted the same as the EDR tape. (Refer to Section 6.3.3.1 for the format. Its location is specified by namelist input parameter DBUTP.)

Cards

Added to the NAMELIST name INPUT are the following:

QCOPY	=	T - If a backup EDR tape is to be made. F - If no backup EDR tape is to be made. (Default = F)
DBUPTP	=	The location (tape slot) or symbol identifying the EDR backup tape (See DTAPE, Section 6.3.3.2). (Default = blank)

PRINTED REPORTS

(Refer to Section 6.3.3.3 for a detailed description of the Printed Reports)

Input/Output Tape

The backup EDR tape is formatted the same as the EDR tape. (Refer to Section 6.3.3.1 for the format. Its location is specified by namelist input parameter DBUTP.)

Cards

Added to the NAMELIST name INPUT are the following:

QCOPY = T - If a backup EDR tape is to be made.
F - If no backup EDR tape is to be made.
(Default = F)

DBUPTP = The location (tape slot) or symbol identifying the EDR backup tape (See DTAPE, Section 6.3.3.2).
(Default = blank)

PRINTED REPORTS

(Refer to Section 6.3.3.3 for a detailed description of the Printed Reports)

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11

JET PROPULSION LABORATORY

Rio

MEMORANDUM

January 9, 1975

TO: Pioneer 11 VHM Co-Investigators and Particle Experimenters

FROM: Edward J. Smith EJS

SUBJECT: Printouts of Preliminary Quick-Look Data

Enclosed are printouts of our preliminary quick-look data obtained during the entire duration of the Pioneer 11 encounter. At the request of the particle investigators, the data are given in the PE or Pioneer-Inertial coordinates (see attached figure). A separate cover sheet explains the various data listings. These data are to be used for correlation purposes subject to the conditions set forth in our letter of agreement governing the exchange of data (dated 31 July 1972).

EJS:pjw

Distribution

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D. E. Jones
D. S. Colburn
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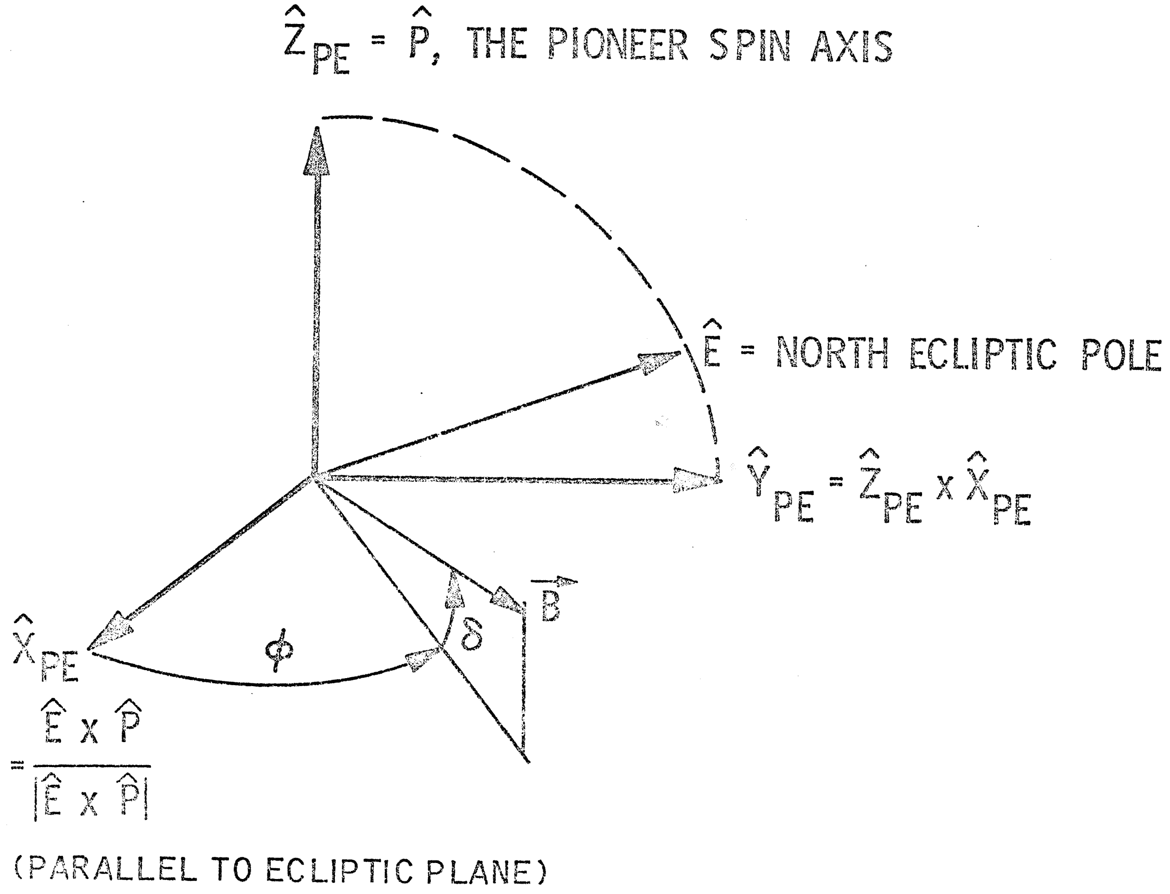
C. P. Sonett
R. W. Fillius
F. B. McDonald
J. A. Simpson
J. Wolfe

PIONEER 11 JUPITER ENCOUNTER QUICK-LOOK MAGNETIC FIELD DATA
FROM THE JPL VECTOR HELIUM MAGNETOMETER.

GRUT	GROUND RECEIPT UNIVERSAL TIME, IN DECIMAL HOURS-OF-THE-DAY. (BASIC TIME RESOLUTION = 0.0001 DAYS = 8.64 SECONDS = 2.4*E-03 HOURS).
BXPE	AVERAGE X COMPONENT OF MAGNETIC FIELD IN PIONEER INERTIAL COORDINATES.
BYPE	AVERAGE Y COMPONENT OF MAGNETIC FIELD IN PIONEER INERTIAL COORDINATES.
BZPE	AVERAGE Z COMPONENT OF MAGNETIC FIELD IN PIONEER INERTIAL COORDINATES.
|B|	SQUARE ROOT OF THE SUM OF THE SQUARES OF THE THREE COMPONENT AVERAGES.
BCKPE	CLOCK ANGLE OF MAGNETIC FIELD IN PIONEER INERTIAL COORDINATES.
BCNPE	CONE ANGLE OF MAGNETIC FIELD IN PIONEER INERTIAL COORDINATES.
DURATION	WIDTH OF DATA AVERAGING WINDOW, IN SECONDS. (GROUND RECEIPT TIMES CORRESPOND TO THE MIDDLE OF THE AVERAGING WINDOW).
REMARKS	ALL COMPONENT AVERAGES WERE ENTERED AT A TIME-SHARE COMPUTER TERMINAL AND MAY THEREFORE CONTAIN TYPING ERRORS. IN MANY CASES, THE DATA WERE ENTERED WITH A PRECISION OF JUST FOUR SIGNIFICANT FIGURES EVEN THOUGH FIVE ARE PRINTED OUT HERE. AN ATTEMPT HAS BEEN MADE TO APPLY THERMAL AND EDDY CURRENT ROLL ATTITUDE CORRECTIONS TO THE OCCULTATION DATA. HOWEVER, A DEGREE OR TWO OF ROLL ERROR MAY STILL BE LURKING IN THESE DATA. THE GROUND RECEIPT TIMES OF THE OCCULTATION DATA ARE ALSO MORE UNCERTAIN THAN THE OTHERS.

PIONEER INERTIAL (PE)
COORDINATES



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COMPUTER SCIENCES CORPORATION
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April 4, 1974

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: P. C. Yu
Code 664.0
Bldg. 02, Room 271

Subject: Documentation Status for Code 664

Gentlemen:

Enclosed are three copies of a table prepared at your request giving the status of all documentation currently under preparation for GSFC Code 664. Also included are titles of documents delivered since early July of 1973 and their associated delivery dates.

If I may be of any further assistance to you in this matter, please contact me.

Very truly yours,

COMPUTER SCIENCES CORPORATION

M. L. Sandson

M. L. Sandson
Technical Area Manager
Scientific Data Analysis

cc: C. Dickman
Code 664
Bldg. 02, Room 271

MLS/ed

SHORT TITLE	AUTHOR	DOCUMENT NUMBER	STATUS
UK-5 GEOM	Goldberg	3000-01900-02TN	Being drafted.
OSO-I & HELOIS 1800 Notes	Korpi	Includes revised 9101-00800-0TN and 3000-10500-01TN	Delivered 20 Feb. 74
NOVA Hardware/Software Interface Specifications	Simpson	3000-01500-01TM	Delivered typed draft Jan. 74
OGO-E 10 Intermediate Flux Program PD. & UG	A. Serlemitsos	3101-02400-01TM	Delivered 10 copies Nov. 30, 1973
Pioneer F/G Rates Summary and Rates Display Program	N. Lal	3000-01600-01TM	Documentation effort suspended indefinitely. Documentation is in the form of hand draft and has been seen by P. Bracken & C. Dickman
IMP-I Intermediate Flux PD & UG	R. Dubord	3101-02100-02TM	Delivered 3 copies Aug. 30, 1973
IMP-I Rates Plot Program PD & UG	R. Dubord	3101-02100-01TM	Delivered 3 copies Aug. 23, 1973
IMP-I and OGO 3/5 Flux Display Program PD & UG	R. Dubord	3101-02100-03TM	Delivered 3 copies Sept. 20, 1973

SHORT TITLE	AUTHOR	DOCUMENT NUMBER	STATUS
Documentation of the revised Trend Check Algorithm	S. Rudie	N/A	Update of the revised trend check algorithm were transmitted for documents 3101-0200-02TM and 3101-02100-04TN. Dec. 15, 1973
IMP-I Orbital Merge Program	R. Dubord	3000-01800-01TM	Delivered handdraft of documentation Jan. 15, for GFSC review
IMP-I Count Summary Program	J. Childs	3000-01800-02TM	Delivered handdraft of documentation Jan. 15, 1974
IMP-H Solar Electron DPS PD & UG	B. Wells	3101-02100-06TM	Delivered one work copy Dec. 30, 1973
IMP-H LISTALL PD & UG	B. Wells	3101-02100-04TM	Delivered one work copy Jan. 15, 1974
IMP-H TRPLOT PD & UG	B. Wells	3101-0200-05TM	Delivered one work copy February 1, 1974

DOCUMENTED SINCE JULY 1, 1973

SHORT TITLE	AUTHOR	DOCUMENT NUMBER	STATUS
HECRE PMPLUS	Grobowsky	3101-01900-01TM	Delivered 23 Aug. '73
SAS-B Summary Program UG	McQuinn	3101-01700-01TM	Delivered 11 Oct. 73
SAS-B 1130 Data Display UG	McQuinn	3101-01700-03TM	Delivered 11 Oct. 73
SAS-B Info. Ret. System UG	Holbrook	3101-01700-04TM	In second review *
SAS-B QLATT PD	Young	3101-01700-05TM	Delivered 23 Oct. '73
SAS-B QLATT UG	Young	3101-01700-06TM	Delivered 24 July '73
SAS-B QLOAMRGE UG	King, Young	3101-01700-07TM	Delivered 12 Oct. '73
SAS-B S/360 Info. Ret. PD	Holbrook	3101-01700-08TM	In second review *
SAS-B 1130 Display Program PD	McQuinn	3101-01700-09TM	Delivered 23 Oct. '73
SAS-B EAP Program Mods	Holbrook	3101-01700-03TM	Delivered 26 Mar. '74
SAS-B Summary Programs PD	McQuinn	3101-01700-10TM	In first review *
SAS-B Sensitivity Program UG	Holbrook, McQuinn, Greville	3101-01700-11TM	In first review*
SAS-B QLOAMRGE PD	Young	3000-02100-01TM	In first review *
SAS-B PRATT PD	Young	3000-02100-02TM	Being drafted
UK-5 UK5SCAN PD&UG	Silbergeld	3101-02500-01TM	Delivered 6 Sept. '73
UK-5 UK5SCAN Change Pages	Silbergeld	3101-02500-01TM Mod. 1	Final correction and signoff
UK-5 UK5MAP DOC.	Silbergeld	3000-01900-01TM	In first review
SAS-B Sensitivity Program PD	Holbrook, McQuinn, Greville	3000-02100-03TM	In first review *
SAS-B 1130 Info. Ret.Prgm. PD	M. King	3000-02100-04TM	In first review *
SAS-B PRATT UG	Young	3000-02100-05TM	Being drafted
SAS-B E+E- Track I/D PD	Greville	3000-02100-06TM	Being drafted

* Drafted prior to the end of August 1973 - Work suspended on these documents because there are no current plans to use them.

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TABLE OF CONTENTS

SECTION 1 - INTRODUCTION

This note documents modifications made to program PIPLOT in order to:
(1) effect significant reduction in core requirements and CPU time; and
(2) generate an index of plots and histograms produced by the program, and a summary of time periods included in the plots and histograms.

In addition to documenting the new subroutines that were developed, this note includes descriptions of those subroutines that have been modified.

SECTION 2 - DESCRIPTION OF NEW SUBROUTINES

2.1 SUBROUTINE PFILLP

PFILLP is called by PIPLOT to analyze current event data and to update the plot and histogram arrays if an allocated plot or histogram needs data from this event type.

Calling Sequence

CALL PFILLP

Interface

Input

- Via COMMON Area DUMDUM

Variable	Type	Description
MAXPLT	I*4	Maximum number of plots that can be in core concurrently
DTAPE	R*8	Serial number of volume from which PHA summary data is being obtained (referenced only in ~~event~~ case of an end of file or I/O error)
NUNIT	I*4	Logical unit number of PHA summary data set
NFILE	I*4	Sequence number of PHA summary file being processed
COEF	R*4	Numbers used in determining whether event satisfies durable (dE/dx) consistency criterion. Specifically, if consistency screening is to be performed, then events will be accepted; if calculated value of first energy loss $\leq$ COEF(i) * (Measured value of T1) and calculated value of first energy loss $\geq$ (Measured value of T1) /COEF(i) i = 1 for HET events H i = 2 for LET events

Variable	Type	Description
TRANS(6)	R*4	(1), MeV/channel for detector A (2), MeV/channel for detector B (3), MeV/channel for detector CI + CII (4), MeV/channel for detector DI (5), MeV/channel for detector DII (6), MeV/channel for detector E
NDATYP	I*4	Ordinal number corresponding to location of data of current event type in data set (see SKIP for relationship between NDATYP and event type)
NTYPE	I*4	= NDATYP, NDATYP ≤ 4 = 3, NDATYP = 5 = 4, NDATYP = 6
DATA	I*2	Current PHA summary record

- Via COMMON Area PLOTS

Variable	Type	Description
NIDPLT	I*4	Number of plots allocated
IDPLOT	(mixed)	For a description of fields, see Table
HLIMIT(2)	I*2	(1), lower limit for CII threshold consistency check (2), upper limit for CII threshold consistency check If, in either case, NDATYP = 1, limits to be used for making threshold check are four times these values
NIDHST	I*4	Number of histograms allocated
DHISTS	R*8	Array containing histograms

Data Modified by Called Subprograms (Used Outside This Segment)

Variable	Type	Description
NOVER( )	I*4	Number of overflow entries in I th plot is contained in NOVER(I)
NEVENT( )	I*4	NEVENT(I) is number of events in Ith plot

Variable	Type	Description
NLOC ( )	I*4	NLOC(I) is number of locations containing events in Ith plot
KPLOTS ( )	I*4	Plot array

Output

- Via COMMON Area PLOTS

Variable	Type	Description
QOFLAG	L*4	QOFLAG(I) indicates whether there was inadequate amount of core for overflow entries Ith plot

COMMON Area Interface With Called Programs (Passed to PFILL)

- Via COMMON Area PLOTS

Variable	Type	Description
QFAIL	L*4	Determines whether event failed a check other than double dE/dx consistency check
QCONS	L*4	Determines whether event failed double dE/dX consistency check
NTRY	I*4	Array containing current event description
NDX	I*4	For description, see PFILL

Data Constants

Variable	Type	Description
IEND	–	Number of half-words in PHA summary record
HTAG	I*2	HTAG(I) is lowest value of first half-word of seventh half-word PHA summary entry when NDATYP = 1
LFACT	I*4	LFACT(I) is number by which HLIMIT(1) and HLIMIT(2) have to be multiplied to obtain values for CII threshold check

Variable	Type	Description
G	R*4	Exponent to be used in double dE/dx consistency check
G1	R*4	1/G

Procedure

1. Set variable ISTR (index of the first entry to be processed equal to IEND) if NDATYP = 1 to indicate that a new summary record needs to be read.

2. Set flag QLET to determine whether the current event type is LET or HET.

3. Determine whether any of the allocated plots needs data from this event type.

4. Identify the first plot for which a double dE/dx consistency criterion is applicable.

5. Determine whether any of the allocated histograms needs data from this event type.

6. If no allocated plot and no allocated histogram needs data from this event type, then call SKIP to skip summary records until a record is found which contains data of the following event type. On return from SKIP, area DATA contains this record, and NDEXD contains the index of the first event belonging to a later type. Store this index in the start-index variable ISTR and return.

7. Read a new summary record if needed.

8. Process entries in this summary record, while the event is of the type appropriate to NDATYP.

A. Call .PUPDAP to unpack the seventh half-word entry into eleven full words in the array NTRY.

B. Compute limits for threshold check.

C. If a plot needs data from this event type, perform the following processes:

(1) Verify that the third detector (one that is not plotted) is within limits (HDPLOT (13, INDEX), HDPLOT, (14, INDEX)). If not, skip further processing of this event for this plot.

(2) Perform CII threshold bit check, depending on the value HDPLOT (3, INDEX). Record results of this analysis in variable QFAIL.

(3) Determine if the events belong in one of the sectors desired. Skip further processing of this event for this plot.

(4) If the double dE/dx criterion is applicable, and this is the first plot for which the consistency criterion is applicable, then compute energy losses from the three channel numbers, using the conversion factors in the array TRANS. Obtain the expected value of the first energy loss by the following relation:

$$\left[2(T_2 + T_3)^G - T_3{}^G\right]^{\frac{1}{G}} - T_2 - T_3 \quad \text{for HET}$$

$$\left[2.103(T_2 + T_3)^G - 1.103T_3{}^G\right]^{\frac{1}{G}} - T_2 - T_3 \quad \text{for LET}$$

(Thicknesses of the first two elements of LET are different, giving rise to a different relationship.)

(5) Check for consistency between the calculated value for T_1 and the measured value. Store the results of this comparison in the variable QCONSP. If durable dE/dx consistency is applicable, and this is not the first plot for which the consistency criterion is applicable, use the results of the previous computation stored in QCONSP.

(6) Set up the variables QFAIL and QCONS.

(7) Determine priority mode assignments. For a description of how this is done, see PFILL.

(8) Call PFILL to include this event in the plot. An alternate return from PFILL indicates that the core assigned to the overflow area for this plot has been used up and, therefore, the overflow-entry list will be incomplete. This indication is saved in the variable QOFLAG.

D. If a histogram needs data from event type, perform histogram processing.

E. Save the index of the entry in the variable ISTR.

2.2 SUBROUTINE PINITP

PINITP is called by PCHOSP to initialize a specified plot area. It performs the following functions:

1. Prepare the grid for this plot.
2. Initialize all counters that relate to this plot.
3. Set the pointer for the overflow list to the start of the overflow list for this plot, and fill the ordinate pointer list with null pointers.
4. Determine n, s.t. 2^2 = compression factor for this plot, and store this value for use by routines PFILL and PRETRV.
5. Determine if alternate plot option, i.e., A' (instead of A) and DI' (instead of DI) is applicable, and store an indication of this for later use.

In addition, on the first call, the routine will

1. Compute and store displacements of the rows relative to the start of this plot.
2. Allocate overflow space for all plots, depending on the maximum number of plots specified. The overflow area for each plot is allocated ω words, where ω is given by

$$\omega = \frac{\text{Area allocated to plots and overflows} - (\text{Number of plots})*(\text{Length of a plot})}{(\text{Number of plots})}$$

Calling Sequence

CALL PINITP (INDEX)

where INDEX identifies the plot area to be initialized.

Interface

Input

- Via COMMON Area PLOTS

Variable	Type	Description
IDPLOT	(mixed)	(IDPLOT(I, INDEX), I = 1, 12) is area that contains attributes of plots to be allocated. See Table for a description of various fields in this area

- Via COMMON Area FLAG

Variable	Type	Description
QHETF	(L*4)	Determines whether alternate plot option is applicable for plots of HET data
QLETF	(L*4)	Determines whether alternate plot option is applicable for plots of LET data

- Via COMMON Area DUMDUM

Variable	Type	Description
MAXPLT	I*4	Maximum number of plots that can concurrently reside in core

Procedure

1. On first call

Displacement of each of the 128 rows of the plot is computed and stored in COMMON area PLOTS for later use. Thus, there is created an array of 128 numbers, the Ith element of which contains the displacement of (the) Ith row of the plot relative to the start of the plot area. (Index I runs from 0-127.) The displacement of the Ith row is given by (127-I)*133.

The parameter MAXPLT in COMMON area PLOTS contains the maximum number of plots that need to be in core concurrently. Of the total area allocated for plots and overflows (146880 bytes), MAXPLT*17280 bytes are allocated to the plots themselves, and the remaining area is divided equally into MAXPLT segments. Displacement of each segment relative to the start of area PLOTS is stored in the area STARTPTR. Also, the displacement of the last 12-word entry in each segment is stored in area LASTPTR.

2. On each call

The pointer array corresponding to INDEX is filled with null pointers. The counters corresponding to this INDEX are set to 0. The type of events that the plot will contain is obtained from the array IDPLOT, and flags QHETF and QLETF are examined to determine if alternate plot option is applicable to the plot corresponding to INDEX. The results of this examination are stored in the element corresponding to INDEX in the array QFLAG.

The compression factor for the plot is obtained from the IDPLOT array, and n is determined such that

$$2^n = \text{compression factor}$$

The value of n is stored in the element of array NCOMP appropriate to INDEX. This value will be used by the routine PFILL to compress coordinates. Compression of coordinates is obtained by shifting, thus obviating the necessity of using expensive divide and multiply instructions.

The plot grid is constructed, and the abscissa and the ordinate axis are labeled. Routine INCORE is called to generate the labels.

2.3 SUBROUTINE PFILL

PFILL is an entry point in the CSECT PINITP, and is called by PFILLP to perform the following functions:

1. Add together frequencies of occurrence of the event (defined by 11-word field NTRY in COMMON area PLOTS) in desired priority modes.
2. Compute compressed coordinates.
3. Update the character in the location corresponding to coordinates of the current event.
4. If the new frequency at the location exceeds 35, and if this is the first time an overflow has occurred at this point, make a new overflow entry. If this is not the first time, update the overflow entry to reflect the frequency of the current event.

Calling Sequence

CALL PFILL (INDEX, &ALT1)

where INDEX identifies the plot in which the event is to be included, and ALT1 is the alternate return taken when the area allocated for overflow entries for this plot has been used up.

Interface

Input

- Via COMMON Area PLOTS

Variable	Type	Description
IDPLOT	(mixed)	For description, see PINITP
NDX	I*4	Index in array NTRY, s.t. NTRY(NDX) represents frequency of occurrence in priority 0

Variable	Type	Description
		= 4, unquestionable priority events (case 1) = 7, questionable priority events, when cyclic reordering of priorities is requested (case 2)

Word	Priority Mode (Case 1)	Priority Mode (Case 2)
NTRY(4)	0	1
NTRY(5)	1	2
NTRY(6)	2	3
NTRY(7)	3	0

NTRY	I*4	Array containing current event definition. See Table

Procedure

1. Examine bytes 20 through 23 of the IDPLOT area corresponding to INDEX to determine priority modes applicable to the plot. (If byte 20 + i is nonzero, then priority i is desired. Add frequencies corresponding to desired priority modes.

2. If frequency in desired modes is zero, then nothing needs to be done. If frequency is nonzero, do the following:

   A. Examine fail flag QFAIL to determine whether the event failed some test; if so, identify the cause of failure. If the cause of failure was the double dE/dx consistency requirement, update double dE/dx failure counter; otherwise, update the threshold-consistency-failure counter, and exit.

   B. If event failed no test, do the following:

      (1) If alternate plot option was indicated (QFLAG(INDEX) = .TRUE.), add first two readouts (words 1 and 2 of array NTRY), and shift right by 1 + NCOMPR(INDEX) bits to

obtain the ordinate. Otherwise, obtain the readout corresponding to the ordinate (the readout corresponding to the ordinate is pointed to be the 17th half-word of IDPLOT area corresponding to INDEX) and shift right by NCOMPR(INDEX) bits to obtain the ordinate.

(2) If the compressed ordinate exceeds 127, add the frequency to top-of-plot counter NTOP(INDEX), and exit.

(3) Obtain the readout corresponding to abscissa (the 18th half-word of IDPLOT area corresponding to INDEX points to this readout). Shift right by NCOMPR(INDEX) bits to obtain abscissa.

(4) If compressed abscissa exceeds 127, add the frequency to right-of-plot counter NRIGHT(INDEX), and exit.

(5) Obtain the character at the address corresponding to the compressed coordinate. Using the translate table, determine the frequency corresponding to the character.

(6) If the frequency is zero, then this is a new location; update location counter, NLOC(INDEX).

(7) Update the event counter, NEVENT(INDEX).

(8) If the frequency corresponding to the event when added to the number at the location exceeds 35, go to the overflow section.

(9) Find the character corresponding to the updated frequency, store this character in the plot array, and exit.

(10) Store the character asterisk (*) at the address corresponding to the compressed coordinate.

(11) Obtain from the pointer array corresponding to INDEX, the displacement of the first overflow entry for this ordinate.

(12) If displacement is zero, create a new entry as follows:

- Obtain the displacement of the first available entry for this INDEX; this is found at POINTER(INDEX). The displacement obtained is compared with the displacement of the last allowed entry LASTPTR(INDEX) to determine whether there is room for this entry. If there is no more room, return with 4 in register 15; otherwise, perform the following steps.

- Store the displacement contained in POINTER(INDEX) in the pointer array. At the address pointed to by POINTER(INDEX): (A) store abscissa value (4 bytes); (B) store frequency (4 bytes); (C) store zero to indicate that this is the last entry for this ordinate; and (D) update POINTER(INDEX) to reflect that a 12-byte entry has been made.

(13) If displacement is nonzero, then this is the displacement of the first overflow entry for this ordinate. Beginning with this entry, search the list until an entry is found such that the abscissa is less than or equal to the abscissa of the entry. If the abscissa equals the abscissa of the entry, update the frequency. If the abscissa is less than the abscissa of the entry, create a new entry and adjust the pointer. If the abscissa is greater than the abscissa of all entries in the list, create a new entry and adjust the pointer.

2.4 SUBROUTINE PRETRV

PRETRV is an entry point in the CSECT PINITP, and is called by PPLOTP to retrieve and print overflow entries for a specified plot.

Calling Sequence

```
CALL PRETRV(INDEX)
```

where INDEX identifies the plot whose overflow entries have to be printed.

Interface

Input

- Via COMMON Area PLOTS

Variable	Type	Description
KPLOTS	-	Array containing plots and overflow entries
PTRRAY(INDEX)	-	Pointer array for this plot
NCOMPR(INDEX)	-	n s.t., 2^n is compression factor

- Via Calls to other Subprograms

  The FORTRAN library routine IBCOM# is called to format the retrieved overflow entries, and to write these out on logical unit 4.

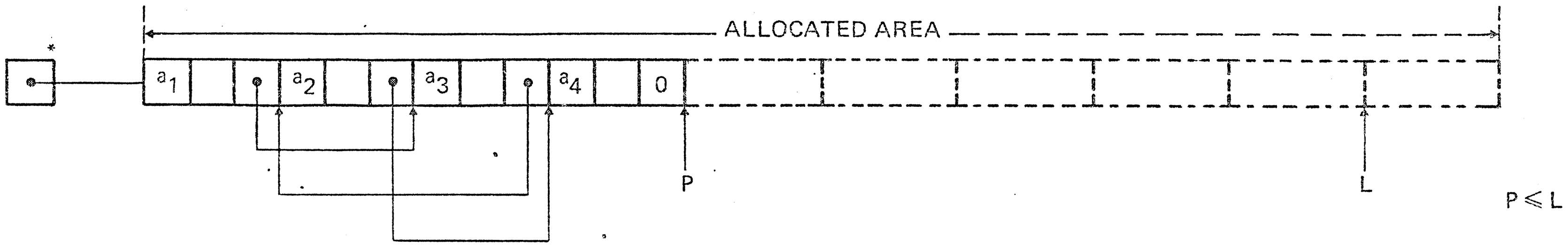
Output

- Via Logical Unit 4 (ddname-FT04F001)

  Formatted listing of overflow entries in the format shown in Figure 2-1.

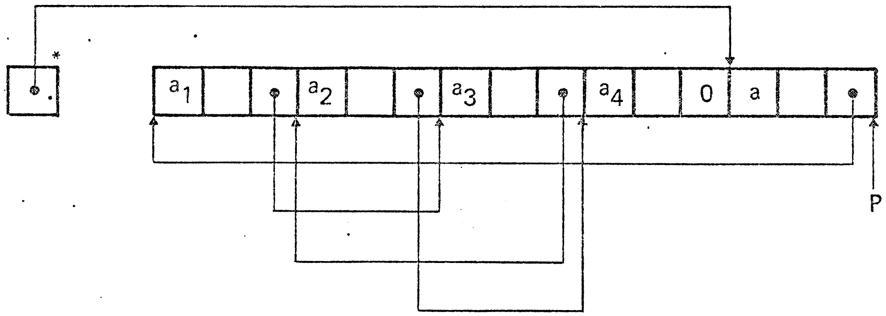
Procedure

The pointer array is searched to determine if there are any overflow entries for a given ordinate. If there is an entry, then the ordinate is decompressed, and the abscissa for all entries are decompressed in steps of five entries. The



THUS THE ORDERING IS $a_1 < a_3 < a_2 < a_4$

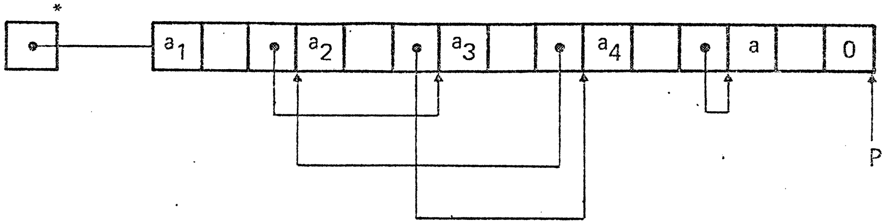
LET $a < a_1$; THEN THE FOLLOWING STRUCTURE OBTAINS



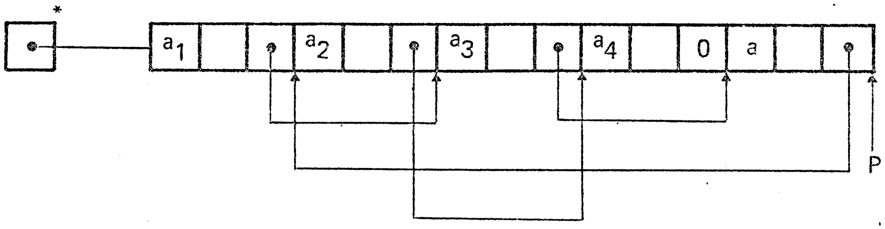
FORMAT OF 3-WORD ENTRY:

WORD 1 — ABCISSA
WORD 2 — FREQUENCY
WORD 3 — POINTER TO NEXT HIGHER ABCISSA ENTRY, IF ONE EXISTS; 0 IF OTHERWISE

LET $a > a_4$



LET $a_3 < a < a_2$



*ELEMENT OF POINTER ARRAY CORRESPONDING TO CURRENT ORDINATE.

fig. 2-1

Figure 2-1. Listing of Overflow Entries

decompressed values and frequency are saved in a 15-word area; IBCOM# is called to write these out.

References

For a format translation needed for a call to IBCOM#, see IBM FORTRAN PLM.

2.5 SUBROUTINE SKIP

SKIP is an ALC CSECT which is invoked by PFILLP to skip summary data corresponding to a given event type and to return the record in which change of event type takes place, and the displacement of first PHA summary entry in this record that does not belong to the given event type.

Calling Sequence

CALL SKIP (DATA, NDATYP, NDEXD, &ALT1, &ALT2)

Interface

Input

- Via Arguments in Call

Variable	Type	Description
DATA	I*2	Area containing PHA summary record. Data in this area is ignored when NDATYP = 1
NDATYP	I*4	Ordinal number corresponding to location of data of event type to be skipped. Data is ordered on PHA summary tape as follows:

NDATYP	Event Type
1	HET-3
2	HET-2
3	HET-1
4	HET-0
5	LET-1
6	LET-0

- Via Subprogram Calls

The address of the summary record to be examined is obtained via a call to FREAD, which reads a record and returns the address of the area containing the record. FREAD references the PHA summary tape data set (logical unit 45).

Output

- Via Arguments in Call

Variable	Type	Description
DATA	-	Area containing record where data for event type corresponding to NDATYP ends. If NDATYP = 6, SKIP does not alter contents of area DATA
NDEXD	I*4	Index in array DATA corresponding to first entry which does not belong to event type corresponding to NDATYP. If NDATYP = 6, SKIP does not alter contents of NDEXD

- Via Alternate Returns

Variable	Type	Description
RETURN 1	-	Alternate return indicating that an end of file was detected by FREAD while attempting to read a PHA summary record
RETURN 2	-	Alternate return indicating that an I/O error was detected by FREAD while reading a PHA summary record

Procedure

1. Determine the event type corresponding to NDATYP.
2. If the event type is LET-0, return.
3. If the event type is HET-3 (NDATYP = 1), there is no record currently in core. Read a record.
4. Read records while the last entry in the record belongs to the current event type.

5. Examine the current record to determine the displacement of the first entry belonging to the event type lower than the event type corresponding to NDATYP.

6. Move this record into the area DATA by calling routine FMOVE (a member of the contributed program library SY3. CONTRIB).

7. Compute the FORTRAN index corresponding to the displacement obtained above. Store the displacement in NDEXD, and return with a zero in register 15.

On End of File

Return with 4 in register 15.

On I/O Error

Return with 8 in register 15.

SECTION 3 - MODIFICATIONS TO EXISTING SUBROUTINES

Subroutines PTAPEP, PPLOTP, and PHISTP have been modified to provide for printing out two summaries: one (in index form) of the histograms, and another of two detector plots generated by the run. Following is a brief description of the modifications to each subroutine.

3.1 SUBROUTINE PTAPEP

The only modification to PTAPEP is a call to subroutine TIMEIN after reading the header record of each file. Subroutine TIMEIN stores the start and end times of the summary for later printout. If the file is a merged summary, the start and end times of the individual summaries that were merged are extracted from the header and stored for printout.

3.2 SUBROUTINE PPLOTP

Subroutine PPLOTP has been modified to print an index summarizing the plots generated. The index is in tabular form and contains, for each plot, the following information: plot type; compression factor; high and low plot boundaries; the value used in testing for failure of double dE/dx criteria; event types included in plot; sectors plotted; priority modes plotted; and whether or not the CI + CII threshold indicator is to be used to screen data to be plotted. In addition, space is provided for printing information about the actual meaning of the CI + CII threshold key if it is other than yes or no (1 or 0) (see input card description in user's guide). A brief explanation is also printed describing the disposition of events with doubtful priority.

Since the type of information, and the number of values to be printed in the index, may vary greatly from one plot to the next, the output format is kept in an array and varied according to the requirements of each plot. The lines in the index describing the plot are written on logical unit 3, having the same pass through PPLOTP that the actual plot is written on logical unit 4.

Another change in PPLOTP eliminates an implied "do loop" in the writing of each plot. Subroutine WRITE is called to print the plot array on logical unit 4. After each plot is printed, PRETRV is called to retrieve write overflow entries. If the overflow indicator is set, a warning is printed indicating that the printed overflow list is incomplete.

Before control returns to the main program, PPLOTP checks the number of plots still to be done for the plot period. If all have been done, subroutine TIMOUT is called to print the list of time periods which comprise the plot data. This list is printed on logical unit 3 beneath the plot index.

3.3 SUBROUTINE PHISTP

Subroutine PHISTP has been modified to print an index summarizing the histograms generated. The index is similar to the index of two detector plots and is generated in a similar manner (using a variable format specification in an array). For each histogram, the following information is printed in the index: plot type; compression factor; high/low bounds; alternate detectors and range of values for alternate detectors; event types plotted; sectors plotted; priority modes included; and the CI + CII threshold key. In addition, a brief explanation is printed describing the disposition of events whose priority is in doubt. The lines in the index describing the histogram are written on logical unit 1 during the same pass through PHISTP that the histogram is written on logical unit 2.

Before control returns to the main program, PHISTP examines the number of histograms still to be allocated. If this number is nonzero, control returns to the main program. If it is zero, and the number of allocated histograms is nonzero, the histogram array is examined to determine if all of the allocated histograms have been printed. If they have been printed, then the number of allocated histograms is set to zero.

If all histograms for the plot period have been printed, then subroutine TIMOUT is called to print the list of time periods from which data for the histogram was gathered. This list is printed on logical unit 1 beneath the histogram index.

3.4 SUBROUTINE TIMEIN

TIMEIN is called by PTAPEP to store start and end times of the summary intervals whose data is included in the current group of plots.

Calling Sequence

CALL TIMEIN

Procedure

If the summary currently being processed is not a merged summary, the milliseconds of day of the start and end of the interval are converted fractions of day and added to the start and end Julian days, respectively. The start and end modified Julian day and fraction are then stored in array SEGDAY.

If the summary is a merged summary, the start and end modified Julian day and fraction are each extracted from the PHA header record and stored in array SEGDAY. Array SEGDAY can contain start and end times for up to 500 intervals. Variable IGGY contains the count of intervals stored in the array SEGDAY.

3.5 SUBROUTINE TIMOUT

TIMOUT is called to print the list of summary intervals accumulated in calls to TIMEIN. TIMOUT is an entry point in TIMEIN.

Calling Sequence

CALL TIMOUT (LINE19, IOTHER, NPRINT)

Parameters

Name	Type	I/O	Description
NPRINT	I*4	I	Logical unit number on which printing is to be done
IOTHER	I*4	I	If nonzero, accumulated intervals will be saved for printout later on another logical unit
LINE19	I*4	I/O	Current count of lines printed on logical unit NPRINT since last page eject

Procedure

For each interval in the array SEGDAY, the start and end times are converted to year, month, day, hour, minute, and second using subroutines CNVMJD and FRCHMS. As the start and end times are printed, the value of LINE19 is incremented. If LINE19 is equal to or greater than 54, a page eject is generated and LINE19 is reset.

After all the intervals have been printed, the value of IOTHER is checked. If it is equal to zero, the count of stored intervals, IGGY, is reset to zero; otherwise, IGGY is left intact. Thus, when called from PPLOTP, IOTHER contains the count of histograms still to be done. If not all histograms have been done, then the value IGGY must be preserved so that the contents of SEGDAY can be printed on a later call to TIMOUT from PHISTP.

3.6 SUBROUTINE FRCHMS

FRCHMS is used to convert fraction of day to hours, minutes, and seconds of day.

Calling Sequence

CALL FRCHMS (FRCTN, HHRS, HMINS, HSECS)

Parameters

Name	Type	I/O	Description
FRCTN	R*4	I	Fraction of day to be converted
HHRS	I*2	O	Converted time of day in hours, minutes, and seconds
HMINS	I*2	O	
HSECS	I*2	O	

Procedure

The algorithm is

$$HHRS = FRCTN * 24 \text{ HRS/DAY}$$

where the result is truncated to an integer.
Then the remaining portion of the day is

$$REST = FRCTN - (HHRS/24)$$

then

$$HMINS = REST * 1440 \text{ MINS/DAY}$$

and similarly

$$REST2 = REST - HMINS/1440$$

$$HSECS = REST * 86400 \text{ SECS/DAY}$$

JCL Changes

The data sets referenced by this program are listed below:

```
//GO.FT06F001 DD SYSOUT=A,DCB=(BLKSIZE=1374,BUFNO=1)
//GO.FT01F001 DD SYSOUT=A,
// DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1330,BUFNO=1)
//GO.FT02F001 DD SYSOUT=A,
// DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1330,BUFNO=1)
//GO.FT03F001 DD SYSOUT=A,
// DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1330,BUFNO=1)
//GO.FT04F001 DD SYSOUT=A,
// DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1330,BUFNO=1)
//GO.FT08F001 DD SYSOUT=A,
// DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1330,BUFNO=1)
//GO.FT40F001 DD DSN=K3.ZB2NL.SB001.PGPSCATP,DISP=SHR,DCB=BUFNO=1
//GO.FT41F001 DD DSN=K3.ZB2NL.SB001.PGPSCAT1,DISP=SHR,DCB=BUFNO=1
//GO.FT42F001 DD DSN=K3.ZB2NL.SB001.PGPSCAT2,DISP=SHR,DCB=BUFNO=1
//GO.FT43F001 DD DSN=K3.ZB2NL.SB001.PGPSCAT3,DISP=SHR,DCB=BUFNO=1
//GO.FT44F001 DD DSN=K3.ZB2NL.SB001.PGPSCAT4,DISP=SHR,DCB=BUFNO=1
//GO.FT45F001 DD DSN=PIOSUM,UNIT=(2400-9,,DEFER),DISP=SHR,
// VOL=SER=PICSUM,DCB=(DEN=3,BUFNO=1)
//GO.FT49F001 DD UNIT=2314,SPACE=(244,(20,20)),DCB=BLKSIZE=244
//GO.FT50F001 DD UNIT=2314,SPACE=(244,(20,20)),DCB=BLKSIZE=244
//GO.SYSUDUMP DD SYSOUT=A
//GO.DATA5 DD *,DCB=(BLKSIZE=800,BUFNO=1)
```

The SYSOUT = A datasets referenced are as follows:

Dataset	Description
FT06F001	Program messages and errors
FT01F001	Summary index and list of intervals for histograms
FT02F001	Histograms are printed

Dataset	Description
FT03F001	Summary index and list of intervals for two detector plots
FT04F001	Output dataset for two detector plots
FT08F001	Output dataset for listing rates information in PHA header

SECTION 4 - CHANGES TO USER'S GUIDE FOR PIONEER PHA SUMMARY PLOT PROGRAM

4.1 INTRODUCTION

Since the writing of the User's Guide for the PHA Summary Plot Program, many changes have been made to this program. While most of these changes are transparent to the user, one new input parameter (MAXPLT) has been added, and the logical unit numbers for the line printer outputs have been re-arranged, thereby modifying the JCL.

4.2 THE MAXPLT PARAMETER

MAXPLT is input by the user in column 75 of the Consistency Criterion Card. It is an integer between 1 and 6 and is the number of two detector plot resources to be made available to the program; if not specified, this value defaults to 6.

When MAXPLT is less than 6, the additional core normally used for plot resources is made available for extra storage of plot locations with event counts greater than 35. If any one plot has more than 600 such locations, then MAXPLT must be less than 6 or else only the first 600 locations will be listed and the following message will precede the listing of these locations:

```
                              WARNING
THERE WERE MORE THAN 600 LOCATIONS WITH EVENT COUNTS GREATER
THAN 35.
THE FOLLOWING TABLE IS INCOMPLETE.
REDUCE MAXPLT PARAMETER AND RESUBMIT RUN FOR THIS PLOT TO
GET LISTING OF ALL OVERFLOW LOCATIONS.
```

Note that for multiple-period-per-grid plots, the total number of plots requested should not exceed MAXPLT.

Plot overflow locations are indicated by an asterisk (*) on the two detection plots. When the warning message is received, the user may determine the correct value to input for MAXPLT by estimating the number of asterisks and using the following listing:

MAXPLT	Maximum Overflow Locations Listed Per Plot
6	600
5	1008
4	1620
3	2640
2	4680
1	10800

4.3 CONSISTENCY (DOUBLE dE/dX) CRITERIA CARD FORMAT

Column	Type	Description
1	A1	'C', card type identifier
2-10	F9.6	L_{HET}, HET consistency coefficient
11-19	F9.6	L_{LET}, LET consistency coefficient
20-28	F9.6	Transformation coefficient for detector A
29-37	F9.6	Transformation coefficient for detector B
38-46	F9.6	Transformation coefficient for detector CI + CII
47-55	F9.6	Transformation coefficient for detector DI
56-64	F9.6	Transformation coefficient for detector DII
65-73	F9.6	Transformation coefficient for detector E
74-75	I2	MAXPLT

4.4 PLOT PERIOD CARD

Column	Type	Description
1	A1	'P', card type indicator
2-7	A6	Blank; summary tape volume serial number
8-11	4X	Blank
12-13	I2	Year of data; summary tape file number
14-15	I2	Month of year (unused)
16-17	I2	Day of month (unused)
18-19	I2	Hour of day (unused)
20-21	I2	Minute of hour (unused)
22-23	I2	Second of minute (unused)
24-27	I4	Value associated with CI + CII threshold indicator being OFF
28-31	I4	Value associated with CI + CII threshold indicator being ON

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GODDARD SPACE FLIGHT CENTER

Enclosure 1

EDR File 3

Format and Definition

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File 3 (See Figure)   File 3 is binary and contains S/C attitude data for the past 31 days. There is a ten-word entry for each day. All words are right adjusted unless otherwise stated. Missing entries will be filled with zeros. The first entry is the least current and the last entry in the file is the **most** current.

1. Word 1 (DAY-GMT) Elapsed days since start of year
2. Word 2 (GMT) Elapsed time in milliseconds since start of day for time of first data word in record
3. Word 3 (SPARE) Blanks
4. Word 4 (FLAG) The flag interpretation is as follows:

   00=Special Refinement (±0.1 degree accuracy)
   01=High-Gain Antenna (±0.3 degree accuracy)
   10=Medium-Gain Antenna (±1.3 degree accuracy)
   11=Dynamic Position for Delta V Maneuver (±3.0 degree accuracy)

5. Word 5 (CLON-Celestial Longitude degrees of the spin axis) Floating point form as used on customers computer
6. Word 6 (CLAT-Celestial Latitude degrees of the spin axis) Floating point form as used on customers computer
7. Word 7 (CKAH-Clock Angle of Sun, degrees) Floating point form as used on customers computer
8. Word 8 (CKAS-Clock Angle of Star, degrees) Floating point form as used on customers computer
9. Words 9 - 10 (SPARE) Blanks

	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32	
1	DAY	LEAST CURRENT ENTRY
2	GMT	
3	SPARE	
4	FLAG	
5	CLON	
6	CLAT	
7	CKAH	
8	CKAS	
9	SPARE	
10	SPARE	
	REPEAT WORDS 1-10 TWENTY-NINE	
	TIMES FOR WORDS 11-300	
300		
301	DAY	MOST CURRENT ENTRY
302	GMT	
303	SPARE	
304	FLAG	
305	CLON	
306	CLAT	
307	CKAH	
308	CKAS	
309	SPARE	
310	SPARE	
	EOF	

GSFC/CRT FILE 3 ATTITUDE DATA

TYPE-BINARY
LOGICAL RECORD LENGTH - 10 WORDS
PHYSICAL RECORD LENGTH - 310 WORDS
FILE SIZE - 1 PHYSICAL RECORD

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GODDARD SPACE FLIGHT CENTER

Enclosure 2

EDR File 4

Format and Definition

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d. File 4 (See Figure 5-12) - All words are right justified and binary unless otherwise stated.

(1) Word 1 (GMT) - Time in elapsed milliseconds from start of day for time of the first data word in the record.

(2) Word 2 (Day of Year) - Self explanatory.

(3) Word 3 (TCF) - Time correction flag. The following codes are in binary: 000 = no correction, 111 = suspect time or corrected time.

(4) Word 4 (AREFSELS) - Reference Select Status - 2 bits. Fill value of "all ones" indicates value missing.

Bits	Meaning
00	ERROR
01	STAR
10	SUNB
11	SUNA

(5) Word 5 (SNR) - (Signal + Noise)/Noise in floating point form as used on customer's computer.

(6) Word 6 (DSS) - Deep space station which was tracking. See Figure 5-50.

(7) Word 7 (Bit Rate) - Bit rate at which data record was taken. See Figure 5-51.

(8) Word 8 (MOD-FMT) - Mode and Format are two data values, three bits and five bits respectively, packed to form, eight bits right justified of Word 8.

Mode: The following codes are in binary: 000 or 001 = real time; 100 or 101 = telemetry store; 010 or 011 = memory readout.

Format: See Figure 5-52.

(9) Word 9 (RTLT) - The Round Trip Light Time will be given in total milliseconds.

(10) Word 10 (ESC Subcom ID) - The Extended Frame Counter will be a combined word from the S/C telemetry of both the subcommutator identification word and the extended frame counter word. Together they comprise a counter from 0 to 8191.

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(11) Word 11 (ASTDLYC) - Star Delay Time (1/256 second resolution) in DN. Twelve bits with the telemetry bits reversed to give proper bit weighing. Latest available value - Fill of "all ones" indicates value missing.

(12) Word 12 (Flag 1, Flag 2, Flag 3, Flag 4) - These are flags for RAT, ASPNPDC, SPF, ARIPPHEC, respectively. Each flag is eight bits. Flag values are: 0 = OK, 1 = old value, 10 = value missing, and 11 = corrected value.

(13) Word 13 (RAT - Roll Attitude Timer) - Engineering Subcom Words C-112 and C-116. This time permits correlation of the attitude of the roll index reference line with given telemetered science and engineering data. (Floating point form as used on customer's computer.) *

(14) Word (ASPNPDC - Spin Period) - The time between two successive roll pulses of the spacecraft. (Engineering Words C-405, C-406, C-407.) Floating point form as used on customer's computer. seconds *

(15) Word 15 (SPF) - Engineering Word C-417 is the flag for spin period (three bits). If bit 30 is 0, then SPSG (Spin Period Sector Generator) roll reference = 0°, if set to 1 = 180°.

Bits 31 and 32	SPSG Modes
00	Non-Spin Averaging
01	ACS
10	Spin Averaging

days 170
168
with bad
ARIPPHEC

(16) Word 16 (ARIPPHEC - Roll Pulse/Roll-Index Pulse Phase Error) - The phase error measurement between the Roll Pulse and Roll-Index Pulse with up to a maximum of 60.5 msec of phase error may be a plus or a minus quantity and is generated by the Spin Period Sector Generator (SPSG). Floating point form including sign as used on customer's computer. (msec)

(17) Word 17 (Time of C-112) - GMT time that C-112 was received (RAT). All "ones" indicate time was missing.

(18) Word 18 (DC Bus Voltage - C-107) - Range 26-30 VDC. Floating point form as used on customer's computer. Floating point fill value of 1 x 10^6 indicates data was missing.

(19) Word 19 DC Bus Current - C-129) - Range 0-6A. Floating point form as used on customer's computer. Floating point fill value of 1 x 10^6 indicates data was missing.

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(20) Word 20 (C-108/GMT of C-108) - Located in Bit 5 of Word 20. It indicates the power status of the GSFC/CRT instrument: 1 = on, 0 = off. GMT of C-108 is located in Bits 6-32 of Word 20. It is the time that C-108 was received. If Word 20 is all "ones", C-108 was missing for this subcom cycle.

(21) Word 21 (PT - S/C Platform Temperature #6) - -20°F to 110°F. Floating point form as used on customer's computer. Floating point fill value of 1×10^6 indicates data was missing.

(22) Word 22 (F, DQ) - Bit 1 of Word 22 is the fill indicator: 0 equals data, 1 equals fill. Bits 2 and 3 of Word 22 are dependent on Bit 1 of Word 22. If Bit 1 equals 0, then Bits 2 and 3 (DQ) are the Data Quality Indicator. The following codes in binary: 11 equals all indicators are good, data is good; 10 equals at least one indicator is bad, data is suspect; 01 equals at least two indicators are bad, data is suspect; 00 equals data is bad. See Figure 5-49. If Bit 1 equals 1, then Bit 2 will indicate extent of filler: 0 equals at least this frame of data is filled with "ones" and data resumes in this physical record; 1 equals the rest of this physical record is filled with "ones".

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<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th><th>20</th><th>21</th><th>22</th><th>23</th><th>24</th><th>25</th><th>26</th><th>27</th><th>28</th><th>29</th><th>30</th><th>31</th><th>32</th></tr>
<tr><td>1</td><td colspan="32">GMT</td></tr>
<tr><td>2</td><td colspan="32">DAY OF YEAR</td></tr>
<tr><td>3</td><td colspan="32">TCF</td></tr>
<tr><td>4</td><td colspan="32">AREFSELS</td></tr>
<tr><td>5</td><td colspan="32">SNR</td></tr>
<tr><td>6</td><td colspan="32">DSS</td></tr>
<tr><td>7</td><td colspan="32">BIT RATE</td></tr>
<tr><td>8</td><td colspan="24"></td><td colspan="3">MOD</td><td colspan="5">FMT</td></tr>
<tr><td>9</td><td colspan="32">RTLT</td></tr>
<tr><td>10</td><td colspan="19"></td><td colspan="13">ESC</td></tr>
<tr><td>11</td><td colspan="32">ASTDLYC</td></tr>
<tr><td>12</td><td colspan="8">FLAG4</td><td colspan="8">FLAG3</td><td colspan="8">FLAG2</td><td colspan="8">FLAG1</td></tr>
<tr><td>13</td><td colspan="32">RAT</td></tr>
<tr><td>14</td><td colspan="32">ASPNPDC</td></tr>
<tr><td>15</td><td colspan="32">SPF</td></tr>
<tr><td>16</td><td colspan="32">ARIPPHEC</td></tr>
<tr><td>17</td><td colspan="32">GMT OF C-112</td></tr>
<tr><td>18</td><td colspan="32">DC BUS VOLTAGE</td></tr>
<tr><td>19</td><td colspan="32">DC BUS CURRENT</td></tr>
<tr><td>20</td><td colspan="5">C-108</td><td colspan="27">GMT OF C-108</td></tr>
<tr><td>21</td><td colspan="32">PT</td></tr>
<tr><td>22</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 0</td></tr>
<tr><td>23</td><td colspan="4">FILL</td><td colspan="3">9</td><td colspan="3">10</td><td colspan="3">11</td><td colspan="3">12</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
<tr><td>24</td><td colspan="16"></td><td colspan="4">FILL</td><td colspan="3">41</td><td colspan="3">42</td><td colspan="3">43</td><td colspan="3">44</td></tr>
<tr><td>⋮</td><td colspan="32">REPEAT WORDS 22-24 FOR WORDS 25-90 SCIDS 1-22</td></tr>
<tr><td></td><td colspan="32"></td></tr>
<tr><td>91</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 23</td></tr>
<tr><td>92</td><td colspan="4">FILL</td><td colspan="3">9</td><td colspan="3">10</td><td colspan="3">11</td><td colspan="3">12</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
<tr><td>93</td><td colspan="10"></td><td colspan="6">E-124</td><td colspan="4">FILL</td><td colspan="3">41</td><td colspan="3">42</td><td colspan="3">43</td><td colspan="3">44</td></tr>
<tr><td>94</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 24</td></tr>
<tr><td>95</td><td colspan="4">FILL</td><td colspan="3">9</td><td colspan="3">10</td><td colspan="3">11</td><td colspan="3">12</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
</table>

GSFC/CRT
TYPE - BINARY
LOGICAL RECORD LENGTH - 384 WORDS
PHYSICAL RECORD LENGTH - 1301 WORDS
FILE SIZE - VARIABLE

FILE 4

EXPERIMENT DATA
FORMAT A

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Figure 5-12. GSFC/CRT File 4 (Sheet 1 of 4)

<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th><th>20</th><th>21</th><th>22</th><th>23</th><th>24</th><th>25</th><th>26</th><th>27</th><th>28</th><th>29</th><th>30</th><th>31</th><th>32</th></tr>
<tr><td>96</td><td colspan="10"></td><td colspan="6">E-125</td><td colspan="4">FILL</td><td colspan="3">41</td><td colspan="3">42</td><td colspan="3">43</td><td colspan="3">44</td></tr>
<tr><td>97</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 25</td></tr>
<tr><td>98</td><td colspan="4">FILL</td><td colspan="3">9</td><td colspan="3">10</td><td colspan="3">11</td><td colspan="3">12</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
<tr><td>99</td><td colspan="10"></td><td colspan="6">E-126</td><td colspan="4">FILL</td><td colspan="3">41</td><td colspan="3">42</td><td colspan="3">43</td><td colspan="3">44</td></tr>
<tr><td>100</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 26</td></tr>
<tr><td>101</td><td colspan="4">FILL</td><td colspan="3">9</td><td colspan="3">10</td><td colspan="3">11</td><td colspan="3">12</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
<tr><td>102</td><td colspan="10"></td><td colspan="6">E-127</td><td colspan="4">FILL</td><td colspan="3">41</td><td colspan="3">42</td><td colspan="3">43</td><td colspan="3">44</td></tr>
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<tr><td>106</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 28</td></tr>
<tr><td>107</td><td colspan="4">FILL</td><td colspan="3">9</td><td colspan="3">10</td><td colspan="3">11</td><td colspan="3">12</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
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<tr><td></td><td colspan="32"></td></tr>
<tr><td>⋮</td><td colspan="32">REPEAT FORMAT OF WORDS 22-24 FOR WORDS 112-213 SCIDS 30-63</td></tr>
<tr><td>213</td><td colspan="32"></td></tr>
<tr><td>214</td><td colspan="32"></td></tr>
<tr><td>⋮</td><td colspan="32">REPEAT FORMAT OF WORDS 22-213 FOR WORDS 214-405 SCIDS 64-127</td></tr>
<tr><td>405</td><td colspan="32"></td></tr>
<tr><td>406</td><td colspan="32"></td></tr>
<tr><td>⋮</td><td colspan="32">REPEAT FORMAT OF WORDS 22-405 TWO TIMES FOR WORDS
406-1173 SCIDS 128-383</td></tr>
<tr><td>1173</td><td colspan="32"></td></tr>
<tr><td>1174</td><td colspan="32"></td></tr>
<tr><td>⋮</td><td colspan="32">128 WORDS OF FILLER FOR WORDS 1174-1301</td></tr>
<tr><td>1301</td><td colspan="32"></td></tr>
<tr><td></td><td colspan="32">EOR</td></tr>
<tr><td></td><td colspan="32"></td></tr>
<tr><td></td><td colspan="32"></td></tr>
</table>

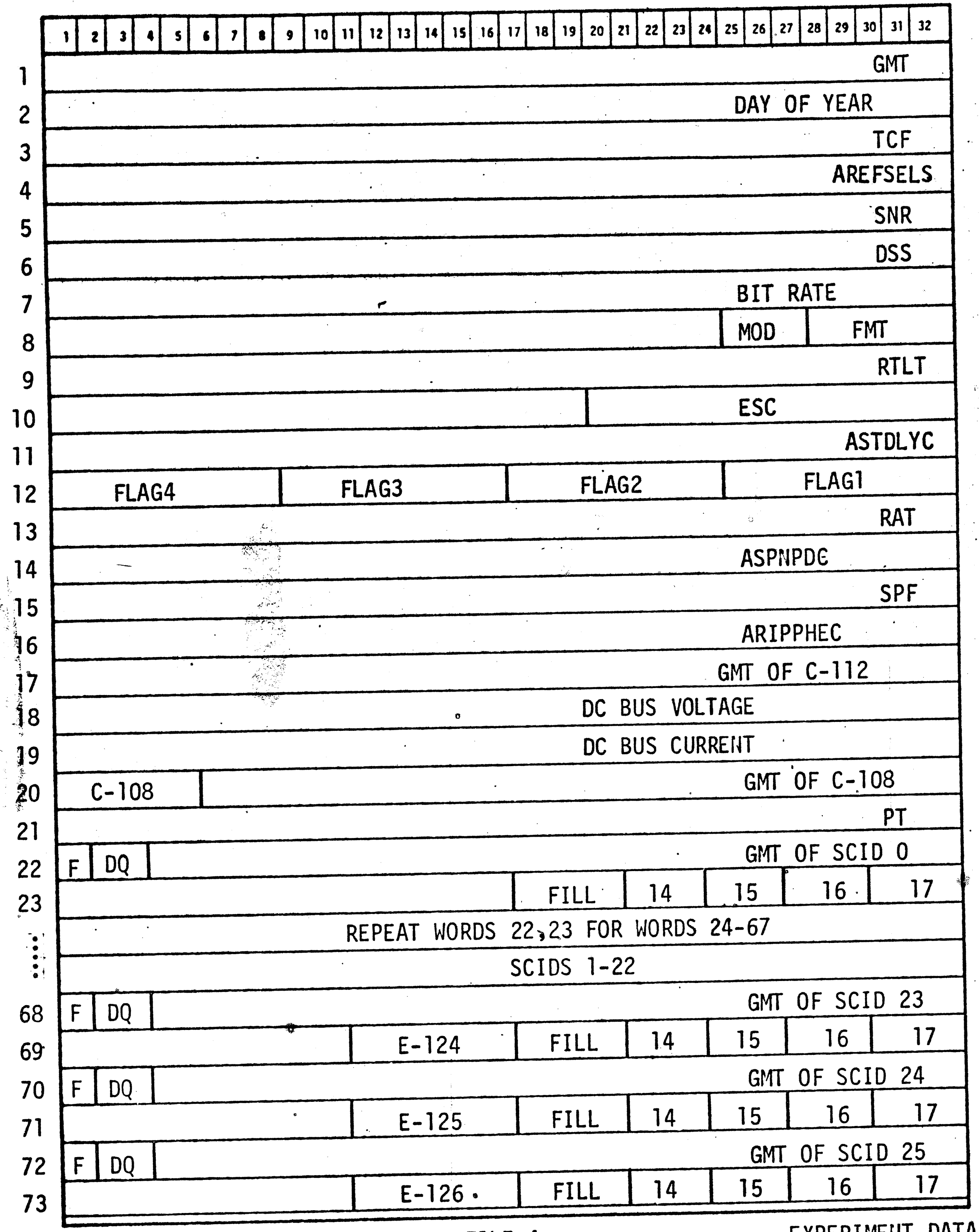
102 words

97-103

GSFC/CRT FILE 4 EXPERIMENT DATA
FORMAT A (CONTD)

Figure 5-12. GSFC/CRT File 4 (Sheet 2 of 4)

DRAFT



1	GMT					
2	DAY OF YEAR					
3	TCF					
4	AREFSELS					
5	SNR					
6	DSS					
7	BIT RATE					
8		MOD	FMT			
9	RTLT					
10		ESC				
11	ASTDLYC					
12	FLAG4	FLAG3	FLAG2	FLAG1		
13	RAT					
14	ASPNPDG					
15	SPF					
16	ARIPPHEC					
17	GMT OF C-112					
18	DC BUS VOLTAGE					
19	DC BUS CURRENT					
20	C-108	GMT OF C-108				
21	PT					
22	F	DQ	GMT OF SCID 0			
23		FILL	14	15	16	17
⋮	REPEAT WORDS 22,23 FOR WORDS 24-67					
	SCIDS 1-22					
68	F	DQ	GMT OF SCID 23			
69	E-124	FILL	14	15	16	17
70	F	DQ	GMT OF SCID 24			
71	E-125	FILL	14	15	16	17
72	F	DQ	GMT OF SCID 25			
73	E-126	FILL	14	15	16	17

GSFC/CRT
TYPE - BINARY
LOGICAL RECORD LENGTH - 256 WORDS
PHYSICAL RECORD LENGTH - 1301 WORDS
FILE SIZE - VARIABLE

FILE 4

EXPERIMENT DATA
FORMAT B

DRAFT

Figure 5-12. GSFC/CRT File 4 (Sheet 3 of 4)

DRAFT

<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th><th>20</th><th>21</th><th>22</th><th>23</th><th>24</th><th>25</th><th>26</th><th>27</th><th>28</th><th>29</th><th>30</th><th>31</th><th>32</th></tr>
<tr><td>74</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 26</td></tr>
<tr><td>75</td><td colspan="10"></td><td colspan="6">E-127</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
<tr><td>76</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 27</td></tr>
<tr><td>77</td><td colspan="10"></td><td colspan="6">E-128</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
<tr><td>78</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 28</td></tr>
<tr><td>79</td><td colspan="10"></td><td colspan="6">E-129</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
<tr><td>80</td><td>F</td><td colspan="2">DQ</td><td colspan="29">GMT OF SCID 29</td></tr>
<tr><td>81</td><td colspan="10"></td><td colspan="6">E-130</td><td colspan="4">FILL</td><td colspan="3">14</td><td colspan="3">15</td><td colspan="3">16</td><td colspan="3">17</td></tr>
<tr><td>:</td><td colspan="32"></td></tr>
<tr><td>:</td><td colspan="32">REPEAT FORMAT OF WORDS 22-23 FOR WORDS 82-149 SCIDS 30-63</td></tr>
<tr><td>149</td><td colspan="32"></td></tr>
<tr><td>150</td><td colspan="32"></td></tr>
<tr><td>:</td><td colspan="32">REPEAT FORMAT OF WORDS 22-149 FOR WORDS 150-277 SCIDS 64-127</td></tr>
<tr><td>277</td><td colspan="32"></td></tr>
<tr><td>278</td><td colspan="32"></td></tr>
<tr><td>:</td><td colspan="32">REPEAT FORMAT OF WORDS 22-277 FIVE TIMES FOR</td></tr>
<tr><td>:</td><td colspan="32">WORDS 278-1301 SCIDS 128-639</td></tr>
<tr><td>1301</td><td colspan="32"></td></tr>
<tr><td></td><td colspan="32">EOR</td></tr>
</table>

82
21
60

149
81
68

277
149
128

GSFC/CRT FILE 4 EXPERIMENT DATA FORMAT B (CONTD)

Figure 5-12. GSFC/CRT File 4 (Sheet 4 of 4)

DRAFT

VALUE (BINARY)	BCD	MEANING
11	3	ALL INDICATORS ARE GOOD, DATA IS GOOD
10	2	AT LEAST ONE INDICATOR IS BAD, DATA IS SUSPECT
01	1	AT LEAST TWO INDICATORS ARE BAD, DATA IS SUSPECT
0	0	DATA IS BAD - NO SYNC

THIS VALUE IS COMPUTED BY THE FOLLOWING LOGIC:

QI = FS (1+S+H), where:

FS = 1 IF DATA STREAM IS IN SYNC IN 360
0 IF DATA STREAM NOT IN SYNC

S = 1 IF AVERAGE SNR OVER FRAME IS $\geq$ A SPECIFIED MINIMUM
0 IF AVERAGE SNR OVER FRAME IS $<$ A SPECIFIED MINIMUM

H = 1 IF HSD BLOCK WAS RECEIVED WITH NO ERROR INDICATORS
0 IF ANY BIT ERRORS WERE DETECTED IN HSD BLOCK

Figure 5-49. Quality Indicator (Binary)

	VALUE (BINARY)
DSS 11	00001011
DSS 12	00001100
DSS 14	00001110
DSS 21	00010101
DSN SIMULATION CENTER (SIMCEN)	00011011
DSS 27	
DSS 41	00101001
DSS 42	00101010
DSS 51	00110011
DSS 61	00111101
DSS 62	00111110
DSS 71	01000111
CAPE BUILDING AO (DSS 70)	01000110
SFOF (DSS 00)	00000000
MERRITT ISLAND MSFN (MIL) (DSS 90)	01011010
USNS VANGUARD MSFN (VAN) (DSS 91)	01011011
BERMUDA MSFN (BDA) (DSS 92)	01011100
ASCENSION MSFN (ACN) (DSS 93)	01011101
CANARY ISLAND MSFN (CYI) (DSS 94)	01011110
BOULDER, COLORADO (DSS 99)	01100011

Figure 5-50. DSS Codes (Source Codes)

DRAFT

VALUE (BINARY)	BCD	RATE IN BITS PER SECOND
0000	0	16
0001	1	32
0010	2	64
0011	3	128
0100	4	256
0101	5	512
0110	6	1024
0111	7	2048

Figure 5-51. Rate of Data Transmission From Spacecraft (Binary)

FORMAT ID	BCD	FORMAT
0100Ø	8 OR 9	A
0000Ø	0 OR 1	B
0X100	4 OR 12	C 1
0X101	5 OR 13	C 2
0X110	6 OR 14	C 3
0X111	7 OR 15	C 4
11000	24	D1 WITH A
10000	16	D1 WITH B
11001	25	D2 WITH A
10001	17	D2 WITH B
11010	26	D3 WITH A
10010	18	D3 WITH B

Ø = DON'T CARE STATE (MAY BE A ONE OR A ZERO)
X = 1 WHEN IN ROTARY C (OPERATIONALLY FORCED)

Figure 5-52. Format ID Assignments

[illegible]

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA 94035

REPLY TO
ATTN OF: PAF-3-10(244-8)

February 20, 1973

To: Distribution

Subject: Pioneer 10 Data Processing Managers

A recent check has been made into the Experimenter Data Record (EDR) formats for the Pioneer 10 telemetry data.

It has been discovered that File 4 of the EDRs contains an error in the "flag" information contained in the header of each record of File 4. The nature of the error is that the order of the "flags" for the RAT (Roll Attitude Timer), ASPNPDC (Spin Period), SPF (Spin Mode), and ARIPPHEC (Roll-Pulse/Roll-Index Phase Error) is incorrect.

The parameter values themselves are correct and in the order currently described in the section of PC-262, The Pioneer F/G Off-Line Data Processing System wherein your EDR formats for File 4 are discussed. The enclosure to this memo is a draft copy which you are requested to insert in PC-262 to reflect the proper position of the "flags" associated with the parameters. The formal change will be sent shortly in a formal revision of PC-262 but in the meantime the enclosed draft is complete.

Charles F. Hall

Charles F. Hall
Manager, Pioneer Project

Enclosure:
1. Distribution List
2. Draft of Correction to PC-262: Pioneer 10 Telemetry EDR File 4

ENCLOSURE 1 to Pioneer Letter PAF-3-10
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Enclosure 2

BFEC/ARC

DRAFT OF CORRECTION TO PC-262:

PIONEER 10 TELEMETRY EDR FILE 4

(7) Line 8 & 9 (RTLT) - The Round Trip Light Time will be given in total milliseconds.

(8) Line 10 (ESC Subcom ID) - The Extended Frame Counter will be a combined word from the S/C telemetry of both the subcommutator identification word and the extended frame counter word. Together they comprise a counter from 0 to 8191.

(9) Line 11 (ASTDLYC) - Star delay time (1/256 second resolution) in DN. Twelve bits with telemetry bits reversed to give proper bit weighing -999 indicates missing value.

(10) Line 12 (Flag 1, Flag 2, Flag 3, Flag 4) - These are flags for SPF, RAT, ASPNPDC, ARIPPHEC, respectively. Each flag is six bits. Flag values are: 0 = OK, 1 = old value, 2 = missing value, and 3 = corrected value.

(11) Line 13 & 14 (RAT - Roll Attitude Timer) - Engineering Subcom Words C-112 and C-116. This time permits correlation of the attitude of the roll index reference line with given telemetered science and engineering data. Floating point form.

(12) Line 15 (ASPNPDC - Spin Period) - The time between two successive roll pulses of the spacecraft. Engineering Subcom Words C-405, C-406, C-407. Floating point form.

(13) Line 16 (SPF) - Engineering Subcom Word C-417 is the flag for spin period. If value is 0, 1 or 2, then SPSG (Spin Period Secotr Generator) roll reference = 0°, if value is 4, 5 or 6, then SPSG roll reference = 180°.

Value	SPSG Modes
4 or 0	Non-Spin Averaging
5 or 1	ACS
6 or 2	Spin Averaging

(14) Line 17 & 18 (ARIPPHEC - Roll Pulse/Roll-Index Pulse Phase Error) - The phase error measurement between the Roll Pulse and Roll-Index Pulse with up to a maximum of ± 60 msec of phase error, generated by the Spin Period Sector Generator (SPSG).

(15) Line 19 & 20 (Time of C-112) - GMT time that C-112 was received. Zero indicates time was missing.

(16) Line 21 (DC Bus Voltage C-107) - Range 26-30 VDC. Floating point form. Zero indicates value was missing.

(7) Line 8 & 9 (RTLT) - The Round Trip Light Time will be given in total milliseconds.

(8) Line 10 (ESC Subcom ID) - The Extended Frame Counter will be a combined word from the S/C telemetry of both the subcommutator identification word and the extended frame counter word. Together they comprise a counter from 0 to 8191.

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Value	SPSG Modes
4 or 0	Non-Spin Averaging
5 or 1	ACS
6 or 2	Spin Averaging

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(15) Line 19 & 20 (Time of C-112) - GMT time that C-112 was received. Zero indicates time was missing.

(16) Line 21 (DC Bus Voltage C-107) - Range 26-30 VDC. Floating point form. Zero indicates value was missing.

DRAFT

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I. Objectives

The NASA/Goddard Cosmic Ray Instrument is a cosmic radiation analyzer designed to detect and measure the energy spectra, atomic and isotopic composition, and angular distribtuion of galactic and solar cosmic rays from ~50 KeV to ~800 MeV/nucleon in interplanetary space and in the radiation belts surrounding Jupiter as the spacecraft passes near the planet. The instrument includes three separate multi-element solid state telescope assemblies to cover the energy range in three overlapping ranges and to quantize the energy loss in each telescope element. The resulting data are conditioned and stored for presentation to the spacecraft telemetry system upon demand. Background effects due to local interactions are minimized by requiring multiple coincidence between several elements. Consistency requirements applied during data analysis further reduce background effects.

II. Instrument Description

The instrument is mounted on the spacecraft with each telescope perpindicular to the spin axis so that they scan the northern and sourthern celestial hemispheres. Angular distribution and energy spectra are determined by counting the number of particles passing thru each telescope and by digitizing the pulse amplitude from each detector for a quasi-randomly chosen single particle. The several coincidence and amplitude criteria required to initiate an analysis are priority ranked. Less frequent events, such as heavy nuclei, are preferentially selected for transmission to the telemetry system to improve the statistics of these relatively rare events.

return original to Stilwell

The instrument contains three multi element solid state detector telescopes sensitive to particles in over lapping energy ranges. The telescopes are designated as:

A. The High Energy Telescope (HET)

B. One Low Energy Telescope (LET-I)

C. A Second Low Energy Telescope sensitive to lower energy particle (LET-II).

The range of energies covered for the various particle types and the geometric factor for each telescope is shown briefly in table 1.

TABLE I

Particle Component	Energy Range
Galactic cosmic ray protons	4.5 - 800 MeV
Solar protons	.05 - 800 MeVγ
Galactic cosmic ray Helium	4.5 - 600 MeV/nucleon
Solar Helium	1.0 - 600 MeV/nucleon
He^3/He^4,D/H	4.5 - 50 MeV/nucleon
Galactic and Solar Electrons	.050 - 5.0 MeV
Li, Be, B, C, N, O, F, Ne and their isotopic composition	6 MeV/nuc - 200 MeV/nucleon
Integral flux	> 800 MeV

Energy Ranges for Angular Distribution Studies

Hydrogen	.05 - 120 MeV
Helium	4.5 - 120 MeV/nucleon
Electrons	.05 - 5 MeV

Geometrical Factors

High Energy Telescope	0.220 cm^2-ster.
Low Energy Telescope I	0.155 cm^2-ster.
Low Energy Telescope II	0.015 cm^2-ster.

A. High Energy Telescope (HET)

The high energy telescope is a four element array and is shown schematically in Figure 1. Two of these elements (A and B) are single, lithium-drifted silicon detectors, 300 mm^2 in area and 2.5 mm thick. The third element is a stacked arrangement of four 850 mm^2, 2.5 thick lithium drifted silicon detectors (C_1 and C_2, while the fourth element C_3 is a similar detector which identifies events as stopping somewhere in the telescope ABC_1C_2 or as penetrating the entire telescope. For particles which come to rest within the telescope (20 - 50 MeV/nucleon) three measurements are made - energy loss (dE/dx), total energy, and range. The simultaneous measurement of total energy and range provides a very powerful method for rejecting detector background, which is a particularly significant problem in this energy regime. For particles which penetrate completely through the stack of solid state devices, three separate dE/dx measurements are made. This will allow the differential energy spectra to be obtained for helium and hydrogen from 50 - 800 MeV/nucleon. Charge resolution for penetrating particles will be possible up to approximately 200 MeV/nucleon.

Figure 1 also shows a simplified logic drawing for the HET. In addition to the three 10-bit addresses associated with the pulse height analysis of each HET event, we require additional bits to identify the coincidence condition which initiated the analysis, identify the data as HET, identify the spin sector in which the event occurred, and to determine if the event penetrated to C_2 and/or C_3. The coincidence conditions which can initiate an analysis are shown in Figure 1 and correspond to stopping particles, stopping heavies (He and above), penetrating heavies, and all penetrating particles. Since these detectors will usually be telemetry-readout limited, the priority system will select these rare particles for analysis on a time shared basis, thus artificially enhancing the fraction of alpha particles and heavies in the data. The true ratios of these particles in interplanetary space can be determined from the counting rates of the various coincidence conditions listed in the figure. Certain rates are sectored, e.g., counted into eight different counters corresponding to eight equal sectors (45°) of spin, synchronized to the see-sun direction.

B. Low Energy Telescope (LET-I)

LET-I is a three element dE/dx vs E telescope plus an anti-coincidence detector. It will cover the energy range from 3 to 22 MeV/nucleon, and in this interval charge resolution will be possible from Z = 1 (hydrogen) to Z = 8 (oxygen). The telescope is designed to measure both the energy spectra and angular distributions over these intervals.

The detector and its associated electronic system configuration is shown in Figure 2. Detectors D_1 and D_2 are identical silicon surface barrier devices each 100 microns thick and 100 mm^2 in area. They serve the dual purposes of defining the geometry of the detector telescope and also providing a redundant double dE/dx measurement. Detector E is a lithium drifted silicon device 2.5 mm in thickness and 300 mm^2 in area. It serves as a total energy measuring element. The F detector, another 2.5 mm thick lithium drifted silicon device, simply acts as an anticoincidence. Events of the type $D_1D_2\bar{E}$ and $D_1D_2E\bar{F}$ will be analyzed. The $D_1D_2\overline{EF}$ events correspond to protons between 3 and 5 MeV whereas the $D_1D_2E\bar{F}$ events include the 5 to 22 MeV range for protons.

Figure 2 also outlines the pulse height analysis system, conditions, and the auxilliary bits required. A priority system similar to HET is incorporated to emphasize rare events, and many different count rates are monitored. Several rates are also sectored by eight to allow us to reconstruct an angular scan.

This detector, like the HET, is self-calibrating. In addition the telescopes have been designed such that an overlap in the individual energy responses of the detectors does exist. This will then allow cross calibrations between detectors.

C. Low Energy Telescope (LET-II)

This telescope is specially designed to study low energy protons and electrons in the Jovian radiation belts and particles of solar origin in the interplanetary region. Since this detector system is quite small, it can be effectively shielded from the spacecraft RTG's with lead and aluminum. A schematic of this detector and the associated electronics is shown in Figure 3.

There are three elements:

S_1 50 μ - 50 mm^2 Silicon Surface Barrier

S_2 2.5 mm - 50 mm^2 Lithium-drifted Silicon

S_3 2.5 mm - 200 mm^2 Lithium-drifted Silicon

The S_1 thickness was chosen to minimize the electron response without making an unreasonable sacrifice in the detector performance.

The detectors S_1 and S_2 are used individually and in coincidence as total absorption spectrometers. S_3 operating in an anticoincidence mode insures that only stopping particles are analyzed. In addition, S_2 is made with a coaxial detector enclosing the center active region so as to provide anticoincidence to particles coming from the sides. S_1 will stop electrons in the range 50 - 150 keV and protons in the range 50 keV - 3 MeV. The S_2 detector will respond to electrons in the energy interval 150 keV - 1 MeV and the proton interval is 3 MeV - 20 MeV, and in these ranges an unambiguous separation of electrons and protons is possible. Figure 5 also lists the rates and sectored rates that are monitored for this detector. Stopping alphas in the S_1 detector will have a unique response from 1 MeV - 3 MeV/ nucleon for solar alpha events.

D. Instrument Operation

The output signals from each telescope element are amplified and actively shaped in a charge-sensitive preamplifier and post-amplifier producing gaussian shaped pulses suitable for amplitude analysis. Pulse amplitude distriminators produce logical outputs which are combined digitally to detect each of the coincidence - amplitude conditions listed in figures 1, 2 and 3. Certain coincidence conditions can initiate digitization of the amplitudes of the detector output pulses. Delay lines allow time ($\sim 3\ \mu$sec) for the coincidence system to recognize one of the allowed conditions, prime the pulse height analyzers (PHA's), and open the linear gates briefly so that analysis of pulses from the passage of a single particle through the telescope may be performed. The digitized output and the auxiliary identification bits (total of 40 in all) constitute a unique event and is preserved in storage for later readout to telemetry. If a particle of higher priority is detected prior to readout, analysis is allowed and the resulting data replaces the previous data in readout storage.

In addition, the occurrences of many other coincidence conditions are detected by the coincidence matrices. There are 57 such unique conditions which are commutated into 32 counters on a time sharing basis. Each counter is a 24 stage binary register whose output is converted to a 12 bit log of the number of events accumulated, with accuracy better than 0.5%. Sixteen counters are devoted to sectored rates, sixteen to unsectored rates. The accumulation interval for the sectored rate counters is synchronized to the spacecraft roll to insure that the live time is exactly an integral number of rolls, and the rate of output is gated to one of eight counters during each 45^o portion of spacecraft roll. The number of rolls during each accumulation interval is automatically determined by the bit rate in use.

Commands may be sent to the experiment which turn off the PHA's to reduce power consumption by ~ 0.45 watts, to disable the sectored rate roll-synchronizer, and to turn on or off an internal pulser which provides electronic stimulus to the preamplifiers and following circuitry. When power is switched on, the instrument is set to the preferred mode of operation (PHA's and roll synchronizer on, internal stimulus off).

Any of the remaining options (Low Power, Internal Stim. On, or Roll Synchronizer Off) are used only for engineering purposes and are not preferred.

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INSTRUMENT OUTPUT (VOLTS)	S/C OTU OUTPUT (DECIMAL)	ELECTRONIC TEMP (°F)	INSTRUMENT OUTPUT (VOLTS)	S/C OTU OUTPUT (DECIMAL)	ELECTRONIC TEMP (°F)
0	0	—	1.51	32	35 34
.02	1	—	1.55	33	34
.07	2	—	1.60	34	33
.12	3	—	1.65	35	31
.17	4	132	1.70	36	30
.22	5	122	1.74	37	28
.26	6	113	1.79	38	27
.31	7	104	1.84	39	26
.36	8	98	1.89	40	24
.40	9	92	1.94	41	23
.45	10	87	1.99	42	22
.50	11	83 81	2.03	43	20
.54	12	80	2.08	44	19
.59	13	76	2.13	45	18
.64	14	72	2.18	46	17
.69	15	68	2.22	47	15
.74	16	65	2.27	48	14
.78	17	63	2.32	49	13
.83	18	61	2.37	50	12
.89	19	58	2.42	51	10
.83	20	56	2.46	52	9
.97	21	54	2.51	53	8 10?
1.02	22	52	2.56	54	7
1.07	23	51	2.61	55	6
1.12	24	49	2.65	56	5
1.16	25	47	2.70	57	3
1.21	26	45	2.75	58	2
1.26	27	43	2.80	59	0
1.31	28	42	2.85	60	-1
1.36	29	40	2.89	61	-2
1.41	30	38	2.94	62	-3
1.46	31	37	2.99	63	-4

REFERENCE: GSFC CALIBRATION CURVE DATED 3/16/72
WORD E125

REPRODUCED FROM

TITLE
ELECTRONIC TEMPERATURE
CALIBRATION DATA
GSFC / CRT
PIONEER 11

PIONEER PROGRAM
NASA
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA

DOC. NO

FIG.

REV. NO.

DATE

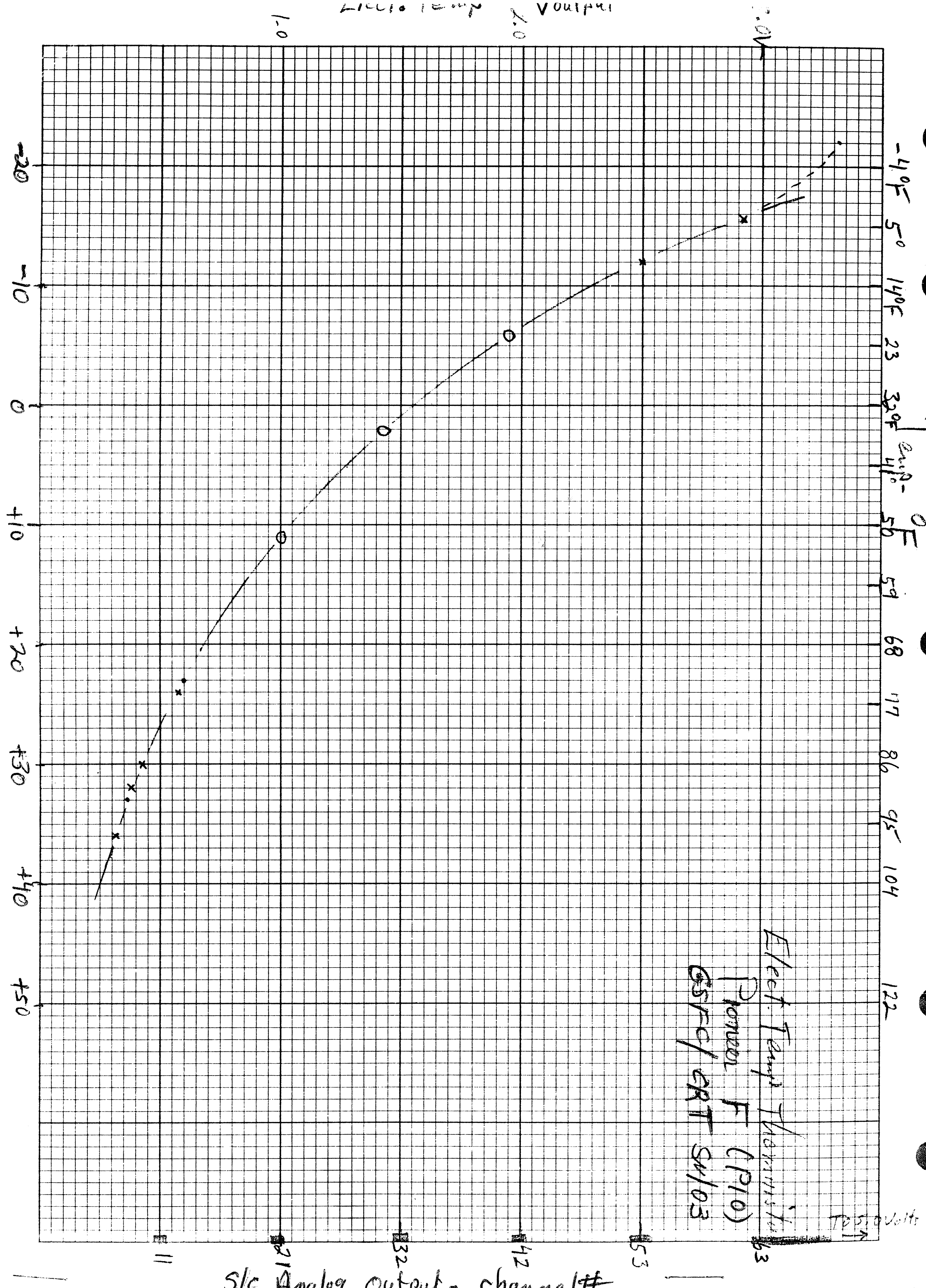
SHEET OF

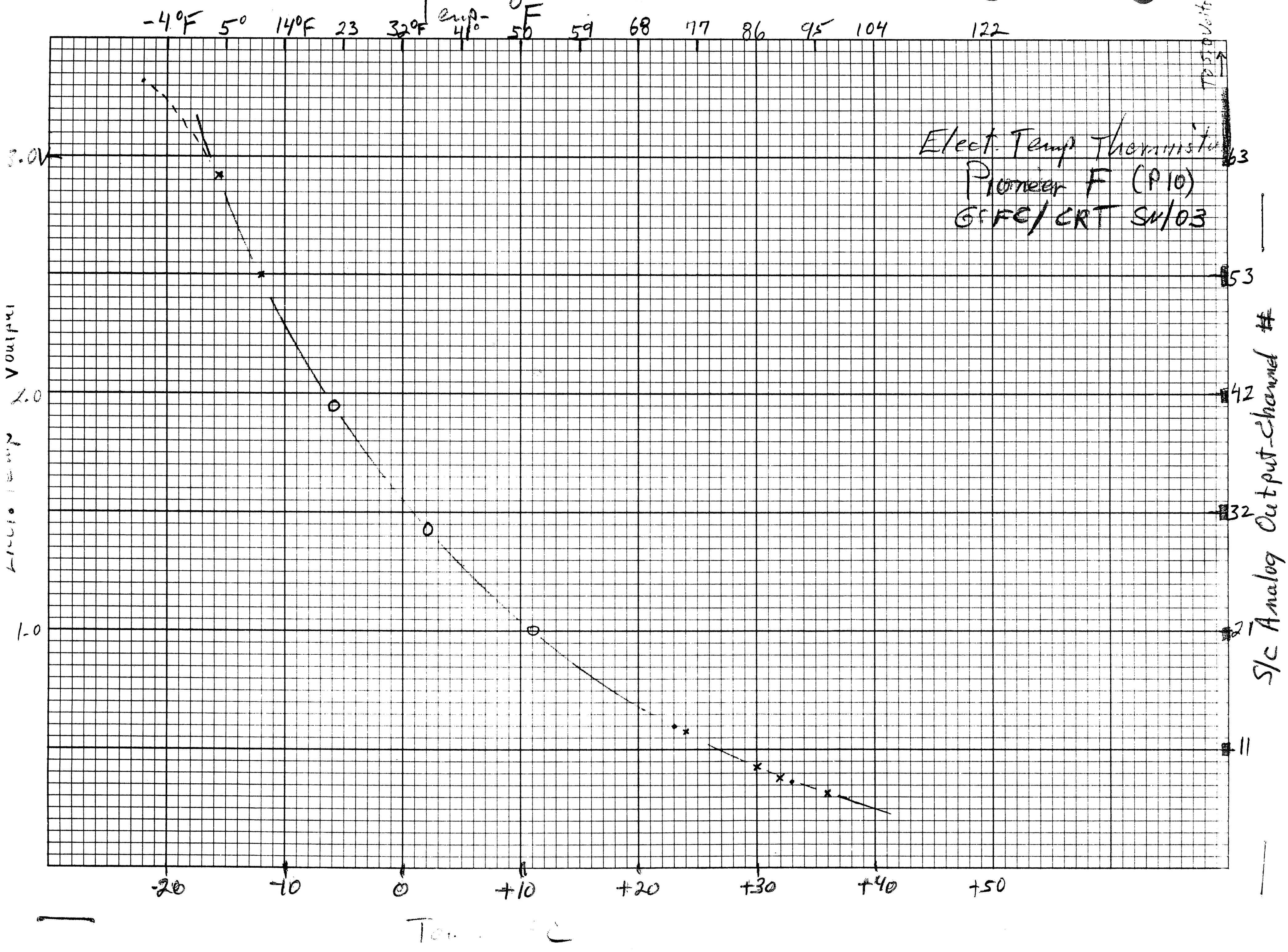
INSTRUMENT OUTPUT (VOLTS)	S/C OTU OUTPUT (DECIMAL)	ELECTRONIC TEMP (°F)	INSTRUMENT OUTPUT (VOLTS)	S/C OTU OUTPUT (DECIMAL)	ELECTRONIC TEMP (°F)
0	0	—	1.51	32	35
.02	1	—	1.55	33	34
.07	2	—	1.60	34	33
.12	3	—	1.65	35	31
.17	4	132	1.70	36	30
.22	5	122	1.74	37	28
.26	6	113	1.79	38	27
.31	7	104	1.84	39	26
.36	8	98	1.89	40	24
.40	9	92	1.94	41	23
.45	10	87	1.99	42	22
.50	11	83	2.03	43	20
.54	12	80	2.08	44	19
.59	13	76	2.13	45	18
.64	14	72	2.18	46	17
.69	15	68	2.22	47	15
.74	16	65	2.27	48	14
.78	17	63	2.32	49	13
.83	18	61	2.37	50	12
.89	19	58	2.42	51	10
.83	20	56	2.46	52	9
.97	21	54	2.51	53	8
1.02	22	52	2.56	54	7
1.07	23	51	2.61	55	6
1.12	24	49	2.65	56	5
1.16	25	47	2.70	57	3
1.21	26	45	2.75	58	2
1.26	27	43	2.80	59	0
1.31	28	42	2.85	60	-1
1.36	29	40	2.89	61	-2
1.41	30	38	2.94	62	-3
1.46	31	37	2.99	63	-4

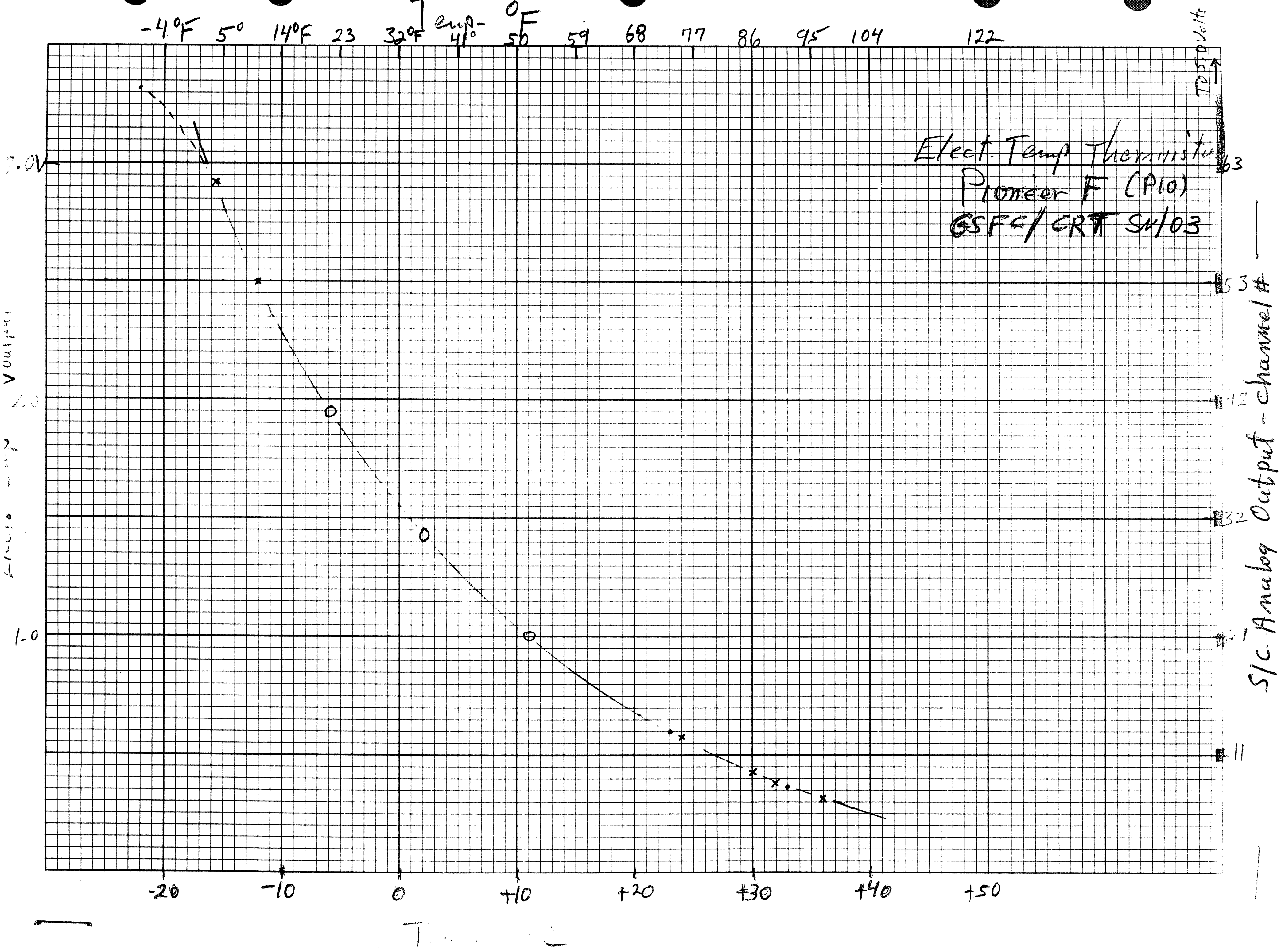
REFERENCE: GSFC CALIBRATION CURVE DATED 3/16/72

WORD E125

REPRODUCED FROM	TITLE	PIONEER PROGRAM NASA AMES RESEARCH CENTER MOFFETT FIELD, CALIFORNIA
	ELECTRONIC TEMPERATURE CALIBRATION DATA GSFC / CRT PIONEER 11	DOC. NO
		FIG.
	REV. NO. / DATE	SHEET OF


Elect. Temp Thermistor
Pioneer F (P10)
GSFC/CRT 8/4/03
Elect. Temp. V output
1.0
2.0
3.0V
-20
-10
0
+10
+20
+30
+40
+50
-4°F
5°
14°F
23
32°F
41°
50
59
68
77
86
95
104
122
Temp. °F
11
21
32
42
53
63
TP 5.0 Volts
S/C Analog Output - channel #


Elect. Temp Thermistor
Pioneer F (P10)
GSFC/CRT SW/03
Temp- °F
-4°F
5°
14°F
23
32°F
41°
50
59
68
77
86
95
104
122
Elect Temp Voutput
3.0V
2.0
1.0
-20
-10
0
+10
+20
+30
+40
+50
Temp °C
S/C Analog Output Channel #
63
53
42
32
21
11
To 5.0 Volts



Elect. Temp Thermistor
Pioneer F (P10)
GSFC/CRT SN/03

Traveler Copy

PFG.274-234
Attachment - Page 12

DET CA-

PIONEER "F" THERMAL-VAC
EXPERIMENT CALIBRATION TABLE 1
(UC T2, GSFC DT, ARC TE, USC-T5, UI T3, ~~[illegible]~~)

Should also work for SC platform +

COUNTS	°F	COUNTS	°F	COUNTS	°F
0	-	25	63	50	17
1	-	26	60	51	16
2	-	27	58	52	14
3	-	28	56	53	13
4	-	29	54	54	11
5	-	30	52	55	10
6	148	31	50	56	8
7	138	32	48	57	6
8	130	33	47	58	5
9	123 122	34	45	59	3
10	118	35	43	60	2
11	112	36	41	61	0
12	106	37	39	62	- -1.6°F*
13	102	38	38	63	- -3.2°F*
14	97	39	36	64	-
15	93	40	34	65	-
16	89	41	32		
17	84	42	30 ok		
18	81	43	29		
19	79	44	27		
20	76	45	25		
21	73 71	46	24		
22	70	47	22		
23	67	48	21		
24	65	49	19		

* PER G. MURPHY NOV. 17, 1971

Jack Jacobs

~~Ply. 82~~

589-0700 $100
Paul Koffer O/d
B&H olds → 117-54-03-~~025~~ C25-30F
~~1279-945-C25-201~~
1110 Fidler Lane
Suite A
SS 20910

Pioneer Prototype Inst. - S/N 02
(CRT)

~~P 21~~

Page	T (electronics)	V_{pri} 24
21	24°C	1.689V
22	23	1.714
24	22	1.771
26	-29	3.011
	-31	3.020
32	+34	1.318
34	-18°C	2.785
40	~~+40°C~~ +12°C	2.633
41	31.9	1.541
45	32°	1.43
50	25.6°C	1.648
80	29.3	1.554
81	28.9	1.591
82	29.2	1.504
83	29.2	1.504
85	-16°C	2.824
86	-17.0°C	2.907
87	-16.0	2.817

1612
6541
− 1612
4928

2000 CKK
~~12079~~ 12K
Jim Coleman
Toyota

need
readout counts → T
or counts ⇐ voltage

Training Copy

DET CAL

PIONEER "F" THERMAL-VAC
EXPERIMENT CALIBRATION TABLE 1
(UC T2, GSFC DT, ARC TE, USC-T5, UI T3, [illegible])

COUNTS	°F	COUNTS	°F	COUNTS	°F
0	-	25	63	50	17
1	-	26	60	51	16
2	-	27	58	52	14
3	-	28	56	53	13
4	-	29	54	54	11
5	-	30	52	55	10
6	148	31	50	56	8
7	133	32	48	57	6
8	130	33	47	58	5
9	123	34	45	59	3
10	118	35	43	60	2
11	112	36	41	61	0
12	106	37	39	62	- -1.6°F *
13	102	38	38	63	- -3.2°F *
14	97	39	36	64	-
15	93	40	34	65	-
16	89	41	32		
17	84	42	30		
18	81	43	29		
19	79	44	27		
20	76	45	25		
21	73	46	24		
22	70	47	22		
23	67	48	21		
24	65	49	19		

* PER G. MURPHY NOV. 17, 1971

Jack Jacobs

Ply. ~~82~~

$100

589-0700

Paul Koffer

B&H

Olds

117-54-03-C25-20 F

Old

Pioneer Prototype Inst. - S/N 02
(CRT)

~~P21~~

~~1279-945-C25-20~~

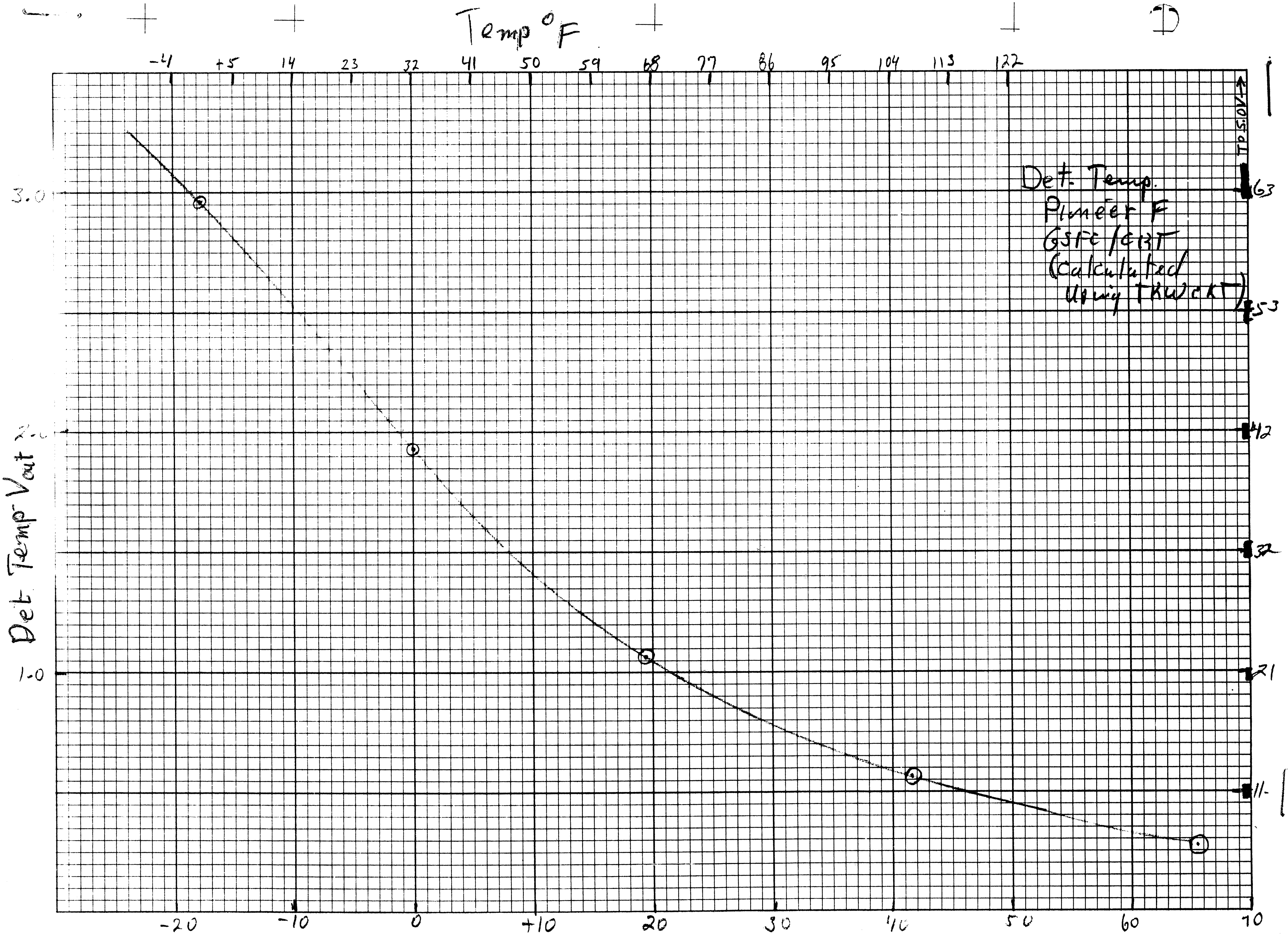
1110 Fidler Lane
Suite A
SS 20910

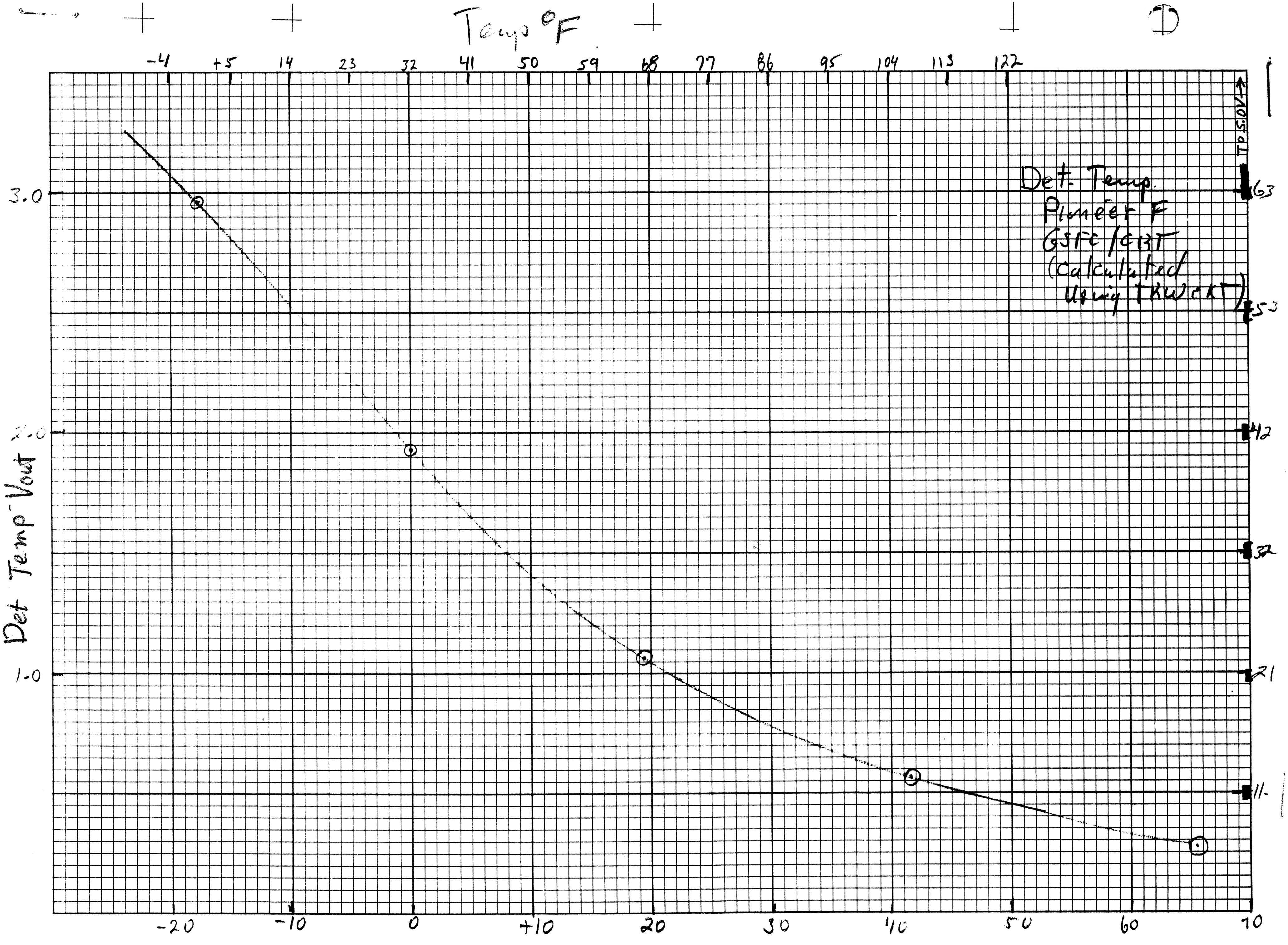
Page	T (electronics)	V pri 24
21	24°C	1.689 V
22	23	1.714
24	22	1.771
26	-29	3.011
	-31	3.020
32	+34	1.318
34	-18°C	2.785
40	~~+11°C~~ +12°C	2.633
41	31.9	1.541
45	32°	1.43
50	25.6°C	1.648
80	29.3	1.554
81	28.9	1.591
82	29.2	1.504
83	29.2	1.504
85	-16°C	2.824
86	-17.0°C	2.907
87	-16.0	2.817

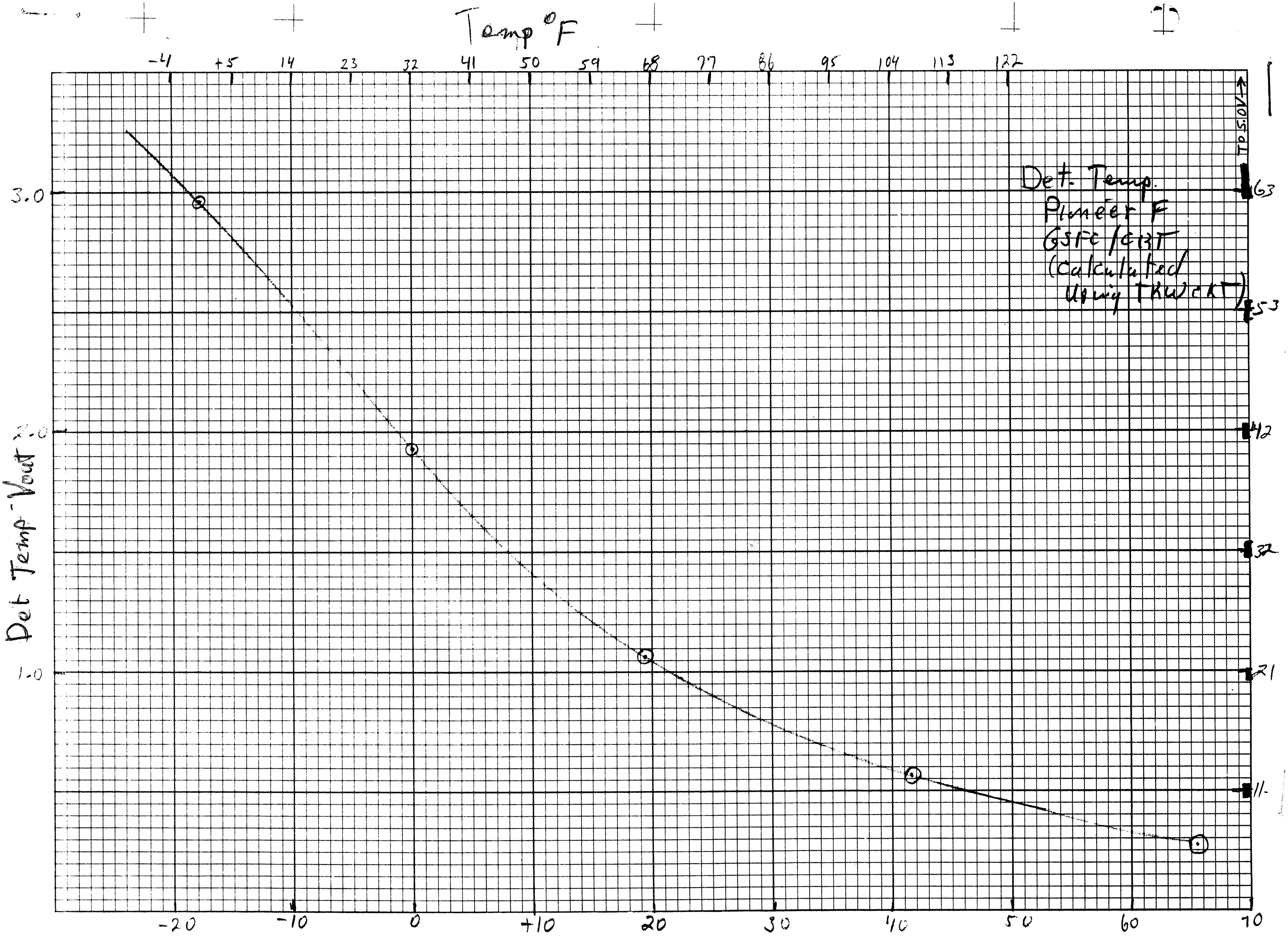
1612

6541
- 1612
4928

2000 CKK
~~12079~~ 12K
Jim Coleman
Toyotta


Temp °F
-4
+5
14
23
32
41
50
59
68
77
86
95
104
113
122
Det. Temp.
Pioneer F
GSFC/CBT
(Calculated
Using TKWCKT)
TO 5.0V →
63
53
42
32
21
11
Det Temp Vout
3.0
2.0
1.0
-20
-10
0
+10
20
30
40
50
60
70


D
Temp °F
-4
+5
14
23
32
41
50
59
68
77
86
95
104
113
122
Det. Temp.
Pioneer F
GSFC/CRT
(Calculated
Using TRW CKT)
TO 5.0V
63
53
42
32
21
11
Det Temp Vout
3.0
2.0
1.0
-20
-10
0
+10
20
30
40
50
60
70



Det. Temp.
Pioneer F
GSFC/CRT
(Calculated
Using TKWckT)

INSTRUMENT OUTPUT (VOLTS)	S/C OTU OUTPUT (DECIMAL)	ELECTRONIC TEMP (°F)	INSTRUMENT OUTPUT (VOLTS)	S/C OTU OUTPUT (DECIMAL)	ELECTRONIC TEMP (°F)
0	0	—	1.51	32	35
.02	1	—	1.55	33	34
.07	2	—	1.60	34	33
.12	3	—	1.65	35	31
.17	4	132	1.70	36	30
.22	5	122	1.74	37	28
.26	6	113	1.79	38	27
.31	7	104	1.84	39	26
.36	8	98	1.89	40	24
.40	9	92	1.94	41	23
.45	10	87	1.99	42	22
.50	11	83	2.03	43	20
.54	12	80	2.08	44	19
.59	13	76	2.13	45	18
.64	14	72	2.18	46	17
.69	15	68	2.22	47	15
.74	16	65	2.27	48	14
.78	17	63	2.32	49	13
.83	18	61	2.37	50	12
.89	19	58	2.42	51	10
.93	20	56	2.46	52	9
.97	21	54	2.51	53	8
1.02	22	52	2.56	54	7
1.07	23	51	2.61	55	6
1.12	24	49	2.65	56	5
1.16	25	47	2.70	57	3
1.21	26	45	2.75	58	2
1.26	27	43	2.80	59	0
1.31	28	42	2.85	60	-1
1.36	29	40	2.89	61	-2
1.41	30	38	2.94	62	-3
1.46	31	37	2.99	63	-4

REFERENCE: GSFC CALIBRATION CURVE DATED 3/16/72

WORD E125

REPRODUCED FROM	TITLE ELECTRONIC TEMPERATURE CALIBRATION DATA GSFC / CRT PIONEER 11		PIONEER PROGRAM NASA AMES RESEARCH CENTER MOFFETT FIELD, CALIFORNIA
			DOC. NO.
			FIG.
	REV. NO.	DATE	SHEET OF