



*National Aeronautics and Space Administration
Goddard Earth Science
Data Information and Services Center (GES DISC)*

README Document for the Nimbus-7 Limb Infrared Monitor of the Stratosphere (LIMS) Level 1 Radiance Data

LIMSN7L1RAT

Last Revised 01/04/2019

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1. Introduction

This document provides basic information on using the Nimbus-7 Scanning Chopper Radiometer (LIMS) Level-1 Radiance Data product.

1.1 Data Product Description

The Nimbus-7 Limb Infrared Monitor of the Stratosphere (LIMS) Level-1 Radiance Data product contains calibrated, earth-located radiances, as well as housekeeping information, instrument status, and data quality information. Radiances of the Earth limb were measured both day and night in six spectral bands (6.2, 6.3, 9.6, 11.3, and two at 15 micrometers). Though calibrated, the radiances are not corrected for instrument effects such as field-of-view, electronic delay, and spacecraft motion.

Each file contains one orbit of data (~14 orbits per day). LIMS is a limb profiler and spatial coverage is near global between latitude -64 and +84 degrees. Vertical coverage is from about 10 to 50 km (O3 channel to 65 km), with vertical resolution of about 1.5 km. The data are available from 25 October 1978 through 30 May 1979. The principal investigators for the LIMS experiment were Dr. James M. Russell, III from NASA Langley and Dr. John Gille from NCAR.

This product was previously available from the NASA National Space Science Data Center (NSSDC) under the name LIMS Radiance Archival Data (LIMS/RAT) with the identifier ESAC-00032 (old id 78-098A-01B).

1.1.1 The Limb Infrared Monitor of the Stratosphere

The objective of the Nimbus-7 Limb Infrared Monitor of the Stratosphere (LIMS) experiment was to map the vertical profiles of temperature and the concentration of ozone, water vapor, nitrogen dioxide, and nitric acid in the lower to middle stratosphere range, with extension to the stratopause for water vapor and into the lower mesosphere for temperature and ozone. LIMS had a six-channel infrared (IR) radiometer that incorporated Hg-Cd-Te detectors cooled by a two-stage solid cryogen cooler. The six bands were used to measure NO₂ at 6.2 microns, H₂O at 6.9 microns, O₃ at 9.6 microns, HNO₃ at 11.3 microns, and CO₂, one narrow and one wide, both centered at 15 microns. LIMS mapped vertical profiles of thermal IR emission every 12 seconds from the earth limb, scanning once in the up direction and then in the down direction.. The instrument operated successfully for about seven months. The experiment was the follow-on to the Limb Radiance Inversion Radiometer (LRIR) flown on the previous Nimbus 6 satellite.

1.1.2 Nimbus-7 Overview

The Nimbus-7 satellite was successfully launched on December 11, 1972. The primary experiments included: (1) a Temperature-Humidity Infrared Radiometer (THIR) for measuring day and night surface and cloud top temperatures, as well as the water vapor content of the upper atmosphere, (2) an Electrically Scanning Microwave Radiometer (ESMR) for mapping the microwave radiation from the Earth's surface and atmosphere, (3) an Infrared Temperature Profile Radiometer (ITPR) for obtaining vertical profiles of temperature and moisture, (4) the Nimbus-E Microwave Spectrometer (NEMS) for determining tropospheric temperature profiles, atmospheric water vapor abundances, and cloud liquid water contents, (5) a Selective Chopper Radiometer (LIMS) for observing the global temperature structure of the atmosphere, and (6) a Surface Composition Mapping Radiometer (SCMR) for measuring the differences in the thermal emission characteristics of the Earth's surface.

The orbit of the satellite can be characterized by the following:

- circular orbit at 1100 km
- inclination of 99.9 degrees
- period of an orbit is about 107.2 minutes
- orbits cross the equator at 26 degrees of longitude separation
- sun-synchronous

1.2 Algorithm Background

The Nimbus-7 LIMS data were generated from the spacecraft telemetry, attitude and orbital data. The data were originally processed on IBM 360 computers using a 24-bit words, and copied to 1600 bpi 9-track tapes for archival. Further information on the LIMS instrument and data processing can be found in the Nimbus-7 Users' Guide Section 4.

1.3 Data Disclaimer

The data should be used with care and one should first read the Nimbus-7 User's Guide, Section 4 describing the LIMS experiment. Users should cite this data product in their research.

2. Data Organization

The Nimbus-7 Limb Infrared Monitor of the Stratosphere Level-1 Radiance Data spans the time period from October 25, 1978 to May 30, 1979. Each file typically contains one orbit of data.

2.1 File Naming Convention

The data product files are named according to the following convention:

<Platform>-<Instrument>_<Level>-<Product>_<DateTime>_<Orbit>_<TapeNumber>.<Suffix>

where:

- o Platform = name of the platform or satellite (Nimbus7)
- o Instrument = name of the instrument and product (LIMS)
- o Level = process level (L1)
- o Product = radiance archive tape (RAT)
- o Date = Data start date and time in UTC in format <YYYY>m<MMDD>t<hhmm> where
 1. YYYY = 4 digit year (1978 - 1979)
 2. MM = 2 digit month (01-12)
 3. DD = 2 digit day of month (01-31)
 4. hh = 2 digit hour (00-23)
 5. mm = 2 digit minute (00-23)
- o Orbit = 5 digit number of orbit (preceded by letter 'o')
- o TapeNumber = 5 digit number of tape (preceded by 'DD' - primary or 'DC' - backup)
- o Suffix = the file format (always TAP, indicating tape binary data)

File name example: Nimbus7-LIMS_L1-RAT_1978m1025t0146_o00011_DD54233.TAP

2.2 File Format and Structure

The data are stored as they were originally written in IBM binary (big-endian) record oriented structured files. The files were written on the original 1600 bpi 9-track tapes using a blocked FORTRAN format. The first file on the tape is the tape header file with two records containing text encoded information about the tape. This is followed by a set of orbit data files. Each orbit file on the tape contains a set of records with a FORTRAN record size word, the data record, and a FORTRAN record trailing size word. There are typically about 260 records per orbit file. At the end of the orbit file there is an End-of-File word (the last file on the tape will end with a double End-of-File word). Each data record in a file represents one LIMS up and down profile scan, with radiances from each of the six channels: CO₂N(arrow), CO₂W(ide), O₃, HNO₂, H₂O and NO₂. Each data file typically contains one orbit of data (there are about 14 orbits per day). For the contents and layout of the documentation, see section 3.1

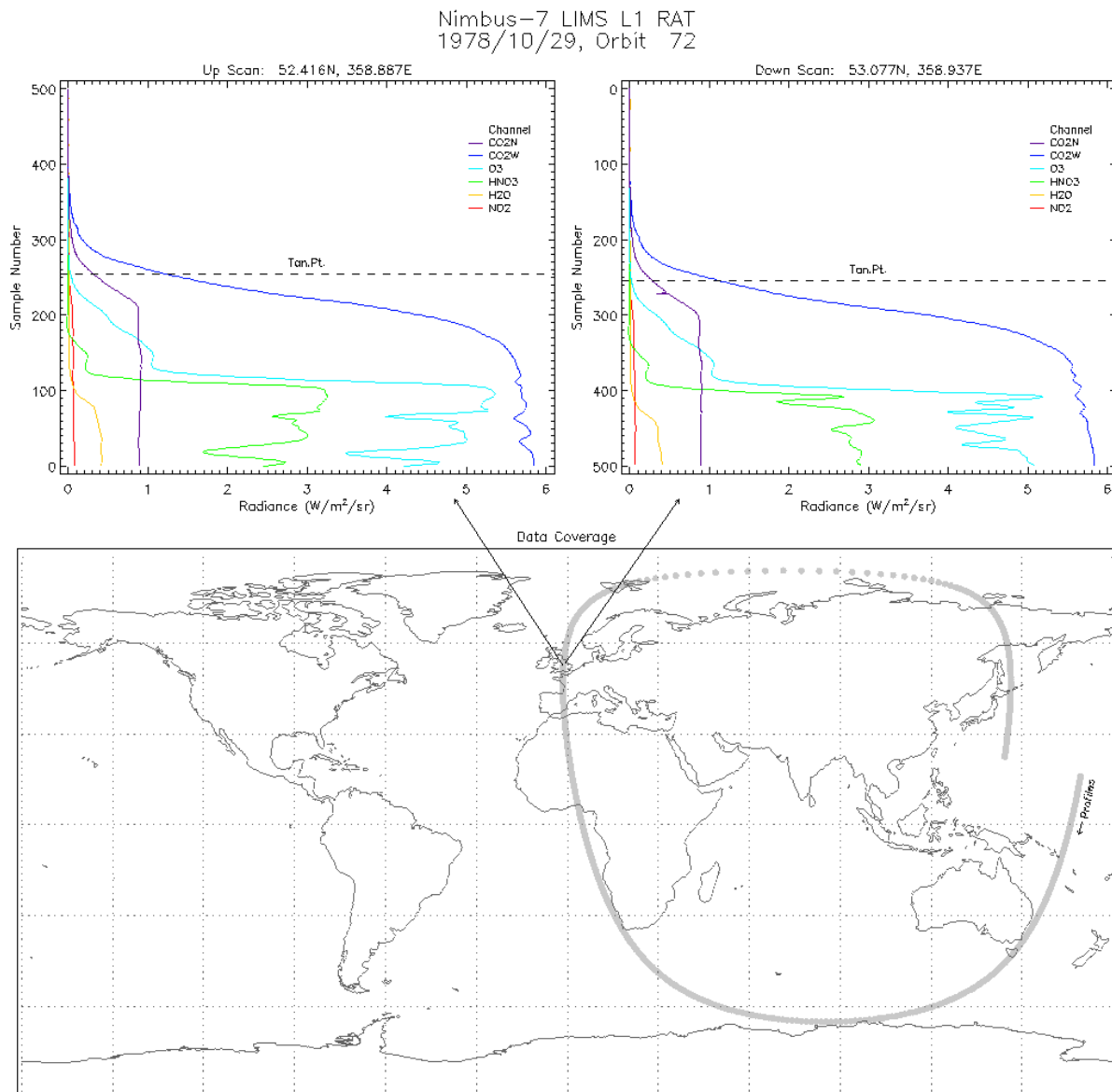
During data recovery a total of 2857 orbit data files were retrieved from the tapes, with 2585 files from the primary DD tapes, and just 272 files from the backup DC tapes. Most of the files from the

DC tapes were identical copies of files from the DD tapes, some contained missing records which were complete on the DD tape file counterparts, and only 14 were unique. One DD tape file was missing an orbit and so its DC tape file counterpart was kept instead. In summary, a total of 2599 LIMS orbit files were retrieved as part of this data collection and are archived at the GES DISC.

2.3 Key Science Data Fields

The primary science data fields in this data product are the LIMS calibrated radiances in units of $\text{mW}/\text{m}^2/\text{sr}/\text{cm}^{-1}$ for each of the six IR channels.

Figure 1: Typical Nimbus-7 LIMS Level 1 RAT data file showing up-scan radiances for each band (upper left), down-scan radiances for each band (upper right), and data coverage (bottom).



3. Data Contents

The granularity of this data product is one orbit.

3.1 Data Records

The Nimbus-7 User's Guide does not describe the layout of the file format. Refer instead to the Tape Specification, number T564011, Rev. C, titled "LIMS Radiance Archival Tape".

The original tape files each included a tape header file. These were then followed by a set of up to 15 orbit data files, which would include about 260 data records consisting of the up and down limb scan profiles. As part of the recovery, the GES DISC has extracted and archived the orbit data files from the tape. The original data were written on IBM machines using 24-bit words. During tape data recovery these words were saved as three 8-bit bytes (some words consist of two 12-bit half words). Each profile data record consists of 3360 24-bit words (see Table 3-1 below). Each profile data record starts and ends with a four byte 32-bit integer word giving the record size in bytes.

Table 3-1: Data Record (10080 bytes or 3360 24-bit words in 2520 32-bit words)

Word	Field Name	Units	Type	Comments
1	Physical Record No. and Record I.D.		2 ½ words	
2 - 511	CO ₂ Narrow Channel Samples	W m ² sr ⁻¹	1020 ½ words	Scale/offset below
512 - 1021	CO ₂ Wide Channel Samples	W m ² sr ⁻¹	1020 ½ words	Scale/offset below
1022 - 1531	O ₃ Channel Samples	W m ² sr ⁻¹	1020 ½ words	Scale/offset below
1532 - 2041	HNO ₃ Channel Samples	W m ² sr ⁻¹	1020 ½ words	Scale/offset below
2042 - 2296	H ₂ O Channel Samples	W m ² sr ⁻¹	510 ½ words	Scale/offset below
2297 - 2551	NO ₂ Channel Samples	W m ² sr ⁻¹	510 ½ words	Scale/offset below
2552 - 2557	Scale Factor for Unpacking Channels		6 words	
2558 - 2560	Offset for Unpacking Channels		6 ½ words	
2561 - 2563	Spares		3 words	Set to zeroes
2564 - 3073	Scan Angle Increments for Samples	10 ⁻³ radians	1020 ½ words	Divide by 21350
3074	Scan Direction for 1 st and 2 nd Half of Samples		2 ½ words	1=up, 2=down, 0= missing
3075 - 3138	RVDT Readout Voltages		128 ½ words	
3139	Index of First RVDT Readout	V	1 word	

3140 – 3141	Time GMT Scan #1: Day, Hour, Minute, and Second		4 ½ words	
3142 – 3143	Time GMT Scan #2: Day, Hour, Minute, and Second		4 ½ words	
3144	Index of Sample for Time of Scans #1 and #2		2 ½ words	
3145	Minor frame of 1 st Sample of Scans #1 and #2		2 ½ words	
3146	UFOT Mode Flags for Scans #1 and #2		2 ½ words	4 = adaptive scan 6 = space calib. 7 = source calib.
3147	Calibration Data Indicator for Scans #1 and #2		2 ½ words	1 = space calib. 2 = source calib. 0 = no calib.
3148	Start and Stop Index of Source Calibration		2 ½ words	Zero if not present
3149	Start and Stop Index of Space Calibration		2 ½ words	Zero if not present
3150 – 3152	Index of 1 st , 2 nd , 3 rd CAP for Scans #1 and #2		6 ½ words	Zero if not present
3153 – 3155	Elevation Angle Counts for CAPs above		6 ½ words	Zero if not present
3156 – 3157	Tan. Pt. Latitude and Longitude for Scan #1	degrees	2 words	Lat: minus 90000 then divide 10000 Lon: divide 10000
3158 – 3159	Tan. Pt. Latitude and Longitude for Scan #2	degrees	2 words	Lat: minus 90000 then divide 10000 Lon: divide 10000
3160 – 3161	TP Local Time Scan #1: Day, Hour, Min, and Sec		4 ½ words	
3162 – 3163	TP Local Time Scan #2: Day, Hour, Min, and Sec		4 ½ words	
3164	Tangent Point Day/Night Flag Scan #1 and #2		2 ½ words	1 = day 2 = night
3165	Spacecraft Day/Night Flag Scan #1 and #2		2 ½ words	1 = day 2 = night
3166 – 3167	Sun Ascension (Azimuth) from ILT	10 ⁻⁹ radians	2 words	
3168 – 3169	Sun Declination (Elevation) from ILT	10 ⁻⁹ radians	2 words	
3170	Greenwich Hour Angle from ILT	10 ⁻⁶ radians	1 word	
3171	DSAS Right Ascension to Sun from ILT		1 word	
3172	DSAS Declination to Sun from ILT		1 word	
3173 – 3197	Spacecraft Pitch	10 ⁻³ radians	25 words	
3198 – 3222	Spacecraft Roll	10 ⁻³ radians	25 words	
3223 - 3247	Spacecraft Yaw	10 ⁻³ radians	25 words	

3248 – 3272	Spacecraft Pitch Rate	10^{-3} rad/sec	25 words	
3273 – 3297	Spacecraft Roll Rate	10^{-3} rad/sec	25 words	
3298 – 3300	Spacecraft Latitude, Longitude, Altitude for Scan #1	deg/km	3 words	Lat: minus 90000 then divide 10000 Lon: divide 10000 Alt: divide 10000
3301 – 3303	Spacecraft Latitude, Longitude, Altitude for Scan #2	deg/km	3 words	Lat: minus 90000 then divide 10000 Lon: divide 10000 Alt: divide 10000
3304	Index of ACS Values and Number of Errors Detected		2 ½ words	
3305 - 3329	Error Type Indicator and Index of Errors (25 total)		13 ½ words	
3330	Focal Plane Temperature and OMP Temperature	°K	2 ½ words	Divide by 10
3331	Detector Temp. and Primary Optics Temp.	°K	2 ½ words	Det: divide 40 Opt: divide 10
3332	IFC (PRT) Temperature and IFC (THR) Temperature	°K	2 ½ words	Divide by 100 add 280
3333	-15 VDC Monitor and IEU Temperature	V / °K	2 ½ words	V: divide 100 T: divide 10
3334	FEU Temperature and Scan Motor Current	10^{-3} amp/°K	2 ½ words	Temp: divide 10
3335	Cryo Shield Temperature and Scan Motor Temp.	°K	2 ½ words	Divide 10
3336 – 3343	Status Bits as Contained on the ILT		8 words	
3344 – 3349	Decalibration Coefficient Scale and Offset		12 ½ words	
3350 – 3358	Spares		9 words	Set to zeroes
3359	Orbit Number		1 word	
3360	Checksum		1 word	

3.2 Metadata

The metadata are contained in a separate XML formatted file having the same name as the data file with .xml appended to it.

Table 3-2: Metadata attributes associated with the data file.

Name	Description
LongName	Long name of the data product.
ShortName	Short name of the data product.
VersionID	Product or collection version.
GranuleID	Granule identifier, i.e. the name of the file.
Format	File format of the data file.
ChecksumType	Type of checksum used.
ChecksumValue	The value of the calculated checksum.
SizeBytesDataGranule	Size of the file or granule in bytes.
InsertDateTime	Date and time when the granule was inserted into the archive. The format for date is YYYY-MM-DD and time is hh-mm-ss.
ProductionDateTime	Date and time the file was produced in format YYYY-MM-DDThh:mm:ss.sssssZ
RangeBeginningDate	Begin date when the data was collected in YYYY-MM-DD format.
RangeBeginningTime	Begin time of the date when the data was collected in hh-mm-ss format.
RangeEndingDate	End date when the data was collected in YYYY-MM-DD format.
RangeEndingTime	End time of the date when the data was collected in hh-mm-ss format.
PlatformShortName	Short name or acronym of the platform or satellite
InstrumentShortName	Short name or acronym of the instrument
SensorShortName	Short name or acronym of the sensor
WestBounding Coordinate	The westernmost longitude of the bounding rectangle(-180.0 to +180.0)
NorthBounding Coordinate	The northernmost latitude of the bounding rectangle(-90.0 to +90.0)
EastBounding Coordinate	The easternmost longitude of the bounding rectangle(-180.0 to +180.0)
SouthBounding Coordinate	The southernmost latitude of the bounding rectangle(-90.0 to +90.0)
Orbit	Satellite orbit number.
ElapsedMinTime	Duration in minutes of data collected during an orbit.

4. Reading the Data

The data are written in a binary record-oriented format. Using the record format specification in the section above, users can write software to read the data files. Please note that the data were originally written using a big-endian format, therefore users on little-endian machines will need to swap bytes for the words.

A sample FORTRAN program is included in the Appendix section which will read in the data records. Additionally a FORTRAN function is included to perform byte swapping.

5. Data Services

5.1 GES DISC Search

The GES DISC provides a keyword, spatial, temporal and advanced (event) searches through its unified search and download interface:

<https://disc.gsfc.nasa.gov/>

5.2 Documentation

The data product landing pages provide information about these data products, as well as links to download the data files and relevant documentation:

https://disc.gsfc.nasa.gov/datacollection/LIMSN7L1RAT_001.html

5.3 Direct Download

These data products are available for users to download directly using HTTPS:

https://acdisc.gesdisc.eosdis.nasa.gov/data/Nimbus7_LIMS_Level1/LIMSN7L1RAT.001/

6. More Information

6.1 Contact Information

Name: GES DISC Help Desk

URL: <https://disc.gsfc.nasa.gov/>

E-mail: gsfc-help-disc@lists.nasa.gov

Phone: 301-614-5224

Fax: 301-614-5228

Address: Goddard Earth Sciences Data and Information Services Center
Attn: Help Desk
Code 610.2
NASA Goddard Space Flight Center
Greenbelt, MD 20771, USA

6.2 References

"The Nimbus-7 User's Guide - Section 4: The Limb Infrared Monitor of the Stratosphere (LIMS) Experiment", NASA Goddard Space Flight Center, November 1972, Pages 71-103

Nimbus G, Nimbus Observation Processing System (NOPS) Requirements Document # NG-34, Tape Specification T564011, Rev. C, "LIMS Radiance Archival Tape (RAT)", NASA Goddard Space Flight Center, Greenbelt, MD, 1981

7. Appendices

Acknowledgments

The Nimbus data recovery task at the GES DISC is funded by NASA's Earth Science Data and Information System program.

Acronyms

BCD: Binary Coded Decimal

EOS: Earth Observing System

ESDIS: Earth Science and Data Information System

GES DISC: Goddard Earth Sciences Data and Information Services Center

GSFC: Goddard Space Flight Center

L1: Level-1 Data

LIMS: Limb Infrared Monitor of the Stratosphere

NASA: National Aeronautics and Space Administration

QA: Quality Assessment

RAT: Radiance Archival Tape

UT: Universal Time

FORTRAN Code

```
C-----
C ^NAME: READ_LIMSRAT
C   This program will read a Nimbus 7 LIMS Radiance Archival Tape (RAT)
C   Level-1 data file.
C
C   The LIMSRAT files contain a series of data records. Each of the data
C   records contain the up and down data profiles for each of the six
C   LIMS bands (CO2N, CO2W, O3, HNO3, H2O and NO2), along with ancillary
C   info. This program will print the contents of each data record.
C
C ^MAJOR VARIABLES:
C   FNAME   - name of input file
C   BUFF    - buffer for data record
C   TEMP    - buffer for holding temporary 4-byte word
C   WORD    - integer 4-byte word
C   IRECSZ  - size of record in bytes
C   IOS     - I/O status number
C
C ^NOTES:
C   Compile: gfortran -o READ_LIMSRAT.EXE READ_LIMSRAT.FOR
C
C ^ORGANIZATION: NASA/GSFC, Code 610.2
C
C ^AUTHOR:   James Johnson
C
C ^ADDRESS:  james.johnson@nasa.gov
C
C ^CREATED:  January 2, 2019
C-----

      CHARACTER          FNAME*1024      ! Filename
      CHARACTER          BUFF(10080)    ! Buffer for data record
      INTEGER*4          IRECSZ          ! Size of records
      INTEGER*4          WRDARR(3360)    ! Word array (32-bit integers)
      INTEGER*4          IWORD           ! 4-byte word
      CHARACTER          TEMP(4)         ! Buffer to hold 4-byte word
      EQUIVALENCE        (TEMP,IWORD)

C Get the name of the input data file to read
  WRITE (0, *), 'Enter the name of the input file:'
  READ (5, '(A)') FNAME
  PRINT '("File = ",A)', FNAME

C Open the specified input file
  OPEN (UNIT=1, FILE=FNAME, STATUS='OLD', ACCESS='DIRECT',
        &      FORM='UNFORMATTED', RECL=1, ERR=99, IOSTAT=IOS)

C Initialize N (record number) and IOFF (byte offset in file)
  N=0
  IOFF=0
```

```

C Loop through the file reading all records in file
  5 DO

C   Read the first 4-byte word or record size header
      DO I=1,4
          READ (1, REC=IOFF+I, IOSTAT=IOS, ERR=90) TEMP(I)
      END DO
      IRECSZ = IWORD
      IOFF=IOFF+(I-1)

      IF (IRECSZ .EQ. 0) THEN
C   PRINT '("WARNING: END-OF-TAPE MARK")'
          PRINT '("WARNING: END-OF-TAPE MARK")'
          GOTO 5
      ENDIF

C Next read the block of data
      DO I=1,IRECSZ
          READ (1, REC=IOFF+I, IOSTAT=IOS) BUFF(I)
          IF (IOS .NE. 0) THEN
              PRINT '("ERROR: BUFF ",I4,X,I4," , IOSTAT: ",I6)', N,I-1,IOS
              IRECSZ = I-1
              GOTO 20
          ENDIF
      END DO
      IOFF=IOFF+(I-1)
      N=N+1

C Convert record to array of words
      CALL W24W32(IRECSZ,BUFF,WRDARR)

C Print data record
      CALL PRDREC(IRECSZ/3,WRDARR)

C Finally read the last 4-byte word (should match first record size)
  20 DO I=1,4
      READ (1, REC=IOFF+I, IOSTAT=IOS, ERR=90) TEMP(I)
  END DO
      IF (IRECSZ .NE. IWORD) THEN
          PRINT '("WARNING: IRECSZ ",I10," != ",I10)', IWORD, IRECSZ
      ENDIF
      IOFF=IOFF+(I-1)

      END DO

C Close the input file
  90 CLOSE(1)
      GOTO 100

  99 PRINT '("ERROR: OPEN FILE, IOSTAT: ",I6)', IOS

  100 STOP
      END

```

```

C-----
C   This Subroutine converts 24-bit (3-byte) words to IEEE 32-bit word
C-----
      SUBROUTINE W24W32(IRECSZ,BUFF,WRDARR)

      CHARACTER          BUFF(10080)  ! Buffer for data record
      INTEGER*4          WRDARR(3360)  ! Word array
      INTEGER*4          IWORD         ! 4-byte word
      CHARACTER          TEMP(4)       ! Buffer to hold 4-byte word
      EQUIVALENCE        (TEMP,IWORD)

      J=1
      DO I=1,IRECSZ,3
         TEMP(1)=BUFF(I+2)
         TEMP(2)=BUFF(I+1)
         TEMP(3)=BUFF(I)
         TEMP(4)=CHAR(0)
C These words can be negative, check bit 23 and convert
         IF (J.GE.3173.AND.J.LT.3298) THEN
            IF (ISHFT(IWORD,-23).NE.0) THEN
               IWORD = -1*(X'00FFFFFF' - IWORD)
            ENDIF
         ENDIF
         WRDARR(J)=IWORD
         J=J+1
      END DO

      RETURN
      END

```

```

C-----
C   This Subroutine will converts 24-bit long int to 12-bit short int
C-----
      SUBROUTINE I4TOI2(NWORDS,IWORD,ISHORT)

      INTEGER*4          IWORD(510)
      INTEGER*2          ISHORT(510*2)

      DO I=1,NWORDS
         ISHORT(I*2-1) = ISHFT(IWORD(I),-12)
         ISHORT(I*2)   = IAND(IWORD(I),X'FFF')
      END DO

      RETURN
      END

```

```

C-----
C   This Subroutine will print the Data Record
C-----
      SUBROUTINE PRDREC(NWORDS,IWORD)

      INTEGER*4          IWORD(3360)    ! Word array
      INTEGER*2          ISHORT(1020)   ! Array of shorts

C Word 1: Physical Record Number, Record ID (End Flag and Digit)
      IRECNO = ISHFT(IWORD(1), -12)
      IRECID = IAND(IWORD(1), X'FF')
      PRINT '( "*****" )'
      PRINT '( "Record No/End / ID" )'
      PRINT '(X,I8,X,I1,I7)', IRECNO, ISHFT(IRECID, -7), IAND(IRECID, X'7F')
C Words 2-511: Radiance from CO2N(arrow) Band
      CALL I4TOI2(510, IWORD(2:511), ISHORT)
      PRINT '( "RadCO2N" )'
      PRINT '(8(X,I8))', ISHORT(1:510)
      PRINT '(8(X,I8))', ISHORT(511:1020)
C Words 512-1021: Radiance from CO2W(ide) Band
      CALL I4TOI2(510, IWORD(512:1021), ISHORT)
      PRINT '( "RadCO2W" )'
      PRINT '(8(X,I8))', ISHORT(1:510)
      PRINT '(8(X,I8))', ISHORT(511:1020)
C Words 1022-1531: Radiance from O3 Band
      CALL I4TOI2(510, IWORD(1022:1531), ISHORT)
      PRINT '( "RadO3" )'
      PRINT '(8(X,I8))', ISHORT(1:510)
      PRINT '(8(X,I8))', ISHORT(511:1020)
C Words 1532-2041: Radiance from HNO3 Band
      CALL I4TOI2(510, IWORD(1532:2041), ISHORT)
      PRINT '( "RadHNO3" )'
      PRINT '(8(X,I8))', ISHORT(1:510)
      PRINT '(8(X,I8))', ISHORT(511:1020)
C Words 2042-2296: Radiance from H2O Band
      CALL I4TOI2(255, IWORD(2042:2296), ISHORT)
      PRINT '( "RadH2O" )'
      PRINT '(8(X,I8))', ISHORT(1:255)
      PRINT '(8(X,I8))', ISHORT(256:510)
C Words 2297-2551: Radiance from NO2 Band
      CALL I4TOI2(255, IWORD(2297:2551), ISHORT)
      PRINT '( "RadNO2" )'
      PRINT '(8(X,I8))', ISHORT(1:255)
      PRINT '(8(X,I8))', ISHORT(256:510)
C Words 2552-2557: Scale Factor for each band
      PRINT '( "Scale Factor" )'
      PRINT '(6(X,I8))', IWORD(2552:2557)
C Words 2558-2560: Offset for each band
      CALL I4TOI2(3, IWORD(2558:2560), ISHORT)
      PRINT '( "Offset" )'
      PRINT '(8(X,I8))', ISHORT(1:6)
C Words 2561-2563: Spares (zero filled)
      PRINT '( "Spares" )'
      PRINT '(3(X,I8))', IWORD(2561:2563)

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C Words 2564-3073: Scan Angle Increment
  CALL I4TOI2(510,IWORD(2564:3073),ISHORT)
  PRINT '("Scan Angle Increment")'
  PRINT '(8(X,F8.6))',ISHORT(1:510)/21350.
  PRINT '(8(X,F8.6))',ISHORT(511:1020)/21350.
C Word 3074: Scan Direction
  CALL I4TOI2(1,IWORD(3074),ISHORT)
  PRINT '("Scan Direction")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Words 3075-3138: RVDT Output Voltage
  CALL I4TOI2(64,IWORD(3075:3138),ISHORT)
  PRINT '("RVDT Output Voltage")'
  PRINT '(8(X,I8))',ISHORT(1:128)
C Word 3139: Index of First RVDT Readout
  PRINT '("Index of First RVDT Readout")'
  PRINT '(X,I8)',IWORD(3139)
C Words 3140-3141: Time For Scan 1
  CALL I4TOI2(2,IWORD(3140:3141),ISHORT)
  PRINT '("Time For Scan 1")'
  PRINT '(4(X,I8))',ISHORT(1:4)
C Words 3142-3143: Time For Scan 2
  CALL I4TOI2(2,IWORD(3142:3143),ISHORT)
  PRINT '("Time For Scan 2")'
  PRINT '(4(X,I8))',ISHORT(1:4)
C Word 3144: Index of Sample
  CALL I4TOI2(1,IWORD(3144),ISHORT)
  PRINT '("Index of Sample")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Word 3145: Minor Frame
  CALL I4TOI2(1,IWORD(3145),ISHORT)
  PRINT '("Minor Frame")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Word 3146: UFOT Mode Flags
  CALL I4TOI2(1,IWORD(3146),ISHORT)
  PRINT '("UFOT Mode Flags")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Word 3147: Cal. Data Indicator
  CALL I4TOI2(1,IWORD(3147),ISHORT)
  PRINT '("Cal. Data Indicator")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Word 3148: Start/Stop Index of Source Cal.
  CALL I4TOI2(1,IWORD(3148),ISHORT)
  PRINT '("Start/Stop Index of Source Cal.")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Word 3149: Start/Stop Index of Space Cal.
  CALL I4TOI2(1,IWORD(3149),ISHORT)
  PRINT '("Start/Stop Index of Space Cal.")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Words 3150-3152: Index of CAP
  CALL I4TOI2(3,IWORD(3150:3152),ISHORT)
  PRINT '("Index of CAP")'
  PRINT '(3(X,I8))',ISHORT(1:6)
C Words 3153-3155: Elev. Ang. Cnts at CAP
  CALL I4TOI2(3,IWORD(3153:3155),ISHORT)
  PRINT '("Elev. Ang. Cnts at CAP")'
  PRINT '(3(X,I8))',ISHORT(1:6)

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C Word 3156: Tan. Pt. Latitude Scan 1
  PRINT '("Tan. Pt. Latitude Scan 1")'
  PRINT '(X,G13.7)',(IWORD(3156)-900000)/10000.
C Word 3157: Tan. Pt. Longitude Scan 1
  PRINT '("Tan. Pt. Longitude Scan 1")'
  PRINT '(X,G13.7)',IWORD(3157)/10000.
C Word 3158: Tan. Pt. Latitude Scan 2
  PRINT '("Tan. Pt. Latitude Scan 2")'
  PRINT '(X,G13.7)',(IWORD(3158)-900000)/10000.
C Word 3159: Tan. Pt. Longitude Scan 2
  PRINT '("Tan. Pt. Longitude Scan 2")'
  PRINT '(X,G13.7)',IWORD(3159)/10000.
C Words 3160-3161: T.P. Local Time For Scan 1
  CALL I4TOI2(2,IWORD(3160:3161),ISHORT)
  PRINT '("T.P. Local Time For Scan 1")'
  PRINT '(4(X,I8))',ISHORT(1:4)
C Words 3162-3163: T.P. Local Time For Scan 2
  CALL I4TOI2(2,IWORD(3162:3163),ISHORT)
  PRINT '("T.P. Local Time For Scan 2")'
  PRINT '(4(X,I8))',ISHORT(1:4)
C Word 3164: T.P. Day/Night Flag
  CALL I4TOI2(1,IWORD(3164),ISHORT)
  PRINT '("T.P. Day/Night Flag")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Word 3165: S/C Day/Night Flag
  CALL I4TOI2(1,IWORD(3165),ISHORT)
  PRINT '("S/C Day/Night Flag")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Words 3166-3167: Sun Right Ascension (Azimuth)
  PRINT '("Sun Right Ascension (Azimuth)")'
  PRINT '(X,G13.7)',IWORD(3166:3167)*1.0E-09
C Words 3168-3169: Sun Declination (Elevation)
  PRINT '("Sun Declination (Elevation)")'
  PRINT '(X,G13.7)',IWORD(3168:3169)*1.0E-09
C Greenwich Hour Angle
  PRINT '("Greenwich Hour Angle")'
  PRINT '(X,G13.7)',IWORD(3170)*1.0E-06
C Word 3171: DSAS Right Ascension to Sun (Azimuth)
  PRINT '("DSAS Right Ascension to Sun (Azimuth)")'
  PRINT '(X,I8)',IWORD(3171)
C Word 3172: DSAS Declination to Sun (Elevation)
  PRINT '("DSAS Declination to Sun (Elevation)")'
  PRINT '(X,I8)',IWORD(3172)
C Words 3173-3197: S/C Pitch
  PRINT '("S/C Pitch")'
  PRINT '(5(X,G13.7))',IWORD(3173:3197)*1.0E-03
C Words 3198-3222: S/C Roll
  PRINT '("S/C Roll")'
  PRINT '(5(X,G13.7))',IWORD(3198:3222)*1.0E-03
C Words 3223-3247: S/C Yaw
  PRINT '("S/C Yaw")'
  PRINT '(5(X,G13.7))',IWORD(3223:3247)*1.0E-03
C Words 3248-3272: S/C Pitch Rate
  PRINT '("S/C Pitch Rate")'
  PRINT '(5(X,G13.7))',IWORD(3248:3272)*1.0E-03

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C Words 3273-3297: S/C Roll Rate
  PRINT '("S/C Roll Rate")'
  PRINT '(5(X,G13.7))',IWORD(3273:3297)*1.0E-03
C Word 3298: S/C Latitude, Scan 1
  PRINT '("S/C Latitude, Scan 1")'
  PRINT '(X,G13.7)',(IWORD(3298)-900000)/10000.
C Word 3299: S/C Longitude, Scan 1
  PRINT '("S/C Longitude, Scan 1")'
  PRINT '(X,G13.7)',IWORD(3299)/10000.
C Word 3300: S/C Altitude, Scan 1
  PRINT '("S/C Altitude, Scan 1")'
  PRINT '(X,G13.7)',IWORD(3300)/10000.
C Word 3301: S/C Latitude, Scan 2
  PRINT '("S/C Latitude, Scan 2")'
  PRINT '(X,G13.7)',(IWORD(3301)-900000)/10000.
C Word 3302: S/C Longitude, Scan 2
  PRINT '("S/C Longitude, Scan 2")'
  PRINT '(X,G13.7)',IWORD(3302)/10000.
C Word 3303: S/C Altitude, Scan 2
  PRINT '("S/C Altitude, Scan 2")'
  PRINT '(X,G13.7)',IWORD(3303)/10000.
C Word 3304: Index of ACS Value / Number of Errors
  CALL I4TOI2(1,IWORD(3304),ISHORT)
  PRINT '("Index of ACS Value / Number of Errors")'
  PRINT '(2(X,I8))',ISHORT(1:2)
C Words 3305-3329: Error Type / Index of Error
  CALL I4TOI2(25,IWORD(3305:3329),ISHORT)
  PRINT '("Error Type / Index of Error")'
  PRINT '(2(X,I8))',ISHORT(1:50)
C Word 3330: Foc. Pla. Temp. / OMP Temp.
  CALL I4TOI2(1,IWORD(3330),ISHORT)
  PRINT '("Foc. Pla. Temp. / OMP Temp.")'
  PRINT '(X,G13.7)',ISHORT(1)/10.,ISHORT(2)/10.
C Word 3331: Dectector Temp. / Pri. Opt. Temp.
  CALL I4TOI2(1,IWORD(3331),ISHORT)
  PRINT '("Dectector Temp. / Pri. Opt. Temp.")'
  PRINT '(X,G13.7)',ISHORT(1)/40.,ISHORT(2)/10.
C Word 3332: IFC (PRT) Temp. / IFC (THR) Temp.
  CALL I4TOI2(1,IWORD(3332),ISHORT)
  PRINT '("IFC (PRT) Temp. / IFC (THR) Temp.")'
  PRINT '(X,G13.7)',ISHORT(1)/100.+280,ISHORT(2)/100.+280
C Word 3333: -15 VDC Monitor / IEU Temp.
  CALL I4TOI2(1,IWORD(3333),ISHORT)
  PRINT '("-15 VDC Monitor / IEU Temp.")'
  PRINT '(X,G13.7)',ISHORT(1)/(-100.),ISHORT(2)/10.
C Word 3334: FEU Temp. / Scan Motor Current
  CALL I4TOI2(1,IWORD(3334),ISHORT)
  PRINT '("FEU Temp. / Scan Motor Current")'
  PRINT '(X,G13.7)',ISHORT(1)/10.,ISHORT(2)/1.
C Word 3335: Cryo. Shield Temp. / Scan Motor Temp.
  CALL I4TOI2(1,IWORD(3335),ISHORT)
  PRINT '("Cryo. Shield Temp. / Scan Motor Temp.")'
  PRINT '(X,G13.7)',ISHORT(1)/10.,ISHORT(2)/10.
C Words 3336-3343: Status Bits ILT
  PRINT '("Status Bits ILT")'
  PRINT '(X,B24.24)',IWORD(3336:3343)

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C Words 3344-3349: Decalib Coefficients Scale and Offs
  CALL I4TOI2(6,IWORD(3344:3349),ISHORT)
  PRINT '("Decalib Coefficients Scale and Offset")'
  PRINT '(2(X,I8))',ISHORT(1:12)
C Words 3350-3358: Spares (zero filled)
  PRINT '("Spares (zero filled)")'
  PRINT '(8(X,I8))',IWORD(3350:3358)
C Words 3359: Orbit No.
  PRINT '("Orbit No.")'
  PRINT '(X,I8)',IWORD(3359)
C Words 3360: Checksum
  PRINT '("Checksum")'
  PRINT '(X,I8)',IWORD(3360)

RETURN
END
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