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LARSPEC User's Manual

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Preface

LARSPEC is a system of Fortran and assembler computer programs used to access and analyze data obtained from spectrometer or multiband radiometer systems that have been used for laboratory or field research. The LARSPEC software system is designed to be used on an IBM computer operating under VM370/CMS. LARSPEC has been through several stages of development since its initiation in 1972 by William R. Simmons.

The purpose of the 'LARSPEC User's Manual' is to describe the capabilities of the LARSPEC system to researchers and how to access and use the system.

Several people have contributed to the development of the LARSPEC software system:

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1. Introduction

LARSPEC is a system of Fortran and assembler computer programs used to access and analyze data obtained by spectrometer or multiband radiometer systems that have been used for laboratory or field research.

The data used for input to LARSPEC include spectral information either in 'continuous' wavelength formats - spectrometers - or in discrete wavelength bands - multiband radiometers. The data also include identification information such as crop species that are stored with the spectral information.

Instruments that have been used to collect spectral data for laboratory or field research that are included in the LARSPEC system are:

- Purdue/LARS Exotech 20C field spectroradiometer system
- NASA/JSC Field Spectrometer System (FSS)
- NASA/JSC Field Signature Acquisition System (FSAS)
- NASA/ERL Exotech 20D field spectroradiometer system
- Purdue/LARS Exotech 100 Landsat band radiometer field system
- Purdue/LARS Clevenger spectrometer system

One can refer to NASA/JSC Field Research Project Plans for more information describing the spectrometer or multiband radiometer systems. The LARSPEC data format is general so that the data from most any spectrometer or radiometer system may be included in the LARSPEC data band.

LARSPEC has three overall capabilities:

- Printing and punching statistics of wavelength bands (DSEL)
- Plotting identification information and spectral data (GSPEC)
- Printing and punching identification record information (IDLIST)

The following subsections - 1.1, 1.2, and 1.3 - briefly discuss the capabilities of the three processors.

Section 2, Operating Procedures, describes how to access the LARSPEC system. Section 3, Control Card Dictionary, discusses the function of the LARSPEC terminal commands and control cards. Section 4, Processor Input and Output Descriptions, discusses example control card decks which illustrate the capabilities of each of the three processors. Section 5, Identification Record Mnemonic Codes, list the four-letter codes for each parameter in the identification record. Section 6, Format of Punch Output, describes the format of the punch output from each processor. Section 7, Error Messages, describes the LARSPEC error messages.

The appendices provide support information. Appendix A is a copy of the abbreviated control card listing that the user can obtain at the computer using the LARSPEC terminal command - 'REFERENCE'. Appendix B describes the tape format of the spectrometer/radiometer data. Appendix C describes a utility processor to copy and update the spectrometer/radiometer tapes. Appendix D includes a listing of the spectrometer/radiometer library data tapes.

1.1 DSEL - Data Selection Processor

The DSEL processor can select observations according to user specified ID parameters and calculate averages of data values over user specified wavelength bands. The averaged band means can be printed along with other descriptive statistics which include standard deviation, range, variance, and percent deviation. A matrix of interband correlations can also be requested. The band mean information can be punched on computer cards along with, optionally, the agronomic and/or geometric parameters (the same set as IDLIST punches). This deck can be used as input to statistical analysis packages.

A clustering algorithm is also available in the DSEL processor to separate the specified observations into spectral subclasses. The printed output using the cluster option includes a grouping table based on a separability measure called transformed divergence, cluster means and variances, and number of data points per cluster class. A LARSYS-formatted statistics deck can be punched for use with the LARSYS software system.

1.2 GSPEC - Data Graph Processor

The GSPEC processor is used for data verification, exploratory analysis of spectral characteristics, and qualitative assessments of relationships between reflectance and wavelength and/or agronomic or soil characteristics.

This processor can select either all observations in a data set or a subset of the data depending on the user specified ID parameters. GSPEC provides graphical output of the data for certain spectra - reflective and/or emissive for the observation. The graph or plot may be of the values of one individual spectra or an average of the values of several spectra depending on user specified parameters.

The graph output can be sent to either the line printer, user terminal, or the Varian (an electro-static printer). The plotting options available include polar coordinates, logarithmic scales, curvefitting, and general scaling and plot specifications. The graph values can be printed in tables or punched in binary format on computer cards for use with other computer programs.

1.3 IDLIST - Data Identification List Processor

The IDLIST processor is used to select certain observations and print the identification (ID) information associated with those observations. The observations are selected according to user specified ID parameters such as all observations with a scene type 'CORN' or all observations collected on a particular date in the crop year. After either the entire data set or a subset of the data is selected, the user is able to specify which of the ID parameters is to be printed. This listing of selected observations is printed at the line printer. An additional feature of IDLIST is the ability to output subsets of the ID information - agronomic and/or geometric - in a card format or disk file that is useable in subsequent data analyses using other software such as SPSS or SAS.

2. Procedures For Using LARSPEC

Abbreviated commands are used in the LARSPEC system to allow the user to specify various functions to be performed. The commands are of two types: (1) terminal commands, similar to CMS commands, to specify various virtual computer configurations and (2) control card commands to specify the operations to be performed on the LARSPEC data. LARSPEC control cards are organized using a monitor-supervisor concept. 'Monitor' commands designate which of the processing functions (IDLIST, DSEL, or GSPEC) will be initiated. Supervisor commands designate the options within a processing function.

There are two modes under which LARSPEC jobs may be processed: (1) batch and (2) interactive. Each mode has different methods of use. Three ways to submit batch jobs are (Section 2.1):

- LARSPEC BATCH terminal command (see page 2-4).
- Control cards from card reader (see page 2-8).
- Control cards from disk file (see page 2-9).

Three ways to submit interactive jobs are (Section 2.2):

- Control cards from card reader (see page 2-11).
- Control cards from disk file (see page 2-13).
- Control cards from terminal (see page 2-14).

The procedures for each of the above six methods to submit a LARSPEC job are described on the page listed with each method.

The data input to the LARSPEC system may be from either tape or disk files. The researcher should refer to the 'Field Research Spectrometer/Radiometer Library Tape Listing' for the tape numbers containing the desired data. Section 4 contains examples of LARSPEC programs using tapes as the data input. Section 2.3 discusses how to set up a LARSPEC data base on a disk file.

Punch output from the LARSPEC system may be placed directly onto a disk file (instead of on cards). Section 2.4 discusses how to direct punch output to a disk file.

2.1 Batch Mode

The 'batch' cards and the LARSPEC control cards for the batch processor can be: (1) punched on computer cards and sent to the batch processor from a card reader, (2) entered on a disk file and sent to the batch processor from disk, or (3) submitted using the LARSPEC 'BATCH' terminal command to set up the 'batch' cards and send the job to the batch processor.

The general form of a LARSPEC batch job is:

BATCH MACHINE 'machine name'

User one of batch machines:

Machine	Time Limit (Min)	Operation
BATQUICK	1	Day/Night
BATSHORT	15	Day/Night
BATMED	45	Day/Night
BATLONG	500	Night
BATEOD	60	Day/Night
BATJSC	240	Night

BATCH ID 'User ID' 'User first name' 'User last name'

BATCH OUTPUT printsite / @userid (COPY NN CLASS X HOLD / NOHOLD) punchsite / @userid (*)

* same as for printer
NN is number of copies. Must be less than 100.
  NN default is 1
X is any valid computer class. Default is A.
COPY, CLASS, HOLD, and NOHOLD may be abbreviated as
  CO, CL, HO, NO.
NOHOLD is default
The options may be in any order
If @userid is used, printer or punched output will
  be spooled to a reader file of that userid.

I LARSPEC

RUN LARSPEC RUN

LARSPEC control cards

An alternative form is:

```
BATCH MACHINE....
BATCH ID....
BATCH OUTPUT....
EXEC$$
EXEC  CONFIGUR LARSPEC
&STACK  RUN LARSPEC
EXEC LARSPEC PUNCH DISK
EXEC BACKUP 'tape in' D
$$
LARSPEC control cards
```

This setup allows one to back any punch output onto tape during the batch job session.

Batch job submitted using LARSPEC BATCH terminal command

If the user has the LARSPEC control cards (with no batch cards) on his permanent disk or in his card reader and wants to send the job to the batch processor, he can use the LARSPEC BATCH terminal command. The procedure to submit a batch job using the BATCH terminal command is:

- Initialize LARSPEC (I LARSPEC)
- Enter LARSPEC control cards on disk (if not already done so) using
  CMS EDIT
  or
  Keypunch and read control cards in card reader with 'ID userid' as first card.
- Type the LARSPEC Terminal Command:

  CCINPUT 'filename' 'filetype'

  where 'filename' 'filetype' is the name of the control card disk file or

  CCINPUT CARDS

  for control cards in card reader
- Type the LARSPEC Terminal Command:

  PRINT 'print location'

  to change the print output location for the batch job if desired.
- Type the LARSPEC Terminal Command:

  PUNCH 'punch location'

  to change the punch output location for the batch job if desired.
- Type the LARSPEC Terminal Command:

  BATCH
  or
  BATCH BACKUP 'tape' [(FILE 'filename' or INIT]

  BATCH specifies that the 'normal' set of batch cards will be used. BATCH BACKUP 'tape' specifies that the batch cards are to be set up so that any punch output will be backed up onto tape 'tape number'.

  Note: The options BACKUP 'tape' are considered as a group which are either all included or all omitted. There are no defaults for the BACKUP tape. The BACKUP output is placed in the last file on the BACKUP tape, or optionally the specified file, (FILE 'filenumber', or the initial file, (INIT.

- The user is now in the LARSPEC BATCH sub-environment. The list of batch cards is printed on the terminal. The user, after reviewing the list, may do one of three things:
  - send the job to the batch processor with batch cards as presently set up
  - change the batch card specifications
  - exit the LARSPEC BATCH sub-environment
- Change (CHANGE) the batch card specifications if desired.

  The specifications that may be changed are:

  BATCH machine
  (enter ? for list of current batch machines)

  Printer site

  Punch site

  User ID and user name

  LARSPEC input file
  enter new filename filetype
  or enter RDR for reader file

  User has option to display the specified control card file at the terminal

  NOTE: If the user presses the return key when prompted for particular changes, no changes will be made.

  NOTE: The user can not activate or deactivate the BATCH BACKUP option while in the BATCH sub-environment. If a change is desired, exit BATCH sub-environment and reenter.
- Send (SEND) the control cards with specified batch cards to the batch processor.

  After the SEND command is issued, control is returned to the user to exit the LARSPEC BATCH sub-environment change the batch specifications for a new input file, or repeat the send command.
- Exit (EXIT) the LARSPEC BATCH sub-environment

  Control is returned to the LARSPEC environment.

An example of the terminal output during a session using the LARSPEC BATCH terminal command follows. The commands in lower case are typed by the user. The commands in upper case are issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user commands.

```
>login example
ENTER PASSWORD
XXXXXXX
ENTER NAME:  john doe
LOGMSG 09:08:22 EST THURSDAY 11/15/79
LOGON AT 09:09:23 EST THURSDAY 11/15/79
>i larspec
T=0.08/0.25 09:10:30
>ccinput id list
T=0.04/0.07 09:11:03
>print   computer
FUTURE PRINTER OUTPUT WILL BE PRINTED AT THE COMPUTER SITE.
T=0.05/0.09 09:11:08
>batch

BATCH CARDS AT THE PRESENT ARE:

BATCH MACHINE BATEOD
BATCH ID 'YOURID' 'FIRST' 'LAST'
BATCH OUTPUT COMPUTER COMPUTER
I LARSPEC
RUN LARSPEC RUN
CONTROL CARDS -- DISK FILE -- ID LIST

DO YOU WANT TO SEND CARDS TO BATCH ( SEND ) , CHANGE BATCH
CARDS ( CHANGE ) , OR EXIT BATCH FUNCTION ( EXIT ) ?
>change
CHANGES IN [ MACHINE, PRINTER, PUNCH, ID, NAME, FILENAME,
FILETYPE.]

MACHINE ( NOW IS BATEOD . ENTER '?' TO SEE BATCH MACHINE
LIST  )
>?

            MACHINE      CPU LIM.      COST/HR      OPERATION
            -------      --------      -------      ---------
            BATQUICK       1 MIN.       $565        DAY/NIGHT
            BATSHORT      15 MIN.       $565        DAY/NIGHT
            BATMED        45 MIN.       $565        DAY/NIGHT
            BATLONG      500 MIN.       $325          NIGHT
            BATEOD        60 MIN.       $565        DAY/NIGHT
            BATJSC       240 MIN.       $325          NIGHT

MACHINE ( NOW IS BATEOD . ENTER '?' TO SEE BATCH MACHINE
LIST. )
>batjsc
PRINTER ( NOW IS COMPUTER ) :
>
PUNCH ( NOW IS COMPUTER ) :
>
USER ID AND USER'S NAME ( NOW IS 'YOURID' 'FIRST' 'LAST' ) :
>
FILENAME - FILETYPE ( NOW IS ID LIST . ENTER 'RDR' FOR
CARD READER. ) :
>
```

```
TYPE CARD FILE AT TERMINAL ( YES, NO ) :
>yes

$TAPE 3986
$IDLIST
END
$END
$EXIT

HIT 'RETURN' TO CONTINUE
>
BATCH CARDS AT THE PRESENT ARE:

BATCH MACHINE BATJSC
BATCH ID 'YOURID' 'FIRST' 'LAST'
BATCH OUTPUT COMPUTER COMPUTER
I LARSPEC
RUN LARSPEC RUN
CONTROL CARDS -- DISK FILE -- ID LIST

DO YOU WANT TO SEND CARDS TO BATCH ( SEND ) , CHANGE BATCH
CARDS ( CHANGE ) , OR EXIT BATCH FUNCTION ( EXIT ) ?
>send
THESE BATCH CARDS WILL BE SENT TO BATJSC
PUN FILE 5121 TO BATCH    COPY 01 NOHOLD
DO YOU WANT TO SEND CARDS TO BATCH ( SEND ) , CHANGE BATCH
CARDS ( CHANGE ) , OR EXIT BATCH FUNCTION ( EXIT ) ?
>exit
T=0.42/1.11 09:12:21
```

In the above example, the control card input was from a disk file named 'ID LIST' and the printer output was designated to go to the computer room. The 'normal' batch cards were designated. The only batch card option that was changed was the batch machine - BATEOD to BATJSC. The control card disk file was printed at the terminal so that the user could verify the control cards.

Batch job submitted from card reader

The procedure to follow to submit a batch job from the card reader is:

- Keypunch 'ID BATCH' card
- Keypunch Batch cards
- Keypunch LARSPEC control cards
- Read cards into card reader

An example deck is:

```
ID          BATCH
BATCH MACHINE BATEOD
BATCH ID EXAMPLE JOHN DOE
BATCH OUTPUT COMPUTER COMPUTER
I LARSPEC
RUN LARSPEC RUN
$TAPE 4290
$IDLIST
SELECT RUSE(1-20)
LIST DACO, SCTY
END
$END
$EXIT
```

Batch job submitted from disk file

The procedure to follow to submit a LARSPEC job to the batch processor from control cards in a disk file is:

- Enter LARSPEC control cards on disk with name 'filename' 'filetype' using either CMS EDIT command or reading them onto disk from the card reader.
- Enter Batch cards at the beginning of the file using CMS EDIT command.
- Type (in CMS)
  SPOOL PUNCH TO BATCH
  PUNCH 'filename' 'filetype'
  SPOOL PUNCH TO 'user punchsite'
  or
  SPOOL PUNCH OFF   to send punch output to computer room

An example LARSPEC control card deck entered on a disk file name 'ID LIST' to be sent to the batch processor is:

```
BATCH MACHINE BATEOD
BATCH ID EXAMPLE JOHN DOE
BATCH OUTPUT COMPUTER COMPUTER
I LARSPEC
RUN LARSPEC RUN
$TAPE 4290
$IDLIST
SELECT RUSE(1-20)
LIST DACO, SCTY
END
$END
$EXIT
```

An example of the terminal commands to send a LARSPEC job to the batch processor from control cards in a disk file follows. The commands in lower case are those typed by the user. The commands in upper case are issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user commands.

```
>i cms370
CMS (VERSION 5.12) READY:
>edit id list
R; T=0.03/0.09 09:12:04

EDIT:
>i
INPUT:
>batch machine bateod
>batch id example john doe
>batch output computer computer
>i larspec
>run larspec run
>
EDIT:
>file
R; T=0.04/0.17 09:12:53

>spool punch to batch
R; T=0.01/0.01 09:13:00

>punch id list
PUN FILE 4809   TO BATCH   COPY 01 NOHOLD
R; T=0.01/0.04 09:13:06

>spool punch off
R; T=0.01/0.01 09:13:58
```

In the above terminal session, the control card file named 'ID LIST' had been created during a previous session using CMS EDIT. The five 'batch' cards were entered at the beginning of the file and then the edited file was sent to the batch processor using the 'SPOOL' and 'PUNCH' CP/CMS commands. After the punch output was spooled back to the computer room, the user could then log off or continue the terminal session.

2.2 Interactive Mode

LARSPEC can be run interactively at the user cathode ray tube (CRT) or typewriter terminal. The user may: (1) keypunch the LARSPEC control cards and submit them from the card reader, (2) enter the control cards on his permanent disk or (3) enter the control cards directly into the LARSPEC program during execution. The three methods are described more fully below.

<u>Interactive job with control cards from card reader</u>

The procedure to submit an interactive job via the card reader is:

- Keypunch control cards
- Read the control card deck with an 'ID' card as the first card into card reader
- Log onto the computer
- Initialize LARSPEC (I LARSPEC)
- Start execution (RUN LARSPEC)

An example deck set up to be read into the card reader follows:

```
ID        EXAMPLE
$TAPE 4290
$IDLIST
SELECT RUSE(1-20)
LIST DACO, SCTY
END
$END
$EXIT
```

An example of the terminal commands to execute a LARSPEC job via control cards from the card reader is given below. The commands in lower case are those typed by the user. The commands in upper case are issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user commands.

```
>login example
ENTER PASSWORD:
XXXXXXXXXXXXXX
ENTER NAME:  john doe
LOGMSG 08:31:06 EST Thursday 09/27/79
FILES:  001 RDR, NO PRT, NO PUN
LOGON AT 08:33:21 EST Thursday 09/27/79
>i larspec
T=0.08/0.19 08:33:58
>run larspec
```

After the temp disks and system disks have been attached, LARSPEC will begin execution using the cards that were read into the card reader as the control card input. The user does not need to specify that the cards are coming from the card reader because this method is the default. Note that if there is more than one reader file in the card reader, LARSPEC will try to execute the first input file in the queue even though it may not be the desired file of LARSPEC control cards.

Interactive job with control cards from disk file

The procedure to submit an interactive job from a disk file is:

- Log onto the computer
- Initialize LARSPEC (I LARSPEC)
- Enter LARSPEC control cards on disk with name 'filename' 'filetype' using either CMS EDIT command or reading them onto disk from the card reader.
- Identify disk file as control card input (CCINPUT)
- Start execution (RUN LARSPEC)

An example control card deck set up on the user's permanent disk with name 'IDLIST CC' is:

```
$TAPE 4290
$IDLIST
SELECT RUSE(1-20)
LIST DACO, SCTY
END
$END
$EXIT
```

An example of the terminal commands to execute the above control cards is given below. The commands in lower case are typed by the user. The commands in upper case are issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user commands.

```
>login example
ENTER PASSWORD:
XXXXXXXXXXXXXX
ENTER NAME:  john doe
LOGMSG - 08:06:54 EST Thursday 09/27/79
LOGON AT 08:10:28 EST Thursday 09/27/79
>i larspec
SPECTRAL ANALYSIS SYSTEM READY
T=0.08/0.18 08:21:22
>edit idlist cc
   .      .
   .      .           create disk file using CMS EDIT
   .      .
>file
T=0.10/0.20 08:25:20
>ccinput idlist cc
T=0.04/0.06 08:25:32
>run larspec
```

At this point in processing, LARSPEC will attach the appropriate system and temp disks, check control cards contained in file 'IDLIST CC' for errors, and execute the job. The output will be sent to the remote site of the user. After execution is completed, control will be returned to the LARSPEC environment ready for the user to enter another 'CCINPUT' command or the user can log off the system.

Interactive job with control cards from terminal

The last method of executing a LARSPEC job interactively is to enter each control card at the terminal. LARSPEC checks the format of each card as it is typed. If no error occurs, the next control card can be issued until all the cards have been entered. The LARSPEC terminal command that controls this method is 'CCINPUT TERMINAL'.

The procedure to enter the control cards to the LARSPEC program directly is:

- Log onto the computer
- Initialize LARSPEC (I LARSPEC)
- Identify terminal as control card input (CCINPUT TERMINAL)
- Execute job (RUN LARSPEC)
- Enter control cards

An example of the terminal commands to execute a job interactively with control cards entered from the terminal is given below. The control card deck example is the same as the one illustrated in the previous discussion on control cards from disk. The commands in lower case are those typed by the user. The commands in upper case are issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user input.

```
>login exmaple
ENTER PASSWORD:
>XXXXXXXXXXXXXX
ENTER NAME:  john doe
LOGMSG - 09:12:23  EST Thursday 09/27/79
LOGON AT 09:12:46  EST Thursday 09/27/79
>i larspec
SPECTRAL ANALYSIS SYSTEM READY
T=0.08/0.18  09:13:31
>ccinput terminal
T=0.02/0.04  09:13:31
>run larspec
DASD 192 DETACHED
GETTING REQUESTED TEMP DISK
LARSLIB 29C HAS BEEN ATTACHED AS 29C
C(29) R/O
29C HAS BEEN LOGGED IN AS C DISK
DASD 29C DETACHED
EXECUTION BEGINS . . .
******LARSPEC VERSION 3.0 -- REVISED 08/07/79
>$tape 4290
******$TAPE 4290
>$idlist
*****$IDLIST
>select ruse(1-20)
>list daco,scty
>end
I0002 TAPE 4290 HAS BEEN REQUESTED ON UNIT 181 (TAPMOUNT)
TAPE 181 ATTACHED
I0003 TAPE READY . . . EXECUTION CONTINUING (TAPMOUNT)
  $IDLIST REENTRY
>$end
*****$END
>$exit
*****$EXIT
*****JOB COMPLETED.  CORRECT CONTROL CARD ERRORS (IF ANY) IF YOU WISH TO
     REUSE DECK.
PRT FILE 2498 to RSCS COPY 01 NOHOLD
T=1.90/3.81  09:15:31
```

At the end of processing, control is returned to LARSPEC COMMAND environment where the user can issue another 'CCINPUT' command or log off the system.

A disadvantage of this method is that the control cards are not saved. This method, however, is an easy way to run short, one-time jobs.

2.3 Data Input From Disk

Data input to the LARSPEC system may be from disk, in addition to tape. Data input from disk is a two step process.

1) Set up data disk file for LARSPEC input
2) Execute LARSPEC jobs using data disk file as input

This section covers the first step. The execution step for jobs with disk file input is the same as for jobs with tape file input. The only difference is that one uses the $TAPE moniter control card and the other uses the $DISK moniter control card.

The input disk file can be set up in two ways:

a) copy desired data from LARSPEC tape to LARSPEC data disk
b) Transfer saved data disk file from backup tape or user's permanent disk to LARSPEC data disk. In other words the data file was created in a previous session and saved on a user backup tape or copied to the users permanent disk.

Method to copy data from LARSPEC tape to LARSPEC data disk

The procedure to create a data disk file from a LARSPEC tape is:

- Log onto the computer
- Initialize LARSPEC (I LARSPEC)
- Create deck of LARSPEC control cards to copy data from tape to disk
- Set up LARSPEC data disk (DDISK CREATE)
- Execute job (RUN LARSPEC)

Optionally one can then:

- Back newly created data disk file to backup tape. (DDISK BACKUP)
- Copy newly created data disk file to user's permanent disk (DDISK COPY)

An example control card deck to copy LARSPEC data from tape to disk is:

```
$TAPE 3986
$IDLIST
SELECT EXNU(79100806)
OPTIONS COPYDISK
END
$END
$EXIT
```

An example of the terminal commands to copy data from a LARSPEC tape to disk follows: The commands in lower case are typed by the user. The commands in upper case are issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user commands.

```
>login example
    .
    .
    .
>i larspec
T=0.08/0.20 08:40:59
>edit idlist cc
NEW FILE:
EDIT:
>i
INPUT:
>$tape 3986
>$idlist
>select exnu(79100806)
>options copydisk
>end
>$end
>$exit
>
EDIT:
>file
T=0.08/0.17 08:42:06
>ddisk create winter wheat
TEMP      153 HAS BEEN ATTACHED AS 195.  (003.00 MEGABYTES)
195 HAS BEEN LOGGED IN AS B   DISK.
T=0.07/0.16 08:42:33
>ccinput idlist cc
T=10.51/15.12 08:44:36
>ddisk backup  8000
I0002  TAPE 8000 HAS BEEN REQUESTED ON UNIT 181    (TAPMOUNT)
TAPE 181 ATTACHED
I0003  TAPE READY...    EXECUTION CONTINUING      (TAPMOUNT)
B DISK HAS BEEN BACKED UP TO FILE 12 OF TAPE 8000
T=3.66/16.51 08:50:58
```

In the above example, a LARSPEC data file named 'WINTER WHEAT' was created on disk. The data file was backed up onto tape 8000 to file 12.

Once the data file is on the LARSPEC data disk, any LARSPEC job can be run using the disk file as input. No tape will have to be mounted for subsequent jobs during the interactive session.

See 'OPTIONS COPYDISK' in section 3.5 for information concerning the number of observations that can fit on the LARSPEC data disk.

Method to copy saved LARSPEC data file from tape to LARSPEC data disk

This is the procedure for a user to follow to use a LARSPEC data disk file that was created and saved in a previous session.

- Log onto the computer
- Initialize LARSPEC (I LARSPEC)
- Set up LARSPEC data disk file (DDISK TAPE)
- Execute job(s) (RUN LARSPEC)

An example of the terminal commands follows. The commands in lower case are typed by the user. The commands in upper case are issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user commands.

```
>login example
   .
   .
   .
>i larspec
T=0.08/0.22 09:02:49
>ddisk tape 8000 12 winter wheat
TEMP     153 HAS BEEN ATTACHED AS 195.  (003.00 MEGABYTES)
195 HAS BEEN LOGGED IN AS B   DISK.
 I0002 TAPE 8000 HAS BEEN REQUESTED ON UNIT 181    (TAPMOUNT)
TAPE 181 ATTACHED
 I0003 TAPE READY...    EXECUTION CONTINUING       (TAPMOUNT)
 LOADING..... .
 WINTER WHEAT B4
TAPE 181 DETACHED
T=3.11/15.48 09:06:20
>ccinput terminal
T=0.04/0.09 09:06:58
>run
   .
   .
T=9.28/12.98 09:08:25
```

In the above example, a data file named 'WINTER WHEAT' was copied from backup tape 8000 to the LARSPEC data disk. The user then executed a set of control cards by entering them directly from the terminal using the LARSPEC terminal command - CCINPUT TERMINAL. At the end of processing the user can execute additional jobs using the data disk file as input.

<u>Method to copy saved LARSPEC data file from permanent disk to LARSPEC data disk</u>

This is the procedure for a user to follow to copy a saved LARSPEC data disk file from the user's permanent disk to the LARSPEC data disk.

- Log onto the computer
- Initialize LARSPEC (I LARSPEC)
- Set up LARSPEC data disk file (DDISK COPY)
- Execute job(s) (RUN LARSPEC)

An example of the terminal commands follows. The commands in lower case are typed by the user. The commands in upper case are issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user commands.

```
>login example
    .
    .
    .
    .
>i larspec
    .
    .
    .
T=0.08/0.19 09:03:58
>ddisk copy data ex19
TEMP      151 HAS BEEN ATTACHED AS 195.   (003.00 MEGABYTES)
195 HAS BEEN LOGGED IN AS B    DISK.
T=0.08/2.48 09:05:21
>ccinput graph ex19
T=0.04/0.06 09:05:38
>run larspec
     .
     .
     .
PRT FILE 4799   TO   RSCS     COPY 01 NOHOLD
T=2.10/3.96 09:07:03
```

In the above example, the user copied the data file named 'DATA EX19' from his permanent A disk to the LARSPEC data disk. The control cards used for the job that was executed were in the disk file named 'GRAPH EX19'. After execution was completed, the user could then log off the system or set up another control card deck to be executed without having to recopy the data file to the LARSPEC data disk.

2.4 Punch Output to Disk

Punch output from LARSPEC may be placed directly onto disk instead of cards. The LARSPEC terminal command 'PUNCH DISK' controls this capability. The punch output may be placed on the users permanent disk (A disk) or a temporary disk (D disk). The command is:

```
PUNCH DISK          (defaults to D disk)
    or
PUNCH DISK A
```

The name of the punch file on the disk is 'PUNCH FILE'.

The procedure to place punch output onto disk is:

- Log onto the computer
- Initialize LARSPEC (I LARSPEC)
- Specify punch output to disk (PUNCH DISK)
- Execute job

Optionally one can then:

- Erase any unwanted files on D disk and back 'PUNCH FILE' to tape
- Edit 'PUNCH FILE'
- Copy 'PUNCH FILE' to users permanent disk

An example of the terminal commands follows. The commands in lower case are typed by the user. The commands in upper case are issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user commands.

```
>login example
      .
      .
      .
>i larspec
T=0.08/0.24 09:20:19
>punch disk
DISK 'D' NOT ACCESSED.
PUNCH OUTPUT WILL BE PUT ON D DISK.
T=0.09/0.16 09:20:23
>ccinput dsel exl
T=0.04/0.07 09:20:27
>run larspec
GETTING REQUESTED TEMP DISK.
LARSLIB 29C HAS BEEN ATTACHED AS 29C
C (29C) R/O
29C HAS BEEN LOGGED IN AS C  DISK.
DASD 29C DETACHED
EXECUTION BEGINS...
 ****** LARSPEC VERSION 3.0 -- REVISED 11/13/79
 ****** $TAPE 4290
 ****** $DSEL
 I0002 TAPE 4290 HAS BEEN REQUESTED ON UNIT 181    (TAPMOUNT)
TAPE 181 ATTACHED
 I0030 TAPE READY...   EXECUTION CONTINUING    (TAPMOUNT)
 I0060 STATISTICS PROCESSING STARTS FOR CLASS SW
 I0060 STATISTICS PROCESSING STARTS FOR CLASS ALFALFA
 I0060 STATISTICS PROCESSING STARTS FOR CLASS GRASS
        $DSEL REENTRY
 ****** $END
 ****** $EXIT
 ****** $JOB COMPLETED.
PRT FILE 5133  TO RSCS    COPY 01 NOHOLD
TAPE 181 DETACHED
T=8.77/20.96 09:25:31
>list * * d
PUNCH   FILE
LARSPEC IDENT
BANDS   LARSPEC
LARSPEC STATS
T=0.07/0.11 09:26:38
>erase larspec ident D
T=0.05/0.07 09:26:53
>erase bands larspec D
T=0.05/0.09 09:27:00
>erase larspec stats D
T=0.05/0.06 09:27:06
>l * * d
PUNCH   FILE
T=0.05/0.07 09:27:09
>cms exec backup 8000 D ( file 12
 I0002 TAPE 8000 HAS BEEN REQUESTED ON UNIT 181     (TAPMOUNT)
TAPE 181 ATTACHED
 I0002 TAPE READY...   EXECUTION CONTINUING      (TAPMOUNT)
D DISK HAS BEEN BACKED UP TO FILE 12 OF TAPE 8000
TAPE 181 DETACHED
PRT FILE 5142 TO RSCS    COPY 01 NOHOLD
T=3.18/14.02 09:32:25
```

In the above terminal session, punch output was specified to be placed in the D disk. A job was executed using the control cards stored in disk file, 'DSEL EX1'. After processing was completed, unwanted files on the D disk were erased and the punch output on the D disk in file 'PUNCH FILE' was backed up to file 12 on tape 8000.

3.0 Control Card Dictionary

The control card dictionary discusses the functions and defaults of the LARSPEC terminal commands and control cards.

3.1 LARSPEC Terminal Commands

Processing Function: LARSPEC Terminal

Key Word: BATCH

Control Parameters:

BACKUP 'tape number' [(FILE 'filenumber' or (INIT)]

'No control parameter'

Function:

The BATCH command places the needed batch cards in front of the specified control card deck and sends the file to the batch machine.

Command Default:

None; no file is sent to the batch machine.

Control Parameters:

BACKUP 'tape number' [(FILE 'filenumber' or (INIT)] - Specifies that the backup to tape option is desired. 'tape' indicates the tape number to which the backup is written. This option sets up the batch cards so that any punch output from the LARSPEC job will be backed up to the last file on the specified backup tape or optionally the initial file on the tape - (INIT, or the specified file on the tape - (FILE 'filenumber'). If the option BACKUP is specified, a tape number must also be specified because there are no defaults for backup tapes to be mounted.

' No control parameter ' - Sets up the five batch header cards and sends the deck to the batch machine. For more detailed information on both batch options, refer to Section 2.1.

Note: [. . .] above indicates that the parameters listed within the brackets are optional.

Key Word: CCINPUT
Control Parameters: CARDS, TERMINAL, 'FN' 'FT' 'No control parameters'

Function:

Indicates from which device (CARDS, TERMINAL, 'FN' 'FT') control cards are expected.

Command Default:

CARDS - Control cards are expected from the card reader.

Control Parameters:

CARDS	- LARSPEC control cards are expected from the card reader.
TERMINAL	- Control cards are expected from the user's terminal.
'FN' 'FT'	- Control cards are to be read from the file on the user's A-disk named 'Filename' 'Filetype'.
'No control parameter'	- The device (CARDS, TERMINAL, 'FN' 'FT') from where the control cards are expected will be printed on the terminal.

Key Word: CLEAR
Control Parameters:

Function:

Clears or purges the user's spooled card reader of all card decks.

Command Default:

None; no card decks are purged from user's card reader.

Control Parameters:

NONE.

Key Word: CMS
Control Parameters: 'CMS Commands'

Function:

Allows the user to execute CMS terminal commands while in the LARSPEC environment. This card is necessary to print or punch CMS files.

Command Default:

None; if no CMS command is issued; none will be executed.

Control Parameters:

Any CMS or CP command.

Key Word: 'CMS commands'
Control Parameters:

Function:

Allows the user to execute any valid CMS terminal command while in the LARSPEC environment. The key word and control parameters will be treated as a CMS command if the keyword is not a LARSPEC terminal command.

Command Default:

None; if no CMS command is issued, none will be executed.

Control Parameters:

Any CMS or CP command.

Key Word: DDISK

Control Parameters:

ACCESS,
BACKUP 'tape' [(FILE 'filenumber' or (INIT)]
COPY['fn' 'ft' 'fm']
CREATE [('fn' 'ft')]
TAPE 'tape' 'fileno' [('fn' 'ft')]
'No control parameter'

Function:

The DDISK command options are to be used in conjunction with COPYDISK and $DISK to create and/cr access a user disk data base. The DDISK command options are used to prepare a temporary disk for a data file and to save a disk data base file which has been generated.

Command Default:

NONE.

Control Parameters:

ACCESS - Accesses a data base temp disk which has been released.

BACK 'tape' [(FILE 'filenumber' or INIT)] - Backs up previously created disk data base on the temp disk to the last file on the specified tape or optionally the specified file - (FILE 'filenumber' or initial file- (INIT on the tape.

COPY ['fn' 'ft' 'fm'] - Copies the disk data base with default name-MSPEC BASE-or optional name -'fn' 'ft' - from the default disk -A- or optional disk-'fm'- to a temp disk for use by LARSPEC.

CREATE['fn' 'ft'] - Gets a temp disk to be used for creating a disk data base with default name -MSPEC BASE - or optional name - 'fn' 'ft'.

TAPE 'tape' 'fileno' ['fn' 'ft'] - Loads the disk data base with default name-MSPEC BASE- or optional name -'fn' 'ft' - from 'tape' and 'fileno' to a temp disk for use by LARSPEC.

' No control parameter' - A list of valid DDISK options will be listed on the user's terminal.

Note: [. . .] above indicates that the parameters listed within the brackets are optional.

The temp disk that is set up for the disk data base contains room for 3 megabytes of information. See OPTIONS COPYDISK in section 3.5 for information concerning the number of observations that can fit on the temp disk.

Key Word: EXIT	
Control Parameters:	

Function:

Terminates LARSPEC environment and returns control to CMS command environment. No disks will be detached.

Command Default:

NONE.

Control Parameters:

NONE.

Key Word: MSG
Control Parameters: 'userid' 'message'

Function:

A message is sent to the 'userid' specified. The command to send a message to the computer operator is MSG CP 'Message'.

Command Default:

None; no messages are sent.

Control Parameters:

NONE.

Processing Function: LARSPEC Terminal

Key Word: NEWS
Control Parameters:

Function:

The latest LARSPEC system news is printed on the line printer. The news consists of changes and latest updates made to LARSPEC.

Command Default:

None; if card is omitted, no LARSPEC news is printed.

Control Parameters:

NONE.

Processing Function: LARSPEC Terminal

Key Word: PRINT
Control Parameters: HOLD, RELEASE, 'site-id', TERMINAL 'No control parameter'

Function:

Directs where the printer output is to be sent and if it is to be printed immediately at the end of job execution.

Command Default:

If the PRINT card is omitted, the output will be sent to the user's terminal site. If the user is using a dial-up terminal, output will be sent to the LARS computer site.

Control Parameters:

HOLD - Printer output is held and not printed until the user issues 'PRINT RELEASE' or logs off the system.

Default: Output is not held.

RELEASE - Previously held output is printed.

'site-id' - Printer output is directed to a specific site.

Default: Site of user terminal. For dial-up, output is sent to the LARS computer site.

TERMINAL - Printer output is typed on the user's terminal.

Default: Line printer

'No control parameter' - The printer site will be listed on the user's terminal.

Default: None

Key Word: PUNCH

Control Parameters:

DISK, DISK A, HOLD, RELEASE, 'site-id', TERMINAL

'No control parameter'

Function:

Directs where the punch output is to be sent and if it is to be punched immediately at the end of job execution.

Command Default:

If the PUNCH card is omitted and there is punch output, the output is sent to card punch.

Control Parameters:

DISK - Punch output will be sent to the D disk as PUNCH FILE D1. The D disk is the default disk.

Default: Punch output sent to card punch.

DISK A - Punch output will be sent to the user's A disk as PUNCH FILE A1.

Default: Punch output sent to card punch.

HOLD - Punch output is held and not punched until the user issues 'PUNCH RELEASE' or logs off the system.

Default: Punch output is not held.

RELEASE - Previously held output is punched.

'site-id' - Punch output is directed to a specific site.

Default: Site of user terminal. For dial-up, punch output is sent to LARS computer site.

TERMINAL - Punch output is typed at the terminal. Note: With this option, no punch files or cards are generated.

Default: Punch output is sent to card punch.

'No control parameter' - The punch site will be listed on the user's terminal.

Processing Function: LARSPEC Terminal

Key Word: QUIT
Control Parameters:

Function:

This card ends the terminal session. The user is logged off the system.

Command Default:

None; either this command or the LOG command is needed to terminate the terminal session.

Control Parameters:

NONE.

Processing Function: LARSPEC Terminal

Key Word: REFERENCE
Control Parameters: ALL, COMMANDS, DSEL, GSPEC, IDLIST, INITIALIZATION

Function:

Prints listings of control cards.

Command Default:

None; no listings are printed.

Control Parameters:

ALL	- Prints listings of all control cards for LARSPEC terminal commands, DSEL, GSPEC, IDLIST, and the LARSPEC initialization control cards.
COMMANDS	- Prints listings of LARSPEC terminal commands.
DSEL	- Prints listings of LARSPEC DSEL control cards.
GSPEC	- Prints listings of LARSPEC GSPEC control cards.
IDLIST	- Prints listings of LARSPEC IDLIST control cards.
INITIALIZATION	- Prints listings of LARSPEC initialization monitor control cards.

Processing Function: LARSPEC Terminal

Key Word: RESET
Control Parameters:

Function:

Reinitializes or resets all LARSPEC terminal commands to the original default values.

Command Default:

NONE.

Control Parameters:

NONE.

Processing Function: LARSPEC Terminal

Key Word: RUN
Control Parameters: LARSPEC [3M / 1200K / 600K / 300K] [TEST / NOTEST] [CLEAR / NOCLEAR]

Function:

The RUN LARSPEC card executes the LARSPEC system.

Command Default:

NONE.

Control Parameters:

LARSPEC - Attaches all system and work disks enabling the LARSPEC job to be executed. Options available include: (1) the size of work disk to be attached [3M, 1200K, 600K, and 300K]; (2) if a load map is to be placed on the user A disk [TEST]; and (3) if the attached work disk is to have all previously written files erased before execution of current job[CLEAR].

The user may specify more than one option but only one from each set.

Default: The default options are 1200K, NOTEST and CLEAR.

3.2 Monitor Control Cards

Processing Function: LARSPEC Monitor

Key Word: $CARD
Control Parameters:

Function:

All monitor control and supervisor control cards are expected from the card reader.

Card Default:

NONE.

Control Parameters:

NONE.

Processing Function: LARSPEC Monitor

Key Word: $COMM
Control Parameters: 64 characters

Function:

Specifies a 64 character comment to be printed at the top of each page of printout.

Card Default:

None; no comment is printed.

Control Parameters:

A character set of no more than 64 alphanumeric characters.

Processing Function: LARSPEC Monitor

Key Word: $DATE
Control Parameters: 20 characters

Function:

Replaces the date the LARSPEC job is run with the 20 characters specified.

Card Default:

The date the LARSPEC job is generated.

Control Parameters:

A character set of no more than 20 alphanumeric characters.

Key Word: $DISK
Control Parameters: None

Function:

Requests that the LARSPEC data disk be searched for the observations that are requested by any processing function which follows in the control card deck instead of tape(s).

Card Default:

None: If the data disk has not been requested using the $DISK card, no disk file will be searched for the requested observations.

Control Parameters:

None:

Note: If the $DISK card is used, the LARSPEC terminal command-DDISK section 3.1, must be used as described in section 2.3.

Processing Function: LARSPEC Monitor

Key Word: $DSEL	
Control Parameters:	

Function:

Monitor control card causing control to be transferred to DSEL processor.

Card Default:

None; card is required to select the DSEL processor.

Control Parameters:

NONE.

Key Word: $END
Control Parameters:

Function:

Causes control to be returned from the LARSPEC processor (DSEL, GSPEC, or IDLIST) to the LARSPEC program monitor.

Card Default:

$END is required in order to return program control from LARSPEC processor (DSEL, GSPEC, or IDLIST) to LARSPEC monitor.

Control Parameters:

NONE.

Processing Function: LARSPEC Monitor

Key Word: $EXIT
Control Parameters:

Function:

Signifies end of LARSPEC processing function, LARSPEC data tape is rewound, unloaded, and detached.

Card Default:

None; card is required to complete a LARSPEC job.

Control Parameters:

NONE.

Processing Function: LARSPEC Monitor

Key Word: $GSPEC
Control Parameters:

Function:

Monitor control card causing control to be transferred to the GSPEC processor.

Card Default:

None; card is required to invoke graphics processor.

Control Parameters:

NONE.

Processing Function: LARSPEC Monitor

Key Word: $HD1
Control Parameters: 64 characters

Function:

Replaces the first header line with the 64 characters specified.

Card Default:

The standard header, "LABORATORY FOR APPLICATIONS OF REMOTE SENSING"

Control Parameters:

A character set containing no more than 64 alphanumeric characters.

Processing Function: LARSPEC Monitor

Key Word: $HD2
Control Parameters: 64 characters

Function:

Replaces the second header line with the 64 characters specified.

Card Default:

The standard header, "PURDUE UNIVERSITY"

Control Parameters:

A character set containing no more than 64 alphanumeric characters.

Processing Function: LARSPEC Monitor

Key Word: $IDLIST
Control Parameters:

Function:

Monitor control card causing control to be transferred to the IDLIST processor.

Card Default:

None; card is required to select the IDLIST function.

Control Parameters:

NONE.

Processing Function: LARSPEC Monitor

Key Word: $RESET
Control Parameters:

Function:

Reinitializes LARSPEC Monitor Control Cards. Causes all buffers and control card parameters for Monitor Control Cards, $HD1, $HD2, $COMM, $DATE, $TYPE, $TAPE, $CARD, and $REWIND to be cleared.

Card Default:

NONE.

Control Parameters:

NONE.

Key Word: $REWIND	
Control Parameters: YES, NO	

Function:

Specifies if mounted LARSPEC data tape is to be rewound to the load point at the beginning of execution of each set of processor control cards.

Card Default:

Tape will be rewound before each set of processor control cards is processed.

Control Parameters:

YES	- causes tape to be rewound to load point.
NO	- tape is not rewound before next set of processor control cards is processed.

Processing Function: LARSPEC Monitor

Key Word: $TAPE
Control Parameters: N1, N2, . . .N5

Function:

Specifies which LARSPEC data tapes will be searched for the following processing functions. The $TAPE card has same effect as the OPTIONS TAPE card listed in $IDLIST, $DSEL, and $GSPEC.

Card Default:

If no tape has been specified by either using the $TAPE or OPTIONS TAPE card, no tape will be searched.

Control Parameters:

N1, N2. . .N5	N1 through N5 are LARSPEC data tapes numbers that will be searched during a processing function for data. The maximum number of tapes that can be specified for a search is five.

Processing Function: LARSPEC Monitor

Key Word: $TYPE
Control Parameters:

Function:

All monitor and supervisor control card decks are expected to be input from the user typewriter or CRT terminal.

Card Default:

All monitor and supervisor control card decks are expected to be input from card reader.

Control Parameters:

None.

3.3 DSEL Processor Supervisor Control Cards

Processing Function: DSEL

Key Word: BANDS
Control Parameters: LL1-UL1, LL2-UL2,...LLn-ULn

Function:

specifies the upper and lower wavelength band limits in micrometers to be selected. If clustering is requested a maximum of 30 wavelength bands can be specified. If clustering is not requested a maximum of 100 wavelength bands can be specified.

Card Default:

None; card is required to specify wavelength bands to be used.

Control Parameters:

LL1-UL1 - LL1 indicates the lower wavelength band limit and UL1 indicates the upper wavelength band limit for the first set of bands requested.

Processing Function: DSEL

Key Word: CASES
Control Parameters: PUNCH, NOPUNCH, FFORMAT, BINARY, AGRONOMIC, NOAGRON, GEOMETRIC, NOGEOM

Function:

controls the punching of data values and header parameters. See section 6 for a description of the punch output format.

Card Default:

None; no data is punched if CASES card is omitted.

Control Parameters:

PUNCH - punch band means for each selected run on computer cards.

Default: no data punched.

NOPUNCH - suppresses punching of band means.

Default: no data punched.

FFORMAT - band mean punch output produced in F format (F7.2).

Default: F format (F7.2)

BINARY - band mean punch output is produced in Binary.

Default: F format (F7.2)

DSEL CASES

AGRONOMIC

-punches agronomic information with band means for each selected observation including:

Date data collected	Level of factor 1
Observation number	Level of factor 2
Serial number	Level of factor 3
Day of year data collec.	Level of factor 4
Time data collected	Level of factor 5
Scene type	Level of factor 6
Field number	Level of factor 7
Plot number	Level of factor 8
Replication number	Row width
Species	Planting date
Variety	Plant height
Day since planting	Percent ground cover
Maturity stage	Leaf area index
Numerical Maturity Stage	Leaves per plant
Plant count	Plant moisture
Fruit count	Plant water content
Leaf condition	Radiant temp.
green	Target temp
brown	Grain yield
yellow	Grain test weight
Grain moisture content	
Dry biomass-gr. leaves	
Dry biomass-yel. leaves	
Dry biomass-br. leaves	
Dry biomass-stems	
Dry biomass-fruit	
Dry biomass-weeds	
Dry biomass-total	
Fresh biomass total	

See section 6 for a description of the format of the data on the cards.

Default: no agronomic information punched.

NOAGRON

-suppresses punching of agronomic information with band means.

Default: no agronomic information punched.

GEOMETRIC

-punches geometric information with band means for each selected observation including:

Date data collected	Observation number
Serial number	Time data collected
Scene type	Location
View zenith angle	Location latitude
View Azimuth angle	Location longitude
Irradiance zenith angle	Irradiance azimuth angle

See section 6 for a description of the format of the data on the cards.

Default: no geometric information punched.

NOGEOM — suppresses punching of geometric information with band means.

Default: no geometric data punched.

Processing Function: DSEL

Key Word: CLASS
Control Parameters: NNNNNNNN

Function:

signifies the start of class specification. Maximum number of classes allowed is 15.

Card Default:

none; CLASS card is required in DSEL.

Control Parameters:

NNNNNNNN - one to eight character alphanumeric code designating the class name.

Key Word: CLUSTER

Control Parameters:

MAXCL(N), CONV(XX.X), THRESH(X.XX)

Function:

specifies various clustering options to the DSEL processor. Any or all of the control parameters may be specified.

Card Default:

none; CLUSTER card is required for clustering to occur.

Control Parameters:

MAXCL(N) - N specifies the number of cluster classes wanted.

Default: N=2

CONV(XX.X) - of the vectors input to cluster, only XX.X percent need to be unchanged for successful clustering. The number may be either integer or real.

Default: XX.X=100.0

THRESH(X.XX) - threshold value for grouping of clusters in cluster grouping table is set to X.XX. A value for two classes less than the specified value will cause those classes to be grouped in cluster grouping table. A value greater than that specified will cause no grouping in table.

Default: X.XX=0.75

CLUSTER (con't)

Note: The following equation may be used to determine the number of observations that may be clustered within the available work space:

$$MAXCL*NOBND*(4+NOBND)+MAXCL/2*(MAXCL+1)*(MAXCL+2)+NOBS*(NOBND+\tfrac{1}{2})<29{,}000$$

where: MAXCL is number of cluster classes wanted
NOBND is number of bands used for clustering
NOBS is number of observations clustering

The following table may be used for reference

MAXCL	NOBND	Approximate Maximum Number of Observations
5	10	2690
5	20	1290
5	30	780
10	10	2610
10	20	1170
10	30	610
15	10	2530
15	20	1045
15	30	440

Processing Function: DSEL

Key Word: END
Control Parameters:

Function:

signifies end of supervisor control cards. Additional supervisor control cards or class cards may follow.

Card Default:

none; card is required.

Control Parameters:

NONE.

Processing Function: DSEL

Key Word: LIST
Control Parameters: XXXX, ALL, NOSUPRES, NOLIST, ONELINE

Function:

specifies which header parameters will be printed for those observations that meet the select conditions (see SELECT control card).

Card Default:

If LIST card is not used, a one line listing, ONELINE, is printed including: serial number, experiment number, observation number, time data collected, day data collected, experiment name, location, crop or scene type, plot or field number, and instrument name.

Control Parameters:

XXXX - for each observation listed the ID parameter with the name XXXX is printed. There is a specific four letter code for each header parameter (refer to section 5. for codes).

Default: one line listing is printed.

ALL - for each observation listed all ID parameters will be printed. Those with null values will be suppressed.

Default: one line listing is printed.

NOSUPRES - for each observation selected all ID parameters will be printed, including those which have null values. Those with null values will be printed with asterisks as their value.

Default: one line listing is printed.

NOLIST - listing of header parameters will be supressed for all runs processed.

Default: one line listing is printed.

ONELINE - a one line listing will be produced for each run. The header parameters include: run sequencer, observation number, serial number, time data collected, day data collected, experiment name, instrument name, and plot or field number.

Processing Function: DSEL

Key Word: OPTIONS
Control Parameters: TAPE(N1, N2,...)

Function:

tapes will be searched for data. The maximum number of tapes to be searched per LARSPEC job run is five. This card has the same function as the $TAPE card. If both cards, the OPTIONS TAPE and $TAPE cards are included in one run, the OPTIONS TAPE card will override or reset the tape numbers previously defined on the $TAPE card.

Card Default:

If no tape has been requested by using either the $TAPE or OPTIONS TAPE card, no tape will be searched.

Control Parameters:

TAPE(N1, N2,...) - N1, N2...N5 specifies the tape number of tapes to be searched for the user specified observations through SELECT card. Tapes are mounted in order specified on the OPTIONS card.

Key Word: OUTPUT
Control Parameters: GROUP, NOGROUP, SUMMARY, NOSUMMARY

Function:

specifies grouping table from cluster and summary table of field homogeneity.

Card Default:

none; no grouping or summary table is produced.

Control Parameters:

GROUP - a grouping table of cluster classes is produced. Table includes threshold value used for grouping criteria, group number, cluster number, and number of points per cluster.

Default: No grouping table produced.

NOGROUP - grouping table is suppressed.

Default: no grouping table produced.

SUMMARY - a summary table illustrating field homogeneity. Table includes plot or field number, number of points per field or plot, and number of points in each field assigned to the different clusters.

Default: no summary table produced.

NOSUMMARY - summary table is suppressed.

Default: no summary table produced.

Processing Function: DSEL

Key Word: SELECT
Control Parameters: XXXX(LL-UL), XXXX(LL-UL+L), XXXX(L1, L2,...), XXXX(A...),XXXX(A...A:B...B), -XXXX( ), .OR.

Function:

Selects observations from entire data set on requested tape(s) that meet the specifications on the SELECT card. Multiple SELECT cards may be used.

Card Default:

None; card is required to select data.

Control Parameters:

XXXX(LL-UL) - selects observations with ID parameter XXXX that have integer or real data values. The specific four letter header codes for ID parameters XXXX are described in section 5. LL refers to the lower limit value. All observations having a value within the limits LL and UL inclusive for parameter XXXX will be selected.

Default: No observations selected.

XXXX(LL-UL+L) - selects observations with ID parameter XXXX that have integer data values. LL refers to the lower limit value and UL refers to the upper limit value. All observations having a value between the upper and lower limit for parameter XXXX and an increment of L are selected.

Default: The increment value for an integer data value is 1.

XXXX(L1, L2, L3...) - selects observations with ID parameter XXXX equal to L1, L2, ... LN. A combination of the above parameters for select may be used, for example:

SELECT RUSE(1,5,9-21)

selects observations with run sequence 1,5, and 9 through 21.

SELECT RUSE(1,5,9-21+3)

selects observations with run sequence 1,5,9,12,15,18, 21.

Default: No observations selected.

XXXX(A. . .A) - selects observations with alphanumeric ID parameter equal to A...A.

Default: No observations selected.

XXXX(A...A:B...B) - selects observations with alphanumeric ID parameter equal to A...A or B...B. More than 2 sets may be specified on on SELECT card. For example:

SELECT SCTY(CORN:WINTER WHEAT:PASTURE)

selects all observations that have a scene type of either corn or winter wheat or pasture.

Default: No observations are selected.

-XXXX(   ) - selects observations with ID parameter XXXX except those specified observations, or those outside set limits. For example:

SELECT -SCTY(PASTURE), RUSE(1-50)

selects all observations between run sequence 1 through 50 whose scene type is not pasture.

One may use a combination of the same ID parameter with and without the not sign, but the result will be all observations used. For example:

SELECT OBNU(10-30), -OBNU(20,22)

selects observation numbers 1 through the last observation on the tape.

Default: No observations are selected.

.OR. - specifies end of one condition set. An observation will be selected if all the conditions or parameters prior to the .OR. are met or all conditions or parameters after the .OR. are met. For example:

SELECT RUSE(10-15), CLCO(50), .OR., RUSE(10-15), SCTY(CORN)

selects observations with run sequence 10 through 15 and cloud cover of 50% or run sequence 10 through 15 and scene type of corn. An exception to the above use of the .OR. option is that if the same parameter is repeated before the .OR., the observation is selected if it meets either condition. For example:

SELECT RUSE(1), RUSE(6), CLCO(50), .OR., RUSE(10)

is interpreted as if the user had typed:

SELECT RUSE(1), CLCO(50),.OR., RUSE(6),CLCO(50),.OR., RUSE(10)

<u>Default</u>: No data observations selected.

Key Word: STATISTICS
Control Parameters: RUNSTATS, NRUNSTATS, CORRELATION, NOCORR, CLASSTATS, NCLASSTAT SPECPLT, NOSPECPLT, DISK, NODISK, PUNCH, NOPUNCH

Function:

controls which statistics will be printed or punched and which coincident spectral plots will be generated.

Card Default:

None; no statistics printed or coincident spectral plots generated.

Control Parameters:

RUNSTATS - statistics for each run are printed including the run number, class and cluster name, wavelength band limits, wavelength bands means, the maximum and minimum values for each band, standard deviation, variance, percent deviation, and number of data points averaged for band mean.

Default: RUNSTATS

NRUNSTATS - suppresses printing of RUNSTATS.

Default: RUNSTATS

CORRELATION - produces a wavelength band correlation matrix for each class.

Default: No correlation matrix printed.

NOCORR - Suppresses printing of wavelength band correlation matrix.

Default: No correlation matrix produced.

CLASSTATS	- statistics for each class are printed for each band: wavelength band limits, means, minimum and maximum observation means, variance, standard deviation, percent deviation, and number of observations. Point statistics for each band: standard deviation, percent deviation, and total number of data points. <u>Default</u>: no class statistics printed.
NCLASSTAT	- suppresses class statistics. <u>Default</u>: no class statistics printed.
SPECPLT	- produces a coincident spectral plot plus and minus one standard deviation for each class. <u>Default</u>: no coincident spectral plot printed.
NOSPECPLT	- suppresses printing of coincident spectral plot. <u>Default</u>: no coincident spectral plot printed.
DISK	- a LARSYS formatted statistics deck is placed on the user's primary disk (A-disk). A statistics deck containing cluster class information can be specified. <u>Default</u>: statistics deck is not put on A disk.
NODISK	- a LARSYS statistics deck is not punched. <u>Default</u>: no statistics deck put on A disk.
PUNCH	- a LARSYS formatted statistics deck is punched on cards. <u>Default</u>: no statistics deck is punched.
NOPUNCH	- suppresses punching of a LARSYS statistics deck. <u>Default</u>: no statistics deck is punched.

Processing Function: DSEL

Key Word: *END
Control Parameters:

Function:

signifies end of class cards. If clustering was requested, all data up to this card will be clustered together.

Card Default:

none; card is required.

Control Parameters:

NONE.

3.4 GSPEC Processor Supervisor Control Cards

Key Word: CLASS
Control Parameters: NNNNNNNN

Function:

Signifies the start of class specification. Maximum number of classes allowed is 10. CLASS cards are expected if SELECT control parameter was used in supervisor control cards. The CLASS card may be followed by SELECT, XRDATA, YTDATA, ZPDATA, USET, and UPSET control cards to specify the particular information to be used for the class.

Card Default:

None; CLASS card is required in GSPEC if plotting more than one set of data per graph.

Control Parameters:

NNNNNNNN - One to eight character alphanumeric code designating the class name.

Processing Function: GSPEC

Key Word: END
Control Parameters:

Function:

Signifies end of supervisor control cards. Additional supervisor control decks or class cards may follow.

Card Default:

None; card is required.

Control Parameters:

NONE.

Key Word: GRAPH

Control Parameters:

XXXX(LL-UL), XXXX(LL-UL+L), XXXX(L1, L2, . . .),XXXX(A...A)
XXXX(A...A:B...B), -XXXX( ), .OR.
'No control parameter'

Function:

Selects observations from entire data set on requested tape(s) that meet the specifications on the GRAPH card. Multiple GRAPH cards may be used. Use of GRAPH card indicates that no class cards are included. There will be only one plot or set of data per graph.

Card Default:

None; either GRAPH or SELECT card is required to select data, but not both.

Control Parameters:

XXXX(LL-UL) - graphs observations with ID parameter XXXX that have integer or real data values. The specific four letter header codes for ID parameter XXXX are described in section 5. LL refers to the lower limit value and UL refers to the upper limit value. All observations having a value within the limits LL and UL inclusive for parameter XXXX will be selected.

Default: No observations graphed.

XXXX(LL-UL+L) - graphs observations with ID parameter XXXX that have integer data values. LL refers to the lower limit value and UL refers to the upper limit value. All observations having a value between the upper and lower limit for parameter XXXX and an increment of L are selected.

Default: The increment value for integer type parameters is 1.

XXXX(L1, L2, L3...) - graphs observations with ID parameter XXXX equal to L1, L2, L3,...LN. A combination of the above parameters for select may be used, for example:

GRAPH RUSE(1,5,9-21)

graphs observations with run sequence 1, 5, and 9 through 21.

GRAPH RUSE (1, 5, 9-21+3)

graphs observations with run sequence 1, 5, 9, 12, 15, 18, 21.

Default: No observations graphed.

XXXX(A...A) - graphs observations with alphanumeric ID parameter equal to A...A.

Default: No observations graphed.

XXXX(A...A:B...B) - graphs observations with alphanumeric ID parameter equal to A...A or B...B. More than 2 sets may be specified on one GRAPH card. For example:

GRAPH SCTY(CORN:WINTER WHEAT:PASTURE)

graphs all observations that have a scene type of either corn or winter wheat or pasture.

Default: No observations graphed.

-XXXX( ) - graphs observations with ID parameter XXXX except those specified observations, or those outside set limits. For example:

GRAPH -SCTY(PASTURE), RUSE(1-50)

graphs all observations between run sequence 1 through 50 whose scene type is not pasture. One may use a combination of the same ID parameter with and without the not sign, but the result will be all observations used. For example:

GRAPH OBNU(10-30), -OBNU(20,22)

graphs observations numbers 1 through the last observations on the tape.

Default: No observations are graphed.

.OR. - specifies end of one condition set. An observation will be selected if all the conditions or parameters prior to the .OR. are met or all conditions or parameters after the .OR. are met. For example:

GRAPH RUSE(10-15), CLCO(50), .OR., RUSE(10-15), SCTY(CORN)

graphs observations with run sequence 10 through 15 and cloud cover of 50% or run sequence 10 through 15 and scene type of corn.

Note: If the same parameter is repeated within a condition set, the observation is selected if it meets either condition, for example:

GRAPH RUSE(1), RUSE(6), CLCO(50), .OR., RUSE(10)

is interpreted as if the user had typed:

GRAPH RUSE(1), CLCO(50), .OR., RUSE(6), CLCO(50), .OR., RUSE(10)

Default: No data observations graphed.

'No control parameters' - The GSPEC status area will be in non-class mode. This is only applicable for XRDATAn, YTDATAn, and ZPDATAn request. Refer to XRDATA parameter for description of those requests.

Key Word: LIST
Control Parameters: XXXX, ALL, NOSUPRES, NOLIST, ONELINE

Function:

Prints header parameter information at the line printer for data observations graphed.

Card Default:

If the LIST card is not used, a one line listing is printed at the line printer. The header parameters include run sequence number, observation number, serial number, time data collected, day data collected, experiment name, location, crop/soil, or scene type, plot/field number, and instrument name.

Control Parameters:

XXXX - for each data observation selected, the ID parameter with the name XXXX is printed. There is a specific four letter code for each header parameter (refer to section 5. for codes).

ALL - for each data observation selected, all ID parameters will be printed. Those with null values will be suppressed.

NOSUPRES - if ALL has also been specified, all ID parameters will be printed including those which have null values. Those with null values will be printed with asterisks as their value.

NOLIST - listing of header parameter information will be suppressed for all data observations processed.

ONELINE - a oneline listing will be produced for each data observation. The header parameters include: run sequence number, observation number, serial number, time data collected, day data collected, experiment name, location, crop/soil or scene type, plot/field number, and instrument name.

Key Word: OPTIONS

Control Parameters:

PRINT, NOPRINT, STD, NOSTD, PUNCH, NOPUNCH, SYMBOLS(A,...), NOGRAPH, GRAPH, TAPE(N,...), TPLOT, NOTPLOT, INTERACTIVE, NOINTERACTIVE, LINES(X_1,...X_{10}), SIZEGRAPH(XL, XU, YL, YU), SIZEGRAPH, NOCONTROLCARDS, CONTROLCARDS, HOLDGRAPH, DRAWGRAPH, CENTERBAND, FULLBAND

Function:

Specifies options available in displaying, printing, or punching data. Multiple cards may be used.

Card Default:

If OPTIONS card is omitted, system defaults are used. These defaults are specified below.

Control Parameters:

PRINT - A table of the selected data values to be graphed is printed at the line printer.

Default: NOPRINT

NOPRINT - No table of data values is printed.

STD - Standard deviations are calculated along with the class average at each wavelength. The standard deviations are graphed. If PRINT option is specified with STD option, the wavelength band, response value, and standard deviation are printed for each class to be graphed. If the PUNCH option is also specified, the standard deviation will be punched. The option only applies for response-wavelength type data requests.

NOSTD - No standard deviations are calculated for classes.

PUNCH - A copy of the selected data values to be graphed are punched in binary format.

Default: NOPUNCH

NOPUNCH - No data is punched.

SYMBOLS(A,...) - Defines the symbols to be used for character type lines on the graphs in order of class. User may specify any acceptable character or number.

Default: The default is (1,2,3...9, A,...). There are two types of default lines, character and dash lines. For all types of graphs on the line printer or terminal and non-response vs. wavelength type graphs on the varian, the default is character type lines. The default is dashed lines for response vs. wavelength graphs on the varian. The default for either character or dash lines may be overridden with the "USET DASH" or "USET CHARACTER" command. Different types of dashed lines may be requested using the OPTIONS LINES parameter or the UPSET SETDASH parameter.

NOGRAPH - Suppresses plotting of graph.

Default: GRAPH

GRAPH - Selected data will be graphed.

TAPE(N_1, N_2...N_5) - N_1, N_2,...N_5 specifies the tape number of LARSPEC tapes to be searched for data. Tapes are mounted in order specified on the OPTIONS card. The limit for the number of tapes to be searched is five.

Default: If no tape has been requested by using either the $TAPE or OPTIONS card, no tape will be searched.

TPLOT - Plot the equivalent black body temperature at each wavelength for each class of emissive response-wavelength type data.

Default: NOTPLOT

NOTPLOT - No temperature plot is graphed.

INTERACTIVE - Allows the user to operate interactively with this set of control and/or class cards. For example, the user may change the symbols representing the classes or plot different combinations of classes. For a more detailed description of allowable commands in the INTERACTIVE mode, refer to the section "INTERACTIVE CONTROL commands."

Default: NOINTERACTIVE

NOINTERACTIVE - The user is not able to interact or change any control cards after execution of the program begins.

LINES(X1,...X10) - Defines the characteristics of the dashed lines to be plotted on the varian. Refer to GCS manual for more information on line characteristics. The order of lines on OPTIONS LINES card is by class.

Default: The line characteristic designator in order by class: 77, 92, 9434, 32, 92943234, 9272, 3454, 9434, 12, 3234.

Designator	Line Characteristic
77	————
92	. . .
9434	.——
32	- - - -
92943234	. . - -
9272	.————
3454	- ———
9434	.——
12	- - - -
3234	— — — —

SIZEGRAPH(XL, XU, YL, YU)-Sets the location and physical size of the graph on output device in inches from XL to XU in X direction and from YL to YU in Y direction. The origin (0,0) is at the lower left side of device.

Default: SIZEGRAPH

The default size of the graph available for each device in inches:

Device	XL	XU	YL	YU
Lineprinter	0.0	9.9	0.0	6.875
CRT Terminal	0.0	7.99	0.0	5.0
Varian	1.2	7.75	.75	7.50

The maximum size for graphs available for each device in inches:

Device	XL	XU	YL	YU
Lineprinter	0.0	9.9	0.0	9.9
CRT Terminal	0.0	7.99	0.0	5.3
Varian	0.0	10.56	0.0	10.56

SIZEGRAPH - The size of graph produced will be the default limits for the specific output device.

NOCONTROLCARDS - Suppresses printing of control cards used in executing the program at the line printer.

Default: CONTROLCARDS

CONTROLCARDS - Control cards are printed on the line printer.

HOLDGRAPH -Immediate plotting of the graph to the output device will not be done for this processing request. This option allows the user to put more than one graph on an output "page", this includes the line printer, CRT terminal, and varian devices. If the OPTION HOLDGRAPH command is used, then option SIZEGRAPH (XL, XU, YL, YU) may be specified to define different locations for the graphs on a page.

Default: DRAWGRAPH

DRAWGRAPH -The graph will immediately be sent to the output device.

CENTERBAND -Centerband data will be plotted. Each band will be represented by one data value. This is the default for spectrometer data.

FULLBAND -Fullband data will be plotted. Each band will be represented by two data values. This is the default for radiometer data and may not be specified for spectrometer data.

Key Word: OUTPUT
Control Parameters: VARIAN, TERMINAL, LPRINTER

Function:

Specifies the output device where graph will be sent.

Card Default:

Graphs will be printed on the line printer-LPRINTER.

Control Parameters:

VARIAN	- Graphs will be sent to the electrostatic printer.
TERMINAL	- Graphs will be sent to the CRT terminal or user typewriter.
LPRINTER	- Graphs will be sent to the line printer.

Processing Function: GSPEC

Key Word: PLOTCLASS
Control Parameters: $N_1, N_2, \ldots$ 'No Control Parameters'

Function:

Specifies which classes of data will be plotted, printed, and/or punched.

Card Default:

All defined classes of data are plotted on one graph.

Control Parameters:

$N_1, N_2, \ldots$ - Only classes $N_1, N_2, \ldots$ will be plotted, printed, or punched.

Default: All classes are used.

'No Control Parameter' - All classes will be plotted, printed, or punched.

Key Word: SELECT

Control Parameters:

XXXX(LL-UL), XXXX(LL-UL+L), XXXX(L1, L2,...), XXXX(A...A),
XXXX(A...A:B...B), -XXXX( ), .OR.
'No control parameters'

Function:

Selects observations from entire data set on requested tape(s) that meet the specifications on the SELECT card. Multiple SELECT cards may be used. Use of SELECT card indicates that class cards are included; there may be more than one plot per graph and/or observations may be averaged.

Card Default:

None; either GRAPH or SELECT card is required to select data, but not both.

Control Parameters:

XXXX(LL-UL) - selects observations with ID parameter XXXX that have integer or real data values. The specific four letter header codes for ID parameter XXXX are described in section 5. LL refers to the lower limit value and UL refers to the upper limit value. All observations having a value within the limits LL and UL inclusive for parameter XXXX will be selected.

Default: No observations selected.

XXXX(LL-UL+L) - selects observations with ID parameter XXXX that have integer data values. LL refers to the lower limit value and UL refers to the upper limit value. All observations having a value between the upper and lower limit for parameter XXXX and an increment of L are selected.

Default: The increment value for integer type parameters is 1.

XXXX(L1, L2, L3...) - selects observations with ID parameter XXXX equal to L1, L2...LN. A combination of the above parameters for select may be used, for example:

SELECT RUSE(1, 5, 9-21)

selects observations with run sequence 1, 5, and 9 through 21.

SELECT RUSE(1, 5, 9-21+3)

selects observations with run sequence 1, 5, 9, 12, 15, 18, 21.

Default: No observations selected.

XXXX(A...A) - selects observations with alphanumeric ID parameter equal to A...A.

Default: No observations selected.

XXXX(A...A:B...B) - selects observations with alphanumeric ID parameter equal to A...A or B...B. More than 2 sets may be specified on one SELECT card. For example:

SELECT SCTY(CORN:WINTER WHEAT:PASTURE)

selects all observations that have a scene type of either corn or winter wheat or pasture.

Default: No observations are selected.

-XXXX(   ) - selects observations with ID parameter XXXX except those specified observations, or those outside set limits. For example:

SELECT -SCTY(PASTURE), RUSE(1-50)

selects all observations between run sequence 1 through 50 whose scene type is not pasture.

One may use a combination of the same ID parameter with and without the not sign, but the result will be all observations used. For example:

SELECT OBNU(10-30), -OBNU(20,22)

selects observation numbers 1 through the last observation on the tape.

Default: No observations are selected.

.OR. - specifies end of one condition set. An observation will be selected if all the conditions or parameters prior to the .OR. are met or all conditions or parameters after the .OR. are met. For example:

SELECT RUSE(10-15), CLCO(50), .OR., RUSE(10-15), SCTY(CORN)

selects observations with run sequence 10 through 15 and cloud cover of 50% or run sequence 10 through 15 and scene type of corn.

NOTE: If the same parameter is repeated within a condition set, the observation is selected if it meets either condition. For example:

SELECT RUSE(1), RUSE(6), CLCO(50), .OR., RUSE(10)

is interpreted as if the user had typed:

SELECT RUSE(1), CLCO(50), .OR., RUSE(6), CLCO(50), .OR., RUSE(10)

Default: No data observations selected.

'No control parameters' - the GSPEC status area will be in the class mode. Class cards are required (only applicable for XRDATAn, YTDATAn, and ZPDATAn requests).

Processing Function: GSPEC

Key Word: TITLE
Control Parameters: (XXXX),A...A 'No Control Parameter'

Function:

Defines the title and the size of the characters used for the title. Size may be small, medium, large or extra large. This option is applicable for varian output only.

Card Default:

A default title is printed for only single run plotting of response vs. wavelength data and curve fits. Otherwise, no title is printed.

Control Parameters:

(XXXX) - Defines size of characters for title as SMALL (1/16"), MEDIUM(1/8"), LARGE(3/16"), and EXTRA LARGE (1/4").

Default: MEDIUM

A...A - Specifies title to be placed above graph. There is a limit of 59 characters in title.

'No Control Parameters'- Default title, if applicable, is used.

Key Word: UPSET
Control Parameters: POLYNOMIAL-DEGREE(N), PRECISION(N), SETDASH(N), TICINTERVAL(N), TICX(N), TICY(N) 'No Control Parameter'

Function:

Sets GCS parameters which specify the values of certain options to be used in plotting the graph. The most commonly used parameters are listed. Any real or integer GCS UPSET option which applies may be used. Refer to the GCS user's manual for a complete list of UPSET parameters. Multiple UPSET cards

Note that only the first four characters of the control parameters are required.

Card Default:

If the UPSET card is not specified - most of the defaults listed below are GCS calculated.

Control Parameters:

POLYNOMIAL-DEGREE(N) - Specifies the degree of the polynomial to be created in calculating a least squares fit through the collection of points. A request for a polynomial fit of degree less than 1 or greater than 10 results in an error. Caution should also be taken in attempting to perform a high degree fit with a small number of data points.

Default: N=2

PRECISION(N) - Specifies the number (N) of significant digits to appear when displaying real numbers on a graph.

Default: N=4

SETDASH(N) - Specifies the characteristics of the dashed lines to be plotted on the varian.

Default: Refer to OPTIONS LINES in GSPEC control card dictionary for default line characteristics. The default line values are 77, 92, 9434, 32, 924943234, 9272, 3454, 9434, 12, 3234.

TICINTERVAL(N) - Specifies the distance in current user units between tic marks of a ticked line.

Default: GCS calculated depending on data being graphed.

TICX(N) - Specifies the distance between tic marks or grid lines along the X axis.

Default: GCS calculated depending on data being graphed.

TICY(N) - Specifies the distance between tic marks or grid lines along the Y axis.

Default: GCS calculated depending on data being graphed.

'No Control Parameters'- No global UPSET options will be passed to GCS plotting routines. All previously set UPSET options will be initialized and reset to the defaults.

Key Word: USET
Control Parameters: AUTOSCALE, BESTFORMAT, EDGEAXES, FITLINEAR, FITPOLYNOMIAL, FITSPLINE, GFORMAT, GRIDAXIS, IFORMAT, LINXAXIS, LINYAXIS, LNXAXIS, LNYAXIS, LOGARITHMIC, LOGXAXIS, LOGYAXIS, NOAXES, NOXLABEL, NOYLABEL, PIRADIANS, PLAINAXIS, POLAR, RADIANS, RECTANGULAR, XALPHABETIC, XAXIS, XBOTHLABELS, XEDGEYZERO, YZEROXEDGE, XLOGARITHMIC, XNUMERIC, XZEROYEDGE, YEDGEXZERO, YAXIS, YALPHABETIC, YLOGARITHMIC, YNUMERIC, ZEROAXES 'No Control Parameter'

Function:

Sets graphics compatability system (GCS) parameters which define the type of graph to be plotted. The most commonly used parameters are listed, however, any GCS USET option which applies may be used. Refer to the GCS user's manual for a complete description of all USET options. Multiple USET cards may be used. Note that only the first four characters of the control parameters are required.

Card Default:

Default control card parameters are listed below.

Control Parameters:

AUTOSCALE - Uses the input scale parameters from XRSCALE and YTSCALE to generate a scale that fits compactly on the specified output device.

Default: AUTOSCALE. Applies only for non response-wavelength graphs.

BESTFORMAT - This command prints the numeric label output on the graph in best possible format, depending on whether the numeric label is an integer or real number.

Default: BESTFORMAT

EDGEAXES - Specifies that X and Y axes will be drawn along the edge of the graph next to the labels.

Default: EDGEAXES.

FITLINEAR - A linear (straight) line is fit through the points.

Default: No linear line is fit through the points.

FITPOLYNOMIAL - A least squares polynomial is fit to the points. A second degree fit is performed unless the UPSET POLYNOMIAL-DEGREE (N) command indicates a higher degree polynomial fit.

Default: No least squares polynomial of any degree is fit through the points.

FITSPLINE	- A spline curve is fit through the points. The number of data points to be fitted must be greater than two and less than one hundred. Default: No spline curve is fit through the points.
GFORMAT	- Numeric labels along the axes will be printed in real format. Default: BESTFORMAT
GRIDAXIS	- The graph will have a grid background. The grid size depends on the user specified or GCS calculated tic interval. Default: TICAXIS
IFORMAT	- The numeric labels along the X and Y axes are in integer format. Default: BESTFORMAT
LINXAXIS	- The X axis will be in linear cartesian format. Default: LINXAXIS
LINYAXIS	- The Y axis will be in linear cartesian format. Default: LINYAXIS
LNXAXIS	- The X axis will be in natural logarithmic format. Data must be plotted in logarithmic units using USET LOGARITHMIC or XLOGARITHMIC commands. Default: LINXAXIS
LNYAXIS	- The Y axis will be in natural logarithmic format. Data must be plotted in logarithmic units using USET LOGARITHMIC or YLOGARITHMIC commands. Default: LINYAXIS
LOGARITHMIC	- Data will be plotted in logarithmic units for both X and Y coordinates. Default: RECTANGULAR
LOGXAXIS	- X axis will be in common (base 10) logarithmic format. Data must be plotted in logarithmic units using USET LOGARITHMIC or XLOGARITHMIC commands. Default: LINXAXIS
LOGYAXIS	-Y axis will be in common (base 10) logarithmic format. Data must be plotted in logarithmic units using USET LOGARITHMIC or YLOGARITHMIC commands. Default: LINYAXIS
NOAXES	- No X or Y axes will be drawn on graph.

NOXLABEL - No X labels, numeric or alphanumeric, are drawn on the graph.

Default: XBOTHLABEL

NOYLABEL - No Y labels, numeric or alphanumeric, are drawn on the graph.

Default: YBOTHLABEL

PIRADIANS - Angular information for polar graphs is interpreted in Pi radians. This option can be used with the USET POLAR command.

Default: DEGREES

PLAINAXIS - No tic marks will be drawn on the graph axes.

Default: TICAXES

POLAR - Plotting of the data is done in polar units (Rho, Theta). If the USET option POLAR is specified, either RADIANS or PIRADIANS may be used to change the theta units.

Default: RECTANGULAR

RADIANS - Angular information for polar graphs will be interpreted in radians. This option may be used with POLAR option.

Default: DEGREES

RECTANGULAR - Plotting of data will be in rectangular (X, Y) units.

Default: RECTANGULAR

XALPHABETIC - An alphabetic label will be drawn for the X axis. No numeric labels will be written along the X axis at the tic intervals.

Default: XBOTHLABELS

XAXIS - Only the X axis will be drawn

Default: XYAXES

XBOTHLABELS - Both alphabetic and numeric labels will be printed along the X axis.

Default: XBOTHLABELS

XEDGEYZERO
YZEROXEDGE - If either of these two commands are specified on the USET card, the X axis will be plotted in EDGEAXIS format and the Y axis will be plotted in ZEROAXES format.

Default: EDGEAXES

XLOGARITHMIC - Data will be plotted in logarithmic X and linear Y units.

Default: RECTANGULAR

XNUMERIC - A numeric label will be drawn for the X axis, but no alphabetic labels.

Default: XBOTHLABELS

XZEROYEDGE
YEDGEXZERO - If either of these two commands are specified on the USET card, the Y axis will be drawn in EDGEAXES format and the X axis will be in ZEROAXES format.

Default: EDGEAXES

YAXIS - Only the Y axis will be drawn

Default: XYAXES

YALPHABETIC - An alphabetic label will be drawn for the Y axis but no numeric labels.

Default: YBOTHLABELS

YLOGARITHMIC - Data will be graphed in Y logarithmic and X linear units

Default: RECTANGULAR

YNUMERIC - numeric label is drawn for the Y axis. No alphabetic label is drawn.

Default: YBOTHLABELS

ZEROAXES - The X and/or Y axis is drawn along the zero value if the zero value falls between the minimum and maximum input values for the X and/or Y axes. The input values are set by the XRSCALE and YTSCALE options. The labels will be at the edge of the graph.

Default: EDGEAXES

'No Control Parameter' - No global USET options will be passed to GCS plotting routines. All previously set USET options will be initialized and reset to the defaults.

Key Word: XRDATA

Control Parameters:

WAVELENGTH

XXXX, BAND(LL-UL)

XRDATAn, YTDATAn, ZPDATAn

Function:

Specifies the data to be used for the X or radius (R) coordinate values of the graph.

Card Default:

If the card is omitted from the deck, the X axis value will be wavelength.

Control Parameters:

WAVELENGTH - [1]The X or R coordinate values will be wavelength.

[1]If WAVELENGTH is specified on the XRDATA card, no other combinations of control parameters or arithmetic functions are allowed on this card. For example the following options are NOT permissable:

XRDATA WAVELENGTH/LEAR
or
XRDATA WAVELENGTH* 100

XXXX - [2]The X or R coordinate values will be the real or integer ID parameter with the name XXXX. Refer to section 5 for code identifiers.

BAND(LL-UL) - [2]The X or R coordinate values will be the average response in the wavelength band LL to UL.

[2] A combination of these two control parameters may be specified on the same card. For example:

XRDATA BAND(.5-.6)/BAND(.8-1.1)+LEAR
or
XRDATA LEAR *100

The function may contain the following operations:

*,-,+,/,and **. It may also contain SIN, COS, TAN, ARSIN, ARCOS, ATAN, ALOG, ALOG10, EXP, and SQRT functions.

- -

XRDATAn - the values will be the data stored originally as the X or R data for CLASS "n". For example:

XRDATA3 is the XR data originally designated for CLASS 3.

This is more fully illustrated in the examples from section 4.2.

YTDATAn - the values will be the data stored originally as the Y or theta (T) data for CLASS "n". For example:

YDATA3 is the YT data originally designated for CLASS 3.

This is described in section 4.2.

ZPDATAn - the values will be the data stored originally as the Z or Phi (P) data for CLASS "n". For example:

ZPDATA3 is the ZP data originally designated for CLASS 3.

This is described in section 4.2.

A combination of XRDATAn, YTDATAn, and ZPDATAn control parameters may be used. For example:

XRDATA XRDATA1/YTDATA2 + XRDATA2

- -

NOTE: There is a limit of 9 different parameters (XXXX and BAND(LL-UL) or XRDATAn and YTDATAn and ZPDATAn) within a function. There is an overall limit of 30 parameters for all functions within the same processing request.

Processing Function: GSPEC

Key Word: XRLABEL
Control Parameters: A...A 'No control parameter'

Function:

Specifies label to be printed under X axis.

Card Default:

Standard label is printed.

Control Parameters:

A...A - Label of up to 40 characters to be placed below the X axis. The standard set for response vs. wavelength graphs is "Wavelength (μm)". The standard set for other graph types where possible are the XRDATA control parameters.

'No Control Parameter' - The default label for X axis is used if applicable.

Key Word: XRSCALE
Control Parameters:
SW, SW(LL, HH, II), SW(FULL), LW, LW(LL, HH, II), LW(FULL)

Function:

Specifies the scale values to be used in graphing the data along the X or radius (R). This card can also specify the interval of the wavelength samples to be used for response vs. wavelength type graphs.

Card Default:

In response vs. wavelength type graphs wavelengths, 0.4 through 2.4 with an interval of 2 are plotted. For other type graphs - band and/or ID information - a 'nice' scale is used. That scale is from 0 to slightly more than the maximum XR value.

Control Parameters:

SW - specifies that the default scale will be used for the X or R(XR) axis. For response vs. wavelength type graphs, SW specifies that reflective (short) wavelength data will be plotted, printed and/or punched.

SW(LL, HH, II) - sets the scale of XR axes to have a lower limit of LL and an upper limit of HH with a sampling interval every II. For response vs. wavelength type graphs every II sample from LL to HH micrometers will be read from the data tape for plotting, printing, and/or punching.

Default: SW(.4, 2.4, 2)

SW(FULL) - specifies that the lower limit of the XR axis for the short wavelength data or other type data will be the minimum XR value and the upper limit is the maximum XR value.

LW - specifies that emissive(long) wavelength data be graphed and that the default scale will be used for the XR axis. The default scale is 2.5 to 14 μm and every second sample.

LW(LL, HH, II)	- sets the scale of the XR axis for long wavelength data to be from LL to HH. This option specifies that every II sample from LL to HH be read from data tape for plotting, printing, and/or punching.
LW(FULL)	- specifies that the lower limit of the XR axis for long wavelength data be the minimum XR value, and that the upper limit be the maximum XR value.

Key Word: YTDATA
Control Parameters:
RESPONSE
XXXX, BAND(LL-UL)
XRDATAn, YTDATAn, ZPDATAn

Function:

specifies the data to be used for the Y or Theta (T) coordinate values of the graph.

Card Default:

If the card is omitted from the deck, the Y axis value will be spectral response.

Control Parameters:

RESPONSE - [1]The Y or T coordinate values will be spectral response. This is the default parameter.

[1]If RESPONSE is specified on the YTDATA card, no other combinations of control parameters or arithmetic functions are allowed on this card. For example the following options are NOT permissable:

YTDATA RESPONSE/LEAR
or
YTDATA RESPONSE * 100

XXXX - [2]the Y or T coordinate values will be the real or integer ID parameter with the name XXXX. Refer to section 5 for code identifiers.

BAND(LL-UL) - [2]The Y or T coordinate values will be the average response in the wavelength band LL to UL.

[2]A combination of these two control parameters may be specified on the same card. For example:

YTDATA BAND(.5-.6)/BAND(.8-1.1)+LEAR
or
YTDATA LEAR * 100

The function may contain the following operations:

*,-,+,/, and **. It may also contain SIN, COS, TAN, ARSIN, ARCOS, ATAN, ALOG, ALGO10, EXP, and SQRT functions.

- -

XRDATAn - The values will be the data stored originally as the X or R data for CLASS "n". For example:

XRDATA3 is the XR data for CLASS 3.

This is more fully illustrated in the examples from section 4.2.

YTDATAn - The values will be the data stored originally as the Y or Theta (T) data for CLASS "n". For example:

YTDATA3 is the YT data originally designated for CLASS 3.

This is described in section 4.2.

ZPDATAn - The values will be the data stored originally as the Z or Phi (P) data for CLASS "n". For example:

ZPDATA3 is the ZP data originally designated for CLASS 3.

This is described in section 4.2.

A combination of XRDATAn, YTDATAn, and ZPDATAn control parameters may be used. For example:

YTDATA XRDATA1/ZPDATA3 + YTDATA2

- -

NOTE: There is a limit of 9 different parameters (XXXX and BAND(LL-UL) or XRDATAn and YTDATAn and ZPDATAn) within a function. There is an overall limit of 30 parameters for all functions within the same processing request.

Key Word: YTLABEL
Control Parameters: A...A 'No control parameter'

Function:

Specifies label to be printed to the left of Y axis.

Card Default:

Standard label is printed.

Control Parameters:

A...A	- Label of up to 40 characters to be placed to the left of Y axis. The standard set for response vs. wavelength are the units of response values. The standard set for the other graph types where possible are the YTDATA Control parameters.
'No Control Parameter'	- The default label for Y axis is used if applicable

Key Word: YTSCALE

Control Parameters:

SW, SW(LL, HH), SW(FULL), LW, LW(LL, HH), LW(FULL)

Function:

Specifies the scale values to be used in graphing the data along the Y or theta (T) axis.

Card Default:

If this card is omitted, 0 through 100 are the response values for response vs. short wavelength type graphs; 0 through 1500 are the default response scale values for response vs. emissive (long) wavelength type graphs. For other type graphs, the default is 0 to slightly more than the maximum YT value.

Control Parameters:

SW	- specifies that the default scale will be used for the Y or theta (T) axis.
SW(LL, HH)	- response vs. wavelength type graphs and other types of graphs to be from LL to HH.
SW(FULL)	- specifies that the lower limit of the YT axis be the minimum YT value and that the upper limit be the maximum YT value.
LW	- specifies that the default scale be used for the YT axis of the emissive (long) wavelength data graphs. Default is 0 to 1500.
LW(LL, HH)	- sets the scale of the YT axis for long wavelength data to be from LL to HH.
LW(FULL)	- specifies that the lower limit of the YT axis for long wavelength data be the minimum YT value and that the upper limit be the maximum YT value.

Key Word: ZPDATA
Control Parameters:
XXXX, BAND(LL-UL)
XRDATAn, YTDATAn, ZPDATAn
'No control parameters'

Function:

Specifies that the ZPDATA will be plotted versus the XRDATA. The standard deviation data is automatically stored as ZPDATA.

Card Default:

There is no default for this card as LARSPEC is not yet three dimensional in plotting.

Control Parameters:

XXXX - [1]The Z or P coordinate values will be the real or integer ID parameter with the name XXXX. Refer to section 5. for code identifiers.

BAND(LL-UL) - [1]The Z or P coordinate values will be the average response in the wavelength band LL to UL.

[1]A combination of these two control parameters may be specified on the same card. For example:

ZPDATA BAND(.5-.6)/BAND(.8-1.1)+LEAR
or
ZPDATA LEAR * 100

The function may contain the following operations: *,-,+, /, and **. It may also contain SIN, COS, TAN, ARSIN, ARCOS, ATAN, ALOG, ALOG10, EXP, and SQRT functions.

XRDATAn - The values will be the data stored originally as the X or R data for CLASS "n". For example:

XRDATA3 is the XR data originally designated for CLASS 3.

This is more fully illustrated in the examples from section 4.2.

YTDATAn - The values will be the data stored originally as the Y or Theta (T) data for CLASS "n". For example:

YTDATA3 is the YT data originally designated for CLASS 3.

This is described in section 4.2.

ZPDATAn - The values will be the data stored originally as the Z or Phi (P) data for CLASS "n". For example:

ZPDATA3 is the ZP data originally designated for CLASS 3.

This is described in section 4.2.

A combination of XRDATAn, YTDATAn, and ZPDATAn control parameters may be used. For example:

ZPDATA XRDATA1 + YTDATA1 * ZPDATA1

'No control parameter' - ZPDATA versus XRDATA will not be plotted. No ZPDATA cards will be expected.

NOTE: There is a limit of 9 different parameters (XXXX and BAND(LL-UL) or XRDATAn and YTDATAn and ZPDATAn) within a function. There is an overall limit of 30 parameters for all functions within the same processing request.

Processing Function: GSPEC

Key Word: *END
Control Parameters:

Function:

Signifies end of class cards. Additional supervisor control cards and CLASS cards may follow or if end of all classes, precedes $END Control card.

Card Default:

NONE; card is required.

Control Parameters:

NONE.

**** INTERACTIVE CONTROL COMMANDS ****

The following commands can be input during execution of a GSPEC job if the command OPTIONS INTERACTIVE was initially specified in the control card deck. The commands allow the user the flexibility to add or delete classes to be graphed and to change any of the supervisor control parameters.

INPUT COMMAND Long Form	Short Form	FUNCTION
Supervisor Keyword & Control Parameter	-	Resets current parameters with those specified on input.
FIND n	F n	Go to the nth class to insert or change requests or add a class. F 0 will return to the global or supervisor control area.
NEXT	N	Graphs the next set of data for single run plotting through "GRAPH" request.
PRINT	P	Prints current GSPEC status area flags at the terminal in the form of control cards for both global and class areas.
PRINT GLOBAL	P GL	Prints only the global status area.
PRINT CLASS	P CL	Prints only the class status area.
QUIT	Q	Ends interactive session-go to disk or reader deck for next processing request.
RUN	R	Execute job using requested data with the present status of the GSPEC status area flags.
TOP	T	Begin changing control cards again. Want to erase rather than add parameters to "GRAPH", "SELECT", "LIST", "USET", or "UPSET".
DELETE	D	Delete the entire set of current class cards. CLASS area is reached via the "FIND" command.

The interactive control parameters do not actually change the control cards in the original reader or disk file. Instead, use of the interactive control commands actually change the flags in the GSPEC status area. The GSPEC status area was originally set with the original control cards.

3.5 IDLIST Processor Supervisor Control Cards

Processing Function: IDLIST

Key Word: CASES
Control Parameters: AGRONOMIC, NOAGRON, GEOMETRIC, NOGEOM

Function:

Controls punching of data - identification (header) information.

Card Default:

None; card is required for data to be punched.

Control Parameters:

AGRONOMIC - punches agronomic header information for each selected observation including:

Date data collected	Level of factor 1
Observation number	Level of factor 2
Serial number	Level of factor 3
Day of year	Level of factor 4
Time data collected	Level of factor 5
Scene type	Level of factor 6
Field number	Level of factor 7
Plot number	Level of factor 8
Replication number	Dry Biomass-gr. leaves
Species	Dry biomass-yel. leaves
Variety	Dry biomass-br. leaves
Day since planting	Dry biomass-stems
Maturity stage	Dry biomass-fruit

Numerical maturity stage	Dry biomass-weeds
Plant count	Dry biomass-total
Fruit count	Fresh biomass-total
Leaf condition	Grain moisture content
green	Grain yield
brown	Grain test weight
yellow	Row width
Planting date	Plant height
Percent ground cover	Leaf area index
Leaves per plant	Plant moisture
Plant water content	Target temperature
Radiant temperature	

See section 6 for a description of the format of the data on the cards.

Default: no agronomic information punched.

NOAGRON - suppresses punching of agronomic information.

Default: no agronomic information punched.

GEOMETRIC - punches geometric header information for each selected observation including:

Date data collected	Irradiance zenith angle
Serial number	Irradiance azimuth angle
Scene type	Time data collected
View zenith angle	Location
View azimuth angle	Location latitude
Observation number	Location longitude

Default: no geometric information punched.

NOGEOM - suppresses punching of geometric header information for each selected observation.

Default: no geometric information punched.

Processing Function: IDLIST

Key Word: END
Control Parameters:

Function:

Indicates the end of control cards for one IDLIST request. Additional supervisor control card sets may follow.

Card Default:

END card is required.

Control Parameters:

NONE.

Processing Function: IDLIST

Key Word: LIST
Control Parameters: XXXX, ALL, NOSUPRES, NOLIST, ONELINE

Function:

Specifies ID parameters for printing.

Card Default:

If LIST card is not used, a one line listing is printed including: run number, experiment number, observation number, time data collected, day data collected, experiment name, location, crop or scene type, plot or field number, and instrument name.

Control Parameters:

XXXX - represents the four letter code name of the ID parameters to be printed. See Section 5 for four letter codes. Only the values for the parameter represented by XXXX will be printed.

Default: One line listing is printed.

ALL - Causes printing of all ID parameters for runs selected. Only the NOSUPRES parameter may be used with the ALL option.

Default: One line listing is printed.

NOSUPRES - For each observation selected all ID parameters will be printed, including those which have null values. Those with null values will be printed with asterisks as their value.

Default: One line listing is printed.

NOLIST - Listing will be supressed for this processing function.

Default: one line listing is printed.

ONELINE - one line listing is printed. ONELINE includes run number, experiment number, observation number, time data collected, day data collected, experiment name, location, crop or scene type, plot or field number, and instrument name.

Processing Function: IDLIST

Key Word: OPTIONS
Control Parameters: TAPE(N1, N2,...N5) COPYDISK

Function:

Tapes will be searched for data. The maximum number of tapes to be searched per LARSPEC job execution is five. This card has the same function as the $TAPE card. If both cards, the OPTIONS TAPE and $TAPE card, are included in one run, the OPTIONS TAPE card will override or reset the tape numbers previously defined on the $TAPE card.

Card Default:

If the OPTIONS card is omitted, system defaults are used. These defaults are specified below.

Control Parameters:

TAPE (N1, N2, ...) - N1, N2,...N5 specifies the tape number of tapes to be searched for the user specified observations, input through SELECT card. Tapes are mounted in order specified on the OPTIONS card.

Default: None. If no tape has been requested by using either the $TAPE or OPTIONS TAPE card, no tape will be searched.

COPYDISK - This option causes the selected data from tape to be copied to a disk file that has been set up using the LARSPEC terminal command - DDISK. See sections 2.3 and 3.1.

Default: None. Data is not copied from tape to disk file.

COPYDISK (con't)

In creating a disk data base as described in section 2.3, it is important that the user consider the type of data being copied and the number of observations to be included in the file. Depending on the instrument and/or type of data on the tape the maximum number of observations that can be included in one disk file ranges from 382 to 2160. The following table will serve as a simple guide.

DATA TYPE	MAX. NUMBER OF OBSERVATIONS	BYTES PER OBSERVATION
Exotech Model 100 Landsat Band Radiometer	2160	1384
Exotech 20C, FSAS, & Exotech 20D (Field Research Wavelength Format)	1415	2108
FSS (Field Spectrometer System)	970	3076
Exotech 20C (original wavelength format)	382	7760

The data type of a particular tape can be determined by refering to the Data Library Tape Listing, Appendix D. The limits on the maximum number of runs are established as "safe" limits for a disk file containing only the data type specified. In some cases, it may be possible to exceed these limits without exceeding the disk space limits.

The number of bytes per observation for different instrument systems and data types are included in the table above to help a user determine the size of a mixed instrument disk data base. In this case, the user can assume that the available space is 3 million bytes minus approximately 7000 bytes which are needed for system usage and the select catalog described below.

THE SELECT CATALOG

As an aid to the user in keeping track of the source of data for a particular data base disk file, a "Select Catalog" is included at the beginning of the data base file. This catalog is invisible to the LARSPEC program but can be displayed by the user via the CMS TYPE command. To display the catalog at the terminal the user should enter:

TYPE 'filename' 'filetype' B1 1 n

where 'filename' 'filetype' is MSPEC BASE unless the user specified another name when the file was created:

n= number of lines to display, dependent on the users knowledge of the catalog size.

If the catalog size is not known, it is best to let n be 5 or less since undefined characters found at the end of the file will cause the terminal screen to clear. The select catalog includes the tape number(s) and the select cards used in the IDLIST job to create the mini data base. An example is given below:

```
20 FIELD SPECTRORADIOMETER DATA
$TAPE(S) 5037
SELECT OBNU (81615-816422)
SELECT SPEC (BARLEY), SPEC (OATS)
```

Processing Function: IDLIST

Key Word: SELECT
Control Parameters: XXXX(LL-UL), XXXX(LL-UL+L), XXXX(L1, L2,. . .), XXXX(A...A), XXXX(A...A:B...B), -XXXX( ), .OR.

Function:

selects observations from entire data set on requested tape(s) that meet the specifications on the SELECT card. Multiple SELECT cards may be used.

Card Default:

If no SELECT card is entered, data observations having a run sequence, RUSE, 1-9999 are selected. This should include all observations on the tape.

Control Parameters:

XXXX(LL-UL) - selects observations with ID parameter XXXX that have integer or real data values. LL refers to the lower limit value and UL refers to the upper limit value. All observations having a value within the limits LL and UL inclusive for parameter XXXX will be selected. The specific four letter codes for XXXX are described in section 5.

Default: RUSE(1-9999)

XXXX(LL-UL+L) - selects observations with ID parameters XXXX that have integer data values. LL refers to the lower limit value and UL refers to the upper limit value. All observations having a value between the upper and lower limit for parameter XXXX and an increment of L are selected.

Default: The increment value for an integer data value is 1.

XXXX(L1, L2, L3,...)	- selects observations with ID parameter XXXX equal to L1, L2, ...LN. A combination of the above parameters for select may be used, for example: SELECT RUSE (1,5,9-21) selects observations with run sequence 1,5, and 9 through 21. SELECT RUSE(1,5,9-21+3) selects observations with run sequence 1,5,9,12,15, 18, and 21. Default: No observations selected.
XXXX(A...A)	- selects observations with alphanumeric ID parameter equal to A...A. Default: No observations selected.
XXXX(A...A:B...B)	- selects observations with alphanumeric ID parameter equal to A...A or B...B. More than 2 sets may be specified on one SELECT card. For example: SELECT SCTY(CORN:WINTER WHEAT:PASTURE) selects all observations that have a scene type of either corn or winter wheat or pasture. Default: No observations are selected.
-XXXX( )	- selects observations with ID parameter XXXX except those specified observations or those outside set limits. For example: SELECT -SCTY(PASTURE), RUSE(1-50) selects all observations between run sequence 1 through 50 whose scene type is not pasture. One may use a combination of the same ID parameter with and without the not sign, but the result will be all observations used. For example: SELECT OBNU(10-30), -OBNU(20-22) selects observation numbers 1 through the last observation on the tape. Default: No observations are selected.
.OR.	- specifies end of one condition set. An observation will be selected if all the conditions or parameters prior to the .OR. are met or all conditions or parameters after the .OR. are met. For example: SELECT RUSE(10-15), CLCO(50), .OR., RUSE(10-15), SCTY(CORN) selects observations with run sequence 10 through 15 and cloud cover of 50% or run sequence 10 through 15 and scene type of corn. An exception to the above use

of the .OR. option is that if the same parameter is repeated before the .OR., the observation is selected if it meets either condition. For example:

SELECT RUSE(1), RUSE(6), CLCO(50), .OR., RUSE(10)

is interpreted as if the user had typed:

SELECT RUSE(1), CLCO(50), .OR., RUSE(6), CLCO(50),.OR., RUSE(10)

Default: No data observations selected.

4.0 Processor Input and Output Descriptions

This section discusses example control card decks which illustrate the capabilities of each of the three processors - DSEL, GSPEC, and IDLIST.

4.1 Example DSEL Control Card Decks and Output Descriptions

The capabilities of the DSEL processor include printing and/or punching specified wavelength band statistics, clustering LARSPEC data into spectral classes, and punching identification record information. The capabilities of DSEL are illustrated by the control card deck examples and associated output which are described in this section. Table 4.1-1 lists the major DSEL capabilities and identifies the example decks which illustrate a use of that capability.

The examples include a couple combinations of control card instructions to cover a range of capabilities. However, the examples are not inclusive of all possibilities that one can do. Table 4.1-2 identifies the page on which each example is discussed.

Table 4.1-1 Major DSEL capabilities and the example decks which illustrate those capabilities.

Capabilities (and control cards)	Example decks
Data specifications:	
Specify desired observations (SELECT;OPTIONS TAPE)	1,2
Specify 1 to 100 wavelength bands (BANDS)	1,2
Statistics specifications (spectral data) for:	
Individual observations including means, variances, minimum and maximum values, and percent deviation. (STATISTICS RUNSTATS)	1
Groups of observations including means variances, minimum and maximum values, percent deviation, correlations, and covariances. (STATISTICS CLASSTATS, CORRELATION)	2
Cluster specifications (spectral data):	
Group data into 2 to 15 clusters (CLUSTER;OUTPUT)	2
Output specifications:	
Punch band means (CASES PUNCH, FFORMAT, BINARY)	1
Punch LARSYS type statistics deck (STATISTICS DISK, PUNCH)	2
Punch identification record information (CASES AGRONOMIC, GEOMETRIC)	1
Graph coincident spectral plot (STATISTICS SPECPLT)	2
Print identification record information (LIST)	1

Table 4.1-2. Reference page numbers for each DSEL example deck.

Example Deck	Page
1	4.1-4
2	4.1-10

DSEL Example 1

```
$TAPE 4298
$DSEL
BANDS .5-.6, .6-.7, .7-.8, .8-1.1
SELECT DACO(770616)
LIST ONELINE
CASES PUNCH, AGRONOMIC, FFORMAT
STATISTICS RUNSTATS, CORRELATION
END
CLASS SPRWHT
SELECT FINU(169)
CLASS ALFALFA
SELECT FINU(182)
CLASS GRASS
SELECT FINU(233)
*END
$END
$EXIT
```

In this DSEL control card deck, the BANDS card specifies that wavelength band averages are to be calculated for the four reflective LANDSAT bands. The global and class SELECT indicates that observations are selected for one spring wheat field, one alfalfa field, and one grass field on June 16, 1977. 'STATISTICS RUNSTATS, CORRELATION' produces statistics for each observation including means, minimum values, maximum values, variance, standard deviation, percent deviation, and number of points as illustrated in Figure 4.1-1. The correlation matrix for each class is given in Figure 4.1-2. The option 'CASES PUNCH, AGRONOMIC, FFORMAT' punches a data deck, Figure 4.1-3, consisting of five cards per observation. The first eight cards of the deck describe the information that have been punched: the format of the data cards, and the spectral band selected. The remainder of the deck, broken down by class, has five data cards per observation. The first four cards of each observation are the agronomic information associated with that observation;the last card of the observation contains the spectral band means for the bands selected. The option FFORMAT indicates that the band mean punched output will be in F-format and not binary.

CLASS NAME	DATE	OBS	SER	SPECTRAL BAND	MEAN	RANGE MINIMUM	MAXIMUM	VARIANCE	STANDARD DEVIATION	PERCENT DEVIATION	NO. PTS	USER CLASS
SPRWHT	770616	37	25	0.500- 0.600	3.54	2.07	4.08	0.74	0.86	24.31	11	SPRWHT
				0.600- 0.700	4.48	2.07	10.99	11.18	3.34	74.57	11	
				0.700- 0.800	23.89	5.20	35.87	142.99	11.96	50.06	11	
				0.800- 1.100	35.62	31.91	38.73	2.89	1.70	4.77	31	
ALFALFA	770616	48	1	0.500- 0.600	5.59	3.97	6.37	0.65	0.80	14.38	11	ALFALFA
				0.600- 0.700	7.29	5.23	12.54	8.30	2.88	39.54	11	
				0.700- 0.800	18.30	9.47	22.87	22.33	4.73	25.71	11	
				0.800- 1.100	25.77	22.87	28.25	2.43	1.56	6.05	31	
	770616	48	2	0.500- 0.600	5.64	3.02	6.49	0.81	0.90	15.93	11	ALFALFA
				0.600- 0.700	7.21	5.13	12.42	7.76	2.79	38.65	11	
				0.700- 0.800	17.45	8.70	22.43	24.03	4.90	28.08	11	
				0.800- 1.100	24.95	22.43	27.89	2.16	1.47	5.89	31	
	770616	48	3	0.500- 0.600	5.29	3.56	6.34	0.89	0.94	17.81	11	ALFALFA
				0.600- 0.700	6.77	4.36	12.52	9.90	3.15	46.46	11	
				0.700- 0.800	19.83	9.13	25.01	31.26	5.59	28.20	11	
				0.800- 1.100	27.15	25.01	29.52	1.49	1.22	4.50	31	
	770616	48	4	0.500- 0.600	5.60	3.64	6.59	1.05	1.02	18.27	11	ALFALFA
				0.600- 0.700	7.34	5.14	12.81	8.59	2.93	39.93	11	
				0.700- 0.800	17.92	8.94	23.10	26.15	5.11	28.53	11	
				0.800- 1.100	25.71	23.10	28.75	1.79	1.34	5.21	31	
	770616	48	5	0.500- 0.600	5.52	3.82	6.45	0.85	0.92	16.67	11	ALFALFA
				0.600- 0.700	6.99	4.90	12.30	7.68	2.77	39.64	11	
				0.700- 0.800	17.79	7.83	23.45	33.28	5.77	32.42	11	
				0.800- 1.100	26.15	23.45	28.67	2.37	1.54	5.88	31	
	770616	48	6	0.500- 0.600	5.12	3.25	6.22	0.91	0.96	18.67	11	ALFALFA
				0.600- 0.700	6.78	4.26	13.44	12.54	3.54	52.23	11	
				0.700- 0.800	22.36	8.53	28.41	46.41	6.81	30.47	11	
				0.800- 1.100	30.12	28.41	31.72	0.77	0.88	2.92	31	
	770616	48	7	0.500- 0.600	5.26	3.26	6.35	1.01	1.01	19.11	11	ALFALFA
				0.600- 0.700	6.72	4.44	12.74	9.84	3.14	46.66	11	
				0.700- 0.800	18.95	7.77	25.27	43.07	6.56	34.64	11	
				0.800- 1.100	27.64	25.27	30.33	1.80	1.34	4.86	31	
	770616	48	8	0.500- 0.600	5.43	3.74	6.28	0.69	0.83	15.29	11	ALFALFA
				0.600- 0.700	7.32	5.23	12.67	9.01	3.00	40.99	11	
				0.700- 0.800	18.35	9.96	22.16	18.31	4.28	23.32	11	
				0.800- 1.160	24.93	22.16	27.59	2.68	1.64	6.56	31	
	770616	48	9	0.500- 0.600	5.44	3.77	6.32	0.79	0.89	16.36	11	ALFALFA
				0.600- 0.700	6.99	5.17	12.09	7.01	2.65	37.86	11	
				0.700- 0.800	17.13	7.79	22.28	29.23	5.41	31.55	11	
				0.800- 1.100	25.02	22.28	27.99	2.24	1.50	5.98	31	
	770616	48	10	0.500- 0.600	5.60	3.92	6.44	0.76	0.87	15.53	11	ALFALFA
				0.600- 0.700	7.31	5.34	12.74	8.14	2.85	39.01	11	
				0.700- 0.800	17.77	8.40	22.15	25.68	5.07	28.51	11	
				0.800- 1.100	24.56	22.09	27.59	2.50	1.58	6.43	31	
	770616	48	11	0.500- 0.600	5.27	3.30	6.31	1.01	1.00	19.02	11	ALFALFA
				0.600- 0.700	6.69	4.37	12.58	9.46	3.08	45.99	11	
				0.700- 0.800	18.35	7.69	24.10	36.87	6.07	33.09	11	
				0.800- 1.100	26.60	24.10	28.96	1.92	1.39	5.21	31	

Figure 4.1-1. Run statistics generated by using 'STATISTICS RUNSTATS' in DSEL.

CORRELATION MATRIX

SPECTRAL BAND	0.50 0.60	0.60 0.70	0.70 0.80	0.80 1.10
0.50 0.60	1.000			
0.60 0.70	0.926	1.000		
0.70 0.80	-0.602	-0.397	1.000	
0.80 1.10	-0.832	-0.829	0.751	1.000

CORRELATION MATRIX

SPECTRAL BAND	0.50 0.60	0.60 0.70	0.70 0.80	0.80 1.10
0.50 0.60	1.000			
0.60 0.70	0.867	1.000		
0.70 0.80	-0.797	-0.581	1.000	
0.80 1.10	-0.848	-0.765	0.930	1.000

CORRELATION MATRIX

SPECTRAL BAND	0.50 0.60	0.60 0.70	0.70 0.80	0.80 1.10
0.50 0.60	1.000			
0.60 0.70	0.968	1.000		
0.70 0.80	0.764	0.730	1.000	
0.80 1.10	0.167	-0.020	0.031	1.000

Figure 4.1-2. An example of correlation matrices for the three specified classes.

```
MODULE DATA DECK FOR LARSPEC        BCD DEC  18,1979 10 04 37 AM
DACO,OBNU,SENU,SEQNUM,CLASS,JUDA,TIDA,SCTY,PLNU,RENU,SPEC,VARI,
LOF1,LOF2,LOF3,LOF4,LOF5,LOF6,LOF7,LOF8,ROWI,PLDA,DAPL,MATU,NMAT,HEIG,PEGR,LEAR,
LEPL,PLCO,FRCO,GRLE,YELE,BRLE,PLMO,PMOW,RATE,TATE,YELD,TSWT,GMOS,
DBGL,DBYL,DBBL,DBST,DBFR,DBWE,DBTO,FRBI
I6,I4,I2,I2,I2,I3,I6,4A4,I4,1X,I2,4A4,4A4/16X,8I2,F5.2,I6,I3,4A4,2F5.2,I3,F5.2/
16X,F4.1,2F7.1,3I3,I2,F8.2,F4.1,F5.2,F8.1,F6.2,F4.1/16X,8F8.2
BANDS   0.500 -  0.600,  0.600 -  0.700,    0.700 -  0.80,    0.800 -  1.100
CLASS SPRWHT        BAND MEANS
770616  37 1 1 1167160119WHEAT     DRYLAND 169F 1SPRING WHEAT
770616  37 1 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  37 1 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 1 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 1 5 1     3.66     4.93    25.89    34.60
770616  37 2 1 1167160120WHEAT     DRYLAND 169F 2SPRING WHEAT
770616  37 2 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  37 2 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 2 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 2 5 1     3.91     5.06    22.66    31.52
770616  37 3 1 1167160121WHEAT     DRYLAND 169F 3SPRING WHEAT
770616  37 3 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  37 3 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 3 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 3 5 1     3.78     4.79    21.59    32.16
770616  37 4 1 1167160122WHEAT     DRYLAND 169F 4SPRING WHEAT
770616  37 4 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  37 4 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 4 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 4 5 1     3.78     5.06    22.85    32.03
770616  37 5 1 1167160123WHEAT     DRYLAND 169F 5SPRING WHEAT
770616  37 5 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  37 5 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 5 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 5 5 1     3.93     4.99    21.61    31.49
770616  37 6 1 1167160124WHEAT     DRYLAND 169F 6SPRING WHEAT
770616  37 6 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  37 6 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 6 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 6 5 1     3.75     4.68    22.47    33.44
770616  37 7 1 1167160125WHEAT     DRYLAND 169F 7SPRING WHEAT
770616  37 7 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  37 7 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 7 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 7 5 1     3.64     4.40    24.09    36.48
770616  37 8 1 1167160126WHEAT     DRYLAND 169F 8SPRING WHEAT
770616  37 8 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  37 8 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 8 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 8 5 1     4.06     5.30    20.87    29.63
770616  37 9 1 1167160127WHEAT     DRYLAND 169F 9SPRING WHEAT
770616  37 9 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  37 9 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 9 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 9 5 1     3.64     4.47    22.91    34.85
770616  3710 1 1167160128WHEAT     DRYLAND 169F10SPRING WHEAT
770616  3710 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  3710 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  3710 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  3710 5 1     3.71     4.70    22.61    32.95
770616  3711 1 1167160129WHEAT     DRYLAND 169F11SPRING WHEAT
770616  3711 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  3711 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  3711 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  3711 5 1     3.89     4.82    22.41    32.16
770616  3712 1 1167160130WHEAT     DRYLAND 169F12SPRING WHEAT
770616  3712 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  3712 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  3712 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  3712 5 1     3.85     5.13    23.40    31.89
770616  3713 1 1167160131WHEAT     DRYLAND 169F13SPRING WHEAT
770616  3713 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  3713 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  3713 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  3713 5 1     3.83     4.72    21.84    33.17
770616  3714 1 1167160132WHEAT     DRYLAND 169F14SPRING WHEAT
770616  3714 2 1-9-9-9 3-9 1-9-9-9.00      -9 -9FULLY HEADED      -9.00 0.48 30-9.00
770616  3714 3 1-9.0    -9.0     -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  3714 4 1    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  3714 5 1     3.73     4.78    22.82    32.22
```

Figure 4.1-3. Listing of punch output using 'CASES PUNCH, AGRONOMIC, FFORMAT'.

The 'LIST ONELINE' card specifies that a one line type listing of identification information for each selected run will be printed, Figure 4.1-4. Note that the ID listing includes the class name(s) that the observation belongs to.

LARSPEC(VER 3.0)
USER -- NANCY

LABORATORY FOR APPLICATIONS OF REMOTE SENSING
PURDUE UNIVERSITY

DEC 18,1979
01 15 51 PM

RUN SEQ	COLLECT DATE	OBSRVTN NUMBER	SERIAL NUMBER	COLLEC TIME	EXPERIMT NUMBER	EXPERIMENT NAME	LOCATION	CROP SPECIES (C) SOIL SERIES (S) SCENE TYPE (T)	PLOT/ FIELD NO.	INSTRUMT NAME	DATA TAKEN
2036	6/16/77	616017	77401701	155100	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	233 F	FSS	RF/TH
		CLASS NAME	....			GRASS					
2037	6/16/77	616017	77401702	155101	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	233 F	FSS	RF/TH
		CLASS NAME	....			GRASS					
2038	6/16/77	616017	77401703	155102	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	233 F	FSS	RF/TH
		CLASS NAME	....			GRASS					
2039	6/16/77	616017	77401704	155103	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	233 F	FSS	RF/TH
		CLASS NAME	....			GRASS					
2040	6/16/77	616017	77401705	155104	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	233 F	FSS	RF/TH
		CLASS NAME	....			GRASS					
2041	6/16/77	616017	77401706	155105	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	233 F	FSS	RF/TH
		CLASS NAME	....			GRASS					
2042	6/16/77	616017	77401707	155106	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	233 F	FSS	RF/TH
		CLASS NAME	....			GRASS					
2043	6/16/77	616017	77401708	155107	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	233 F	FSS	RF/TH
		CLASS NAME	....			GRASS					
2044	6/16/77	616017	77401709	155108	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	233 F	FSS	RF/TH
		CLASS NAME	....			GRASS					
2498	6/16/77	616037	77403701	160119	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2499	6/16/77	616037	77403702	160120	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2500	6/16/77	616037	77403703	160121	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2501	6/16/77	616037	77403704	160122	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2502	6/16/77	616037	77403705	160123	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2503	6/16/77	616037	77403706	160124	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2504	6/16/77	616037	77403707	160125	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2505	6/16/77	616037	77403708	160126	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2506	6/16/77	616037	77403709	160127	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2507	6/16/77	616037	77403710	160128	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2508	6/16/77	616037	77403711	160129	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2509	6/16/77	616037	77403712	160130	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2510	6/16/77	616037	77403713	160131	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2511	6/16/77	616037	77403714	160132	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2512	6/16/77	616037	77403715	160133	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2513	6/16/77	616037	77403716	160134	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2514	6/16/77	616037	77403717	160135	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2515	6/16/77	616037	77403718	160136	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2516	6/16/77	616037	77403719	160137	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2517	6/16/77	616037	77403720	160138	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2518	6/16/77	616037	77403721	160139	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2519	6/16/77	616037	77403722	160140	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2520	6/16/77	616037	77403723	160141	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2521	6/16/77	616037	77403724	160142	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2522	6/16/77	616037	77403725	160143	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	169 F	FSS	RF/TH
		CLASS NAME	....			SPRWHT					
2709	6/16/77	616048	77404801	161250	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2710	6/16/77	616048	77404802	161251	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2711	6/16/77	616048	77404803	161252	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2712	6/16/77	616048	77404804	161253	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2713	6/16/77	616048	77404805	161254	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2714	6/16/77	616048	77404806	161255	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2715	6/16/77	616048	77404807	161256	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2716	6/16/77	616048	77404808	161257	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2717	6/16/77	616048	77404809	161258	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2718	6/16/77	616048	77404810	161259	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2719	6/16/77	616048	77404811	161300	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					
2720	6/16/77	616048	77404812	161301	77102227	INTENSIVE SITE	HAND CO. S. DAK.	C ALFALFA HAY	182 F	FSS	RF/TH
		CLASS NAME	....			ALFALFA					

Figure 4.1-4. Output of 'LIST ONELINE' in DSEL giving **identification** information and class name.

DSEL Example 2

```
$TAPE 4298
$DSEL
BANDS .45-.52, .52-.60, .63-.69, .76-.90, 1.55-1.75, 2.08-2.35
SELECT DACO(770616)
CLUSTER MAXCL(12), CONV(98.5)
LIST NOLIST
STATISTICS NRUN, SPECPLT, DISK, CLASS, CORRELATION
OUTPUT SUMMARY, GROUP
END
CLASS 770616
*END
$END
$EXIT
```

In this example, the user is clustering the entire data set collected on June 16, 1977, denoted by the 'SELECT DACO(770616)'. The 'CLUSTER MAXCL(12), CONV(98.5)' indicates that there will be 12 distinct spectral classes and subclasses identified within the data selected. The CONV(98.5) option indicates that when 98.5% of all vectors to be clustered do not change cluster centers on the last iteration, clustering will be complete. Figure 4.1-5 displays the output generated by using 'CLUSTER MAXCL(12), CONV(98.5)'. The output lists the number of clusters specified, the number of observations used in clustering, the initial cluster centers for each specified wavelength band for each cluster class, the number of iterations needed to complete clustering using the 98.5% convergence parameter, the number of points or observations in each cluster class, and the means and variances in each wavelength band for each of the 12 cluster classes.

The command 'STATISTICS NRUN, SPECPLT, DISK, CLASS, CORRELATION' indicates that no individual run statistics will be printed, however, a coincident spectral plot (Figure 4.1-6) will be printed, a LARSYS-formatted statistics deck (Figure 4.1-7) will be placed on the user's permanent disk, class statistics will be printed (Figure 4.1-8), and a correlation matrix for each cluster class will be printed.

CLUSTERING INFORMATION

NUMBER OF CLUSTERS = 12   NUMBER OF RUNS CLUSTERED = 1946   NUMBER OF RUNS NOT USED = 0

INITIAL CLUSTER CENTERS

CH(1)	CH(2)	CH(3)	CH(4)	CH(5)	CH(6)
6.24	7.77	10.64	12.10	32.32	27.79
5.84	7.36	10.07	13.88	30.35	25.42
5.43	6.95	9.50	15.65	28.38	23.04
5.02	6.54	8.92	17.42	26.41	20.66
4.61	6.14	8.35	19.20	24.44	18.29
4.21	5.73	7.78	20.97	22.47	15.91
3.80	5.32	7.21	22.74	20.50	13.53
3.39	4.91	6.63	24.52	18.53	11.16
2.99	4.50	6.06	26.29	16.56	8.78
2.58	4.10	5.49	28.06	14.59	6.41
2.17	3.69	4.92	29.84	12.62	4.03
1.76	3.28	4.34	31.61	10.65	1.65

```
I0172       0/ 1946 VECTORS UNCHANGED ON THE     1TH ITERATION.   (CLUST3)
I0172    1550/ 1946 VECTORS UNCHANGED ON THE     2TH ITERATION.   (CLUST3)
I0172    1694/ 1946 VECTORS UNCHANGED ON THE     3TH ITERATION.   (CLUST3)
I0172    1776/ 1946 VECTORS UNCHANGED ON THE     4TH ITERATION.   (CLUST3)
I0172    1814/ 1946 VECTORS UNCHANGED ON THE     5TH ITERATION.   (CLUST3)
I0172    1819/ 1946 VECTORS UNCHANGED ON THE     6TH ITERATION.   (CLUST3)
I0172    1842/ 1946 VECTORS UNCHANGED ON THE     7TH ITERATION.   (CLUST3)
I0172    1871/ 1946 VECTORS UNCHANGED ON THE     8TH ITERATION.   (CLUST3)
I0172    1886/ 1946 VECTORS UNCHANGED ON THE     9TH ITERATION.   (CLUST3)
I0172    1902/ 1946 VECTORS UNCHANGED ON THE    10TH ITERATION.   (CLUST3)
I0172    1917/ 1946 VECTORS UNCHANGED ON THE    11TH ITERATION.   (CLUST3)
```

CLUSTER	POINTS	MEANS CH(1)	CH(2)	CH(3)	CH(4)	CH(5)	CH(6)
1	197	6.13	7.69	10.65	15.54	31.97	27.34
2	223	5.82	7.26	9.99	14.64	30.29	25.88
3	61	5.14	6.41	8.82	13.47	27.72	23.67
4	43	4.26	5.34	7.46	11.39	24.65	20.96
5	25	5.02	6.90	9.08	22.12	25.51	17.00
6	172	4.28	6.11	7.94	21.74	21.05	12.14
7	150	3.58	5.48	7.19	28.43	19.70	9.92
8	205	3.23	4.88	6.45	22.15	17.00	9.12
9	416	2.40	3.80	5.13	26.45	14.01	6.39
10	65	1.18	1.76	2.04	8.94	3.80	1.54
11	299	2.33	3.81	5.26	32.38	14.46	5.74
12	90	2.39	4.13	5.73	41.93	14.50	5.16

CLUSTER VARIANCES

	CH(1)	CH(2)	CH(3)	CH(4)	CH(5)	CH(6)
1	0.24	0.50	0.88	1.10	0.60	0.78
2	0.13	0.28	0.57	0.83	0.54	0.95
3	0.23	0.25	0.38	2.13	0.72	0.88
4	0.31	0.40	0.67	1.62	2.48	2.32
5	0.24	0.37	0.48	8.40	1.52	4.78
6	0.27	0.36	0.48	3.40	1.78	1.37
7	0.32	0.48	0.73	8.78	3.12	2.05
8	0.18	0.34	0.49	2.86	2.61	1.53
9	0.17	0.32	0.47	2.99	3.02	1.55
10	0.20	0.41	0.71	9.37	3.35	0.72
11	0.18	0.51	0.65	4.08	3.75	1.07
12	0.21	0.49	0.77	14.16	5.06	1.50

Figure 4.1-5. Cluster means and variances using 'CLUSTER MAXCL(12), CONV(98.5)' in DSEL.

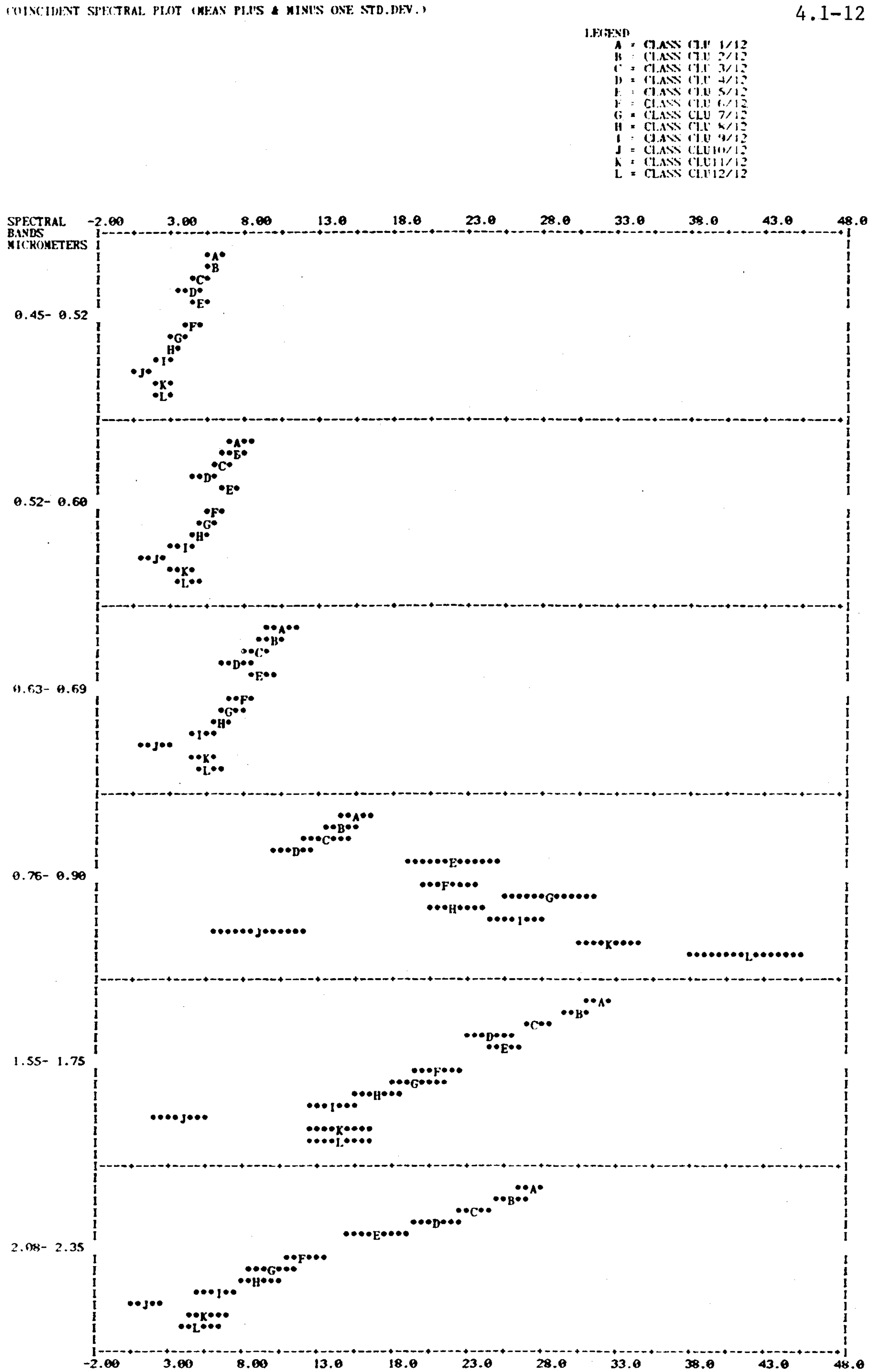

Figure 4.1-6. Coincident spectral plot generated using SPECPLT option.

```
LARS LARSPEC VERSION 1 STATISTICS FILE      1
CLASS CLU 1/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU 2/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU 3/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU 4/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU 5/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU 6/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU 7/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU 8/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU 9/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU10/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU11/12
99999999                9999 9999     9 9999 9999     9    CJH
CLASS CLU12/12
99999999                9999 9999     9 9999 9999     9    CJH
   12 CLASS     12 FIELD      6 CHANNELS
CHAN   1 WAVELENGTH 0.45- 0.52 CODE    1 C0    0.0  C1    0.0  C2    0.0
CHAN   2 WAVELENGTH 0.52- 0.60 CODE    1 C0    0.0  C1    0.0  C2    0.0
CHAN   3 WAVELENGTH 0.63- 0.69 CODE    1 C0    0.0  C1    0.0  C2    0.0
CHAN   4 WAVELENGTH 0.76- 0.90 CODE    1 C0    0.0  C1    0.0  C2    0.0
CHAN   5 WAVELENGTH 1.55- 1.75 CODE    1 C0    0.0  C1    0.0  C2    0.0
CHAN   6 WAVELENGTH 2.08- 2.35 CODE    1 C0    0.0  C1    0.0  C2    0.0
NO. PTS.        197       223        61        43        25       172       150
NO. PTS.        205       416        65       299        90
MN.....!5.......8TD..7.....E
MN.).J........L-........€A...4
MN..€.....T....!.P.A.........
MN.......AS.........Y...V....6.
MN.&....>)...J.......V...C.....T
MN....../...".8....W......B..
MN..!...............?!.......ZO
MN......*..................J.E
MN.............R..............
MN..J4..............B.........
MN..|..........€...¬...X)...$O.
MN...I......$T........Y....I
CV .U= ... ".Z ... US. .€. .?. ..N 3.J......... .#. ..¬ ... Q"...">..DM
CV...X..... ..E G..
CV ..| . . ... ... .B. J?. .Y. _.. U.. M....SI...0.......5. I.*.......&..
CV...G.A.0 ... 2..
CV .8. .F# .. ..S ... /.. !.2 G.. Q.0...Q .D. ... ... ¬M! ....€. ....
CV.....O!. .Z. .V*
CV |.. ... .8Z ... A.I .<# ... ... P....SV |.. ... .#. .R..... ... ..V
CV ..#.%............
CV ..B ... !.. <.. ... :6. ..F K." ....F.A ....A...J.. R....... *.. ...
CV .-.A......$..<%.
CV .Q. ... !.. .). -.X #....... ... ..|...| ... ... )........... .N..984
CV .....6. .'....|
CV ... |.. !.. %.. .?. .P...... ... .D..._. %.. ... S....L.....6 C.G ..E
CV P-.....N...!..L.
CV .._ ... .|. ..Q /.. '.G..KP........X..M. ... ... !.. (.)...D ...  #.
CV /.. ........#..AD
CV ..T .3. ..Q .ZE ).# .5..*...O...LT...L. .Z. .*. ... .*..... //G 'M.
CV ......O4.........
CV ..F ... ... $.* H/P ... TP...........N.. .6. .....F.......S. .X6 .#.
CV L6C..#....Z ...
CV ..N ..M A.. €.7 H.. X.. .IS ... ..N..!. ... ....... .VC...L ... A..
CV NU. .......K...A
CV ... (.. '.O *.. .E! D.. ..U .#. ....S.. ..> ........A.GO.&I. ->. #&.
CV .Q.A...........E
EOS              *****    LAST CARD OF STATISTICS DECK    *****
```

Figure 4.1-7. LARSYS-formatted statistics deck generated in DSEL.

CLASS STATISTICS

CLASS NAME	SPECTRAL BAND	BAND MEAN STATISTICS: MEAN	RANGE MINIMUM	RANGE MAXIMUM	VARIANCE	STANDARD DEVIATION	PERCENT DEVIATION	NO. RUNS	POINT STATISTICS: STANDARD DEVIATION	PERCENT DEVIATION	PTS IN BAND
CLU 1/12	0.450- 0.520	6.13	5.28	8.30	0.24	0.49	8.08	197	0.63	10.29	1576
	0.520- 0.600	7.69	6.42	10.52	0.50	0.71	9.18	197	0.97	12.66	1773
	0.630- 0.690	10.65	8.86	13.94	0.88	0.94	8.79	197	1.24	11.66	1379
	0.760- 0.900	15.54	13.15	19.25	1.10	1.05	6.75	197	1.77	11.38	2955
	1.550- 1.750	31.97	30.30	34.57	0.60	0.77	2.42	197	0.97	3.04	4137
	2.080- 2.350	27.34	25.26	29.49	0.78	0.88	3.23	197	1.71	6.24	5516

CORRELATION MATRIX

SPECTRAL BAND	0.45 0.52	0.52 0.60	0.63 0.69	0.76 0.90	1.55 1.75	2.08 2.35
0.45 0.52	1.000					
0.52 0.60	0.940	1.000				
0.63 0.69	0.879	0.974	1.000			
0.76 0.90	0.809	0.919	0.968	1.000		
1.55 1.75	0.153	0.132	0.170	0.214	1.000	
2.08 2.35	-0.201	-0.306	-0.327	-0.263	0.616	1.000

Figure 4.1-8. Class statistics and correlation matrix for cluster class 1 using 'STATISTICS CLASS, CORRELATION' option.

The 'LIST' card specifies that no identification information for the selected observations should be printed.

The field homogeneity table (Figure 4.1-9) is an ordered list of the fields or plots that have been clustered which identifies the number of observations in each field or plot that occur in each cluster class. The option 'OUTPUT SUMMARY' in DSEL produces the field homogeneity table. The 'OUTPUT GROUP' option generates the separability table (Figure 4.1-10) and the cluster grouping table (Figure 4.1-11). The separability table lists pairwise combinations of cluster classes, the euclidean distances between cluster centers, and a quotient value.

The clustering algorithm used in DSEL is essentially a variation of the ISODATA method of Ball and Hall (1), modified for the LARSYS software system and described in detail in the LARSYS User's Manual (2). In general, the cluster algorithm implements an unsupervised clustering algorithm which classifies individual data points into a predefined number of clusters. The algorithm is based upon the distance relationship between each point and the centers of groups of points (clusters). The initial cluster centers are determined by calculating the principle eigenvector and using this as the axis for assignment of initial cluster centers.

The cluster grouping table lists the cluster numbers, numbers of observations in each cluster class, and the group to which the cluster class belongs. The results of the cluster grouping table, based on the transformed divergence, indicate which cluster classes can be grouped together and still have a Gaussian normal distribution of points. The clusters which are grouped together may not be the same cover type but the classes are spectrally similar. The criteria for grouping classes together, in this example, is a threshold value of 0.75. The user may change this threshold value through the option THRES on the cluster card.

FIELD HOMOGENEITY

FIELD/ PLOT	NO. PTS	PTS IN CLUSTER											
		1	2	3	4	5	6	7	8	9	10	11	12
56	9	0	0	0	0	0	0	0	1	8	0	0	0
58	16	0	0	0	0	0	10	4	2	0	0	0	0
66	57	0	0	0	0	0	7	8	10	22	0	10	0
75	12	0	0	2	0	10	0	0	0	0	0	0	0
76	14	0	0	10	4	0	0	0	0	0	0	0	0
77	26	0	0	0	0	1	14	0	3	0	8	0	0
86	12	0	3	8	1	0	0	0	0	0	0	0	0
87	15	0	0	0	0	0	0	0	0	12	0	3	0
104	12	0	0	0	0	0	0	1	0	7	0	2	2
106	13	0	0	0	0	1	6	3	3	0	0	0	0
109	41	0	0	0	0	0	25	3	12	1	0	0	0
112	49	33	7	6	3	0	0	0	0	0	0	0	0
120	22	6	15	1	0	0	0	0	0	0	0	0	0
123	26	10	16	0	0	0	0	0	0	0	0	0	0
124	27	9	18	0	0	0	0	0	0	0	0	0	0
127	28	0	0	0	0	5	6	13	2	2	0	0	0
133	28	0	0	0	0	0	1	0	20	7	0	0	0
134	22	10	12	0	0	0	0	0	0	0	0	0	0
135	10	0	0	0	0	0	1	0	8	1	0	0	0
136	46	0	0	0	0	0	0	0	0	6	12	28	0
142	36	0	0	0	0	0	0	14	0	3	0	15	4
144	53	0	0	0	0	0	0	4	3	20	18	8	0
147	55	27	24	4	0	0	0	0	0	0	0	0	0
148	56	0	0	0	0	0	0	0	0	48	6	2	0
151	26	0	0	0	0	0	0	0	0	1	0	25	0
152	28	0	0	0	0	0	0	1	11	15	0	1	0
153	26	17	8	1	0	0	0	0	0	0	0	0	0
154	25	0	0	0	0	0	0	0	0	24	0	1	0
156	24	0	0	0	0	0	0	0	1	19	0	4	0
162	29	0	0	0	0	0	0	0	12	13	0	4	0
163	24	0	0	0	0	0	0	0	0	3	17	4	0
168	29	0	0	0	0	2	15	0	12	0	0	0	0
169	25	0	0	0	0	0	0	0	0	3	0	22	0
172	10	0	0	0	0	0	0	0	0	2	0	8	0
174	19	0	0	0	0	0	2	3	6	3	4	1	0
176	53	31	22	0	0	0	0	0	0	0	0	0	0
180	25	0	0	0	0	0	0	0	5	20	0	0	0
181	10	0	0	0	0	0	0	0	0	0	0	0	10
182	12	0	0	0	0	0	7	4	1	0	0	0	0
188	26	0	0	0	0	0	0	0	0	0	0	0	26
190	29	7	22	0	0	0	0	0	0	0	0	0	0
191	26	0	0	0	0	0	2	0	23	1	0	0	0
192	27	0	0	0	0	0	0	0	0	14	0	13	0
193	28	0	0	0	0	0	0	0	0	24	0	4	0
194	53	0	0	0	0	0	27	6	8	3	0	6	3
196	25	9	11	4	1	0	0	0	0	0	0	0	0
198	28	0	0	0	0	0	19	5	0	1	0	3	0
199	28	17	11	0	0	0	0	0	0	0	0	0	0
203	24	0	24	0	0	0	0	0	0	0	0	0	0
204	28	1	16	2	9	0	0	0	0	0	0	0	0
210	25	0	0	0	0	0	2	0	18	4	0	1	0
211	24	0	0	0	0	0	0	0	5	14	0	5	0
217	15	0	0	0	0	0	0	0	0	0	0	6	9
218	28	19	9	0	0	0	0	0	0	0	0	0	0
219	14	0	0	0	0	0	4	0	10	0	0	0	0
221	17	1	5	0	0	0	0	1	0	0	0	6	4
222	29	0	0	13	16	0	0	0	0	0	0	0	0
231	19	0	0	10	9	0	0	0	0	0	0	0	0
232	8	0	0	0	0	0	0	0	0	8	0	0	0
233	9	0	0	0	0	0	3	0	6	0	0	0	0

Figure 4.1-9. Field homogeneity table produced in DSEL using option 'OUTPUT SUMMARY'.

SEPARABILITY INFORMATION

I	J	D(I,J)	D(I)	D(J)	D(I)+D(J)	QUOT
1	2	2.543	3.097	2.286	5.383	0.472
1	3	6.459	3.040	2.940	5.980	1.080
1	4	11.430	3.151	5.363	8.514	1.342
1	5	14.003	0.913	5.267	6.180	2.266
1	6	20.050	1.118	4.263	5.381	3.726
1	7	25.369	0.861	4.992	5.853	4.334
1	8	25.170	1.167	4.566	5.733	4.390
1	9	30.656	1.003	4.171	5.173	5.926
1	10	40.450	2.581	2.127	4.708	8.592
1	11	33.391	0.852	2.974	3.826	8.727
1	12	39.301	0.744	3.263	4.006	9.809
2	3	3.923	2.170	2.950	5.121	0.766
2	4	8.893	2.206	5.386	7.593	1.171
2	5	12.613	1.115	6.106	7.221	1.747
2	6	18.235	1.336	4.238	5.574	3.271
2	7	23.940	1.081	5.057	6.138	3.900
2	8	23.210	1.371	4.465	5.836	3.977
2	9	28.836	1.210	4.157	5.367	5.373
2	10	37.966	2.165	2.110	4.275	8.882
2	11	31.891	1.064	3.000	4.064	7.847
2	12	38.251	0.957	3.352	4.309	8.877
3	4	4.988	3.114	5.036	8.150	0.612
3	5	11.155	3.511	8.037	11.548	0.966
3	6	15.733	3.151	4.200	7.351	2.140
3	7	21.985	2.886	5.079	7.965	2.760
3	8	20.337	2.935	4.260	7.195	2.827
3	9	26.133	2.645	4.053	6.698	3.901
3	10	34.142	2.925	2.051	4.976	6.861
3	11	29.700	2.489	3.026	5.515	5.385
3	12	36.741	2.356	3.502	5.857	6.273
4	5	11.714	2.591	7.860	10.452	1.121
4	6	14.101	2.901	4.326	7.227	1.951
4	7	20.919	2.479	5.225	7.704	2.715
4	8	17.800	3.084	4.008	7.092	2.510
4	9	23.740	2.746	3.944	6.690	3.549
4	10	29.486	5.627	1.957	7.583	3.888
4	11	28.053	2.430	3.146	5.576	5.031
4	12	35.969	2.222	3.839	6.060	5.935
5	6	6.799	4.436	4.318	8.754	0.777
5	7	11.469	4.171	5.670	9.842	1.165
5	8	12.198	3.799	5.218	9.017	1.353
5	9	17.198	3.349	5.383	8.732	1.970
5	10	31.224	3.814	3.369	7.183	4.347
5	11	19.636	3.431	3.723	7.154	2.745
5	12	26.077	3.745	4.609	8.354	3.121
6	7	7.280	4.778	7.318	12.096	0.602
6	8	5.521	4.641	5.213	9.854	0.560
6	9	11.022	4.563	5.414	9.977	1.105
6	10	25.238	4.610	4.579	9.189	2.747
6	11	14.619	4.510	4.324	8.835	1.655
6	12	22.621	4.681	6.421	11.101	2.038
7	8	6.960	7.947	4.796	12.743	0.546
7	9	7.566	5.536	5.828	11.365	0.666
7	10	27.371	7.099	6.388	13.487	2.029
7	11	8.277	5.258	4.684	9.943	0.832
7	12	15.404	6.430	7.218	13.649	1.129
8	9	6.202	4.725	5.104	9.828	0.631
8	10	20.967	5.138	5.013	10.152	2.065
8	11	11.218	4.501	4.698	9.199	1.219
8	12	20.375	4.547	7.661	12.208	1.669
9	10	21.199	5.215	7.102	12.317	1.721
9	11	5.987	4.850	5.319	10.169	0.589
9	12	15.560	4.792	8.852	13.644	1.140
10	11	26.392	8.090	6.064	14.154	1.865
10	12	35.169	8.710	8.589	17.299	2.033
11	12	9.590	5.475	9.592	15.067	0.636

AVERAGE QUOTIENT 2.998

Figure 4.1-10. Separability grouping table generated by 'OUTPUT GROUP' option in DSEL.

RESULTS OF CLUSTER GROUPING

THRESHOLD = 0.750

GROUP	CLUSTERS	NO. PTS.
1		
	1	197
	2	223
2		
	3	61
	4	43
3		
	5	25
4		
	6	172
	7	150
	8	205
5		
	9	416
	11	299
6		
	10	65
7		
	12	90

Figure 4.1-11. Cluster grouping table generated by 'OUTPUT GROUP' option in DSEL.

4.2 Example GSPEC Control Card Decks and Output Descriptions

The capabilities of the GSPEC processer include graphing, printing and/or punching LARSPEC spectral data and/or identification record information. The capabilities of GSPEC are illustrated by the control card deck examples and associated output which are described in this section. The examples include several different combinations of control card instructions to cover a range of capabilities. However, the examples are not inclusive of all that one can do. Table 4.2-1 lists the major GSPEC capabilities and identifies the example decks which illustrate a use of that capability. The example decks given in Table 4.2-1 are listed in order of complexity. Table 4.2-2 identifies the page on which each example is discussed.

Table 4.2-1. Major GSPEC capabilities and the example decks which illustrate those capabilities

Capability (and control cards)	Example Decks
Data specification: graph of Spectrometer observations (GRAPH)	1,19
Multiband radiometer observations in full-band wavelength format. (GRAPH; OPTIONS FULLBAND)	2
Multiband radiometer observations in center-band wavelength format. (GRAPH; OPTIONS CENTERBAND)	3
Means of spectral observations (SELECT; CLASS)	5,6,7,8,9,15,16,19
Means and standard deviations of spectral observations (SELECT; OPTIONS STD; CLASS)	6,7
Identification record information and/or spectral band means. (GRAPH; XRDATA; YTDATA; ZPDATA)	10,12,17,19
Identification record information and/or spectral band means for specified classes. (SELECT; XRDATA; YTDATA; ZPDATA; PLOTCLASS; CLASS)	11,13,14,18,19
Function of identification record information and/or spectral band means. (XRDATA; YTDATA; ZPDATA)	12,17
Function of originally specified data - spectral observations (XRDATA; YTDATA; ZPDATA)	16,19
Function of originally specified data - identification record information and/or band means (XRDATA; YTDATA; ZPDATA)	18,19

Table 4.2-1. Major GSPEC capabilities and the example decks which illustrate those capabilities. (con't)

Capability (and control cards)	Example Decks
Graph specifications:	
Axes' scales (XRSCALE; YTSCALE; USET AUTOSCALE)	2,3,7,8,9,15,16,17,19
Axes' labels (alphanumeric) (XRLABEL; YTLABEL)	13,14,16,17,18,19
Axes' tic marks (UPSET T1CX, TICY)	16,17
Title (TITLE)	7,8,9,11,16,17,19
Line and symbol types (OPTION LINES, SYMBOLS; USET DCHAR, etc.)	8,9,10,12,13,17,19
Curve fits (USET FITLINEAR, POLYNOMIAL, SPLINE UPSET POLYNOMIAL DEGREE(n))	13,14,19
Polar coordinates (USET POLAR, AUTOSCALE)	17
Logarithmic scales (USET XLOGARITHMIC, YLOGARITHMIC, LOGARITHMIC, AUTOSCALE)	15
Multiple graphs on page (OPTIONS HOLDGRAPH, DRAWGRAPH, SIZEGRAPH)	16

Table 4.2-1. Major GSPEC capabilities and the example decks which illustrate those capabilities. (con't)

Capability (and control cards)	Example Decks
Output specifications:	
Graphs printed at line printer	1,5,6,19
Graphs printed at terminal	19
Graphs printed at varian (OUTPUT)	2,3,7-18,19
Table of identification information (LIST)	(See IDLIST or DSEL)
Table of data (OPTIONS PRINT)	4,5,6,7,11,15
Punch data (OPTIONS PUNCH)	-
Utility specifications:	
Interactive (OPTIONS INTERACTIVE; RUN; PRINT; NEXT; QUIT; FIND)	19

Table 4.2-2. Reference page numbers for each GSPEC example deck.

Example deck	Page
1	4.2-6
2	-8
3	-10
4	-12
5	-14
6	-17
7	-20
8	-23
9	-25
10	-27
11	-29
12	-32
13	-34
14	-37
15	-41
16	-45
17	-49
18	-51
19	-59

GSPEC Example 1

```
$TAPE 3986
$GSPEC
GRAPH RUSE(141-145)
LIST NOLIST
END
$END
$EXIT
```

In this example, the user requests separate graphs of individual observations of spectrometer data. This is a simple way to review the spectral data.

The 'GRAPH' card specifies that each observation with run sequencers 141 through 145 on tape 3986 should be plotted on separate graphs. Figure 4.2-1 contains the graph for run sequencer 141. The 'LIST' card specifies that no identification information should be printed. The output graph will be plotted on the line printer since no OUTPUT card is specified. The example, Figure 4.2-1, is for spectrometer data.

Note that the default scale is .4 to 2.4 and 0 to 100 for the X and Y axes, respectively. Default alphanumeric labels are used for the axes. Also note that the default symbol for the line printer output (and terminal) is '1'. The default line type would have been a smooth line if the output had been sent to the Varian.

Since no title was specified, a default title is given for individual response versus wavelength type graphs. The information included in the default title is run sequencer, date data collected, observation number, serial number, time data collected, scene type, species, or soil series, and plot or field number.

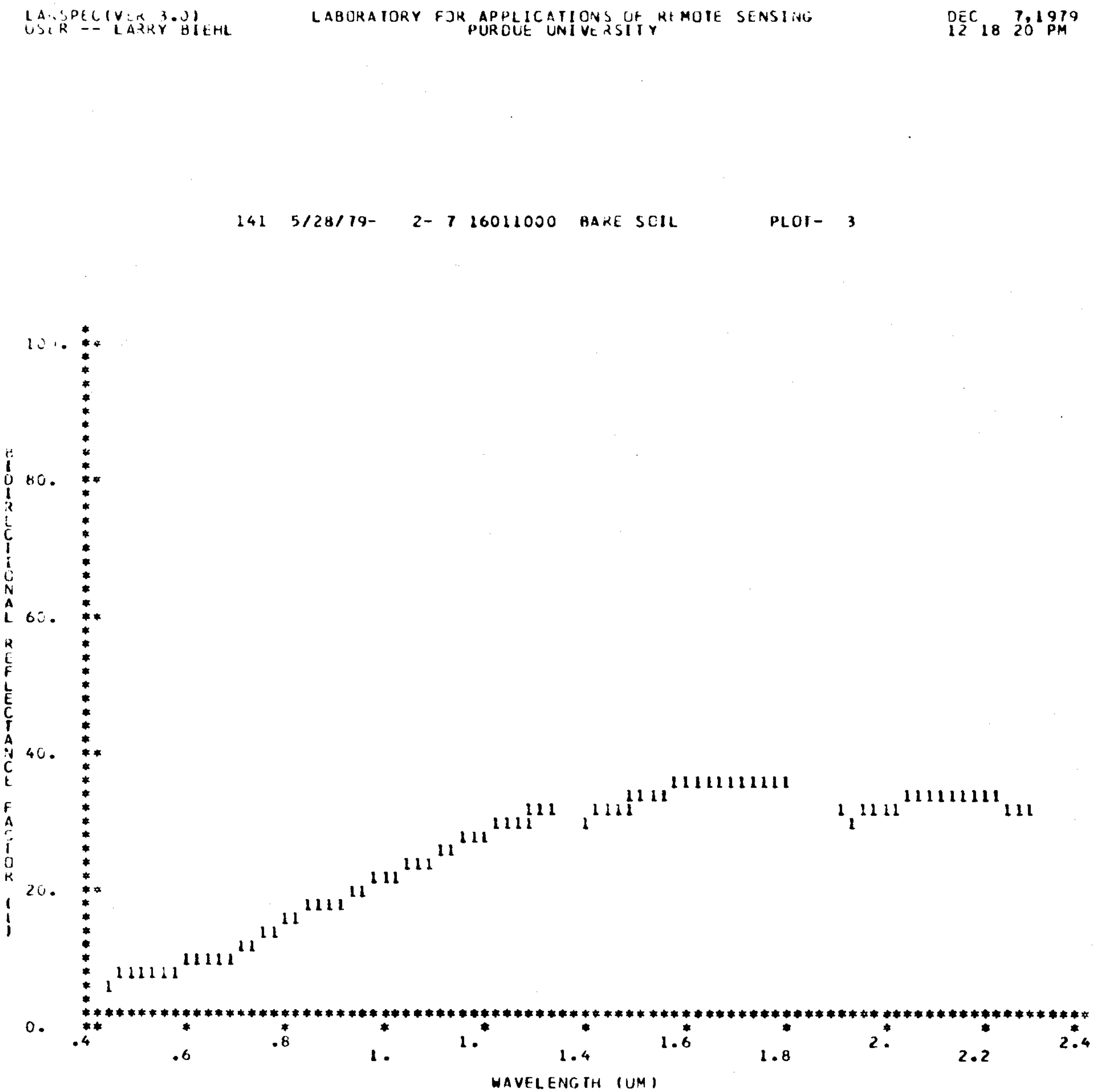

Figure 4.2-1. Graph of a single observation of spectral data collected by a spectrometer type instrument.

GSPEC Example 2

```
$TAPE 3984
$GSPEC
GRAPH RUSE(911)
LIST NOLIST
YTSCALE SW(0,50)
OUTPUT VARIAN
END
$END
$EXIT
```

In this example, the user requests separate graphs of individual observations of multiband radiometer data in 'full-band' wavelength format. This is a simple way to review spectral data from multiband radiometers.

The 'GRAPH' card specifies that the observation being run sequencer 911 on tape 3984 will be graphed, Figure 4.2-2. The 'LIST' card specifies that no identification information will be printed. The 'YTSCALE' parameter specifies that the Y axis should be scaled from 0 to 50. The 'OUTPUT' card specifies that the graph will go to the Varian printer/plotter. The example is for Landsat band radiometer data. The wavelength format of the plotted data is 'full-band' format.

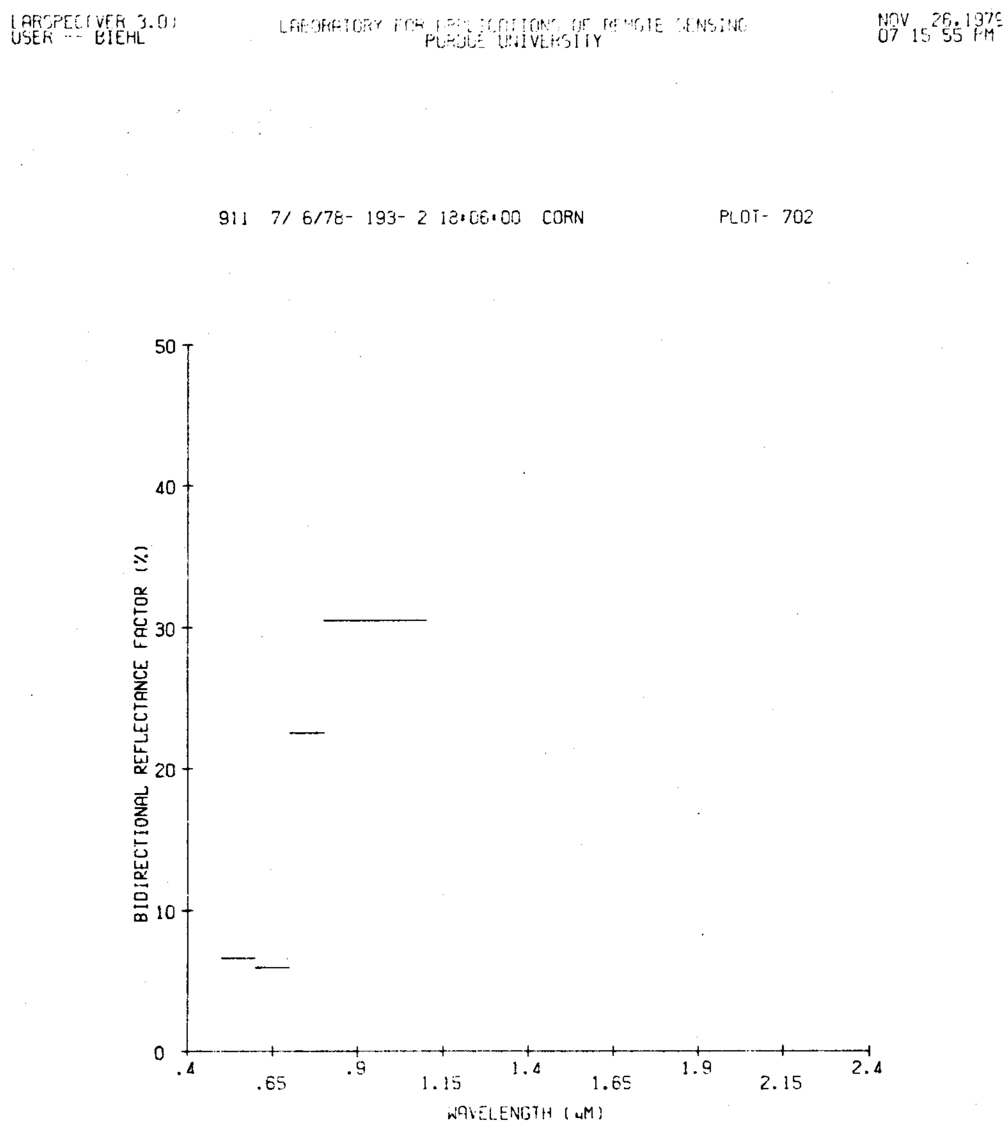

Figure 4.2-2. Graph of a single observation of spectral data collected by a multiband radiometer type instrument. The data in the graph is in 'full-band' wavelength format.

GSPEC Example 3

```
$TAPE 3984
$GSPEC
GRAPH RUSE(911)
LIST NOLIST
YTSCALE  SW(FULL)
USET AUTOSCALE
OPTIONS CENTERBAND
OUTPUT VARIAN
END
$END
$EXIT
```

In this example, the user requests separate graphs of individual observations of multiband radiometer data in 'center-band' wavelength format.

Example 3 is very similar to example 2. The 'GRAPH' card specifies that the observation which is run sequencer 911 on tape 3984 will be graphed, Figure 4.2-3. The 'LIST' card specifies that no identification information will be printed. The 'YTSCALE' and 'USET AUTOSCALE' cards work together. These two cards specify that the Y axis should be scaled automatically dependent upon the full scale range of the data. The 'OPTIONS CENTERBAND' card specifies that the multiband radiometer data are to be plotted in 'center-band' wavelength format. The data in Figure 4.2-3 are from a Landsat band radiometer. Lines are drawn between the centers of each spectral band for Varian output.

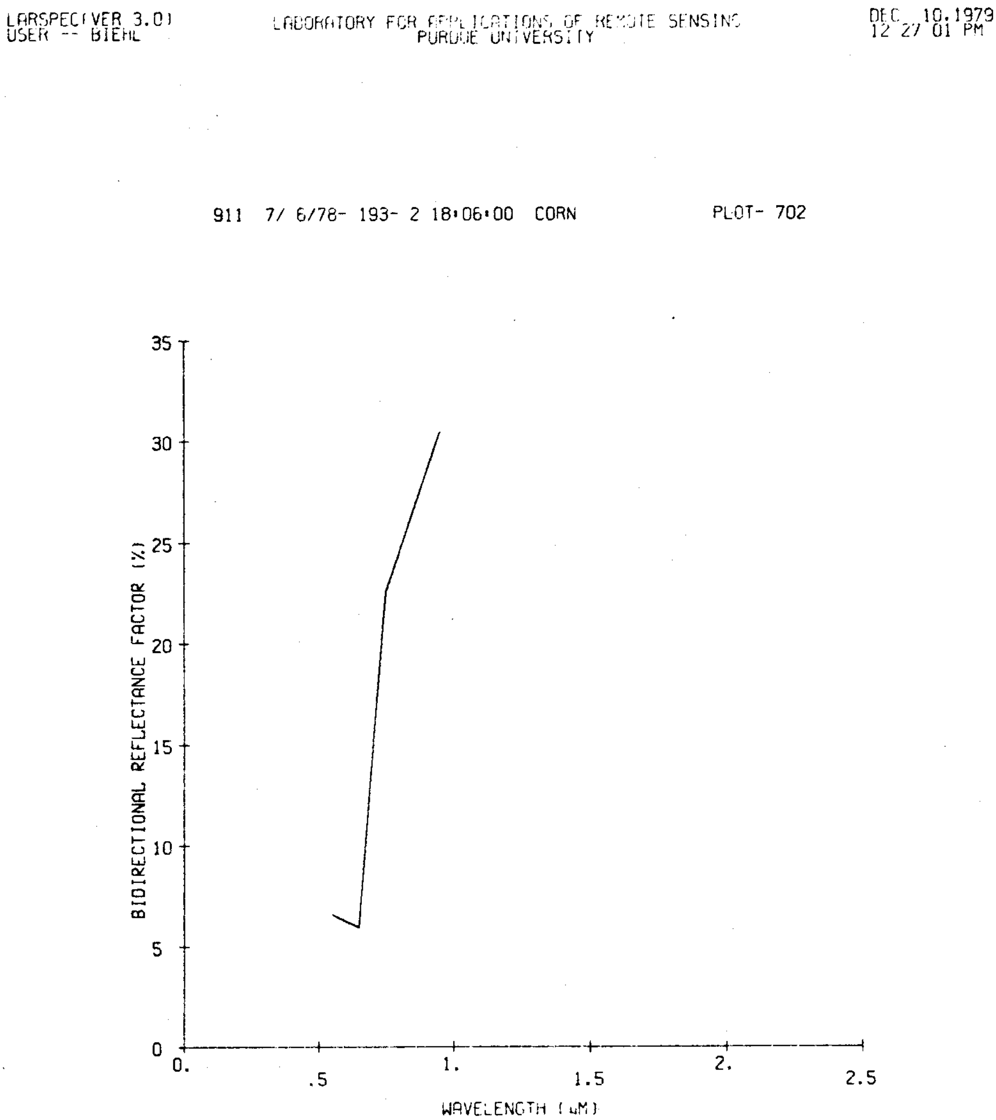

Figure 4.2-3. Graph of a single observation of spectral data collected by a multiband radiometer type instrument. The data in the graph is in 'center-band' wavelength format.

GSPEC Example 4

```
$TAPE 3984
$GSPEC
GRAPH DACO(780705),EXNU(78105802),RUSE(1-662)
LIST NOLIST
OPTIONS  PRINT,NOGRAPH
END
$END
$EXIT
```

For this example the user did not want any plots of data. The user requested a table of the spectral data for the observations collected on 7/5/78 for experiment number 78105802, that were between run sequencers 1 and 662 or tape 3984.

The run sequencer range, 'RUSE(1-662)', used on the 'GRAPH' card helps to reduce the time it takes to read the data from the tape. The tape contains over a 1,000 observations or run sequencers; however the user knew that the data he wanted were between run sequencers 1 and 662. By using 'RUSE(1-662)', the user specified that the tape should not be searched any further after run sequencer 662.

The 'LIST' card specifies that no identification information for the selected observations should be printed. The 'OPTIONS PRINT' card specifies that the data to be plotted should be printed in a table, Figure 4.2-4. However, the 'NOGRAPH' option specifies that graphing should be skipped. The table in Figure 4.2-4 represents the printed table format for individual observations of spectral data collected by multiband radiometer instruments. A line of spectral information is printed for each selected observation along with the date, observation number and field or plot number. To obtain the column of information illustrated in Figure 4.2-4 one must turn the graph flag off, 'OPTIONS NOGRAPH'. Otherwise, there will be separate tables for each observation that are separated by the graph for each observation.

RESPONSE		BIDIRECTIONAL REFLECTANCE FACTOR (%)				
		PLOT/	WAVELENGTH (MICROMETERS)			
DATE	OBS	FIELD	0.50- 0.60	0.60- 0.70	0.70- 0.80	0.80- 1.10
780705	237	702 P	5.87	6.02	18.14	24.19
780705	238	702 P	6.35	6.61	17.28	21.87
780705	239	703 P	6.16	6.17	19.20	27.13
780705	240	703 P	5.78	5.58	17.19	23.81
780705	241	708 P	6.73	6.76	18.35	24.20
780705	242	708 P	7.58	7.80	20.07	26.36
780705	243	709 P	6.45	7.06	17.59	23.36
780705	244	709 P	7.30	8.39	18.83	24.44
780705	245	719 P	5.51	5.29	20.49	28.65
780705	246	719 P	6.08	5.96	21.64	28.57
780705	247	720 P	6.27	6.85	17.03	23.16
780705	248	720 P	7.50	8.18	19.62	24.78
780705	249	721 P	7.44	8.03	19.27	26.46
780705	250	721 P	8.18	9.05	22.96	28.59
780705	251	722 P	7.26	7.81	21.84	28.53
780705	252	722 P	7.44	7.89	18.80	23.72
780705	253	731 P	7.26	8.04	22.22	29.76
780705	254	731 P	7.82	8.91	22.51	29.84
780705	255	732 P	7.17	7.60	20.62	28.48
780705	256	732 P	7.73	8.62	21.38	27.56
780705	257	733 P	6.85	7.17	21.63	29.53
780705	258	733 P	8.06	8.99	20.68	26.70
780705	259	734 P	6.29	6.88	18.12	24.40
780705	260	734 P	5.54	5.42	20.02	28.61

Figure 4.2-4. Example of printed table for individual observations of multiband radiometer data using 'OPTIONS PRINT, NOGRAPH'.

GSPEC Example 5

```
$TAPE 3984
$GSPEC
SELECT  EXNU(78105802)
LIST NOLIST
OPTIONS PRINT
END
CLASS  780622
SELECT DACO(780622)
CLASS  780629
SELECT DACO(780629)
CLASS  780706
SELECT DACO(780706)
CLASS  780711
SELECT DACO(780711)
CLASS  780808
SELECT DACO(780808)
CLASS  780822
SELECT DACO(780822)
CLASS  780905
SELECT DACO(780905)
*END
$END
$EXIT
```

In this example, the user requested a graph of the means of several classes of multiband radiometer observations and a table of the plotted values for each class.

The observations selected are those collected for experiment number 78105802 that are on tape 3984. No identification information is to be printed (listed). The 'OPTIONS' card specifies that a table of the plotted values should be printed, Figure 4.2-5. The 'CLASS' and class 'SELECT' cards specify the subset of the observations defined by the global 'SELECT' card to be averaged for each class.

The graph, Figure 4.2-6, will be printed on the line printer by default; no 'OUTPUT' card was included. Note that for the line printer (and the terminal) output graphs, a symbol is plotted at the start and end positions for each wavelength band for the full-band wavelength plot format. The user can specify lines to be drawn between the start and end points of each band by including a 'USET DCHARACTER' card in the global section of the control cards. 'DCHARACTER' specifies dashed lines with character (or symbol) terminaters. The default line types for the line printer and terminal output devices are null lines with character terminaters, NCHARACTER'. Dashed lines are drawn as the default for Varian type graphs as illustrated in examples 2 and 3.

RESPONSE CLASS	BIDIRECTIONAL REFLECTANCE FACTOR (%) 0.50- 0.60	0.60- 0.70	0.70- 0.80	0.80- 1.10
780622	12.77	15.58	23.45	28.11
780629	8.51	9.63	19.68	25.18
780706	9.18	9.35	26.55	35.38
780711	7.39	7.37	25.83	36.60
780808	4.35	2.44	25.55	38.37
780822	4.90	4.05	26.02	37.99
780905	5.58	5.13	24.71	35.52

Figure 4.2-5. Printed table for class averages of several multiband radiometer observations.

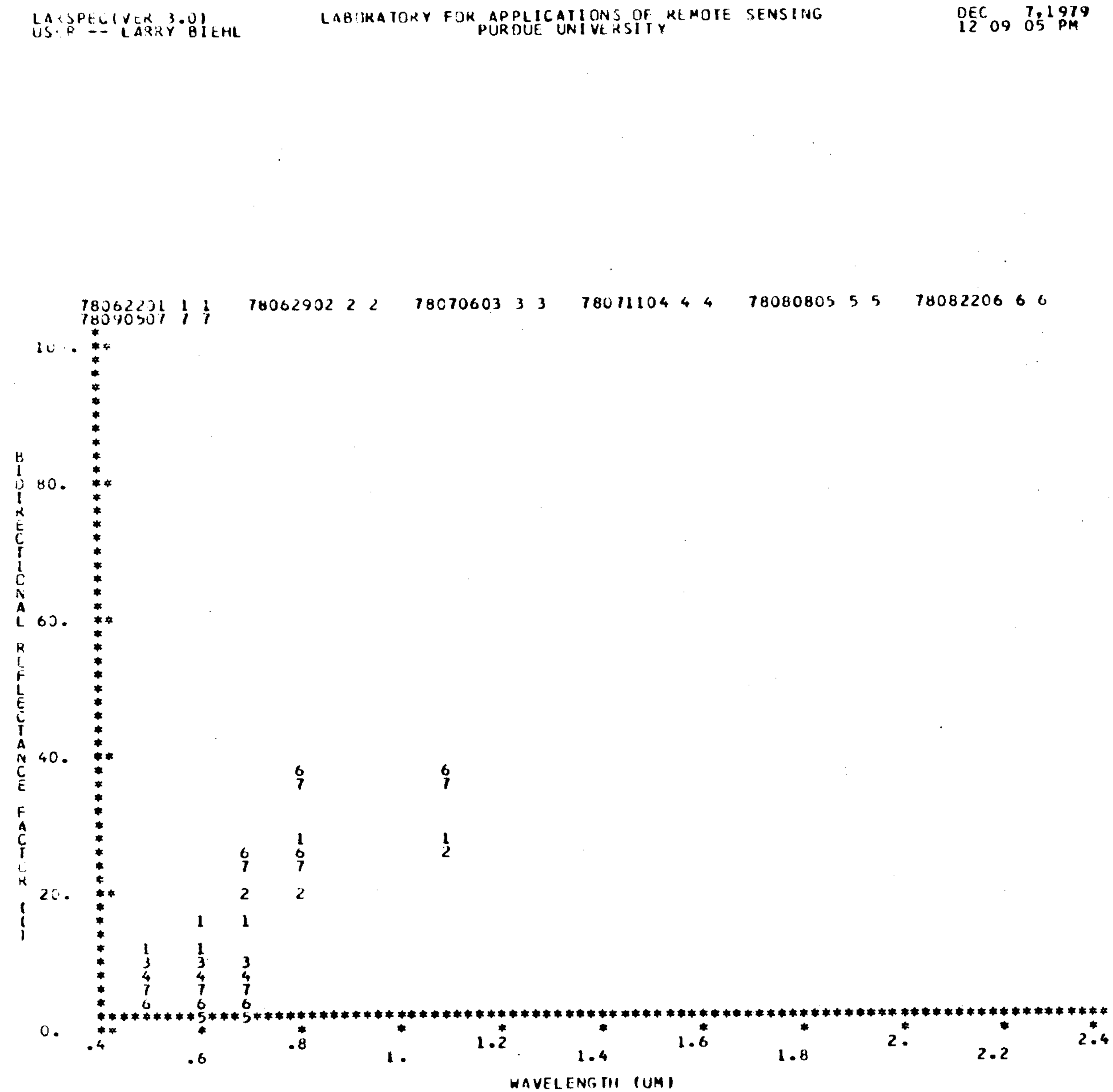

Figure 4.2-6. Line printer graph of the class averages for selected multiband radiometer data in 'full-band' wavelength format.

GSPEC Example 6

```
$TAPE 3984
$GSPEC
SELECT  EXNU(78105802)
LIST NOLIST
OPTIONS PRINT,STD,CENTERBAND
END
CLASS  780622
SELECT DACO(780622)
CLASS  780629
SELECT DACO(780629)
CLASS  780706
SELECT DACO(780706)
CLASS  780711
SELECT DACO(780711)
CLASS  780808
SELECT DACO(780808)
CLASS  780822
SELECT DACO(780822)
CLASS  780905
SELECT DACO(780905)
*END
$END
$EXIT
```

In this example, the user requested a graph of the means and standard deviations of several classes of multiband radiometer observations and a table of the plotted values for each class.

This example is the same as example 5, except for two items. The 'OPTIONS STD' card specifies that the standard deviation of the observation in each class should be plotted (and printed). The 'OPTIONS CENTERBAND' parameter specifies that the multiband radiometer data should be plotted in 'centerband' wavelength format, Figure 4.2-7. For line printer graphs as given in Figure 4.2-7 (and terminal graphs) a symbol will be plotted at the center of each wavelength band of data. The user may include a 'USET DCHARACTER' card if he wishes lines to be drawn between the symbols as described in example 5.

The format of the table of plotted values for averages and standard deviations of multiband radiometer observations is illustrated in Table 4.2-8.

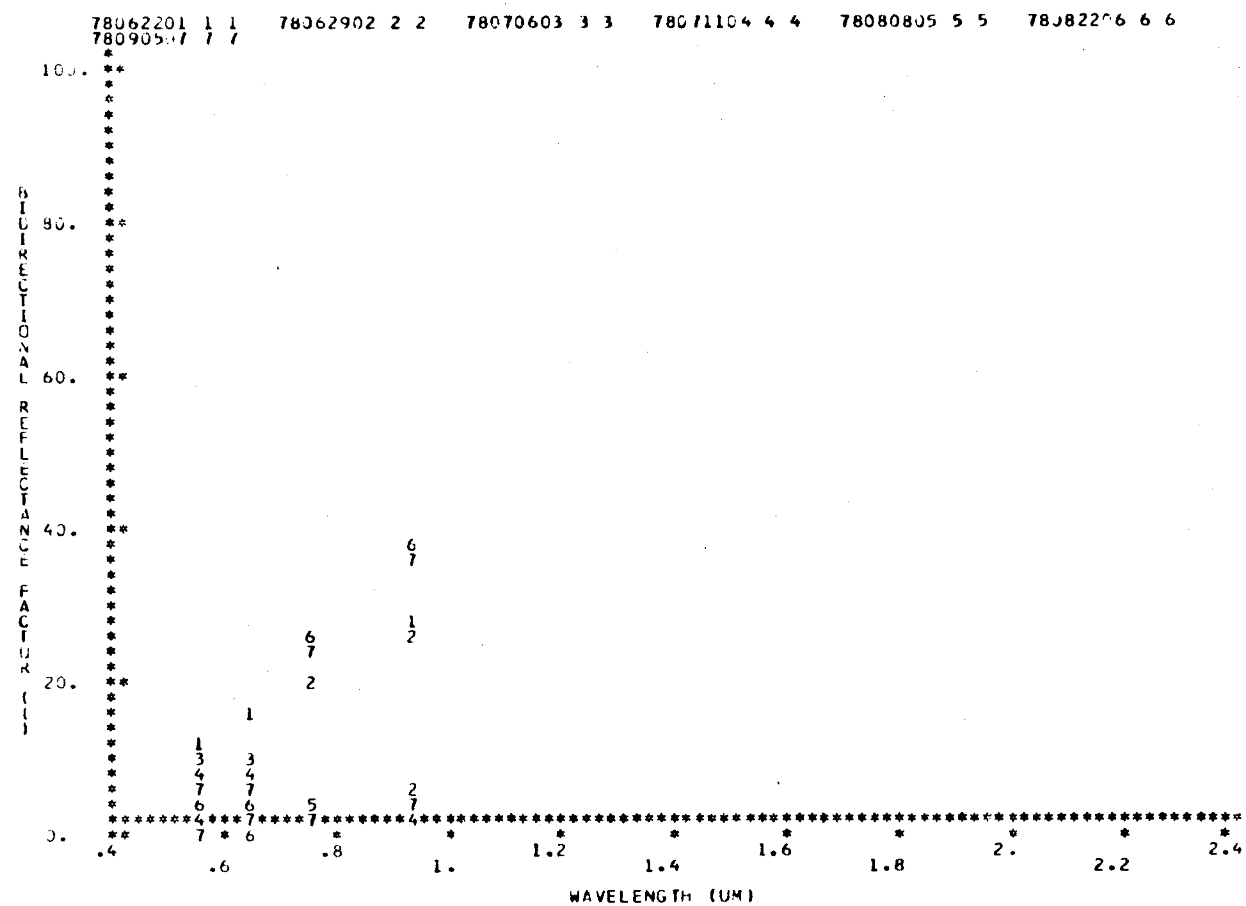

Figure 4.2-7. Line printer graph of the class averages and standard deviations for selected multiband radiometer data in 'center-band' wavelength format.

RESPONSE	BIDIRECTIONAL REFLECTANCE FACTOR (%)	
WAVE LENGTH MICROMETERS	RESPONSE	STANDARD DEVIATION
CLASS 780622		
0.50- 0.60	12.77	1.98
0.60- 0.70	15.58	2.47
0.70- 0.80	23.45	3.23
0.80- 1.10	28.11	3.65
CLASS 780629		
0.50- 0.60	8.51	2.83
0.60- 0.70	9.63	3.54
0.70- 0.80	19.68	4.71
0.80- 1.10	25.18	5.58
CLASS 780706		
0.50- 0.60	9.18	2.01
0.60- 0.70	9.35	2.58
0.70- 0.80	26.55	3.22
0.80- 1.10	35.38	4.15
CLASS 780711		
0.50- 0.60	7.39	1.34
0.60- 0.70	7.37	1.66
0.70- 0.80	25.83	1.91
0.80- 1.10	36.60	2.25
CLASS 780808		
0.50- 0.60	4.35	1.00
0.60- 0.70	2.44	0.86
0.70- 0.80	25.55	3.22
0.80- 1.10	38.37	4.36
CLASS 780822		
0.50- 0.60	4.90	0.82
0.60- 0.70	4.05	0.96
0.70- 0.80	26.02	2.59
0.80- 1.10	37.99	4.25
CLASS 780905		
0.50- 0.60	5.58	0.92
0.60- 0.70	5.13	1.01
0.70- 0.80	24.71	2.54
0.80- 1.10	35.52	4.59

Figure 4.2-8. Printed table for class averages and standard deviations of multiband radiometer observations.

GSPEC Example 7

```
$TAPE 3986
$GSPEC
SELECT  DACO(790528),EXNU(79100806)
YTSCALE  SW(0,50)
TITLE WINTER WHEAT TREATMENTS
OUTPUT VARIAN
OPTIONS STD,PRINT
END
CLASS  MON-0
SELECT  LOF1(1),LOF2(1,2)
CLASS  SUL-0
SELECT  LOF1(1),LOF2(3)
CLASS MON-60
SELECT  LOF1(2),LOF2(1,2)
CLASS  SUL-60
SELECT  LOF1(2),LOF2(3)
CLASS  MON-120
SELECT  LOF1(3),LOF2(1,2)
CLASS  SUL-120
SELECT  LOF1(3),LOF2(3)
*END
$END
$EXIT
```

In this example the user requested a graph of the averages and standard deviations of several classes of spectrometer observations and a table of the plotted values for each class.

The global 'SELECT' card in this example specifies that the data on tape 3986 collected on 5/28/79 for experiment number 79100806 will be used. The 'YTSCALE' card specifies that the Y axis should be scaled from 0 to 50. The 'TITLE' card specifies that a title will be placed above the graph. The graph will be plotted on the Varian as specified by the 'OUTPUT' card.

The 'OPTIONS STD' card specifies that the standard deviations of the observations for each class should be plotted along with the means. The 'OPTIONS PRINT' parameter specifies that a table of the plotted data, both means and standard deviations, should be printed, Figure 4.2-9. Note in Figure 4.2-9, that missing data for response-wavelength type graphs are designated as -1. Any X-Y coordinate pair that has one or more missing values is not plotted.

The 'CLASS' and class 'SELECT' cards identify the subset of the data specified by the global 'SELECT' card that are to be averaged for each class. In other words the spectral means of all the observations in each class will be plotted, Figure 4.2-10. The 'CLASS' cards specifies the names that are to go with each class.

LARSPEC(VER 3.0)
USER -- LARRY BIEHL

LABORATORY FOR APPLICATIONS OF REMOTE SENSING
PURDUE UNIVERSITY

DEC 7,1979
05 05 41 PM

RESPONSE   BIDIRECTIONAL REFLECTANCE FACTOR (%)

CLASS MCN-0

***** SAMPLE GROUP 1   RANGE   0.350- 2.400 MICROMETERS

WAVE LENGTH MICROMETERS	RESPONSE	STANDARD DEVIATION	WAVE LENGTH MICROMETERS	RESPONSE	STANDARD DEVIATION	WAVE LENGTH MICROMETERS	RESPONSE	STANDARD DEVIATION
0.350	-1.00	-1.00	1.050	30.05	2.09	1.730	16.81	2.55
0.370	-1.00	-1.00	1.070	30.64	2.13	1.750	16.26	2.51
0.390	-1.00	-1.00	1.090	30.81	2.16	1.770	15.61	2.53
0.410	-1.00	-1.00	1.110	30.59	2.18	1.790	15.21	2.46
0.430	-1.00	-1.00	1.130	29.08	2.13	1.810	15.02	2.45
0.450	2.88	0.36	1.150	26.66	2.21	1.830	-1.00	-1.00
0.470	2.73	0.38	1.170	25.42	2.17	1.850	-1.00	-1.00
0.490	2.94	0.35	1.190	25.18	2.20	1.870	-1.00	-1.00
0.510	3.78	0.39	1.210	25.33	2.26	1.890	-1.00	-1.00
0.530	5.45	0.52	1.230	25.76	2.34	1.910	-1.00	-1.00
0.550	6.65	0.58	1.250	26.24	2.38	1.930	-1.00	-1.00
0.570	6.46	0.56	1.270	26.48	2.37	1.950	5.94	0.89
0.590	5.84	0.57	1.290	26.23	2.36	1.970	5.35	1.61
0.610	5.46	0.61	1.310	24.88	2.42	1.990	5.74	1.74
0.630	5.11	0.63	1.330	23.16	2.32	2.010	6.28	1.71
0.650	4.68	0.66	1.350	21.53	2.70	2.030	6.79	1.80
0.670	4.27	0.65	1.370	-1.00	-1.00	2.050	7.09	1.85
0.690	5.60	0.72	1.390	-1.00	-1.00	2.070	7.71	2.03
0.710	11.40	0.90	1.410	-1.00	-1.00	2.090	8.22	2.06
0.730	19.42	1.16	1.430	9.62	1.98	2.110	8.61	2.01
0.750	24.60	1.42	1.450	9.27	2.02	2.130	8.99	2.03
0.770	26.61	1.52	1.470	9.63	1.94	2.150	9.35	1.97
0.790	27.36	1.65	1.490	10.53	2.08	2.170	9.68	1.99
0.810	27.82	1.77	1.510	11.46	2.10	2.190	9.88	1.95
0.830	28.31	1.74	1.530	12.56	2.21	2.210	9.95	1.98
0.850	28.69	1.76	1.550	13.76	2.30	2.230	9.86	1.98
0.870	28.45	1.70	1.570	14.66	2.38	2.250	9.74	1.88
0.890	28.71	1.73	1.590	15.56	2.44	2.270	9.17	1.93
0.910	28.87	1.74	1.610	16.36	2.46	2.290	8.58	1.86
0.930	28.57	1.74	1.630	17.10	2.54	2.310	8.13	1.73
0.950	27.56	1.79	1.650	17.50	2.58	2.330	-1.00	-1.00
0.970	26.98	1.86	1.670	17.69	2.57	2.350	-1.00	-1.00
0.990	27.30	1.89	1.690	17.58	2.57	2.370	-1.00	-1.00
1.010	28.11	1.95	1.710	17.27	2.53	2.390	-1.00	-1.00
1.030	29.14	2.05						

Figure 4.2-9. Printed table,'OPTIONS PRINT', of class averages and standard deviations for response wavelength type graphs of spectrometer data. The above information is for one of the six classes in the example.

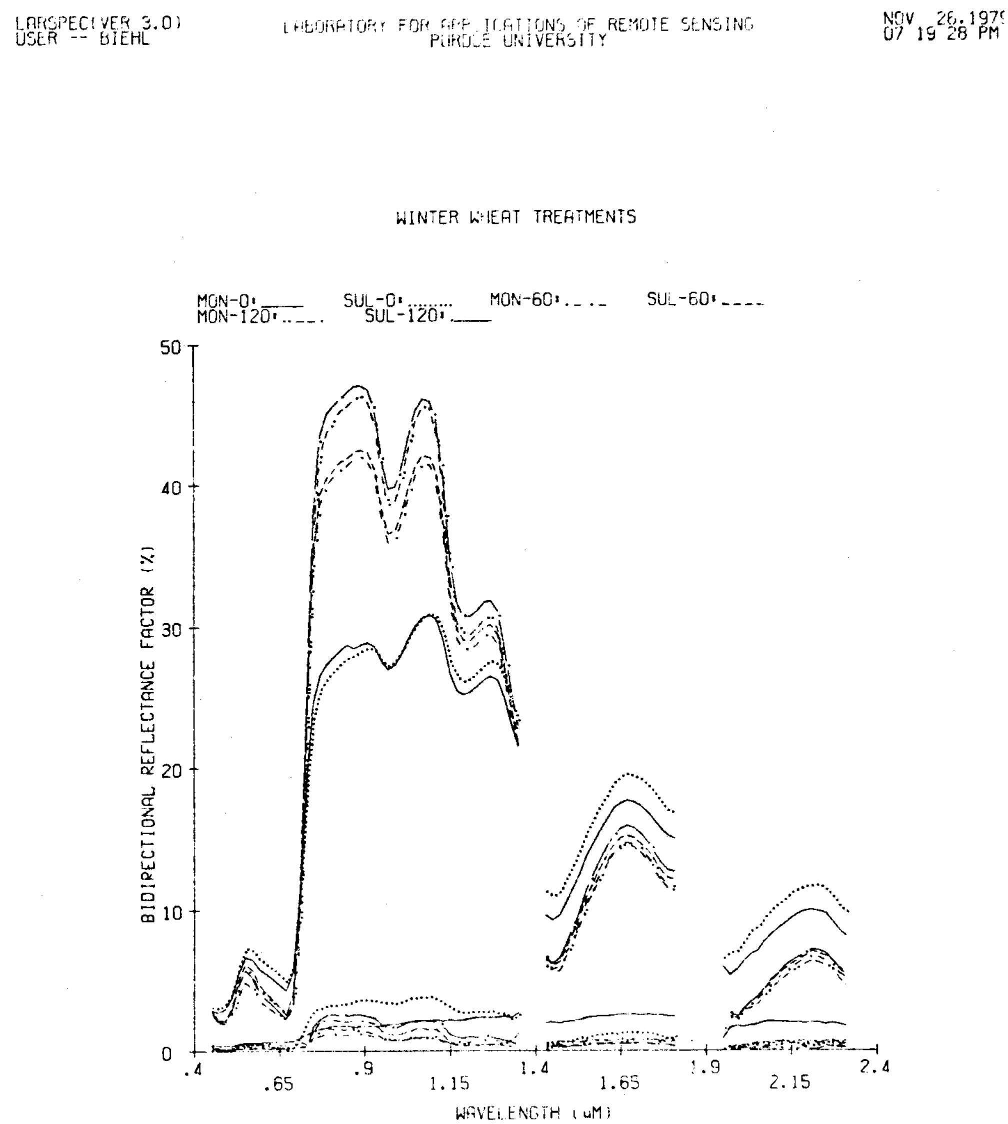

Figure 4.2-10. Graph of averages and standard deviations of six classes of spectrometer observations.

GSPEC Example 8

```
$TAPE 4297, 4298, 4299
$GSPEC
SELECT FINU(169)
LIST NOLIST
XRSCALE SW(.4, 1.8)
YTSCALE SW(0,50)
OPTIONS LINES(77, 92, 12, 3234, 9272, 92943234)
TITLE (EXTRA)
TITLE SPRING WHEAT FIELD OVER THE GROWING SEASON
OUTPUT VARIAN
END
CLASS 4/21/77
SELECT DACO(770421)
CLASS 5/10/77
SELECT DACO(770510)
CLASS 6/1/77
SELECT DACO(770601)
CLASS 6/16/77
SELECT DACO(770616)
CLASS 7/07/77
SELECT DACO(770707)
CLASS 7/27/77
SELECT DACO(770727)
*END
$END
$EXIT
```

In this example the user chose to average the spectral data over one spring wheat field for six dates in the growing season, Figure 4.2-11. The data for this field (169) were found on three tapes, 4297, 4298, 4299. The user specified the X and Y axis scaling through the use of 'XRSCALE' and 'YTSCALE' cards. The default scale labels for the X axis, WAVELENGTH (μm), and the Y axis, BIDIRECTIONAL REFLECTANCE FACTOR (%), were used. The graphed output was sent to the Varian (electrostatic printer), through the 'OUTPUT VARIAN' command. A title was specified and the size of the characters in the title was defined as extra large. The dashed line types to be used in the graph were specified by the OPTIONS LINES command. See 'OPTIONS LINES' in GSPEC control card dictionary section on page 3.4-10 for a discussion of the code for dash line descriptions.

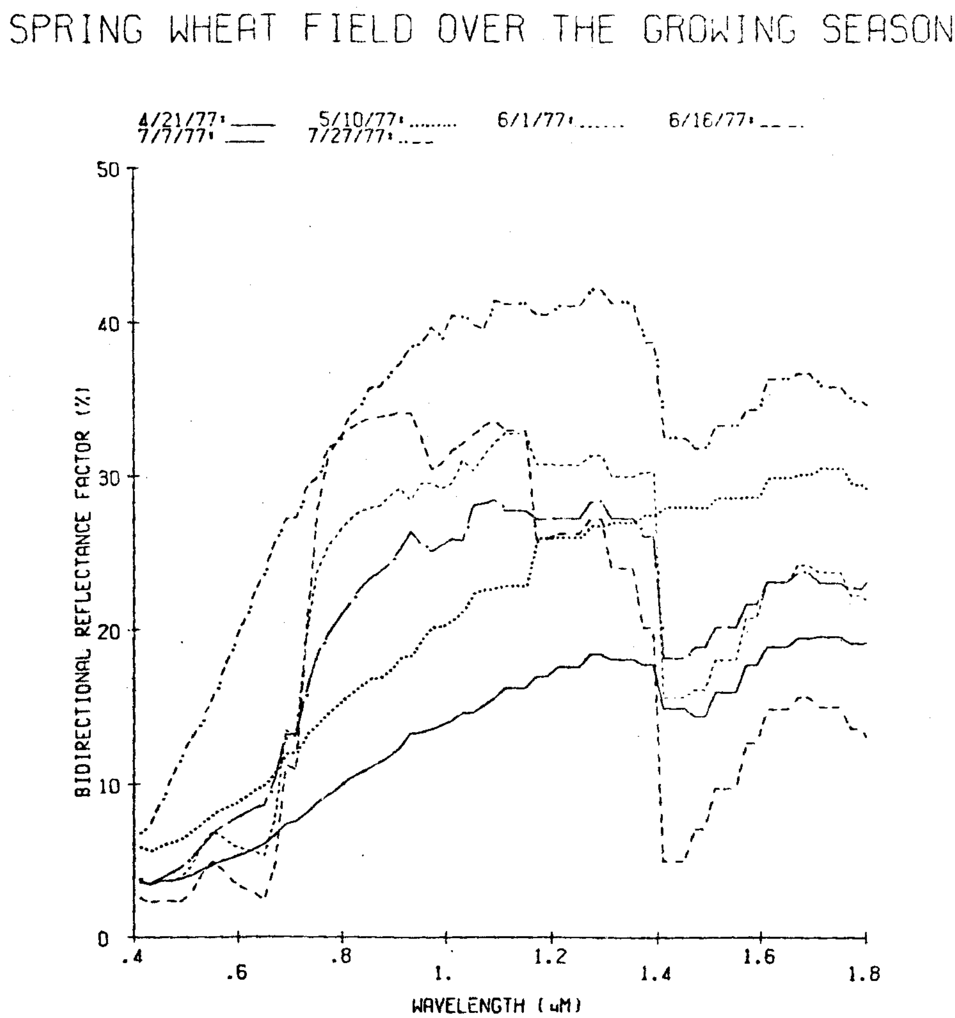

Figure 4.2-11. Varian output of field averaged spectra over the growing season.

GSPEC Example 9

```
$TAPE 4290
$GSPEC
SELECT RUSE(309-371)
LIST NOLIST
XRSCALE SW(FULL)
YTSCALE SW(FULL)
OUTPUT VARIAN
OPTIONS LINES (77, 92, 3234, 9272, 12)
TITLE SPECTRA AVERAGED OVER SPECIFIC CROPS ON JUNE 16, 1977
END
CLASS SPRWHT
SELECT  SPEC(SPRING WHEAT)
CLASS OATS
SELECT  SPEC(OATS)
CLASS BARLEY
SELECT  SPEC(BARLEY)
CLASS CORN
SELECT  SPEC(CORN)
CLASS ALFALFA
SELECT  SPEC(ALFALFA HAY)
*END
$END
$EXIT
```

In this example, the user requested a graph of different species of crops with the axes to be scaled to the full range represented in the data. The user selected spectra from tape 4290. The global 'SELECT' card specifies that the data for run sequencers 309 thru 371 should be used for this graph. The class 'SELECT' cards such as 'SELECT SPEC(SPRING WHEAT)' specify the subset of the data between run sequencers 309 and 371 that should be averaged for each class.

The 'XRSCALE' and 'YTSCALE' control cards set the scale of the X and Y axes so that the lower and upper limit values printed on the axes will be in the minimum and maximum data values for the spectra, Figure 4.2-12. Note that the above XRSCALE and YTSCALE commands, SW(FULL), may not give nice numeric labels along the axes. One can obtain nice numeric labels using the SW(FULL) option by also including a 'USET AUTOSCALE' card; see example 3. The graph is printed on the Varian. The title specified on the TITLE card is printed using default (MEDIUM) size lettering. Each class name is printed at the top of the graph along with the corresponding line characteristic indicated by the 'OPTIONS LINES' command. See 'OPTIONS LINES' in GSPEC control card dictionary section on page 3.4 for a discussion of the code for dash line descriptions.

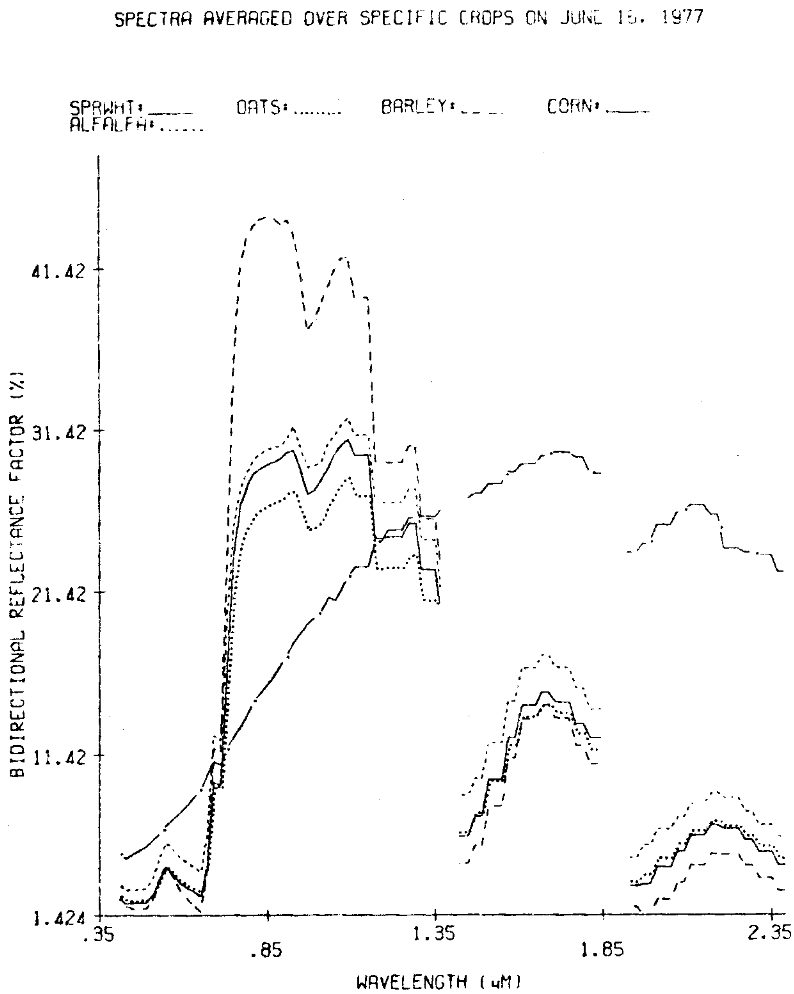

Figure 4.2-12. Averaged spectra using, 'XRSCALE SW(FULL)' and 'YTSCALE SW(FULL)' option .

GSPEC Example 10

```
$TAPE 3995
$GSPEC
GRAPH EXNU(77100213),LOF2(1),-DACO(770713)
LIST NOLIST
XRDATA  LEAR
YTDATA  BAND(.76-.90)
OPTIONS SYMBOLS(+)
OUTPUT VARIAN
END
$END
$EXIT
```

In this example, the user requests a plot of wavelength band averages and identification record information. All the previous examples were response-wavelength type graphs.

The 'SELECT' card requests that all observations on tape 3995 that were collected for experiment number 77100213 and having a level of factor two equal to 1 but not being collected on 7/13/77 should be used. The 'LIST' card indicates that no identification (ID) information should be printed. The 'XRDATA' card specifies that the data for the X ordinate should be the ID parameter leaf area index. The Y ordinate, YTDATA, should be the average response in band .76-.90 μm. The 'OPTIONS SYMBOLS' card identifies the symbol to be plotted as +. The output will be sent to the Varian printer/plotter. The graph for this example is given in Figure 4.2-13.

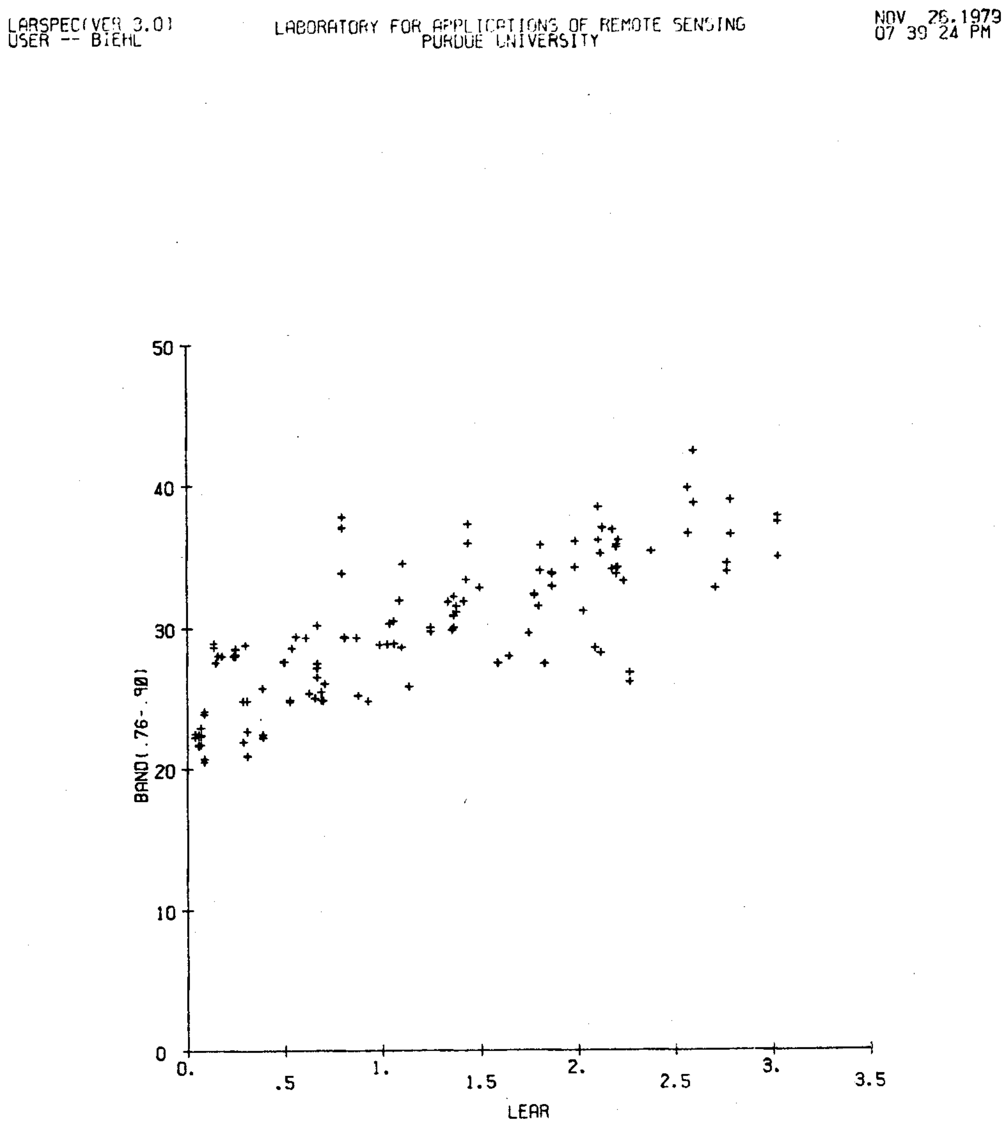

Figure 4.2-13. Graph of wavelength band average and identification record information.

GSPEC Example 11

```
$TAPE 3991
$GSPEC
SELECT  EXNU(78100802)
LIST NOLIST
XRDATA  LEAR
YTDATA  BAND(.76-.90)
TITLE 1978 CORN NITROGEN EXPERIMENT
OPTIONS PRINT
OUTPUT VARIAN
END
CLASS  NI-0
SELECT  LOF1(1)
CLASS  NI-67
SELECT  LOF1(2)
CLASS  NI-134
SELECT  LOF1(3)
CLASS  NI-202
SELECT  LOF1(4)
*END
$END
$EXIT
```

In this example, the user specifies a plot of band and identification information for the separate treatments in a given experiment.

The 'SELECT' card specifies that all observations collected for experiment number 78100802 on tape 3991 should be used. The data for the X ordinate is leaf area index. The data for the Y ordinate is the average response for band .76-.90 μm. There will be a title above the graph and the graph will be plotted on the Varian.

The 'OPTIONS PRINT' card specifies that a table of the plotted values should be printed, Figure 4.2-14. Note, in the table, that missing or null data values are designated as -101. Any coordinate pair which include one or more missing values is not plotted in the graph. Also note that the description of the X and Y ordinate data for each class is printed above the table for each class along with the class name.

The 'SELECT' cards for each of the four classes define the subset of the observations defined by the global SELECT to be used for each class. In this example the four different treatments of nitrogen fertilization were plotted in separate classes, Figure 4.2-15. The default symbols for each class are 1, 2, 3 and 4.

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CLASS NI-0

XRDATA LEAR
YTDATA BAND(.76-.90)

XRDATA	YTDATA	XRDATA	YTDATA	XRDATA	YTDATA	XRDATA	YTDATA
0.420	17.59	1.370	32.68	3.470	35.05	-101.000	30.11
0.420	18.28	2.070	30.33	2.200	34.59	-101.000	30.11
0.470	26.47	2.170	31.36	2.610	35.10	1.950	31.55
0.520	31.93	3.190	35.69	3.110	34.92	1.970	28.98
1.060	24.00	3.190	36.19	2.200	31.90	2.160	30.95
1.190	26.35	3.910	37.26	2.610	32.35	-101.000	26.05
1.370	26.48	3.240	36.71	3.110	35.92	-101.000	24.71
1.060	31.00	2.790	31.02	-101.000	28.31	-101.000	27.00
1.190	32.45	3.500	36.43				

CLASS NI-67

XRDATA LEAR
YTDATA BAND(.76-.90)

XRDATA	YTDATA	XRDATA	YTDATA	XRDATA	YTDATA	XRDATA	YTDATA
0.460	16.90	1.410	33.28	3.350	38.72	-101.000	31.57
0.460	17.26	2.240	27.90	2.510	31.43	-101.000	30.05
0.530	25.83	2.440	35.74	3.330	36.24	2.200	28.84
0.650	31.85	2.290	35.30	3.330	37.46	2.310	29.25
1.770	21.53	3.710	34.55	3.100	35.75	2.310	29.69
1.720	29.23	4.420	38.71	2.510	32.70	1.810	30.82
1.720	29.03	4.420	39.72	3.330	35.07	-101.000	24.98
1.410	28.01	2.920	40.30	3.320	36.77	-101.000	22.97
1.770	25.19	3.090	29.67	3.100	35.44	-101.000	21.78
1.720	34.55	3.300	35.65	-101.000	28.01	-101.000	21.34
1.720	33.42	-101.000	36.41	-101.000	33.43		

CLASS NI-134

XRDATA LEAR
YTDATA BAND(.76-.90)

XRDATA	YTDATA	XRDATA	YTDATA	XRDATA	YTDATA	XRDATA	YTDATA
0.520	19.13	1.560	31.00	4.160	34.89	-101.000	28.74
0.520	19.50	1.660	31.87	-101.000	34.45	-101.000	31.02
0.580	19.67	2.080	32.74	3.690	36.51	-101.000	33.43
0.520	19.34	2.080	32.99	3.790	35.55	-101.000	31.88
0.520	19.76	2.530	34.34	3.790	38.34	-101.000	31.41
0.580	21.08	2.530	34.43	3.300	34.86	2.320	30.88
0.580	23.80	3.270	34.98	3.300	34.22	2.320	28.99
0.530	25.78	3.270	36.09	3.890	36.33	2.390	27.17
0.550	31.77	2.770	36.90	3.320	36.63	2.390	28.77
0.550	31.96	2.520	36.82	3.740	35.59	2.570	29.05
1.290	24.89	2.520	37.32	3.300	35.19	2.760	31.53
1.290	25.48	4.160	38.86	3.300	32.02	2.760	27.51
1.560	27.14	4.160	38.86	3.890	33.84	-101.000	23.33
1.560	28.37	4.230	39.79	3.890	35.21	-101.000	24.33
1.660	27.85	4.400	38.95	3.320	35.06	-101.000	20.78
2.080	28.15	4.420	37.33	3.740	37.19	-101.000	22.57
2.080	28.69	4.420	38.99	3.740	36.72	-101.000	23.99
1.290	27.06	3.750	32.62	-101.000	32.10	-101.000	23.83
1.290	26.19	3.750	36.77	-101.000	32.55	-101.000	24.25
1.560	32.18						

CLASS NI-202

XRDATA LEAR
YTDATA BAND(.76-.90)

XRDATA	YTDATA	XRDATA	YTDATA	XRDATA	YTDATA	XRDATA	YTDATA
0.880	30.20	2.630	39.46	3.790	37.43	-101.000	34.86
0.370	31.38	4.140	38.65	3.390	38.60	3.110	33.90
1.890	28.45	4.360	39.45	4.110	37.13	2.780	30.95
1.560	29.33	4.350	40.21	3.790	34.74	3.390	31.94
1.890	34.13	4.170	37.47	3.390	38.22	-101.000	27.68
1.560	33.44	4.480	37.52	-101.000	34.22	-101.000	25.96
2.470	30.20	3.730	37.32	-101.000	34.52	-101.000	26.18
3.250	34.46	4.110	38.50				

Figure 4.2-14. Table of plotted values for wavelength band averages/ identification information type plots using 'OPTIONS PRINT'.

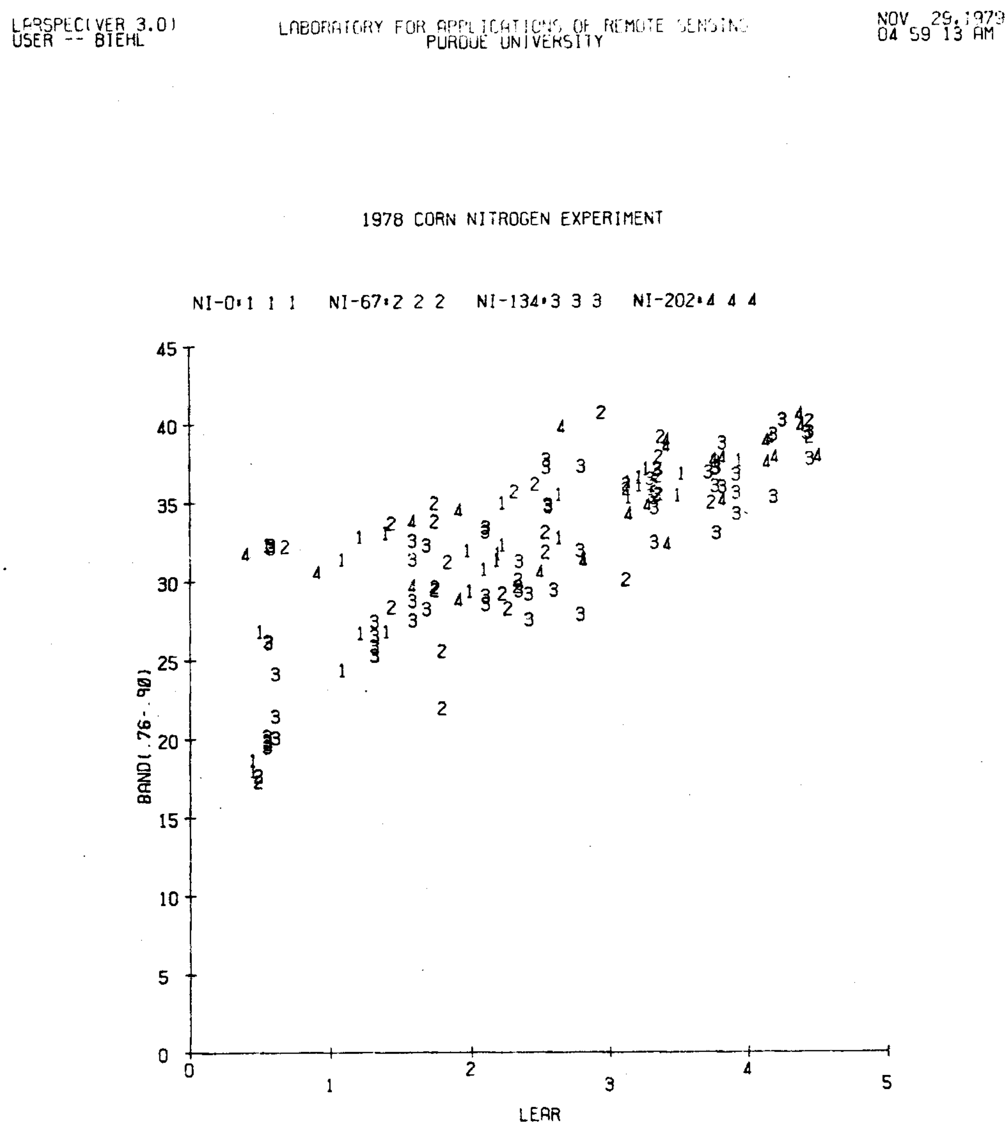

Figure 4.2-15. Graph of the data for four specified classes of wavelength band averages and identification record information.

GSPEC Example 12

```
$TAPE 4319
$GSPEC
GRAPH EXNU(78105802),RUSE(1-2750)
LIST NOLIST
XRDATA  EP02*DBGL/100
YTDATA  BAND(.8-1.1)/BAND(.6-.7)
OPTIONS SYMBOLS(+)
OUTPUT VARIAN
END
$END
$EXIT
```

In this example, the user requests a plot of the function of wavelength band averages and identification record information.

The user designated that all observations that were collected for experiment 78105802 between run sequencers 1 and 2750 on tape 4319 be used. Since 'GRAPH' was used instead of 'SELECT', no class cards are required. The 'LIST' card specifies that no identification information will be printed for the selected observations. The user requested that the X ordinate data, 'XRDATA', be a function of experimenter parameter 2 and the dry biomass for green leaves. The Y ordinate data, 'YTDATA', will be the ratio of the .8 to 1.1 μm and the .6-.7 band responses. The output data will be plotted with the symbol, '+', and the graph will be sent to the Varian printer/plotter, Figure 4.2-16. Note that the default X and Y axes labels are the 'XRDATA' and 'YTDATA' specifications.

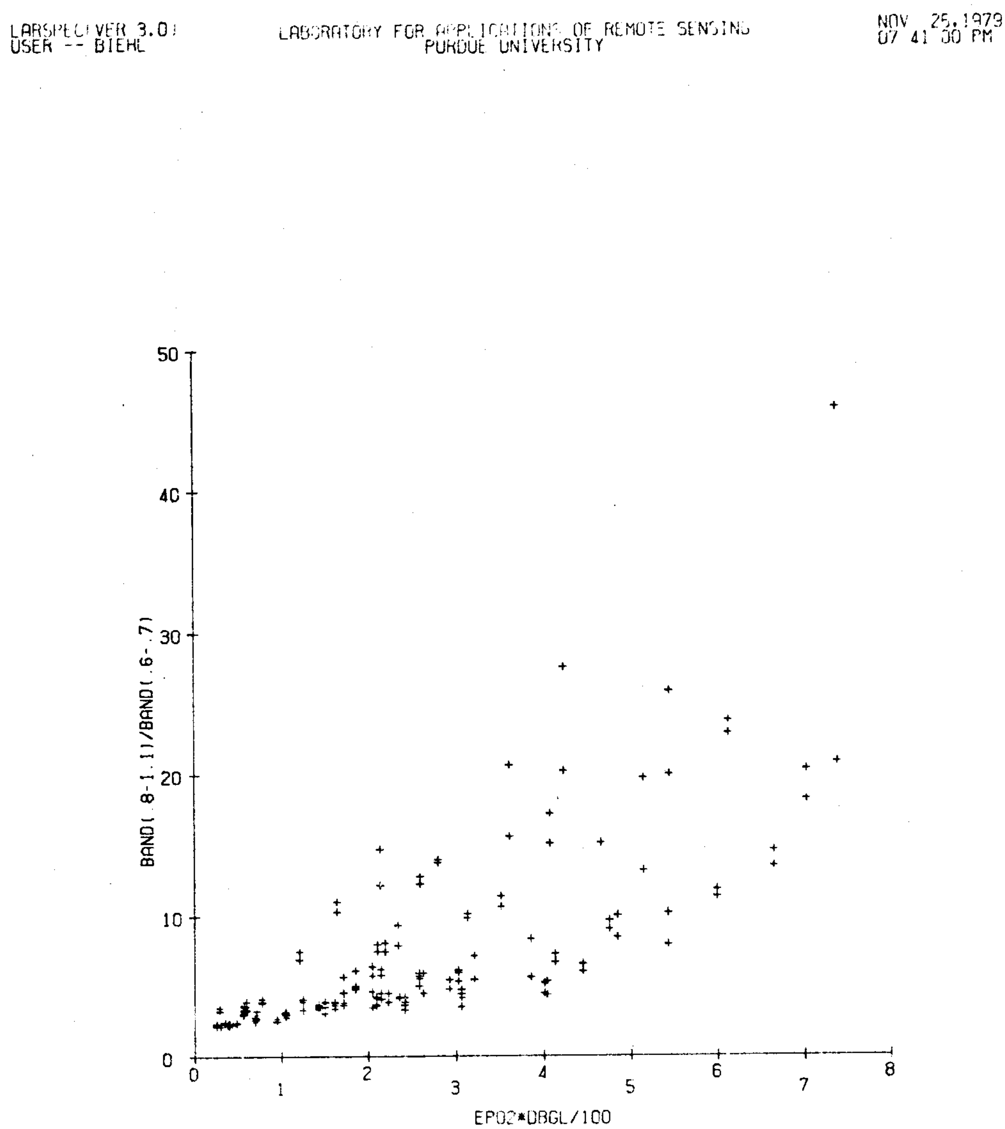

Figure 4.2-16. Graph of the function of wavelength band averages and identification record information.

GSPEC Example 13

```
$TAPE
GSPEC
SELECT  EXNU(77100213),LOF2(1),-DACO(770713)
LIST NOLIST
XRDATA  LEAR
YTDATA  BAND(.76-.90)
XRLABEL  LEAF AREA INDEX
YTLABEL  BRF RESPONSE FOR .76-.90 >U<M
OUTPUT VARIAN
OPTIONS SYMBOLS(+)
END
CLASS  DATA
CLASS  CURVEFIT
USET FITLINEAR
*END
$END
$EXIT
```

This deck is an example of plotting data points along with a fitted curve through the data points.

The same data as selected in example 10 is used for this example - 'SELECT, XRDATA, and YTDATA' cards.

Note that in this example, however, class cards will be required since the 'SELECT' card was used instead of the 'GRAPH' card. The 'XRLABEL' and 'YTLABEL' cards request user defined labels for the X and Y axes, respectively. The output graph will go to the Varian and the symbol to be used for the first class is '+'. Two classes are defined by the two 'CLASS' cards. Since the X and Y coordinate data are defined in the global area, 'XRDATA' and 'YTDATA' cards, the same data is defined for each class. The data plotted for the first class will be the individual data points. The 'USET' parameter in the second class, 'CLASS CURVEFIT', specifies that a linear curve should be fit through the data points and only the fitted curve will be plotted. Note that the coefficient of determination and the coefficients of the fitted line are given as a default title, Figure 4.2-17. The coefficients are also printed in a table, Figure 4.2-18.

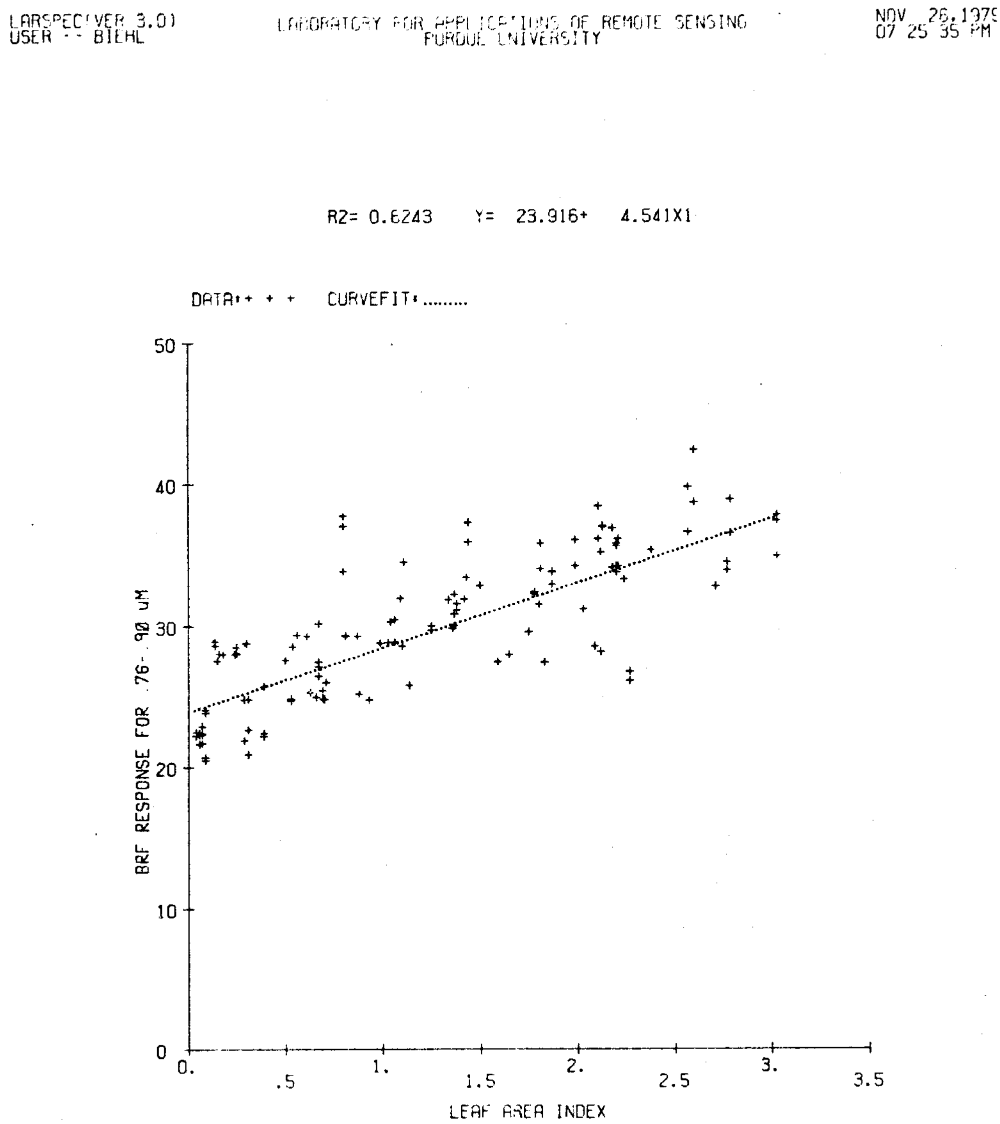

Figure 4.2-17. Graph of wavelength band averages and identification information along with a fitted curve through the points.

```
LEAST SQUARES COEFFICIENTS FOR CLASS CURVEFIT

   R2 =   0.62428
   X0         23.9165
   X1          4.5413
```

Figure 4.2-18. Printed table of the coefficient of determination and the coefficients of the fitted curve.

GSPEC Example 14

```
$TAPE 3983,3993,3995
$GSPEC
SELECT EXNA(SPRING WHEAT ND)
XRDATA  LEAR
YTDATA  BAND(.63-.69)
LIST NOLIST
OUTPUT VARIAN
USET FITPOLYNOMIAL
XRLABEL  LEAF AREA INDEX
YTLABEL  .63-.69 >U<M BAND
TITLE  SPRING WHEAT EXPERIMENT
END
CLASS  1975
SELECT  YEDA(75),LOF1(1)
CLASS  1976
SELECT YEDA(76),LOF1(1)
CLASS  1977
SELECT  YEDA(77),LOF2(1),-DACO(770713)
*END
$END
$EXIT
```

This deck is an example of multiple curve fits through several classes of specified data.

In this example, all the observations collected for the Spring Wheat ND experiment that are on tapes 3983, 3993, and 3995 are to be selected. The X ordinate data are to be leaf area index. The Y ordinate data are to be the average response in the .63-.69 μm band. No identification information for the selected observations will be printed (listed). The 'XRLABEL' and 'YTLABEL' cards specify user labels for the X and Y axes. Note that the '>' symbol on the YTDATA card requests a shift to lower case characters. The '<' symbols requests a shift to upper case characters. The lower case u is a μ. The 'TITLE' card specifies the title to be placed above the graph. The 'CLASS' and class 'SELECT' cards define three classes of information. The first class will contain the observations collected in 1975 for the Spring Wheat ND experiment that have a level of factor 1 code equal to 1. Class two is defined similarly for 1976 data. Class three contains the 1977 observations that were not collected on 7/13/77 that have a level of factor 2 code equal to 1.

GSPEC Example 14 (con't.)

The 'USET POLYNOMIAL' cards designates that a polynomial curve should be fit through each class of data points. Only the fitted curve for each class will be plotted, Figure 4.2-19. The 'USET' parameter applies for all classes since it is in the global section of control cards. The 'USET' parameter in example 13 applied for only one class since it was within the class section of control cards. The default degree of the polynomial curve fit is 2. The 'UPSET POLYNOMIAL(X)' parameter may be used to change the degree of the polynomial curve fit. A table is also printed giving the coefficient of determination and the coefficients of the fitted curve for each class, Figure 4.2-20.

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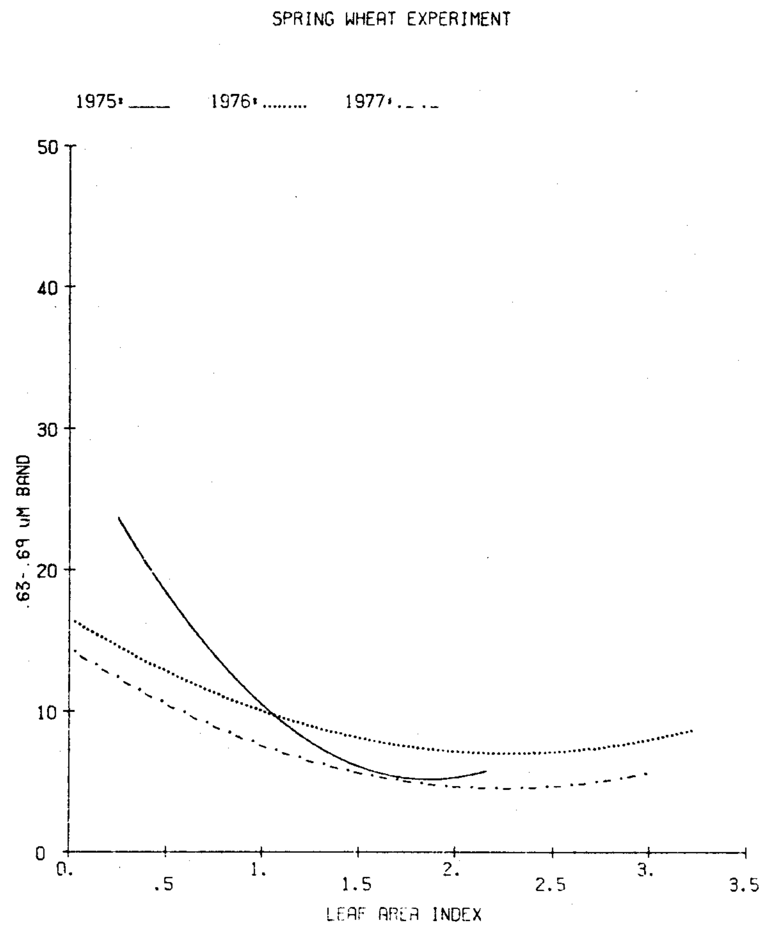

Figure 4.2-19. Graph of curve fits through three classes of spectral data.

LEAST SQUARES COEFFICIENTS FOR CLASS 1975

R2 =	0.64858
X0	29.8383
X1	-26.4970
X2	7.1039

LEAST SQUARES COEFFICIENTS FOR CLASS 1976

R2 =	0.58260
X0	16.4622
X1	-8.3958
X2	1.8529

LEAST SQUARES COEFFICIENTS FOR CLASS 1977

R2 =	0.74887
X0	14.3821
X1	-8.8114
X2	1.9613

Figure 4.2-20. Printed table containing the coefficient of determination and the coefficients of the fitted curve for each class.

GSPEC Example 15

```
$TAPE 3991
$GSPEC
SELECT EXNA(P&K EXPT SOYBEAN), SPEC(SOYBEANS)
LIST NOLIST
USET AUTOSCALE, LOGYAXIS, YLOGARITHMIC
OPTIONS PRINT
OUTPUT VARIAN
END
CLASS 6/28/78
SELECT DACO(780628)
CLASS 7/5/78
SELECT DACO(780705, 780706)
CLASS 7/16/78
SELECT DACO(780716)
CLASS 8/4/78
SELECT DACO(780803, 780804)
CLASS 8/20/78
SELECT DACO(780820)
CLASS 9/15/78
SELECT DACO(780915, 780923)
*END
$END
$EXIT
```

For this example, the user requests a semi-logarithmic graph of selected spectral data.

In this example, all observations collected for the experiment named, P&K EXPT SOYBEAN and being of species, SOYBEANS, should be selected from tape 3991. No identification information for the selected observations will be printed. The 'USET LOGYAXIS' parameter defines the Y axis to be in logarithmic (base 10) units. The 'USET YLOGARITHMIC' parameter designates that the data should be plotted in logarithmic Y- linear X coordinates units. The 'USET AUTOSCALE' parameter specifies that the axes should be scaled automatically, ie the user will not define the absolute limits. The output graph, Figure 4.2-21 , will go to the Varian. The 'CLASS' and 'SELECT' cards define the observations to be averaged for each class. The use of logarithmic units in this example accentuates the variation for response levels between of 0 and 10 more than response levels between 10 and 100.

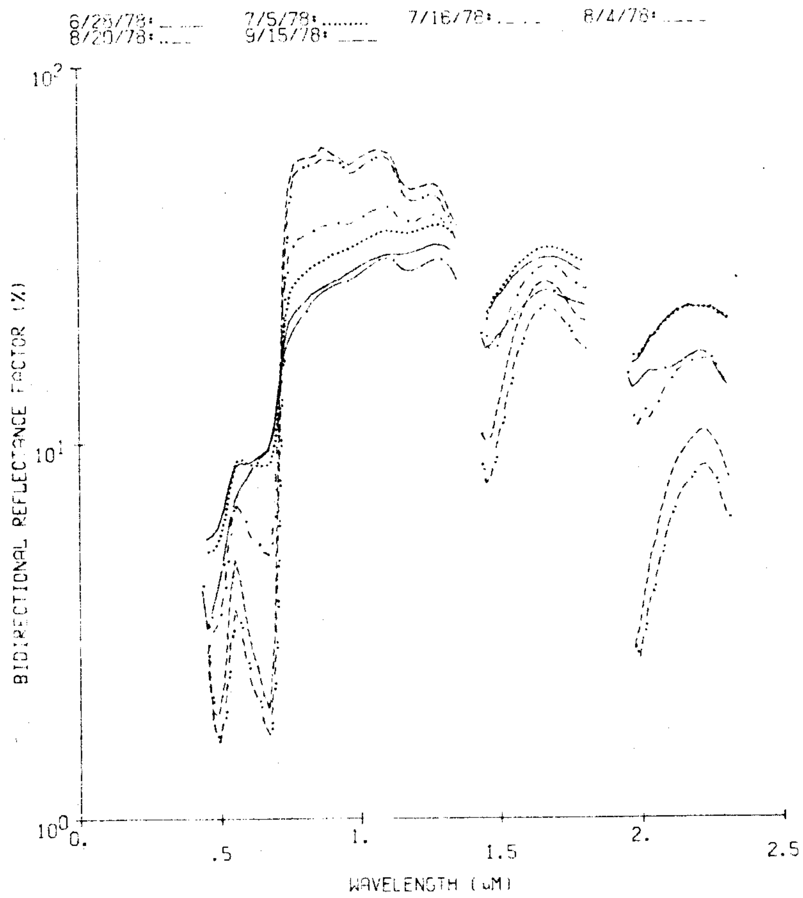

Figure 4.2-21. Example of logarithmic data plotted using the option 'USET AUTOSCALE, LOGYAXIS, YLOGARITHMIC'.

GSPEC Example 15 (con't.)

The 'OPTIONS PRINT' card specifies that a table of the plotted values will be printed for each class of data. Figure 4.2-22 illustrates the type and format of the data tables generated by the PRINT command for spectrometer type data. The class name of the first class, 'CLASS 6/28/78' is listed at the top of Figure 4.2-22 and the subsequent class names are listed above the corresponding class information. The data for each class was selected on the basis of date the date were collected such as 'SELECT DACO(780628)' for the first class.

RESPONSE BIDIRECTIONAL REFLECTANCE FACTOR (%)

CLASS 6/29/78

***** SAMPLE GROUP 1 RANGE 0.350- 2.400 MICROMETERS

WAVE LENGTH MICROMETERS	RESPONSE	WAVE LENGTH MICROMETERS	RESPONSE	WAVE LENGTH MICROMETERS	RESPONSE	WAVE LENGTH MICROMETERS	RESPONSE
0.350	-1.00	0.870	25.61	1.390	-1.00	1.910	-1.00
0.370	-1.00	0.890	26.10	1.410	-1.00	1.930	-1.00
0.390	-1.00	0.910	26.59	1.430	-1.00	1.950	-1.00
0.410	-1.00	0.930	26.96	1.450	21.95	1.970	16.10
0.430	-1.00	0.950	27.62	1.470	22.57	1.990	16.42
0.450	5.55	0.970	28.14	1.490	24.04	2.010	17.29
0.470	5.67	0.990	28.75	1.510	24.81	2.030	18.56
0.490	5.92	1.010	29.34	1.530	26.02	2.050	19.12
0.510	6.63	1.030	29.94	1.550	27.24	2.070	20.07
0.530	7.72	1.050	30.38	1.570	28.03	2.090	20.89
0.550	8.61	1.070	30.76	1.590	28.95	2.110	21.48
0.570	8.82	1.090	31.22	1.610	29.62	2.130	22.18
0.590	8.81	1.110	31.32	1.630	30.16	2.150	22.33
0.610	8.91	1.130	31.39	1.650	30.48	2.170	22.72
0.630	9.11	1.150	31.38	1.670	30.61	2.190	22.53
0.650	9.34	1.170	31.53	1.690	30.62	2.210	22.52
0.670	9.65	1.190	31.76	1.710	30.50	2.230	22.42
0.690	10.68	1.210	32.13	1.730	30.09	2.250	22.47
0.710	13.90	1.230	32.46	1.750	29.49	2.270	22.02
0.730	18.28	1.250	32.89	1.770	28.71	2.290	21.44
0.750	20.89	1.270	33.29	1.790	28.14	2.310	20.74
0.770	22.17	1.290	33.14	1.810	-1.00	2.330	-1.00
0.790	22.97	1.310	32.90	1.830	-1.00	2.350	-1.00
0.810	23.64	1.330	32.04	1.850	-1.00	2.370	-1.00
0.830	24.52	1.350	-1.00	1.870	-1.00	2.390	-1.00
0.850	25.17	1.370	-1.00	1.890	-1.00		

CLASS 7/5/78

***** SAMPLE GROUP 1 RANGE 0.350- 2.400 MICROMETERS

WAVE LENGTH MICROMETERS	RESPONSE	WAVE LENGTH MICROMETERS	RESPONSE	WAVE LENGTH MICROMETERS	RESPONSE	WAVE LENGTH MICROMETERS	RESPONSE
0.350	-1.00	0.870	30.21	1.390	-1.00	1.910	-1.00
0.370	-1.00	0.890	30.83	1.410	-1.00	1.930	-1.00
0.390	-1.00	0.910	31.48	1.430	-1.00	1.950	-1.00
0.410	-1.00	0.930	31.70	1.450	21.09	1.970	16.77
0.430	-1.00	0.950	32.15	1.470	23.69	1.990	16.75
0.450	5.11	0.970	32.72	1.490	24.59	2.010	17.63
0.470	5.18	0.990	33.24	1.510	25.79	2.030	18.74
0.490	5.53	1.010	33.96	1.530	27.05	2.050	19.20
0.510	6.33	1.030	34.68	1.550	28.56	2.070	20.22
0.530	7.79	1.050	35.10	1.570	29.51	2.090	20.93
0.550	8.91	1.070	35.68	1.590	30.56	2.110	21.52
0.570	8.98	1.090	36.15	1.610	31.25	2.130	[illegible]
0.590	8.73	1.110	36.02	1.630	32.00	2.150	22.30
0.610	8.66	1.130	35.89	1.650	32.44	2.170	22.47
0.630	8.66	1.150	35.67	1.670	32.48	2.190	22.34
0.650	8.67	1.170	35.59	1.690	32.50	2.210	22.46
0.670	8.78	1.190	35.85	1.710	32.13	2.230	22.21
0.690	10.02	1.210	36.21	1.730	31.63	2.250	22.12
0.710	14.86	1.230	36.55	1.750	30.97	2.270	21.39
0.730	21.41	1.250	37.03	1.770	30.18	2.290	21.37
0.750	25.11	1.270	37.43	1.790	29.89	2.310	20.87
0.770	26.66	1.290	37.25	1.810	-1.00	2.330	-1.00
0.790	27.53	1.310	36.86	1.830	-1.00	2.350	-1.00
0.810	28.24	1.330	35.55	1.850	-1.00	2.370	-1.00
0.830	29.20	1.350	-1.00	1.870	-1.00	2.390	-1.00
0.850	29.87	1.370	-1.00	1.890	-1.00		

CLASS 7/16/78

***** SAMPLE GROUP 1 RANGE 0.350- 2.400 MICROMETERS

WAVE LENGTH MICROMETERS	RESPONSE	WAVE LENGTH MICROMETERS	RESPONSE	WAVE LENGTH MICROMETERS	RESPONSE	WAVE LENGTH MICROMETERS	RESPONSE
0.350	-1.00	0.870	37.40	1.390	-1.00	1.910	-1.00
0.370	-1.00	0.890	37.53	1.410	-1.00	1.930	-1.00
0.390	-1.00	0.910	37.76	1.430	-1.00	1.950	-1.00
0.410	-1.00	0.930	38.01	1.450	18.92	1.970	11.56
0.430	-1.00	0.950	37.77	1.470	17.01	1.990	10.98
0.450	3.23	0.970	37.74	1.490	17.95	2.010	12.08
0.470	3.13	0.990	38.58	1.510	19.59	2.030	11.49
0.490	3.32	1.010	39.34	1.530	21.45	2.050	12.17
0.510	4.05	1.030	40.11	1.550	23.30	2.070	13.09
0.530	5.73	1.050	40.90	1.570	24.94	2.090	13.98
0.550	6.92	1.070	41.43	1.590	26.32	2.110	14.73
0.570	6.60	1.090	41.67	1.610	27.50	2.130	15.32
0.590	5.92	1.110	41.54	1.630	28.44	2.150	15.74
0.610	5.57	1.130	40.59	1.650	28.93	2.170	16.08
0.630	5.36	1.150	38.63	1.670	29.23	2.190	16.31
0.650	5.11	1.170	38.27	1.690	28.96	2.210	16.30
0.670	5.02	1.190	38.21	1.710	28.51	2.230	16.48
0.690	6.33	1.210	38.50	1.730	27.84	2.250	16.06
0.710	13.00	1.230	39.24	1.750	26.84	2.270	15.38
0.730	24.37	1.250	39.60	1.770	25.88	2.290	14.66
0.750	31.40	1.270	39.80	1.790	25.28	2.310	14.02
0.770	33.97	1.290	39.57	1.810	25.36	2.330	-1.00
0.790	34.78	1.310	37.99	1.830	-1.00	2.350	-1.00
0.810	35.32	1.330	36.18	1.850	-1.00	2.370	-1.00
0.830	36.06	1.350	-1.00	1.870	-1.00	2.390	-1.00
0.850	36.73	1.370	-1.00	1.890	-1.00		

Figure 4.2-22. Example of output for first three classes using 'OPTIONS PRINT'.

GSPEC Example 16

```
$TAPE 3991,4318
$GSPEC
SELECT DACO(780720),.OR.,EXNU(77100701)
YTSCALE SW(0,60)
YTLABEL BRF(%)
UPSET TICX(0.1), TICY(5)
OUTPUT VARIAN
LIST NOLIST
TITLE (LARGE)
TITLE CORN CANOPY/AQUALF SOIL BACKGROUND
OPTIONS HOLDGRAPH, SIZEGRAPH(1.5,7.5,5.0,8.0)
END
CLASS CORN/DRY
SELECT PLNU(202,204,206)
CLASS CORN/WET
SELECT PLNU(210,203,205)
CLASS BARE/DRY
SELECT SENU(77333906,77334506,77334606)
CLASS BARE/WET
SELECT SENU(77333406,77334006,77334406)
*END
SELECT
XRDATA XRDATA1
YTSCALE SW(0,4)
UPSET TICX(0.1), TICY(0.5)
XRLABEL WAVELENGTH(MICROMETERS)
YTLABEL BRF RESPONSE RATIO
TITLE DRY/WET TREATMENT RATIOS
OPTIONS DRAWGRAPH, SIZEGRAPH(1.5,7.5,0.0,3.0)
PLOTCLASS 1,2
END
CLASS CORN
YTDATA YTDATA1/YTDATA2
CLASS SOIL
YTDATA YTDATA3/YTDATA4
*END
$END
$EXIT
```

In this example, the user requests that two graphs be on the same page, Figure 4.2-23. The graph at the top of the page includes curves for both bare soil and corn. The graph at the bottom of the page are algebraic functions of the data in the top graph.

The first graph is specified by the cards down to the first '*END' card. All observations collected for experiment number 77100701 or collected on 7/20/78 that are on tapes 3991 and 4318 will be used for the graph. The Y axis will be scaled from 0 to 60. The user defined label for the Y axis will be 'BRF(%)'. The 'UPSET' parameters specify the tic intervals for the X and Y axes. The output will go to the Varian and no identification

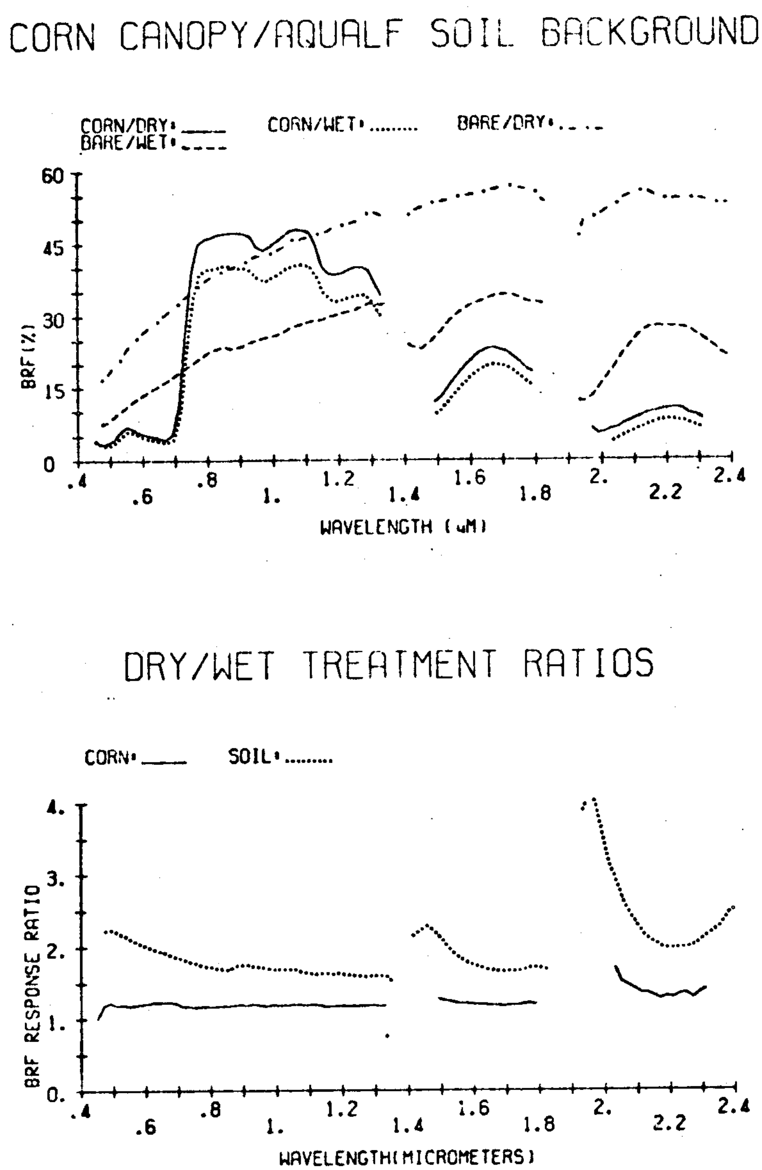

Figure 4.2-23. Example of two graphs on a page using the options HOLDGRAPH, SIZEGRAPH, and DRAWGRAPH.

information for the selected observations will be printed. A title will be placed above the graph and the size of the characters in the title will be large.

The 'OPTIONS SIZEGRAPH' parameter specifies the location of the graph on the page in inches from lower left corner. The 'OPTIONS HOLDGRAPH' specifies that the graph should not be sent to the output queue when this graph is finished. In other words additional graphs will be placed on the page in subsequent sets of control cards.

The 'CLASS' and class 'SELECT' cards specify the subset of the observation defined by the global 'SELECT' to be averaged for each class.

The second set of control cards, between the first '*END' and the second '*END', specify a graph which represents ratios of the data plotted in the first graph. The 'XRDATA' card specifies that the data to be used for the X ordinate for all classes should be the same data as used for the X ordinate of Class 1 in the original data read from tape, ie. wavelength. The 'XRDATA' cards specifies the X ordinate data for all classes since it is in the global section of control cards.

The 'UPSET' parameter specifies the axes tic intervals and the 'XRLABEL' and 'YTLABEL' parameters specify the X and Y axes labels, respectively.

The 'TITLE' card specifies a new title for this graph. The size of the characters will still be large since there was no card in this control card set specifying a change. In general specified control parameters stay in affect from control card set to control card set until they are respecified by another control card.

The location of this graph is given by this 'OPTION SIZEGRAPH' card. The 'OPTION DRAWGRAPH' indicates that when this graph is finished, this graph and any other 'held' graphs should be sent to the output queue, ie. plotted.

The 'CLASS' cards specify the number of classes and the name for each class. The class 'YTDATA' cards specify the Y ordinate data to be used for each class. The 'YTDATA' card for the first class specifies that Y ordinate data should be the ratio of the Y ordinate data for classes 1 and 2 in the original data read from tape, ie. the ratio of the CORN/wet and CORN/dry classes. The 'YTDATA' card for the second class specifies the Y ordinate data for class 2 to be the ratio of the Y ordinate data for classes 3 and 4 in the original data read from tape.

The user could add additional control card sets to specify a different set of functions of the original data. The 'XRDATA' and 'YTDATA' cards as used in the second control card set above always refer back to the original set of data read from tape or disk.

GSPEC Example 17

```
$TAPE 4047
$GSPEC
GRAPH RUSE(325-333), DACO(790519), OBNU(19-24)
XRDATA .9848*BAND(.595-.605)/COS(IRZE/57.2958)
YTDATA 90-IRZE
OUTPUT VARIAN
OPTIONS SYMBOLS(+)
XRSCALE SW(0,100)
YTSCALE SW(0,90)
USET POLAR, GRIDAXIS
UPSET TICX(10.), TICY(10.)
TITLE PAINTED BARIUM SULFATE ANGLE STUDY
XRLABEL BIDIRECTIONAL REFLECTANCE FACTOR (%)
YTLABEL BIDIRECTIONAL REFLECTANCE FACTOR (%)
END
$END
$EXIT
```

This set of control cards is an example of a polar plot with a grid axes, Figure 4.2-24.

The 'GRAPH' card specifies that all observations from 19 thru 24 collected on 5/19/79 being between run sequences 325 and 333 on tape 4047 will be used.

The 'XRDATA' card specifies the radius ordinate of the graph. The radius ordinate is to be a function of both the average response for a wavelength band and the irradiance zenith angle. The 'COS' function is the same as the Fortran COS function (cosine) and therefore the argument was converted from degrees to radians (IRZE/57.2958). The 'YTDATA' card specifies the data to be used for the theta ordinate, in degrees.

The output will go to the Varian and the symbol to be used for the plotting is '+'. The 'XRSCALE' card defines the radius axis limits - 0 to 100 units and the 'YTSCALE' card defines the theta axis limits - 0 to 90 degrees.

The 'USET' card specifies that the graph is to be in polar coordinates and that the graph should have a grid background. The 'UPSET' card specifies the tic interval for the axes. A title will be placed above the graph and the user has defined the alphanumeric labels to be placed along the axes.

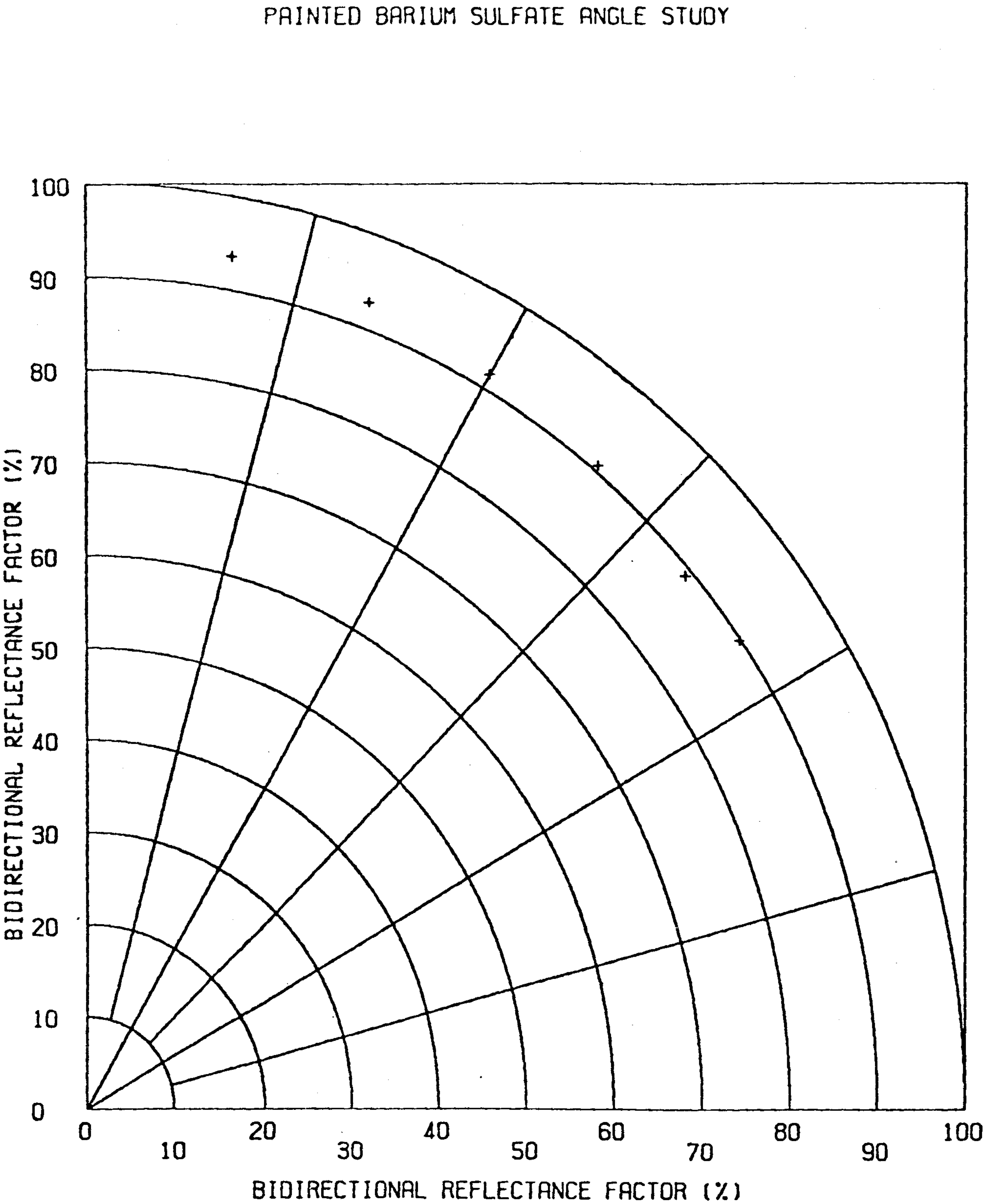

Figure 4.2-24. Example of a polar plot with an overlaying grid.

GSPEC Example 18

```
$TAPE 3995
$GSPEC
SELECT  EXNU(77100213),LO12(1),-DACO(770713)
LIST NOLIST
OUTPUT VARIAN
PLOTCLASS 1
END
CLASS  LAI
XRDATA  LEAR
YTDATA  BAND(.45-.52)
ZPDATA  BAND(.76-.90)
CLASS  HEIGHT
XRDATA  HEIG
YTDATA  BAND(.52-.60)
ZPDATA  BAND(1.2-1.3)
CLASS  PLANTCNT
XRDATA  PLCO
YTDATA  BAND(.63-.69)
ZPDATA  BAND(2.08-2.35)
CLASS  PLANTMOS
XRDATA  PLMO
YTDATA  BAND(1.55-1.75)
ZPDATA  FRBI
*END
ZPDATA
END
*END
PLOTCLASS  2
XRLABEL  PLANT HEIGHT (METERS)
END
*END
GRAPH
XRDATA  XRDATA1
YTDATA  YTDATA2/ZPDATA1
XRLABEL
END
SELECT
XRLABEL  LEAF AREA INDEX
YTLABEL  RESPONSE BRF  (%)
END
CLASS  TM3
YTDATA  YTDATA3
CLASS TM4
YTDATA ZPDATA1
*END
$END
$EXIT
```

This example illustrates how a user can request several different graphs from a single set of data read from tape (or disk) into the computer. The complete control card deck consists of five sets of control cards which specify five different graphs.

Set 1

In the first set of control cards, the 'SELECT' card specifies the observations that are to be read from tape 3995. No identification information from the selected observations is to be printed and the output is to go to the Varian. The 'PLOTCLASS' card specifies that only the information for the first class is to be plotted. In other words, classes 2, 3, and 4 should be skipped for this graph. The 'PLOTCLASS' card is very useful for graphing different combinations of classes without rereading tape or disk files.

The 'XRDATA', 'YTDATA', and 'ZPDATA' cards specify the data to be used for the X and Y ordinates for each class. Note that since GSPEC is not set up for three dimensional graphs, the 'ZPDATA' is plotted versus the 'XRDATA', Figure 4.2-25. (This is consistent with class averages and standard deviations plotted versus wavelength for response - wavelength graphs. The standard deviation is treated as 'ZPDATA'.) Therefore, the graph in Figure 4.2-25 is a plot of the average response in the .45-.52 μm band versus leaf area index and the average response in the .76-.90 μm band versus leaf area index.

Note that the three features specified for four classes actually represent 12 features of information for each of the selected observations.

Set 2

The second set of control cards illustrates how one can turn the plotting of 'ZPDATA' versus 'XRDATA' off, Figure 4.2-26. The 'END' card in the 2nd control card set signifies the end of the global control cards. The '*END' cards signifies the end of the class cards; ie. in this set none of the class specifications were damaged. Note that any parameter (flag) set by the control cards in set 1 will apply for control card set 2. The parameters stay set until changed by a control card. The graph in Figure 4.2-26 represents the plot of the average response in the .45-.52 μm band versus leaf area index.

Set 3

The third graph for this example, Figure 4.2-27, is the plot of the data specified for class 2. The user has supplied his own label for the X axis. Figure 4.2-27 represents the plot of only 'YTDATA' versus 'XRDATA' since 'ZPDATA' was 'turned off' in the previous control card set.

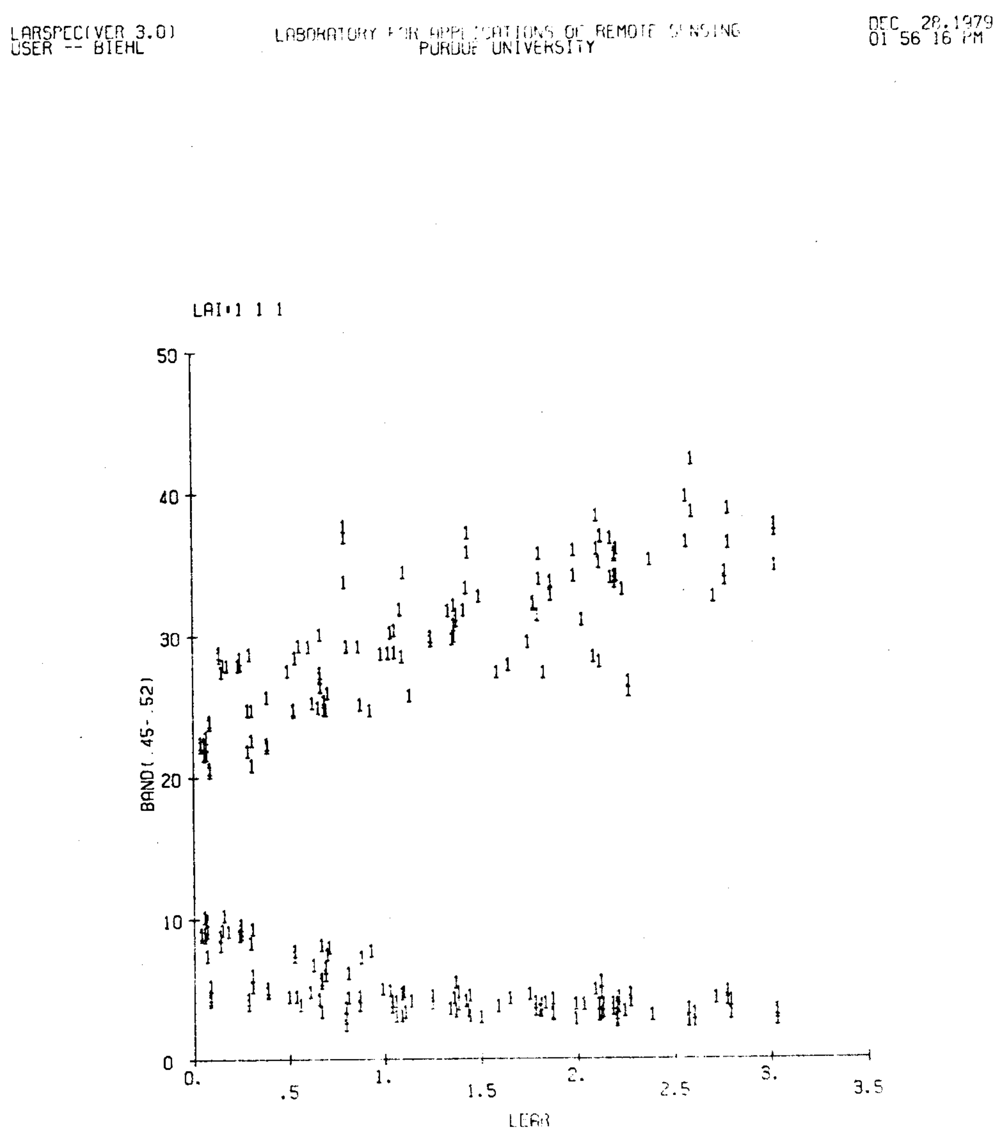

Figure 4.2-25. Graph illustrating plot of 'ZPDATA' and 'YTDATA' versus 'XRDATA' for class 1- 'PLOTCLASS 1'.

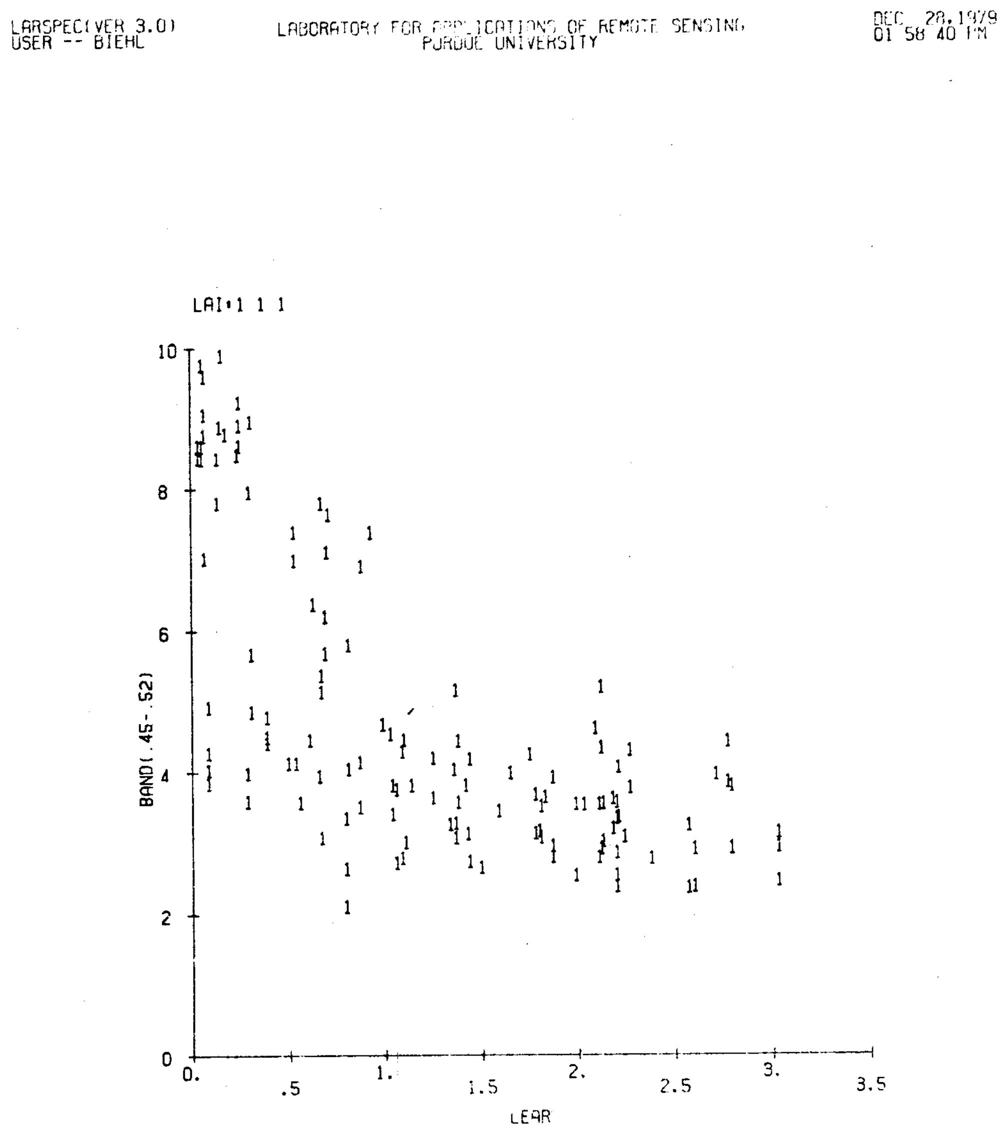

Figure 4.2-26. Graph illustrating plot of data for class 1 with 'ZPDATA' ordinate turned off.

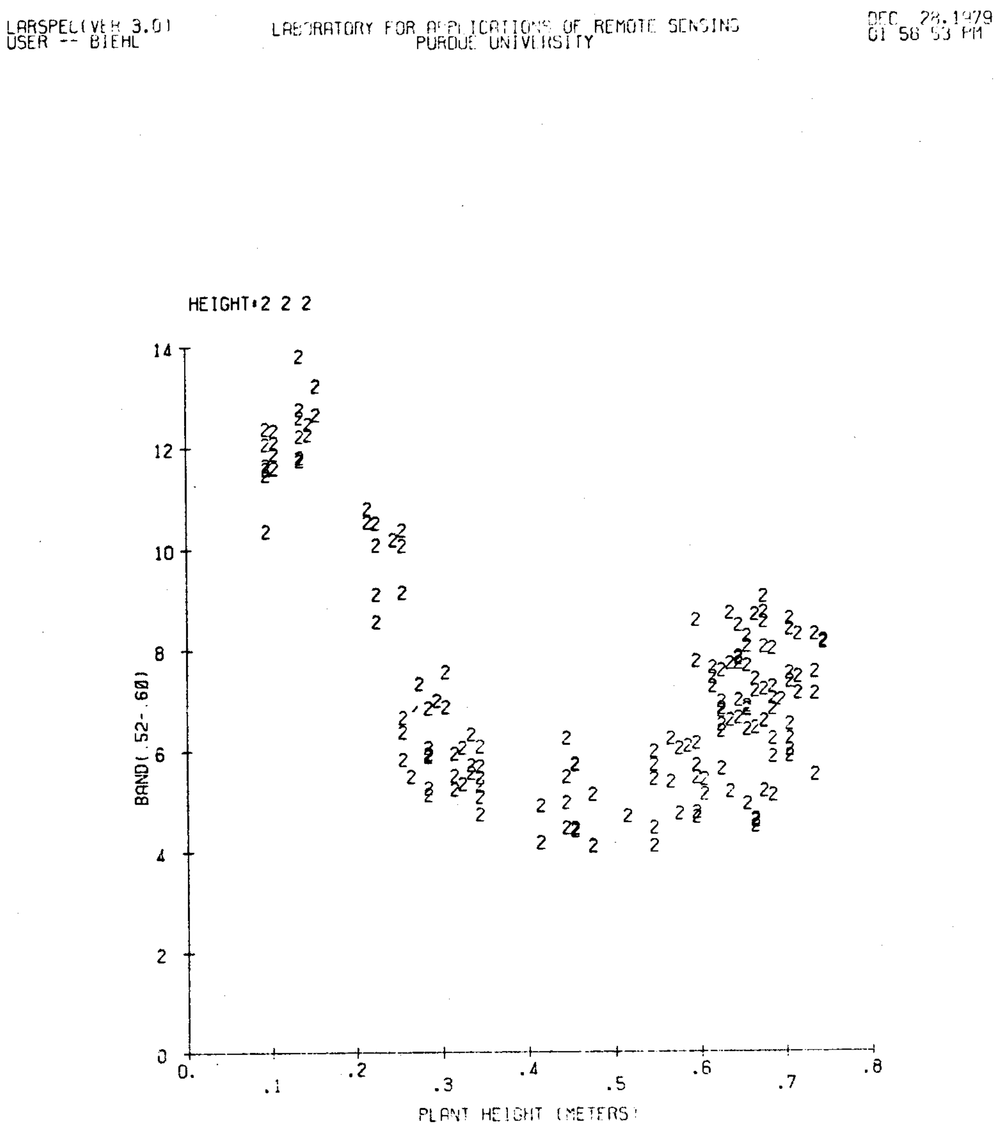

Figure 4.2-27. Graph illustrating use of 'PLOTCLASS' control card.

Set 4

The fourth set of control cards for this example requests that a function (or a different combination) of the originally specified data be plotted.

The 'GRAPH' card indicates that, no classes will be defined. No other information is included on the 'GRAPH' card since the data is not being selected from tape or disk; the data has already been read into the computer. The 'XRDATA' card specifies that the data for the X ordinate be the same data as originally specified for the X ordinate of class 1. The 'YTDATA' card specifies that the Y ordinate data be the ratio of the original data specified for the Y ordinate of class 2 and the Z ordinate of class 1. In other words the data plotted in Figure 4.2-28 represents the ratio of the average responses in the .52-.60 μm band and the .76-.90 μm band versus leaf area index.

The 'XRLABEL' card specifies that the default label should be used. This card 'turns off' the label specified in control card set 3.

Set 5

The fifth set of control cards requests another combination of the originally specified data be plotted. Two classes are specified for this graph.

The 'SELECT' card specifies class cards will be included. No other information is included on the 'SELECT' card since the data is not being read from tape or disk.

The 'XRLABEL' and 'YTLABEL' cards specify the labels for the X and Y axes, respectively.

The 'CLASS' and 'YTDATA' cards specify the data to be used for the Y ordinate for each class. The Y ordinate for the first class is the data originally specified for the Y ordinate of class 3. The Y ordinate for the second class is the data originally specified for the Z ordinate of class 1. Since no 'XRDATA' card is included in this control card set, the 'XRDATA' card from the previous control card set will still be in effect. In other words Figure 4.2-29 represents the plot of the average response for the .63-.69 μm band versus leaf area index for class 1 and plot of the average response for the .76-.90 μm band versus leaf area index for class 2.

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PURDUE UNIVERSITY

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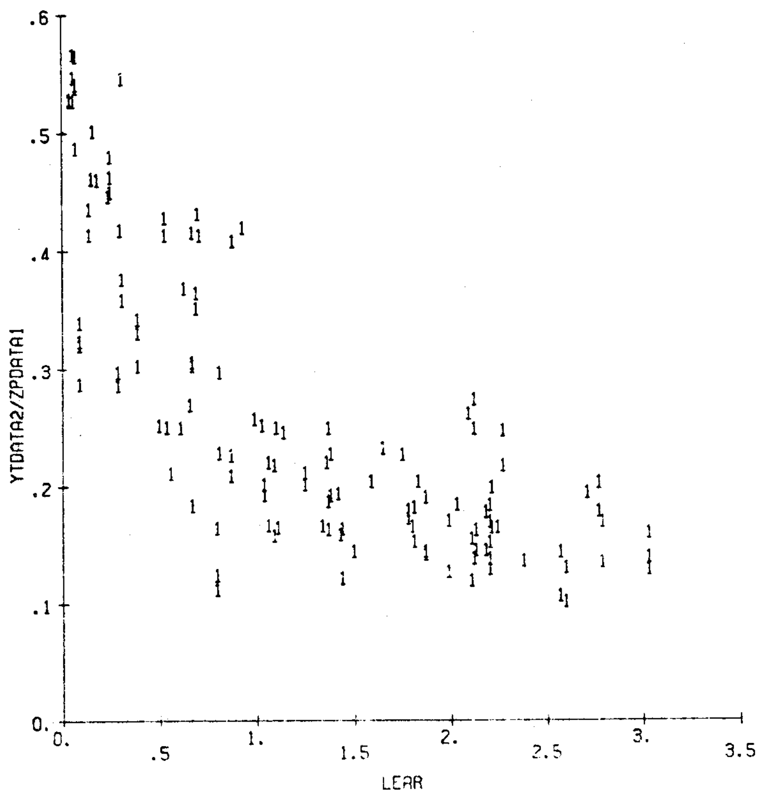


Figure 4.2-28. Graph illustrating ability to graph a function of the originally specified data.

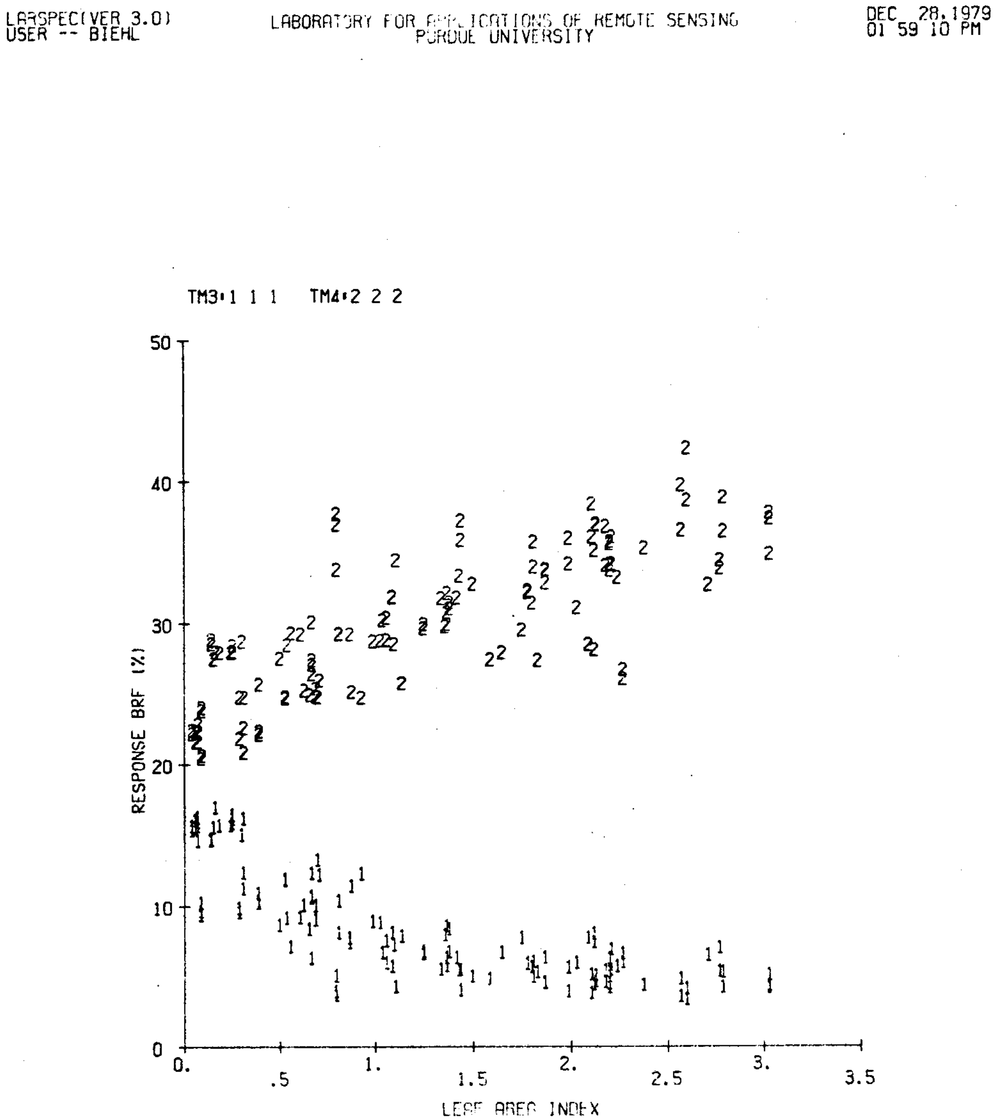


Figure 4.2-29. Graph illustrating ability to graph different combinations of the originally specified data.

GSPEC Example 19

```
        $DISK
        $GSPEC
Set 1   GRAPH   RUSE(1-5)
        OPTIONS SYMBOL(.), NOCONTROLCARD,INTERACTIVE
        OUTPUT TERMINAL
        END
        SELECT  RUSE(45-63)
        OPTI SYMB
        END
        CLASS   SOIL
        SELECT  RUSE(48)
        CLASS   W.WHEAT
Set 2   SELECT  RUSE(49)
        CLASS   OATS
        SELECT  RUSE(63)
        CLASS   S.WHEAT
        SELECT  RUSE(57)
        CLASS   BARLEY
        SELECT  RUSE(59)
        *END
        SELECT  EXNU(77100213), LOF2(1), -DACO(770713)
        LIST NOLIST
        PLOTCLASS 1
        END
        CLASS   LEAR-FA
        SELECT
        XRDATA  LEAR
        YTDATA  BAND(.63-.69)
        CLASS HEIG-FA
        SELECT
        XRDATA  HEIG
Set 3   YTDATA  BAND(.52-.60)
        CLASS   PLCO-FA
        SELECT
        XRDATA  PLCO
        YTDATA  BAND(.76-.90)
        CLASS PLMO-FA
        SELECT
        XRDATA  IRAZ
        YTDATA  BAND(1.55-1.75)
        *END
        $END
        $EXIT
```

This example illustrates the use of the interactive option. The 'interactive' option allows the user to interact with the data specified for a graph before the program 'reads' the data for the next specified graph. The complete control card deck for this example consists of three sets of control cards. Figure 4.2-30 is the output from a terminal session using the above control card deck.

Discussion of Figure 4.2-30 is divided into three major parts representing each control card set. Each major part is further divided according to the interactive commands and output for each interactively specified graph. The commands in lower case are typed by the user. The information in upper case is issued by the computer. The carat (>) indicates that the keyboard is unlocked to receive user commands.

Control Card Set 1

Set 1.1

The first set of control cards specifies that the data is to be read from a disk file, '$DISK'. The 'DDISK' terminal command will need to be used with this control card deck as discussed in section 2.3. 'GRAPH RUSE(1-5)' indicates that the spectral data for the first five observations in the disk file should be graphed separately. The 'OPTIONS' card specifies that the symbol to be used for the graphs is a '.' and that control should be return to the user after the data have been 'read' and plotted for the first graph - 'INTERACTIVE'. The 'NOCONTROLCARD' option specifies that the control cards should not be printed at the line printer for each graph plotted. The 'NOCONTROLCARD' option is useful in reducing the amount of line printer (or Varian) output when several graphs are being plotted in a row. The 'OUTPUT' command specifies that graphs are to be plotted at the user CRT or typewriter terminal.

The first graph for this set, graph 1.1, is the graph of the spectral data for the first observation in the disk file. After the graph was plotted on the terminal, control was returned to the user, so that the user could interact with the data.

Set 1.2

The user entered the special interactive control command 'NEXT' to indicate that the spectral data for the next requested graph should be plotted. In this case the next requested graph is the spectral data for run sequencer 2. The 'NEXT' special interactive control command applies for only response-wavelength type graphs. The next requested graph may be either the long wavelength data (if requested - XRSCALE LW) or the spectral data for the next requested observation.

Set 1.3

The user requested a new scale for the Y axis. The special interactive control command, 'RUN', specifies that a new graph should be plotted using the control instructions as presently defined. In this case the same data as plotted for set 1.2 will be plotted again with the Y axis scaled from 0 to 40. The 'RUN' command specifies that the data to be used should be the same data as used for the previous graph unless new 'GRAPH', 'SELECT', 'XRDATA', 'YTDATA', or 'ZPDATA' specifications were entered.

Set 1.4

The user requested that the output destination for the graph should be the line printer. The 'RUN' command caused the graph that was plotted in set 1.3 to be plotted again; this time it was plotted at the line printer. The '$GSPEC REENTRY' line indicates that the execution of this step has been completed.

Set 1.5

The user requested that the output destination for the graph should be the Varian printer/plotter. Switching the graph destination from either the terminal or the line printer to the Varian printer/plotter causes the present printer file to be closed and a new printer file started for the Varian output. Again, the 'RUN' command starts the execution of the present set of control specifications.

Set 1.6

The output destination for the graph was specified to be the user terminal. When the destination for graphs is changed from the Varian printer/plotter to either the line printer or the terminal the present Varian file is closed and a new printer file started. The user has to specify the location for the new printer file.

The 'OPTIONS NOINTERACTIVE' command specifies that the user does not want to interact with the data in the rest of the graphs to be plotted

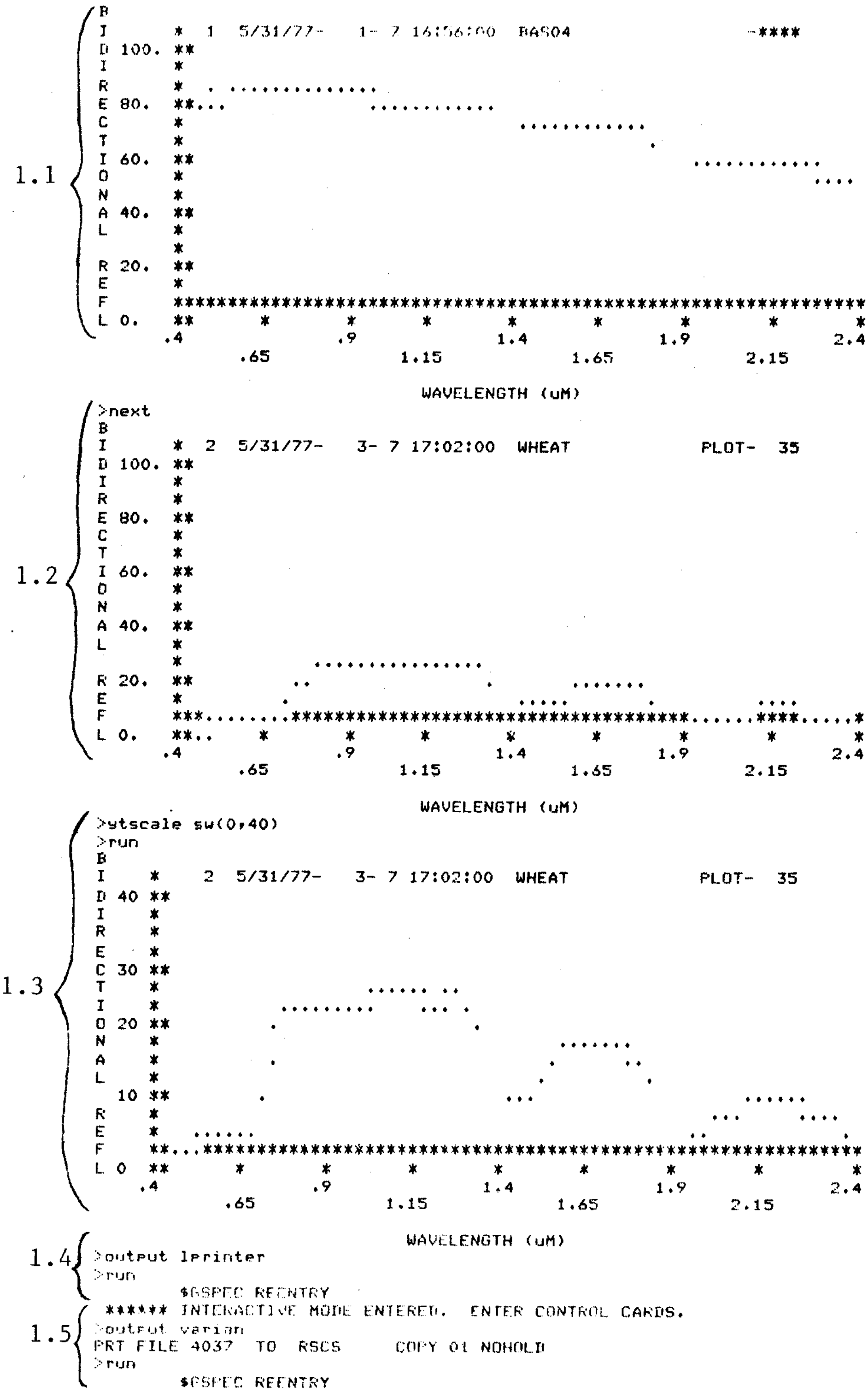
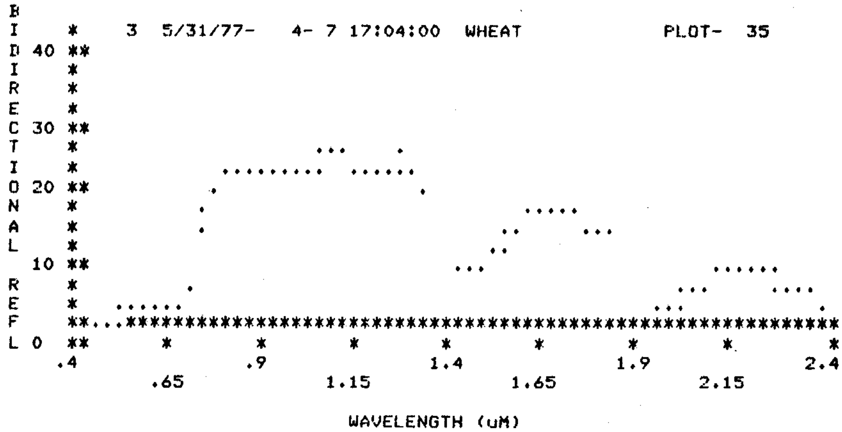
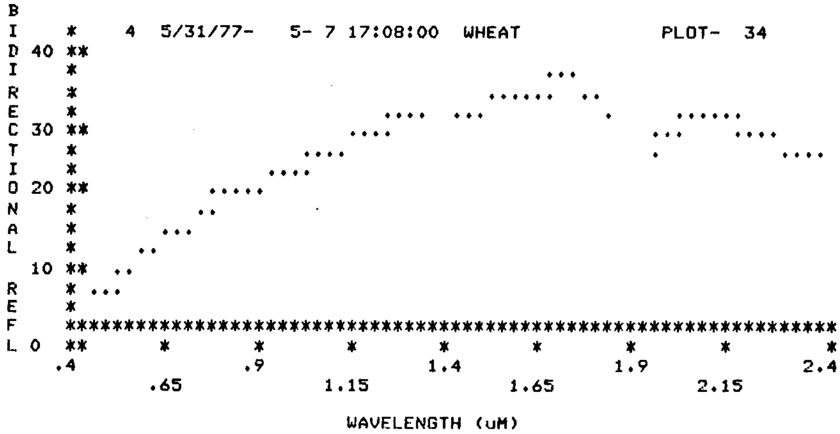


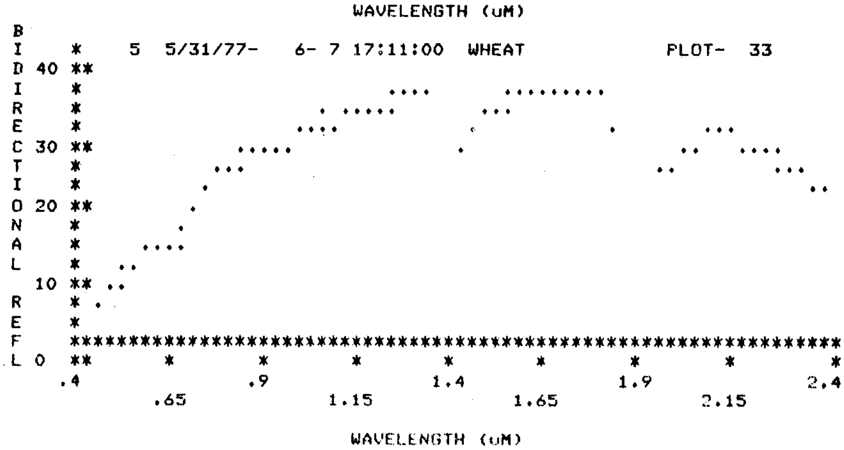
Figure 4.2-30. Example output from a terminal session using the control cards for GSPEC example 19 illustrating the use of the interactive option.

1.6

```
****** INTERACTIVE MODE ENTERED.  ENTER CONTROL CARDS.
>output terminal
TYPE IN PRINTER SITE
>flexlab2
PRINTER SITE IS FLEXLAB2. IS THAT CORRECT? (YES OR NO)
>yes
PRT FILE 4048  TO  RSCS     COPY 01 NOHOLD
>options nointeractive
>next
```








```
$GSPEC REENTRY
```

Figure 4.2-30 (Con't)

for this control card set. The special interactive command 'NEXT' specifies that the spectral data for the next requested graph should be plotted. Note that the data for the next requested graphs, run sequencers 3, 4, and 5, are plotted in sequence without any user interaction. (After the last requested graph is plotted, the interactive option is automatically reinstated. This only occurs if the interactive option was requested in the original control card deck).

This method is an easy way to review data on the terminal. If the user would want to study a graph for a while, he can strike the 'Attention' or 'Break' key at the terminal to place the terminal in CP mode to stop execution. When the user is ready to continue, he enters 'BEGIN' at the terminal to resume execution.

Set 1.7

The special interactive command 'QUIT' was entered to signify that the user was finished with the data as specified by the first control card set and that the next set of control cards should be read.

Control Card Set 2

Set 2.1

The second set of control cards specifies that the average spectral response for five classes of data should be plotted. The global 'SELECT' specifies the data to be used from the disk file - run sequencers 45 through 63. The 'OPTION SYMB' card specifies that the default symbols should be used. The 'CLASS' and class 'SELECT' cards specify the observations to be averaged for each class.

After the graph for this set is plotted, control will be returned to the user so that he may interact with the data.

Set 2.2

The 'PLOTCLASS' command specifies that only classes one and two should be graphed. The special interactive command 'RUN' specifies that the present set of control instructions should be executed as described in set 1.3.

1.7
```
>quit
        $GSPEC REENTRY
```

2.1
```
B
I     *
D 40 **                        444     4355 11115       44444
I     *                       45555   44551111   11    4443534444
R     *                   555555 111  3555             433555555544
E     *                 555 3 111222  4      22222     555       15544
C 30 **               35311222222     5   222     22   5           555
T     *             55552222             22
I     *           5522222              22                    22222
O 20 **          521                   2               22222    22
N     *         51                                     2          2222
A     *      455 2
L     *   4555  2
  10 ** 5532222
R     * 5322
E     * 22
F     ******************************************************************
L 0  **       *       *       *       *       *       *       *       *
     .4              .9              1.4             1.9             2.4
             .65             1.15            1.65            2.15

                          WAVELENGTH (uM)
```

2.2
```
>plotclass 1,2
>run
B
I     *
D 40 **                                       1111
I     *                             1111111   11        1
R     *                        111    1             11111111111
E     *                     111222  1        22222      1         111
C 30 **                 11222222        222     22                  11
T     *               2222             22
I     *          222222              22                      22222
O 20 **         221                  2                 22222    22
N     *        11                                      2          2222
A     *      111 2
L     *    111  2
  10 **   122222
R     * 1122
E     * 22
F     ******************************************************************
L 0  **       *       *       *       *       *       *       *       *
     .4              .9              1.4             1.9             2.4
             .65             1.15            1.65            2.15

                          WAVELENGTH (uM)
```

2.3
```
>graph
>title example of algebraic manipulation
>xrdata xrdata1
>ytdata ytdata1/ytdata2
>ytscale sw(full)
>uset autoscale
>run

      *            EXAMPLE OF ALGEBRAIC MANIPULATION
  2.  **
Y     *         1
T     *                                                11 1      11
D     *          1                                       1111  1111
A 1.5 **          1  11                   111                 111
T     *            11   1                    111    11
A     *                                        1111
1 1.  **                1   1111111111111
/     *                  111 1
Y     *
T     *
D .5  **
A     *
T     *
A     *****************************************************************
2 0.  **      *      *      *      *      *      *      *      *      *
      0.            .5            1.           1.5           2.          2.5
             .25          .75          1.25          1.75         2.25

                            XRDATA1
```

Figure 4.2-30 (con't)

Set 2.3

This set requests that an algebraic function of the data used in set 2.2 be plotted. The 'GRAPH' card designates that no class cards will be used. A title is specified for the graph. The data to be used for the X ordinate is the same data as originally specified for the X ordinate of class one by control card set 2, ie. wavelength. The 'YTDATA' command specifies that data for the Y ordinate should be the ratio of the Y ordinate data originally specified for classes one and two. The 'YTSCALE' and 'USET' commands specify that the scale for the Y axis should represent the full scale range of the data, SW(FULL), and the axis should have 'nice' numeric labels, AUTOSCALE. The 'RUN' command specifies that execution of the control instructions should begin.

Set 2.4

The special interactive command 'PRINT' causes the current set of control instructions to be printed at the terminal in the form of control cards. The control cards printed at the terminal do not exist physically; they just communicate to the user what the current control instructions are.

The 'TITLE' card specifies that the default title, if any, should be used. The 'USET' command indicates that no USET options should be included in the control instructions.

The special interactive command 'QUIT' signifies that the user is completed with the data specified by control card set 2, and that the next set of control cards should be read.

Control Card Set 3

Set 3.1

The third set of control cards specify four classes of band average and identification information to be plotted.

The global 'SELECT' card specifies the observations to be used from the disk file. The 'LIST' card specifies that no identification information should be printed for each selected observation. The

2.4

```
>print
  *
     GRAPH
     XRDATA XRDATA1
     YIDATA YIDATA1/YTDATA2
     USET      AUTO,
     TITLE     EXAMPLE OF ALGEBRAIC MANIPULATION\
     OPTIONS   NOPRINT , NOSTD    , NOPUNCH , INTERACTIVE , FULLBAND    ,
     OPTIONS   GRAPH    , NOTPLOT , NOCONTPOLCRD, DRAWGRAPH   ,
     OPTIONS   TAPE(  20,
     PLOTCLASS  1,
     XRSCALE   SW(      0.40,      2.40, 2.)
     YTSCALE   SW(      0.96,      1.85)
     OPTIONS   SYMBOLS 1,
     OPTIONS   LINES        77.,
     OPTIONS   SIZEGRAPH (  0.0, 8.0, 0.0, 5.0 )
     OUTPUT    TERMINAL
     END
>title
>uset
>quit
        $GSPEC REENTRY
```

3.1

```
     *
  20 **
     *
B    *
A    *1 111
N 15 111111
D    *           1
(    *    1   1  11   1
. 10 **   1 1    1   1
6    *1   1 1  111 1
3    *        1  1 1 1 1 1    1      1     1
-    *         1     1  11 1  1    1       1 11       11
. 5  **          1      11   111     111 111111        11
6    *             1     1     11 1   11 1 111  1   1   1   1
9    *             1                                1
)    ******************************************************************
  0  **       *        *         *        *        *        *        *
    0.                1.                 2.                3.
             .5                1.5                2.5               3.5

                                   LEAR
```

3.2

```
>plotclass 2
>run

     *
  15 **
     *          2
B    *          22
A    *      22  2
N    *      22        2
D 10 **     2         2222
(    *                 2 2                              2  2
.    *                 2                             2 222222 2222
5    *                   2 222                       2 2222222
2    *                   2  2 2222       22      22222 22 222 2
- 5  **                   2 2 2222    2  2 2  2  222 22 2 222   2
.    *                                2  222     2         2
6    *
0    *
)    ******************************************************************
  0  **      *       *       *       *        *       *       *       *
    0.              .2              .4               .6              .8
            .1              .3               .5              .7

                                   HEIG
```

Figure 4.2-30 (con't)

'PLOTCLASS' card specifies that only the first class should be graphed. The 'CLASS' and class 'XRDATA' and 'YTDATA' cards specify the data to be used for each class. The class 'SELECT' cards override the class 'SELECT' cards used in control card set 2. In other words, no class 'SELECT' cards are desired.

After the graph for this set is plotted, control will be returned to the user so that he may interact with the data.

Set 3.2

The 'PLOTCLASS' command for this set designates that only the data for class two should be plotted. The special interactive command 'RUN' specifies that the present set of control instructions should be executed as described in set 1.3.

Set 3.3

This set defines a graph of a different combination of data. The 'GRAPH' command designates that no class cards will be used. The 'XRDATA' and 'YTDATA' commands specify the data to be used for the X and Y ordinates of the graph, respectively. In other words the average response from .52-60 μm will be plotted versus leaf area indices. The 'RUN' command specifies that execution of the control instructions should begin.

Set 3.4

This set defines a graph of another combination of data. This is a graph of the average response from .76-.90 μm versus leaf area index.

Note that in this set and subsequent sets, abbreviations are used for the control commands and special interactive commands. Control card commands may be abbreviated to first four characters; special interactive commands may be abbreviated to first character.

Set 3.5

This set defines a graph of a function of the originally defined data and a curve fit through the data points. The 'SELECT' command designates that class cards will be used. The 'XRDATA' and 'YTDATA' commands specify

3.3

```
>graph
>xrdata xrdata1
>ytdata ytdata2
>run

     *
  15 **
     1
B    *  11
A    111 11
N    11          1
D 10 *1       1  11  11
(    *    1     11
.    *    1 1    1 1
5    *1   1 1 111      1 1    1            1 1         1
2    *1   1    1 1 1 1  11 1  11   1 111 11 111       111
- 5  **          1 1    11   111  1  111   1111 1   1   1   1
.    *             1           11        1 1 1      1
6    *
0    *
)    *******************************************************************
  0  **       *        *         *        *        *        *         *
    0.                1.                  2.                3.
             .5                 1.5                2.5               3.5

                                   LEAR
```

3.4

```
>ytda ytda3
>r

     *
  50 **
     *
B    *                                              1
A 40 **                                             1   1
N    *             1           1      1  1 111      1   1   1
D    *             1     1    111    111 1 1111 1     11    1
( 30 **1       111 1 1 111 1 111     11   1
.    1 1111 1 11 11    1 1        11  1    1  1
7    11   1 1 1 11   11
6 20 11   1
-    *
.    *
9 10 **
0    *
)    *******************************************************************
  0  **       *        *         *        *        *        *         *
    0.                1.                  2.                3.
             .5                 1.5                2.5               3.5

                                   LEAR
```

Figure 4.2-30 (con't)

3.5

```
>sele
>xrda xrda2
>ytda ytda2/ytda1
>xrla leaf area index
>ytla .52-.60/.63-.69
>find 1
     CLASS NUMBER   1 WILL BE EDITED.
     CLASS      LEAF-FA
>class  data
>find 2
     CLASS NUMBER   2 WILL BE EDITED.
     NEW CLASS, SUPPLY CLASS NAME.
>class  curvfit
>uset fitpolynomial
>upset polynomialdegree(1)
>p
     SELE
     XRDA XRDA2
     YTDA YTDA2/YTDA1
     XRLABEL  LEAF AREA INDEX
     YTLABEL  .52-.60/.63-.69
     OPTIONS  NOPRINT , NOSTD    , NOPUNCH , INTERACTIVE , FULLBAND    ,
     OPTIONS  GRAPH    , NOTPLOT , NOCONTROLCRD, DRAWGRAPH    ,
     OPTIONS  TAPE(  20,
     PLOTCLASS  1, 2,
     XRSCALE  SW(     0.02,      3.01, 2.)
     YTSCALE  SW(    18.51,     41.89)
     OPTIONS  SYMBOLS 1, 2,
     OPTIONS  LINES       77.,        92.,
     OPTIONS  SIZEGRAPH (  0.0, 8.0, 0.0, 5.0 )
     OUTPUT   TERMINAL
     END
 ** HIT RETURN FOR CLASS INFORMATION
>

     CLASS    DATA
  *
     CLASS    CURVFIT
     USET     FITP,
     UPSET    POLY(    1.00),
     *END
>r

      *             R2= 0.0828     Y=    1.027+  -0.268X1
  1.5 **
.     *                      1      1
5     *                  1    1      1 1  1
2     *                  1  1 1        1      1
-     *                11     11       11 1  1 1  11     1
. 1.  **      ................1 11              111  1  11 1
6     *                11 1  .............................1 1 1
0     *       11 111     11                             1  .......
/     *       1                                     1 11 1 1 1 1
.     *                                                 1111  1
6 .5  **
3     *
-     *
.     *
6     *********************************************************************
9 0.  **      *       *       *       *       *       *       *       *
     0.              .2              .4              .6              .8
              .1              .3              .5              .7

                           LEAF AREA INDEX
```

Figure 4.2-30 (con't)

the data to be used for the X and Y ordinates for each class, respectively. User supplied alphanumeric labels are given for the X and Y axes.

The special interactive command 'FIND' allows the user to define the class environment that is to be entered. 'FIND 1' specifies that the class one environment should be entered. Any commands, such as 'CLASS', entered after the 'FIND' command will apply for the designated class. 'FIND 2' specifies that the class two environment should be entered. A class name is given for class 2 and 'USET' and 'UPSET' options are given for class 2. The USET and UPSET options specify that a polynomial curve of one degree should be fit through the designated points and plotted.

The special interactive command 'P' or 'PRINT' causes the present set of control instructions to be printed at the terminal in the form of control cards. This allows the user to review the control instructions. The '*' above 'CLASS CURVEFIT' indicates the class environment that the user is presently in. (To go back to the global environment, the user may enter 'FIND 0').

The 'R' or 'RUN' command causes the present set of control instructions to be executed.

Set 3.6

The special interactive command 'F' or 'FIND' allows the user to enter the class 2 environment. The degree of the polynomial curve fit is specified as 2. The 'R' or 'RUN' command causes this altered set of control instructions to be executed.

Set 3.7

The special interactive command 'Q' or 'QUIT' signifies that the user is completed with the data specified by control card set 3 and that the next set of control cards should be read. Execution of this job is completed when the '$END' and '$EXIT' control commands are read.

3.6

```
>f     2
     CLASS NUMBER   2 WILL BE EDITED.
     CLASS      CURVFIT
>upset poly(2)
>r

      *      R2= 0.4980    Y=   0.490+   3.151X1+  -4.039X2
  1.5 **
.     *                         1      1
5     *                     1    1     1 1  1
2     *                     1  1 1        1      1
-     *                   11...................1 1  11     1
. 1.  **              .......11 11            ........  1  11 1
6     *          ......11 1              1       1  1.....1 1 1 1
0     *      1....1     11                              1.....11 1
/     *      .                                       1 11 1 1....
.     *                                                  1111  1..
6 .5  **
3     *
-     *
.     *
6     *****************************************************************
9 0.  **      *       *       *       *       *       *       *       *
     0.              .2              .4              .6              .8
             .1              .3              .5              .7

                              LEAF AREA INDEX
```

3.7

```
>q
        $GSPEC REENTRY
 ****** $END
 ****** $EXIT
 ****** JOB COMPLETED.  CORRECT CONTROL CARD ERRORS (IF ANY) IF YOU WISH
 TO REUSE DECK.
PRT FILE 4053  TO  RSCS      COPY 01 NOHOLD
T=17.63/24.42 08:39:21
```

Figure 4.2-30 (con't)

4.3 Example IDLIST Control Card Decks and Output Descriptions

The capabilities of the IDLIST processor include printing and punching identification information and copying data observations from tape to disk. The capabilities of IDLIST are illustrated by the control card deck examples and associated output which are described in this section. Table 4.3-1 lists the major IDLIST capabilities and identifies the example decks which illustrate a use of that capability.

The examples include a few combinations of control card instructions. However, the examples are not inclusive as to all the combinations possible. Table 4.3-2 identifies the page on which each example is discussed.

Table 4.3-1. Major IDLIST capabilities and the example decks which illustrate those capabilities.

Capabilities (and control cards)	Example Decks
Data specifications:	
Specify desired observations (SELECT; OPTIONS TAPE)	1,2,3,4
Output specifications:	
Punch identification record information (CASES)	3
Print identification record information (LIST)	1,2,3
Copy observations from tape to disk (OPTIONS COPYDISK)	4

Table 4.3-2 Reference page numbers for each IDLIST example deck.

Example Deck	Page
1	4.3-4
2	4.3-6
3	4.3-9
4	4.3-12

IDLIST Example 1

```
$TAPE 4290
$IDLIST
SELECT RUSE (1-20)
LIST ONELINE
END
$END
$EXIT
```

In this example the user specifies a listing in one-line format of the identification information for selected observations 'LIST ONELINE' (Figure 4.3-1.) The 'LIST ONELINE' option is the default and therefore does not need to be included in the control cards.

The 'SELECT RUSE(1-20)' command specifies that all observations between run sequence 1 and 20 should be selected from tape 4290.

)   )   )

*** LISTING OF FIELD SPECTRORADIOMETER DATA ON TAPE 4290 ***

RUN SEQ	COLLECT DATE	OBSRVTN NUMBER	SERIAL NUMBER	COLLEC TIME	EXPERIMT NUMBER	EXPERIMENT NAME	LOCATION	CROP SPECIES (C) SOIL SERIES (S) SCENE TYPE (T)	PLOT/ FIELD NO.	INSTRUMT NAME	DATA TAKEN
1	9/21/76	921269	76326900	182000	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	235 F	FSS	RF/TH
2	9/21/76	921270	76327000	182000	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C CORN	232 F	FSS	RF/TH
3	9/21/76	921271	76327100	182100	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C GRASS FOR HAY	221 F	FSS	RF/TH
4	9/21/76	921272	76327200	182200	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C OTHER GRASS PAST	211 F	FSS	RF/TH
5	9/21/76	921273	76327300	182200	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	210 F	FSS	RF/TH
6	9/21/76	921274	76327400	182200	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	209 F	FSS	RF/TH
7	9/21/76	921275	76327500	182300	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	207 F	FSS	RF/TH
8	9/21/76	921276	76327600	182300	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	283 F	FSS	RF/TH
9	9/21/76	921277	76327700	182400	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	199 F	FSS	RF/TH
10	9/21/76	921278	76327800	182400	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	196 F	FSS	RF/TH
11	9/21/76	921279	76327900	182500	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	195 F	FSS	RF/TH
12	9/21/76	921280	76328000	182600	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C NATIVE GRASS PAS	194 F	FSS	RF/TH
13	9/21/76	921281	76328100	182600	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C OATS	280 F	FSS	RF/TH
14	9/21/76	921282	76328200	182700	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C NATIVE GRASS PAS	191 F	FSS	RF/TH
15	9/21/76	921283	76328300	182700	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C SPRING WHEAT	197 F	FSS	RF/TH
16	9/21/76	921284	76328400	182800	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	198 F	FSS	RF/TH
17	9/21/76	921285	76328500	182900	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	269 F	FSS	RF/TH
18	9/21/76	921286	76328600	183000	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	208 F	FSS	RF/TH
19	9/21/76	921287	76328700	183000	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	212 F	FSS	RF/TH
20	9/21/76	921288	76328800	183100	76102227	INTENSIVE SITE	HAND CO. S. DAK.	C WINTER WHEAT	223 F	FSS	RF/TH

Figure 4.3-1. A oneline listing of the first 20 observations on tape 4290.

IDLIST Example 2

```
$TAPE 4290
$IDLIST
SELECT RUSE(2)
LIST ALL
END
$END
$EXIT
```

In this example, the user requests that all available identification information should be printed for a selected observation. 'SELECT RUSE(2)' specifies that only run sequence 2 on tape 4290 is desired. 'LIST ALL' specifies that all identification parameters that contain information should be printed, Figure 4.3-2. Figure 4.3-3 illustrates the output from the same run sequence number but with a 'LIST ALL, NOSUPRES' option. The 'LIST ALL, NOSUPRES' lists all identification header parameters, even those which have no (or null) data values. The null data values are denoted by asterisks.

••• LISTING OF FIELD SPECTRORADIOMETER DATA ON TAPE 4290 •••

RUN SEQUENCER	2	DATE DATA COLLECTED	9/21/76
DAY OF YEAR	265	OBSERVATION NUMBER	921270
SERIAL NUMBER	76327000	TIME DATA COLLECTED	182000
EXPERIMENT NUMBER	76102227	EXPERIMENT NAME	INTENSIVE SITE
PRINCIPAL INVESTIGATOR	MARVIN BAUER	SCENE TYPE	CORN STUBBLE
LOCATION	HAND CO. S. DAK.	AIR TEMPERATURE (DEGREES C).......	20.1
BAROMETRIC PRESSURE (MM HG)......	770.8	RELATIVE HUMIDITY (PERCENT).......	45.4
WIND SPEED (KILOMETERS/HOUR)........	11	WIND DIRECTION (DEGREES)..........	31
REFORMATTING DATE	3/21/79	REFORMATTING CALIBRATION CODE	3
LATEST ID UPDATE DONE ..	3/21/79	NUMBER OF SAMPLE GROUPS	2
REFLECTIVE CALIBRATION OBS 1 ..	7601225	DISTANCE TO GROUND (METERS)......	60.96
LOCATION LATITUDE	0443000N	LOCATION LONGITUDE	0990000W
FLIGHT LINE	1R1	PHOTOGRAPH SERIAL NO ..	70RF 76-104
NUMBER OF PHOTOGRAPH ROLL	188	PHOTOGRAPH FRAMES	71-76
LEVELS OF FACTOR 4	6	LEVELS OF FACTOR 6	11
FIELD NUMBER	232	FIELD AREA (HECTARES)	32.214
REPLICATION NUMBER	11	SPECIES	CORN
MATURITY STAGE	DOES NOT APPLY	PERCENT GROUND COVER	10
WEEDY	NO	MOISTURE CONTENT (FIELD)	DRY
SURFACE CONDITION	STANDING STUB	EXPERIMENTER'S PARAMETER 03	0.2300
EXPERIMENTER'S PARAMETER 04	0.1700	EXPERIMENTER'S PARAMETER 05	0.1900
EXPERIMENTER'S PARAMETER 06	0.0900	EXPERIMENTER'S PARAMETER 08	0.1400
EXPERIMENTER'S PARAMETER 09	0.0	DATA QUALITY FACTOR 1	(0.55, 0.1043)
DATA QUALITY FACTOR 2	(0.65, 0.1010)	DATA QUALITY FACTOR 3	(1.05, 0.3201)
DATA QUALITY FACTOR 4	(1.67, 0.4255)	DATA QUALITY FACTOR 5	(2.22, 0.2669)
DATA QUALITY FACTOR 7	(9.75, 23.2551)	FACILITY NAME	NASA - JSC
INSTRUMENT NAME	AIRBORNE FSS	SCAN RATE	1.00
FIELD OF VIEW (DEGREES)..........	20.00		
STRESS COMMENTS -- SLIGHT			

DETECTOR NAME	DETECTOR RANGE	DETECTOR EQUILIZATION	NUMBER OF SAMPLES	WAVE BAND COEFFICIENTS A	B	C	D	SAMPLE GROUP
	0.0	0.0	206	0.3400	0.0100	0.0	0.0	1
	0.0	0.0	227	2.6500	0.0500	0.0	0.0	4

Figure 4.3-2. Listing of all ID header parameters that have data values for run sequence number 2.

*** LISTING OF FIELD SPECTRORADIOMETER DATA ON TAPE 4290 ***

RUN SEQUENCER	2	DATE DATA COLLECTED	9/21/76
DAY OF YEAR	265	OBSERVATION NUMBER	921270
SERIAL NUMBER	76327000	TIME DATA COLLECTED	182000
EXPERIMENT NUMBER	76102227	EXPERIMENT NAME	INTENSIVE SITE
PRINCIPAL INVESTIGATOR	MARVIN BAUER	SCENE TYPE	CORN STUBBLE
LOCATION	HAND CO. S. DAK.	AIR TEMPERATURE (DEGREES C).......	20.1
BAROMETRIC PRESSURE (MM HG)......	770.8	RELATIVE HUMIDITY (PERCENT).......	45.4
CLOUD COVER (PERCENT)...............	***	WIND SPEED (KILOMETERS/HOUR).........	11
VISIBILITY (KILOMETERS).............	***	CLOUD TYPE AND ALTITUDE	****************
WIND DIRECTION (DEGREES)...........	31	WET BULB TEMPERATURE (DEGREES C)...	****
REFORMATTING DATE	3/21/79	REFORMATTING CALIBRATION CODE	3
LATEST ID UPDATE DONE ..	3/21/79	NUMBER OF SAMPLE GROUPS	2
REFLECTIVE CALIBRATION OBS 1 ..	7601225	REFLECTIVE CALIBRATION OBS 2	****
CALIBRATION TABLE NUMBER	***	ILLUMINATION	********
THERMAL CALIBRATION OBSERVATION1 ..	****	THERMAL CALIBRATION OBSERVATION2 ..	****
IRRADIANCE ZENITH ANGLE (DEGREES)...	***	IRRADIANCE AZIMUTH ANGLE (DEGREES)..	***
VIEW ZENITH ANGLE (DEGREES).........	***	VIEW AZIMUTH ANGLE (DEGREES)........	***
DISTANCE TO GROUND (METERS)......	60.96	FOCAL DISTANCE (METERS)...........	*****
LOCATION LATITUDE	0443000N	LOCATION LONGITUDE	0990000W
FLIGHT LINE	1R1	PHOTOGRAPH SERIAL NO ..	70RF 76-104
NUMBER OF PHOTOGRAPH ROLL	188	PHOTOGRAPH FRAMES	71-76
ID RECORD TYPE(=1 CROPS,=2 SOILS) ...	**	LEVELS OF FACTOR 1	*****
LEVELS OF FACTOR 2	*****	LEVELS OF FACTOR 3	*****
LEVELS OF FACTOR 4	6	LEVELS OF FACTOR 5	*****
LEVELS OF FACTOR 6	11	LEVELS OF FACTOR 7	*****
LEVELS OF FACTOR 8	*****	FIELD NUMBER	232
FIELD AREA (HECTARES)	32.214	PLOT NUMBER	*****
REPLICATION NUMBER	11	SPECIES	CORN
VARIETY	****************	MATURITY STAGE	DOES NOT APPLY
MATURITY STAGE (NUMERICAL)	*****	ROW WIDTH (METERS)	*****
ROW DIRECTION	****	PLANTING DATE	*********/**/**
DAYS SINCE PLANTING	****	PLANT COUNT (PER SQ. METER)	*******
FRUIT COUNT (PER SQ. METER)	*******	PLANT HEIGHT (METERS).............	*****
LEAVES PER PLANT	****	LEAF CONDITION- GREEN (PERCENT)	***
LEAF CONDITION- YELLOW (PERCENT) ...	***	LEAF CONDITION- BROWN (PERCENT)	***
PERCENT GROUND COVER	10	DRY BIOMASS - TOTAL (G/SQ. M)..	********
DRY BIOMASS - GR LEAVES(G/SQ. M)	********	DRY BIOMASS - YE LEAVES(G/SQ. M)	********
DRY BIOMASS - BR LEAVES(G/SQ. M)	********	DRY BIOMASS - STEMS (G/SQ. M) .	********
DRY BIOMASS - FRUIT (G/SQ. M) .	********	DRY BIOMASS - WEEDS (G/SQ. M) .	********
FRESH BIOMASS - TOTAL (G/SQ. M)	********	PLANT MOISTURE (PERCENT)	***
PLANT MOISTURE WEIGHT (G/SQ. M)	********	LEAF AREA INDEX	*****
CROP YIELD (KG/HA)	********	GRAIN TEST WEIGHT (KG/HECTILITER)	******
GRAIN MOISTURE CONTENT (PERCENT) ..	****	MOISTURE STRESS	****
NUTRIENT DEFICIENCY	****	WEEDY	NO
DISEASE INFECTION	****	INSECT INFECTION	****
HAIL OR WIND DAMAGE	****	LODGING DAMAGE	****
OTHER STRESS	****	SOIL SERIES NAME	****************
SAND CONTENT (PERCENT)	******	SILT CONTENT (PERCENT)	******
CLAY CONTENT (PERCENT)	******	SOIL TEXTURE	****************
MUNSELL COLOR	****************	MOISTURE CONTENT (FIELD)	DRY
MOISTURE CONTENT (LABORATORY) ...	******	SURFACE CONDITION	STANDING STUB
DRAINAGE CLASS	****	SOIL HORIZON..................	********
TARGET TEMPERATURE (DEGREES C)...	******	RADIANT TEMPERATURE (DEGREES C)....	****
TARGET WIDTH (METERS)............	******	TARGET LENGTH (METERS)...........	******
EXPERIMENTER'S PARAMETER 01	*************	EXPERIMENTER'S PARAMETER 02	*************
EXPERIMENTER'S PARAMETER 03	0.2300	EXPERIMENTER'S PARAMETER 04	0.1700
EXPERIMENTER'S PARAMETER 05	0.1900	EXPERIMENTER'S PARAMETER 06	0.0900
EXPERIMENTER'S PARAMETER 07	*************	EXPERIMENTER'S PARAMETER 08	0.1400
EXPERIMENTER'S PARAMETER 09	0.0	EXPERIMENTER'S PARAMETER 10	*************
DATA QUALITY FACTOR 1	(0.55, 0.1043)	DATA QUALITY FACTOR 2	(0.65, 0.1010)
DATA QUALITY FACTOR 3	(1.05, 0.3201)	DATA QUALITY FACTOR 4	(1.67, 0.4255)
DATA QUALITY FACTOR 5	(2.22, 0.2669)	DATA QUALITY FACTOR 6	(*****,********)
DATA QUALITY FACTOR 7	(9.75, 23.2551)	FACILITY NAME	NASA - JSC
INSTRUMENT NAME	AIRBORNE FSS	INSTRUMENT TYPE (=1 RADIOMETER)	**
SCAN RATE	1.00	HIGH SQUARE WAVE LEVEL (VOLTS)...	******
LOW SQUARE WAVE LEVEL (VOLTS)....	******	FIELD OF VIEW (DEGREES)...........	20.00

STRESS COMMENTS -- SLIGHT

DETECTOR NAME	DETECTOR RANGE	DETECTOR EQUILIZATION	NUMBER OF SAMPLES	WAVE BAND COEFFICIENTS A	B	C	D	SAMPLE GROUP
	0.0	0.0	206	0.3400	0.0100	0.0	0.0	1
	0.0	0.0	227	2.6500	0.0500	0.0	0.0	4

Figure 4.3-3. Output using 'LIST ALL, NOSUPRES' option.

IDLIST Example 3

```
$TAPE 4290
$IDLIST
SELECT DACO(770421, 770510, 770616, 770727), FINU(192, 169, 233, 219)
LIST DACO, SPEC, SCTY, PLDA
CASES AGRONOMIC
END
$END
$EXIT
```

In this example, the user requests that the information for four identification parameters be printed for selected observations and that the set of agronomic parameters should be punched.

The 'SELECT' card specifies that all observations collected on 4/21/77, 5/10/77, 6/16/77, and 7/27/77 in fields 192, 169, 233, and 219 should be used. Only tape 4290 will be searched. The 'LIST' card specifies that only the date data collected, species, scene type, and planting date should be printed (Figure 4.3-4). The 'CASES' card specifies that the agronomic data should be punched, Figure 4.3-5. The first 3 cards of the punch output describe the identification header parameters and format of data values that have been punched. The punch output will be in cards or on disk if the PUNCH terminal command was used as described in section 2.4.

*** LISTING OF FIELD SPECTRORADIOMETER DATA ON TAPE 4290 ***

DATE DATA COLLECTED	4/21/77	SPECIES	GRASS FOR HAY
SCENE TYPE	PASTURE		
DATE DATA COLLECTED	4/21/77	SPECIES	OTHER GRASS PAST
SCENE TYPE	PASTURE		
DATE DATA COLLECTED	4/21/77	SPECIES	UNKNOWN CROPS
SCENE TYPE .... WHEAT	DRYLAND	PLANTING DATE	4/17/77
DATE DATA COLLECTED	4/21/77	SPECIES	WINTER WHEAT
SCENE TYPE .... WHEAT	DRYLAND		
DATE DATA COLLECTED	5/10/77	SPECIES	GRASS FOR HAY
SCENE TYPE	PASTURE		
DATE DATA COLLECTED	5/10/77	SPECIES	OTHER GRASS PAST
SCENE TYPE	SUDAN G		
DATE DATA COLLECTED	5/10/77	SPECIES	SPRING WHEAT
SCENE TYPE .... WHEAT	DRYLAND	PLANTING DATE	4/17/77
DATE DATA COLLECTED	5/10/77	SPECIES	SPRING WHEAT
SCENE TYPE .... WHEAT	DRYLAND		
DATE DATA COLLECTED	6/16/77	SPECIES	GRASS FOR HAY
SCENE TYPE	PASTURE		
DATE DATA COLLECTED	6/16/77	SPECIES	OTHER GRASS PAST
SCENE TYPE	BROME GR		
DATE DATA COLLECTED	6/16/77	SPECIES	SPRING WHEAT
SCENE TYPE .... WHEAT	DRYLAND	PLANTING DATE	4/17/77
DATE DATA COLLECTED	6/16/77	SPECIES	SPRING WHEAT
SCENE TYPE .... WHEAT	DRYLAND		
DATE DATA COLLECTED	7/27/77	SPECIES	GRASS FOR HAY
SCENE TYPE	PASTURE		
DATE DATA COLLECTED	7/27/77	SPECIES	OTHER GRASS PAST
SCENE TYPE	BROME G		
DATE DATA COLLECTED	7/27/77	SPECIES	SPRING WHEAT
SCENE TYPE .... WHEAT	HARVESTD	PLANTING DATE	4/17/77
DATE DATA COLLECTED	7/27/77	SPECIES	SPRING WHEAT
SCENE TYPE .... WHEAT	HARVESTD		

Figure 4.3-4. Listing of specified ID header parameters: DACO, SPEC, SCTY, PLDA.

```
MODULE DATA DECK FOR LARSPEC        ID  DEC  26,1979 08 57 23 AM
DACO,OBNU,SENU,SEQNUM,CLASS,JUDA,TIDA,SCTY,PLNU,RENU,SPEC,VARI,
LOF1,LOF2,LOF3,LOF4,LOF5,LOF6,LOF7,LOF8,ROWI,PLDA,DAPL,MATU,NMAT,HEIG,PEGR,LEAR,
LEPL,PLCO,FRCO,GRLE,YELE,BRLE,PLMO,PMOW,RATE,TATE,YELD,TSWT,GMOS,
DBGL,DBYL,DBBL,DBST,DBFR,DBWE,DBTO,FRBI
I6,I4,I2,I2,I2,I3,I6,4A4,I4,1X,I2,4A4,4A4/16X,8I2,F5.2,I6,I3,4A4,2F5.2,I3,F5.2/
16X,F4.1,2F7.1,3I3,I2,F8.2,F4.1,F5.2,F8.1,F6.2,F4.1/16X,8F8.2
770421 612 0A1  111154800PASTURE             233F10GRASS FOR HAY    GRASS FOR HAY
770421 612 0A2   0 0-9 4-910-9-9-9.00      -9 -9EMERGENCE          -9.00 0.10 10-9.00
770421 612 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770421 612 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770421 617 0A1  111154900PASTURE             219F12OTHER GRASS PASTOTHER GRASS PAST
770421 617 0A2   0 0-9 4-912-9-9-9.00      -9 -9EMERGENCE          -9.00 0.10 10-9.00
770421 617 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770421 617 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770421 629 0A1  111155600WHEAT      DRYLAND 192F22UNKNOWN CROPS    SPRING WHEAT
770421 629 0A2   0 0-9 6-922-9-9-9.00770417  4PLANTED NO EMERG-9.00-9.00 10-9.00
770421 629 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770421 629 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770421 632 0A1  111155900WHEAT      DRYLAND 169F22WINTER WHEAT
770421 632 0A2  -9-9-9 1-920-9-9-9.00      -9 -9PLANTED NO EMERG-9.00 0.05 10-9.00
770421 632 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770421 632 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770510 537 0A1  130180100PASTURE             233F12GRASS FOR HAY    GRASS FOR HAY
770510 537 0A2   0 0-9 4-912-9-9-9.00      -9 -9                   -9.00 0.13 30-9.00
770510 537 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770510 537 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770510 542 0A1  130180200SUDAN G             219F10OTHER GRASS PASTOTHER GRASS PAST
770510 542 0A2   0 0-9 4-910-9-9-9.00      -9 -9DOES NOT APPLY   -9.00 0.18 10-9.00
770510 542 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770510 542 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770510 554 0A1  130181000WHEAT      DRYLAND 192F22SPRING WHEAT     SPRING WHEAT
770510 554 0A2   0 0-9 3-920-9-9-9.00770417 23EMERGENCE          -9.00 0.10 10-9.00
770510 554 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770510 554 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770510 557 0A1  130181200WHEAT      DRYLAND 169F22SPRING WHEAT
770510 557 0A2  -9-9-9 3-917-9-9-9.00      -9 -9EMERGENCE          -9.00 0.10 10-9.00
770510 557 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770510 557 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  17 0A1  167155100PASTURE             233F 9GRASS FOR HAY    GRASS FOR HAY
770616  17 0A2   0 0-9 4-9 9-9-9-9.00      -9 -9FULLY HEADED       -9.00 0.20 30-9.00
770616  17 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  17 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  22 0A1  167155300BROME GR            219F14OTHER GRASS PASTOTHER GRASS PAST
770616  22 0A2   0 0-9 4-914-9-9-9.00      -9 -9FULLY HEADED       -9.00 0.71 30-9.00
770616  22 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  22 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  34 0A1  167155900WHEAT      DRYLAND 192F27SPRING WHEAT     SPRING WHEAT
770616  34 0A2   0 0-9 3-926-9-9-9.00770417 60FULLY HEADED       -9.00 0.81 30-9.00
770616  34 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  34 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770616  37 0A1  167160100WHEAT      DRYLAND 169F25SPRING WHEAT
770616  37 0A2  -9-9-9 3-925-9-9-9.00      -9 -9FULLY HEADED       -9.00 0.48 30-9.00
770616  37 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770616  37 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770727 612 0A1  208171900PASTURE             233F15GRASS FOR HAY    GRASS FOR HAY
770727 612 0A2   0 0-9 4-914-9-9-9.00      -9 -9HARVESTED          -9.00 0.05 10-9.00
770727 612 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770727 612 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770727 617 0A1  208172100BROME G             219F12OTHER GRASS PASTOTHER GRASS PAST
770727 617 0A2   0 0-9 4-912-9-9-9.00      -9 -9RIPE MATURE        -9.00 0.25 10-9.00
770727 617 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770727 617 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770727 629 0A1  208172700WHEAT      HARVESTD 192F25SPRING WHEAT    SPRING WHEAT
770727 629 0A2   0 0-9 6-925-9-9-9.00770417101HARVESTED          -9.00-9.00 10-9.00
770727 629 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770727 629 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
770727 632 0A1  208173000WHEAT      HARVESTD 169F30SPRING WHEAT
770727 632 0A2  -9-9-9 6-926-9-9-9.00      -9 -9HARVESTED          -9.00 0.25 10-9.00
770727 632 0A3  -9.0    -9.0    -9.0 -9 -9 -9-9    -9.00-9.0-9.00       -9.0 -9.00-9.0
770727 632 0A4     -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00    -9.00
*END
```

Figure 4.3-5. Listing of data deck punched on computer cards using CASES AGRONOMIC for certain observations.

IDLIST Example 4

```
$TAPE 3991
$IDLIST
SELECT EXNU(78100802)
LIST NOLIST
OPTIONS COPYDISK
END
$END
$EXIT
```

The user requests, in this example, that the selected observations should be copied from tape to disk.

The 'SELECT' parameter specifies that all observations collected for experiment number 78100802 should be used from tape 3991. The 'LIST' card indicates that no ID listing is wanted. The 'OPTIONS COPYDISK' parameter specifies that the selected observations should be copied to the disk set up by the DDISK terminal command discussed in section 2.3.

5. LARSPEC Identification Record Mnenonic Codes

There are two sets of identification (ID) record parameters presently:

Crops
Soils

Some ID parameters such as observation number and time data collected are in both sets. Other parameters such as leaf area index or cation exchange capacity are specific to one set. Each spectral observation contains either a crop's set of parameters or a soil's set, but not both.

The LARSPEC program is set up to handle additional sets of ID parameters if the work warrants. For example, a set could probably be developed for forestry research.

The ID parameters may be in integer value format, real value format, or alphanumeric format for 4, 8, 16, 40, or 148 characters.

The ID parameters are accessed by the LARSPEC program via four letter codes. The four letter codes are unique to the ID parameter and generally are an abbreviation of the parameters.

The four letter codes or mnemonic codes listed on the following pages are given in three groups:

general header parameter (in both crop's or soil's)
agronomic header parameter (unique to crop's set)
soils header parameter (unique to soil's set)

The codes are listed in alphabetical order within each group.

GENERAL HEADER PARAMETERS

Four Letter Code	Description of Data	Data Type
AITE	Air temperature (^{o}C)	Real
BAPR	Barometric pressure (mmHg)	Real
CAOB	Calibration observation number	Integer
CATN	Calibration table number	Integer
CLCO	Cloud cover (%)	Integer
CLTY	Cloud type and altitude	Alphanumeric(4A4)
COB2	Reflective calibration observation 2	Integer
COMM	Comments	Alphanumeric(37A4)
DACO	Date data collected (yymmdd)	Integer
DADA	Day data collected	Integer
DIGR	Distance to ground (meters)	Real
DQF1	Data quality factor 1	Real
DQF2	Data quality factor 2	Real
DQF3	Data quality factor 3	Real
DQF4	Data quality factor 4	Real
DQF5	Data quality factor 5	Real
DQF6	Data quality factor 6	Real
DQF7	Data quality factor 7	Real
EP01	Experimenters parameter 01	Real
EP02	Experimenters parameter 02	Real
EP03	Experimenters parameter 03	Real
EP04	Experimenters parameter 04	Real
EP05	Experimenters parameter 05	Real
EP06	Experimenters parameter 06	Real
EP07	Experimenters parameter 07	Real
EP08	Experimenters parameter 08	Real
EP09	Experimenters parameter 09	Real
EP10	Experimenters parameter 10	Real
EP11	Experimenters parameter 11	Real
EP12	Experimenters parameter 12	Real
EP13	Experimenters parameter 13	Real
EXNA	Experiment name	Alphanumeric (4A4)
EXNU	Experiment number	Integer
FANA	Facility name	Alphanumeric (4A4)
FIVI	Field of view(degrees)	Real
FLLI	Flight line	Alphanumeric (2A4)
FOCA	Focal distance (meters)	Real
HISQ	High square wave voltage	Real
INNA	Instrument name	Alphanumeric (4A4)
IRAZ	Irradiance azimuth angle (degrees)	Integer
IRZE	Irradiance zenith angle (degrees)	Integer
JUDA	Day of year data collected	Integer
LAID	Latest ID update (yymmdd)	Integer

GENERAL HEADER PARAMETERS (CON'T)

Four Letter Code	Description of Data	Data Type
LOCA	Location	Alphanumeric (4A4)
LOF1	Levels of factor 1	Integer
LOF2	Levels of factor 2	Integer
LOF3	Levels of factor 3	Integer
LOF4	Levels of factor 4	Integer
LOF5	Levels of factor 5	Integer
LOF6	Levels of factor 6	Integer
LOF7	Levels of factor 7	Integer
LOF8	Levels of factor 8	Integer
LOLA	Location latitude	Alphanumeric (2A4)
LOLO	Location longitude	Alphanumeric (2A4)
LOSQ	Low square wave voltage level	Real
MODA	Month data collected	Integer
NUSG	Number of sample groups	Integer
OBNU	Observation number	Integer
PHFR	Photograph frame	Alphanumeric (2A4)
PHRO	Photograph roll number	Integer
PHSE	Photograph serial number	Alphanumeric (4A4)
PRIN	Principal investigator	Alphanumeric (4A4)
RATE	Radiant temperature (°C)	Real
RECA	Reformatting calibration code	Integer
REDA	Reformatting date (yymmdd)	Integer
REHU	Relative humidity (%)	Real
RIFR	ID record type (1=crops, 2=soils)	Integer
RUSE	Run sequence number	Integer
SCRA	Scan rate	Real
SCTY	Scene type	Alphanumeric (4A4)
SENA	Series name	Alphanumeric (4A4)
SENU	Serial number	Integer
TCO1	Thermal calibration observation 1	Integer
TCO2	Thermal calibration observation 2	Integer
TIDA	Time data collected in GMT hours	Integer
VIAZ	View azimuth angle (degrees)	Integer
VISI	Visibility (km)	Integer
VIZE	View zenith angle (degrees)	Integer
WBTE	Wet Bulb temperature (°C)	Real
WIDI	Wind direction	Integer
WISP	Wind speed (km/hr)	Integer
YEDA	Year data collected	Integer

AGRONOMIC HEADER PARAMETERS

Four Letter Code	Description of Data	Data Type
BRLE	Leaf condition-brown (%)	Integer
DAPL	Days since planting	Integer
DBBL	Dry biomass-brown leaves (g/sq.m.)	Real
DBFR	Dry biomass-fruit (g/sq.m.)	Real
DBGL	Dry biomass-green leaves (g/sq. m.)	Real
DBST	Dry biomass-stems (g/sq. m.)	Real
DBTO	Dry biomass-total (g/sq. m.)	Real
DBWE	Dry biomass-weeds (g/sq. m.)	Real
DBYL	Dry biomass-yellow leaves (g/sq. m.)	Real
DIIN	Disease infection (yes or no)	Alphanumeric (A4)
DRCL	Drainage class	Integer
FIAR	Field area (hectares)	Real
FINU	Field number	Integer
FRBI	Fresh biomass-total (g/sq. m.)	Real
FRCO	Fruit count (per square meter)	Real
GMOS	Grain moisture content (percent)	Real
GRLE	Leaf condition-green (%)	Integer
HAWI	Hail or wind damage (yes or no)	Alphanumeric (A4)
HEIG	Height (meters)	Real
HORI	Horizon	Alphanumeric (2A4)
ILLU	Illumination	Alphanumeric (2A4)
ININ	Insect infection (yes or no)	Alphanumeric (A4)
INST	Instrument type (1=radiometer)	Integer
LEAR	Leaf area index	Real
LEPL	Leaves per plant (average number)	Real
LODA	Lodging damage (yes or no)	Alphanumeric (A4)
MATU	Maturity	Alphanumeric(4A4)
MOFI	Moisture (field) content	Alphanumeric(4A4)
MOLA	Moisture (laboratory) content (%)	Real
MOST	Moisture stress (yes or no)	Alphanumeric (A4)
MUCO	Munsell color	Alphanumeric (4A4)
NMAT	Maturity stage (numerical)	Real
NUDE	Nutrient deficiency (yes or no)	Alphanumeric (A4)
OTST	Other stress (yes or no)	Alphanumeric (A4)
PECL	Percent clay content (%)	Real
PEGR	Percent ground cover (%)	Integer
PESA	Percent sand content (%)	Real
PESI	Percent silt content (%)	Real
PLCO	Plant count (per square meter)	Real
PLDA	Planting date (yymmdd)	Integer
PLMO	Plant moisture (%)	Real
PLNU	Plot number	Integer
PMOW	Plant moisture weight (g/sq. m.)	Real
RENU	Replication number	Integer
RODI	Row direction	Alphanumeric (A4)
ROWI	Row width (meters)	Real

Four Letter Code	Description of Data	Data Type
SPEC	Species	Alphanumeric (4A4)
STCO	Stress comments	Alphanumeric (10A4)
SUFO	Surface condition	Alphanumeric (4A4)
TALE	Target length (meters)	Real
TATE	Target temperature (^{o}C)	Real
TAWI	Target width (meters)	Real
TEXT	Texture (field)	Alphanumeric(4A4)
TSWT	Grain test weight (kg/hectiliter)	Real
VARI	Variety	Alphanumeric(4A4)
WEED	Weedy (yes or no)	Alphanumeric (A4)
YELD	Yield (kg/ha)	Real
YELE	Leaf conditions-yellow(%)	Integer

SOILS HEADER PARAMETERS

Four Letter Code	Description of Data	Data Type
ACTI	Activity	Integer
ALUM	Aluminum oxide (%)	Real
ASHO	AASHO soil classification	Alphanumeric (2A4)
AVPH	Available Phophorous (kg/ha)	Integer
AVPO	Available Potassium (kg/ha)	Integer
BASA	Base saturation (%)	Integer
BUDE	Bulk density (g/sq. m.)	Real
BUPH	Buffer ph	Real
CAEX	Cation exchange capacity	Real
CALC	Calcium (meq/100g)	Real
CHRO	Munsell color chrome (moist)	Real
CLAY	Clay content (%)	Real
COCO	County code	Integer
COIN	Compression index	Real
COPA	Contrasting particle size class	Integer
COSA	Coarse sand (%)	Real
COSI	Coarse silt (%)	Real
CSNU	Conservative sampling number	Integer
DRCL	Drainage class	Integer
ELCO	Electrical conductivity (mmhos/cm)	Real
ELNU	Engineering lab number	Integer
ERFA	Erosion factor (k)	Real
EROS	Erosion phase	Integer
EXAC	Extractable acidity (meq/100 g)	Real
FINE	Fines	Real
FISA	Fine sand (%)	Real
FISI	Fine silt (%)	Real
FSAN	Fine sand (%)	Real
GRGR	Great group	Alphanumeric(2A4)
HORI	Horizon	Alphanumeric (2A4)
HUE1	Munsell color hue 1(moist)	Real
HUE2	Munsell color hue 2(moist)	Alphanumeric (A4)
IRON	Iron oxide (%)	Real
LIIN	Liquidity index	Integer
LILI	Liquid limit	Integer
LISH	Linear shrinkage	Real
MAGN	Magnesium (meq/100 g)	Real
MANG	Manganese oxide (%)	Real
MESA	Medium sand (%)	Real
MICL	Mineralogy class	Integer
MOTE	Soil moisture tension (bars)	Real
MSAN	Medium sand (%)	Real
MSNU	Multiple sampling number	Integer
MUCO	Munsell color (moist)	Alphanumeric (4A4)
OMOD	Other modifiers	Integer
ORCA	Organic carbon (%)	Real

SOILS HEADER PARAMETERS (CON'T)

Four Letter Code	Description of Data	Data Type
ORDR	Order	Alphanumeric (A4)
PAMA	Parent Material	Integer
PASI	Particle size class	Integer
PHYS	Physiographic position	Integer
PLIN	Plasticity index	Integer
PLLI	Plastic limit	Integer
POTA	Potassium (meq/100g)	Real
SAND	Sand content (%)	Real
SAPO	Sample portion	Real
SENA	Soil series name	Alphanumeric (4A4)
SHLI	Shrinkage limit	Integer
SHRA	Shrinkage ratio	Real
SILI	Silicon dioxide (%)	Real
SILT	Silt content (%)	Real
SLOP	Slope class	Integer
SODI	Sodium (meq/100g)	Real
SOEL	Soil elevation (meters)	Integer
SPGR	Specific gravity (g/cu. m.)	Real
STAB	State abbreviation	Alphanumeric (A4)
STLN	Soil testing lab number	Integer
SUBO	Suborder	Alphanumeric (A4)
SUDE	Surface description	Alphanumeric(10A4)
SUNA	Subgroup name	Alphanumeric (4A4)
TERE	Temperature regime	Alphanumeric (2A4)
TEXT	Textural class	Alphanumeric (4A4)
UNIF	Unified soil classification	Alphanumeric (A4)
VALU	Munsell color value (moist)	Real
VCSA	Very coarse sand (%)	Real
VFSA	Very fine sand (%)	Real
VOSH	Volumetric shrinkage	Real
WACO	Water content (%)	Real
WAPH	Water ph	Real
WIER	Wind erodibility group	Integer
YEAR	Year soil sample collected	Integer

6. Format of Punch Output

The information described in this section includes the format of the punch output from the three LARSPEC processers. Table 6-1 lists the controls cards for each processor which control punch output and indicates which page in this section discusses the format of that output.

Table 6-1. Controls card which control punch output and the page which discusses the format of the punch output

Processor/Control Card	Page
DSEL	
CASES AGRONOMIC	6-2
CASES GEOMETRIC	6-5
CASES PUNCH, FFORMAT	6-7
CASES PUNCH, BINARY	6-9
GSPEC	
OPTIONS PUNCH	6-11
IDLIST	
CASES AGRONOMIC	6-2
CASES GEOMETRIC	6-5

6.1 CASES AGRONOMIC

The 'CASES AGRONOMIC' parameter is included in both the IDLIST and DSEL processors. This control card parameter causes four types of punch output to be produced.

- Identification card - processor, date, time
- List of mnemonic codes of identification (ID) record parameters that are punched.
- Format cards for the punched ID data
- Agronomic ID data for specified observations.

The first three types are for deck description. They are punched once at the beginning of the punch file. The fourth type, the punched ID data, includes four cards. Table 6-2 includes a list of the identification record parameters, their location on the card, and their punch format. Each set of four data cards represents agronomic ID record information for one observation.

Missing or null data for any parameter is punched as a -9 for integer or real formatted parameters and blank for alphanumeric formatted parameters.

Table 6-2. Description of the punched identification record data for the 'CASES AGRONOMIC' control parameter.

Agronomic Card 1

Parameter	Columns	Format	LARSPEC Mnemonic
Date	1-6	I6	DACO
Observation No.	7-10	I4	OBNU
Serial No.	11-12	I2	SENU
*'Card Identifier'	13-14	'A1'	-
+'Class Number'	15-16	I2	-
Day of Year Data Col.	17-19	I3	JUDA
Time	20-25	I6	TIDA
Scene Type	26-41	4A4	SCTY
Field or Plot No.	42-45	I4	FINU or PLNU
Field & Plot Identifier	46	'P', 'F', ' '	-
Replication No.	47-48	I2	RENU
Species	49-64	4A4	SPEC
Variety	65-80	4A4	VARI

Agronomic Card 2

Parameter	Columns	Format	LARSPEC Mnemonic
Date	1-6	I6	DACO
Observation No.	7-10	I4	OBNU
Serial No.	11-12	I2	SENU
*'Card Identifier'	13-14	'A2'	-
+'Class Number'	15-16	I2	-
Level of Factor 1	17-18	I2	LOF1
Level of Factor 2	19-20	I2	LOF2
Level of Factor 3	21-22	I2	LOF3
Level of Factor 4	23-24	I2	LOF4
Level of Factor 5	25-26	I2	LOF5
Level of Factor 6	27-28	I2	LOF6
Level of Factor 7	29-30	I2	LOF7
Level of Factor 8	31-32	I2	LOF8
Row Width	33-37	F5.2	ROWI
Planting Date	38-43	I6	PLDA
Day Since Planting	44-46	I3	DAPL
Maturity State	47-62	4A4	MATU
Num. Maturity Stage	63-67	F5.2	NMAT
Plant Heigth	68-72	F5.2	HEIG
Percent Grand Cover	73-75	I3	PEGR
Leaf Area Index	76-80	F5.2	LEAR

Table 6-2 (con't.)

Agronomic Card 3

Parameter	Columns	Format	LARSPEC Mnemonic
Date	1-6	I6	DACO
Observation No.	7-10	I4	OBNU
Serial No.	11-12	I2	SENU
*'Card Identifier'	13-14	'A2'	-
+'Class Number'	15-16	I2	-
Leaves Per Plant	17-20	F4.1	LEPL
Plant Count	21-27	F7.1	PLCO
Fruit Count	28-34	F7.1	FRCO
Leaf Condition			
green	35-37	I3	GRLE
yellow	38-40	I3	YELE
brown	41-43	I3	BRLE
Plant Moisture	44-45	I2	PLMO
Plant Water Content	46-53	F8.2	PMOW
Radiant Temperature	54-57	F4.1	RATE
Target Temperature	58-62	F5.2	TATE
Grain Yield	63-70	F8.1	YELD
Grain Test Weight	71-76	F6.2	TSWT
Grain Moisture Content	77-80	F4.1	GMOS

Agronomic Card 4

Parameter	Columns	Format	LARSPEC Mnemonic
Date	1-6	I6	DACO
Observation No.	7-10	I4	OBNU
Serial No.	11-12	I2	SENU
*'Card Identifier'	13-14	'A4'	-
+'Class Number'	15-16	I2	-
Dry Biomass -gr. leaves	17-24	F8.2	DBGL
Dry Biomass -ye. leaves	25-32	F8.2	DBYL
Dry Biomass -br. leaves	33-40	F8.2	DBBL
Dry Biomass -stems	41-48	F8.2	DBST
Dry Biomass -fruit	49-56	F8.2	DBFR
Dry Biomass -weeds	57-64	F8.2	DBWE
Dry Biomass -Total	65-72	F8.2	DBTO
Fresh Biomass Total	73-80	F8.2	FRBI

* Card code for IDLIST output - 'An'; card number for DSEL output - I2.

+ Blank for IDLIST output - 2X; class number for DSEL output - I2.

6.2 CASES GEOMETRIC

The 'CASES GEOMETRIC' parameter is included in both the IDLIST and DSEL processors. The control card parameter causes four types of punch output to be produced.

- Identification card - processor, date, time
- List of mnemonic codes of identification (ID) record parameters that are punched
- Format cards for the punched ID data
- Geometric ID data for specified observations

The first three types are for deck description. They are punched once at the beginning of the punch file. The fourth type, the punched ID data, includes one card for each selected observation. Table 6-3 includes a list of the identification record parameters, their location on the card, and their punch format.

Missing or null data for any parameter is punched as a -9 for integer or real formatted parameters and blank for alphanumeric formatted parameters.

Table 6-3. Description of the punched identification record data for the 'CASES GEOMETRIC' control parameter.

Geometric Card 1

Parameter	Columns	Format	LARSPEC Mnemonic
Date	1-6	I6	DACO
Observation No.	7-10	I4	OBNU
Serial Number	11-12	I2	SENU
*'Card Identifier'	13-14	'G1'	-
+'Class Number'	15-16	I2	-
Time	17-22	I6	TIDA
Scene Type	23-38	4A4	SCTY
Location	39-54	4A4	LOCA
View Zenith Angle	55-56	I2	VIZE
View Azimuth Angle	57-59	I3	VIAZ
Irradiance Zenith Angle	60-61	I2	IRZE
Irradiance Azimuth Angle	62-64	I3	IRAZ
Location Latitude	65-72	2A4	LOLA
Location Longitude	73-80	2A4	LOLO

* Card code for IDLIST output - 'G1'; card number for DSEL output - I2.

+ Blank for IDLIST output - 2X; class number for DSEL output - I2.

6.3 CASES PUNCH, FFORMAT

The 'CASES PUNCH,FFORMAT' parameter is included in the DSEL processor. This control card parameter causes three types of information to be produced:

- Identification card - processor, date, time
- List of specified wavelength bands - Bands Card(s)
- Wavelength band means in F7.2 formats for specified observations with class name dividers.

The first two types are for deck descriptions. They are punched once at the beginning of the punch file. The third type, the band means, represents the last portion of the deck. There will be a set of 'Means' cards for each selected observation in each class. Missing data for any wavelength band is punched as a -1.

Table 6-4 includes a list of the parameters, their location, on the card and their punch format for both the Bands cards and the Means cards.

Table 6-4. Description of punched band means cards for the 'CASES PUNCH,FFORMAT' control parameter.

Parameter	Columns	Format
	Band Card(s)	
Card identifier	1-5	'BANDS'
'Space'	6-7	2X
Band 1		
Start wavelength	8-13	F6.3
'dash'	14-16	' - '
End wavelength	17-22	F6.3
'Comma'	23-24	', '
Band 2		
Start wavelength	25-30	F6.3
'dash'	31-33	' - '
End wavelength	34-39	F6.3
'Comma'	40-41	', '
Band 3		
Start wavelength	42-47	F6.3
'dash'	48-50	' - '
End wavelength	51-56	F6.3
'Comma'	57-58	', '
Band 4		
Start wavelength	59-64	F6.3
'dash'	65-66	' - '
End wavelength	67-72	F6.3
	Means Card(s)	
Date Data Collected	1-6	I6
Observation number	7-10	I4
Serial number	11-12	I2
Card number	13-14	I2
Class Number	15-16	I2
'Space'	17	1X
Band 1 Mean	18-24	F7.2
Band 2 Mean	25-31	F7.2
Band 3 Mean	32-38	F7.2
Band 4 Mean	39-45	F7.2
Band 5 Mean	46-52	F7.2
Band 6 Mean	53-59	F7.2
Band 7 Mean	60-66	F7.2
Band 8 Mean	67-73	F7.2
Band 9 Mean	74-80	F7.2

6.4 CASES PUNCH, BINARY

The 'CASES PUNCH,BINARY' parameter is included in the DSEL processor. This control card parameter causes three types of information to be produced:

- Identification card - processor, date, time
- List of specified wavelength bands - Bands card(s)
- Wavelength band means in A4 format for specified observations with class name dividers

The first two types are for deck descriptions. They are punched once at the beginning of the punch file. The third type, the actual band means, represents the last portion of the deck. There will be a set of 'Means' cards for each selected observation in each class. Missing data for any wavelength band is punched as a -1.

Table 6-5 includes a list of the parameters, their location on the card and their punch format for the 'Means' cards. Refer to Table 6-4 for a description of the 'Bands' cards.

Table 6-5. Description of punched band means cards for the 'CASES PUNCH,BINARY' control parameter.

Parameter	Columns	Format
	Bands Card(s) - see Table 6-4	
	Means Cards	
Date data collected	1-6	I6
Observation number	7-10	I4
Serial number	11-12	I2
Card number	13-14	I2
Class number	15-16	I2
Band 1 mean	19-20	A4
Band 2 mean	21-24	A4
Band 3 mean	25-28	A4
Band 4 mean	29-32	A4
Band 5 mean	33-36	A4
Band 6 mean	37-40	A4
Band 7 mean	41-44	A4
Band 8 mean	45-48	A4
Band 9 mean	49-52	A4
Band 10 mean	53-56	A4
Band 11 mean	57-60	A4
Band 12 mean	61-64	A4
Band 13 mean	65-68	A4
Band 14 mean	69-72	A4
Band 15 mean	73-76	A4
Band 16 mean	77-80	A4

6.5 OPTIONS PUNCH (GSPEC)

To Be Completed.

Contact Larry Biehl or Nancy Fuhs if information is needed.

7. LARSPEC Error Messages

E0011 BAD MONITOR CONTROL CARD -- TYPE IN CORRECT CARD (EXOMU)

An error was encountered while interpreting a monitor control card. Probable cause was the misspelling of the requested function, or an invalid function was requested. The user is requested to enter a valid monitor control card via his terminal.

E0012 END OF INPUT DECK -- JOB TERMINATES (EXOMU)

End of control card deck was encountered before a $EXIT card.

E0013 NO CONTROL CARDS WERE IN READER -- JOB TERMINATES (EXOMU)

The user did not read a control card deck into the card reader.

E0014 NO MONITOR CARD WAS ENTERED -- TRY AGAIN (EXOMU)

A null line (only a carriage return) was entered on the user's terminal. LARSPEC responds by waiting for a non-null line to be entered.

E0021 END OF TAPE FILE REACHED BEFORE REQUESTED DATA WAS READ (FINDRN)

Data for a requested run was not on the tape. Processing of the present request is terminated.

E0022 INCORRECT RECORD LENGTH WAS SENSED DURING A READ OPERATION (FINDRN)

An improper length was indicated after reading a data record. Data was unreliable; therefore, processing of the request is terminated.

E0023 PARITY CHECK WAS SENSED DURING A READ OPERATION (FINDRN)

A parity error occurred during a data read, and data was unreliable; therefore, processing of the present request is terminated. The user should request the computer operator to clean the tape drive, and the user should then retry the job.

E0024 TAPE UNIT NOT ATTACHED -- JOB TERMINATED (FINDRN)

E0025 REQUESTED RUN SEQUENCER IS LESS THAN OR EQUAL TO ZERO (FINDRN)

Requested run sequence number in run ID record was invalid, or the user had requested an invalid run on a SELECT RUSE card. The data and ID record were unreliable; therefore, processing of the presently requested function is terminated.

E0026 FIRST SAMPLE REQUESTED IS LESS THAN OR EQUAL TO ZERO (FINDRN)

The lowerlimit on the XRSCALE control card was less than or equal to zero. Processing of the request is terminated.

E0027 SAMPLE INCREMENT IS LESS THAN OR EQUAL TO ZERO (FINDRN)

The interval value on the XRSCALE control card was less than or equal to zero. Processing of the request is terminated.

E0028 FIRST SAMPLE IS GREATER THAN LAST SAMPLE (FINDRN)

The lowerlimit was greater than the upperlimit on the XRSCALE control card. Processing of the request is terminated.

E0030 THE NUMBER OF SAMPLES DIMENSIONED IS LESS THAN THE NUMBER REQUESTED (FINDRN)

The buffer provided by the program to hold the data was too small. Processing of the request is terminated. The user should consult the Reformatting Operations Staff.

E0031 BUFFER SIZE IS INSUFFICIENT TO READ THE DATA (FINDRN)

The buffer provided by the program was sufficiently large enough to hold the expected amount of data, but more data was found than expected. Processing is terminated. The user should consult the Reformatting Operations Staff.

E0033 DATA DOES NOT EXIST FOR AT LEAST ONE SAMPLE GROUP (FINDRN)

Present request is terminated since all of the requested data does not exist.

E0034 RUN CANNOT BE LOCATED ON TAPE (FINDRN)

Processing is terminated.

E0042 ERROR ON SUPERVISOR CONTROL CARD -- TYPE IN CORRECT CARD (RDSETI)

An error was encountered while interpreting a supervisor control card. Probable cause was the misspelling of the requested keywords or an invalid parameter was used. The user is requested to enter a valid supervisor control card via his terminal.

E0043 END OF INPUT DECK -- JOB TERMINATES (RDSETI)

See E0012

E0044 NO SUPERVISOR CARD WAS ENTERED -- TRY AGAIN (RSDETI)

A null line (only a carriage return) was entered on the user's terminal. LARSPEC responds by waiting for a non-null line to be entered.

E0052 ERROR ON SUPERVISOR CONTROL CARD -- TYPE IN CORRECT CARD (RDSETD)

See E0042.

E0053 MORE THAN 15 CLASSES DEFINED (RDSETD)

The maximum number of classes that can be defined is 15. Processing of the request is terminated.

E0054 END OF INPUT DECK -- JOB TERMINATES (RDSETD)

See E0012.

EE055 NO CARD WAS ENTERED -- TRY AGAIN (RDSETD)

A null line (only a carriage return) was entered on the user's terminal. LARSPEC responds by waiting for a non-null line to be entered.

E0061 CORE OVERFLOW BY XXXXXX BYTES (DATA1)

The user's storage area was not large enough. The user should consult the Reformatting Operations staff. The job is terminated.

E0064 SELECT REQUEST NOT ON THE DATA TAPE -- REQUEST IGNORED (DATA1)

The run requested by the user on his SELECT card was not on the tape. Processing of the present request is terminated.

E0066 CLASS cccccccc HAS INSUFFICIENT DATA FOR A CORRELATION MATRIX (STATDK)

Fewer than two runs having valid data in all specified bands fit the class selection criteria for class cccccccc.

E0072 ERROR ON SUPERVISOR CONTROL CARD -- TYPE IN CORRECT CARD (RESETG)

See E0042.

E0073 MORE THAN 10 CLASSES DEFINED (RDSETG)

The maximum number of classes that can be defined is ten. Processing of the present request is terminated.

E0074 END OF INPUT DECK -- JOB TERMINATES (RDSETG)

See E0012.

E0075 NO CARD WAS ENTERED -- TRY AGAIN (RDSETG)

See E0055.

E0081 CORE OVERFLOW BY XXXXXX BYTES (EXOGS1)

See E0061.

E0082 RUN XXXXXXXX NOT USED DUE TO DISCREPANCIES IN WAVE BAND COEFFICIENTS (EXOGS1)

See E0062.

E0084 SELECT REQUEST NOT ON THE DATA TAPE -- REQUEST IGNORED (EXOGS1)

The run requested by the user on his SELECT card or GRAPH RUNU card was not on the tape. Processing of the present request is terminated.

E0091 ERROR IN INITIALIZING PRNTID -- JOB TERMINATES (PRNTID)

The user should consult the Reformatting Operations Staff.

GCS ERROR CODES

The following is a list of the currently defined error codes in GCS:

01 — Invalid key word specification to USET.
02 — Invalid key word specification to UPSET.
03 — No plot files found.
04 — Invalid option for UPRNT1.
05 — Invalid UDOIT system.
06 — Invalid view port boundaries.
09 — Invalid UINPUT option.
10 — UMARGN argument list out of order/Boundary specification invalid.
11 — UMARGN boundary outside of physical device boundary.
12 — UWINDO argument list out of order/Boundary specifications invalid.
13 — UDAREA argument list out of order/Boundary specifications invalid.
14 — UDAREA boundary outside of physical device boundary.
15 — UCLIP invalid argument list.
16 — UCLIP boundary overlap error.
17 — UDIMEN maximum boundary specification invalid.
18 — UAXIS argument list XMIN .GT.XMAX and/or YMIN .GT. YMAX.
19 — UDAREA provided to UAXIS too small for requested options.
20 — UPSET — invalid tic interval. Value .LE.zero specified.
21 — UPSET — invalid scale factor. Value must not be equal to zero.
22 — UPSET — invalid software character size. Value must not be equal to zero.
23 — UPSET — invalid digits of precision. Precision must be greater than zero.
24 — UPSET — attempt to set zero or negative scripting — level.
25 — UPSET — Invalid light pen correlation value. Value must be.GT.zero.
26 — UPSET — Invalid transmission speed. Value must be .GT.zero.
27 — UPSET — Invalid Library file code. File codes must be in range 1 to 99.
28 — UPSET — Invalid error limit. Value must be greater than zero.
29 — UPSET — Invalid error limit. Value must be greater than zero.
30 — UFRAME/UFREND frame table full.
31 — Failure to call UFREND for previous occurrence of same frame.
32 — Failure to call UFREND for another named frame.
33 — UFREND called without any frame active.
34 — UFREND call not for currently active frame.
35 — USHOW/UNSHOW called for undefined frame.
36 — USHOW/UNSHOW called while in frame build status.
51 — Insufficient data points for desired fit.
52 — Input data points exceed fit capacity.
53 — Input data out of order or non functional relationship.
54 — Insufficient array space to return fitted results.
55 — Invalid trend adjustment factor.
56 — Invalid polynomial degree for polynomial fit.
57 — Invalid number of previous periods for moving average fit.
60 — Attempt to build a structure in frame mode.
61 — Nested structure call stack overflow.
64 — Attempt to redefine existing structure.
65 — Structure table overflow.
66 — Attempt to activate a structure while another is still active.
67 — Structure termination without active structure.
68 — Structure termination not for current structure.
69 — Attempt to execute an undefined structure.
70 — Recursive structure build call.
71 — Invalid number of items for UREAD/UINPUT.
72 — Attempted input operation from batch device.

80 — Attempt to create a secondary axis scale of zero.
81 — UAXIS — pen position outside of UDAREA in 'PENAXES'.
82 — Attempt to plot log with window bound .LE. 0.0
83 — Attempt to move to apply log scaling to coordinate whose value is zero.
84 — Log plotting in device space not allowed.
85 — UAXIS — AXIS choice requires 0 to 1 within range of X and/or Y AXIS.
86 — ULINE/U3LINE — Invalid number of points.
91 — UAPEND found zero length string. Terminator placed in first character position.
92 — UWAIT — Negative time period specified.
93 — UQUERY — Invalid option specification.
101 — UHISTO — Insufficient points.
102 — UHISTO — Invlid number of bars.
103 — UHISTO — Unreasonable window for OWNSCALE.
104 — UHISTO — Insufficient UDAREA for options specified.
110 — Invalid number of points for UPIE.
111 — Invalid data value for UPIE.
112 — Invalid max label size for UPIE.
113 — Insufficient room for UPIE display.
114 — UPIE — ABS(Starting Angle > =ABS(Ending Angle).
115 — UPIE — Too many labels outside of pie.
120 — USCATR — Insufficient points specified.
121 — USCATR — Invalid limits for logarithmic scatter diagram.
122 — USCATR — UDAREA too small for specified options.
130 — UBAR — Invalid number of points.
131 — UBAR — Invalid label size.
132 — UBAR — Invalid data value.
133 — UBAR — Insufficient UDAREA for options specified.
140 — UCHART — Invalid number of points.
141 — UCHART — Invalid label size.
142 — UCHART — Invalid number of bars.
143 — UCHART — UDAREA too small for specified options.
150 — UTAXIS — UDAREA too small for specified options.
160 — UTILTY — Invalid action.
161 — UTILTY — Save structure not found.
162 — UTILTY — Utility operation on structure work file.
190 — UVIEW — Viewpoint specified same as view site.
191 — UVWPRT — Aperature specified negative or zero in some dimension.
192 — UVWPRT — Viewport behind viewer.
193 — Attempt to draw through viewpoint.
194 — Hither plane behind or at viewpoint.

8. References

1. Ball, G.H. and D.J. Hall. 1965. ISODATA, a novel method of data analysis and pattern classification. Stanford Research Institute, Melno Park, California.

2. Phillips, T.L., ed. 1973. LARSYS User's Manual. Laboratory for Applications of Remote Sensing, Purdue University, West Lafayette, Indiana.

Appendix A

Abbreviated control card listing

LARSPEC TERMINAL COMMANDS

KEY WORD	CONTROL PARAMETER	FUNCTION	DEFAULT

NOTE THAT SINGLE QUOTES ARE USED TO INDICATE A USER SPECIFIED CONTROL PARAMETER. THE SINGLE QUOTES SHOULD NOT BE TYPED AS PART OF THE CONTROL PARAMETER.

KEY WORD	CONTROL PARAMETER	FUNCTION	DEFAULT
I	LARSPEC	INITIALIZE LARSPEC CONTROL SYSTEM.	(NONE)

NOTE THAT THE I LARSPEC COMMAND MAY BE USED TO CANCEL A RUN. THIS IS DONE BY PRESSING THE ATTENTION KEY ONCE AND THEN ENTERING THE COMMAND.

KEY WORD	CONTROL PARAMETER	FUNCTION	DEFAULT
BATCH	(NONE)	SETS UP THE BATCH HEADER CARDS, ALLOWS USER TO CHANGE HEADER CARDS AS NEEDED, AND SENDS THE DECK TO BATCH.	(NONE)
	BACKUP 'TAPE'	(FILE 'FILENUMBER' (INIT SETS UP BATCH HEADER CARDS SO THAT PUNCH OUTPUT FROM LARSPEC BATCH JOB WILL BE BACKED UP TO LAST FILE ON TAPE OR OPTIONALLY - (FILE 'FILENUMBER' OR INITIAL FILE - (INIT	(NONE)
CCINPUT	CARDS	LARSPEC CONTROL CARDS ARE EXPECTED FROM VIRTUAL CARD READER.	CARDS ARE EXPECTED FROM CARD READER.
	TERMINAL	CONTROL CARDS ARE EXPECTED FROM USER'S TERMINAL.	SAME AS ABOVE.
	'FN' 'FT'	CONTROL CARDS ARE TO BE READ FROM A USER DISK AS 'FILENAME' 'FILETYPE'.	SAME AS ABOVE.
	(NONE)	THE DEVICE (CARDS, TERMINAL, 'FN' 'FT') FROM WHERE THE CONTROL CARDS ARE EXPECTED WILL BE LISTED ON THE TERMINAL.	(NONE)
CLEAR	(NONE)	CLEARS THE USER'S SPOOLED CARD READER OF ALL CARD DECKS.	(NONE)
CMS	'CMS COMMANDS'	EXECUTES CMS TERMINAL COMMANDS. OR SEE NEXT TERMINAL KEYWORD.	(NONE)
'CMS COMMANDS'		ANY VALID CMS COMMANDS MAY BE EXECUTED WHILE ONE IS IN THE LARSPEC ENVIRONMENT. IN OTHER WORDS, THE KEYWORD AND CONTROL PARAMETERS WILL BE TREATED AS A CMS COMMAND, IF THE KEYWORD IS NOT A LARSPEC TERMINAL COMMAND. CAUTION DO NOT ABBREVIATE EDIT OR STAT.	

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LARSPEC TERMINAL COMMANDS

KEY WORD	CONTROL PARAMETER	FUNCTION	DEFAULT
DDISK	ACCESS	ACCESSES TEMP DISK USED FOR THE DISK DATA BASE.	(NONE)
	BACKUP 'TAPE' (FILE 'FILENO.' (INIT	BACKS UP PREVIOUSLY CREATED DISK DATA BASE ON THE TEMP DISK TO THE LAST FILE ON THE SPECIFIED TAPE OR OPTIONALLY - (FILE 'FILENUMBER' OR INITIAL FILE - (INIT.	(NONE)
	COPY ('FN' 'FT' 'FM'	COPIES THE DISK DATA BASE WITH DEFAULT NAME - MSPEC BASE - OR OPTIONAL NAME - 'FN' 'FT' FROM DEFAULT DISK - A - OR OPTIONAL DISK - 'FM' TO A TEMP DISK FOR USE BY LARSPEC.	(NONE)
	CREATE ('FN' 'FT'	GETS TEMP DISK TO BE USED FOR CREATING A DISK DATA BASE WITH DEFAULT NAME - MSPEC BASE - OR OPTIONAL NAME - 'FN' 'FT'.	(NONE)
	TAPE 'TAPE' 'FILENO.' ('FN' 'FT'	LOADS THE DISK DATA BASE WITH DEFAULT NAME - MSPEC BASE - OR OPTIONAL NAME - 'FN' 'FT' FROM 'TAPE' AND 'FILENO' TO A TEMP DISK FOR USE BY LARSPEC.	(NONE)
EXIT	(NONE)	TERMINATES LARSPEC COMMAND ENVIRONMENT AND RETURNS CONTROL TO CMS COMMAND ENVIRONMENT.	(NONE)
MSG	'USERID' 'MESSAGE'	MESSAGE IS SENT TO USERID SPECIFIED. (CP IS USED TO REFERENCE THE COMPUTER OPERATOR.	(NONE)
NEWS	(NONE)	LATEST LARSPEC SYSTEM NEWS IS PRINTED ON THE LINE PRINTER. SUMMERIZES CHANGES MADE AT TIME OF LATEST UPDATE.	(NONE)
PRINT	HOLD	PRINTER OUTPUT IS NOT PRINTED UNTIL 'PRINT RELEASE' OR LOGOUT IS ISSUED.	OUTPUT IS NOT HELD
	RELEASE	PREVIOUSLY HELD OUTPUT IS PRINTED.	
	'SITE-ID'	PRINTER OUTPUT IS DIRECTED TO SPECIFIC SITE.	SITE OF USER TERMINAL.
	TERMINAL	PRINTER OUTPUT IS DISPLAYED ON THE USER'S TERMINAL.	
	(NONE)	THE PRINTER SITE WILL BE LISTED ON THE TERMINAL.	(NONE)

LARSPEC TERMINAL COMMANDS

KEY WORD	CONTROL PARAMETER	FUNCTION	DEFAULT
PUNCH	DISK	PUNCH WILL BE SENT TO D-DISK AS PUNCH FILE D1. D-DISK IS THE DEFAULT DISK.	PUNCH WILL BE SENT TO CARD PUNCH.
	DISK A	PUNCH WILL BE SENT TO A-DISK AS PUNCH FILE A1.	"
	HOLD	PUNCH OUTPUT IS NOT PUNCHED UNTIL 'PUNCH RELEASE' OR LOGOUT IS ISSUED.	OUTPUT IS NOT HELD.
	RELEASE	PREVIOUSLY HELD OUTPUT IS PUNCHED.	
	'SITE-ID'	PUNCH OUTPUT IS DIRECTED TO SPECIFIC SITE.	SITE OF USER TERMINAL.
	TERMINAL	PUNCH OUTPUT IS DISPLAYED ON THE USER'S TERMINAL.	
	(NONE)	THE PUNCH SITE WILL BE LISTED ON THE TERMINAL.	(NONE)
QUIT	(NONE)	END OF TERMINAL SESSION. WILL BE LOGGED OFF.	(NONE)
REFERENCE	ALL	PRINT LISTINGS OF ALL OF THE CONTROL CARDS LISTED BELOW COMMANDS, DSEL, GSPEC, IDLIST, INITIALIZATION.	(NONE)
	COMMANDS	PRINT LISTING OF LARSPEC TERMINAL COMMANDS.	
	DSEL	PRINT LISTING OF LARSPEC DSEL CONTROL CARDS.	
	GSPEC	PRINT LISTING OF LARSPEC GSPEC CONTROL CARDS.	
	IDLIST	PRINTS LISTING OF LARSPEC IDLIST CONTROL CARDS.	
	INITIALIZATION	PRINT LISTING OF LARSPEC MONITER CONTROL CARDS.	
RESET	(NONE)	REINITIALIZES ALL TERMINAL COMMANDS TO DEFAULT VALUES.	(NONE)
RUN	LARSPEC	EXECUTE LARSPEC SYSTEM	(NONE)
	LARSPEC 3M 1200K 600K 300K	TEST CLEAR NOTEST NOCLEAR	
		EXECUTE LARSPEC SYSTEM. THE OTHER PARAMETERS ARE OPTIONS AND ARE NOT REQUIRED. THE OPTIONS ARE:	
	TEST	PLACE COPY OF LOAD MAP ON A-DISK.	NOTEST
	3M, 1200K, 600K, 300K	IDENTIFIES THE SIZE OF THE TEMP DISK (IN BYTES) TO BE ATTACHED DURING EXECUTION.	1200K
	NOCLEAR	DO NOT CLEAR TEMP DISK WHEN IT IS ATTACHED.	CLEAR

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LARSPEC BATCH CARDS

EXAMPLE FOR BATCH DECKS

'NORMAL' BATCH CARD SET UP

```
BATCH MACHINE 'BATCH NAME'                    (SEE NOTE)
BATCH ID 'USERID' 'USER NAME'
BATCH OUTPUT 'PRINTSITE' 'PUNCHSITE'
I LARSPEC
RUN LARSPEC RUN
$TAPE
  .
  .                          (CONTROL CARDS)
  .
$EXIT
```

BATCH CARD SET UP IF ONE WANTS TO BACK PUNCH OUTPUT TO TAPE

```
BATCH MACHINE 'BATCH NAME'                    (SEE NOTE)
BATCH ID 'USERID' 'USER NAME'
BATCH OUTPUT 'PRINTSITE' 'PUNCHSITE'
EXEC$$
EXEC CONFIGUR LARSPEC
&STACK LARSPEC RUN
EXEC LARSPEC PUNCH DISK
EXEC BACKUP 'TAPE NUMBER' D
$$
$TAPE 4047
$DSEL
  .
  .
  .                          (CONTROL CARDS)
  .
  .
$EXIT
```

* NOTE

BATCH MACHINES	TIME LIMITS (MINUTES)	OPERATION
BATQUICK	1	DAY/NIGHT
BATSHORT	15	DAY/NIGHT
BATMED	45	DAY/NIGHT
BATLONG	500	NIGHT
BATEOD	60	DAY/NIGHT
BATJSC	240	NIGHT

LARSPEC CONTROL CARDS REVISED 12/20/79

THE FOLLOWING IS A DESCRIPTION OF THE CONTROL CARDS FOR THE PURDUE/LARS SPECTROMETER/RADIOMETER DATA ANALYSIS PROGRAM (LARSPEC).

THE LARSPEC CONTROL CARDS FOLLOW THE RULES FOR LARSYS CONTROL CARDS AND ARE OF THREE BASIC TYPES ....

1. MONITOR CONTROL CARDS ... THESE CARDS REQUEST SOME SPECIAL ACTION BY THE LARSPEC MONITOR ($DATE,$TYPE,$COMM,ETC.) OR CALL FOR A SPECIFIC PROCESSING FUNCTION ($IDLIST,$GSPEC,ETC.). NOTE THAT THE FIRST CHARACTER ON ANY MONITOR CONTROL CARD IS A DOLLAR SIGN($).

2. SUPERVISOR CONTROL CARDS ... THESE CARDS SPECIFY PROCESSING OPTIONS AND PARAMETERS WITHIN EACH PROCESSING FUNCTION. A SET OF SUPERVISOR CONTROL CARDS MUST FOLLOW A MONITOR CONTROL CARD WHICH CALLS FOR A PROCESSING FUNCTION. EACH SET OF SUPERVISOR CONTROL CARDS MUST BE TERMINATED BY AN 'END' CARD.

3. CLASS CARDS . WHEN CLASS CARDS ARE REQUIRED BY THE PROCESSING FUNCTION OR BY A REQUESTED OPTION, THEY MUST FOLLOW THE 'END' CARD IN THE SUPERVISOR CONTROL DECK OR ANOTHER CLASS DECK. EACH CLASS DECK MUST BE TERMINATED BY A '*END' CARD.

GENERAL RULES FOR PUNCHING AND USING LARSPEC CONTROL CARDS

1. MONITOR AND SUPERVISOR CONTROL CARDS MUST CONTAIN A KEY WORD STARTING IN COLUMN 1 FOLLOWED BY AT LEAST ONE BLANK.

2. THE CONTROL PARAMETERS MAY BE PUNCHED ON THE REMAINDER OF THE CARD UP THROUGH COLUMN 72. COLUMNS 73 THROUGH 80 ARE IGNORED BY THE PROGRAM. BLANKS MAY BE INSERTED BETWEEN PARAMETERS TO IMPROVE READABILITY.

3. BELOW IS A LIST OF ALL MONITOR CONTROL CARDS, SUPERVISOR CONTROL CARDS AND CLASS CARDS WHICH CAN BE USED BY THE LARSPEC PROGRAM. SHOWN IS THE KEY WORD, LIST OF CONTROL PARAMETERS, THE FUNCTION OF THE REQUEST, AND THE DEFAULT OPTION.

4. AN ASTERISK (*) APPEARING IN THE COLUMN LABELED 'REQ' INDICATES THE CONTROL CARD IS REQUIRED FOR PROPER PROGRAM ACTION.

5. THE COLUMN LABELED 'DEFAULT' DESCRIBES THE ACTION TAKEN BY THE PROGRAM IF THE CORRESPONDING REQUEST DOES NOT APPEAR.

6. RESTRICTIONS WITH RESPECT TO ORDERING OF CONTROL CARDS ARE AS FOLLOWS

(A) MONITOR CONTROL CARDS MUST APPEAR FIRST, BUT MAY NOT APPEAR WITHIN SUPERVISOR CONTROL CARDS OR CLASS DECKS.

(B) SUPERVISOR CONTROL DECKS MUST FOLLOW THE MONITOR CONTROL CARD REQUESTING A PROCESSING FUNCTION.

(C) CLASS DECKS MUST FOLLOW THE SUPERVISOR CONTROL DECK IF REQUIRED.

(D) A $END CARD MUST FOLLOW A SUPERVISOR CONTROL DECK OR A CLASS DECK BEFORE ANOTHER MONITOR CONTROL CARD CAN APPEAR.

7. MULTIPLE SUPERVISOR CARDS OF THE SAME TYPE MAY BE USED WHENEVER NECESSARY (I.E., WHENEVER THERE IS INSUFFICIENT SPACE ON ONE CARD FOR ALL NECESSARY PARAMETERS). EACH CARD MUST BEGIN WITH THE KEY WORD AND END ON OR BEFORE COLUMN 72 IN THE SAME MANNER AS IF IT WERE THE ONLY CARD OF THAT TYPE.

USERS ARE ENCOURAGED TO SUBMIT TO LARRY BIEHL SUGGESTIONS FOR ADDITIONS TO AND/OR MODIFICATIONS OF THIS CONTROL CARD DESCRIPTION. ONLY BY TAKING ADVANTAGE OF YOUR EXPERIENCE CAN WE HOPE TO MAKE THE DESCRIPTION AS CLEAR AND COMPLETE AS IS NECESSARY FOR OPTIMAL USE OF LARSPEC.

***** SPECIAL ACTION MONITOR CONTROL CARDS *****

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
$CARD		(NONE)	ALL MONITOR CONTROL CARDS AND SUPERVISOR CONTROL CARDS ARE EXPECTED FROM THE READER	(NONE)
$COMM		64 CHARACTERS	PRINT A COMMENT LINE USING THESE 64 CHARACTERS	NO COMMENT PRINTED
$DATE		20 CHARACTERS	REPLACE THE DATE WITH THESE 20 CHARACTERS	DATE IN COMPUTER PRINTED
$DISK			A MINI-DATA BASE ON DISK WILL BE SEARCHED INSTEAD OF TAPE BY THE PROCESSING FUNCTIONS WHICH FOLLOW.	(NONE)
$DSEL			CAUSES LARSPEC MONITOR TO LOAD AND PASS PROGRAM CONTROL TO DSEL PROCESSOR	
$END			RETURN TO MONITOR	
$EXIT	*	(NONE)	END OF JOB, REWIND & UNLOAD TAPE	(NONE)
$GSPEC			CAUSES LARSPEC MONITOR TO LOAD AND PASS PROGRAM CONTROL TO GSPEC PROCESSOR	
$IDLIST			CAUSES LARSPEC MONITOR TO LOAD AND PASS PROGRAM CONTROL TO IDLIST PROCESSOR	
$HD1		64 CHARACTERS	REPLACE THE FIRST HEADER LINE WITH THESE 64 CHARACTERS	STANDARD HEADER
$HD2		64 CHARACTERS	REPLACE THE SECOND HEADER LINE WITH THESE 64 CHARACTERS	STANDARD HEADER
$RESET		(NONE)	REINITIALIZES LARSPEC	(NONE)
$REWIND		YES NO	REWIND TAPE AT RE-ENTRY DO NOT REWIND TAPE AT RE-ENTRY	YES
$TAPE		N1,N2,N3.. NI	TAPES N1...NI WILL BE SEARCHED FOR ALL PROCESSING FUNCTIONS WHICH FOLLOW. THE LIMIT ON THE NUMBER OF TAPES IS FIVE.	(NONE)
$TYPE		(NONE)	ALL MONITOR CONTROL CARDS AND SUPERVISOR CONTROL CARDS ARE EXPECTED FROM THE TYPEWRITER	CARD READER IS USED

*** NOTE

CONTROL CARD LISTINGS FOR $IDLIST, $GSPEC, AND $DSEL MAY BE OBTAINED BY REFERENCING IDLIST, GSPEC, AND DSEL RESPECTIVELY.

EXAMPLE:
REFERENCE IDLIST
REFERENCE GSPEC
REFERENCE DSEL

***** $DSEL CONTROL CARDS *****

KEY WORD	REC	CONTROL PARAMETER	FUNCTION	INITIAL DEFAULT
$DSEL	*		CAUSES LARSPEC MONITOR TO LOAD AND PASS PROGRAM CONTROL TO DSEL PROCESSOR.	
BANDS	*	LL1-UL1,...	LIMITS FOR WAVELENGTH BAND1 IS LL1 TO UL1 IN MICROMETERS. IF CLUSTERING IS REQUESTED A MAXIMUM OF 30 BANDS.	
SELECT	*	XXXX(LL-UL)	SELECTS RUNS WITH ID PARAMETER XXXX WITHIN THE LIMITS LL TO UL.	
		XXXX(LL-UL+L)	SAME AS ABOVE AND BY INCREMENTS OF L.	INCREMENTS INTEGER 1
		XXXX(L1,L2,...)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO L1 OR L2 OR A COMBINATION OF THE ABOVE CONTROL PARAMETERS FOR SELECT MAY BE USED.	
		XXXX(A...A)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO A...A.	(NONE)
		XXXX(A..A:B..B)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO A..A OR B..B.	
		-XXXX( )	SELECTS RUNS WITH ID PARAMETER XXXX EXCEPT THOSE SPECIFIED RUNS, OR THOSE OUTSIDE SET LIMITS.	(SEE NOTE AT END)
		.OR.	END OF ONE CONDITION SET.	
CLUSTER		MAXCL(N)	N NUMBER OF CLUSTER CLASSES WANTED.	MAXCL(2)
		CONV(XX.X)	MINIMUN NUMBER OF VECTORS UNCHANGED FOR A SUCCESSFUL CLUSTERING IS XX.X PERCENT.	CONV(100.0)
		THRESH(X.XX)	THRESHOLD VALUE FOR POOLING CLUSTERS IS SET TO X.XX.	THRES(0.75)
LIST		XXXX	FOR EACH RUN LISTED THE ID PARAMETER WITH THE NAME XXXX IS PRINTED.	ONELINE PRINTED
		ALL	FOR EACH RUN LISTED ALL ID PARAMETERS WILL BE PRINTED. THOSE WITH NULL NULL VALUES WILL BE SUPPRESSED.	ONELINE IS PRINTED
		NOSUPRES	FOR EACH RUN LISTED ALL ID PARAMETERS WILL BE PRINTED, INCLUDING THOSE WHICH HAVE NULL VALUES. THOSE WITH NULL VALUES WILL BE PRINTED WITH ASTERISKS AS THEIR VALUE.	ONELINE PRINTED
		NOLIST	LISTING WILL BE SUPPRESSED FOR THIS PROCESSING FUNCTION.	ONELINE PRINTED
		ONELINE	A ONE LINE LISTING WILL BE PRODUCED.	
OPTIONS		TAPE(N1,N2,..)	TAPE(S) N1,N2,.. WILL BE SEARCHED FOR DATA. THE LIMIT ON THE NUMBER OF TAPES IS FIVE. THIS WILL RESET $TAPE.	(NONE)

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
CASES		PUNCH	PUNCH OUTPUT ON CARDS	NOPUNCH
		NOPUNCH	SUPPRESSES PUNCHED OUTPUT	
		FFORMAT	PUNCH OUTPUT IN F FORMAT (F7.2)	
		BINARY	PUNCHED OUTPUT IN BINARY	F FORMAT
		AGRONOMIC	PUNCH AGRONOMIC HEADER INFORMATION	NOAGRON
		NOAGRON	SUPPRESS PUNCHING AGRONOMIC INFORMATION	
		GEOMETRIC	PUNCH GEOMETRIC HEADER INFORMATION	NOGEOM
		NOGEOM	SUPPRESS PUNCHING GEOMETRIC INFORMATION	
STATISTICS		RUNSTATS	RUN STATISTICS INCLUDING CLASS AND CLUSTER, RUNU, BAND LIMITS, BAND MEANS, MIN, MAX, STANDARD DEVIATION, VARIANCE, AND PERCENT DEVIATION.	RUNSTATS
		NRUNSTATS	SUPPRESSES RUNSTATS	RUNSTATS
		CORRELATION	PRODUCES A BAND CORRELATION MATRIX FOR EACH CLASS.	NOCORR
		NOCORR	SUPPRESSES MATRIX.	
		CLASSTATS	SAME PARAMETERS AS ABOVE PRINTED FOR EACH DSEL CLASS OR CLUSTER CLASS IF SPECIFIED.	NCLASSTAT
		NCLASSTAT	SUPPRESSES CLASS STATISTICS.	
		SPECPLT	PRODUCES A COINCIDENT SPECTRAL PLOT + & - ONE STD. DEV. FOR EACH CLASS	NOSPECPLT
		NOSPECPLT	SUPPRESS SPECTRAL PLOT	
		DISK	PUTS A LARSYS STAT DECK ON THE USER'S PRIMARY DISK (P-DISK). CLUSTER CLASS IF SPECIFIED.	NODISK
		NODISK	SUPPRESSES LARSYS STAT DECK	
		PUNCH	PUNCHES A LARSYS FORMATTED STAT DECK	NOPUNCH
		NOPUNCH	SUPPRESS PUNCHING OF LARSYS STAT DECK	
OUTPUT		GROUP	OUTPUT SHOWING GROUPING OF CLUSTER CLASSES IS PRODUCED.	NOGROUP
		NOGROUP	GROUPING TABLE IS SUPPRESSED	
		SUMMARY	SUMMARY TABLE ILLUSTRATING FIELD HOMIGENITY.	NOSUMMARY
		NOSUMMARY	SUMMARY TABLE IS SUPPRESSED.	
END	*		END OF SUPERVISOR CONTROL CARDS SUPERVISOR CONTROL CARDS OR CLASS CARDS MAY FOLLOW	

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
CLASS	*	NNNNNN	START OF CLASS NNNNNN MAXIMUM NUMBER OF CLASSES ALLOWED IS 15. SEE NOTE.	
SELECT		XXXX(LL-UL)	SELECTS RUNS FOR CLASS NNNNNN WITH ID PARAMETER XXXX WITHIN THE LIMITS LL TO UL.	
		XXXX(LL-UL+L)	SAME AS ABOVE AND BY INCREMENTS OF L.	INCREMENTS INTEGER 1
		XXXX(L1,L2,...)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO L1 OR L2 OR A COMBINATION OF THE ABOVE CONTROL PARAMETERS FOR SELECT MAY BE USED.	
		XXXX(A...A)	SELECTS RUNS FOR CLASS NNNNNN WITH ID PARAMETER XXXX EQUAL TO A...A.	
		XXXX(A..A:B..B)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO A..A OR B..B.	
		-XXXX( )	SELECTS RUNS WITH ID PARAMETER XXXX EXCEPT THOSE SPECIFIED RUNS, OR THOSE OUTSIDE SET LIMITS.	(SEE NOTE AT END)
		.OR.	END OF ONE CONDITION SET.	
*END	*		END OF CLASS CARDS, IF CLUSTERING WAS REQUESTED ALL DATA UP TO THIS CARD WILL BE CLUSTERED TOGETHER.	

$END RETURN TO MONITOR

*** NOTE

ON CONTROL CARD LIST, IF OPTION ALL IS SPECIFIED ONLY THE OPTION NOSUPRES CAN BE ALSO SPECIFIED ON THE SAME CARD.

A MAXIMUM OF 100 BANDS IS PERMITTED PER PROCESSING REQUEST.

ONE MAY USE A COMBINATION OF THE SAME ID PARAMETER WITH AND WITHOUT THE NOT SIGN, BUT THE RESULT WILL BE ALL RUNS USED.
EX: SELECT OBNU(10-30),-OBNU(20,22) = ALL RUNS

CLASS CARD IS REQUIRED WITH SELECT.

***** $GSPEC CONTROL CARDS *****

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
$GSPEC	*		REQUEST PROCESSOR TO GRAPH, PRINT, AND/OR PUNCH DATA.	
GRAPH	**		GRAPH EACH REQUESTED RUN ON A SEPARATE GRAPH.	
		XXXX(LL-UL)	SELECTS RUNS WITH ID PARAMETER XXXX WITHIN LIMITS LL TO UL.	
		XXXX(LL-UL+L)	SAME AS ABOVE AND BY INCREMENTS OF L. (NO INCREMENT FOR REAL)	INCREMENTS INTEGER 1
		XXXX(L1,L2,...)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO L1 OR L2 OR A COMBINATION OF THE ABOVE CONTROL PARAMETERS FOR SELECT MAY BE USED.	
		XXXX(A...A)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO A...A.	(NONE)
		XXXX(A..A:B..B)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO A..A OR B..B.	
		-XXXX( )	SELECTS RUNS WITH ID PARAMETER XXXX EXCEPT THOSE SPECIFIED RUNS, OR THOSE OUTSIDE SET LIMITS.	(SEE NOTE AT END)
		.OR.	END OF ONE CONDITION SET.	
		'NO CONTROL PARAMETER'	THE GSPEC STATUS AREA WILL BE IN THE NON-CLASS MODE. (ONLY APPLICABLE FOR XRDATAN, YTDATAN, ZPDATAN REQUESTS.)	
SELECT	**		GRAPH DATA IN EACH CLASS AS A SEPARATE PLOT ON GRAPH. THERE IS A LIMIT OF TEN CLASSES. DATA (OR CLASS) CARDS WILL BE EXPECTED.	
			CONTROL PARAMETERS ARE THE SAME AS FOR 'GRAPH'.	
		'NO CONTROL PAREMETER'	THE GSPEC STATUS AREA WILL BE IN THE CLASS MODE. CLASS DATA WILL BE REQUIRED. (ONLY APPLCABLE FOR XRDATAN, YTDATAN, ZPDATAN REQUESTS.)	
LIST		XXXX	FOR EACH RUN LISTED THE ID PARAMETER WITH THE NAME XXXX IS PRINTED.	ONELINE PRINTED
		ALL	FOR EACH RUN LISTED ALL ID PARAMETERS WILL BE PRINTED. THOSE WITH NULL VALUES WILL BE SUPPRESSED.	ONELINE PRINTED
		NOSUPRES	FOR EACH RUN LISTED ALL ID PARAMETERS WILL BE PRINTED, INCLUDING THOSE WHICH HAVE NULL VALUES. THOSE WITH NULL VALUES WILL BE PRINTED WITH ASTERISKS AS THEIR VALUE.	ONELINE PRINTED
		NOLIST	LISTING WILL BE SUPPRESSED FOR THIS PROCESSING FUNCTION.	ONELINE PRINTED
		ONELINE	A ONE LINE LISTING WILL BE PRODUCED.	

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
XRDATA			SPECIFIES THE DATA TO BE USED FOR THE X OR RADIUS(R) COORDINATE VALUES OF THE GRAPH.	
		WAVELENGTH	THE X OR R COORDINATE VALUES WILL BE WAVELENGTH.	WAVELENGTH
		XXXX	THE X OR R COORDINATE VALUES WILL BE THE REAL OR INTEGER ID PARAMETER WITH THE NAME XXXX	WAVELENGTH
		BAND(LL-UL)	THE X OR R COORDINATE VALUES WILL BE THE AVERAGE RESPONSE IN THE WAVELENGTH BAND LL TO UL.	WAVELENGTH
		FUNCTION OF XXXX AND/OR BAND(LL-UL).	EXAMPLES-- LEAR * 100 BAND(.73-.78)/BAND(.62-.68) NOTE-- THE FUNCTON MAY CONTAIN THE *, -, +, /, AND ** FORTRAN OPERATORS. IT MAY ALSO CONTAIN SIN, COS, TAN, ARSIN, ARCOS, ATAN, ALOG, ALOG10, EXP, AND SQRT FORTRAN FUNCTIONS.	
		XRDATAN	THE VALUES WILL BE THE DATA STORED AS THE X OR R DATA FOR CLASS 'N'. EXAMPLE-- XRDATA3 IS THE XR DATA FOR CLASS 3.	WAVELENGTH
		YTDATAN	THE VALUES WILL BE THE DATA STORED AS THE Y OR THETA(T) DATA FOR CLASS 'N'.	WAVELENGTH
		ZPDATAN	THE VALUES WILL BE THE DATA STORED AS THE Z OR PHI(P) DATA FOR CLASS 'N'.	WAVELENGTH
		FUNCTION OF THE DATA STORED IN THE XRDATAN, YTDATAN, AND/OR ZPDATAN ARRAYS.	EXAMPLE-- YTDATA1/YTDATA2 + 2*XRDATA3	

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
YTDATA			SPECIFIES THE DATA TO BE USED FOR THE Y OR THETA(T) COORDINATE VALUES OF THE GRAPH.	
		RESPONSE	THE Y OR T COORDINATE VALUES WILL BE SPECTRAL RESPONSE.	RESPONSE
		XXXX	THE Y OR T COORDINATE VALUES WILL BE THE REAL OR INTEGER ID PARAMETER WITH THE NAME XXXX	RESPONSE
		BANC(LL-UL)	THE Y OR T COORDINATE VALUES WILL BE THE AVERAGE RESPONSE IN THE WAVELENGTH BAND LL TO UL.	RESPONSE
		FUNCTION OF XXXX AND/OR BAND(LL-UL).	(SEE XRDATA EXAMPLE)	
		XRDATAN	(SEE XRDATA)	RESPONSE
		YTDATAN	(SEE XRDATA)	RESPONSE
		ZPDATAN	(SEE XRDATA)	RESPONSE
		FUNCTION OF DATA STORED IN THE XRDATAN,	YTDATAN AND/OR ZPDATAN ARRAYS. (SEE XRDATA)	
ZPDATA			THE ZPDATA WILL BE PLOTTED VS. THE XRDATA. THE STANDARD DEVIATION DATA IS AUTOMATICALLY STORED AS ZPDATA.	
		XXXX	THE Z OR P COORDINATE VALUES WILL BE THE REAL OR INTEGER ID PARAMETER WITH THE NAME XXXX	(NONE)
		BAND(LL-UL)	THE Z OR P COORDINATE VALUES WILL BE THE AVERAGE RESPONSE IN THE WAVELENGTH BAND LL TO UL.	(NONE)
		FUNCTION OF XXXX AND/OR BAND(LL-UL).	(SEE XRDATA EXAMPLE)	
		XRDATAN	(SEE XRDATA)	(NONE)
		YTDATAN	(SEE XRDATA)	(NONE)
		ZPDATAN	(SEE XRDATA)	(NONE)
		FUNCTION OF DATA STORED IN THE XRDATAN,	YTDATAN, AND/OR ZPDATAN ARRAYS. (SEE XRDATA)	
		'NO CONTROL PARAMETER'	ZPDATA VS. XRDATA WILL NOT BE PLOTTED. I.E. ZPDATA CARDS WILL NOT BE EXPECTED.	

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
XRSCALE		SW	SPECIFIES THAT THE DEFFAULT SCALE WILL BE USED FOR X OR R (XR) AXIS. FOR RESPONSE VS. WAVELENGTH TYPE GRAPHS IT ALSO SPECIFIES THAT SHORT WAVELENGTH DATA BE PLOTTED,PRINTED AND/OR PUNCHED. THE DEFAULT IS .4 TO 2.4 USING EVERY SECOND SAMPLE. FOR OTHER TYPE GRAPHS THE DEFAULT WILL BE 0 TO MAXIMUM XR VALUE PLUS A DELTA TO MAKE A 'NICE' SCALE.	0.4, 2.4, 2 FOR WAVE-LENGTH, NICE SCALE FOR OTHER GRAPH TYPES-- 0, X(MAX)+ DELTA
		SW(LL,HH,II)	SETS SCALE OF THE XR AXIS TO HAVE A LOWER LIMIT OF LL AND AN UPPER LIMIT OF HH. FOR RESPONSE VS. WAVELENGTH TYPE GRAPHS EVERY II SAMPLE FROM LL TO HH MICROMETERS WILL BE READ FROM THE DATA TAPE FOR PLOTTING, PRINTING AND/OR PUNCHING.	
		SW(FULL)	SPECIFIES THAT THE LOWER LIMIT OF THE XR AXIS FOR SHORT WAVELENGTH DATA OR OTHER TYPE DATA BE THE MINIMUM XR VALUE AND THAT THE UPPER LIMIT BE THE MAXIMUM XR VALUE.	
		LW	SPECIFIES THAT LONG WAVELENGTH DATA BE PLOTTED AND THAT THE DEFAULT SCALE WILL BE USED FOR THE XR AXIS.	2.5,14,2
		LW(LL,HH,II)	SET THE SCALE OF THE XR AXIS FOR LONG WAVELENGTH DATA TO BE FROM LL TO HH. ALSO SPECIFIES THAT EVERY II SAMPLE FROM LL TO HH BE READ FROM DATA TAPE FOR PLOTTING, PRINTING AND/OR PUNCHING.	
		LW(FULL)	SPECIFIES THAT THE LOWER LIMIT OF THE XR AXIS FOR LONG WAVELENGTH DATA BE THE MINIMUM XR VALUE, AND THAT THE UPPER LIMIT BE THE MAXIMUM XR VALUE.	
YTSCALE		SW	SPECIFIES THAT THE DEFAULT SCALE WILL BE USED FOR Y OR THETA(T) AXIS (YT). FOR SHORT WAVELENGTH RESPONSE VS. WAVELENGTH TYPE GRAPHS, THE DEFAULT IS 0, 100. FOR OTHER TYPE GRAPHS THE DEFAULT IS 0 TO MAXIMUM YT VALUE PLUS A DELTA TO MAKE A 'NICE' SCALE.	0, 100 FOR RESPONSE, NICE SCALE FOR OTHER GRAPH TYPES-- 0, Y(MAX)+ DELTA
		SW(LL,HH)	SETS THE SCALE OF THE YT AXIS FOR SHORT WAVELENGTH RESPONSE VS WAVE-LENGTH TYPE GRAPHS AND OTHER TYPE GRAPHS TO BE FROM LL TO HH.	
		SW(FULL)	SPECIFIES THAT FOR THE YT AXIS OF SHORT WAVELENGTH DATA OR OTHER TYPE DATA, THAT THE LOWER LIMIT BE THE MINIMUM YT VALUE AND THE UPPER LIMIT BE THE MAXIMUM VALUE.	
		LW	SPECIFIES THAT THE DEFAULT SCALE BE USED FOR THE YT AXIS OF THE LONG WAVELENGTH DATA GRAPHS.	0, 1500
		LW(LL,HH)	SETS THE SCALE OF THE YT AXIS FOR LONG WAVELENGTH DATA TO BE FROM LL TO HH.	
		LW(FULL)	SPECIFIES THAT THE LOWER LIMIT OF THE YT AXIS FOR LONG WAVELENGTH DATA BE THE MINIMUM YT VALUE AND THAT THE UPPER LIMIT BE THE MAXIMUM YT VALUE.	

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
USET			SETS GRAPHICS COMPATIBILITY SYSTEM (GCS) PARAMETERS WHICH DEFINE THE TYPE OF GRAPH TO BE PLOTTED. THE MOST COMMONLY USED PARAMETRS ARE LISTED HERE IN ALPHABETICAL ORDER. HOWEVER, ANY GCS USET OPTION WHICH APPLIES MAY BE USED. SEE THE GCS USERS MANUAL FOR A COMPLETE DESCRIPTION OF ALL USET OPTIONS. OTHER USET OPTIONS THAT ARE NOT LISTED HERE REQUEST DIFFERENT TYPES OF LINES SUCH AS TIC LINES, LINES WITH ARROW TERMINATOR, LINES WITH ENDPOINT COORDINATES INDICATED, INVISIBLE LINES WITH ARROW TERMINATORS, ETC.	(NONE)
		AUTOSCALE	MAKE 'NICE' SCALES USING THE INPUT SCALE PARAMETERS - XRSCALE AND YTSCALE.	AUTOSCALE (ONLY FOR NONRESPONSE WAVELENGTH GRAPHS
		BESTFORMAT	NUMERIC LABEL OUTPUT IN BEST POSSIBLE FORMAT.	BESTFORMAT
		EDGEAXES	THE X AND Y AXES WILL BE DRAWN ALONG THE EDGE OF THE GRAPH NEXT TO THE LABELS	EDGEAXES
		FITLINEAR	FIT LINEAR (STRAIGHT) LINE TO POINTS.	
		FITPOLYNOMIAL	FIT LEAST SQUARES POLYNOMIAL TO POINTS.	
		FITSPLINE	FIT SPLINE CURVE TO POINTS.	
		GFORMAT	NUMERIC LABELS WILL BE IN REAL FORMAT	BESTFORMAT
		GRIDAXIS	GRAPH WILL HAVE A GRID BACKGROUND	TICAXES
		IFORMAT	NUMERIC LABELS WILL BE IN INTEGER FORMAT	BESTFORMAT
		LINXAXIS	X-AXIS WILL BE IN LINEAR CARTESION FORMAT.	LINXAXIS
		LINYAXIS	Y-AXIS WILL BE IN LINEAR CARTESION FORMAT.	LINYAXIS
		LNXAXIS	X AXIS WILL BE IN NATURAL LOGARITHMIC FORMAT. NATURAL LOG X AXIS DRAWING	LINXAXIS
		LNYAXIS	Y AXIS WILL BE IN NATURAL LOGARITHMIC FORMAT. NATURAL LOG Y AXIS DRAWING	LINYAXIS
		LOGARITHMIC	DATA WILL BE PLOTTED IN LOGARITHMIC UNITS.	RECTANGULAR
		LOGXAXIS	X AXIS WILL BE IN COMMON (BASE 10) LOGARITHMIC FORMAT. BASE TEN LOG DRAWING.	LINXAXIS
		LOGYAXIS	Y AXIS WILL BE IN COMMON (BASE 10) LOGARITHMIC FORMAT.BASE TEN LOG Y AXIS DRAWING	LINYAXIS
		NOAXES	NOAXES WILL BE DRAWN.	XYAXES
		NOXLABEL	NO X LABELS WILL BE DRAWN.	XBOTHLABEL
		NOYLABEL	NO Y LABEL WILL BE DRAWN.	YBOTHLABEL
		PIRADIANS	ANGULAR INFORMATION FOR POLAR GRAPHS WILL BE INTERPRETED IN PI RADIANS.	DEGREES
		PLAINAXIS	PLAIN AXES WILL BE DRAWN. (NO TIC MARKS)	TICAXES

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
USET (CONT.)		POLAR	PLOTTING WILL BE IN POLAR (RHO, THETA) UNITS.	RECTANGULAR
		RADIANS	ANGULAR INFORMATION FOR POLAR GRAPHS WILL BE INTERPRETED IN RADIANS.	DEGREES
		RECTANGULAR	PLOTTING WILL BE IN RECTANGULAR (X,Y) UNITS.	RECTANGULAR
		XALPHABETIC	AN ALPHABETIC LABEL WILL BE DRAWN FOR THE X AXIS.	XBOTHLABELS
		XAXIS	AN X AXIS WILL BE DRAWN	XYAXES
		XBOTHLABELS	BOTH ALPHABETIC AND NUMERIC LABELS WILL BE PRINTED ALONG X AXIS	XBOTHLABELS
		XEDGEYZERO YZEROXEDGE	THE X-AXIS WILL BE IN EDGEAXIS FORMAT AND THE Y AXIS WILL BE IN ZEROAXES FORMAT.	EDGEAXES
		XLOGARITHMIC	LOGARITHMIC X AND LINEAR Y PLOTTING.	RECTANGULAR
		XNUMERIC	A NUMERIC LABEL WILL BE DRAWN FOR X AXIS.	XBOTHLABELS
		XZEROYEDGE YEDGEXZERO	THE Y-AXIS WILL BE IN EDGEAXES FORMAT AND THE X-AXIS WILL BE IN ZEROAXES FORMAT.	EDGEAXIS
		YAXIS	THE Y AXIS WILL BE DRAWN.	XYAXES
		YALPHABETIC	AN ALPHABETIC LABEL WILL BE DRAWN FOR THE Y AXIS.	YBOTHLABELS
		YLOGARITHMIC	LOGARITHMIC Y AND LINEAR X PLOTTING	RECTANGULAR
		YNUMERIC	A NUMERIC LABEL WILL BE DRAWN FOR Y AXIS.	YBOTHLABELS
		ZEROAXES	THE X AND/OR Y AXIS WILL BE DRAWN ALONG THE ZERO VALUE IF THE ZERO VALUE FALLS BETWEEN THE MINIMUM AND MAXIMUM INPUT VALUES FOR THE X AND/OR Y AXES (XRSCALE & YTSCALE). THE LABELS WILL BE AT THE EDGE OF THE GRAPH.	EDGEAXES
		'NO CONTROL PARAMETER'	NO GLOBAL USET OPTIONS WILL BE PASSED TO GCS PLOTTING ROUTINES.	

KEY WORD	R E Q	CONTROL PARAMETER	FUNCTION	DEFAULT
UPSET			SETS GCS PARAMETERS WHICH SPECIFY THE VALUES OF CERTAIN OPTIONS TO BE USED IN PLOTTING THE GRAPH. THE MOST COMMONLY USED PARAMETERS ARE LISTED. HOWEVER ANY REAL OR INTEGER GCS UPSET OPTION WHICH APPLIES MAY BE USED. SEE THE GCS USER'S MANUAL FOR A COMPLETE DESCRIPTION OF UPSET PARAMETERS. THE THREE ALPHANUMERIC UPSET OPTIONS MAY BE ENVOKED USING THE XRLABEL, YTLABEL, AND OPTIONS SYMBOLS(X,Y,..) $GSPEC CONTROL CARDS.	(NONE)
		POLYNOMIAL-DEGREE(N)	SPECIFIES THE DEGREE OF THE POLYNOMIAL TO BE CREATED IN CALCULATING A LEAST SQUARES FIT THROUGH A COLLECTION OF POINTS. N IS LESS THAN OR EQUAL TO 10.	N = 2
		PRECISION(N)	SPECIFIES THE NUMBER (N) OF SIGNIFICANT DIGITS TO APPEAR WHEN DISPLAYING REAL NUMBERS ON THE GRAPH.	N = 4
		SETDASH(N)	SPECIFIES THE CHARACTERISTICS OF THE DASHED LINES TO BE PLOTTED. SEE OPTION LINES FOR DEFAULT SET.	SEE OPTIONS LINES
		TICINTERVAL(N)	SPECIFIES THE DISTANCE IN CURRENT USER UNITS BETWEEN TIC MARKS OF A TICKED LINE.	(GCS CAL-CULATED)
		TICX(N)	SPECIFIES THE DISTANCE BETWEEN TIC MARKS OR GRID LINES ALONG X AXIS.	(GCS CAL-CULATED)
		TICY(N)	SPECIFIES THE DISTANCE BETWEEN TIC MARKS OR GRID LINES ALONG Y AXIS.	(GCS CAL-CULATED)
		'NO CONTROL PARAMETER'	NO GLOBAL UPSET OPTIONS WILL BE PASSED TO GCS PLOTTING ROUTINES.	
OUTPUT		VARIAN	GRAPH WILL BE PLOTTED ON VARIAN	LPRINTER
		TERMINAL	GRAPH WILL BE PLOTTED ON TERMINAL	LPRINTER
		LPRINTER	GRAPH WILL BE PLOTTED ON LINE FRINTER.	

KEY WORD	R E C	CONTROL PARAMETER	FUNCTION	DEFAULT
OPTIONS		PRINT NOPRINT	PRINTS A COPY OF THE GRAPHED DATA. TURNS OFF ABOVE.	NOPRINT
		STD -- -- NOSTD	STANDARD DEVIATIONS FOR THE CLASS AVERAGE AT EACH WAVELENGTH WILL BE GRAPHED AND PRINTED IF PRINT OPTION ON. TURNS OFF ABOVE.	NOSTD
		PUNCH -- NOPUNCH	PUNCHES A COPY OF THE GRAPHED DATA IN BINARY. TURNS OFF ABOVE.	NOPUNCH
		SYMBOLS(A,...)	DEFINES SYMBOLS USED ON GRAPHS IN ORDER OF CLASS. THE DEFAULT WILL BE 1,2,3,...9,A FOR LPRINTER OR TERMINAL OUTPUT AND OTHER TYPE GRAPHS ON THE VARIAN. THE DEFAULT IS DASHED LINES FOR RESPONSE VS. WAVELENGTH GRAPHS ON THE VARIAN. THE DEFAULT FOR EITHER CHARACTER OR LINES MAY BE OVERRIDDEN WITH 'USET DASH' OR 'USET CHARACTER'. DIFFERINT TYPES OF DASHED LINES MAY BE REQUESTED USING 'UPSET SETDASH(N)'.	DEFINED
		CENTERBAND	CENTERBAND DATA WILL BE PLOTTED. EACH BAND WILL BE REPRESENTED BY ONE DATA VALUE. (DEFAULT FOR SPECTROMETER DATA.)	
		FULLBAND	FULLBAND DATA WILL BE PLOTTED. EACH BAND WILL BE REPRESENTED BY THREE DATA VALUES. (DEFAULT FOR RADIOMETER DATA. MAY NOT BE SPECIFIED FOR SPECTROMETER TYPE DATA.)	
		NOGRAPH GRAPH	SUPRESSES PRINTING OF GRAPH. TURNS OFF ABOVE.	GRAPH
		TAPE(N1,N2,..)	TAPE(S) N1,N2,... WILL BE SEARCHED FOR DATA. THE LIMIT ON THE NUMBER OF TAPES IS FIVE. THIS WILL RESET $TAPE.	(NONE)
		TPLOT -- NOTPLOT	PLOTS EQUIVALENT BLACK BODY TEMPERATURE. TURNS OFF ABOVE.	NOTPLOT
		INTERACTIVE -- -- NOINTERACTIVE	ALLOWS THE USER TO OPERATE INTERACTIVELY WITH THIS SET OF CONTROL AND/OR CLASS CARDS. TURNS OFF ABOVE.	NOINTERACT
		LINES(X1,...X10)	DEFINES THE CHARACTERISTICS OF THE DASHED LINES TO BE PLOTTED. THE DEFAULT SET IS GIVEN IN ORDER OF CLASS. SEE THE UPSET SETDASH OPTICN IN THE GCS MANUAL FOR MORE INFORMATION	77,92,9434, 32, 92943234, 9272,3454, 9434,12,3234
		SIZEGRAPH (XL,XU,YL,YU)	SETS THE LOCATION AND PHYSICL SIZE OF THE GRAPH ON OUTPUT DEVICE IN INCHES FROM XL TO XU IN X DIRECRION AND FROM YL TO YU IN THE Y DIRECTICN.	DEFAULT FOR PARTICULAR OUTPUT DEVICE
		SIZEGRAPH	SIZE OF GRAPH WILL BE DEFAULT FOR OUTPUT DEVICE.	
		NOCONTROLCARDS -- CONTROLCARDS	SUPRESS PRINTING OF CONTROL CARDS WITH OUTPUT. TURNS OFF ABOVE.	CONTROL-CARDS

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
OPTIONS CONT.		HOLDGRAPH	PLOTTING OF GRAPH TO OUTPUT DEVICE WILL NOT BE DONE FOR THIS PROCESING REQUEST. ALLOWS USER TO PUT MORE THAN ONE GRAPH ON OUTPUT DEVICE 'PAGE' (ALSO NEED TO USE 'SIZEGRAPH' TO DEFINE LOCATION).	DRAWGRAPH
		DRAWGRAPH	GRAPH WILL BE SENT TO OUTPUT DEVICE.	
PLOTCLASS		N1,N2...	SPECIFIES THAT ONLY CLASSES N1,N2... BE PLOTTED, PRINTED, AND/OR PUNCHED	ALL CLASSES
		'NO CONTROL PARAMETERS'	ALL CLASSES WILL BE PLOTTED, PRINTED, AND/OR PUNCHED.	
TITLE		(XXXX)	DEFINES THE SIZE OF THE CHARACTERS FOR THE TITLE (ONLY APPLICABLE FOR VARIAN OUTPUT). SIZE MAY BE SMALL, MEDIUM, LARGE, EXTRALARGE.	MEDIUM
		A...A	SPECIFIES TITLE TO BE PLACED ABOVE GRAPH. LIMIT IS 59 CHARACTERS. NOTE-- ONLY DEFAULT IS FOR SINGLE RUN PLOTTING OF RESPONSE VS. WAVELENGTH DATA AND CURVE FITS.	(SEE NOTE)
		'NO CONTROL PARAMETER'	DEFAULT TITLE IF APPLICABLE WILL BE USED.	
XRLABEL		A...A	LABEL OF UP TO 40 CHARACTERS TO BE PLACED BELOW X AXIS. THE STANDARD SET FOR RESPONSE VS. WAVELENGTH GRAPHS IS 'WAVELENGTH(UM)'. THE STANDARD SET FOR OTHER GRAPH TYPES WHERE POSSIBLE ARE THE XRDATA CONTROL PARAMETERS.	STANDARD SET
		'NO CONTROL PARAMETER'	DEFAULT X LABEL IF APPLICABLE WILL BE USED.	
YTLABEL		A...A	LABEL OF UP TO 40 CHARACTERS TO BE PLACED TO THE LEFT OF Y AXIS. THE STANDARD SET FOR RESPONSE VS. WAVELENGTH ARE THE UNITS OF THE RESPONSE VALUES. THE STANDARD SET FOR THE OTHER GRAPH TYPES WHERE POSSIBLE ARE THE YTDATA CONTROL PARAMETERS.	STANDARD SET
		'NO CONTROL PARAMETER'	DEFAULT Y LABEL IF APPLICABLE WILL BE USED.	
END	*		END OF SUPERVISOR CONTROL CARDS SUPERVISOR CONTROL CARDS OR CLASS CARDS MAY FOLLOW.	

CLASS	*	NNNNNN	START OF CLASS NNNNNN MAXIMUM NUMBER OF CLASSES ALLOWED IS 10 FOR A GRAPH. REQUIRED WITH SELECT.
SELECT		SAME AS FOR SELECT ABOVE.	
XRDATA		SAME AS FOR XRDATA ABOVE.	
YTDATA		SAME AS FOR YTDATA ABOVE.	
ZPDATA		SAME AS FOR ZPDATA ABOVE	
USET		SAME AS FOR USET ABOVE.	
UPSET		SAME AS FOR UPSET ABOVE.	
*END	*		END OF CLASS CARDS

$END RETURN TO MONITOR

*** NOTES

ON CONTROL CARD LIST, IF OPTION ALL IS SPECIFIED ONLY THE OPTION NOSUPRES CAN BE ALSO SPECIFIED ON THE SAME CARD.

OPTIONS STD AND TPLOT MAY NOT BE USED IN THE SAME PROCESSING REQUEST.

** EITHER THE GRAPH OR SELECT CARD IS REQUIRED THEY MAY NOT BE USED IN THE SAME PROCESSING REQUEST.

ON THE OUTPUT CONTROL CARD ONLY ONE PARAMETER MAY BE SPECIFIED.

RESPONSE-WAVELENGTH, BAND/ID, OR XRDATAN/YTDATAN/ZPDATAN TYPE GRAPHS CANNOT BE MIXED IN THE SAME PROCESSING REQUEST.

'KILL' MAY BE ENTERED TO STOP EXECUTION OF THE JOB WHEN IN INTERACTIVE MODE OR WHEN THE USER IS REQUESTED TO CORRECT A CONTROL CARD.

ONLY THE FIRST FOUR CHARACTERS OF ANY KEY WORD OF A CONTROL PARAMETER NEEDS TO BE USED. EXAMPLES-- XRDA XRDA2/XRDA3, OR OPTI SYMB(.).

THERE IS A LIMIT OF 9 DIFFERENT PARAMETERS (XXXX AND BAND(LL-UL) OR XRDATAN AND YTDATAN AND ZPDATAN) WITHIN A FUNCTION. THERE IS AN OVERALL LIMIT OF 30 PARAMETERS FOR ALL FUNCTIONS WITHIN THE SAME PROCESSING REQUEST.

THERE IS A LIMIT OF 30,000 VALUES (OR WORDS) FOR THE DATA, THE SELECT TABLE, THE LIST TABLE , AND THE BANDS TABLE. THE NUMBER OF VALUES (OR WORDS) NEEDED FOR DATA CAN BE FOUND USING THE FOLLOWING EQUATION--

VALUES = (NO. CLASSES) X (NO. DIMENSIONS) X
(NO. PAIRED POINTS/CLASS)

IN GENERAL UP TO 27,000 OR 28,000 VALUES ARE AVAILABLE FOR DATA.

EXAMPLE--
(10 CLASSES) X (3 DIMENSIONS) X (900 PAIRED POINTS/CLASS)
= 27,000 VALUES

ONE MAY USE A COMBINATION OF THE SAME ID PARAMETER WITH AND WITHOUT THE NOT SIGN, BUT THE RESULT WILL BE ALL RUNS USED.

EXAMPLE--
SELECT OBNU(10-30),-OBNU(20,22) = ALL RUNS

***** INTERACTIVE CONTROL PARAMETERS *****

INPUT	FUNCTION
SUPERVISOR KEYWORD & CONTROL PARAMETER	RESETS CURRENT PARAMETERS WITH THOSE SPECIFIED ON INPUT.
FIND N OR F N	GO TO THE NTH CLASS TO INSERT OR CHANGE REQUESTS OR ADD A CLASS. 'F O' WILL PUT YOU BACK INTO THE GLOBAL AREA.
NEXT OR N	GRAPH THE NEXT SET OF DATA FOR SINGLE RUN PLOTTING ('GRAPH' REQUEST)
PRINT OR P	PRINT CURRENT $GSPEC STATUS AREA FLAGS AT THE TERMINAL IN THE FORM OF CONTROL CARDS FOR BOTH GLOBAL AND CLASS AREAS.
PRINT GLOBAL OR P GL	PRINT ONLY THE GLOBAL STATUS AREA.
PRINT CLASS OR P CL	PRINT ONLY THE CLASS STATUS AREA.
QUIT OR Q	END INTERACTION SESSION -- GO TO READER FOR NEXT PROCESSING REQUEST.
RUN OR R	EXECUTE JOB USING REQUESTED DATA WITH THE PRESENT STATUS OF THE $GSPEC STATUS AREA FLAGS.
TOP OR T	BEGIN CHANGING CONTROL CARDS AGAIN. THAT IS, WANT TO ERASE RATHER THAN ADD PARAMETERS TO 'GRAPH', 'SELECT', 'LIST', 'USET' OR 'UPSET'.
DELETE OR D	DELETE THE ENTIRE SET OF CURRENT CLASS CARDS-- I.E., CLASS REACHED VIA THE 'FIND' COMMMAND.

***** $IDLIST CONTROL CARDS *****

KEY WORD	REQ	CONTROL PARAMETER	FUNCTION	DEFAULT
$IDLIST	*		REQUEST LISTING OF ID INFORMATION	
SELECT	*	XXXX(LL-UL)	LISTS ID DATA FOR RUNS WITH ID PARAMETER XXXX WITHIN THE LIMITS LL TO UL.	RUSE(1-9999)
		XXXX(LL-UL+L)	SAME AS ABOVE AND BY INCREMENTS OF L. (NO INCREMENT FOR REAL)	INCREMENTS INTEGER 1
		XXXX(L1,L2,...)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO L1 OR L2 OR A COMBINATION OF THE ABOVE CONTROL PARAMETERS FOR SELECT MAY BE USED.	
		XXXX(A...A)	LISTS ID DATA FOR RUNS WITH ID PARAMETER XXXX EQUAL TO A...A.	(NONE)
		XXXX(A..A:B..B)	SELECTS RUNS WITH ID PARAMETER XXXX EQUAL TO A..A OR B..B.	
		-XXXX( )	SELECTS RUNS WITH ID PARAMETER XXXX EXCEPT THOSE SPECIFIED RUNS, OR THOSE OUTSIDE SET LIMITS.	(SEE NOTE AT END)
		.OR.	END OF ONE CONDTION SET.	
LIST		XXXX	FOR EACH RUN LISTED THE ID PARAMETER WITH THE NAME XXXX IS PRINTED.	ONELINE PRINTED
		ALL	FOR EACH RUN LISTED ALL ID PARAMETERS WILL BE PRINTED. THOSE WITH NULL NULL VALUES WILL BE SUPPRESSED.	ONELINE PRINTED
		NOSUPRES	FOR EACH RUN LISTED ALL ID PARAMETERS WILL BE PRINTED, INCLUDING THOSE WHICH HAVE NULL VALUES. THOSE WITH NULL VALUES WILL BE PRINTED WITH ASTERISKS AS THEIR VALUE.	ONELINE PRINTED
		NOLIST	LISTING WILL BE SUPPRESSED FOR THIS PROCESSING FUNCTION.	ONELINE PRINTED
		ONELINE	A ONE LINE LISTING WILL BE PRODUCED.	
OPTION		TAPE(N1,N2,..)	DATA TAPE N1,N2,.. WILL BE SEARCHED FOR DATA. THE LIMIT ON THE NUMBER OF TAPES IS FIVE. THIS WILL RESET $TAPE.	(NONE)
		COPYDISK	COPIES THE DATA FROM TAPE TO DISK.	
CASES		AGRONOMIC	PUNCH AGRONOMIC HEADER INFORMATION	NOAGRON
		NOAGRON	SUPPRESS PUNCHING AGRONOMIC INFORMATION	
		GEOMETRIC	PUNCH GEOMETRIC HEADER INFORMATION	NOGEOM
		NOGEOM	SUPPRESS PUNCHING GEOMETRIC INFORMATION	
END	*		END OF SUPERVISOR CONTROL CARDS ADDITIONAL SUPERVISOR CONTROL DECKS MAY FOLLOW.	
$END	*		RETURN TO MONITOR.	

***** $IDLIST CONTROL CARDS *****

*** NOTE

ON CONTROL CARD LIST, IF OPTION ALL IS SPECIFIED ONLY THE OPTION NOSUPRES CAN BE ALSO SPECIFIED ON THE SAME CARD.

ONE MAY USE A COMBINATION OF THE SAME ID PARAMETER WITH AND WITHOUT THE NOT SIGN, BUT THE RESULT WILL BE ALL RUNS USED.
EX: SELECT OBNU(10-30),-OBNU(20,22) = ALL RUNS

Appendix B

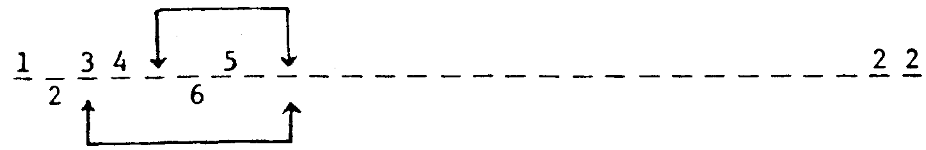
Purdue/LARS Field Spectrometer/Radiometer Data Storage Tape Format

LARS Field Spectroradiometer

Data Storage Tape Format

10/18/79

Tape Format Diagram



1. Tape identifier
2. Tape file mark
3. Run identification record
4. Sample Group Record
5. Data records
6. One complete run

Tape Identifier

The tape identifier consists of 8 words or 32 bytes. Word 1 is the tape number in EBCDIC character format. Words 2 through 8 contain an alphanumeric character string identifying the tape use. The character string is: FIELD SPECTRORADIOMETER DATA.

Run Identification Record

The run ID record is a list of run descriptors. There are two different sets of run descriptors. One set is for crops descriptor information and one set is for soils descriptor information. The descriptors vary in type from general such as date and time to specialized such as soil Munsell color. Not all descriptors are applicable to every run and therefore, for a given run many will be unused. There are five types of descriptors with respect to format; they are: Integer full word, real full word, and alphanumeric strings of lengths 4, 8, and 16. In addition, there is a 148 character field for comments. The descriptor positions, names and formats are given below.

Run Identification Record
(Crops)

Word(s)	'IDNAM2(i,1)' Index	Code	Name	Format
1	1	RUSE	Run sequencer	Integer
2	8	SENU	Serial number	Integer
3	10	EXNU	Experiment number	Integer
4	7	OBNU	Observation number	Integer
5	2	DACO	Data data collected (yymmdd)	Integer
6	3	MODA	Month data collected	Integer
7	4	DADA	Day data collected	Integer
8	5	YEDA	Year data collected	Integer
9	9	TIDA	Time data collected	Integer
10-13	11	EXNA	Experiment name	Alphanumeric (4A4)
14-17	12	PRIN	Principal investigator	Alphanumeric (4A4)
18-21	13	SCTY	Scene type	Alphanumeric (4A4)
22-25	14	LOCA	Location	Alphanumeric (4A4)
26	15	AITE	Air temperature (°C)	Real
27	16	BAPR	Barometric pressure (mmHg)	Real
28	17	REHU	Relative humidity (%)	Real
29	18	CLCO	Cloud cover (%)	Integer
30	19	WISP	Wind speed (km/hr)	Integer
31	20	VISI	Visibility (kilometers)	Integer
32-35	21	CLTY	Cloud type and altitude	Alphanumeric (4A4)
36	22	WIDI	Wind direction	Integer
37	24	REDA	Reformatting date (yymmdd)	Integer
38	25	RECA	*Reformatting calibration code	Integer
39	34	IRZE	Irradiance zenith angle(degrees)	Integer
40	36	VIZE	View zenith angle (degrees)	Integer
41	37	VIAZ	View azimuth angle (degrees clockwise from north)	Integer
42	38	DIGR	Distance to ground (meters)	Real
43	39	FOCA	Focal distance (meters)	Real
44	135	FIVI	Field of view (degrees)	Real
45-46	40	LOLA	Location latitude	Alphanumeric (2A4)
47-48	41	LOLO	Location longitude	Alphanumeric (2A4)
49-50	42	FLLI	Flight line	Alphanumeric (2A4)

Run Identification Record (cont.)
(Crops)

Word(s)	'IDNAM2(i,1)' Index	Code	Name	Format
51-54	43	PHSE	Photograph serial no.	Alphanumeric (4A4)
55	27	NUSG	Number of sample groups	Integer
56	47	LOF1	Level(s) of factor 1	Integer
57	48	LOF2	Level(s) of factor 2	Integer
58	49	LOF3	Level(s) of factor 3	Integer
59	50	LOF4	Level(s) of factor 4	Integer
60	51	LOF5	Level(s) of factor 5	Integer
61	52	LOF6	Level(s) of factor 6	Integer
62	55	FINU	Field number	Integer
63	58	RENU	Replication number	Integer
64	57	PLNU	Plot number	Integer
65-68	59	SPEC	Species	Alphanumeric (4A4)
69-72	60	VARI	Variety	Alphanumeric (4A4)
73-76	61	MATU	Maturity	Alphanumeric (4A4)
77	69	HEIG	Height (meters)	Real
78	63	ROWI	Row width (meters)	Real
79	67	PLCO	Plant count (per sq. meter)	Real
80	68	FRCO	Fruit count (per sq. meter)	Real
81	74	PEGR	Percent ground cover (1%)	Integer
82	70	LEPL	Leaves per plant (av. no.)	Real
83	85	LEAR	Leaf area index	Real
84	89	MOST	Moisture stress (yes or no)	Alphanumeric (A4)
85	90	NUDE	Nutrient deficiency (yes or no)	Alphanumeric (A4)
86	91	WEED	Weedy (yes or no)	Alphanumeric (A4)
87	92	DIIN	Disease infection (yes or no)	Alphanumeric (A4)
88	93	ININ	Insect infection (yes or no)	Alphanumeric (A4)
89	94	HAWI	Hail or wind damage (yes or no)	Alphanumeric (A4)
90	95	LODA	Lodgind damage (yes or no)	Alphanumeric (A4)
91	96	OTST	Other stress (yes or no)	Alphanumeric (A4)
92-101	179	STCO	Stress comments	Alphanumeric (10A4)
102-107			Not used	
108	88	GMOS	Grain moisture content for yield measurement (%)	Real
109	62	NMAT	Maturity stage - numerical	Real
110	80	YELD	Crop yield (kg/ha)	Real
111	87	TSWT	Grain test weight (kg/hectileter)	Real

Run Identification Record (cont.)
(Crops)

Word(s)	'IDNAM2(i,1)' Index	Code	Name	Format
112	84	PMOW	Plant moisture weight (g/sq.m)	Real
113	6	JUDA	Julian day of year	Integer
114	66	DAPL	Days since planting	Integer
115	30	CATN	Calibration table number	Integer
116	35	IRAZ	Irradiance azimuth angle (degrees clockwise from north)	Integer
117-118	31	ILLU	Illumination	Alphanumeric (2A4)
119	26	LAID	Latest ID update (yymmdd)	Integer
120	64	RODI	Row direction	Alphanumeric (A4)
121	65	PLDA	Planting data (yymmdd)	Integer
122	75	DBTO	Dry biomass - total (g/sq.m)	Real
123	76	DBGL	Dry biomass - green leaves (g/sq.m)	Real
124	77	DBYL	Dry biomass - yellow leaves (g/sq.m)	Real
125	78	DBBL	Dry biomass - brown leaves (g/sq.m)	Real
126	79	DBST	Dry biomass - stems (g/sq.m)	Real
127	80	DBFR	Dry biomass - fruit (g/sq.m)	Real
128-131	97	SENA	Series name	Alphanumeric (4A4)
132	98	PESA	Percent sand content	Real
133	99	PESI	Percent silt content	Real
134	100	PECL	Percent clay content	Real
135-138	101	TEXT	Texture, (field)	Alphanumeric (4A4)
139-142	102	MUCO	Munsell color	Alphanumeric (4A4)
143-146	103	MOFI	Moisture (field) content	Alphanumeric (4A4)
147	104	MOLA	Moisture (laboratory) content (%)	Real
148-151	105	SUCO	Surface condition	Alphanumeric (4A4)
152	106	DRCL	Drainage class	Integer
153-154	107	HORI	Horizon	Alphanumeric (2A4)
155	44	PHRO	Number of photograph roll	Integer
156-157	45	PHFR	Photograph frames	Alphanumeric (2A4)
158	108	TATE	Target temperature (°C)	Real
159	111	TALE	Target length (meters)	Real

Run Identification Record (cont.)
(Crops)

Word(s)	'IDNAM2(i,1)' Index	Code	Name	Format
160	110	TAWI	Target width (meters)	Real
161	56	FIAR	Field area (hectares)	Real
162	83	PLMO	Plant moisture (percent)	Integer
163	71	GRLE	Leaf condition - percent green	Integer
164	72	YELE	Leaf condition - percent yellow	Integer
165	73	BRLE	Leaf condition - percent brown	Integer
166			Not used	
167	81	DBWE	Dry biomass - weeds (g/sq.m)	Real
168	82	FRBI	Fresh biomass - total (g/sq.m)	Real
170	112	EP01	Experimenter's parameter 01	Real
171	113	EP02	Experimenter's parameter 02	Real
172	114	EP03	Experimenter's parameter 03	Real
173	185	EP04	Experimenter's parameter 04	Real

Run Identification Record (cont.)
(Crops)

Word(s)	'IDNAM2(i,1)' Index	Code	Name	Format
174	116	EP05	Experimenter's parameter 05	Real
175	117	EP06	Experimenter's parameter 06	Real
176	118	EP07	Experimenter's parameter 07	Real
177	119	EP08	Experimenter's parameter 08	Real
178	120	EP09	Experimenter's parameter 09	Real
179	121	EP10	Experimenter's parameter 10	Real
180	109	RATE	Radiant Temperature (°C)	Real
181	23	WBTE	Wet bulb temperature (°C)	Real
182-183	122	DQF1	Data quality factor 1	2*Real
184-185	123	DQF2	Data quality factor 2	2*Real
186-187	124	DQF3	Data quality factor 3	2*Real
188-189	125	DQF4	Data quality factor 4	2*Real
190-191	126	DQF5	Data quality factor 5	2*Real
192-193	127	DQF6	Data quality factor 6	2*Real
194-195	128	DQF7	Data quality factor 7	2*Real
196-199	129	FANA	Facility name	Alphanumeric (4A4)
200-236	180	COMM	Comments	Alphanumeric(37A4)
237-240	130	INNA	Instrument name	Alphanumeric (4A4)
241	132	SCRA	Scan rate	Real
242	28	CAOB	Calibration observation number	Integer
243			Not used	
244	133	HISQ	High square wave voltage level	Real
245	134	LOSQ	Low square wave voltage level	Real
246	32	TC01	Thermal calibration observation 1	Integer
247	33	TC02	Thermal calibration observation 2	Integer
248	46	RIRF	Run Identification Record Set	Integer
249	53	LOF7	Level(s) of Factor 7	Integer
250	54	LOF8	Level(s) of Factor 8	Integer
251-260			Not used	
261	131	*INST	Instrument Type	Integer
262		UNCA	Uncalibrated data flag	Integer
263	29	COB2	Reflective wavelength calibration observation 2	Integer
264-300			Not used	

Run Identification Record

(Soils)

Word(s)	'IDNAM2(i,2)' Index	Code	Name	Format
1	1	RUSE	Run Sequence	Integer
2	8	SENU	Serial Number	Integer
3	10	EXNU	Experiment Number	Integer
4	7	OBNU	Observation Number	Integer
5	2	DACO	Date Data Collected(yymmdd)	Integer
6	3	MODA	Month Data Collected	Integer
7	4	DADA	Day Data Collected	Integer
8	5	YEDA	Year Data Collected	Integer
9	9	TIDA	Time Data Collected	Integer
10 - 13	11	EXNA	Experiment Name	Alphanumeric (4A4)
14 - 17	12	PRIN	Principal Investigator	Alphanumeric (4A4)
18 - 21	13	SCTY	Scene Type	Alphanumeric (4A4)
22 - 25	14	LOCA	Location	Alphanumeric (4A4)
26	15	AITE	Air Temperature (°C)	Real
27	16	BAPR	Barometric Pressure (mmHg)	Real
28	17	REHU	Relative Humidity (%)	Real
29	18	CLCO	Cloud Cover (%)	Real
30	19	WISP	Wind Speed (km/hr)	Integer
31	20	VISI	Visibility (kilometers)	Integer
32 - 35	21	CLTY	Cloud Type and Altitude	Alphanumeric (4A4)
36	22	WIDI	Wind Direction	Integer
37	24	REDA	Reformatting Date (yymmdd)	Integer
38	25	RECA	*Reformatting Calibration Code	Integer
39	34	IRZE	Irradiance Zenith Angle (degrees)	Integer
40	36	VIZE	View Zenith Angle (degrees)	Integer
41	37	VIAZ	View Azimuth Angle (degrees clockwise from north)	Integer

Run Identification Record (cont.)

(Soils)

Word(s)	'IDNAM2(i,2)' Index	Code	Name	Format
42	38	DIGR	Distance to Ground (meters)	Real
43	39	FOCA	Focal Distance (meters)	Real
44	160	FIVI	Field of View (degrees)	Real
45 - 46	40	LOLA	Location Latitude	Alphanumeric (2A4)
47 - 48	41	LOLO	Location Longitude	Alphanumeric (2A4)
49 - 50	42	FLLI	Flightline	Alphanumeric (2A4)
51 - 54	43	PHSE	Photograph Serial Number	Alphanumeric (4A4)
55	27	NUSG	Number of Sample Groups	Integer
56	47	LOF1	Level(s) of Factor 1	Integer
57	48	LOF2	Level(s) of Factor 2	Integer
58	49	LOF3	Level(s) of Factor 3	Integer
59	50	LOF4	Level(s) of Factor 4	Integer
60	51	LOF5	Level(s) of Factor 5	Integer
61	52	LOF6	Level(s) of Factor 6	Integer
62	53	ORDR	Order	Alphanumeric (A4)
63	54	SUBO	Suborder	Alphanumeric (A4)
64 - 65	55	GRGR	Great Group	Alphanumeric (2A4)
66	56	PASI	Particle Size Class	Integer
67	57	COPA	Contrasting Particle Size Class	Integer
68	58	MICL	Minerology Class	Integer
69	59	OMOD	Other Modifiers	Integer
70 - 71	60	TERE	Temperature Regime	Alphanumeric (2A4)
72 - 73	61	MOZO	Moisture Zone	Alphanumeric (2A4)
74	63	SLOP	Slope Class	Integer
75	64	EROS	Erosion Phase	Integer
76	65	PHYS	Physiographic Position	Integer
77	66	PAMA	Parent Material	Integer

Run Identification Record (cont.)

(Soils)

Word(s)	'IDNAM2(i,2)' Index	Code	Name	Format
78 - 81	67	SUNA	Subgroup Name	Alphanumeric (4A4)
82	69	YEAR	Year Soil Sample Collected	Integer
83	70	STAB	State Abbreviation	Alphanumeric (A4)
84	71	COCO	County Code	Integer
85	72	MSNU	Multiple Sampling Number	Integer
86	73	CSNU	Consecutive Sampling Number	Integer
87	75	STLN	Soil Testing Lab Number	Integer
88	76	ORCA	Organic Carbon (%)	Real
89	77	WAPH	Water pH	Real
90	78	BUPH	Buffer pH	Real
91	79	CALC	Calcium (meq/100g)	Real
92	80	MAGN	Magnesium (meq/100g)	Real
93	81	SODI	Sodium (meq/100g)	Real
94	82	POTA	Potassium (meq/100g)	Real
95	83	EXAC	Extractable Acidity (meq/100g)	Real
96	84	CAEX	Cation Exchange Capacity	Real
97	85	BASA	Base Saturation (%)	Integer
98	86	IRON	Iron Oxide (%)	Real
99	87	ALUM	Aluminum Oxide (%)	Real
100	88	MANG	Manganese Oxide (%)	Real
101	89	SILI	Silicon Dioxide (%)	Real
102	90	AVPH	Available Phosphorous (kg/hectare)	Integer
103	91	AVPO	Available Potassium (kg/hectare)	Integer
104	92	MOTE	Soil Moisture Tension (bars)	Real
105	101	SAND	Sand Content (%)	Real
106	102	SILT	Silt Content (%)	Real
107	103	CLAY	Clay Content (%)	Real

Run Identification Record (cont.)
(Soils)

Word(s)	'IDNAM2(i,2)' Index	Code	Name	Format
108	104	VCSA	Very Coarse Sand (%)	Real
109	105	COSA	Coarse Sand (%)	Real
110	106	MESA	Medium Sand (%)	Real
111	107	FISA	Fine Sand (%)	Real
112	108	VFSA	Very Fine Sand (%)	Real
113	6	JUDA	Julian Day of Year	Integer
114			Not used	
115	30	CATN	Calibration Table Number	Integer
116	35	IRAZ	Irradiance Azimuth Angle (degrees clockwise from north)	Integer
117 - 118	31	ILLU	Illumination	Alphanumeric (2A4)
119		LAID	Latest ID Update (yymmdd)	Integer
120	109	COSI	Coarse Silt (%)	Real
121			Not used	
122	111	ELCO	Electrical Conductivity (mmhos/cm)	Real
123	112	ERFA	Erosion Factor (k)	Real
124	113	WIER	Wind Erodibility Group	Integer
125	114	ELNU	Engineering Lab Number	Integer
126	115	SAPO	Sample Portion	Real
127	116	LILI	Liquid Limit	Integer
128 - 131	68	SENA	Soil Series Name	Alphanumeric (4A4)
132	117	PLLI	Plastic Limit	Integer
133	119	ACTI	Activity	Integer
134	120	LIIN	Liquidity Index	Integer
135 - 138	100	TEXT	Textural Class	Alphanumeric (4A4)
139 - 142	95	MUCO	Munsell Color (moist)	Alphanumeric (4A4)
143	121	SHLI	Shrinkage Limit	Integer
144	122	SHRA	Shrinkage Ratio	Real
145	123	VOSH	Volumetric Shrinkage	Real

Run Identification Record (cont.)

(Soils)

Word(s)	'IDNAM2(i,2)' Index	Code	Name	Format
146	124	LISH	Linear Shrinkage	Real
147	125	COIN	Compression Index	Real
148	126	MSAN	Medium Sand (%)	Real
149	127	FSAN	Fine Sand (%)	Real
150	128	FINE	Fines	Real
151	129	SPGR	Specific Gravity (g/cm^3)	Real
152	62	DRCL	Drainage Class	Integer
153 - 154	74	HORI	Horizon	Alphanumeric (2A4)
155	44	PHRO	Photograph Roll Number	Integer
156 - 157	45	PHFR	Photograph Frames	Alphanumeric (2A4)
158 - 159	130	ASHO	AASHO Soil Classification	Alphanumeric (2A4)
160 - 169	279	SUDE	Surface Description	Alphanumeric (10A4)
170	134	EP01	Experimenter's Parameter 01	Real
171	135	EP02	Experimenter's Parameter 02	Real
172	136	EP03	Experimenter's Parameter 03	Real
173	137	EP04	Experimenter's Parameter 04	Real
174	138	EP05	Experimenter's Parameter 05	Real
175	139	EP06	Experimenter's Parameter 06	Real
176	140	EP07	Experimenter's Parameter 07	Real
177	141	EP08	Experimenter's Parameter 08	Real
178	142	EP09	Experimenter's Parameter 09	Real
179	143	EP10	Experimenter's Parameter 10	Real
180	133	RATE	Radiant Temperature (°C)	Real
181	23	WBTE	Wet Bulb Temperature (°C)	Real
182 - 183	147	DQF1	Data Quality Factor 1	2*Real
184 - 185	148	DQF2	Data Quality Factor 2	2*Real
186 - 187	149	DQF3	Data Quality Factor 3	2*Real

Run Identification Record (cont.)

(Soils)

Word(s)	'IDNAM2(1,2)' Index	Code	Name	Format
188 - 189	150	DQF4	Data Quality Factor 4	2*Real
190 - 191	151	DQF5	Data Quality Factor 5	2*Real
192 - 193	152	DQF6	Data Quality Factor 6	2*Real
194 - 195	153	DQF7	Data Quality Factor 7	2*Real
196 - 199	154	FANA	Facility Name	Alphanumeric (4A4)
200 - 236	180	COMM	Comments	Alphanumeric (37A4)
237 - 240	155	INNA	Instrument Name	Alphanumeric (4A4)
241	157	SCRA	Scan Rate	Real
242	28	CAOB	Calibration Observation Number	Integer
243	131	UNIF	Unified Soil Classification	Alphanumeric (A4)
244	158	HISQ	High Square Wave Voltage Level	Real
245	159	LOSQ	Low Square Wave Voltage Level	Real
246	32	TCO1	Thermal Calibration Observation 1	Integer
247	33	TCO2	Thermal Calibration Observation 2	Integer
248	46	*RIRF	Run Identification Record Set	Integer
249	132	SOEL	Soil Elevation (meters)	Integer
250	144	EP11	Experimenter's Parameter 11	Real
251	145	EP12	Experimenter's Parameter 12	Real
252	146	EP13	Experimenter's Parameter 13	Real
253	93	WACO	Water Content (%)	Real
254	94	BUDE	Bulk Density (g/cm^3)	Real
255	118	PLIN	Plasticity Index	Integer
256	110	FISI	Fine Silt (%)	Real
257	96	HUE1	Munsell Color Hue 1 (moist)	Real
258	97	HUE2	Munsell Color Hue 2 (moist)	Alphanumeric (A4)
259	98	VALU	Munsell Color Value (moist)	Real
260	99	CHRO	Munsell Color Chroma (moist)	Real

Run Identification Record (cont.)
(Soils)

Word(s)	'IDNAM2(i,2)' Index	Code	Name	Format
261	156	*INST	Instrument Type	Integer
262		UNCA	Uncalibrated data flag	Integer
263	29	COB2	Reflective wavelength calibration observation 2	Integer
264-300			Not used	

The complete run identification record contains 300 words. Words not shown here or words which have no data are set to hexidecimal 10000000 - termed a NULL value.

* Reformatting calibration code

- = 1 Bidirectional Reflectance Factor - direct comparison (%)
- = 2 Bidirectional Reflectance Factor - with solar port transfer (%)
- = 3 Bidirectional Reflectance Factor - with solar zenith angle transfer (%)
- = 9 Ratio (%)
- = 10 Wavelength calibration

* Run identification record set

- = 1 crop set
- = 2 soils set

* Instrument type

- = NULL spectrometer type instrument
- = 1 radiometer type instrument

Sample Group Record (Radiometer Type Instrument)

The Sample Group record for radiometer type data contains the detector name, detector range (gain), number of samples in the sample group (=1), the spectral band wavelength limits, the calibrated data value for band, the uncalibrated data value for band, and the sample group (or wavelength band) number. There are 10 words of information for each sample group (or wavelength band). The number of sample groups is given in the identification record (word 55).

'IDNAMS' Word(s)	'IDNAMS' Index	Code	Name	Format
1 - 2	181	DENA	Detector Name	Alphanumeric (2A4)
3	182	DERA	Detector Range	Real
4			Not used	
5	184	NUSA	Number of Samples (=1)	Integer
6	185	WABA	Lower Wavelength Band Limit	Real
7	185	WABA	Upper Wavelength Band	Real
8			Calibrated data value	Real
9			Uncalibrated data value	Real
10			Sample group (or wavelength)	Integer
11 - M	M = ID(55)*10			

Repeat words 1-10 for ID(55) sample groups.

The Sample Group record contains ID(55)*10 words or ID(55)*10*4 bytes. Words which have no data are set to hexidecimal 10000000.

Sample Group Record (Spectrometer Type Instrument)

The Sample Group record for spectrometer type data contains the information describing the detector name, detector range (gain), detector equilization (filter), number of samples in the sample group, the waveband coefficients, and the sample group number. There are 10 words of information for each sample group. The number of sample groups is given in the identification record (Word 55).

Word(s)	'IDNAMS' Index	Code	Name	Format
1 - 2	181	DENA	Detector Name	Alphanumeric (2A4)
3	182	DERA	Detector Range (gain)	Real
4	183	DEEQ	Detector Equilization (filter)	Real
5	184	NUSA	Number of Samples	Integer
6	185	WABA	Initial wavelength value for sample group minus one increment	Real
7	185	WABA	Wavelength increment between samples	Real
8			Not used	
9			Not used	
10			Sample group number	Integer
11 - M	M = ID(55)*10			

Repeat words 1-10 for ID(55) sample groups in order of appearance in Data Records.

The Sample Group record contains ID(55)*10 words or ID(55)*10*4 bytes. Words which have no data are set to hexidecimal 10000000 - termed a NULL value.

Data Records (Spectrometer Type Instrument)

Data records for spectrometer type data follow their corresponding run identification and sample group records. There are no data record, as such, for radiometer type data. One data record follows for each detector sample group defined in the sample group record and in the order defined. Each record contains a record sequence number and calibrated data values in 4 byte floating point format.

BYTES	CONTENTS
1 - 4	Zeros
5 - 8	Sample group sequence number This number is the sequence number of the record (from 1) from the ID record. If the data in the record has been lost, the number will be negative.
9 - M	NS floating point calibrated data values M=4* (NS+2) for NS equal to the number of samples. Data values are set to -1 if no information is available for particular wavelengths.

Data Records (Field Measurements Wavelength Format)

One or two data records follow each header record. The first is spectral bidirectional reflectance factor from the reflective spectral range .35-2.4 micrometers. If thermal data were processed for the particular target, data record two will contain 227 radiance calibrated samples from the spectral range 2.7 to 14.0 micrometers.

Reflective Data Record

Word	Contents
1	= 0
2	= 1
3-208	Bidirectional reflectance factor data in IBM floating point. Data range 0 to 100 with -1. denoting no data.

Thermal Infrared Data Record

Word	Contents
1	= 0
2	= 2
3-229	Radiance data in IBM floating point

Appendix C

Description of Data Tape Utility Processor

EXOUTL SYSTEM

10/16/79

The EXOUTL System is a package of software routines to do utility type operations with spectrometer/radiometer data tapes and bulk tapes. The utility operations include:

* Initialize data tape or bulk tape to spectrometer data or bulk tape format, respectively.

* List ID records of data tapes or bulk tapes.

* Library data from work tape to end of data on library tape (or bulk tape).

* Place end of tape marks on data tape.

* Edit data on data tape(s) - insert runs, replace runs, delete runs, recalibrate data, alter ID record, convert data from old formats to the current format.

* Update ID record using Record Sheets as input.

To use the EXOUTL system, IPL REF370. Then all the needed disks will be properly accessed.

EXOUTL Terminal Commands

$$\text{EXOUTL37} \left(\begin{array}{l}\text{READER}\\ \text{DISK}\\ \text{TERM}\end{array}\right. \quad \text{TEST UPDATE}$$

Parameter	Function
EXOUTL37	Start execution of spectrometer/radiometer utility routines. Control cards are expected from card reader, unless DISK or TERM option is used.
DISK	Control cards are expected from disk. User will be prompted for 'filename' and 'filetype' of disk file.
TERM	Control cards are expected from terminal during execution of program.
TEST	Load map will be placed on P-disk.
UPDATE	Use this parameter when job includes the $UPDATE processor. User will be prompted for 'filename' and 'filetype' of disk file which contains the record sheets.
READER	Control cards are expected from the card reader.

EXOUTL Notes

* An aborted function will put programs back to Moniter routine (XTKMON).

* Example terminal command

  EXOUTL37 DISK

* If the terminal command EXOUTL37 is typed, it defaults to the EXOUTL37 READER form of the command.

EXOUTL SYSTEM

Processing Control Cards

Keyword (Col. 1)	Parameter	Function
$COMMENT	None	Comment
$INITIALIZE	DATA(tape)	Initialize data tape
	BLKLIB(tape)	Initialize 9-track bulk library tape
$IDLIST	BULK(tape)	List ID records of bulk tape
	DATA(tape)	List ID records of data tape
$LIBRARY	BULK,WORK(tape),LIBRARY(tape)	Place bulk runs from work tape onto bulk library tape
	DATA,WORK(tape),LIBRARY(tape)	Place data runs from work tape onto data library tape
$EOF	TAPE(tape),RUSE(I)	Place end-of-file marks on data tape after run sequence number I.

EXOUTL SYSTEM

Processing Control Cards (cont.)

Keyword (Col. 1)	Parameter	Function
$EDIT	DATA,OLD(tape),EDIT(tape), NEW(tape)	Requests editing of "old" data tape to give "new" data tape. Any runs to be inserted in replacement runs will be found on the "edit" tape. "New" data tape will be positioned at beginning.
DELETE	RUSE(LL,UL)	Delete runs on old tape with run sequence number LL through UL.
INSERT	RUSE(I,LL,UL)	Insert runs from edit tape with run sequence numbers LL through UL after run on old tape with run sequence I.
REPLACE	RUSE(I1,I2,LL,UL)	Replace runs on old tape with run sequence numbers I1 through I2, with runs on edit tape with run sequence numbers LL through UL.
RECALIBRATE	RUSE(LL,UL)	Recalibrate runs on old tape with run sequence numbers LL through UL.
CONVERT	RUSE(LL,UL,I)	Convert runs on old tape with run sequence numbers LL through UL from old formats to current format using conversion type I.

EXOUTL SYSTEM

Processing Control Cards (cont.)

Keyword (Col 1.)	Parameter	Function
END	RUSE(LL)	Used to finish all editing. If LL is zero remainder of old tape will be placed on new tape. If LL is negative this will not occur. If LL is positive copying will terminate when run sequence LL has been copied to new tape. If LL is greater than last run sequence on the old tape, copying will terminate when last old run has been copied to the new tape.

Processing Control Cards (cont.)

Keyword (Col. 1)	Parameter	Function

The following edit control cards only apply to editing data tapes.

Keyword (Col. 1)	Parameter	Function
ID	RUSE(I)	Edit ID record of run with run sequence I.
ID Parameter (Mnemonic)	New Value	"New Value" replaces current ID value for specified ID parameter.
ID Parameter (Mnemonic)	NULL	Sets specified ID parameter to NULL (Z10000000)
/*	None	Specifies end of ID Parameter edit cards.

$EDIT Notes

* The OLD tape cannot be backed spaced

  i.e. REPLACE RUSE (20,30,10,20)

  REPLACE RUSE (10,20,20,30)

  is not permissable.

* The EDIT tape can be backed spaced.

* The subroutine to handle tape conversions is a dummy subroutine than just returns to the edit routine each time it is called. If actual format conversions are desired, the user must supply his own subroutine with the following parameters:

```
SUBROUTINE XTKCVT(CNVRUN,TAPE,RUNSEQ)

   Input arguments:

     CNVRUN -- 3 element array, third element contains
               type of conversion. First and second
               elements are not used.
     TAPE   -- variable containing tape to be converted.

     RUNSEQ -- variable containing run sequence to be
               converted.
```

* Example control card decks

```
$EDIT   DATA, OLD(4317), NEW(3354)
ID     RUSE(104)
EP01    311.
FINU    207
MATU    TILLERING
EP02    NULL
/*
ID     RUSE(207)
EP01    701.
/*
END    RUSE(-1)
```

Keyword (Col.1)	Parameter	Function
$UPDATE	OLD(tape),NEW(tape)	Requests that ID records on "old" tape be updated and placed on the 'new' tape. The 'new' tape will be positioned at beginning.
UPDATE	RUSE(LL,UL)	Update all runs with run sequence numbers between LL and UL inclusive. All runs with run sequence numbers from 1 up to LL will be copied directly onto 'new' tape with no change
POINTER		Use the value of the given parameter in the ID record of run on old tape to point to the data in the record sheet disk file that are to be added to the ID record. The possible parameters to use are listed.
	RUSE	Run sequence number
	OBNU	Observation number
	FINU	Field number
	PLNU	Plot number
	EP01	Experimenter parameter 01
	.	.
	.	.
	.	.
	EP13	Experimenter parameter 13
END		Signifies end of control cards for function. One of the parameters must be given.
	ABORT	If no information exists in the record sheet disk file for the given pointer, execution for UPDATE processor should stop and control will return to monitor to read next control card.
	NOABORT	If no information exists in the record sheet disk file for given pointer, then message will be printed, run will be copied from old tape to new tape with no change, and execution will continue.
$END		End of control cards for $UPDATE processor. Control will return to monitor routine. Other EXOUTL

$UPDATE Notes

- Any value given on the records sheet disk file will be placed in the ID record, even if a value already exists for the parameter.

- If OBNU is used as the pointer, then measurement record sheets are required in the disk file. Agronomic or Soils Record Sheets may be included also.

- If FINU or PLNU is used as the pointer, then Agronomic Record Sheets are required in the disk file. The observation code on the Agronomic Sheets will match either the field number (FINU) or plot number (PLNU) given in the ID records.

- If RUSE, EP01, EP02,.... or EP10 is used as the pointer, then Agronomic Record Sheets or Soils Record Sheets are required in the disk file. The observation code on the Agronomic or Soils Record Sheets will match the run ID record values of the given pointer.

- If EP11, EP12, or EP13 is used as the pointer then Soils Record Sheets are required in the disk file. The observation code on the Soils Record Sheets will match the run ID record values of the given pointer.

- Example control card deck:

```
$UPDATE   OLD(3354), NEW(3355)
UPDATE    RUSE(62,500)
POINTER   EP01
END       ABORT
UPDATE    RUSE(600,800)
END       ABORT
$END
```

Appendix D

Spectrometer/Radiometer Data Library Tape Listing

The tape listing will not be provided as a part of this manual. The tape listings will be distributed separately. This section is allocated as a place to store the latest tape listings.