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TECHNICAL MEMORANDUM

SKYLAB S-191 SPECTROMETER
SINGLE SPECTRAL SCAN ANALYSIS PROGRAM

By

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CONTENTS

1.0 PURPOSE

The purpose of this Technical Memorandum is to provide documentation and user information for the S-191 Single Spectral Scan Analysis Program. A breakdown of the computational algorithms is supplied in appendix A, followed by the program listing and examples of sample output in appendices B and C, respectively. Appendix D contains a copy of the flow chart which describes the driver routine in the body of the main program segment.

2.0 INTRODUCTION

The program is written in XTRAN to be run in a stand-alone fashion on the COM-SHARE time sharing system. As nearly as possible, it features a self-prompting operation, enabling it to be operated with minimum knowledge of the internal software logic or system design. Incorporated in its structure are the basic Production Processing Requirements Equations from PHO-TR524. Most calibration data is from MSC-07744.* The set of resolvable wavelengths that can be tested, have been selected from memo TF3-088. Configuration Board Directive update S&AD-081 is included, as are the six wavelength dependent algorithms furnished by Richard Juday (TF3), which are used to compute the ramp voltages.

Input to the program is raw data values from SO42-2 and SO42-5. Output produces the SO42-3 quantities generated by DSAD. Detector temperature ratios, emissivities, dichroic, and mirror reflectivities are generated internally by table lookup single and double linear interpolations as appropriate. A skeleton scheme of program logic flow is given in appendix D.

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*MSC-07744 is *Earth Resources Experiment Package (EREP) Calibration Data.*

3.0 OPERATING INSTRUCTIONS

3.1 General Discussion

A general discussion follows:

- The program may be run from any terminal having access to the COM-SHARE time sharing system.
- The input to the program consists entirely of numeric data and may be keyed in free format. For example, any legitimate manner of representing FORTRAN data types will be recognized.
- Where the program requests two or more data items to be input, keying in an incomplete data set will cause the program to prompt for additional input. However, inputting spurious or extra data will likely generate false output.
- In the event the terminal sets idle after apparently keying in a correct response to a request by the program, a status check can be made on the system without interrupting the program by simultaneously depressing the "control" and "shift" keys and "L." The system generally will respond with an R, D, or T. Their meaning is as follows:

  R = job is presently active within core

  D = I/O disk transfers are taking place

  T = waiting for terminal input

  Most commonly, T means the user has failed to keyin a "carriage return" after inputting data.

- **Internally accumulated noise will be reflected by spurious symbols appearing on the output hardcopy. Before entering data, this noise should be cleared by keying successive (control A).**
- **The program will be operated under control of the XTRAN subsystem whose ready symbol is "+." Whenever the plus sign appears as the first symbol of a line, the system is waiting for an XTRAN command, NOT data.**
- **Any operation may be aborted at anytime by hitting the "escape" key.**

3.2 System Setup

Because this procedure is flexible and subject to change, information regarding this area will not be included in this memorandum, but may be obtained by contacting Ed Downes at 483-3155 or by mail code C-09, and a copy of the current documentation will be forwarded under separate cover.

3.3 Log-in Procedures

See 3.2 above.

3.4 Loading the Program

See 3.2 above.

3.5 Program Options

Discussion:

There are two means whereby the user may control and guide the sequence by which the program processes data. The first is by responding appropriately to the self-prompting commands generated within the hard-wired logic flow. This includes the selection of channel number, ramp length, etc. This also covers the reread capability whereby the program outputs a message such as:

Keyin "0" to continue, "L" to change line "L" = . . .

In the event an error has been made in entering a data set, inputting "L," where "L" is the line number to be changed, will cause the program to backup to allow a new datum to be keyed in. This continues until a zero is entered to continue.

The second means to alter program flow is external to the normal logic and is applicable when a system error has aborted the program or when the "escape" key is hit. Both actions return control to the XTRAN system which is verified by the appearance of a plus sign (+) as the first character of the output line. At this point entering the XTRAN command "go line carriage return," where "line" refers to the circled numbers on the flow chart in appendix D and the statement labels in appendix B. Executing this command will reenter the program at that line with all indexes and registers set at the same values as when program control was lost or abandoned. The most common use of this command will be when nonsequential data sets are processed. See appendix C for a sample output which demonstrates this capability.

A special option allows the processing of channels 3 and 5 simultaneously. A prompt mode instructs the user for input.

3.6 Input

Discussion:

Input parameters are generally a function of the channel selected; however, common to all channels are the following items in the order requested by the program:

- Scan day-hour, minute, second
- Ramp length (in counts)
- Channel number

  1 = long wavelength negative (HgCdTe)
  2 = near infrared (PbS)
  3 = short wavelength (Si #1)
  4 = ramp counts
  5 = short wavelength (Si #2)
  6 = long wavelength positive (HgCdTe)

Also common to all channels are the following:

- Eleven sequential A4 raw count values from S042-5
- Five sequential A (channel) raw count values from S042-5

Additional input required for long wavelength channels:

- **Scan dichroic temperature from S042-2 data**
- **Scan reference temperature from S042-2 data**
- **Scan ambient temperature from S042-2 data**
- **Scan sphere temperature from S042-2 data**
- **Scan heated cal temperature from S042-2 data**
- **Scan detector temperature from S042-2 data**

Additional input required for near infrared calculations:

- Scan detector temperature from S042-2 data

A demonstration of input parameters can be seen in the appendix C model output.

3.7 Output

Discussion:

Output is a function of channel selection and is treated separately as follows:

- Long wavelength (for each wavelength)
  - (1) Table 1 which contains the wavelength associated row number, wavelength, wavelength ramp voltage referenced to a 4.86 volt (971 count) ramp, the actual ramp voltage used in calculation, and the actual ramp voltage converted to counts
  - (2) A printout of the scan temperature parameters

(3) Table 2 which contains the wavelength associated row number, wavelength, responsivity, emissivity, dichroic reflectivity, mirror reflectivity, and detector temperature ratio

(4) The linear equations output by the least squares fit of the 11 and 5 inputted S042-5 raw data values, respectively

(5) VCHAN, which is the output of the Configuration Board Directive S&AD-018 calculations

(6) VBAR as described in appendix A

(7) Blackbody radiances for the dichroic, reference, ambient cal, sphere, and heated cal temperatures

(8) Reference radiance calculation

(9) Source radiance at the chopper cal for the ambient source

(10) Source radiance at the chopper cal for the heated cal source

(11) Channel number

(12) Radiance at the chopper

(13) Radiance at the calibration source

(14) Radiance at the aperture

(15) Scan time of computed values

- Short wavelength (for each wavelength)

  (1) Table 3 which contains the same type of information provided in table 1 (see 3.7, number 1), plus the responsivity

(2) Scan time of computed values

(3) The linear equations output by the least squares fit of the 11 and 5 inputted S042-5 raw data values, respectively

(4) VCHAN, which is the output of the Configuration Board Directive S&AD-018 calculations, is shown in both volts and counts

(5) SWLI, the short wavelength radiance

(6) Channel number

(7) Responsivity

- Near infrared (lead sulphide)

(1) Table 4, similar to table 3, with the addition of the detector temperature ratio

(2-7) See 2 through 7 above.

(8) Detector temperature ratio

3.8 Logout Procedures

To logout simply:

- Keyin "escape" (system responds with "+")
- Keyin "control G" (system responds with "-")
- Keyin "log carriage return"
- Disconnect handset from the acoustic coupler when the carrier light goes out.

4.0 ADDITIONAL REMARKS

- The S042-2 ambient temperature is used for the sphere temperature.
- The S042-2 package temperature is used for the lead sulphide detector temperature.
- Calculations for the short wavelengths in the range of 1.1 to 1.4 micrometers have not been programmed, but may be included at a later date.
- Appendix E was included to show how the S042-5 values were selected for the sample output shown in appendix C.
- It should be noted that the responsivities in the sample output in appendix C have all been set equal to one. This is not the normal case, but is due to the fact that at this writing, the correct responsivities have not been received. Upon their receipt, they will be included to the program and output appropriately.

APPENDIX A

LISTING OF ALGORITHMS

A.1. Algorithms used to compute channel A4 voltage

A.1.A. Select wavelength = "L"

A.1.B. Choose coefficients (A1, A2, A3) from A.1.C. through A.1.H.

A.1.C. 0.40 < "L" < 0.71

A1 = 1.14527
A2 = 3.41492 Segment 2
A3 = 0.0237844

A.1.D. 0.72 < "L" < 1.36

A1 = 2.67633
A2 = 1.52349 Segment 3
A3 = 0

A.1.E. 1.38 < "L" < 2.48

A1 = -1.64778
A2 = 0.966462 Segment 1
A3 = 0.265708

A.1.F. 6.00 < "L" < 9.20

A1 = 0.975941
A2 = 0.266592 Segment 6
A3 = 0.00798181

A.1.G. 9.20 < "L" < 12.7

A1 = -3.12383
A2 = 0.490235 Segment 4
A3 = -0.00932054

A.1.H. 12.7 < "L" < 16.0

A1 = -2.04175
A2 = 0.288636 Segment 5
A3 = 0

A.1.I. Compute $V'A4 = A1 + A2 \cdot L + A3 \cdot L^2$ = (4.86 ramp volt VA4)

A.1.J. $V'A4 \cdot ramp/4.86$ = channel A4 voltage for wavelength "L" and ramplength "ramp."

A.2. Algorithm used to compute blackbody radiances
Description of parameters:

BT(K) = blackbody radiance for "K"
K = 1 = dichroic
K = 2 = reference
K = 3 = ambient
K = 4 = sphere (ambient used)
K = 5 = heated cal
T(K) = temperature in degrees kelvin for "K"
VV(1,L) = wavelength responsivity

A.2.A.

$$BT(K) = \frac{11909.0}{\left(VV(1,L)\right)^5 \cdot \left(e^{(14388.0/(VV(1,L) \cdot T(K))} - 1\right)}$$

A.3. Algorithm used to compute reference radiance
Description of parameters:

BT(2) = reference blackbody radiance
BT(1) = dichroic blackbody radiance
RHOC = chopper reflectivity

A.3.A. RI = reference radiance = $RHOC \cdot BT(2) + (1 - RHOC) \cdot BT(1)$

A.4. Algorithm used to compute the source radiance at the chopper cal for the ambient source (RISA)
Description of parameters:

VV(3,L) = wavelength emissivity
VV(4,L) = wavelength dichroic reflectivity

BT(3) = ambient blackbody radiance
BT(1) = dichroic blackbody radiance
BT(4) = sphere blackbody radiance

A.4.A. $$RISA = VV(3,L) \cdot VV(4,L) \cdot BT(3) + (1 - VV(4,L)) \cdot BT(1) + (1 - VV(3,L)) \cdot VV(4,L) \cdot BT(4)$$

A.5. Algorithm used to compute the source radiance at the chopper cal for the heated cal source (RISH)
Description of parameters:

VV(3,L) = wavelength emissivity
VV(4,L) = wavelength dichroic reflectivity
BT(1) = dichroic blackbody radiance
BT(4) = sphere blackbody radiance
BT(5) = heated cal blackbody radiance

A.5.A. $$RISH = VV(3,L) \cdot VV(4,L) \cdot BT(5) + (1 - VV(4,L)) \cdot BT(1) + (1 - VV(3,L)) \cdot VV(4,L) \cdot BT(4)$$

A.6. Algorithm used to compute "VBAR"
Description of parameters:

VCHI = output of equation A.1 computations after being massaged by Configuration Control Board Directive S&AD-018 algorithms
B(I) = bias for channel "I"
VV(6,L) = wavelength detector temperature ratio

A.6.A. $$VBAR = (VCHI - B(I)) \cdot VV(6,L)$$

A.7. Algorithm used to compute the radiance of the chopper
Description of parameters:

VBAR = (as in A.6 above)
I = channel number
VV(2,L) = wavelength responsivity
RI = reference radiance

A.7.A. $LWLIC = (-1)^I \cdot VBAR/VV(2,L) + RI$

A.8. Algorithm used to compute the radiance at the calibration source

Description of parameters:

LWLIC = radiance at the chopper
VV(4,L) = dichroic reflectivity
BT(1) = dichroic blackbody radiance

A.8.A. LWLIS = (LWLIC - (1 - VV(4,L)) • BT(1)/VV(4,L)

A.9. Algorithm used to compute the radiance at the aperture

Description of parameters:

LWLIS = radiance at the calibration source
VV(5,L) = mirror reflectivity
BT(3) = ambient blackbody radiance

A.9.A. LWLIF = (LWLIS - (1 - VV(5,L)) • BT(3)/VV(5,L)

A.10. Algorithm used to compute short wavelength radiance for channels 3 and 5

Description of parameters:

VCHI = (as in A.6)
B(I) = (as in A.6)
VV(2,L) = wavelength responsivity

A.10.A. SWLI = (VCHI - B(I))/VV(2,L)

A.11. Algorithm used to compute short wavelength radiance for channel 2

Description of parameters:

VCHI = (as in A.6)
B(I) = (as in A.6)
VV(6,L) = lead sulphide detector temperature ratio
VV(2,L) = wavelength responsivity

A.11.A. SWLI(PBS) = (VCHI - B(I)) * VV(6,L)/VV(2,L)

APPENDIX B

LISTING OF PROGRAM SYMBOLICS

```
C: THIS PROGRAM IS DESIGNED TO ACT AS A SINGLE SPECTRAL SCAN ANALYZER
C: AND UTILIZES THE PHO-TR524 PRODUCTION PROCESSING REQUIREMENTS EQUA-
C: TIONS, MSC-07744 CALIBRATION DATA, MEMO TF3-088 WAVELENGTHS, AND CON-

C: FIGURATION BOARD DIRECTIVE S&AD 018 UPDATE TO REPRODUCE THE SO 42-3
C: OUTPUT VALUES GENERATED BY D.S.A.D. USING RAW DATA "SO 42-2", AND
C: "SO 42-5", INPUT.  ALSO INCORPORATED ARE THE SIX WAVELENGTH DEPENDENT

C: ALGORITHMS PROVIDED BY RICHARD JUDAY, (TF3), TO COMPUTE THE RAMP DE-

C: PENDENT CHANNEL VOLTAGES.
C:
C:         DESCRIPTION OF PARAMETERS:
C:
C:   BT(1,2,3,4,5) = BLACKBODY EQUATIONS FOR........
C:   T(1) = TD = DICHROIC TEMPERATURE
C:   T(2) = TR = REFERENCE TEMPERATURE
C:   T(3) = TA = AMBIENT TEMPERATURE
C:   T(4) = TS = SPHERE TEMPERATURE
C:   T(5) = TH = HEATED CAL TEMPERATURE
C:
C:   VV(1) = LAMBDA (WAVELENGTH IN MICROMETERS)
C:   VV(2) = RESPONSIVITY
C:   VV(3) = EMISSIVITY
C:   VV(4) = DICHROIC REFLECTIVITY
C:   VV(5) = MIRROR REFLECTIVITY
C:   VV(6) = DETECTOR TEMPERATURE RATIO
C:   VV(7) = WAVELENGTH VOLTAGE REFERENCED TO 4.86 VOLT RAMP
C:   VV(8) = WAVELENGTH VOLTAGE REFERENCED TO ACTUAL RAMP
C:   VV(9) = WAVELENGTH COUNTS REFERENCED TO ACTUAL RAMP
C:
C:   VV = MAIN PROGRAM DATA ARRAY (STORED EXTERNAL TO PROGRAM)
C:   V  = TABLE LOOKUP ARRAY FOR EMISSIVITY/RHOD/RHOM/
C:        V(1-2,1-35) =  EMISSIVITY
C:        V(3-4,1-38) = DICHROIC REFLECTIVITY
C:        V(5-6,1-11) =  MIRROR REFLECTIVITY
C:        V((1,3,5),1-38) = WAVELENGTH
C:   TERP = DATA ARRAY FOR DETECTOR TEMPERATURE RATIO COMPUTATION
C:   B    = CHANNEL BIAS ARRAY
C:   S    = LITERAL ARRAY FOR TEMPERATURE NAMES
C:   RHOC = .99 = CHOPPER REFLECTIVITY CALCULATION
C:   CNT  = .00500244 = VOLT PER COUNT RATIO
C:   DEG  = 273.2 = CENTIGRADE TO KELVIN CONSTANT
C:
C:
      COMMON B(6), VV(9,90), V(6,38)
      STRING S(5)
      DIMENSION TERP(6,4)
      DIMENSION  T(5), BT(5), DAY(4)
      DATA TERP /1.,1.,1.,1.,1.,1.,1.11,1.11,1.11,1.11,1.12,2.1,
      1.26,1.26,1.26,1.26,1.32,4.3,1.48,1.48,1.48,1.48,1.65,7.2/
      DATA B, RHOC, CNT, DEG
        /.206,.0263,.0554,.1,.025,.200,.99,.00500244,273.2/
      DATA S /'DICHROIC TEMPERATURE','REFERENCE TEMPERATURE',
      'AMBIENT CAL SOURCE TEMPERATURE','SPHERE TEMPERATURE',
      'HEATED CAL SOURCE TEMPERATURE'/
   99 FORMAT (9F13.7)
   98 FORMAT (I3,2X,F6.2,5X,F6.0,6X,F8.5,4X,F7.5,3X,F9.7,1X,F10.8)
   97 FORMAT(F6.2,1X,F6.0,F8.5,1X,F7.5,1X,F9.7,1X,F4.2,1X,F8.3,F8.3,F8.3
                                                    )
   96 FORMAT (I3,2X,F6.2,F10.5,2X,F11.6,4X,F13.8)
   95 FORMAT (6(F7.3,2X))
```

```
   94 FORMAT (6(F7.3,2X),I5)
   93 FORMAT (I3,2X,F6.2,F10.5,2X,F11.6,4X,F13.8,5X,F7.1)
   92 FORMAT (I3,2X,F6.2,F10.5,2X,F11.6,4X,F13.8,F9.0,F11.7)
      OPEN (2,INPUT,/VV/)
      OPEN (3,INPUT,/V/)
   17 READ (2,99) VV
      READ(3,95) ((V(J,J2),J=1,6),J2=1,38)
   12 DISPLAY '. . . . . . . . S-191 SINGLE SPECTRAL SCAN ANALYZER  . . .
 . .'
      DISPLAY '                         COMPILE DATE: ',.CDATE.
      DISPLAY '*********************************************************
*******'
      IV = 1
      DISPLAY 'KEYIN SCAN DAY,HR,MIN,SEC = ',#
      ACCEPT DAY
      DISPLAY 'KEYIN RAMP LENGTH IN COUNTS = ',#
      ACCEPT RAMP
      DISPLAY 'KEYIN CHANNEL # = ',#
      ACCEPT I
      FOR L=1,90:CALL VA4(VV(1,L),VV(2,L),VV(7,L),VV(8,L),RAMP,VV(9,L),I
)
C:
C:   GO 3 =SHORT WAVELENGTH--GO 2 = LONG WAVELENGTH--GO 1 = NEAR I.R.
C:
    8 GO TO (2,1,3,? ?,2) I
C
C           ENTER LONG WAVELENGTH SECTION....
C
    2 DISPLAY
      DISPLAY '                    LONG WAVELENGTH TABLE 1'
      DISPLAY 'ROW--LAMBDA--REF VOLTS--ACTUAL VOLTS--RELATIVE COUNT'
      WRITE (0,96) (L,VV(1,L),(VV(M,L),M=7,9),L=1,33)
      DISPLAY
   14 DISPLAY 'INPUT TD,TR,TA,TS,TH, IN DEGREES CENTIGRADE'
      DO 5 K = 1,5
    6 DISPLAY 'KEYIN SCAN ',#S(K),' = ',#
      ACCEPT T(K)
    5 CONTINUE
    7 DISPLAY 'KEYIN DETECTOR TEMPERATURE IN DEGREES KELVIN = ',#
      ACCEPT TEMP
      DISPLAY 'TD,TR,TA,TS,TH,TEMP =', T,TEMP
      FOR K=1,5: T(K) = T(K) + DEG
C:
C:        COMPUTE INTERPOLATED DETECTOR TEMPERATURE.
C:
      I2 = 1
      IF (TEMP.GT.90.) I2 =  2
      IF (TEMP.GT.95.) I2 = 3
      I1 = 1
      DO 33 N = 1,33
      IF (VV(1,N).GT.8.0) I1 = 2
      IF (VV(1,N).GT.12.) I1 = 3
      IF (VV(1,N).GT.13.) GO TO 44
      CALL INTER1 (I2,TEMP,TERP(I1,I2),TERP(I1,I2+1),VV(6,N))
      GO TO 33
   44 I1 = 4
      IF (VV(1,N).GT.15.) I1 = 5
      CALL INTER1 (I2,TEMP,TERP(I1,I2),TERP(I1,I2+1),VV(6,N))
      V1 = VV(6,N)
      CALL INTER1 (I2,TEMP,TERP(I1+1,I2),TERP(I1+1,I2+1),VV(6,N))
      V2 = VV(6,N)
      CALL INTER2 (V1,V2,VV(1,N),I1,VV(6,N))
   33 CONTINUE
```

```
C
C           COMPUTE EMISSIVITIES, AND REFLECTIVITIES
C
      J1 = 1
      DO 83 J = 3,5
      J2 = 1
      DO 84 K = 1,33
   86 IF((VV(1,K).GE.V(J1,J2)).AND.(VV(1,K).LE.V(J1,J2+1))) GO TO 85
      J2 = J2 + 1
      GO TO 86
   85 X1 = V(J1,J2)
      X2 = V(J1,J2+1)
      Y1 = V(J1+1,J2)
      Y2 = V(J1+1,J2+1)
      DX = X2 - X1
      DY = Y2 - Y1
      DA = VV(1,K) - X1
      VV(J,K) = Y1 + (DA*DY)/DX
   84 CONTINUE
      J1 = J1 + 2
   83 CONTINUE
C:
C::         WRITE OUT TO PRINTER THE INPUT DATA ARRAY.
C:
   21 DISPLAY
      DISPLAY '                        LONG WAVELENGTH TABLE 2'
      DISPLAY 'ROW--LAMBDA--RESPONSIVITY--EMISSIVITY--DICHROIC----MIRROR
---PDET.TEMP'
      WRITE (0,98) (J,(VV(M,J),M=1,6),J=1,33)
      DISPLAY '=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=
=0=0=0=0='
      DO 10 L = 1,33
    9-DISPLAY '      SCAN DAY-HR:MIN:SEC = ',#DAY(1),'-',#DAY(2),':',#DAY
3),':',#DAY(4)
      CALL INPUT (L,I,VCH1,VCH2,IV2)
    4 VBAR = (VCH1 - B(I)) * VV(6,L)
      DISPLAY 'COMPUTED VBAR =',#VBAR
      DISPLAY 'LAMBDA/ RESP / EMISS. / RHOD. /  RHOM. /RHOC/   TD   /

TR  /    TA'
      WRITE (0,97) (VV(LL,L),LL=1,5),RHOC,T(1),T(2),T(3)
      FOR K=1,5:BT(K)=(11909./(VV(1,L)**5*(EXP(14388./(VV(1,L)*T(K))) -1
)))
      FOR K=1,5:DISPLAY #BT(K),' = BLACKBODY RADIANCE FOR ',#S(K)
      RI = RHOC*BT(2) + (1.-RHOC)*BT(1)
      RISA  = VV(3,L)*VV(4,L)*BT(3) + ((1.-VV(4,L))*BT(1))
             + (1.-VV(3,L))*VV(4,L)*BT(4)
      RISH  = VV(3,L)*VV(4,L)*BT(5) + ((1.-VV(4,L))*BT(1))
             + (1.-VV(3,L))*VV(4,L)*BT(4)
      WLLIC = (-1.)**I*VBAR/VV(2,L) + RI
      WLLIS = (WLLIC-(1.-VV(4,L))*BT(1))/VV(4,L)
      WLLIF = (WLLIS-(1.-VV(5,L))*BT(3))/VV(5,L)
      DISPLAY #RI,  ' = REFERENCE RADIANCE CALCULATION'
      DISPLAY #RISA,' = SOURCE RADIANCE AT THE CHOPPER CAL FOR THE AMBIE
T SOURCE'
      DISPLAY #RISH,' = SOURCE RADIANCE AT THE CHOPPER CAL FOR THE HEATE
 CAL SOURCE'
      DISPLAY 'LAMBDA =',#VV(1,L),'   CHANNEL =',#I,'    LWLIC =',#WLLIC

      DISPLAY 'LWLIS =',#WLLIS,'         LWLIF =',#WLLIF
      DISPLAY '=========================================S==============
==========='
   10 CONTINUE
```

```
      GO TO 18
C
C           ENTER SHORT WAVELENGTH SECTION....
C
    3 DISPLAY '==============SHORT WAVELENGTH CALCULATIONS FOLLOW=======
====' 						•
      DISPLAY '                               SHORT WAVELENGTH TABLE 3'
      DISPLAY 'ROW--LAMBDA--REF VOLTS--ACTUAL VOLTS--RELATIVE COUNT--RES
ONSIVITY'                                  P
      WRITE (0,93) (N,VV(1,N),((VV(M,N),M=7,9),VV(2,N)),N=34,62)
      DISPLAY '=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=
=0=0=0=0=0='                               0
      DO 20 L = 34,62
   15-DISPLAY '      SCAN DAY-HR:MIN:SEC =',#DAY(1),'-',#DAY(2),':',#DAY(
),':',#DAY(4)                              3
      CALL INPUT (L,I,VCHI,VCH2,IV2)
      IT = I
   11 SWLI = (VCHI - B(IT)) / VV(2,L)
      DISPLAY 'LAMBDA =',#VV(1,L),'   CHANNEL =',#IT,'   SWLI =',#SWLI,
     *        'RESP =',#VV(2,L)
      DISPLAY '* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * *'
      IF (IV2.GT.0) IT = IV2
      IF (IV2.GT.0) VCHI = VCH2
      IF (IV2.GT.0) GO TO 11
   20 CONTINUE
      GO TO 18
C
C           ENTER LEAD SULPHIDE SECTION.....
C
    1 DISPLAY '===============NEAR INFRA-RED CALCULATIONS FOLLOW========
===='                                      •
      DISPLAY 'KEYIN DETECTOR TEMPERATURE IN DEGREES CENTIGRADE = ',#
      ACCEPT TEMP
      FOR L=63,90: CALL FDET1 (VV(1,L),TEMP,VV(6,L))
      DISPLAY '                                 LEAD SULPHIDE TABLE 4'
      DISPLAY 'ROW--LAMBDA--REF VOLTS--ACTUAL VOLTS--RELATIVE COUNTS--RE
S.--FDETITEMP'                             S
      WRITE (0,92) (N,VV(1,N),((VV(M,N),M=7,9),VV(2,N),VV(6,N)),N=63,90)

      DISPLAY '=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=
=0=0=0=0=0='                               0
      DO 39 L = 63,90
   31-DISPLAY '      SCAN DAY-HR:MIN:SEC =',#DAY(1),'-',#DAY(2),':',#DAY(
),':',#DAY(4)                              3
      CALL INPUT (L,I,VCHI,VCH2,IV2)
      SWLI = (VCHI - B(I)) * VV(6,L) / VV(2,L)
      DISPLAY 'SWLI =',#SWLI,'   LAMBDA =',#VV(1,L),'   CHANNEL =',#I
      DISPLAY 'FDET =',#VV(6,L),'      RESPONSIVITY =',#VV(2,L)
      DISPLAY '* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * *'
   39 CONTINUE
   18 DISPLAY 'KEY IN 1 TO RECYCLE -- 0 TO TERMINATE RUN......',#
      ACCEPT ISET
      IF(ISET.EQ.1) GO TO 12
      DISPLAY '*******************OFF THE AIR************************'

      GO TO 22
   66 ON ERROR: 77
   77 DISPLAY 'ERROR(77) INTERRUPT, L = ',#L,', KEYIN NEW L = ',#
      ACCEPT NEW
      L = NEW
      ON ERROR: SYSTEM
      GO TO (9, 31,15, 1, 15, 9) I
   99 END
```

```
C
C        SUBROUTINE "INTER1" PERFORMS A SINGLE INTERPOLATION OF A
C        POINT "T" WITH RESPECT TO POINTS "T1",AND "T2"
C
C      USAGE: CALL INTER1 ( M, T, T1, T2, V6 )
C
C          DESCRIPTION OF PARAMETERS
C      M = LOWER BOUND OF TABLE ARRAY "Y" VALUE. I.E. (TABLE(X,Y))
C      T = POINT TO BE INTERPOLATED
C      T1= LOWER BOUND TABLE POINT
C      T2= UPPER BOUND TABLE POINT
C      V6= RETURN VALUE OF INTERPOLATED POINT
C
      SUBROUTINE INTER1 (M,T,T1,T2,V6)
      DELT = T2 - T1
      TEP = (85. + 5*(M-1)) - T
      X = DELT * TEP / 5.
      V6 = T1 - X
      RETURN
      END
C
C        SUBROUTINE INTER2 PERFORMS INTERPOLATION OF
C        THE OUTPUT OF SUBROUTINE INTER1
C
C       USAGE: CALL INTER2 (V1, V2,  V, I1, VT)
C
C        DESCRIPTION OF PARAMETERS
C       V1 = 1ST OUTPUT OF INTER1
C       V2 = 2ND OUTPUT OF INTER1
C       V  = WAVELENGTH INPUT
C       I1 = LOWER BOUND OF TABLE ARRAY "X". I.E. (TABLE(X,Y,))
C       VT = RETURN VALUE OF ITER2
C
      SUBROUTINE INTER2 (V1,V2,V,I1,VT)
      DIF = 2.
      IF (I1.EQ.5) DIF = 1.
      D1 = V2 - V1
      D2 = V - 15.
      IF (I1.EQ.4) D2 = V - 13.
      X = D1 * D2 / DIF
      VT = V1 + X
      RETURN
      END
C       SUBROUTINE LINFIT
C
C       PURPOSE
C         MAKE A LEAST-SQUARES FIT TO DATA WITH A STRAIGHT LINE
C             Y = B*X + A
C
C       USAGE
C         CALL LINFIT (X,Y,SIGMAY,NPTS,MODE,SIGMAA,B,SIGMAB,R,VL,ICH)
C
C       DESCRIPTION OF PARAMETERS
C         X      - ARRAY OF DATA POINTS FOR INDEPENDENT VARIABLE
C         Y      - ARRAY OF DATA POINTS FOR DEPENDENT VARIABLE
C         SIGMAY - ARRAY OF STANDARD DEVIATIONS FOR Y DATA POINTS
C         NPTS   - NUMBER OF PAIRS OF DATA POINTS
C         MODE   - DETERMINES METHOD OF WEIGHTING LEAST SQUARES FIT
C                  +1 (INSTRUMENTAL) WEIGHT(I) = 1./SIGMAY(I)**2
C                   0 (NO WEIGHTING) WEIGHT(I) = 1.
C                  -1 (STATISTICAL)  WEIGHT(I) = 1./Y(I)
```

```
C         A      - Y INTERCEPT OF FITTED STRAIGHT LINE
C         SIGMAA - STANDARD DEVIATION OF A
C         B      - SLOPE OF FITTED STRAIGHT LINE
C         SIGMAB - STANDARD DEVIATION OF B
C         R      - LINEAR CORRELATION COEFFICIENT
C         VL     -WAVELENGTH
C         CH     - CHANNEL
C
C:
C:    LINFIT  --  LEAST SQUARES LINEAR FIT.
C:
      SUBROUTINE LINFIT(X1,Y1,SIGMAY1,NPTS,MODE,A,SIGMAA,B,SIGMAB,R,VL,I
     H)
      DOUBLE PRECISION SUM,SUMX,SUMY,SUMX2,SUMXY,SUMY2
      DOUBLE PRECISION XI,YI, WEIGHT, DELTA, VARNCE
      COMMON /C/ X(11), Y(11), SIGMAY(11)
C
C              ACCUMULATE WEIGHTED SUM
C
   11 SUM = 0.
      SUMX = 0.
      SUMY = 0.
      SUMX2 = 0.
      SUMXY = 0.
      SUMY2 = 0.
   21 DO 50 I=1,NPTS
      XI = X(I)
      YI = Y(I)
      IF (MODE) 31, 36, 38
   31 IF (YI) 34, 36, 32
   32 WEIGHT = 1. / YI
      GO TO 41
   34 WEIGHT =1. / (-YI)
      GO TO 41
   36 WEIGHT = 1.
      GO TO 41
   38 WEIGHT = 1. / SIGMAY(I)**2
   41 SUM   = SUM   + WEIGHT
      SUMX  = SUMX  + WEIGHT*XI
      SUMY  = SUMY  + WEIGHT*YI
      SUMX2 = SUMX2 + WEIGHT*XI*XI
      SUMXY = SUMXY + WEIGHT*XI*YI
      SUMY2 = SUMY2 + WEIGHT*YI*YI
   50 CONTINUE
C
C           CALCULATE COEFFICIENTS AND STANDARD DEVIATIONS
C
   51 DELTA = SUM*SUMX2 - SUMX*SUMX
      A = (SUMX2*SUMY - SUMX*SUMXY) / DELTA
   53 B = (SUMXY*SUM  - SUMX*SUMY ) / DELTA
      DISPLAY
      DISPLAY '=========================================================
====='
      DISPLAY '       VOLTAGE(',#VL,',',#ICH,') = ',#B,' * SCAN +',#A
      DISPLAY '=========================================================
==='
      DISPLAY
      RETURN
      END
```

```
C
C          SUBROUTINE VA4 CALCULATES THE CHANNEL 4 REFERENCE
C          VOLTAGE ASSUMING A 4.86 VOLT RAMP LENGTH AND STORES
C          IN VV(7,L) FOR EACH WAVELENGTH.  VV(7,L) IS THEN CON-
C          VERTED TO THE ACTUAL VOLTAGE, AND RELATIVE DIGITAL
C          COUNTS, USING THE ACTUAL RAMP LENGTH AND STORES IN
C          V(8,L), AND V(9,L), RESPECTIVELY
C
C      USAGE: CALL VA4 ( V1, V7, V8, R, V9, IV )
C
C        DESCRIPTION OF PARAMETERS
C          V1 = INPUT WAVELENGTH
C          V2 = RESPONSIVITY
C          V7 = WAVELENGTH REFERENCE VOLTAGE (4.86 VOLTS) RAMP LENGTH
C          V8 = WAVELENGTH ADJUSTED  VOLTAGE (ACTUAL VOLTS) RAMP LENGTH

C          V9 = WAVELENGTH RELATIVE COUNTS TO ADJUSTED VOLTAGE
C          R  = RAMP VOLTAGE LENGTH INPUT
C          IV = ALGORITHM COUNT OPTIMIZER
C
      SUBROUTINE VA4 (V1,V2,V7,V8,R,V9,IV)
      DIMENSION A(3,6)
      DATA A, VPK, CNT
     /1.14527, 3.41492,.0237844, 2.67633, 1.52349, 0.0000000,
     -1.64778, 0.966462,0.265708,0.975941,0.266592,0.00798181,
     -3.12383, 0.490235,-.00932054,-2.04175,.288636,.0000000,
      4.86,    0.00500244/
      R2 = R * CNT
      IF (V1.LT..71) IV = 1
    1 IF (V1.GT..71 ) IV = 2
    2 IF (V1.GT.1.36) IV = 3
    3 IF (V1.GT.2.48) IV = 4
    4 IF (V1.GT.9.20) IV = 5
    5 IF (V1.GT.12.7) IV = 6
    6 V7 = (A(1,IV) + A(2,IV)*V1 + A(3.IV)*V1*V1)
      V8 = V7*R2 / VPK
      V9 = V8 / CNT
      V2 = 1.0000
      RETURN
      END
C
C         SUBROUTINE "INPUT" ACTS AS A DRIVER ROUTINE TO
C         INPUT THE RECEIPT OF THE STANDARD DATA SET PER
C         WAVELENGTH OF 11 CHANNEL 4 VALUES AND 5 CHANNEL
C         V(I) VALUES FOR CHANNEL "I", FROM THE TERMINAL.
C         ALTERNATIVELY, IF IV2 IS UNEQUAL TO ZERO, THEN
C         TWO CHANNELS OF DATA CAN BE SIMULTANEOUSLY PRO-
C         CESSED FOR THE SAME WAVELENGTH.
C
C           USAGE: CALL INPUT (L,I,VCHI,VCH2,IV2)
C
C         DESCRIPTION OF PARAMETERS
C           L      = WAVELENGTH ASSOCIATED ARRAY ROW, I.E."VV(X,L)"
C           I      = INPUT CHANNEL NUMBER
C           VCHI   = RETURN VALUE FOR CHANNEL "I"
C           VCH2   = RETURN VALUE FOR CHANNEL "IV2?-"
C           IV2    = OPTIONAL CHANNEL NUMBER "IV2"
```

```
      SUBROUTINE INPUT ( L, I, VCH1, VCH2, IV2 )
      COMMON B(6), VV(9,60)
      COMMON /C/ D(11), V(11), SIGMAY(11)
      DIMENSION C(11)
      DATA CNT .0050024 4
      VCH2 = 0.
      IV2 = 0
      DISPLAY
      DISPLAY 'INPUT FOR LAMBDA',#VV(1,L),', CHANNEL #',#I,', ROW =',#L

      DISPLAY 'KEYIN 11 POINTS AROUND',#VV(9,L),' COUNTS'
      VL = VV(1,L)
      DO 11 J = 1,11
    9 DISPLAY 'KEYIN',#VV(1,L),' SCAN(',#J,' ) = ',#
      ACCEPT V(J)
      C(J) = V(J)
      V(J) = V(J) * CNT
      D(J) =  (J)
   11 CONTINUE
    3 DISPLAY 'SAMPLE COUNTS ARRAY = ', C
    1 DISPLAY 'KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" ',
      ACCEPT K
      IF (  K.GT.0 ) GO TO 2
      IF (D(10).EQ.0) GO TO 4
      CALL LINFIT (D,V,SIGMAY,11,0,A,SIGMAA,BO,SIGMAB,R,VL,4)
      TLAM = (VV(8,L) - A) / BO
      TCHAN= TLAM + (4.-I) /8.
      KCHAN= IFIX(TCHAN + .5)
      I2 = I
   10 IF (IV2.GT.0) I2 = IV2
      DO 12 M = 1,11
      C(M) = 0.
      D(M) = 0.
      V(M) = 0.
   12 CONTINUE
      DISPLAY 'KEYIN 5 CHANNEL',#I2,' VALUES AROUND RELATIVE SCAN LINE',
KCHAN                                #
      DO 5 J = 1,5
    8 JJ = KCHAN + (J-3)
      DISPLAY 'KEYIN "J" =',#J,' VALUE FOR SCAN',#JJ,' = ',#
      ACCEPT V(J)
      C(J) = V(J)
      V(J) = V(J) * CNT
      D(J) =  (JJ)
    5 CONTINUE
      GO TO 3
    4 CALL LINFIT (D2,V2,SIGMAY,5,0,A,SIGMAA,BO,SIGMAB,R,VV(1,L),I)
      VCHAN = BO * TCHAN + A
      VCNTS = VCHAN / CNT
      IF (IV2.EQ.0) VCH1 = VCHAN
      VCH2 = VCHAN
      DISPLAY 'VCHAN(VOLTS ) =',#VCHAN,' =',#BO,' *',#TCHAN,' +',#A
      DISPLAY 'VCHAN(COUNTS) =',#VCNTS
      DISPLAY
      DISPLAY 'KEYIN "0" TO CONTINUE, "I" TO INPUT CHANNEL "I" DATA ',#

      ACCEPT IV2
      IF (IV2.GT.0) GO TO 10
      GO TO 6
    2 DISPLAY 'OLD SCAN',#K,' = ',#C(K),', KEYIN NEW SCAN',#K,' = ',#
      ACCEPT C(K)
      V(K) = C(K) * CNT
      GO TO 1
    6 RETURN
      END
```

```
C        SUBROUTINE FDETI COMPUTES THE DOUBLE LINEAR
C        INTERPOLATION OF VALUES FOR THE LEAD SULPHIDE
C        DETECTOR TEMPERATURE RATIO.
C
C      USAGE: CALL FDETI (V1,T,V6)
C
C        DESCRIPTION OF PARAMETERS:
C          V1 = WAVELENGTH
C          T  = DETECTOR TEMPERATURE IN DEGREES CENTIGRADE
C          V6 = RETURNED VALUE RATIO
C
      SUBROUTINE FDETI (V1,T,V6)
      DIMENSION PBS(5,6),  P(2)
      DATA PBS /0.0,17.4,23.3,28.5,34.0,1.1,1.0,1.17,1.34,1.53,
               1.6,1.0,1.10,1.24,1.44,2.0,1.0,1.10,1.24,1.44,
               2.4,1.0,1.19,1.44, 1.80,2.5,1.0,1.2125,1.49,1.89/
      K1 = 2
      K2 = 2
    2 IF((T.GE.PBS(K2,1)).AND.(T.LE.PBS(K2+1,1))) GO TO 1
      K2 = S2 + 1
      GO TO 2
    1 IF((V1.GE.PBS(1,K1)).AND.(V1.LE.PBS(1,K1+1))) GO TO 3
      K1 = K1 + 1
      GO TO 1
    3 K3 = K2
      DO 4 K = 1,2
      X1 = PBS(1,K1)
      X2 = PBS(1,K1+1)
      Y1 = PBS(K3,K1)
      Y2 = PBS(K3,K1+1)
      DX = X2 - X1
      DY = Y2 - Y1
      DA = V1 - X1
      P(K) = Y1 + (DA*DY)/DX
      K3 = K3 + 1
    4 CONTINUE
      X1 = PBS(K2,1)
      X2 = PBS(K2+1,1)
      Y1 = P(1)
      Y2 = P(2)
      DX = X2 - X1
      DY = Y2 - Y1
      DA = T - X1
      V6 = Y1 + (DA*DY)/DX
      RETURN
      END
*A
```

APPENDIX C

SAMPLE OUTPUT

```
. . . . . . . . S-191 SINGLE SPECTRAL SCAN ANALYZER . . . . . .
                 COMPILE DATE: APR 12
**********************************************************************
KEYIN SCAN DAY,HR,MIN,SEC = 254,14,00
NEXT DATUM:44
KEYIN RAMP LENGTH IN COUNTS = 973
KEYIN CHANNEL # = 6
```

LONG WAVELENGTH TABLE 1

ROW	LAMBDA	REF VOLTS	ACTUAL VOLTS	RELATIVE COUNT
1	6.00	2.86284	2.867182	573.15669374
2	6.30	2.97227	2.976778	595.06530568
3	6.60	3.08314	3.087814	617.26155880
4	6.90	3.19544	3.200288	639.74545271
5	7.20	3.30918	3.314201	662.51698740
6	7.50	3.42436	3.429554	685.57616287
7	7.80	3.54097	3.546345	708.92297912
8	8.10	3.65902	3.664575	732.55743615
9	8.40	3.77851	3.784243	756.47953398
10	8.70	3.89943	3.905351	780.68927257
11	9.00	4.02180	4.027898	805.18665195
12	9.30	0.62922	0.630177	125.97386862
13	9.60	0.72345	0.724543	144.83786372
14	9.90	0.81599	0.817228	163.36597417
15	10.20	0.90686	0.908234	181.55819998
16	10.50	0.99605	0.997559	199.41454114
17	10.80	1.08356	1.085204	216.93499765
18	11.10	1.16939	1.171169	234.11956952
19	11.40	1.25355	1.255454	250.96825675
20	11.70	1.33603	1.338058	267.48105933
21	12.00	1.41683	1.418982	283.65797726
22	12.30	1.49596	1.498226	299.49901055
23	12.60	1.57340	1.575789	315.00415920
24	12.90	1.68165	1.684206	336.67689942
25	13.20	1.76825	1.770928	354.01287646
26	13.50	1.85484	1.857650	371.34885349
27	13.80	1.94143	1.944373	388.68483053
28	14.10	2.02802	2.031095	406.02080757
29	14.30	2.08574	2.088910	417.57812559
30	14.60	2.17234	2.175632	434.91410262
31	14.90	2.25893	2.262354	452.25007967
32	15.20	2.34552	2.349076	469.58605670
33	15.40	2.40324	2.406891	481.14337473

```
INPUT TD,TR,TA,TS,TH, IN DEGREES CENTIGRADE
KEYIN SCAN DICHROIC TEMPERATURE = 24.893
KEYIN SCAN REFERENCE TEMPERATURE = -15.252
KEYIN SCAN AMBIENT CAL SOURCE TEMPERATURE = 23.281
KEYIN SCAN SPHERE TEMPERATURE = 23.281
KEYIN SCAN HEATED CAL SOURCE TEMPERATURE = 49.025
KEYIN DETECTOR TEMPERATURE IN DEGREES KELVIN = 86.205
TD,TR,TA,TS,TH,TEMP =     24.893   -15.252    23.281    23.281
 49.025    86.205
```

Example 1. – Long wavelength tables 1 and 2; calculations for wavelengths 8.1, 9.3, and 14.1 micrometers; and use of contingency interrupt.

LONG WAVELENGTH TABLE 2

ROW	LAMBDA	RESPONSIVITY	EMISSIVITY	DICHROIC	MIRROR	FDET.TEMP
1	6.00	1.	0.96000	0.66800	0.9300000	1.02651000
2	6.30	1.	0.98000	0.68500	0.9307500	1.02651000
3	6.60	1.	1.00000	0.67700	0.9315000	1.02651000
4	6.90	1.	1.00000	0.67700	0.9322500	1.02651000
5	7.20	1.	1.00000	0.67700	0.9330000	1.02651000
6	7.50	1.	1.00000	0.67700	0.9337500	1.02651000
7	7.80	1.	1.00000	0.67700	0.9345000	1.02651000
8	8.10	1.	0.99800	0.70200	0.9240000	1.02651000
9	8.40	1.	0.99200	0.72100	[illegible]	1.02651000
10	8.70	1.	0.98600	0.73467	0.9023750	1.02651000
11	9.00	1.	0.98000	0.75700	0.8960000	1.02651000
12	9.30	1.	0.98000	[illegible]	0.8909000	1.02651000
13	9.60	1.	0.97800	0.74700	0.8858000	1.02651000
14	9.90	1.	0.97200	0.73050	0.8807000	1.02651000
15	10.20	1.	0.97000	0.71700	0.8908000	1.02651000
16	10.50	1.	0.97000	0.71200	0.9085000	1.02651000
17	10.80	1.	0.96400	0.71200	0.9262000	1.02651000
18	11.10	1.	0.95600	0.71200	0.9389000	1.02651000
19	11.40	1.	0.94400	0.71200	0.9416000	1.02651000
20	11.70	1.	0.94000	0.71833	0.9443000	1.02651000
21	12.00	1.	0.92000	0.72000	0.9470000	1.02651000
22	12.30	1.	0.90500	0.72800	0.9497000	1.02651000
23	12.60	1.	0.92700	0.73000	0.9524000	1.02651000
24	12.90	1.	0.94800	0.72650	0.9551000	1.02651000
25	13.20	1.	0.95900	0.70500	0.9588000	1.02675100
26	13.50	1.	0.96500	0.70850	0.9630000	1.02711250
27	13.80	1.	0.97900	0.71000	0.9672000	1.02747400
28	14.10	1.	1.00000	0.72700	0.9715000	1.02783550
29	14.30	1.	1.00000	0.71550	0.9745000	1.02807650
30	14.60	1.	1.00000	0.64600	0.9790000	1.02843800
31	14.90	1.	1.00000	0.57750	0.9835000	1.02879950
32	15.20	1.	1.00000	0.55100	0.9868000	1.07615600
33	15.40	1.	1.00000	0.55100	0.9886000	1.12339200

```
=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=
     SCAN DAY-HR:MIN:SEC =  254- 14: 0: 44

INPUT FOR-
ESC:  (INPUT)9+1
+GO 77

ERROR(77) INTERRUPT, L =  1, KEYIN NEW L = 8
```

```
INPUT FOR LAMBDA 8.1, CHANNEL # 6, ROW = 8
KEYIN 11 POINTS AROUND 732.5574361 COUNTS
KEYIN 8.1 SCAN( 1 ) = 724
KEYIN 8.1 SCAN( 2 ) = 726
KEYIN 8.1 SCAN( 3 ) = 728
KEYIN 8.1 SCAN( 4 ) = 728
KEYIN 8.1 SCAN( 5 ) = 731
KEYIN 8.1 SCAN( 6 ) = 111
KEYIN 8.1 SCAN( 7 ) = W32
KEYIN 8.1 SCAN( 8 ) = 734
KEYIN 8.1 SCAN( 9 ) = 737
KEYIN 8.1 SCAN( 10 ) = 737
KEYIN 8.1 SCAN( 11 ) = 740
SAMPLE COUNTS ARRAY =      724    726    728    728    731    111
 0    734    737    737    740
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 6
OLD SCAN 6 =  111, KEYIN NEW SCAN 6 = 732
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 7
OLD SCAN 7 =  0, KEYIN NEW SCAN 7 = 734
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 8
OLD SCAN 8 =  734, KEYIN NEW SCAN 8 = 737
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 10
OLD SCAN 10 =  737, KEYIN NEW SCAN 10 = 738
KEYIN "0" TO CONTINUE, "B" TO CHANGE SCAN "J" 0

==============================================================
      VOLTAGE( 8.1, 4) =  8.0032E-03 * SCAN + 3.614808982
==============================================================

KEYIN 5 CHANNEL 6 VALUES AROUND RELATIVE SCAN LINE 6
KEYIN "J" = 1 VALUE FOR SCAN 4 = 394
KEYIN "J" = 2 VALUE FOR SCAN 5 = 397
KEYIN "J" = 3 VALUE FOR SCAN 6 = 400
KEYIN "J" = 4 VALUE FOR SCAN 7 = 401
KEYIN "J" = 5 VALUE FOR SCAN 8 = 400
SAMPLE COUNTS ARRAY =      394    397    400    401    400    0
 0    0    0    0    0
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 0

==============================================================
      VOLTAGE( 8.1, 6) =  8.0032E-03 * SCAN + 1.9447776
==============================================================

VCHAN(VOLTS ) = 1.992542439 = 8.0032E-03 * 5.968217598 + 1.9447776
VCHAN(COUNTS) = 398.3491482

KEYIN "0" TO CONTINUE, "I" TO INPUT CHANNEL "I" DATA 0
COMPUTED VBAR = 1.840062739
LAMBDA/ RESP / EMISS. / RHOD. /  RHOM. /RHOC/   TD   /   TR   /   TA
  8.10      1. 0.99800 0.70200 0.9240000 0.99  298.093 257.948 296.481
 8.844446599E-04 = BLACKBODY RADIANCE FOR DICHROIC TEMPERATURE
 3.49325763E-04 = BLACKBODY RADIANCE FOR REFERENCE TEMPERATURE
 8.5617807E-04 = BLACKBODY RADIANCE FOR AMBIENT CAL SOURCE TEMPERATURE
 8.5617807E-04 = BLACKBODY RADIANCE FOR SPHERE TEMPERATURE
 1.38393694E-03 = BLACKBODY RADIANCE FOR HEATED CAL0SOURCE TEMPERATURE
 3.546769519E-04 = REFERENCE RADIANCE CALCULATION
 8.646015138E-04 = SOURCE RADIANCE AT THE CHOPPER CAL FOR THE AMBIENT SO
RCE                                   U
 1.234347267E-03 = SOURCE RADIANCE AT THE CHOPPER CAL FOR THE HEATED CAL
SOURCE
LAMBDA = 8.1   CHANNEL = 6    LVLIC = 1.840417416
LVLIS = 2.621301783        LVLIF = 2.83683627
====================================================================
```

```
    SCAN DAY-HR
ESC:  (INPUT)9
+GO 77
ERROR(77) INTERRUPT, L =  9, KEYIN NEW L = 12

INPUT FOR LAMBDA 9.3, CHANNEL # 6, ROW = 12
KEYIN 11 POINTS AROUND 125.9738686 COUNTS
KEYIN 9.3 SCAN( 1 ) = 118
KEYIN 9.3 SCAN( 2 ) = 120
KEYIN 9.3 SCAN( 3 ) = 121
KEYIN 9.3 SCAN( 4 ) = 123
KEYIN 9.3 SCAN( 5 ) = 124
KEYIN 9.3 SCAN( 6 ) = 126
KEYIN 9.3 SCAN( 7 ) = 127
KEYIN 9.3 SCAN( 8 ) = 129
KEYIN 9.3 SCAN( 9 ) = 130
KEYIN 9.3 SCAN( 10 ) = 132
KEYIN 9.3 SCAN( 11 ) = 133
SAMPLE COUNTS ARRAY =     118    120    121    123    124    126
 127    129    130    132    133
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 0

==============================================================
      VOLTAGE( 9.3, 4) =  7.503E-03 * SCAN + 0.583869818
==============================================================

KEYIN 5 CHANNEL 6 VALUES AROUND RELATIVE SCAN LINE 6
KEYIN "J" = 1 VALUE FOR SCAN 4 = 554
KEYIN "J" = 2 VALUE FOR SCAN 5 = 560
KEYIN "J" = 3 VALUE FOR SCAN 6 = J62
KEYIN "J" = 4 VALUE FOR SCAN 7 = 560
KEYIN "J" = 5 VALUE FOR SCAN 8 = 557
SAMPLE COUNTS ARRAY =     554    560    0    560    557    0
      0    0    0    0
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 3
OLD SCAN 3 =  0, KEYIN NEW SCAN 3 = 562
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 0

==============================================================
      VOLTAGE( 9.3, 6) =  3.0012E-03 * SCAN + 2.77611
==============================================================

VCHAN(VOLTS ) = 2.79388246 = 3.0012E-03 * 5.921784774 + 2.77611
VCHAN(COUNTS) = 558.5530709

KEYIN "0" TO CONTINUE, "I" TO INPUT CHANNEL "I" DATA 0
COMPUTED VBAR = 2.662646284
LAMBDA/ RESP / EMISS. / RHOD. /  RHOM. /RHOC/   TD   /   TP   /   TA
  9.30     1. 0.98000 0.76200 0.8909000 0.99  298.093 257.948 296.481
 9.59196284=E-04 = BLACKBODY RADIANCE FOR DICHROIC TEMPERATURE
 4.263530757E-04 = BLACKBODY RADIANCE FOR REFERENCE TEMPERATURE
 9.323621744E-04 = BLACKBODY RADIANCE FOR AMBIENT CAL SOURCE TEMPERATURE

 9.323621744E-04 = BLACKBODY RADIANCE FOR SPHERE TEMPERATURE
 1.418631423E-03 = BLACKBODY RADIANCE FOR HEATED CAL SOURCE TEMPERATURE

 4.316815078E-04 = REFERENCE RADIANCE CALCULATION
 9.387486927E-04 = SOURCE RADIANCE AT THE CHOPPER CAL FOR THE AMBIENT SO
RCE                                   U
 1.301875117E-03 = SOURCE RADIANCE AT THE CHOPPER CAL FOR THE HEATED CAL
SOURCE
LAMBDA = 9.3   CHANNEL = 6    LWLIC = 2.663077966
LWLIS = 3.494553382        LWLIF = 3.922383726
=====================================================================
```

```
ESC:  (INPUT)9
               +[--
+GO 77
ERROR(77) INTERRUPT, L =  13, KEYIN NEW L = 28

INPUT FOR LAMBDA 14.1. CHANNEL # 6, ROW = 28
KEYIN 11 POINTS AROUND 406.0208076 COUNTS
KEYIN 14.1 SCAN( 1 ) = 399
KEYIN 14.1 SCAN( 2 ) = 400
KEYIN 14.1 SCAN( 3 ) = 401
KEYIN 14.1 SCAN( 4 ) = 403
KEYIN 14.1 SCAN( 5 ) = 405
KEYIN 14.1 SCAN( 6 ) = 406
KEYIN 14.1 SCAN( 7 ) = 408
KEYIN 14.1 SCAN( 8 ) = 409
KEYIN 14.1 SCAN( 9 ) = 411
KEYIN 14.1 SCAN( 10 ) = 412
KEYIN 14.1 SCAN( 11 ) = 414
SAMPLE COUNTS ARRAY =     399    400    401    403    405    406
 408    409    411    412    414
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 0

==============================================================
      VOLTAGE( 14.1, 4) =  7.639418181E-03 * SCAN + 1.985884945
==============================================================

KEYIN 5 CHANNEL 6 VALUES AROUND RELATIVE SCAN LINE 6
KEYIN "J" = 1 VALUE FOR SCAN 4 = 450
KEYIN "J" = 2 VALUE FOR SCAN 5 = 450
KEYIN "J" = 3 VALUE FOR SCAN 6 = 453
KEYIN "J" = 4 VALUE FOR SCAN 7 = 450
KEYIN "J" = 5 VALUE FOR SCAN 8 = 454
SAMPLE COUNTS ARRAY =     450    450    453    450    454    0
 0    0    0    0    0
KEYIN "0" TO CONTINUE, "J" TO CHANGE SCAN "J" 0

==============================================================
      VOLTAGE( 14.1, 6) =  4.001600001E-03 * SCAN + 2.2338932
==============================================================

VCHAN(VOLTS ) = 2.256574115 = 4.001600001E-03 * 5.667961563 + 2.2338932

VCHAN(COUNTS) = 451.1343692

KEYIN "0" TO CONTINUE, "I" TO INPUT CHANNEL "I" DATA 0
COMPUTED VBAR = 2.113819884
LAMBDA/ RESP / EMISS. / RHOD. /  RHOM. /RHOC/   TD   /   TP   /   TA
 14.10     1. 1.00000 0.72700 0.9715000 0.99  298.093 257.948 296.481
 7.20294357E-04 = BLACKBODY RADIANCE FOR DICHROIC TEMPERATURE
 4.169963817E-04 = BLACKBODY RADIANCE FOR REFERENCE TEMPERATURE
 7.065728968E-04 = BLACKBODY RADIANCE FOR AMBIENT CAL SOURCE TEMPERATURE

 7.065728968E-04 = BLACKBODY RADIANCE FOR SPHERE TEMPERATURE
 9.400443368E-04 = BLACKBODY RADIANCE FOR HEATED CAL SOURCE TEMPERATURE

 4.200293615E-04 = REFERENCE RADIANCE CALCULATION
 7.103188554E-04 = SOURCE RADIANCE AT THE CHOPPER CAL FOR THE AMBIENT SO
RCE                                       U
 8.800525923E-04 = SOURCE RADIANCE AT THE CHOPPER CAL FOR THE HEATED CAL
SOURCE
LAMBDA = 14.1   CHANNEL = 6    LWLIC = 2.114239913
LWLIS = 2.907899963       LWLIF = 2.993185615
=====================================================================
```

```
ESC:  (INPUT)9+1
+GO 3
==============SHORT WAVELENGTH CALCULATIONS FOLLOW============
    0                          SHORT WAVELENGTH TABLE 3
ROW--LAMBDA--REF VOLTS--ACTUAL VOLTS--RELATIVE COUNT--RESPONSIVITY
 34     0.40   2.51504       2.518860       503.52619946            1.0
 35     0.42   2.58373       2.587652       517.27802572            1.0
 36     0.44   2.65244       2.656464       531.03366140            1.0
 37     0.46   2.72117       2.725295       544.79310650            1.0
 38     0.48   2.78991       2.794145       558.55636101            1.0
 39     0.50   2.85868       2.863014       572.32342496            1.0
 40     0.52   2.92746       2.931902       586.09429831            1.0
 41     0.54   2.99626       3.000809       599.86898109            1.0
 42     0.56   3.06508       3.069735       613.64747328            1.0
 43     0.58   3.13392       3.138680       627.42977490            1.0
 44     0.60   3.20278       3.207644       641.21588592            1.0
 45     0.62   3.27166       3.276627       655.00580638            1.0
 46     0.64   3.34056       3.345630       668.79953625            1.0
 47     0.66   3.40978       3.414651       682.59707554            1.0
 48     0.68   3.47841       3.483691       696.39842424            1.0
 49     0.70   3.54737       3.552751       710.20358238            1.0
 50     0.72   3.77324       3.778968       755.42494741            1.0
 51     0.74   3.80371       3.809484       761.52517691            1.0
 52     0.76    3.83418       3.840000       767.62540642            1.0
 53     0.78   3.86465       3.870516       773.72563592            1.0
 54     0.80   3.89512       3.901032       779.82586543            1.0
 55     0.82   3.92559       3.931548       785.92609494            1.0
 56     0.84   3.95606       3.962064       792.02632444            1.0
 57     0.86   3.98653       3.992580       798.12655395            1.0
 58     0.88   4.01700       4.023096       804.22678345            1.0
 59     0.90   4.04747       4.053612       810.32701296            1.0
 60     0.93   4.09318       4.099386       819.47735721            1.0
 61     0.96   4.13888       4.145160       828.62770147            1.0
 62     1.10   4.35217       4.358773       871.32930802            1.0
=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=
      SCAN DAY-HR:MIN:SEC = 254- 14: 0: 44

INPUT FOR LAMBDA 0.4, CHANNEL # 6, ROW = 34
KEYIN 11 POINTS AROUND 503.5261995 COUNTS
KEYIN 0.4 SCAN( 1 ) = H
ESC:  (INPUT)9+1

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    +
```

Example 2. — Short wavelength table 3.

GO 1

==============NEAR INFRA-RED CALCULATIONS FOLLOW==============

KEYIN DETECTOR TEMPERATURE IN DEGREES CENTIGRADE = 24.6623

LEAD SULPHIDE TABLE 4

ROW	LAMBDA	REF VOLTS	ACTUAL VOLTS	RELATIVE COUNTS	RESP.	FDET1TEMP
63	1.40	0.22605	0.226397	45.25740927	1.	1.1678211
64	1.44	0.29490	0.295345	59.04015624	1.	1.1615923
65	1.48	0.36459	0.365144	72.99313128	1.	1.1553436
66	1.52	0.43513	0.435794	87.11633438	1.	1.1491348
67	1.56	0.50653	0.507296	101.40976557	1.	1.1429061
68	1.60	0.57877	0.579650	115.87342482	1.	1.1366773
69	1.64	0.65187	0.652855	130.50731215	1.	1.1366773
70	1.68	0.72581	0.726912	145.31142755	1.	1.1366773
71	1.72	0.80061	0.801820	160.28577102	1.	1.1366773
72	1.76	0.87625	0.877580	175.43034256	1.	1.1366773
73	1.80	0.95275	0.954191	190.74514217	1.	1.1366773
74	1.84	1.03009	1.031654	206.23016986	1.	1.1366773
75	1.88	1.10829	1.109969	221.88542561	1.	1.1366773
76	1.92	1.18733	1.189335	237.71090944	1.	1.1366773
77	1.96	1.26723	1.269152	253.70662134	1.	1.1366773
78	2.00	1.34798	1.350021	269.87256132	1.	1.1366773
79	2.04	1.42957	1.431742	286.20872936	1.	1.1485591
80	2.08	1.51202	1.514314	302.71512548	1.	1.1604409
81	2.12	1.59532	1.597738	319.39174966	1.	1.1723227
82	2.16	1.67947	1.682013	336.23860192	1.	1.1842045
83	2.20	1.76446	1.767140	353.25568225	1.	1.1960863
84	2.24	1.85031	1.853119	370.44299066	1.	1.2079680
85	2.28	1.93701	1.939949	387.80052713	1.	1.2198498
86	2.32	2.02456	2.027630	405.32829168	1.	1.2317316
87	2.36	2.11296	2.116164	423.02628430	1.	1.2436134
88	2.40	2.20221	2.205548	440.89450498	1.	1.2554952
89	2.44	2.29231	2.295785	458.93295375	1.	1.2673770
90	2.48	2.38326	2.386872	477.14163058	1.	1.2792588

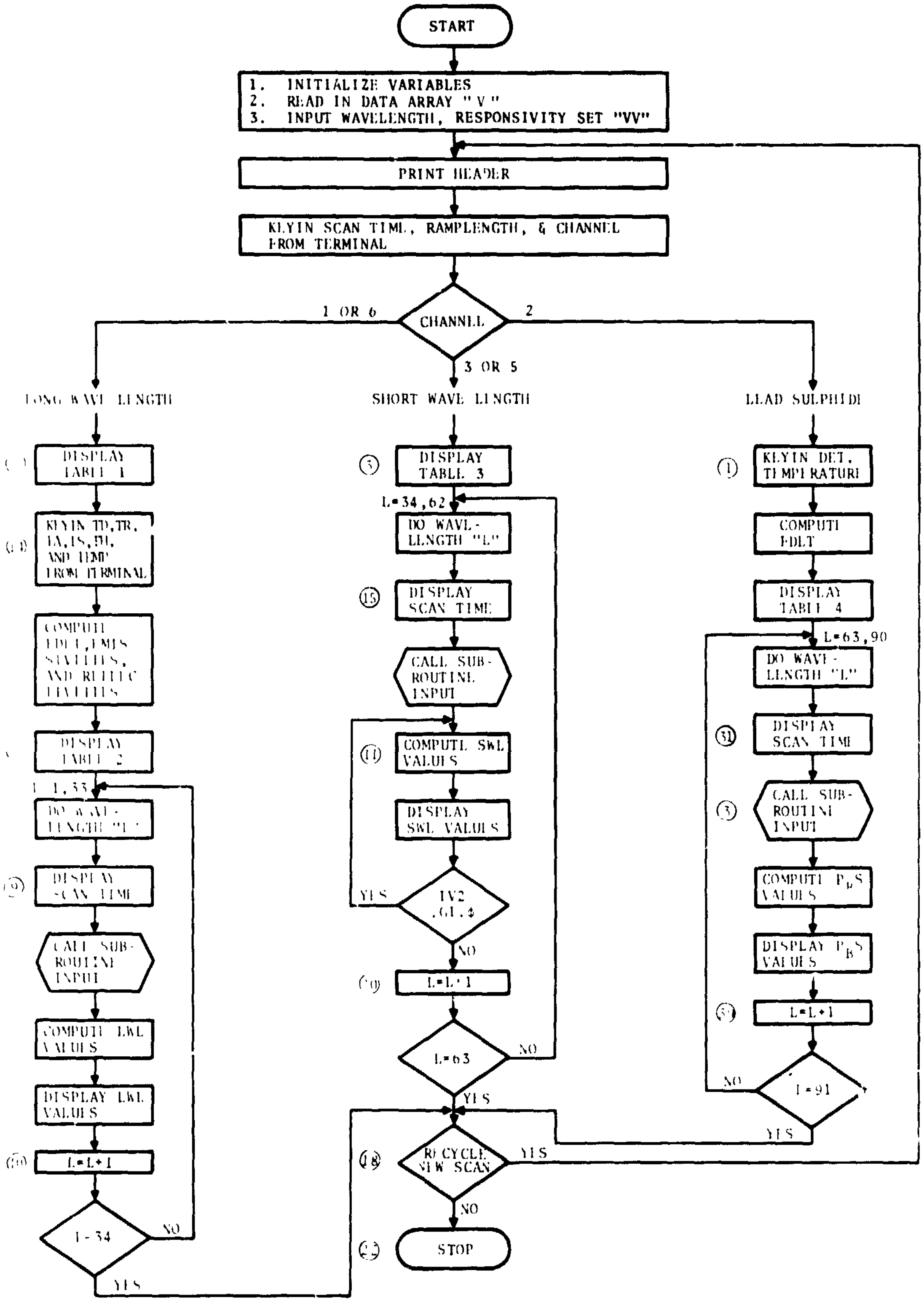
=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=0=

Example 3. – Near infrared table 4.

APPENDIX D

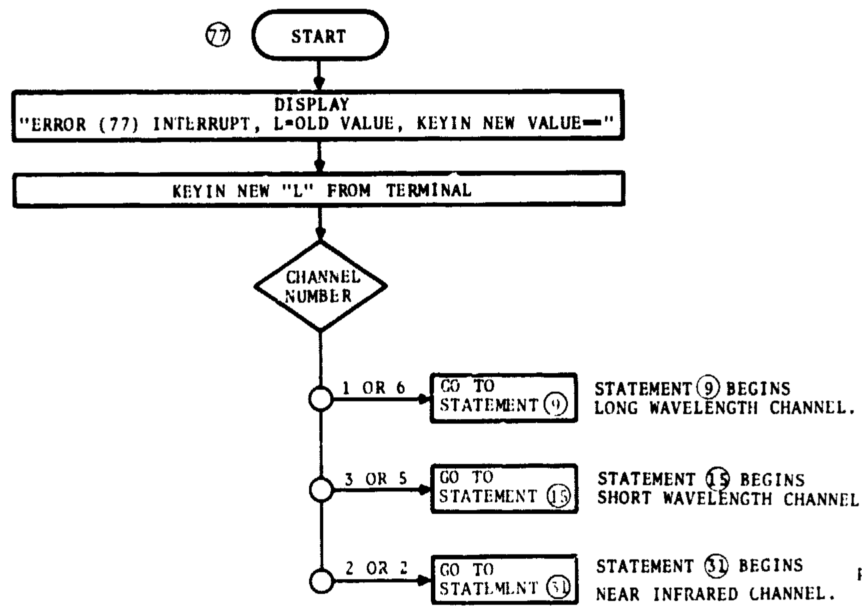
FLOW DIAGRAMS

S-191 SINGLE SPECTRAL SCAN ANALYSIS PROGRAM



REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

S-191 CONTINGENCY INTERRUPT OVERLAY



*NOTE: STATEMENT (77) IS ACCESSED BY KEYING IN "GO 77 CARRIAGE RETURN" AFTER AN "ESCAPE" IS HIT, OR BY KEYING IN "GO 77 CARRIAGE RETURN" AFTER A SYSTEM ERROR OCCURS.

APPENDIX E

S042-5 SAMPLE INPUT SOURCE LISTING

***S191 RAW DATA (CHANNELS A1 THROUGH A6)**
PROJECT 1-090-303-LC3-41-2

MISSION 3 ORBIT 0 SITE 0
SENSOR S191 RECORDING FORMAT S191 (191) FLIGHT DATE 11 SEP 73

GMT HRS:MINS:SECS	A001 LWL RAD PBS AND S13 COUNTS	A002 SWL RAD COUNTS	A003 SWL RAD S11 COUNTS	A004 FILTER POSITION COUNTS	A005 SWL RAD S12 COUNTS	A006 LWL RAD DET POS COUNTS
13:56:10.827	391.	5.	15.	719.	6.	0.
13:56:10.828	390.	5.	15.	721.	6.	0.
13:56:10.830	393.	6.	14.	723.	5.	0.
13:56:10.831	393.	7.	13.	724.	5.	0.
13:56:10.833	389.	4.	14.	1 → 726.	5.	0.
13:56:10.834	386.	7.	13.	2 → 727.	5.	0.
13:56:10.836	378.	7.	13.	3 → 729.	5.	0.
13:56:10.837	383. ← 1	5.	13.	4 → 730.	5.	0.
13:56:10.839	384. ← 2	5.	11.	5 → 732.	5.	0.
13:56:10.840	387. ← 3	5.	11.	6 → 733.	5.	0.
13:56:10.842	391. ← 4	5.	12.	7 → 735.	5.	0.
13:56:10.843	396. ← 5	4.	12.	8 → 736.	5.	0.
13:56:10.844	399.	4.	12.	9 → 738.	5.	0.
13:56:10.846	401.	6.	13.	10 → 739.	5.	0.
13:56:10.847	402.	6.	13.	11 → 741.	5.	0.
13:56:10.849	406.	5.	13.	741.	5.	0.
13:56:10.850	409.	5.	14.	744.	5.	0.
13:56:10.852	412.	7.	15.	746.	5.	0.
13:56:10.853	413.	7.	15.	747.	5.	0.
13:56:10.855	411.	7.	15.	748.	5.	0.
13:56:10.856	415.	6.	15.	750.	5.	0.
13:56:10.858	416.	4.	13.	752.	5.	0.
13:56:10.859	421.	3.	12.	753.	5.	0.
13:56:10.861	426.	2.	11.	755.	5.	0.
13:56:10.862	429.	1.	12.	756.	5.	0.
13:56:10.863	427.	3.	12.	758.	5.	0.
13:56:10.865	435.	3.	13.	759.	5.	0.
13:56:10.866	435.	4.	13.	761.	5.	0.
13:56:10.868	440.	4.	12.	762.	5.	0.
13:56:10.869	446.	4.	12.	764.	5.	0.
13:56:10.871	446.	3.	14.	766.	5.	0.
13:56:10.872	449.	3.	14.	767.	5.	0.

*See appendix C, example 1, wavelength = 8.1 micrometers for an application of this source listing and the use of the relative scan line numbers.