SOLAR-A FILE FORMAT CONTROL DOCUMENT

Version 2.00
25-Mar-92

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1. SCOPE

This document describes the formats of the raw data files that will compose the reformatted Solar-A dataset, the observing log, the event log, and the flare catalog.

There will be seven reformatted files: one each for the BCS (Bragg Crystal Spectrometer), HXT (Hard X-ray Telescope), and WBS (Wide Band Spectrometer); for SXT (Soft X-ray Telescope) there will be two files – partial frame image (PFI) and full frame image (FFI); and two spacecraft common files – one containing raw attitude control data (ATT), and a Spacecraft Common Basic Part File (CBA) that will contain all the housekeeping data for the spacecraft and experiments (the "basic" part). The structure of SXT and BCS files will be based on instrument modes, while the HXT, WBS, and houskeeping files will be based on telemetry frames.

The previous File Control Documents (before Ver 2.0) made references to bit patterns using the ISAS/NEC convention of bit 7 being the least significant bit (LSB) (example: xxxxxxx = 01234567). The documentation for Ver 2.0 and all future versions refer to bit 0 being the least significant bit. An example reference would be bits 4:6 in the byte being refered to are AAA in the byte xAAAxxxx. The change in notation was to make programming easier since most software functions work with the LSB being bit 0.

There has been an attempt to avoid using real numbers and to use scaled integers instead. As the data is reduced more and more, it will be difficult to avoid using real numbers. Future versions of the File Control Document will address that issue.

The structure data type definitions listed in this document are in the form of the FORTRAN syntax for structure definitions. There is one set of master structure definitions. Programs take that definition and make the IDL structure definitions and the File Control Document TEX file that is included in this document. In this manner the FCD and the IDL definitions can easily be kept up to date. One distiction that should be noted is that the field names for the CHARACTER data types have had their names changed when being converted to an IDL structure. The string "st$" is added before the original field name as listed in this document and the FORTRAN definition files. For example, if the tag is define as

```
CHARACTER*16 ProgName
```

then the IDL tag name would be "ST$ProgName" and the tag would be a byte array of 16 elements long (bytarr(16)). This was necessary because IDL has the capability of having variable length strings, and the read statement had to have a fixed known length.

```
In order to highlight and emphaize where there have been changes between FCD
version 1.2 and 2.0 a brief summary is listed  here:
        * There have been slight adjustments to the contents and definitions
           of the structures of all of the instruments
        * There will now be an observing per week (not per month)
        * There are ephemeris files (FEM files) summarizing the spacecraft
          day/night, SAA, and station contact transitions.
        * A summary subset of the pointing information is contained in
          PNT files which will be kept on-line for the whole mission.
        * A complete archive history of all tapes made and distriubted will
          be available in XAD and XBD files.
```

2. FILE NAMES

2.1 File Name Prefixes

All file name prefixes shall be three characters long.

The following prefixes shall be used for the corresponding file types:

File Type	Prefix	Direct Reformatter Output	Weekly Files
Spacecraft Attitude Control Data	ADA	*	
BCS Raw data	BDA	*	
BCS Spectroscopic Data	BSR		
BCS Fitted Spectra file	BSF		
BCS Calibrated Parameter file	BPC		
BCS fit parameters file	BPF		
Spacecraft Housekeeping data (Common Basic Area)	CBA	*	
Event log	EVN		
Ephemeris S/C data	FEM		*
HXT Raw data	HDA	*	
HXT Image Deconvolved	HXI		
Observing log	OBS		*
Pointing summary files	PNT		*
SXT FFI Raw data	SFR	*	

```
SXT PFI Raw data                        SPR        *
SXT (Both FFI/PFI) Background Subtract  SBS
SXT (Both FFI/PFI) Calibration          SBC
SXT PFI Background Subtracted           SPS
SXT FFI Calibration                     SFC
SXT PFI Raw data (part of whole file)   SPP
SXT Groundbased Data (MicroVAX)         SGB

WBS Raw data                            WDA        *

Exabyte tape ASCII log files            XAD                       *
Exabyte tape binary log files           XBD                       *
```

The "File ID" is of the form "yymmdd.hhmm" where "yy" is the year, "mm" is the month, "dd" is the date, "hh" is the hour and "mm" is the minutes of the first minute of sun for the orbit. Thus, for data covering an orbit that starts at 1250 UT on 3 September 1991, the file for the BCS would be: `BDA910903.1250`

Please note that the SXT file names (e.g. SPR, SFR, ...) given above describe files which are internally of the same format and are referred generically throughout this document as "SDA." The different BCS file names refer to files which have different internal formats.

Temporary reformatted files will be written to permit quick look analysis, and to these files an additional character – "T" – will be added to the name to identify it as such. Text listing files which correspond to the data files will have the character "L" appended to their filenames.

```
File Name Examples:         BDA910901.1234
SFR910902.1234
SFR910902.1234_T
SFR910902.1234_L
                               REF910902.1234_LOG
```

2.2 File ID's

The file ID's shall be 11 characters long in the format shown below:

```
YYMMDD.HHMM

where YY - Year of data
      MM - Month of data
      DD - Day of data
      HH - Hours
      MM - Minutes
```

The file ID for the reformatted data files shall be constructed by the reformatting program from the first minute of sunlight as given by the predicted space ephemeris. This method is used instead of using the actual first minute of sunlight from the telemetry data, since the data from the beginning of an orbit might be overwritten or otherwise lost. Thus, the file ID may not always correspond exactly to the actual time of the first data set.

The ID shall be passed unchanged to all derived files.

NOTE: The ISO-9660 standard for CD-ROMs only allows 8 characters for file name and 3 characters for the extension. We might have to reconsider for the file ID.

3. DATA FLOW

This section describes how the data is converted into the reformatted data base files and the observing log and event log files.

The raw telemetry data will be transferred from the ISAS Sirius storage system on the FACOM mainframe computer to one of the co-investigators workstation computers (DEC 5500). The reformatter is written in IDL Ver 2.0 and can be run on any of the workstations (DEC, Sun, ...). The reformatter will run automatically using the raw telemetry as the input.

Data will be reformatted and put in temporary files on a daily basis after each set of KSC passes. Only KSC real time and BDR dumps made at KSC will be reformatted at this time. Approximately 4 days after the end of the week, all of the DSN data should have arrived and the data will be reformatted again using all data available. This data will replace the temporary data and will be distributed to all of the co-investigator institutions. The temporary data will generally cover 24 hours and will not be time ordered. The final distributed data will have one orbit of data in each file and will be time ordered.

The observing log will also run automatically, but it will use the reformatted data files as the input.

```
Program:        Reformatter
Location:       Workstation Computer (DEC 5500)
Input:          Raw Telemetry transferred from Sirius Storage/Access System
Output:         Reformatted Data files:
                                        CBAyymmdd.hhmm
                                        SFRyymmdd.hhmm
                                        SPRyymmdd.hhmm
                                        BDAyymmdd.hhmm
                                        WDAyymmdd.hhmm
                                        HDAyymmdd.hhmm
                                        ADAyymmdd.hhmm
Duration:       One file per instrument per S/C orbit
Sizes:          ??
-----------------

Program:        Observing Log Generator
```

```
Location:       Workstation Computer (DEC 5500)
Input:          Reformatted files
Output:         OBSyy_ww
Duration:       One file per week
Sizes:          ??
-----------------

Program:        Event Log Generator
Location:       Workstation Computer (DEC 5500?)
Input:          Solar-A Observing Log
                Tracking Log (active region # and coordinates)
                Ground Base Observation Log
                CD-ROM Index listing
Output:         EVENT.LOG
Duration:       One file for whole mission (??)
Sizes:          ??
-----------------

Program:        Flare Catalog Generator
Location:       Workstation Computer (DEC 5500?)
Input:          Reformatted Files - hand searched(?)
                Observing Log
Output:         FLARE.LOG
Duration:       One file for whole mission (??)
Sizes:          ??
-----------------
```

4. DEFINITION OF REFORMATTED FILE STRUCTURES

Figure 3-1 Flow of Solar-A Data

4. DEFINITION OF REFORMATTED FILE STRUCTURES

The reformatted data files will be binary and arranged in VMS-style fixed length record formats. On UNIX systems the logical records will be padded as necessary, and on VMS systems the files will be direct access. The word convention that will be used on all reformatted data files is that used by DEC. There is one IDL subroutine which does all of the reading and writing. If the data file is being read on a machine that requires that the bytes be swapped (a Sun workstation for example), the subroutine will handle that automatically.

The data structure of SXT and BCS files will be based on instrument modes, while the HXT, WBS, and houskeeping files will be based on telemetry frames.

Each file shall be logically divided into the following six sections:

1. File Information and Pointer Section
2. File Header Section
3. Quasi-Static Index Section
4. Index and Data Section
5. Instrument Optional Sections
6. Road Map Section

4.1 Pointer Section

This always begins at the first record of the file. Within a file, the record lengths will be fixed, but the different kinds of reformatted files may have different lengths. Thus, the number of spares will vary depending on the file type. The program which reads the file will learn from the Pointer Section how to read the rest of the file and where to go to get certain data.

The pointer section will be the same for all 6 types of reformatted files (CBA, BDA, HDA, SDA, WDA, ATT) as well as the OBS, FEM, and PNT files.

```
STRUCTURE       /Pointer_Rec/
  INTEGER*2     Pointer_Version/'1011'x/
                                 !    0- Pointer structure version

  BYTE          type_integer    !    2- Integer format convention
```

Figure 4-1 Solar-A Reformatted Files

```
                            !           1 = DEC (Digital)
  BYTE          type_real       !   3- Real format convention
                            !           1 = DEC (Digital)
  BYTE          file_structure  !   4- (e.g., fixed record, stream of bytes)
                            !           1 = stream (IDL /BLOCK)
  INTEGER*4     VMS_rec_Size    !   5- Logical (physical on VMS) record length

                            !           -1 for the following pointers means no such section

  INTEGER*4     file_header     !   9- Pointer to File Header (Section 4.2)
                            !         Bytes from beginning of file
  INTEGER*4     qs_section      !  13- Pointer to Quasi-Static Index section
                            !         Bytes from beginning of file
  INTEGER*4     data_section    !  17- Pointer to Index and Data section
                            !         Bytes from beginning of file
  INTEGER*4     opt_section     !  21- Optional data section (BCS, WBS)
                            !         Bytes from beginning of file
  INTEGER*4     map_section     !  25- Pointer to Road Map section
                            !         Bytes from beginning of file
  INTEGER*4     TotBytes        !  29- Total number of bytes in the file

  INTEGER*2     Header_Version /'1021'x/
                            !  33- Header structure version
  INTEGER*2     Roadmap_Version !  35- Road map structure version
                            !         This value is defined in the
                            !         "Wrt___Map" Routines.
  INTEGER*2     Data_Version    !  37- Data structure version
                            !         This value is only used for
                            !         ATT and WBS files.

  INTEGER*4     itest           !  39- Integer test pattern
                            !           (value = '01020304'x = 16909060
  REAL*4        rtest           !  43- Real test pattern
                            !           (value = 1.234e+5)
  BYTE          Spare(1)        !  47- Spare
END STRUCTURE                   ! 48- Total
```

4.2 File Header

The file header provides information on what data is contained in the file, generally, the extent of the time covered by the contents.

The file header section will be the same for all 6 types of reformatted files (CBA, BDA, HDA, SDA, WDA, ATT) as well as the OBS, FEM, and PNT files.

```
STRUCTURE       /File_Header_Rec/
  INTEGER*4     fileVerNo        !  00- File Structure version number
  INTEGER*4     progVerNo        !  04- Program version number (v.vvv * 1000)
  CHARACTER*16  progName         !  08- Name of creating program
  CHARACTER*11  fileCreDate      !  24- file Creation Date (DD-MON-YYYY)
  CHARACTER*8   fileCreTime      !  35- file Creation Time (HH:MM:SS)
  INTEGER*4     first_time       !  43- Time of first DATA SET in file
  INTEGER*2     first_day        !  47- Day of first DATA SET in file
  INTEGER*4     last_time        !  49- Time of last DATA SET in file
  INTEGER*2     last_day         !  53- Day of last  DATA SET in file
  integer*4     orb_st_time      !  55- Start time (millisec of day) of ORBIT
  integer*2     orb_st_day       !  59- Start day (since 1-Jan-79)
  integer*4     orb_en_time      !  63- End time (millisec of day) or orbit
  integer*2     orb_en_day       !  81- End day (since 1-Jan-79)
                                 !              (use ^^ times to compare to check with
                                 !              quasi-static index times)

  INTEGER*4     nDataSets        !  83- Number of data sets.    Each data set is:
                                 !              For SDA this is a single image
                                 !              For CBA,HDA,ATT this is a single major frame
                                 !              For WDA this is two major frames
                                 !              For BDA this is a single spectra
  INTEGER*4     maxSamps         !  87- The maximum number of bins, samples, or
                                 !              pixels in all data sets in the file.

  INTEGER*4     ntot_qs          !  91- Total number of quasi-static entries
  INTEGER*4     nrep_qs          !  95- Number of repeated quasi-static entries
```

```
                              !               (should generally be zero, except when
                              !               a parameter is changed in orbit)
INTEGER*4     ntot_opt        !  99- Total number of optional entries
                              !           Not generally used since there is usually
                              !           a header structure at the beginning of the
                              !           optional data section.

CHARACTER*3   file_type       !103- Declaration of file type
                              !               The prefix of the file type so that
                              !               the file can be identified internally.
                              !               Valid Options are:
                              !                               BDA, SPR, SFR, HDA, WDA, ADA, CBA
CHARACTER*3   spacecraft      !106- Identification of the spacecraft from
                              !               which the data originated
                              !               Valid Options are:
                              !                               SMM, P78, HIN, YOH (Yohkoh, Solar-A),
                              !                               Gnd (Ground testing)
CHARACTER*3   instrument      !109- Identification of the instrument from
                              !               which the data originated
                              !               Valid Options are:
                              !                               BCS, HXT, SXT, WBS, ATT
CHARACTER*3   machine         !112- The computer and/or operating system
                              !               used to create the file
                              !               Valid Options are:
                              !                               ULX     - DEC Ultrix
                              !                               VMS     - DEC VMS system
                              !                               SGI     - Silicon Graphics Unix system
                              !                               IBM
                              !                               SUN
                              !                               FAC     - Facom
                              !               Byte ordering and the storage of reals
                              !               can be different on different computers.
CHARACTER*13  FileID          !115- File ID (to derive the file name)

CHARACTER*80  comment1        !128- comment field 1
CHARACTER*80  comment2        !208- comment field 2
```

```
  integer*2     refVerNo        !288- Reformatter program Version Number  (v.vvv * 1000)

  BYTE          spare(46)       !290- spare
END STRUCTURE                   !320- Total
```

4.3 Quasi-Static Index Section

This section of the file contains index information that does not vary during the course of an orbit, or varies slowly. In the latter case, the index information is time-tagged to show when the contents of the quasi-static data record are valid. Each instrument will have a common quasi-static record as shown here:

```
STRUCTURE       /QS_General1_Rec/
  integer*2     entry_type /'1011'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) of valid data
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  integer*2     scOffset(3)     !  14- Offset from S/C Boresight (arcsec)
                                !            (0) = Pitch; (1) = Yaw; (2) = Roll
                                !              [NOT IMPLEMENTED AS OF 25-Mar-92]
  integer*2     hxtOffset(3)    !  20- Offset from HXT boresight (arcsec)
                                !            (0) = Pitch; (1) = Yaw; (2) = Roll
                                !              [NOT IMPLEMENTED AS OF 25-Mar-92]
  integer*2     sxtOffset(3)    !  26- Offset from SXT boresight (arcsec)
                                !            (0) = Pitch; (1) = Yaw; (2) = Roll
                                !              [NOT IMPLEMENTED AS OF 25-Mar-92]
  integer*2     bcsaOffset(3)   !  32- Offset from BCS-A boresight (arcsec)
                                !            (0) = Pitch; (1) = Yaw; (2) = Roll
                                !              [NOT IMPLEMENTED AS OF 25-Mar-92]
  integer*2     bcsbOffset(3)   !  38- Offset from BCS-B boresight (arcsec)
                                !            (0) = Pitch; (1) = Yaw; (2) = Roll
```

```
                           !              [NOT IMPLEMENTED AS OF 25-Mar-92]
  integer*2     offset_version  !  44- Offset solution version
                           !              [NOT IMPLEMENTED AS OF 25-Mar-92]

  integer*4     bAngle          !  46- Solar B angle (arcsec)
                           !              [NOT IMPLEMENTED AS OF 25-Mar-92]
  byte          dpf             !  50- Data presence flag
                           !              b0:  Solar B angle is available
                           !              b1:  Offset data is available
                           !              [NOT IMPLEMENTED AS OF 25-Mar-92]

  integer*2     time_sol_ver    !  51- Current algorithm and parameter version
                           !              used for converting between DP time
                           !              and universal time
                           !              [NOT IMPLEMENTED AS OF 25-Mar-92]
  byte          spare(11)       !  53- Spare
END STRUCTURE                   ! 64- Total
```

Each instruments will have it's own special quasi-static records and those are described in later sections.

4.4 Index and Data Section

This section contains blocks of data records, and each data block is prefixed with a short index block. The contents of this section depends on the file type and is discussed in later sections. The data structure of SXT and BCS files will be based on instrument modes, while the HXT, WBS, and houskeeping files will be based on telemetry frames.

Every instrument will have a structure with identical information. The following is the general instrument structure.

```
STRUCTURE       /GEN_Index_rec/
  integer*2     index_version /'1011'x/
                                !  00- Index structure version                    Ground Info
                                !              AAAABBBB CCCCDDDD
                                !              AAAA = Instrument
                                !                              1= General
                                !                              2= BCS
```

```
                            !                               3= SXT
                            !                               4= HXT
                            !                               5= WBS
                            !                               6= ATT
                            !                               7= CBA
                            !                               8= Other
                            !                               9= FEM
                            !                               A= PNT
                            !               BBBB = Reserved for future use
                            !               CCCC = Separates different types of entries
                            !                             (different QS types, ...)
                            !               DDDD = Version secondary number

integer*4     time          !  02- Time (millisec of day)                                   Derived from DP_Time
                            !               (see "day" description for more details)
integer*2     day           !  06- Day (since 1-Jan-79)                                     Derived from DP_Time
                            !           For BCS: This is the time that the data is
                            !                               taken (not when it is read out of
                            !                               the queue).    It uses the DP_Time
                            !                               and the BCS clock value.
                            !           For HXT: This is major frame time.    There is a
                            !                               four second offset buffer in the HXT
                            !                               electronics.    The data for the dataset
                            !                               is actually for 4 seconds BEFORE the
                            !                               time listed in these fields.
                            !                               NOTE: The definition for this fields might
                            !                               be changed in Apr '92 to be the true time
                            !                               of the data.    In that case, the read routines
                            !                               will make a four second offset correction for
                            !                               the old data files.
                            !           For SXT: This is major frame time when the
                            !                               image was commanded.    For the actual time
                            !                               that the shutter opened, add the "exposure
                            !                               latency" value (usually ~100 msec) to this time
                            !           For SXT/Gnd:  This is the time when the file
                            !                               was created
```

```
                                !       For WBS: This is major frame time

byte          dp_time(4)        !  08- DP time for the major frame
                                !       For BCS: This value is empty (see BCS_DP_Sync_Rec)
                                !                           (0) = TIMER1                            W50 F1
                                !                                       LSB = "SFK" = 2048 sec
                                !                                       (period of SFK clock = 4096)
                                !                           (1) = TIMER2                            W50 F0
                                !                                       LSB = "SFC" = 8 sec
                                !                                       (period of SFC clock = 16)
                                !                           (2) = TIMER3                            W51 F0
                                !                                       LSB = "FA" = 0.03125 sec
                                !                           (3) = FI (Frame Indicator)              W03 F0
byte          DP_mode           !  12- DP Mode                                          W50 F2
                                !       For BCS: This value is empty (see BCS_DP_Sync_Rec)
                                !           b0:4 =  xxx01001 (= 9) Flare mode
                                !                           xxx01011 (=11) BCS-Out mode
                                !                           xxx01100 (=12) Night mode
                                !                           xxx01101 (=13) Quiet mode
byte          DP_rate           !  13- DP Rate                                          W48 F15
                                !       For BCS: This value is empty (see BCS_DP_Sync_Rec)
                                !           b5:7 =  100xxxxx (=4) High rate
                                !                           010xxxxx (=2) Medium rate
                                !                           001xxxxx (=1) Low rate
byte          Flare_Control     !  14- Flare flag control (active triggers)             W50 F60
                                !       For BCS: This value is empty (see BCS_DP_Sync_Rec)
                                !           b4   = BCS triggering enabled
                                !           b3   = HXS-PC1 triggering enabled
                                !           b2   = SXS-PC triggering enabled
                                !           b0:1 = SXS sensors to allow triggering enabled
                                !                           00 = SXS-PC11
                                !                           01 = SXS-PC12 (default)
                                !                           10 = SXS-PC21
                                !                           11 = SXS-PC22
byte          Flare_Status(4)   !  15- Flare flag status                                W50 F16n+3
                                !       For BCS: This value is empty (see BCS_DP_Sync_Rec)
```

```
                            !             b7   = Flare/RBM flag control (set = Auto)
                            !                             Controls flare and RBM flags (auto/manual)
                            !             b6   = SXS detects a flare
                            !             b5   = HXS detects a flare
                            !             b4   = BCS detects a flare
                            !             b3   = RBM flag status (used for judging
                            !                         false or true Gamma burst (GBD))
                            !                         (set= should cancel GBD flag)
                            !             b2   = RBM flag status for false or true flares
                            !                         (set= should cancel flare flag)
                            !             b0:1 = Flare status
                            !                             00:  No flare
                            !                             10:  Normal flare
                            !                             11:  Great flare
                            !                             01:  BCS-MEM Dump Control
byte          RBM_Status    !  19- Radiation Belt Montitor Status                          W50 F61
                            !             b7   = RBM status (set = on)
                            !                             (RBM flag on allows for canceling flares)
                            !             b4:5 = Flare mode
                            !                             11:  Great Flare
                            !                             10:  Normal Flare
                            !                             00:  Quiet
                            !                             01:  BCS Memory mode out
byte          Telemetry_mode !  20- Telemetry mode                                         W51 F06
                            !             b0:3    = 0000 - Real time link
                            !                             = 0001 - Recording playback
                            !                             = 0101 - TMX Reproduce High
                            !                             = 0110 - TMX Reproduce Low
                            !                             = 0111 - TMS Reproduce High (no convolution)
                            !                             = 1000 - TMS Reproduce low
                            !                             = 1001 - TMS Reproduce High (Convolution)
byte          cal_status    !  21- CAL status                                              W51 F55
                            !             b6 = HXT-CAL enable/disable (DP editing status)
                            !             b5 = HXT-CAL-DATA (overrides columns 6 and 7)
                            !             b4 = HXS-PH enable/disable
                            !             b3 = HXS-PH-CAL-DATA
```

```
                                !             b2 = GRS-CAL enable/diable
                                !             b1 = GRS-CAL-DATA
                                !         - - - - - - - - - - - - - - - - - - - - - - - - -

integer*4     pntg_angle(3)     !  22- X,Y,Z euler angles in sun pointing coordinates           From Mainframe
                                !         (See ATT_STRUCT for full definition)
byte          pntg_Trace        !  34- Information on how pointing was derived                  From Mainframe
                                !         and whether there is data present
                                !         (See ATT_STRUCT for full definition)
byte          pntg_jitter       !  36- Magnitude of pointing change                             From Mainframe
                                !         (See ATT_STRUCT for full definition)

                                !         - - - - - - - - - - - - - - - - - - - - - - - - -
byte          telemetry         !  38- Telemetry source information                             W7 in 16 byte leader
                                !             b0:3 = Ground Station
                                !                             0 = KSC Real time data
                                !                             1 = KSC playback data
                                !                             5 = DSN - Goldstone playback data
                                !                             7 = DSN - Canberra playback data
                                !                             9 = DSN - Madrid playback data
                                !                             15 = Ground based (test data)
                                !             b4:7 = Bit rate
                                !                             0 = low
                                !                             1 = medium
                                !                             2 = high
byte          sirius(5)         !  39- Sirius data base information ??                                                     Ground Info
                                !             TODO ??  - What info here?  - path?
                                !             [NOT IMPLEMENTED AS OF 25-Mar-92]


                                !         - - - - - - - - - - - - - - - - - - - - - - - - -
byte          data_quality      !  44- Data quality                                             Ground Info
                                !                             1 = good
                                !             [NOT IMPLEMENTED AS OF 25-Mar-92]
integer*4     nmissSamps        !  45- Number of missing bytes (due to telemetry                Ground Info
                                !         drop outs - minor or major frames)
```

```
                              !               [NOT IMPLEMENTED AS OF 25-Mar-92]
integer*4     StartSamp       !  45- Starting sample number of good data              Ground Info
                              !               (zero if there are no dropouts)
                              !               [NOT IMPLEMENTED AS OF 25-Mar-92]

                              !           - - - - - - - - - - - - - - - - - - - - - - - - -
byte          data_word_type  !  49- Data word type (byte, integer*2, real...)                          Ground Info
                              !               b0:3 = Data word type
                              !                               0 = byte
                              !                               1 = integer*2
                              !                               2 = integer*4
                              !                               3 = real*4
                              !               b4   = Set if data is compressed
integer*2     nIndexStruct    !  50- Number of "extra" index structures following
                              !           the general index structure
                              !           (for additional "ground" structures,
                              !           processing information structures, ...)
integer*2     nIndexByte      !  52- Number of bytes in the index records
integer*4     nDataByte       !  54- Number of byte in the data section

byte          SXT_Pow_stat    !  58- Power Status (0=off, 1=on)                       W48  F25
                              !               b7 = 5 Volts
                              !               b6 = 28 Volts
                              !               b5 = Filter Wheel
                              !               b4 = Shutter / Aspect Controller
                              !               b3 = Micro A Select
                              !               b2 = Micro B Select
                              !               b1 = Camera
                              !               b0 = Thermoelectric Cooler (TEC)
BYTE          bcs_pow_stat    !  59- BCS Power status                                 W112 F32n+3
                              !               b0 = Calibibration-B (set=enabled)
                              !               b1 = HVB logical flag (set=enabled)
                              !               b2 = HVB power (set=on)
                              !               b3 = Spectrometer B (set=on)
                              !               b4 = Calibibration-A (set=enabled)
                              !               b5 = HVA logical flag (set=enabled)
```

```
                              !             b6 = HVA power (set=on)
                              !             b7 = Spectrometer A (set=on)
  byte          hxt_Pow_stat  !  60- HXT Power status                                W48 F32+1
                              !             b7 = HXT1 (electronics for 00 to 31)
                              !             b6 = HXT2 (electronics for 32 to 63)
                              !             b5 = OS memory status
                              !             b4 = HXA on/off
                              !             b3 = HXA cal
                              !             b2 = HXT cal
                              !             b1 = HV reduction fuction on/off (enable SAA HV on/off)
                              !                       Usually HV is 900 V, reduced to ~0 V when on
                              !             b0 = HV enable (double command safety)
                              !                       HV cannot go on until this is enabled
  byte          wbs_pow_stat  !  61- Power status                                    W48 F32n+2
                              !             b7 = WBS HV enable/disable
                              !             b6 = WBS on/off (set=on)
                              !             b5 = WBS-A on/off (set=on)
                              !             b4 = SXS-HV on/off (set=on)
                              !             b3 = HXS-HV on/off (set=on)
                              !             b2 = GRS-HV1 on/off (set=on)
                              !             b1 = GRS-HV2 on/off (set=on)
                              !             b0 = RBM-HV on/off (set=on)
  byte          SXT_Control   !  62- SXT Control Status                              W114 F32
                              !             b7   = Power control mode (1=auto, 0=manual)
                              !             b6   = SXT control mode (1=auto, 0=manual)
                              !             b2:3 = SXT day/night mode
                              !                             00 = SXT day mode
                              !                             01 = SXT evening mode
                              !                             10 = SXT night mode
                              !                             11 = SXT morning mode
                              !             b1   = SXTE-U hard reset (1=executed)
                              !             b0   = SXTE-U soft reset (1=executed)
  byte          spare1(15)    !  63- Spare Bytes
END STRUCTURE                 ! 80- Total
```

4.5 Instrument Optional Sections

The BCS obtains count rates independantly from the spectral data. These are held in this optional section, together with the time that the samples were accumulated.

The HXT aspect sensor (HXA) data is contained in a section by itself at the end of the ATT file.

4.6 Road Map Section

The Road Map section contains pointers to all of the Index/Data records in the preceding section. The pointers are expressed in bytes from the beginning of the file, where the counting begins from 0. The appropriate file record for VMS files may be calculated by dividing these quantitites by the file record length (see `VMS_rec_Size` in §4.1).

The contents of the roadmap are a sub-set of the index record so all information in the roadmap must be present in the index record. The roadmap allows a user to access a brief summary of the contents of the file and to perform searches on that summary to select what data should be extracted. The roadmap generally holds mode information and an indication of the signal level observed. A further description of each instruments roadmap section is given below.

4.7 Summary of Different Structure Types

In later chapters, the various file sections are defined in terms of software structures. The correspondance between the file sections and the structure names is given below:

```
                                  Structure Name
                                  --------------
Pointer Section
                                  Pointer_Rec

File Header
                                  File_Header_Rec

Quasi-Static Index Section
                                  QS_General1_Rec
                                  BCS_QS_Instr_Rec
```

```
                                BCS_QS_Conv_Rec
                                BCS_QS_Group_Rec
                                HXT_QS_Instr_Rec
                                HXT_QS_Conv_Rec
                                SXT_QS_Instr_Rec
                                SXT_QS_Conv_Rec
                                WBS_QS_Instr_Rec
                                WBS_QS_Offset_Rec
                                WBS_QS_Del_Rec
                                WBS_QS_Conv1_Rec
                                WBS_QS_Conv2_Rec
Index Sections
                                ATT_Index_Rec
                                BCS_Index_Rec
                                HXT_Index_Rec
                                GEN_Index_Rec
                                SXT_Index_Rec
                                WBS_Index_Rec
Data Sections
                                HXT_PC_Data_Rec
                                HXT_PH_Data_Rec
                                CBA_Data_Rec
                                BCS_Data_Rec
                                SXT_Data_Rec
                                WBS_DHK_Data_Rec
                                WBS_PC_Data_Rec
                                WBS_PH_Data_Rec
Optional Data Section
                                BCS_DP_Sync_Rec
                                HXA_Scan_Rec
Road Map Section
                                BCS_Roadmap_Rec
                                HXT_Roadmap_Rec
                                SXT_Roadmap_Rec
                                WBS_Roadmap_Rec
```

```
Observing Log Section
                                Obs_FileID_Rec
                                Obs_OrbitSol_Rec
                                Obs_WBSHXT_Rec
                                Obs_BCS_Rec
                                Obs_Sxt_Rec
                                Obs_BCS_Status_Rec
                                Obs_HXT_Status_Rec
                                Obs_WBS_Status_Rec

Event Log Section
                                Evn_Common_Rec
                                Evn_PFI_Rec
```

5. SPACECRAFT COMMON BASIC PART FILE (CBA)

```
File Identifier:            CBA
Record Size:                16 bytes
```

The CBA (common basic area) data file is one of the reformatted data files which is written by the reformattor. All data that is necessary to analyze the scientific data is removed from the “basic part” and inserted into the index sections of the instrument data files. It is not expected to be necessary to access this file since all relevant data has been copied to the instrument files.

The general layout of this and the other reformatted data files is:

1. File Information / Pointer Section
2. File Header Section
3. Quasi-Static Index Section
4. Index/Data, Index/Data, . . . Section
5. Road Map Section

5.1 Pointer Section

The pointer section is described in Section 4.1.

5.2 File Header

The File Header is described in Section 4.2.

5.3 Quasi-Static Index Section

The structure QS_General1_Rec described in Section 4.3 will be used.

5.4 Index and Data Section

This section contains a series of index and data blocks. Only the General Index Structure is needed for this entry. There is no additional index structured needed.

The data blocks will contain all the spacecraft and experiment houskeeping data stored in the "Basic Part" of the telemetry which constitutes 25% of the bubble data recorder. One block per major frame. Descriptions of the raw telemetry words are available, but are mostly written in Japanese.

```
STRUCTURE       /CBA_Data_Rec/
  byte          basic(4,8,64)   !      0- Basic part
END STRUCTURE                   !2048- Total
```

5.5 Instrument Optional Section

The CDA file contains no optional section.

5.6 Road Map Section

This section contains a record for every "block" in the Index/Data section. The information in this section is a subset of the index structure (see the general index structure for a full explanation of each field).

```
STRUCTURE       /CBA_Roadmap_Rec/
                                !          For a full description of the fields,
                                !          look at the Index_Rec definition

  integer*4     ByteSkip        !  00- Offset in bytes from the beginning of
                                !          of the data file for the beginning
                                !          of the data set index structure.

  integer*4     time            !  04- Major frame time (millisec of day)
  integer*2     day             !  08- Major frame day (since 1-Jan-79)

  byte          DP_mode         !  10- DP Mode
```

```
  byte          DP_rate         !  11- DP Rate

  integer*4     sxt_ffi         !  12- Serial number for SXT FFI image
                                !          (to allow easy matching to engineering information
                                !          like AEC,ARS,ART ...)
  integer*4     sxt_pfi         !  16- Serial number for SXT PFI image

  byte          SXT_Pow_stat    !  20- SXT Power Status
  BYTE          bcs_pow_stat    !  21- BCS Power status
  byte          hxt_Pow_stat    !  22- HXT Power status
  byte          wbs_pow_stat    !  23- WBS Power status

  byte          spare(8)        !  24-
END STRUCTURE                   ! 32- Total
```

6. BCS RAW DATA FILE (BDA)

```
File Identifier:              BDA
Record Size:                  16 bytes
```

The BDA (BCS DAta) file is one of the reformatted data files which is written by the reformattor. The general layout of this and the other reformatted data files is:

1. File Information / Pointer Section
2. File Header Section
3. Quasi-Static Index Section
4. Index/Data, Index/Data, . . . Section
5. Optional Data Section (DP sync data)
6. Road Map Section

6.1 Pointer Section

The pointer section is described in Section 4.1.

6.2 File Header

The File Header is described in Section 4.2.

6.3 Quasi-Static Index Section

The structure QS_General1_Rec described in section 4.3 will be used.

```
STRUCTURE       /BCS_QS_Instr_Rec/
  integer*2     entry_type /'2011'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) of valid data
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
```

```
integer*4     en_time          !  08- End time (millisec of day)
integer*2     en_day           !  12- End day (since 1-Jan-79)

                               !        - - - - - - - - - - - - - - - - - - - - - - - - -
byte          SCAval(2,4)      !  14- Upper and lower channel SCA settings                  W49 F32n+0,2,4,6,8,
                               !              (Channel, 0=lower)                                          10,12,14
                               !              (channel, 1=upper)
byte          hv_control       !  22- HV control (commanded)                                W49 F32n+16
                               !              b0:2 = trim for HVA
                               !              b4:6 = trim for HVB
                               !              NOTE: Changes in one orbit during a cal
BYTE          stim_control     !  24- Stimulus on/off                                       W49 F32n+26
                               !              b0   = Detector A internal stim generator (set=off)
                               !              b1   = Detector A stim source (set=internal)
                               !              b2   = Detector A multiplexor (set=disable)
                               !              b4   = Detector B internal stim generator (set=off)
                               !              b5   = Detector B stim source (set=internal)
                               !              b6   = Detector B multiplexor (set=disable)
                               !        - - - - - - - - - - - - - - - - - - - - - - - - -
byte          Fe26_thresh      !  xx- Fe XXVI threshold                                     W66 F28 SF4n+2
                               !              value*16 = actual threshold counts
byte          chan_mfd         !  xx- Channels selected and min flare duration              W66 F28 SF4n+3
                               !              LSB = b0
                               !              b5:7 = SAA Algorithm channel
                               !              b4:5 = Flare algorithm channel
                               !              b0:3 = Mininum flare duration
byte          SAA_Thresh       !  xx- SAA Threshold                                         W66 F29 SF4n+3
                               !              value*16 = actual threshold counts
byte          Flr_RiseThresh   !  xx- Flare rise threshold                                  W66 F30 SF4n+3
                               !              value*16 = actual threshold counts
byte          Flr_DecayThresh  !  xx- Flare decay threshold                                 W66 F31 SF4n+3
                               !              value*16 = actual threshold counts
byte          Flr_OptionID     ! xx- Flare Option ID                                       W66 F63 SF4n+3
                               !        - - - - - - - - - - - - - - - - - - - - - - - - -

BYTE          sensitivity(4)   !  26- Det.  Sensitivity (Nominal Val= 200)                   Ground Defined
```

```
  INTEGER*4     posGain(4)      !  30- Position Gain for det (Angstrom/Bin)                    Ground Defined
  INTEGER*4     posOffset(4)    !  46- Position Offsets.  (micro-Angstrom)                      Ground Defined
                                !            NOTE that the Gain and offset are the
                                !            slope and intercept of the line giving
                                !            the conversion between bin numbers and
                                !            wavelength.

  integer*2     bcs2dp_ver      !  62- Algorithm and parameters used to convert                Ground Defined
                                !            between BCS timer and DP timer

  byte          spare(12)       !  64-
END STRUCTURE                   ! 80- Total

STRUCTURE       /BCS_QS_Conv_Rec/
  integer*2     entry_type /'2031'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  integer*4     hv_conv(2)      !  14- Conversion for high voltage in 0.01 KeV
                                !            (0) = intercept; (1) = slope
                                !            NOT IMPLEMENTED AS OF 25-Mar-92]
  integer*4     temp_conv(2)    !  22- Conversion for temperature in 0.01 deg.
                                !            NOT IMPLEMENTED AS OF 25-Mar-92]

  integer*2     solution_ver    !  30- Solution version
                                !            NOT IMPLEMENTED AS OF 25-Mar-92]

  byte          spare(32)       !  32-
END STRUCTURE                   ! 64- Total
```

The second structure defines the bin group lists:

```
STRUCTURE       /BCS_QS_Group_Rec/
```

```
  integer*2     entry_type /'2041'x/
                                ! 00- Structure/Entry type

                                !     - No starting and ending times are needed for the
                                !         grouper plan.
  integer*4     time            ! 02- Creation time in msod
  integer*2     day             ! 06- Creation date in days since 1-Jan-1979

  integer*2     length          ! 08- Total No of bytes of data created by the plan
  integer*2     ModeID          ! 10- The modeID that is described
  byte          ngrp(4)         ! 12- Number of groups for each channel
  integer*2     groups(10,4)    ! 16- The Grouper plan for each channel
                                !           groups(*,ichan) = [nout1,nbin1, nout2,nbin2, nout3,nbin3, ...]
                                !                           where ichan is then channel in question
                                !                                         nout1 is the number of output values
                                !                                         nbin1 is the number of raw input values binned
  byte          spare(32)       ! 96- Spare
END STRUCTURE                   !128- Total
```

6.4 Index and Data Section

The "blocks" in this section are combined index and data records. The blocks may span more than one file record, but the start of a new block will always be at the file record boundary. The boundries between individual blocks are determined from the corresponding road map section, which contains pointers to the record number. BCS data blocks are of variable lengths – the length is the total of the number of groups of bins in all channels. Each byte of the block contains the (compressed) counts for the corresponding bin group received during the data gather interval.

A BCS "mode" is one integration of a given interval ("dgi") for a particular grounper (bin) plan. A BCS "sequence" is several modes running depending on the flare flag. There is typically one sequence for quiet mode and one for flare.

The DP mode and rate must be derived from the BCS_INDEX field "DP_Flags" since the information in the GEN_INDEX is for the major frame when the data was read out, not when the data was taken (BCS data is stored in a queue in the BCS microprocessor)

The structure of the BDA mode indexes are as follows:

```
STRUCTURE       /BCS_Index_Rec/
  integer*2     index_version /'2011'x/
                                ! 00- Index structure version

  byte          dp_time_out(4)  ! 02- DP time (timer1,2,3 and FI) for when
                                !         the data is read out
                                !         Use this time to check the state of the
                                !         Spacecraft during readout - see
                                !         BCS_DP_Sync_Rec structure

                                !         - - - - - - - - - - - - - - - - - - - - - - - - -
  BYTE          blockID         ! 06- BCS Block ID                                      Derived
                                !           =0:  Normal Queue Data Block
                                !           =1:  Fast Queue Data Block
                                !           =2:  Micro Dump Block (fixed extraction)
                                !                   Reformatter forces this mode whenever the
                                !                   CPU is disabled
                                !           =3:  Cal Data Block (fixed extraction)
                                !           =4:  Queue data where the modeID in the
                                !                   header is not recognized.
                                !           =5:  Normal or fast queue data which have fill
                                !                   data (garabage).    Avoid this value to avoid
                                !                   these datasets when making light curves.

  BYTE          ModeID          ! 09- Mode ID (Grouper Plan)                            Mode Header(8)
                                !            For "Normal" and "Fast" queue data
                                !            (BlockID = 0 or 1) this value is the
                                !            ModeID used in conjunction with the
                                !            grouper plan.
                                !
                                !            If the mode ID is not recognized, then
                                !            it is set to 255, and the mode header
                                !            is put out with the beginning of the
                                !            data.
                                !
```

```
                            !            For "Cal Mode" (BlockID = 3)
                            !            this holds the channel number as
                            !            derived from PHA_CONTROL with a
                            !            1.5 major frame delay
                            !                            b4:7 = first 256 bytes
                            !                            b0:3 = last 256 bytes
                            !            Value = 1,2,3,4
                            !            Value = 0 if unknown (data dropouts)
BYTE          ModeRepNum    !  10- Mode Repeat Number                               Mode Header(6)
BYTE          ControlTally  !  11- Control Byte Tally                               Mode Header(7)
                            !
BYTE          ControlByte   !  12- Control Byte                                     Mode Header(12)

BYTE          dgi           !  13- Data Gather Interval (125 msec units)            Mode Header(9)
                            !            For "Cal Mode" (BlockID = 3)
                            !            this value comes from                           W49 F22
INTEGER*2     nSampPChan(4) !  14- Number of data samples per channel               (From Grouper Plan)

INTEGER*2     total_cnts(4) !  22- Total counts in each channel for the mode        Derived
                            !        Saved counts have been divided by 10 to
                            !        to avoid overflow problems

BYTE          DP_Flags      !  30- DP Flags received by BCS                         Mode Header(4)
                            !            b0      = Radiation Belt monitor (set = yes)
                            !            b1,2    = 0,0:  No flare
                            !                            = 1,0:  Normal Flare
                            !                            = 1,1:  Great Flare
                            !                            = 0,1:  BCS MEM Mode
                            !            b3,4    = 0,0:  Low (1 kps)
                            !                            = 1,0:  Med (4 kps)
                            !                            = 0,1:  Hi (32 kps)
                            !                            = 1,1:  Hi (32 kps)
                            !            b5      = BCS-OUT after flare (set = enable)
                            !            b6      = BCS-OUT after night (set = enable)
                            !            b7      = Currently BCS-OUT mode
BYTE          BCS_Status    !  31- BCS Status                                       Mode Header(5)
```

```
                          !             b0 = SAA Threshold exceeded (set = yes)
                          !             b1 = Flare threshold exceeded (set = yes)
                          !             b2 = HVU's turned off by BVS SAA algorithm
                          !             b3 = Fe XXVI thershold exceeded
                          !             b4 = BCS is in night state
                          !             b5 = BCS is in SAA state
                          !             b6 = Status of data in queue (set = hi)
                          !             b7 = Status of BCS flare flag (set = hi)

  byte        MissBasicData  !  32- Flag to mark if the DP major frames                   Derived
                          !         for the period when the data was taken
                          !         were telemetered down (set = got the data)
                          !             (ie:  got the basic part data for
                          !             the period when the data was taken)
  byte        MissModeID     ! 33- Missing the beginning of the data which                Derived
                          !         has the mode ID so all information is
                          !         guessed.

  INTEGER*2   length         !  35- Total No of bytes of data created by the plan
                          !         This is the array length of the output vector
                          !         which holds all of the channels.   This is the
                          !         true length, where INDEX.GEN.NDATABYTES is the
                          !         number of bytes written to the disk, which could
                          !         have padded zeros.
  BYTE        spare(14)      !  34- Spare bytes
END STRUCTURE                ! 48- Total
```

The data blocks contain the four channel spectra as “output” from the accumulator. The bin list is needed to split this data into channels, and wavelength bins.

The data is a one dimensional array. The size of the array is defined in the index structure and is the total number of bins for all four channels. The reading routine will return a 1-D array if only one data set is read, or a 2-D array if many data sets are read (where the length of the second dimension is the number of datasets extracted)

6.5 Instrument Optional Section – DP Sync Section

A number of records each containing the 12 event counters (light curve data), the high voltage monitor values, the temperatures, and an associated time stamp. There is one entry per major frame.

```
STRUCTURE       /BCS_DP_Sync_Rec/
  integer*2     index_version /'2022'x/
                                !  00- Index structure version

  INTEGER*4     time            !  02- Time (ms of day) of major frame during readout
  INTEGER*2     day             !  06- Day since 1-Jan-79 or major frame during readout

  byte          dp_time(4)      !  08- DP time (timer1,2,3 and FI) for when
                                !          the data is read out
                                !          (see Gen_Index for an explanation of the values)
  byte          DP_mode         !  12- DP Mode during the readout
                                !          (see Gen_Index for an explanation of the values)
  byte          DP_rate         !  13- DP Rate during readout
                                !          (see Gen_Index for an explanation of the values)
  byte          Flare_Control   !  14- Flare flag control during readout
                                !          (see Gen_Index for an explanation of the values)
  byte          Flare_Status(4) !  15- Flare flag status during readout
                                !          (see Gen_Index for an explanation of the values)
  byte          RBM_Status      !  19- Radiation Belt Montitor Status
                                !          (see Gen_Index for an explanation of the values)
  byte          Telemetry_mode  !  20- Telemetry mode
                                !          (see Gen_Index for an explanation of the values)
  byte          cal_status      !  21- CAL status
                                !          (see Gen_Index for an explanation of the values)

                                !          - - - - - - - - - - - - - - - - - - - - - - - - -

  INTEGER*2     All_Cnts(4,2)   !  22- All counts for the 4 channels                     W66 F00/01,F06/07,...
                                !
                                !          Units = counts per "Acc_Interval" (see below)
```

```
INTEGER*2     Lim_Cnts(4,2)   !  38- Limited for the 4 channels                              W66 F02/03,F08/09
                              !
                              !          Units = counts per "Acc_Interval" (see below)
INTEGER*2     Acc_Cnts(4,2)   !  54- Accepted for the 4 channels                             W66 F04/05,F10/11
                              !
                              !      NOTE: For All_Cnts, Lim_Cnts, and Acc_cnts
                              !              the following applies
                              !          Units = counts per "Acc_Interval" (see below)
                              !              Cnts(n,m)       n = channel
                              !                                              m = 2 per major frame
                              !              The onboard counter is an unsigned 16-bit counter
                              !              The reformatted data is saved as a signed 16-bit value
                              !              If the value is negative, then 65536 (which is 2^16)
                              !              needs to be added to the value.
integer*2     Acc_interval(2) !  70- Accumulation interval (sec)                             Derived
                              !          This value is only relevant for the differences
                              !          made to the PREVIOUS major frame for all_cnts(*,0)
                              !          Since there are two values dumped each major frame,
                              !          the delta within the single major frame all_cnts(*,1)
                              !          is defined by the DP_RATE for that major frame.
                              !              Valid values are:
                              !                              0 = Raw number (not counts/sec)
                              !                                      Implies dropout for previous major frame
                              !                              8 sec = 1/2 * 16 sec (med rate)
                              !                              1 sec = 1/2 * 2 sec (high rate)
                              !                              ?  sec = transition high to med- TODO
                              !                              ?  sec = transition med to high - TODO
                              !          - - - - - - - - - - - - - - - - - - - - - - - - -

byte          pha_counts(8)   !  74- PHA Data                                                W66 F24,25,26,27
                              !
BYTE          PHA_Control(2)  !  82- PHA Control                                             W49 F32n+18
                              !          - - - - - - - - - - - - - - - - - - - - - - - - -
BYTE          SpecStatus(2)   !  84- Spectrometer status                                     W112 F32n+3
                              !              b0 = Calibibration-B (set=enabled)
                              !              b1 = HVB logical flag (set=enabled)
```

```
                            !              b2 = HVB power (set=on)
                            !              b3 = Spectrometer B (set=on)
                            !              b4 = Calibibration-A (set=enabled)
                            !              b5 = HVA logical flag (set=enabled)
                            !              b6 = HVA power (set=on)
                            !              b7 = Spectrometer A (set=on)
  byte          CommandStat(2)  !  86- Command Status                          W112 F32n+4
                            !              b0 = Command decode (set=disabled)
                            !              b1 = Program address set (set=disabled)
                            !              b2 = Program load (set=disabled)
                            !              b3 = CPU processor (set=disabled)
                            !              b4 = Low RAM (set=enable)
                            !              b5 = Watchdog Timer (set=disabled)
                            !              b6 = Block Command (BC) (set=enable)
                            !              b7 = Digital Electronics (set=on)

  byte          cpu(4,2)        !  88- Microprocessor information/diagnostics  W66 F28,29,30,31
                            !
                            !          Has the clock value to tie the DP clock
                            !          to the BCS clock.

                            !          - - - - - - - - - - - - - - - - - - - - - - - - -
  BYTE          HV_mon(2)       !  96- HV monitor voltage (0-255)              W32 F32,33 SF2n
                            !              SF2n ==> changes every 2 MF!!?!?!
                            !          (See quasi-static section for conversions)
  byte          crytemp(2)      !  98- Crystal Bank Temperatures (milli-Celsius) W32 F31,32 SF2n+1
                            !          (See quasi-static section for conversions)
  BYTE          Elec_Temp       !100- Electronics temperature                 W32 F33    SF2n+1
                            !          (See quasi-static section for conversions)
  byte          spare(11)       !101
END STRUCTURE                   !112- Total
```

There is a header at the beginning of the optional section describing the number of entries.

```
STRUCTURE       /BCS_DPs_Head_Rec/
  integer*2     index_version /'2031'x/
```

```
                                ! 00- Index structure version

  INTEGER*2     nEntries        !   2- Number of BCS_DP_Sync_Rec to follow

  byte          spare(12)       !   4- Spares
END STRUCTURE                   ! 16- Total
```

6.6 Road Map Section

This section contains a record for every "block" in the Index/Data section. The information in this section is a subset of the index structure (see that structure for a full explanation of each field).

```
STRUCTURE       /BCS_Roadmap_Rec/
                                !         For a full description of the fields,
                                !         look at the Index_Rec definition

  integer*4     ByteSkip        ! 00- Offset in bytes from the beginning of
                                !         of the data file for the beginning
                                !         of the data set index structure.

  integer*4     time            ! 04- Time of data (millisec of day)
  integer*2     day             ! 08- Day of data (since 1-Jan-79)

  BYTE          blockID         ! 10- BCS Block ID                                      Derived
  BYTE          seqID           ! 11- Observation Sequence ID
  BYTE          ModeID          ! 12- Mode ID (Grouper Plan)
  BYTE          moderepnum      ! 13- Mode Repeat Number
  BYTE          dgi             ! 14- Data Gather Interval (125 msec units)
  BYTE          DP_Flags        ! 15- DP Flags received by BCS                          (From Mode Header)
  BYTE          BCS_Status      ! 16- BCS Status                                        (From Mode Header)

  INTEGER*2     total_cnts(4)   ! 17- Total counts in each channel for the mode

  INTEGER*2     length          ! 25- Total No of bytes of data created by the plan
  BYTE          ControlTally    ! 27- Control Byte Tally
```

```
  byte          spare(4)         !  28- Spares
END STRUCTURE                    ! 32- Total
```

7. HXT RAW DATA FILES (HDA)

```
File Identifier:                HDA
Record Size:                    16 bytes
```

The HDA (HXT DAta) file is one of the reformatted data files which is written by the reformattor. The general layout of this and the other reformatted data files is:

1. File Information / Pointer Section
2. File Header Section
3. Quasi-Static Index Section
4. Index/Data, Index/Data, . . . Section
5. Optional Section for HXA data
6. Road Map Section

7.1 Pointer Section

The pointer section is described in Section 4.1.

7.2 File Header

The File Header is described in Section 4.2.

7.3 Quasi-Static Index Section

The structure QS_General1_Rec described in section 4.3 will be used.

```
STRUCTURE       /HXT_QS_Instr_Rec/
                                !              NOT IMPLEMENTED AS OF 25-Mar-92]

  integer*2     entry_type /'4011'x/
                                !  00- Structure/Entry type
```

```
  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  !TBD

  byte          spare(50)       !  14- Spare
END STRUCTURE                   ! 64- Total

STRUCTURE       /HXT_QS_Conv_Rec/
                                !              NOT IMPLEMENTED AS OF 25-Mar-92]

  integer*2     entry_type /'4021'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  integer*4     off_dhk(2)      !  14- Offset time in millisec from MF time for DHK data
  integer*4     off_pc(2)       !  22- Offset time in millisec from MF time for PC data
  integer*4     off_ph(2)       !  30- Offset time in millisec from MF time for PHA data
  integer*4     off_hxa(2)      !  38- Offset time in millisec from MF time for HXA data
                                !              (1) = high rate; (2) = medium rate

  integer*4     energy(5)       !  46- Energy conversion in 0.01 KeV
  integer*4     hv_conv(2)      !  66- Conversion for high voltage in 0.01 KeV
                                !              (1) = intercept; (2) = slope
  integer*4     temp_conv(2)    !  74- Conversion for temperature in 0.01 deg.
  integer*2     solution_ver    !  82- Solution version

  byte          spare(44)       !  84-
END STRUCTURE                   !128- Total
```

[Add explanation of energy conversion "energy(5)" and conversion for HV and temp]

7.4 Index and Data Section

One index/data block for every major frame. The digital house keeping data is included in the index record. The DHK PC (pulse count) data is only seen in FL and QT modes and will come once per major frame (this is the low energy channel only).

```
STRUCTURE       /HXT_Index_Rec/
  integer*2     index_version /'4011'x/
                               !    0- Index structure version                            Ground Info
                               !              AAAABBBB CCCCDDDD

  byte          Pow_stat(2)    !    2- Power status                                       W48 F32+1
                               !              b7 = HXT1 (electronics for 00 to 31)
                               !              b6 = HXT2 (electronics for 32 to 63)
                               !              b5 = OS memory status
                               !              b4 = HXA on/off
                               !              b3 = HXA cal
                               !              b2 = HXT cal
                               !              b1 = HV reduction fuction on/off (enable SAA HV on/off)
                               !                        Usually HV is 900 V, reduced to ~0 V when on
                               !              b0 - HV enable (double command safety)
                               !                        HV cannot go on until this is enabled
  byte          HV_stat(2)     !    4- HV Status on/off                                   W48 F32+17 (+29)
                               !              b7 = HV0 on/off for sensor 00 to 07
                               !              b6 = HV7 on/off for sensor 56 to 63
  byte          HXT_Mon(2)     !    6- Memory content of OS-Memory                        W49 F32+31
                               !              b7 = HXT1 (electronics for 00 to 31)
                               !              b6 = HXT2 (electronics for 32 to 63)
                               !              b5 = HXA on/off
                               !              b4 = Analog part of HXT-E on/off
                               !              b3 = HV reduction fuction on/off (enable SAA HV on/off)
                               !                        Usually HV is 900 V, reduced to ~0 V when on
                               !              b2 = RBM flag (from DP)
```

```
byte          gain_control(64)!   8- Electronics gain for each sensor                          W65
                              !             Hopefully changed only once a month
byte          HV_control(8)   !  72- HV setting                                               W49 F32+9,11,13,15
                              !             Hopefully changed only once a month

byte          HV_values(8)    !  80- High voltage values (HK monitor output)                  W32 F19-F26 (even MF #s)
                              !         (See quasi-static section for conversions)
byte          temps(21)       !  88- HXT Temperatures (HK monitor output)                     W32 F61-F63 (even MF #s)
                              !         (See quasi-static section for conversions)
                              !
byte          dhk_data(64)    !109- DHK PC Data (low energies)                               W64 F00-F63
                              !         In PC mode:
                              !             Integrated photon counts in low channel
                              !         In PH (cal) mode:
                              !             Sensor number (same value for 4 minor frames...)

integer*2     sum_L           !173- Summation of all 64 subcollimator
                              !             counts (cnts/sec)
                              !         Low energy (15-24.4 KeV)
integer*2     sum_M1          !175- Medium-1 energy (24.4-35.2 KeV) cnts/sec
integer*2     sum_M2          !177- Medium-2 energy (35.2-56.8 KeV) cnts/sec
integer*2     sum_H           !179- High energy (56.8-100 KeV) cnts/sec
integer*2     sigma_L         !181- Standard deviation of low energy channels
                              !         of fan beam elements only.    Not corrected for
                              !         integration period.
                              !             Sensor #s:  (octal)      00,01,04,05
                              !                                                             10,11,14,15
                              !                                                             60,61,64,65
                              !                                                             70,71,74,75
                              !         For PH mode ....  TODO

byte          dataRecTypes    !183- What data follows (setting bits)                          Derived
                              !             b7 = PC data follows
                              !             b6 = PH (cal) data follows
                              !             Derived from (W51 F7 b0:1) - Output from DP
```

```
                                !                               00 = PC data
                                !                               01 = Cal data
                                !                               10 = Dummy
                                !                               11 = Cal data
                                !               W51 F55 b5:6
                                !                               b6 = calibration enable/disable
                                !                               b5 = Telemetry allocation

  byte          spare(8)        !184- Spare
END STRUCTURE                   !192- Total
```

The PC (pulse count) data is only seen in FL and comes four times per major frame. The PH (pulse height) data is only seen in calibration mode (uses SXT telemetry and it uses the internal source). The PH data takes four major frames to come down, and will be broken into four parts with a data index for each part. PC and PH are exclusive to each other.

```
STRUCTURE       /HXT_PC_Data_Rec/
                                !               hxt_pc(i,j,k)           i=energy band
                                !                                                               j=sensor #
                                !                                                               k=repetition #
  byte          pc_data(4,64,4) !      0- PC data
END STRUCTURE                   !1024- Total

STRUCTURE       /HXT_PH_Data_Rec/
                                !               hxt_ph(i,j)             i=energy channel
                                !                                                               j=sensor #
  byte          ph_data(64,64)  !      0- PH data
END STRUCTURE                   !4096- Total
```

7.5 Instrument Optional Section

There are no optional sections for HXT.

7.6 Road Map Section

This section contains a record for every "block" in the Index/Data section. The information in this section is a subset of the index structure (see that structure for a full explanation of each field).

```
STRUCTURE       /HXT_RoadMap_Rec/
                                !         For a full description of the fields,
                                !         look at the Index_Rec definition

  integer*4     ByteSkip        !  00- Start byte of index rec

  integer*4     time            !  04- Major frame time (millisec of day)
  integer*2     day             !  08- Major frame day (since 1-Jan-79)
  byte          Flare_Control   !  14- Flare flag control (active triggers)
                                !         Copied from GEN_INDEX (needed here to put
                                !         into the observing log entry)
  byte          Flare_Status    !  15- Flare flag status

  byte          DP_mode         !  10- DP Mode
  byte          DP_rate         !  11- DP Rate

  byte          Pow_stat        !  12- Power status
  byte          HV_stat         !  13- HV Status

  integer*2     sum_L           ! 14- Summation of Low energy counts (cnts/sec)
  integer*2     sum_M1          !  16- Medium-1 energy
  integer*2     sum_M2          !  18- Medium-2 energy
  integer*2     sum_H           ! 20- High energy
  integer*2     sigma_L         ! 22- Standard deviation of low energy channels

  byte          dataRecTypes    !  24- What data follows
                                !TODO - Flag to show start of PH data ??

  byte          spare(5)        !  25-
END STRUCTURE                   ! 32
```

8. SXT RAW DATA FILES (SDA)

```
File Identifier:                SDA
Record Size:                    16 bytes
```

The SDA (SXT DAta) file is one of the reformatted data files which is written by the reformattor. The general layout of this and the other reformatted data files is:

1. File Information / Pointer Section
2. File Header Section
3. Quasi-Static Index Section
4. Index/Data, Index/Data, ... Section
5. Road Map Section

8.1 Pointer Section

The pointer section is described in Section 4.1.

8.2 File Header

The File Header is described in Section 4.2.

8.3 Quasi-Static Index Section

The structure QS_General1_Rec described in section 4.3 will be used.

```
STRUCTURE       /SXT_QS_Instr_Rec/
                                !              NOT IMPLEMENTED AS OF 25-Mar-92]

  integer*2     entry_type /'3011'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
```

```
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  integer*2     gain_const      !  14- Camera gain constant (e/DN*100)

  character*11  DC_FileID       ! 16- Suggested dark current file name to be used

  integer*2     solution_ver    !  27- Solution version

  byte          spare(3)        !  29-
END STRUCTURE                   ! 32- Total

STRUCTURE       /SXT_QS_Conv_Rec/
                                !            NOT IMPLEMENTED AS OF 25-Mar-92]

  integer*2     entry_type /'3021'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  integer*2     temp_conv(10,2) !  14- Conversion for temperature in 0.01 deg.

  integer*2     solution_ver    !  54- Solution version

  byte          spare(8)        !  56-
END STRUCTURE                   ! 64- Total
```

8.4 Index and Data Section

One data index will be created for each PFI (Partial Frame Image) EXPOSURE (not each image). The observing regions ("ORs") that require several exposures to make one image will have a different index for each exposure. There will be one data index for each ROI (Region of Interest) in a multiple ROI FFI (Full Frame Image) (even though it only takes one exposure).

All references to image shape are in terms of 1x1 pixels (not the current image summation)

```
STRUCTURE       /SXT_Index_Rec/
  integer*2     index_version /'3012'x/
                                !    0- Index structure version                                     Ground Info
                                !          (See GEN_INDEX for explanation)

  byte          pfi_ffi         !    2- Image information
                                !              b0:2 = Image type
                                !                        0 = PFI ("raw" PFI strips - not assembled)         Derived
                                !                        1 = FFI
                                !                        2 = PFI (assembled ORs)
                                !                        3 = FFI - Patrol image buffer dump
                                !                              (b0=0 is PFI, b0=1 is FFI)
                                !              b3   = For FFI 0=BLS off, 1=BLS on                      W114 F00 B4
                                !              b4:7 = For PFI = "OR" expsoure #                        W114 F43
                                !              b4:7 = For FFI = ROI# of nROI                           Derived

                                !
  byte          periph          !    3- Aspect/shutter/filter information                         W114 F08/02
                                !              b7   = Aspect door (0=closed, 1=open)
                                !              b6   = Shutter mode (0=Frame Transfer, 1=Mech)
                                !              b3:5 = Filter B position
                                !                           1 = Open
                                !                           2 = Al 1400 Angstrom
                                !                           3 = Al/Mg/Mn
                                !                           4 = Ber 100 microns
                                !                           5 = Al 12 microns
```

```
                                !                          6 = Mg3Mu
                                !             b0:2 = Filter A position
                                !                          1 = Open
                                !                          2 = Narrow Band (4310 A, 30 A FWHM)
                                !                          3 = Quartz defocusing lens ('photon flood')
                                !                          4 = Diffuser
                                !                          5 = Wide Band (4600 A, 185 A FWHM)
                                !                          6 = Neutral Density Mask (8%)
byte          ExpLevMode        !   4- Exposure mode/level                                  W114 F09/03
                                !             b6:7 = Exposure mode (0=normal, 1=dark, 2=LTF)
                                !             b0:5 = Mailbox exposure level
byte          imgparam          !   5- Image parameter information                          W114 F24/18
                                !             b6:7 = Exposure cadence (0=2sec,1=1sec,2=.5sec)
                                !             b4:5 = Number of ROI (0=1 ROI, 1=2 ROI, ...)
                                !             b2:3 = Compression (0=Cmp, 1=Low8, 2=Hi8)
                                !             b0:1 = Image resolution (0=1x1,1=2x2,3=4x4)
byte          flush             !   6- Flush information                                    W114 F40/34
                                !             b0:1 = Pre-exposure Full frame flushes (0-3)
                                !             b2:3 = Set-up full frame flushes
                                !                          # flushes = 2*(b2:3 value) in ROM
                                !                                    = 4*(b2:3 value) 30-sep-91 to 7-Oct-91?
                                !                                    = 8*(b2:3 value) after 7-Oct-91
                                !             b4:7 = Guard band
integer*4     explat            !   7- Exposure latency (mailbox value)                     W114 F10,F26/04,20
integer*4     expdur            !  11- Exposure duration (mailbox value)                   W114 F42,F58/36,52

integer*2     shape_cmd(2)      !  15- Commanded image shape (nx by ny)                    W114 F57,F57/xx,22
                                !             (the col,lin# are in summed (output) pixels)
                                !          For observing regions, the "ny" is the
                                !                full observing region size
                                !          For FFI, "nx" always = 1024, 512, or 256
                                !          For multiple ROI FFI "ny" is width of one ROI         W114 F38 or 54 or 23
integer*2     shape_sav(2)      !  19- Image shape saved (nx by ny)                        Derived
                                !             (the col,lin# are in summed (output) pixels)
                                !          For observing regions, "ny" always = 64
integer*2     corner_cmd(2)     !  23- Commanded starting corner (x0, y0)                  W114 F27,11/21
```

```
                                   !           (the col,lin# are in 1x1 pixels)
                                   !           The values are CCD column numbers and are NOT
                                   !           reversed.   The SXT images have been reversed before
                                   !           being written to disk so CCD column 0 is to the
                                   !           right (high indcies) in the image array
                                   !
                                   !           Col 0 is "image-0", col 1 is "image-1"
                                   !           in figure on page 97 of blue book.   Neither
                                   !           of these pixels are summed in summation mode
                                   !       For FFI, "x0" always = 0 (but check BLS on/off)
                                   !       For multiple ROI FFI "y0" is the start of one ROI         W114 F37 or 53 or 07
integer*2      corner_sav(2)       !  27- Starting corner saved (x0, y0)                          Derived
                                   !           (the col,lin# are in 1x1 pixels)

integer*2      FOV_Center(2)       !  31- Pitch and yaw relative to the sun center                Derived
                                   !       of the center of the SXT FOV (in arcsec)
                                   !       (for the PFI strip, not the OR)
                                   !           (1) = yaw; (2) = pitch
                                   !       (used to relate to active region list)
                                   !           Temporary Definition:
                                   !                           yaw   = (512 - center_fov(0))*2.45
                                   !                           pitch = (center_fov(1) - 638)*2.45
                                   !                 where center_fov is pixel location in 1x1
                                   !                 pixels (not including the BLS pixels)
integer*2      FOV_Ver             !  35- Information on how solution was derived                 Ground Info

byte           ObsRegion           !  37- Observing region Number                                 W114 F50
                                   !           b6:7 = FFI Seq Table # (0-3)
                                   !                           From Entry Table
                                   !           b4:5 = PFI Seq Table # (0-3)
                                   !           b0:3 = Observing region number (0-8)
                                   !                           Location # on the sun
                                   !                           (0-3) Updated by QT ARS
                                   !                           (4-7) Updated manually (with ART option)
                                   !                           (8)   Updated by FL ARS
byte           seq_num             !  38- Sequence Number (1-13)                                  W114 F59/55
```

```
                              !            b0:3 = Entry in sequence table (1-13)
                              !            b4:7 = Word or line sync error bits
integer*2     seq_tab_serno   !  39- Sequence table serial used                        Ground Info

integer*4     serial_num      !  41- Serial number of image                            W115 F18,34,50/16,32,48
integer*4     mloop           !  45- Main loop counter                                 W115 F19,35,51/02,03
byte          loops(4)        !  49- Loop counters     (1) = loop 2                    W115 F04/01
                              !                                   (2) = loop 3                    W115 F20/17
                              !                                   (3) = loop 4                    W115 F36/33
                              !                                   (4) = loop 5                    W115 F52/49

byte          Pow_stat        !  53- Power Status (0=off, 1=on)                        W48  F25
                              !            b7 = 5 Volts
                              !            b6 = 28 Volts
                              !            b5 = Filter Wheel
                              !            b4 = Shutter / Aspect Controller
                              !            b3 = Micro A Select
                              !            b2 = Micro B Select
                              !            b1 = Camera
                              !            b0 = Thermoelectric Cooler (TEC)
byte          SW_stat         !  54- Active Software (1=active)                        W114 F12
                              !            b7 = Quiet ARS on/off
                              !            b6 = Quiet ARS 1 or 2
                              !            b5 = Flare ARS on/off
                              !            b4 = ARS morning patrol on/off
                              !            b3 = AEC patrol on/off
                              !            b2 = ART on/off
                              !            b1 = ART
                              !            b0 = ART
byte          SXT_Control     !  55- SXT Control Status                                W114 F32
                              !            b7   = Power control mode (1=auto, 0=manual)
                              !            b6   = SXT control mode (1=auto, 0=manual)
                              !            b4:5 = SXT day/night mode
                              !                           00 = SXT day mode
                              !                           01 = SXT evening mode
                              !                           10 = SXT night mode
```

```
                        !                               11 = SXT morning mode
                        !                b1   = SXTE-U hard reset (1=executed)
                        !                b0   = SXTE-U soft reset (1=executed)
byte       sxtfmt       !  56- SXT Format info 8:2 or 2:8                        W115 F00

byte       temp_ccd     !  57- CCD Temperature                                   W113 F52
                        !          Value is actually 1 MF out of sync?
byte       temp_hk(20)  !  58- House keeping temperature                         W32 F18-26 SF2n+1
                        !          (See quasi-static section for conversions)
                        !              temp_hk(0) = TEC hot end                       W32 F18 SF2n+1
                        !              temp_hk(1) = CCD camera head                   W32 F19 SF2n+1
                        !              temp_hk(2) = Filter wheel housing              W32 F20 SF2n+1
                        !              temp_hk(3) = Forward support plate             W32 F21 SF2n+1
                        !              temp_hk(4) = Aspect Telescope (NOT FUNCTIONING)        W32 F22 SF2n+1
                        !              temp_hk(5) = Metering tube center              W32 F23 SF2n+1
                        !              temp_hk(6) = Filter wheel hub (aft             W32 F24 SF2n+1
                        !              temp_hk(7) = Shutter motor case                W32 F25 SF2n+1
                        !              temp_hk(8) = TSA (thermal strap) S/C end       W32 F26 SF2n+1
                        !              temp_hk(9)  = Upper Panel Sensor 4 (UP-4)      W32 F42 SF2n+1
                        !              temp_hk(10) = Cemter Panel Sensor 1 (CP-1)     W32 F55 SF2n+1
                        !              temp_hk(11) = Center Panel Sensor 2 (CP-2)     W32 F56 SF2n+1
                        !              temp_hk(12) = Center Panel Sensor 3 (CP-3)     W32 F57 SF2n+1
                        !              temp_hk(13) = Base Panel Sensor 4 (BP-4)       W32 F61 SF2n+1
                        !              temp_hk(14) = (spare)
                        !              temp_hk(15) = (spare)
                        !              temp_hk(16) = (spare)
                        !              temp_hk(17) = (spare)
                        !              temp_hk(18) = (spare)

byte       HW_error(2)  !  78- Hardware error since last exposure                W113 F07,23 ?
byte       j_register   !  80- Which buffer is used                              W114 F33?

byte       Img_Max      !  81- Maximum intensity                                 Derived
                        !          (0-255, high 8 bits)
                        !          The image is decompressed first where necessary
byte       Img_Avg      !  82- Average intensity of whole image                  Derived
```

```
                                 !              1x1 - first subtract 12.8 DN offset
                                 !              2x4 - first subtract 30.7 DN offset
                                 !              4x4 - first subtract 73.6 DN offset
                                 !          (0-255, high 8 bits)
                                 !          The image is decompressed first where necessary
  byte          Img_Dev          !  83- Standard deviation of the whole image                   Derived
                                 !          (0-255) - Not scaled
                                 !          The image is decompressed first where necessary
  byte          PercentD         ! 84- Percentage of data present                              Derived
                                 !          (value 255 = 100%)
  byte          PercentOver      !  85- Percentage of data over [N] counts                      Derived
                                 !          (value 255 = 100%)
                                 !              1x1 - the # pixels over 2000 DN (decompressed)
                                 !              2x2 - the # pixels over 3500 DN (decompressed)
                                 !              4x4 - the # pixels over 3500 DN (decompressed)

  byte          AEC_Status       !  86- AEC Status                                              W114 F44
                                 !              NOTE: True only for the LAST "PFI Strip" in
                                 !                          an observing region
                                 !              b4:7 = Maximum number of selcted regions
                                 !                             in AT ARS1 (0-4)
                                 !              b2:3 = AEC Status of PFI-AEC
                                 !                                00b = proper
                                 !                                01b = Over exposure
                                 !                                10b = Under exposure
                                 !              b0:1 = AEC Status of Patrol-AEC
                                 !                                (see PFI-AEC above)
  byte          spare(9)         !  87- Spare bytes
END STRUCTURE                    ! 96- Total
```

There is additional information available in the ground based data. When accessing ground based data that has been converted to the SDA format, there is an additional index structure which follows the "standard" index structure. The ground based structure is as follows:

```
STRUCTURE       /SXT_Gnd_Idx_Rec/
  integer*2     index_version /'3021'x/
```

```
                              !  00- Index structure version

  character*16  filename      !    2- MicroVAX file name

  character*6   experiment    !  18- Description of experiment
  character*6   source        !  24- Description of the source
  character*6   ccddev        !  30- CCD used

  integer*4     x_pos         !  36- Translation Stage X Position
  integer*4     y_pos         !  40- Translation Stage Y Position
  integer*4     z_pos         !  44- Translation Stage Z Position

  real*4        az            !  48- Azimuth of MSFC optical bench
  real*4        el            !  52- Azimuth of MSFC optical bench
  real*4        cexp          !  56- Commanded exposure duration (sec)
  real*4        aexp          !  60- Actual exposure duration (sec)

  character*6   filta         !  64- Filter A name (since filters were changed over testing period)
  character*6   filtb         !  70- Filter B name

  character*16  soufilename   !  76- MicroVAX source file name
                              !          (for cases of dark current subtraction)
  character*16  dcfilename    !  92- MicroVAX dark current file name
                              !          (for cases of dark current subtraction)

  byte          spare(20)     !108- Spare bytes
END STRUCTURE                 !128- Total
```

There will be SXT data files where processing has been performed on an image. When processing has been performed on a file, an additional structure is required to track what processing is done. The order of the index structure entries is the order in which the operations were performed.

```
STRUCTURE       /SXT_Proc_Idx_Rec/
  integer*2     index_version /'3031'x/
                              !    0- Index structure version                              Ground Info
  byte          operation     !    2- Operation performed (1=that action was performed)
```

```
                                 !              1 = Subtraction ("other" image time
                                 !                      is for the dark current image
                                 !              2 = Flat fielding / normalization
                                 !              3 = Ratioing
                                 !              4 = Registration
                                 !              5 = Summation / Mosaic
                                 !              6 = Extracted only a portion of FFI
                                 !              7 = Zoom (change plate scale size)
  integer*2     tech_ver         !    3- Technique version
                                 !              AAAABBBB CCCCDDDD
  integer*4     time             !    5- Time (millisec of day) of "other" image
                                 !          with which the operation was performed
  integer*2     day              !    9- Day (since 1-Jan-79) of "other" image

  byte          spare(21)        !  11- Spare bytes
END STRUCTURE                    ! 32- Total
```

The data is a two dimensional array. The size of the array is defined in the index structure. The reading routine will return a 2-D array if only one data set is read, or a 3-D array if many data sets are read (where the length of the third dimension is the number of datasets extracted)

8.5 Instrument Optional Section

There are no optional sections for SXT.

8.6 Road Map Section

This section contains a record for every "block" in the Index/Data section. The information in this section is a subset of the index structure (see that structure for a full explanation of each field).

```
STRUCTURE       /SXT_RoadMap_Rec/
                                !          For a full description of the fields,
                                !          look at the Index_Rec definition

  integer*4     ByteSkip        !  00- Offset in bytes from the beginning of
                                !          of the data file for the beginning
                                !          of the data set index structure.

  integer*4     time            !  04- Major frame time (millisec of day)
  integer*2     day             !  08- Major frame day (since 1-Jan-79)

  byte          DP_mode         !  10- DP Mode
  byte          DP_rate         !  11- DP Rate

  byte          pfi_ffi         !  12- Image information
  byte          periph          !  13- Aspect/Shutter/Filter information
  byte          ExpLevMode      !  14- Exposure mode/level
  byte          imgparam        !  15- Image parameter information

  byte          ObsRegion       !  16- Observing region Number
  byte          seq_num         !  17- Sequence Number (1-13)

  integer*2     shape_cmd(2)    !  18- Commanded image shape (nx by ny)
  integer*2     FOV_Center(2)   !  22- Pitch and yaw relative to the sun center
                                !          of the center of the SXT FOV (in arcsec)

  byte          Img_Max         !  26- Maximum intensity
  byte          Img_Avg         !  27- Average intensity of whole image
  byte          Img_Dev         !  28- Average intensity around the max
  byte          PercentD        ! 29- Percentage of data present
```

```
  byte          PercentOver     !  30- Percentage of data over [N] counts

  byte          Flare_Status    !  31- Flare flag status

  integer*4     serial_num      !  32- Serial number of image
                                !          ** NOT INCLUDED IN OBSERVING LOG **
  byte          AEC_Status      !  36- AEC Status
                                !          ** NOT INCLUDED IN OBSERVING LOG **
  integer*2     seq_tab_serno   !  37- Sequence table serial used
  byte          spare2(9)       !  39- Spare bytes
END STRUCTURE                   ! 48 Total
```

9. WBS RAW DATA FILES (WDA)

```
File Identifier:               WDA
Record Size:                   16 bytes
```

The WDA (WBS DAta) file is one of the reformatted data files which is written by the reformattor. The general layout of this and the other reformatted data files is:

1. File Information / Pointer Section
2. File Header Section
3. Quasi-Static Index Section
4. Index/Data, Index/Data, ... Section
5. Road Map Section

9.1 Pointer Section

The pointer section is described in Section 4.1.

9.2 File Header

The File Header is described in Section 4.2.

9.3 Quasi-Static Index Section

The structure QS_General1_Rec described in section 4.3 will be used.

```
STRUCTURE       /WBS_QS_Instr_Rec/
                                !              NOT IMPLEMENTED AS OF 25-Mar-92]

  integer*2     entry_type /'5011'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
```

```
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  byte          gain(32)        !  14- Gain information                                          W49 F32n+1,3,5,7,17,19,21,23

  byte          spare(18)       !  46-
END STRUCTURE                   ! 64- Total

STRUCTURE       /WBS_QS_Offset_Rec/     !  Start time (offset?)  of 1st PC data
                                !              NOT IMPLEMENTED AS OF 25-Mar-92]

  integer*2     entry_type /'5021'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  integer*4     sxs_pc          !  14- SXS offset relative to the time in the main
                                !          index record.    The units are in increments
                                !          of 1 microsec.    The delay is mainly due
                                !          to the DP software.
  integer*4     hxs_pc          !  18- hxs offset
  integer*4     grs_pc1         !  22- grs1 offset
  integer*4     grs_pc2         !  26- grs2 offset
  integer*4     rbm_pc          !  30- rbm offset
  integer*4     gbd_pc          !  34- gbd offset
  integer*4     dhk             !  38- dhk offset

  integer*2     solution_ver    !  42- Solution version

  byte          spare(20)       !  44-
END STRUCTURE                   ! 64 Total
```

```
STRUCTURE       /WBS_QS_Del_Rec/        !Time between Samples
                                        ![two values ?  one for hi, one for med]

                                !              NOT IMPLEMENTED AS OF 25-Mar-92]
  integer*2     entry_type /'5031'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  integer*4     sxs_pc          !  14- SXS interval between samples in units of
                                !         microseconds.    The values include
                                !         corrections for satellite clock variations.
  integer*4     hxs_pc          !  18- hxs interval
  integer*4     grs_pc1         !  22- grs1 interval
  integer*4     grs_pc2         !  26- grs2 interval
  integer*4     rbm_pc          !  30- rbm interval
  integer*4     gbd_pc          !  34- gbd interval
  integer*4     dhk             !  38- dhk interval

  integer*2     solution_ver    !  42- Solution version

  byte          spare(20)       !  44-
END STRUCTURE                   ! 64 Total

STRUCTURE       /WBS_QS_Conv1_Rec/      !  Conversion Factors for PH data
                                !              NOT IMPLEMENTED AS OF 25-Mar-92]
  integer*2     entry_type /'5041'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)
```

```
  integer*4     sxs_ph0         !  14- energy * 0.01 keV
  integer*4     sxs_phw         !  18- width  * 0.001 keV/ch
  integer*4     hxs_ph0         !  22- base   * 0.01 sq(keV)
  integer*4     hxs_phw         !  26- width  * 0.01 sq(keV)/ch
  integer*4     hxs_chw         !  30- Factor * 0.001
  integer*4     rbm_ph0         !  34- base   * 0.01 sq(keV)
  integer*4     rbm_phw         !  38- width  * 0.01 sq(keV)/ch
  integer*4     rbm_chw         !  42- Factor * 0.001
  integer*4     grs1_ph0        !  46- base   * 0.01 sq(keV)
  integer*4     grs1_phw        !  50- width  * 0.01 sq(keV)/ch
  integer*4     grs1_chw        !  54- Factor * 0.01
  integer*4     grs2_ph0        !  58- base   * 0.01 sq(keV)
  integer*4     grs2_phw        !  62- width  * 0.01 sq(keV)/ch
  integer*4     grs2_chw        !  66- Factor * 0.01
  integer*4     grsh_ph0        !  70- energy *10.0 keV
  integer*4     grsh_phw        !  74- width  * 1.00 keV/ch

  integer*2     solution_ver    !  78- Solution version

  byte          spare(48)       !  80-
END STRUCTURE                   !128 Total
```

The conversion equation from the PH data to energy is as follows:

```
 SXS(ith ch):    Energy (in keV)        = 0.01*SXS_PH0 + 0.001*i*(SXS_PHW)
 HXS(ith ch):    Energy (in keV)        = 0.01*HXS_CHW * (.01*i*HXS_PHW + HXS_PH0)**2
 RBM(ith ch):    Energy (in keV)        = 0.01*RBM_CHW * (.01*i*RBM_PHW + RBM_PH0)**2
 GRS(ith ch):    Energy (in keV)        = 0.01*GRS_CHW * (.01*i*GRS_PHW + GRS_PH0)**2
 GRH(ith ch):    Energy (in keV)        = 10.0*GRSH_PH0 + i*GRSH_PHW            (i<8)
                               = 10.0*GRSH_PH0 + (2*i-8)*GRSH_PHW       (i>7)
```

The real conversion coefficients may be varied during an orbit by sending BC's; this can be followed by tracing the change of PI-OS words in the reformatted data. The conversion factors corresponding to these change will be given as a following table.

```
STRUCTURE       /WBS_QS_Conv2_Rec/      !  Conversion Factors for AHK data
                                !              NOT IMPLEMENTED AS OF 25-Mar-92]
  integer*2     entry_type /'5051'x/
                                !  00- Structure/Entry type

  integer*4     st_time         !  02- Start time (millisec of day) entries are valid
  integer*2     st_day          !  06- Start day (since 1-Jan-79)
  integer*4     en_time         !  08- End time (millisec of day)
  integer*2     en_day          !  12- End day (since 1-Jan-79)

  integer*2     sxs_hv0         !  14- voltage * 0.1 volts
  integer*2     sxs_hvc         !  16- voltage * 0.01 volts/chan
  integer*2     hxs_hv0         !  18- voltage * 0.1 volts
  integer*2     hxs_hvc         !  20- voltage * 0.01 volts/chan
  integer*2     grs1_hv0        !  22- voltage * 0.1 volts
  integer*2     grs1_hvc        !  24- voltage * 0.01 volts/chan
  integer*2     grs2_hv0        !  26- voltage * 0.1 volts
  integer*2     grs2_hvc        !  28- voltage * 0.01 volts/chan
  integer*2     rbm_hv0         !  30- voltage * 0.1 volts
  integer*2     rbm_hvc         !  32- voltage * 0.01 volts/chan
  integer*2     sxst_tm0        !  34- temp * 0.01 degrees
  integer*2     sxst_tmc        !  36- temp * 0.01 degrees/chan
  integer*2     hxst_tm0        !  38- temp * 0.01 degrees
  integer*2     hxst_tmc        !  40- temp * 0.01 degrees/chan
  integer*2     grst_tm0        !  42- temp * 0.01 degrees
  integer*2     grst_tmc        !  44- temp * 0.01 degrees/chan
  integer*2     rbmt_tm0        !  46- temp * 0.01 degrees
  integer*2     rbmt_tmc        !  48- temp * 0.01 degrees/chan

  integer*2     solution_ver    !  50- Solution version
```

```
  byte          spare(12)       !  52-
END STRUCTURE                   ! 64 Total
```

The conversion equation for the high voltage is:

```
High_Voltage (ith ch) = HV0 + i*HVC     (volts)
```

The conversion equation for the temperature is:

```
Temperature (ith ch) = TM0 + i*TMC      (degrees)
```

9.4 Index and Data Section

There is one index section (and matching data section) for every two major frames.

NOTE: The WBS instrument uses a analog to digital converter which produces an UNSIGNED 16 bit value. When using certain PC data, care should be taken to correct for data that exceeds 2^{15}. These values will show up as negatives and can be corrected by changing the variable to an INTEGER*4 and adding 2^{16}.

```
STRUCTURE       /WBS_Index_Rec/
  integer*2     index_version /'5011'x/
                                !    0- Index structure version                                  Ground Info
                                !             AAAABBBB CCCCDDDD

  byte          pow_stat(2)     !  02- Power status                                             W48 F32n+2
                                !             b7 = WBS HV enable/disable
                                !             b6 = WBS on/off (set=on)
                                !             b5 = WBS-A on/off (set=on)
                                !             b4 = SXS-HV on/off (set=on)
                                !             b3 = HXS-HV on/off (set=on)
                                !             b2 = GRS-HV1 on/off (set=on)
                                !             b1 = GRS-HV2 on/off (set=on)
                                !             b0 = RBM-HV on/off (set=on)
  byte          gbd_status1     !  04- [TODO - ADD INFO]                                        W50 F63
```

```
byte            gbd_status2     !  05-                                                     W50 F47
                                !            b5   = block 1?
                                !            b4   = block 0?
                                !            b0:3 = ?
                                !        [TODO - ADD INFO]
byte            PIOS(8,2)       !  06- WBS control
                                !            (0,*) = GRS1 Control                                W49 F32n+1
                                !                  b6:7 = HV control
                                !                            00 = 750 V (default)
                                !                            01 = 720 V
                                !                            10 = 780 V
                                !                            11 = 810 V
                                !                  b4:5 = Amp-L Gain
                                !                            00 = X1 (What is this?  TODO??)
                                !                            01 = 1.11
                                !                            10 = 1.22
                                !                            11 = 1.33
                                !                  b2:3 = Amp-H Gain
                                !                            00 = X1 (What is this?  TODO??)
                                !                            01 = 1.11
                                !                            10 = 1.22
                                !                            11 = 1.33
                                !                  b1   = CAL discriminator (set=60 keV, low=30 KeV)
                                !                  b0   = CAL disabled/enabled
                                !            (1,*) = GRS2 Control                                W49 F32n+3
                                !                  b6:7 = HV control
                                !                            00 = 700 V (default)
                                !                            01 = 670 V
                                !                            10 = 730 V
                                !                            11 = 760 V
                                !                  b4:5 = Amp-L Gain
                                !                            00 = X1 (What is this?  TODO??)
                                !                            01 = 1.11
                                !                            10 = 1.22
                                !                            11 = 1.33
                                !                  b2:3 = Amp-H Gain
```

```
!                               00 = X1 (What is this?  TODO??)
!                               01 = 1.11
!                               10 = 1.22
!                               11 = 1.33
!               (2,*) HXS Control                                       W49 F32n+5
!                     b6:7 = HV control
!                               00 = 730 V (default)
!                               01 = 700 V
!                               10 = 760 V
!                               11 = 790 V
!                     b4:5 = Amp Gain
!                               00 = X1 (What is this?  TODO??)
!                               01 = 1.13
!                               10 = 1.30
!                               11 = 0.43
!                     b2   = MD Control (high=100 keV, low=50 keV)
!                     b1   = CAL discriminator (high=1.0 MeV, low=0.5 MeV)
!                     b0   = CAL enable/disable
!               (3,*) = BC-DATA                                         W49 F32n+7
!               (4,*) = RBM Control                                     W49 F32n+17
!                     b6:7 = HV control
!                               00 = 1250 V (default)
!                               01 = 1200 V
!                               10 = 1300 V
!                               11 = 1350 V
!                     b4:5 = Amp Gain
!                               00 = X1 (What is this?  TODO??)
!                               01 = 1.15
!                               10 = 1.30
!                               11 = 0.55
!                     b2:3 = SSD Discrimination levels
!                               00 = 20 keV (default)
!                               01 = 40 keV
!                               10 = 70 keV
!                               11 = 90 keV
!                     b1   = MD Control (high=100 keV, low=50 keV)
```

```
!                 b0   = SSD off/on
!           (5,*) = SXS1 Control                                  W49 F32n+19
!                 b6:7 = HV control
!                           00 = 2300 V (default)
!                           01 = 2250 V
!                           10 = 2350 V
!                           11 = 24000 V
!                 b4:5 = Amp Gain
!                           00 = X1 (What is this?  TODO??)
!                           01 = 1.11
!                           10 = 1.22
!                           11 = 1.33
!                 b2:3 = MD1 Control
!                           00 =  7.5 keV (default)
!                           01 = 10.0 keV
!                           10 = 12.5 keV
!                           11 = 15.0 keV
!                 b0:1 = MD2 Control
!                           00 = 15.0 keV (default)
!                           01 = 20.0 keV
!                           10 = 25.0 keV
!                           11 = 30.0 keV
!           (6,*) = SXS2 Control                                  W49 F32n+21
!                 b7   = RBM Flag (set=on)
!                 b4:5 = Amp Gain
!                           00 = X1 (What is this?  TODO??)
!                           01 = 1.11
!                           10 = 1.22
!                           11 = 1.33
!                 b2:3 = MD1 Control
!                           00 =  7.5 keV (default)
!                           01 = 10.0 keV
!                           10 = 12.5 keV
!                           11 = 15.0 keV
!                 b0:1 = MD2 Control
!                           00 = 15.0 keV (default)
```

```
                             !                        01 = 20.0 keV
                             !                        10 = 25.0 keV
                             !                        11 = 30.0 keV
                             !            (7,*) = BC-DATA                          W49 F32n+23
byte          ahk_hv(5)      !  22- Analog house keeping (AHK) voltages         W32 F27,28,29,30,31
                             !            (0) = SXS HV (0-5 V)
                             !            (1) = HXS HV
                             !            (2) = GRS HV1
                             !            (3) = GRS HV2
                             !            (4) = RBM HV
byte          ahk_temp(4)    !  27- Analog house keeping (AHK) Temperatures     W32 F91,92,93,94
                             !            (0) = SXS Temperature
                             !            (1) = HXS Temperature
                             !            (2) = GRS Temperature
                             !            (3) = RBM Temperature
byte          bcs_a_temp     !  31- TODO - why is this here?                                      W32 F95

integer*2     sxs1           !  32- SXS2 channel 1 counts per sec.    (3-15 keV)      Derived
                             !        Only SXS_PC21 are totaled
                             !        NOTE: For reformatter Ver 1.06 and before,
                             !                    the data stored here was for PC12
integer*2     sxs2           !  34- SXS2 channel 2 counts per sec.    (15-40 keV)     Derived
                             !        Only SXS_PC22 are totaled
                             !        NOTE: For reformatter Ver 1.06 and before,
                             !                    the data stored here was for PC21
integer*2     hxs            !  36- HXS counts per sec.    (20-600 keV)               Derived
                             !        HXS_PC1 and HXS_PC2 are totaled
                             !        Data is decompressed first
integer*2     grs1           !  38- GRS1 counts per sec.    (0.2-0.7 MeV)             Derived
                             !        GRS_PC11 and GRS_PC21 are totaled
                             !        Data is decompressed first
integer*2     grs2           !  40- GRS2 counts per sec.    (0.7-4 MeV)               Derived
                             !        GRS_PC12 and GRS_PC22 are totaled
                             !        Data is decompressed first
integer*2     rbmsc          !  42- RBMSC counts per sec.  (5-300 keV)               Derived
                             !        PC1 and PC2 are totaled
```

```
  integer*2     rbmsd           !  44- RBMSD counts per sec.  (20 keV)                                Derived
  integer*2     unit_time       !  46- Unit time (in .01 sec)                                        Derived

  byte          dataRecTypes    !  48- What data follows (set bits)
                                !                            b0 = wbs_dhk_data_rec
                                !                            b1 = wbs_pc_data_rec
                                !                            b2 = wbs_ph_data_rec
  byte          nmf             !  49- "Which" major frames are in the following data
                                !                            b0 = First half (even MF #s)
                                !                            b1 = Second half (odd MF #s)
                                !             A value of (3) says there are 2 MF of data
  byte          spare(14)       !  50
END STRUCTURE                   ! 64- Total
```

The following structures describe the possible WBS data structures. The data will be saved in the compressed format that is telemetered down from the spacecraft.

```
STRUCTURE       /WBS_DHK_Data_Rec/      !Digital House Keeping (DHK)
  byte          sxs_ud1(8)      !     0- [add words - elaborate]                                       W67 F16n+0
  byte          sxs_adct1(8)    !     8- [add words - elaborate]                                       W67 F16n+2
  byte          sxs_ud2(8)      !    16- [add words - elaborate]                                      W67 F16n+1
  byte          sxs_adct2(8)    !    24- [add words - elaborate]                                      W67 F16n+3
  byte          hxs_ud(8)       !    32- [add words - elaborate]                                      W67 F16n+4
  byte          hxs_adct(8)     !    40- [add words - elaborate]                                      W67 F16n+6
  byte          hxs_cal(8)      !    48- [add words - elaborate]                                      W67 F16n+5
  byte          grs_udh1(8)     !    56- [add words - elaborate]                                      W67 F16n+7
  byte          grs_adclt1(8)   !    64- [add words - elaborate]                                      W67 F16n+10
  byte          grs_adcht1(8)   !    72- [add words - elaborate]                                      W67 F16n+12
  byte          grs_udh2(8)     !    80- [add words - elaborate]                                      W67 F16n+8
  byte          grs_adclt2(8)   !    88- [add words - elaborate]                                      W67 F16n+11
  byte          grs_adcht2(8)   !    96- [add words - elaborate]                                      W67 F16n+13
  byte          grs_cal(8)      !  104- [add words - elaborate]                                      W67 F16n+9
  byte          rbm_sc_ud(8)    !  112- [add words - elaborate]                                      W67 F16n+14
  byte          rbm_sc_adct(8)  !  120- [add words - elaborate]                                      W67 F16n+15
END STRUCTURE                   ! 128 Total
```

```
STRUCTURE       /WBS_PC_Data_Rec/       !pulse count data
                                !          Soft X-Ray Spectrometer (SXS)
  integer*2     sxs_pc11(16)    !  00- SXS1 Detector, chan 1 (3-15 keV)                   W96,W97 F8n+0
  integer*2     sxs_pc12(16)    !  32- SXS1 Detector, chan 2 (15-40 keV)                  W96,W97 F8n+1
  integer*2     sxs_pc21(16)    !  64- SXS2 Detector, chan 1 (3-15 keV)                   W96,W97 F8n+2
  integer*2     sxs_pc22(16)    !  96- SXS2 Detector, chan 2 (15-40 keV)                  W96,W97 F8n+3

                                !          Hard X-Ray Spectrometer (HXS)
  byte          hxs_pc1(32)     !  128- (20-60 keV)                                       W99 F4n+0
  byte          hxs_pc2(32)     !  160- (60-600 keV)                                      W99 F4n+1

                                !          Gamma-Ray Burst Detection (GBD)
  byte          gbd_pc1(32)     !  192- [add words - elaborate]                           W99 F4n+2
  byte          gbd_pc2(32)     !  224- [add words - elaborate]                           W99 F4n+3

                                !            Gamma-Ray Spectrometer (GRS)
  byte          grs_pc11(16)    !  256- (0.2-0.7 MeV)                                     W98 F8n+0
  byte          grs_pc12(16)    !  272- (0.7-4.0 MeV)                                     W98 F8n+1
  byte          grs_pc21(16)    !  288- (0.2-0.7 MeV)                                     W98 F8n+2
  byte          grs_pc22(16)    !  304- (0.7-4.0 MeV)                                     W98 F8n+3
  byte          grs_pc13(8)     !  320- (4-7 MeV)                                         W98 F16n+4
  byte          grs_pc14(8)     !  328- (7-10 MeV)                                        W98 F16n+5
  byte          grs_pc15(8)     !  336- (8-30 MeV)                                        W98 F16n+6
  byte          grs_pc16(8)     !  344- (30-100 MeV)                                      W98 F16n+7
  byte          grs_pc23(8)     !  352- (4-7 MeV)                                         W98 F16n+12
  byte          grs_pc24(8)     !  360- (7-10 MeV)                                        W98 F16n+13
  byte          grs_pc25(8)     !  368- (8-30 MeV)                                        W98 F16n+14
  byte          grs_pc26(8)     !  376- (30-100 MeV)                                      W98 F16n+15

                                !            Radiation Belt Monitor (RBM)
  integer*2     rbm_sc_pc1(16)  !  384- NaI scintillation detector (5-60 keV)             W96,W97 F8n+4
  integer*2     rbm_sc_pc2(16)  !  416- NaI scintillation detector (60-300 keV)           W96,W97 F8n+5
  integer*2     rbm_sd_pc(16)   !  448- Si detector (20 kev)                              W96,W97 F8n+6
END STRUCTURE                   ! 480 Total

STRUCTURE       /WBS_PH_Data_Rec/
```

```
  byte          sxs_ph1(128,2)  !      0- SXS1 pulse height data (2-30 keV)
                                !            Chan 0-127 for 1st MF, and 2nd MF
  byte          sxs_ph2(128,2)  !  256- SXS2 pulse height data (2-30 keV)
                                !            Chan 0-127 for 1st MF, and 2nd MF
  byte          grs_phl1(128)   !  512- GRS pulse height data for lower channels (0.2-10 MeV)
                                !            Chan 0-127 takes 2 MF to dump
  byte          grs_phl2(128)   !  640- GRS pulse height data for lower channels (0.2-10 MeV)
                                !            Chan 0-127 takes 2 MF to dump
  byte          hxs_ph(32,4)    !  768- HXS pulse height data (20-400 keV)
                                !            Chan 0-31 twice for 1st MF, and 2nd MF
  byte          rbm_sc_ph(32,4) !  896- NaI scintillation detector (5-300 keV)
                                !            Chan 0-31 twice for 1st MF, and 2nd MF
  byte          grs_phh1(16)    !1024- GRS pulse height data for higher channels (8-100 MeV)
                                !            Chan 0-15                                       W96
  byte          grs_phh2(16)    !1040- GRS pulse height data for higher channels (8-100 MeV)
END STRUCTURE                   !1056 Total
```

9.5 Instrument Optional Section

WBS does not use the optional data section.

9.6 Road Map Section

This section contains a record for every “block” in the Index/Data section. The information in this section is a subset of the index structure (see that structure for a full explanation of each field).

```
STRUCTURE       /WBS_RoadMap_Rec/
                                !          For a full description of the fields,
                                !          look at the Index_Rec definition

  integer*4     ByteSkip        !  00- Starting byte of index rec

  integer*4     time            !  04- Major frame time (millisec of day)
  integer*2     day             !  08- Major frame day (since 1-Jan-79)
```

```
  byte          DP_mode         !  10- DP Mode
  byte          DP_rate         !  11- DP Rate

  byte          pow_stat        !  12- [add words - elaborate]
  byte          flags           !  13- [add words - elaborate]

  integer*2     sxs1            !  32- SXS2 channel 1 counts per sec.    (3-15 keV)
  integer*2     sxs2            !  34- SXS2 channel 2 counts per sec.    (15-40 keV)
  integer*2     hxs             !  36- HXS counts per sec.    (20-600 keV)
  integer*2     grs1            !  38- GRS1 counts per sec.    (0.2-0.7 MeV)
  integer*2     grs2            !  40- GRS2 counts per sec.    (0.7-4 MeV)
  integer*2     rbmsc           !  42- RBMSC counts per sec.  (5-300 keV)
  integer*2     rbmsd           !  44- RBMSD counts per sec.  (20 keV)
  integer*2     unit_time       !  28- Unit time (in .01 sec)

  byte          nmf             !  30- "Which" major frames are in the following data
  byte          spare(1)        !  31
END STRUCTURE                   ! 32 Total
```

10. ATTITUDE CONTROL FILE (ATT)

```
File Identifier:              ATT
Record Size:                  16 bytes
```

The ATT (ATTitude control) file is one of the reformatted data files which is written by the reformattor. The general layout of this and the other reformatted data files is:

1. File Information / Pointer Section
2. File Header Section
3. Quasi-Static Index Section
4. Index/Data, Index/Data, ... Section
5. Optional Section (HXA scans)
6. Road Map Section

10.1 Pointer Section

The pointer section is described in Section 4.1.

10.2 File Header

The File Header is described in Section 4.2.

10.3 Quasi-Static Index Section

The structure QS_General1_Rec described in section 4.3 will be used.

10.4 Index and Data Section

All of the attitude control data is saved separately to allow for smoothing over time and quick easy access. There is one block per major frame.

```
STRUCTURE       /ATT_Data_Rec/
                                !----- Inertial Reference Unit (IRU) ----------------------
  byte          iru_pow_stat(2) !    0- IRU Power Status                                        W48 F32n+13
                                !              b7 = ??
                                !              b6 = Loop??
                                !              b5 = X Motor on/off
                                !              b4 = Y Motor on/off
                                !              b3 = Z Motor on/off
                                !              b2 = S Motor on/off
                                !              b1 = ??
                                !              b0 =
  byte          iru_LM(5,2)     !    2- IRU ??
                                !        (i,j)  j=two values per major frame
                                !              (0,*) = X voltage??  (0-3 V)
                                !              (1,*) = Y voltage??  (0-3 V)
                                !              (2,*) = Z voltage??  (0-3 V)
                                !              (3,*) = S voltage??  (0-3 V)
                                !              (4,*) = MC??
  byte          iru_temp        !  12- IRU Temperature                                          W32 F52 SF2n
  integer*4     iru(3,8)        !    0- X roll?
                                !          Y roll?
                                !          Z roll?
                                !        (i,j)  i=0 is X, i=1 is Y, i=2 is Z
                                !                      j=eight values per major frame
                                !    W17 is high 8 bits of 24 bit value
                                !    W18 is middle 8 bits of 24 bit value
                                !    W19 is low 8 bits of 24 bit value
                                !
                                !      24-bit value is the roll/pointing?
                                !              LSB (1 DN) = 0.08 arcsec (one "pulse")

                                !----- Geomagnetic Attitude Sensor (GAS) ----------------------
  byte          gas_pow_stat    !  ??- GAS Power Status                                         W48 F24
                                !              b2 = GAS on/off
                                !              b1 = GAS Sensor SA/SB (set = SB)
  byte          gas_A_HK        ! ??- GAS-A Analog house keeping                                W32 F36 SF2n+1
```

```
byte          gas_E_HK       ! ??- GAS-A Analog house keeping                              W32 F54 SF2n
byte          gas(3,4)       !  96- X position                                              W81 F16n+8
                             !          Y position                                              W82 F16n+8
                             !          Z position                                              W83 F16n+8
                             !        (i,j)  i=0 is X, i=1 is Y
                             !                      j=four values per major frame
                             !      8-bit value is the ??  position
                             !      between 0 and 512 pixels
                             !              LSB (1 DN) = .0390625 volts (10,000 nT/volt)

                             !----- Two-Dimensional Fine Sun Sensor (TFSS) ----------------
byte          tfss_pow_stat  !???- TFSS Power status                                       W48 F24
                             !              b5 = TFSS on/off
                             !              b4 = TFSS Cal??
byte          tfss_v(2)      !      - TFSS voltages??                                                                            W32 F
byte          tfss_temp      !      - TFSS Temperature                                        W32 F55 SF2n
integer*2     TFSS(2,4)      !108-X Position                                               W82,W83 F16n+12
                             !        Y Position                                               W82,W83 F16n+13
                             !        (i,j)  i=0 is X, i=1 is Y
                             !                      j=four values per major frame
                             !    W82 is high 8 bits of 12 bit value
                             !    W83 b4:7 = low 8 bits of 12 bit value
                             !      12-bit value is the ??  position
                             !      between 0 and 512 pixels
                             !              LSB (1 DN) = 0.00054 deg
                             !    W83
                             !              b3 = x/y sun presence        (1=on, 0=off)
                             !              b2 = x/y quality flag        (1=on, 0=off)

                             !----- Non-Spin Type Attitude Sensor (NSAS) -----------------
byte          nsas_pow_stat  !???- NSAS Power status                                       W48 F24
                             !              b7 = NSAS on/off
                             !              b6 = NSAS Cal??
byte          nsas_v(2)      !      - NSAS voltages??                                                                            W32 F
byte          nsas_temp      !      - NSAS Temperature                                        W32 F56 SF2n
integer*2     nsas(2,4)      !124- NSAS X address?                                                                            W82,W83 I
```

```
                                !         NSAS Y address?                                                       W82
                                !         (i,j)  i=0 is X, i=1 is Y
                                !                     j=four values per major frame
                                !    W82 is high 8 bits of 12 bit value
                                !    W83 b4:7 = low 8 bits of 12 bit value
                                !      12-bit value is the ??  position
                                !      between 0 and 512 pixels
                                !              LSB (1 DN) = 0.5 pixels)
                                !              x=0, y=0 ==> 0.025 deg
                                !    W83
                                !              b3 = x/y sun presence        (1=on, 0=off)
                                !              b2 = x/y edge flag           (1=on, 0=off)
                                !              b1 = x/y upper discriminator (1=on, 0=off)
                                !              b0 = x/y lower discriminator (1=on, 0=off)

                                !----- Star Tracker (STT) ----------------------
byte          stt_pow_stat      !???-STT power status                              W48 F2
                                !              b7 = CPU1 on/off
                                !              b6 = CPU2 on/off
                                !              b5 =
                                !              b4 =
                                !              b3 =
                                !              b2 =
                                !              b1 =
                                !              b0 =
byte          stt_stat(3)       !??  - STT Status                                   W48 F18,34,50
                                !              b7 =
                                !              b6 =
                                !              b5 =
                                !              b4 =
                                !              b3 =
                                !              b2 =
                                !              b1 =
                                !              b0 =
byte          stt_v             !??  - STT Voltages
                                !              For FI = 0 = STT CCD                        W32 F17 SF4n
```

```
                              !              For FI = 2 = STT REG                                    W32 F17 SF4n+2
byte          stt_temp(2)     !??  - STT Temperatures                                          W32 F56,58 SF2n

integer*2     stt_H_Pos(2)    !140-STT star position (H) - horizontal?                                       W82,W83 F32n+2
                              !        (j) j=two values per major frame
                              !      16-bit value is the star pixel position ?
                              !      between 0 and 512 pixels
                              !              LSB (1 DN) = 0.007812 pixels
integer*2     stt_V_Pos(2)    !144-STT star position (V) - vertical?                                          W82,W83 F32n+10
                              !        (j) j=two values per major frame
integer*2     stt_int(2)      !148-STT star intensity                                         W82,W83 F32n+18
                              !        (j) j=two values per major frame
integer*2     stt_alarm(2)    !152-STT alarm signal                                           W82,W83 F32n+26
                              !        (j) j=two values per major frame

                              !----- HXT 2-D Aspect Sensor ----------------------
byte          hxa_pow_stat    !  ??- HXA Power Status                                          W48 F1
                              !              b4 = HXA on/off
                              !              b3 = HXA cal
integer*2     hxa_addr(32,2)  !156- Address of positions below discriminator                  W33,W34,W34 F00-F63
                              !          (limbs and fiducial)
                              !        (j,i) j=32 addresses per major frame
                              !                    i=0 is two sets of addresses per major frame
                              !              The variable "hxa_xnum" tells how many x adresses
                              !              there are in "hxa_addr" and "hxa_ynum" tells how
                              !              many y addresses.    The y addresses need to have
                              !              2048 subtracted from the value.
byte          hxa_xnum(2)     !284- Number of positions along X below discrim                 W49 F32n+25
                              !                    Two sets per major frame
byte          hxa_ynum(2)     !286- Number of positions along Y below discrim                 W49 F32n+27
                              !                    Two sets per major frame
byte          hxa_gain(2)     !288- Gain for HXA                                              W49 F32n+29
                              !                    Two sets per major frame
byte          HXA_gain_cont(2)!  80- Gain control commanded                                    W49 F32+25
                              !              Hopefully not changed
                              !              TODO - what is this - same Frame/Word as "hxa_xnum"
```

```
                         !----- S/C Processed pointing info ----------------------
integer*4     sc_pntg(3,2)   !290- X,Y,Z euler angles in sun pointing coordinates
                         !      - X Offset from sun center                              W17,W18,W19 F32n+8
                         !          Y offset from sun center                             W17,W18,W19 F32n+16
                         !          Z roll from solar-north                              W17,W18,W19 F32n+24
                         !        (i,j)  i=0 is X, i=1 is Y, i=2 is Z
                         !                      j=two values per major frame
                         !    W17 is high 8 bits of 24 bit value
                         !    W18 is middle 8 bits of 24 bit value
                         !    W19 is low 8 bits of 24 bit value
                         !              LSB (1 DN) = 0.1 arcsec

                         !----- Ground Processed pointing info ----------------------
integer*4     pntg_angle(3)  !290- X,Y,Z euler angles in sun pointing coordinates           From Mainframe
                         !          1 DN = 0.1 arcsec
integer*4     pntg_dev(3)    !302- X,Y,Z standard deviation of attitude                     From Mainframe
                         !          determination errors
                         !          1 DN = .01"
integer*4     pntg_motion(3) !314- X,Y,Z estimated drift rates                              From Mainframe
                         !          1 DN = 1.0"/hour
integer*4     pntg_status    !326- Status                                                   From Mainframe
                         !              b15 = TFSS  0=not used, 1=used
                         !              b14 = NSAS  0=not used, 1=used
                         !              b13 = STT   0=not used, 1=used
                         !              b12 = GAS   0=not used, 1=used
                         !              b11 = IRU   0=not used, 1=used
                         !              b10 = ACP   0=not used, 1=used
                         !              b9  = Spec  0=coarse, 1=fine
                         !              b8  =       0=propagation, 1=renewal
                         !              b7  =       0=forward, 1=backward
                         !              b6  = sun presence 0=night, 1=day
                         !              b5  = earth occultation 0=occul, 1=not occul
byte          pntg_Trace     !  30- Information on how pointing was derived                 Ground Info
                         !          and whether there is data present
                         !              0 = No data present
```

```
                              !              1 = Original Technique used 20-Oct-91 to ??
                              !                      The data in "pntg_angle" is the average of
                              !                      8 raw IRU values (there are 8 values per
                              !                      major frame).    If the time of the data
                              !                      does not match the time of the IRU data
                              !                      within 5 minutes, then no data is present.
  byte          pntg_jitter   !  32- Magnitude of pointing change over ??sec                  Derived
                              !              in ??
                              !              scaled - TODO

  byte          spare(10)     !330-
END STRUCTURE                 !400- Total
```

10.5 Instrument Optional Section

The full one dimensional scan will occur once every 32 major frames.

```
STRUCTURE       /HXA_Scan_Rec/         !HXA 2 1-D Scans
  integer*4     time            !  04- Major frame time (millisec of day)
  integer*2     day             !  08- Major frame day (since 1-Jan-79)

  byte          x_scan_int(2048)!      - X scan intensity
  byte          y_scan_int(2048)!      - Y scan intensity
  integer*2     nPoScan         !      - Number of points in the scan (2048 if full)

  byte          spare(8)        !
END STRUCTURE                   !4112
```

10.6 Road Map Section

This section contains a record for every "block" in the Index/Data section. The information in this section is a subset of the index structure (see that structure for a full explanation of each field).

```
STRUCTURE       /ATT_Roadmap_Rec/
                                !          For a full description of the fields,
                                !          look at the Index_Rec definition

  integer*4     ByteSkip        !  00- Offset in bytes from the beginning of
                                !          of the data file for the beginning
                                !          of the data set index structure.

  integer*4     time            !  04- Major frame time (millisec of day)
  integer*2     day             !  08- Major frame day (since 1-Jan-79)

  byte          DP_mode         !  10- DP Mode
  byte          DP_rate         !  11- DP Rate

  byte          Flare_Control   !  12- Flare flag control (active triggers)
  byte          Flare_Status    !  13- Flare flag status
  byte          RBM_Status      !  14- Radiation Belt Montitor Status
  byte          Telemetry_mode  !  15- Telemetry mode
  byte          cal_status      !  16- CAL status

  byte          SXT_Pow_stat    !  17- SXT Power Status
  BYTE          bcs_pow_stat    !  18- BCS Power status
  byte          hxt_Pow_stat    !  19- HXT Power status
  byte          wbs_pow_stat    !  20- WBS Power status
  byte          SXT_Control     !  21- SXT Control Status

  byte          telemetry       !  22- Telemetry source information

  byte          spare(9)        !  23-
END STRUCTURE                   ! 32- Total
```

11. OBSERVING LOG

The Yohkoh Observing Log is intended to provide a database which will allow people to search for occasions when a given event occurs. The database contains information on the instrument modes as well as the signals being detected by a variety of instruments. The file is generated directly from the reformatted database ROADMAP sections. It is possible to produce WBS, HXT and BCS light curves with four second resolution with this dataset. It is also possible to generate a list of all occurances of a given SXT image type (for example, return a list of all images taken with a given resolution, filter, and signal level). The Observing Log has the necessary information to allow the user to go directly to the original reformatted data and extract the raw data for analysis.

11.1 Organization of Observing Log

The Observing Log file is a binary file and is organized in a manner similar to the reformatted data files, however, the observing log does not have a roadmap. There is also a single file for one week of data.

1. Pointer Section
2. File Header Section
3. Pointer to Start of New Orbit Section
4. Instrument Entries

11.1.1 Pointer Section

The pointer section is described in Section 4.1.

11.1.2 File Header Section

The File Header is described in Section 4.2.

11.1.3 Quasi-Static Section

There is no data being saved in this section

Figure 11-1 Solar-A Observing Log File

Figure 11-2 Overview for Using the Solar-A Observing Log File

11.1.4 New Orbit Start Pointer Section

Every file will hold one weeks worth of data. Assuming 15 orbits per day, this section will hold 105 pointers. The optional section pointer in the file header will point to this section.

```
STRUCTURE       /Obs_NewOrbit_Rec/
  integer*4     time            !  00- Start time of orbit
  integer*2     day             !  04- Stard day of orbit
  integer*4     StEntry         !  06- Pointer to start of orbit of data
                                !          in entry number (ie 32 or 48 byte blocks)
                                !          from the beginning of the data section.
                                !          The counter starts at 1.
  byte          spare(6)        !  10- Spares
END STRUCTURE                   ! 16- Total
```

There is a header record before the new orbit pointer structures recording how many entries there are.

```
STRUCTURE       /Obs_NewOrb_Hd_Rec/
  integer*4     nOrbitRec       !  00- Number of orbit record entries
  byte          spare(28)       !    4- Spares
END STRUCTURE                   ! 32- Total
```

11.1.4 Data Section

Each observing log data entry has an "entry_type" associated with it. The "entry_type" defines what kind of data is contained in the record. The breakdown of this word is as follows:

```
                                !      b0:4 Entry Type
                                !        0 = File ID entry
                                !        1 = Orbit Entry
                                !       16 = SXT
                                !       17 = WBS/HXT
                                !       18 = BCS
                                !      b5:7 Entry version number
```

11.2 Spacecraft Common Entries

11.2.1 File ID Entry

There will be a File ID entry for every orbit. This entry is used to derive the file name after search the observing log and finding a data set to research.

```
STRUCTURE       /Obs_FileID_Rec/
  byte          entry_type      !  00- Observing Log Entry Type/Version

  integer*4     time            !  01- Major frame time (millisec of day)
  integer*2     day             !  05- Major frame day (since 1-Jan-79)

  character*13  fileId          !  07- File ID for the orbit worth of data

  integer*4     sxt_pfi         !  20- First SXT PFI Image serial number in the FileID
                                !          (if zero, there are no images for that fileID)
  integer*4     sxt_ffi         !  24- First SXT FFI Image serial number in the FileID
                                !          (if zero, there are no images for that fileID)

  integer*2     delta_min       !  28- Number of minutes covered by this FileID
  byte          spare(2)        !  30- Spare
END STRUCTURE                   ! 32- Total
```

11.2.2 Orbital Solution Entry

There will be a orbital solution entry approximately every week.

```
STRUCTURE       /Obs_OrbitSol_Rec/
  byte          entry_type      !  00- Observing Log Entry Type/Version

  integer*4     epoch_time      !  01- Epoch time (millisec of day)
  integer*2     epoch_day       !  05- Epoch day (since 1-Jan-79)
```

```
  integer*4     sol_time        !  07- Solution time (millisec of day)
  integer*2     sol_day         !  11- Solution day (since 1-Jan-79)

  real*4        x               !  13- (km)
  real*4        y               !  17- (km)
  real*4        z               !  21- (km)
  real*4        xdot            !  25- (km/s)
  byte          spare1(3)       !  29- Spare

  byte          cont_mark1 /255/!  32- Continuation of an entry mark
  real*4        ydot            !  33- (km/s)
  real*4        zdot            !  37- (km/s)
  real*4        pin             !  41- (deg.n)??
  real*4        h               !  45- (km)

  real*4        a               !  49- (km)
  real*4        e               !  53-
  real*4        i               !  57- (deg)
  byte          spare2(3)       !  61- Spare

  byte          cont_mark2 /255/!  64- Continuation of an entry mark
  real*4        an              !  65- (deg)
  real*4        ap              !  69- (deg)
  real*4        ma              !  73- (deg)
  real*4        lam             !  77- (deg.n)

  integer*4     element_no      !  81-

  byte          spare3(11)      !  85- Spare
END STRUCTURE                   ! 96- Total
```

11.3 Instrument Entries

For a full explanation of the fields, consult the instrument index or quasi-static sections of this document.

11.3.1 WBS/HXT Instrument Entry

There will be a WBS/HXT entry every two major frames while in HIGH and MEDIUM telemetry rate. Whenever the discrimator, gain, or high voltage settings change for any of these instruments, there will be a calibration entry. Since there is one data set per major frame for HXT, two sets of data values will be averaged. Both the WBS and HXT are in counts per second and have been compressed using a simple SQRT of the original value.

```
STRUCTURE       /Obs_WBSHXT_Rec/
  byte          entry_type      !    0- Observing Log Entry Type/Version

  integer*4     time            !    1- Major frame time (millisec of day)
  integer*2     day             !    5- Major frame day (since 1-Jan-79)

  byte          DP_mode         !    7- DP Mode
  byte          DP_rate         !    8- DP Rate
  byte          Flare_Control   !    9- Flare flag control (active triggers) W50
  byte          Flare_Status    !  10- Flare flag status

  byte          HXT_Pow_stat    !  11- HXT Power status                                  (W48 F32+1)
  byte          HXT_sum_L       ! 12- Low energy (cnts/sec)
                                !          Simple square root compression of original value
  byte          HXT_sum_M1      !  13- Medium-1 energy
                                !          Simple square root compression of original value
  byte          HXT_sum_M2      !  14- Medium-2 energy
                                !          Simple square root compression of original value
  byte          HXT_sum_H       ! 15- High energy
                                !          Simple square root compression of original value
  byte          HXT_sigma_L     ! 16- Standard deviation of 16 "Fanbeam" subcollimator
                                !              counts (cnts/sec) - Low energy
                                !          Simple square root compression of original value
  byte          HXT_HV_stat     !  17- HXT HV Status                                     (W48 F32+17 (+29))
                                !          Total for HXT = 7

  byte          WBS_sxs1        !  18- SXS1 counts per sec.    Only SXS_PC12 are totaled
                                !          Simple square root compression of original value
```

```
  byte          WBS_sxs2       !  19- SXS2 counts per sec.    Only SXS_PC21 are totaled
                               !          Simple square root compression of original value
  byte          WBS_hxs        !  20- HXS counts per sec.    HXS_PC1 + HXS_PC2
                               !          Simple square root compression of original value
  byte          WBS_grs1       !  21- GRS1 counts per sec.    GRS_PC11 + GRS_PC21
                               !          Simple square root compression of original value
  byte          WBS_grs2       !  22- GRS2 counts per sec.    GRS_PC12 + GRS_PC22
                               !          Simple square root compression of original value
  byte          WBS_rbmsc      !  23- RBMSC counts per sec.    PC1 + PC2
                               !          Simple square root compression of original value
  byte          WBS_rbmsd      !  24- RBMSD counts per sec.
                               !          Simple square root compression of original value
  byte          WBS_Pow_Stat   !  25-
  byte          WBS_Stat       !  26- To be defined/expanded
                               !          Total for WBS = 9

  byte          WhichInstru    !  27- Which instruments are included and
                               !          how many records (data sets) were averaged
                               !          If the value is zero, there is no data
                               !              b0-3:  HXT
                               !              b4-7:  WBS
  byte          spare(4)       !  28- Spare
END STRUCTURE                  ! 32- Total

STRUCTURE       /Obs_HXT_Status_Rec/
  byte          entry_type     !  00- Observing Log Entry Type/Version

  integer*4     time           !  01- Major frame time (millisec of day)
  integer*2     day            !  05- Major frame day (since 1-Jan-79)

  byte          HV_control(4)  !  07-                                                   W49 F32+9,11,13,15
  byte          HXA_gain_cont  !  11- gain control commanded                            W49 F32+25

  byte          spare(20)      !  12-
END STRUCTURE                  ! 32- Total
```

```
STRUCTURE       /Obs_WBS_Status_Rec/
  byte          entry_type      !  00- Observing Log Entry Type/Version

  integer*4     time            !  01- Major frame time (millisec of day)
  integer*2     day             !  05- Major frame day (since 1-Jan-79)

  real*4        hiVolt(?)              !
  integer*2     discriminator(?)!
  real*4        gain(?)                  !

  byte          spare(25)       !    7-
END STRUCTURE                   ! 32- Total
```

11.3.2 BCS Instrument Entry

There will be a BCS entry every four seconds. Whenever the discriminator, gain, or high voltage settings change for BCS, there will be a calibration entry. Since there can be many data sets over those four seconds, the average will be taken before putting the BCS information in the observing log entry. The "total_cnts" field is uncompressed and the "all_cnts" and "acc_cnts" have been compressed with a simple SQRT function.

```
STRUCTURE       /Obs_BCS_Rec/
  byte          entry_type      !    0- Observing Log Entry Type/Version

  integer*4     time            !    1- Major frame time (millisec of day)
  integer*2     day             !    5- Major frame day (since 1-Jan-79)

  BYTE          blockID         ! 07- BCS Block ID
  BYTE          SeqID           ! 08- Observation Sequence ID
  BYTE          ModeID          ! 09- Mode ID (Grouper Plan)
  BYTE          dgi             !  10- Data Gather Interval (125 msec units)
  BYTE          DP_Flags        !  11- DP Flags received by BCS
  BYTE          BCS_Status      !  12- BCS Status

  integer*2     total_cnts(4)   !  13- Total counts in each channel for the mode
```

```
  byte          All_cnts(4)     !  21- BCS Counts for all events
                                !         Simple square root compression of original value
  byte          Acc_cnts(4)     !  25- BCS Accumulated counts
                                !         Simple square root compression of original value
  byte          Acc_interval    !  29- Accumulation interval (sec)

  byte          nAveraged       !  30- Number of spectra and DP major frames that
  byte          spare(1)        !  31- Spare
END STRUCTURE                   ! 32- Total

STRUCTURE       /Obs_BCS_Status_Rec/
  byte          entry_type      !  00- Observing Log Entry Type/Version

  integer*4     time            !  01- Major frame time (millisec of day)
  integer*2     day             !  05- Major frame day (since 1-Jan-79)

  byte          hiVolt(2)       !  07- High Voltage trim value (0-7)
  byte          HV_mon(2)       !  09- High voltage monitor (0-255)
  byte          discrim(2,4)    !  11- Low, high discriminator value (0-255)
  byte          relays          !  19- Relays status
  byte          status_2        !  20- Other status bits...

  byte          spare(11)       !  21- Spare
END STRUCTURE                   ! 32- Total
```

11.3.3 SXT Instrument Entry

There will be a SXT entry for every image taken but not more often than every two seconds (during the 0.5 and 1.0 sec cadence modes). One entry per multiple ROI FFI.

```
STRUCTURE       /Obs_SXT_Rec/
  byte          entry_type      !    0- Observing Log Entry Type/Version

  integer*4     time            !  01- Major frame time (millisec of day)
  integer*2     day             !  05- Major frame day (since 1-Jan-79)

  byte          DP_mode         !  07- DP Mode
  byte          DP_rate         !  08- DP Rate

  byte          pfi_ffi         !  09- Image information
  byte          periph          !  10- Aspect/Shutter/Filter information
  byte          ExpLevMode      !  11- Exposure mode/level
  byte          imgparam        !  12- Image parameter information

  byte          ObsRegion       !  13- Observing region Number
  byte          seq_num         !  14- Entry in sequence table (1-13)
  integer*2     seq_tab_serno   !  15- Sequence table serial used

  integer*2     shape_cmd(2)    !  17- Commanded image shape (nx/4 by ny/4)
  integer*2     FOV_Center(2)   !  21- Pitch and yaw relative to the sun center
                                !          of the center of the SXT FOV (in arcsec)

  byte          Img_Max         !  25- Maximum intensity
  byte          Img_Avg         !  26- Average intensity of whole image
  byte          Img_Dev         !  27- Average intensity around the max
  byte          PercentD        ! 28- Percentage of data present
  byte          PercentOver     !  29- Percentage of data over [N] counts

  byte          Flare_Status    !  30- Flare flag status
```

```
  byte          spare(1)        !  31- Spare bytes
END STRUCTURE                   ! 32- Total
```

11.4 Estimated Size of the Log

The current observing logs are approximately 2 megabytes per week, which comes to 100 megabytes per year.

12. POINTING LOG

The pointing log (PNT) was established so that a reduced set of the ADA files could be kept on-line for the whole mission. The PNT file will eventually contain the processed pointing information for every major frame for which the S/C was observing. Since the data reduction techniques are continuously evolving, it is impracticle to try to have the best reduced pointing information in the scientific data files. The old instrument files would not have the newest and most stable solutions. Because of this, the PNT files were created. There still is processed pointing in each instrument file, but the techniques vary to arrive at that solution. For movies that cover a long period, it is necessary to use the PNT files.

12.1 Organization of Pointing Log

The Pointing Log file organization is almost exactly the same as that of the Observing Log. See section 11.1 for futhur information.

12.1.1 Data Section

```
STRUCTURE       /PNT_Data_Rec/
                                !NOTE: See ATT_STRUCT for details on definitions.

  integer*2     index_version /'A011'x/
                                !  00- Index structure version


  integer*4     time            !    2- Major frame time (millisec of day)
  integer*2     day             !    6- Major frame day (since 1-Jan-79)

  integer*4     iru(3)          !    8- Inertial Reference Unit
  integer*2     TFSS(2)         !  20- Two-Dimensional Fine Sun Sensor
  integer*2     hxa(4)          !  24- HXT Aspect sensor
                                !             (0) = low address for x
                                !             (1) = high address for x
                                !             (2) = low address for y
                                !             (3) = high address for y
```

```
  integer*4     sc_pntg(3)      !  32- X,Y,Z euler angles in sun pointing coordinates
  byte          status          !  44- b0 - Set if flare mode
                                !         b1:2 - DP rate - "non-standard" convention
                                !                                   0 = low
                                !                                   1 = medium
                                !                                   2 = high
                                              3 = unknown (bad telemetry)
                                !         b3 - HXA data present (set if present)

  byte          spare(3)        !  45-
END STRUCTURE                   ! 48- Total
```

13. SPACECRAFT EPHEMERIS LOG

A reduced set of the spacecraft ephemeris information is available in the FEM files. Information contained in the FEM files are items like times for start of S/C day, S/C night, start and end times for SAA and station contacts. There is one file per week. The files are generated from the AOSLOS program which was transfered from the FACOM Mainframe to the workstations. All values are ground predicted times.

13.1 Organization of S/C Ephemeris Log

The S/C Ephemeris Log file organization is almost exactly the same as that of the Observing Log. See section 11.1 for futhur information.

13.1.1 Data Section

```
STRUCTURE       /FEM_Data_Rec/
  integer*2     path            !  00- The SIRIUS mainframe path ID (only the last
                                !         4 characters since the date is the first
                                !         6 characters (yyddmm)
  integer*4     time            !  00- Beginning of S/C day (Millisec of day)
                                !         (True predicted start time, no margin worked
                                !         in like the FileID has)
  integer*2     day             !  04- Beginning of S/C day (days since 1-Jan-79)

  integer*2     night           !  06- Start of S/C night in seconds from S/C day
  integer*2     st_saa          !  08- Start of S/C SAA in seconds from S/C day
  integer*2     en_saa          !  10- End of S/C SAA in seconds from S/C day

  integer*2     st_station(3)   !  12- Start of station contact in seconds from S/C day
                                !             (i) = can be three station contacts in one day
  integer*2     en_station(3)   !  16- End of station contact in seconds from S/C day
                                !             (i) = can be three station contacts in one day
  byte          st$station(3)   !  20- Station
                                !                             'U' = KSC
                                !                             'C' = Canberra
                                !                             'M' = Madrid
                                !                             'G' = Goldstone
                                !             (i) = can be three station contacts in one day
  byte          st$antenna(3,2) !  26- Antenna to be used (A or B)
                                !             (i,j)
                                !             (i) = can be three station contacts in one day
                                !             (j) = can be two antenna uses per contact
  integer*2     cng_antenna(3)  !  22- Time that the antenna must be changed in
                                !         seconds from S/C day.    If the antenna is not
                                !         changed, then these values are zero
                                !             (i) = can be three station contacts in one day
  byte          use_station(3)  !  30- Whether the station was actually used for a down
                                !         link or not (0=no, 1=yes)
```

```
                               !         DERIVED AFTER DOWNLINK BY LOOKING AT SIRIUS DATA

  integer*2     sc_rev         !  30- Spacecraft revolution number
                               !         This is actually only the number of S/C day/night
                               !         transitions
  byte          week           !  32- Week number (1-53)
  byte          year           !  33- year (91,92,...)
  byte          iday           !  34- Day within the week (0-6)
  byte          day_rev        !  35- Revolution number within the day (1-15)

  character*13  fileid         !  36- The master fileid for this orbit
                               !         The FileID time is approximately 5 minutes before
                               !         the true S/C day time.    This is the time used for
                               !         extraction to insure that data in one orbit is not
                               !         broken across files.

  byte          spare(1)       !  49- Spare
END STRUCTURE                  ! 64- Total
```

14. EVENT LOG

The event log will be a compact summary of the significant "mode-related" events. The input for the file will be

1. Observing Log
2. Tracking Log (active region number and coordinates)
3. CD-ROM index listing

The event log will look for CHANGES of states (modes, instruments on/off, day/night, ...) instead of making entries at a fixed cadence.

14.1 Entry Types

14.1.1 Common Entry

```
STRUCTURE       /Evn_Common_Rec/
  integer*2     entry_type      !  00- Event Log Entry Type/Version

  integer*4     time            !  02- Major Frame time (millisec of day)
  integer*2     day             !  06- Major Frame day (since 1-Jan-79)

  byte          Instru_on_off   !  08- Instrument on/off
                                !              0:  HXT
                                !              1:  SXT
                                !              2:  BCS
                                !              3:  WBS-SXS
                                !              4:  WBS-HXS
                                !              5:  WBS-GRS
                                !              6:  WBS-RBM
  byte          mode_rate       !  09- DP mode rate
                                !              0:  Day/Night    (set = day)
                                !              1:  SAA          (set = SAA active)
                                !              2-3:  DP Mode    (FL, QT, NT, other)
                                !              4-5:  Telemetry Rate     (Lo, Med, Hi)
```

```
                            !               6:  FFI Exposure (set = exposure taken)
  byte          bcs_mode        !  10- BCS Mode Change (What is new mode?)
  byte          flare_flag      !  11- Flare flag
                                !               0:  SXS         (set = triggered)
                                !               1:  HXS         (set = triggered)
                                !               2:  BCS         (set = triggered)
  byte          CDROM_index(2)  !  12- CD-ROM (or other) index number
  byte          Telem_info      !  14- Telemetry Coverage (Show transitions)
                                !               0:  BDR Coverage (set = covered)
                                !               1:  Real Time    (set = covered)
  byte          FFI_Expos(4)    !  15- Full width exposure paremeters
                                !               (0):  Compression/resolution/...
                                !               (1):  Start Row
                                !               (2):  End Row
                                !               (3):  ??
  byte          spare(13)       !  19-
END STRUCTURE                   ! 32- Total
```

14.1.2 SXT PFI Entry

For every different observing region or active region (different table entry into the ROIT table) a summary of the number of images taken for that region will be entered in the Event Log.

```
STRUCTURE       /Evn_PFI_Rec/
  integer*2     entry_type      !  00- Event Log Entry Type/Version

  integer*4     time            !  02- Major Frame time (millisec of day)
  integer*2     day             !  06- Major Frame day (since 1-Jan-79)

  integer*2     FOV_Center(2)   !  08- Pitch and yaw relative to the sun center
                                !         of the center of the SXT FOV (in arcsec)

  integer*2     NOAA_number     !  12- NOAA number
  integer*2     num_images(4)   !  14- Summary of imagess
                                !               (1) = Number of images - thin filters
```

```
                                 !              (2) = Number of images - medium filter
                                 !              (3) = Number of images - thick filters
                                 !              (4) = Number of images - optical filters

  byte          resolution      !  22- Highest resolution?  or one entry per res?
  byte          FOV             ! 23- Field of view (largest/smallest/???)

  byte          spare(8)        !  24- Spare
END STRUCTURE                   ! 32- Total
```

14.2 Estimated Size of the Log

Assume every orbit will have the following number of entries required:

```
Day/Night change         1   per orbit
Instrument on/off        1.3 per orbit
SAA                      0.3 per orbit
BDR Coverage            10   per orbit
DP mode change           2   per orbit
Telemtry Rate Change     4   per orbit
Flare Flag               2   per orbit
BCS mode change          4   per orbit
FFI Exposure             2   per orbit
--------------------------------------
                        27   per orbit
```

Assume every orbit will have 8 different PFI active regions.

```
Common Entries  = 27 entries * 20 bytes = 540 bytes/orbit
PFI Entries     =  8 entries * 20 bytes = 160 bytes/orbit
                                          ---------------
                                          700 bytes/orbit
```

Assuming 15 orbits per day, 365 days per year, 3 years:

```
Total (for 3 years) = 700 * 15 * 365 * 3 = 11.5 MBytes
                                          = 22,000 blocks
```

15. FLARE CATALOG

A flare catalog will be generated using the observing log, the event log, ground based information, and a careful look at the data by hand.

```
          Date        Start       End       Peak      NOAA   X-Ray   Location   Size    Solar-A   Ground
Time        Time      Time     Number  Class   N/S E/W  (arcmin)  B H S W   S M
C X X B   O E
S T T S   O E
N S
        dd-mmm-yy   hh:mm:ss    hh:mm:ss  hh:mm:ss   ######   n##.#  ### ###    ###     .  .  .  .      .  .
```

16. ACCESS SOFTWARE

There are IDL routines available to read all of the reformatted data. In the following examples, the input is infil (the input filename) and dsets (a vector holding the dataset numbers to be extracted).

```
rd_fheader, infil, file_header
rd_pointer, infil, pointer
rd_roadmap, infil, roadmap
rd_xda, infil, dsets, index, data

rd_sda, infil, dsets, index, data
rd_bda, infil, dsets, index, data
rd_wda, infil, dsets, index, data
rd_hda, infil, dsets, index, data
rd_ada, infil, dsets, index, data
rd_cba, infil, dsets, index, data
rd_bda_dp, infil, dp_sync
```

The Software Control Document gives a further description of the access routines available.