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FINAL REPORT
WISP INFORMATION DISPLAY
SYSTEM USER'S MANUAL

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Prepared for:

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M&S COMPUTING, INC.

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PREFACE

The Wind Shear Information Display System (WISP) User's Manual provides a detailed description for using WISP to collect, store, and process wind shear data received from Laser Doppler Velocimeter (LDV) systems. WISP was developed for NASA at Marshall Space Flight Center (Contract No. NAS8-32024) to store and process wind shear data for NASA analysts.

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LIST OF ACRONYMS

COP	WISP Control Program
DCAD	Data Acquisition Task
DEC	Digital Equipment Corporation
LDV	Laser Doppler Velocimeter
NASA	National Aeronautics and Space Administration
PLOT	Data Display Task
RSX-11M	DEC Operating System
TDUMP	Raw Data Dump Task
WISP	Wind Shears Program

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1. INTRODUCTION

The Wind Shears Program (WISP) is a real-time data acquisition and display system developed by M&S Computing, Inc., Huntsville, Alabama, for the National Aeronautics and Space Administration (NASA) Electronics and Control Laboratory located at the George C. Marshall Space Flight Center in Huntsville, Alabama, under Contract NAS8-32024.

WISP is executed on a Digital Equipment Corporation (DEC) PDP-11/35 computer under the real-time operating system RSX-11M Version 1. Extensive operator interaction provides the requisite data mode and data display parameters to the data acquisition (DCAD) and data display (PLOT) tasks.

Data is acquired in real time from a pulsed Laser Doppler Velocimeter (LDV). The data represents positional information and integrated intensity information obtained from twenty to eighty data filters. Each filter corresponds to a specific Doppler shift dependent upon the selected pulse width. Certain calculations are performed on the data to obtain parameters for display.

Data display provides near real-time feedback of wind shear activity within the viewing volume. A flexible X, Y plot routine provides a variety of displays for examining the wind shear characteristics.

The WISP system supports the collection of data on magnetic tape for permanent storage or analysis, or both.

1.1 Document Structure

Section 2 describes the hardware and software configuration required to execute the WISP system. Included in this section is a start-up procedure from a power-down condition.

Section 3 describes the WISP operator control program and provides query/response examples for initiating real-time or post processing operations.

Section 4 describes the data collection task (DCAD) and outlines the calculations performed on the incoming data. Included in this section is a description of the magnetic tape format.

Section 5 describes the data display task (PLOT) and provides examples of displays obtained from execution of the real-time simulation program.

Section 6 describes the raw data dump task (TDUMP), and provides examples of operator actions required to obtain the desired dump format.

Section 7 describes the three-dimensional plot tasks, and provides instructions for their use.

Appendix A provides descriptions of each named variable in the intertask common block. These variables are passed between the active tasks for system communication.

Appendix B provides operating information with respect to possible system anomalies. The procedures outlined herein will allow continuous data collection, possibly at the expense of real-time visual displays. This appendix also provides information relative to recovery from anomalous operations.

2. SYSTEM START-UP PROCEDURE

This section describes starting the hardware and software systems of WISP.

2.1 Starting WISP from a Power-Off Condition

The following sequence should be followed exactly.

2.1.1 Power On

To apply power to the system, the process console key should be moved to the POWER position (see Figure 2-1). This should turn on power to all the hardware components. When power is first supplied to the graphics terminal, the screens are brightly illuminated and should be cleared by depressing the RESET PAGE key in the upper left corner of the terminal keyboard.

2.1.2 Disk Drive

Within a few seconds after power is applied to the system, the LOAD indicator light is illuminated on the disk drive (see Figure 2-2). The Production disk cartridge must be inserted on Unit 0 and the WFILES disk cartridge on Unit 1 and the LOAD/RUN switches placed in the RUN position. After a few more seconds, the RUN and ONCYL indicators are illuminated. Note that the WTPROT indicator should not be illuminated. If it is, the WTPROT momentary contact switch must be depressed to clear it. If at any time during the session another disk is required, the LOAD/RUN switch must be placed in the LOAD position. After a short time, the LOAD indicator is illuminated and the disk can be removed. The door cannot be opened unless power is on and the LOAD indicator is illuminated.

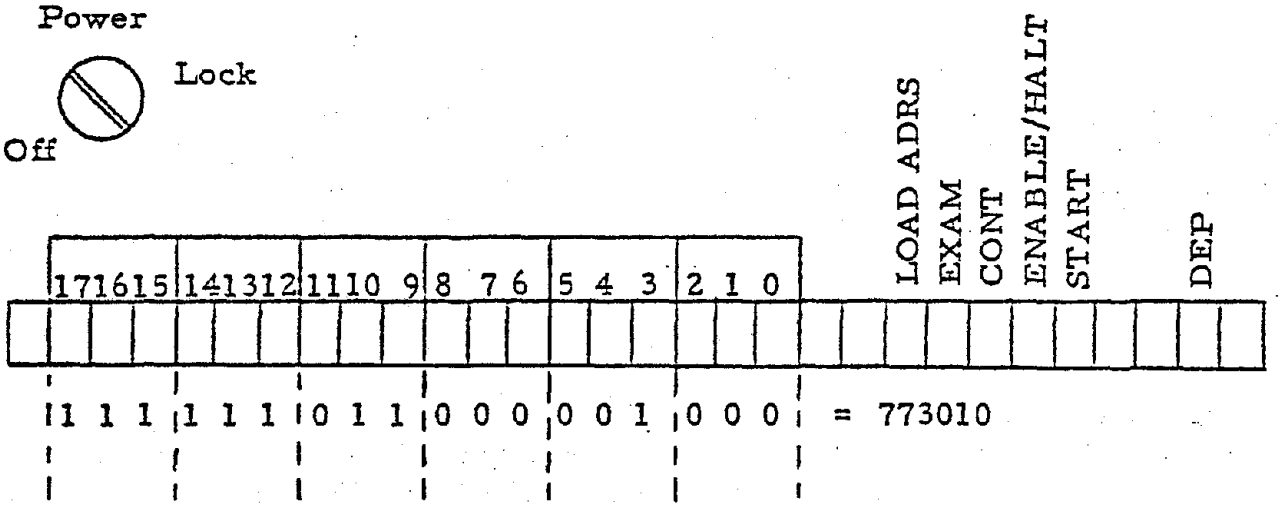
2.1.3 Loading RSX-11M into Memory

WISP operates in the PDP-11 family of programs under the control of the standard DEC PDP-11 RSX-11M. RSX-11M is stored on the disk and must be called into the processor memory before anything further can be done. A special memory unit with a small program that transfers RSX-11M from disk to memory is provided with WISP. The user simply causes the processor to begin running that program and RSX-11M is automatically loaded. The procedure is as follows:

PDP-11/35

1. Place the ENABLE/HALT switch in the HALT position (down).

PDP-11/35



1 = Switch Up

0 = Switch Down

Figure 2-1

DISK DRIVE CONTROLS AND INDICATORS

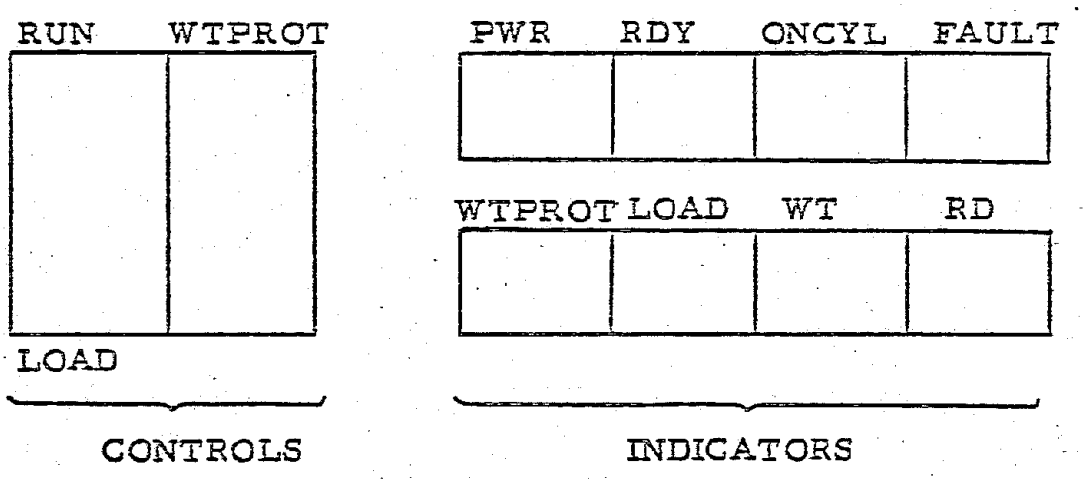


Figure 2-2

2. Load the switch register with 773010 (octal) (see Figure 2-1).

3. Depress and release the LOAD ADRS switch.

4. Place the ENABLE/HALT switch in the ENABLE position (up).

5. Depress and release the START switch.

The Monitor is now loaded into memory and identifies itself by displaying on the graphics terminal screen:

> RSX-11M 08 48K Mapped

> RED DK0: = SY0:

> MOU DK0:

Note: In this manual underscoring is used to designate system output, whereas user input is not underscored.

If the above message does not appear, the computer may not have loaded the LOAD ADDRESS. To correct this situation, depress both the ENABLE/HALT and START switches simultaneously. Then release the START switch and repeat steps 3 through 5 for loading RSX into memory. The user should then type MOU DK1: (RETURN).

At this time, the user should log into the system in the following manner:

- Ensure that the TTY LOCK key at the lower left corner of the graphics terminal keyboard is depressed.

- Enter at the keyboard the date and time in these formats:

  > TIM MM/DD/YY(RETURN)

  where

  DD is the day (one or two digits).

  MM is the month (one or two digits).

  YY is the year (two digits).

Note: In this manual (RETURN) is used to indicate entry of the RETURN key immediately following the specified data entry with no intervening blanks.

The prompt sign (>) will appear again. Enter

> TIM HH:MM:SS(RETURN)

where

HH is the hour (one or two digits).

MM is the minute (one or two digits).

SS is the second (one or two digits).

The prompt sign will appear again.

If an error is made during the entry described above, it can be corrected by either of the following methods:

- The RUBOUT key eliminates one character at a time, starting with the last character entered. When all characters back to and including the erroneous one are rubbed out, the user can reenter them properly. Since the characters are stored on the screen, the RUBOUT does not actually remove their image, but simply indicates that they have been deleted.

- The CTRL/U command rubs out an entire line at a time. Thus, if an error in entry is made near the beginning of a line and not noticed immediately, the line can be canceled by depressing the U key while holding the CTRL key down. This causes the ^U characters to be added at the end of the canceled line and a line-feed, carriage return to take place. The terminal is then ready for a new line.

The user is now logged into the system and can proceed. The desired program can now be requested by entering the command RUN and the program name. For example:

> RUN WISP(RETURN)

requests WISP to be run. Sections 3 and 4 describe how the user proceeds from this point. Figure 2-3 shows a correct log-in entry. The WISP System requires only the name of the control program (COP) to be entered to initiate the WISP process. For example:

≥COP(RETURN)

will automatically start the control program.

2.1.4 Using the Tape Transport

A magnetic tape is not absolutely essential for operation of WISP, but since the user may wish to retrieve or store data on tape, this section explains the working of the tape transport itself. Refer to Figure 2-4 for the controls and indicators discussed below. Instructions for using the tape transport are:

- Place the PWR ON/OFF switch in the PWR ON position.
- Place the START/STOP switch in the STOP position.
- Place the ON LINE/OFF LINE switch in the OFF LINE position.
- Place the LOAD/BR REL switch in the BR REL position. If it was already in the BR REL position, switch it to LOAD and back to BR REL again.
- Mount the magnetic tape reel on the lower capstan and thread the tape according to Figure 2-5. If a write enable ring is not mounted on the file reel, the FILE PROT indicator is illuminated and the tape can be read, but not erased or written. Thus, if the tape files are only to be read, but it is not anticipated that any files will be added to the tape, the user may leave off the write enable ring to protect his tape from accidental erasure.
- Place the FWD/REW/REV switch in the FWD position.
- Place the LOAD/BR REL switch in the LOAD position. The tape is loaded into the vacuum columns and the LOAD indicator is illuminated.

CORRECT LOG-IN PROCEDURE

```
   PSX-11M 08  48K   MAPPED     -- Indicated RSX is loaded
>RED  DK0'=SY0'
>MOU  DK0'
>MOU  DK1'
>TIM 4/21/77 08:10:00
>COP                             --User request to run WISP
```

NOTE: > are placed by RSX to indicate that it is ready for an entry.

Figure 2-3

TAPE TRANSPORT CONTROLS AND INDICATORS

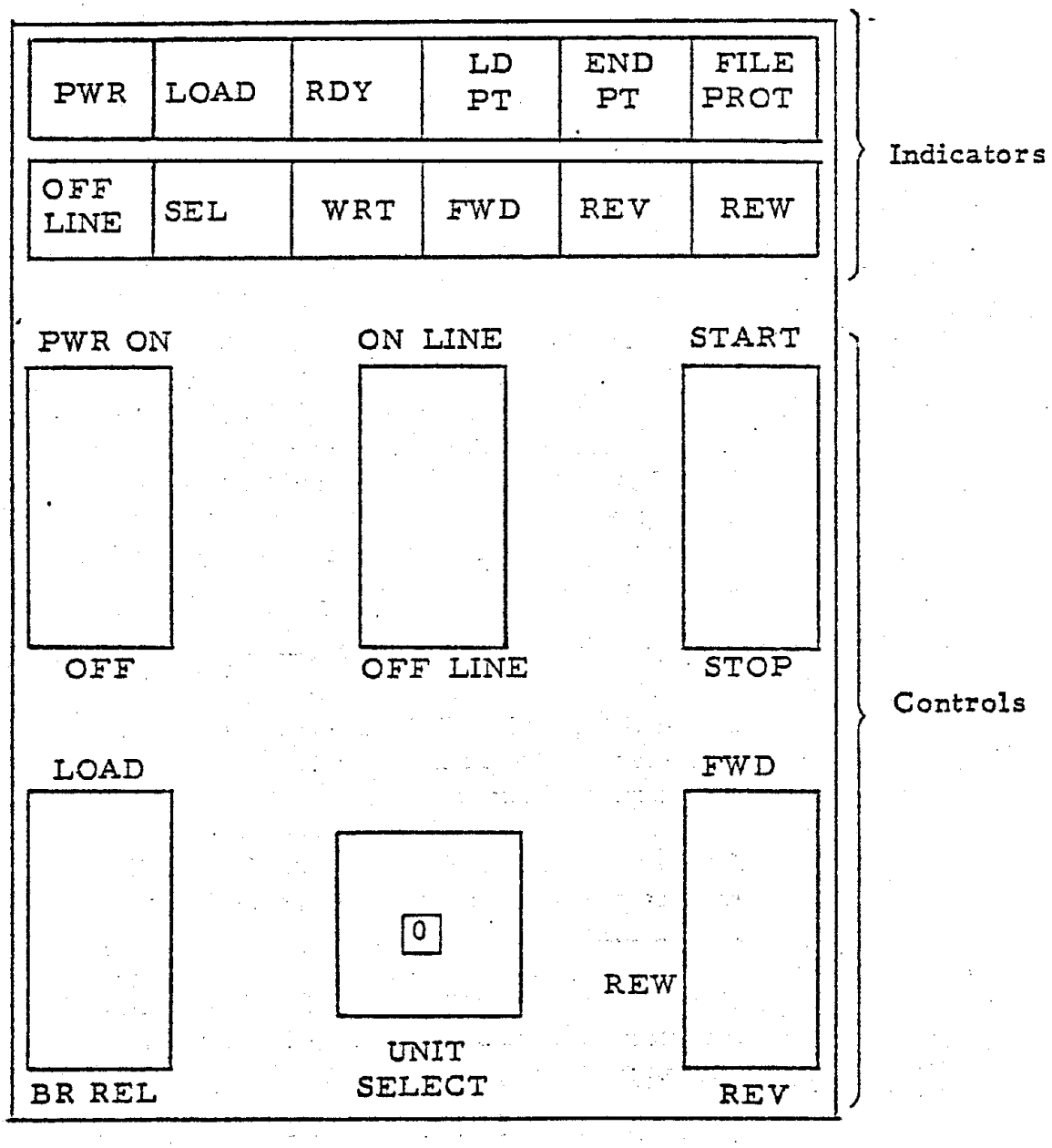


Figure 2-4

THREADING THE TAPE TRANSPORT

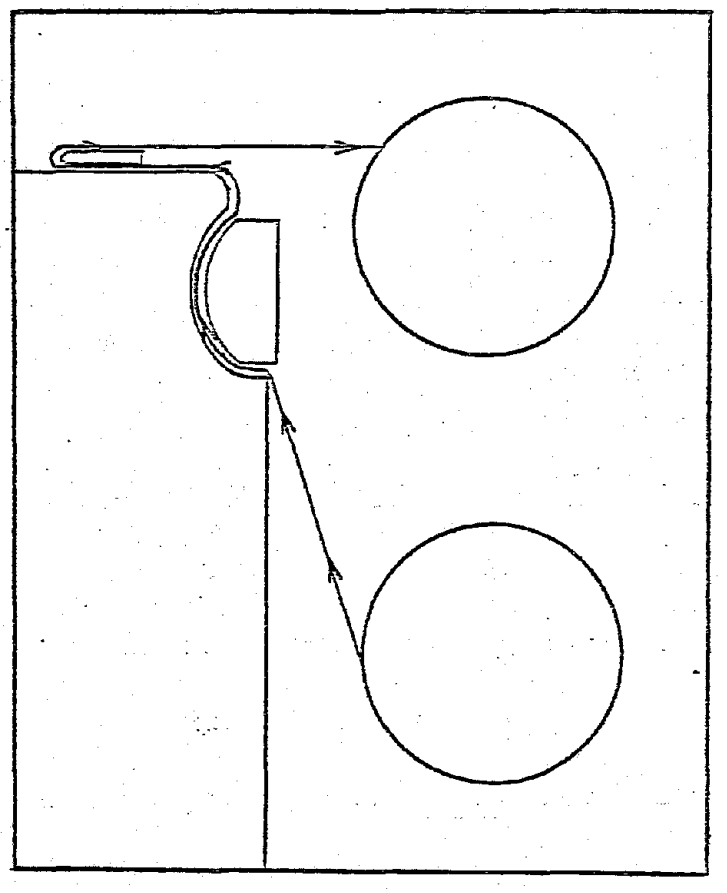


Figure 2-5

- Place the START/STOP switch in the START position. The tape is advanced to the load point and the LD PT indicator is illuminated.

- Ensure that the UNIT SELECT thumbwheel is in position 0 for storing data and position 0 for reading data (post-processing).

- Place the ON LINE/OFF LINE switch in the ON LINE position.

If at any time during an operating session a different tape is required, the user may reverse the above process to rewind a tape to the load point and remove it, then follow the process to load a new tape. Before a tape can be used, it must have been properly prepared as described in Section 7.

2.2 Recovering WISP from a System "Crash"

There may be times when an abnormal hardware or software condition will cause the system to "crash," i.e., control of the system is lost. The normal way to recover system control is as follows:

- Reboot the system as described in Section 2.1.3.

- Disregard messages that appear on the screen.

- Type the appropriate RUN command and proceed normally.

2.3 To ROLLIN the System

In some cases there may be a disk "crash" which can only be recovered by placing a new copy of the system on the disk (ROLLIN). To ROLLIN, proceed as follows:

- Place the HALT switch down.

- Mount the ROLLIN tape on Unit 0 and place tape unit on-line.

- Enter 773050 (octal) in the console switches (refer to example for normal system boot in Figure 2-1. Note that this is a different number).

- Load ADDRESS.
- Remove HALT.
- Depress START.

The message ROLLIN V07

#

will appear.

- Type /RW to rewind the tape.

To ROLLIN the production disk, type DK0:<MT0:SYSTEM/FI with the production disk mounted on disk Unit 0. To ROLLIN the FILES disk, type DK1:<MT0:FILES/FI with the FILES disk mounted on disk Unit 1. Note that both ROLLIN's are contained on the same tape.

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3. SOFTWARE DESCRIPTION

3.1 Overview

The WISP software consists of a three-task structure which, when operated under the RSX-11M Operating System, provides for the collection and analysis of real-time LDV data.

The main control task, COP, provides all operator interaction by means of a query/response session. This allows the operator to select data collection and/or plot parameters as well as data source (i.e., LASER, TAPE). At the conclusion of the session, the operator specifies the selection to go (G) or to terminate (Q). COP will start (or stop) the two remaining tasks, DCAD and PLOT.

DCAD is the data collection task. Incoming interrupts from the LDV processor are fielded by a device handler. The data is placed in a specified buffer area and calculations are performed. At the completion of each frame of data, consisting of 100 data words transferred from the LDV processor, DCAD signals PLOT that a frame is ready for plot output processing.

PLOT prepares the computed data values for graphic output. At any time PLOT may be interrupted by the operator to change plot characteristics or to do any of the functions allowed by COP. The interrupt of plot activities is accomplished by typing COP<CR> at the terminal. When the G command is given, COP will stop and PLOT will resume from the point of interruption.

The remainder of this section describes in detail the control program, Section 4 describes the data collection task (DCAD), and Section 5 describes the PLOT task.

3.2 WISP Control Program Description

The WISP Control Program (COP) provides for all operator interaction with the WISP System. Through tutorial question and answer sequences, COP allows considerable flexibility in data parameter manipulation.

Figure 3-1 presents the main control display for the WISP system. Each of the key-in characters are discussed in detail below. Responses to the queries presented in the following paragraphs are "YES" or "NO." Where responses other than "YES" or "NO" are required, a description of the type of response required is provided.

WIND SHEARS - CONTROL DISPLAY

TYPE IN THE KEY-IN CHARACTER TO SPECIFY OPTIONS AND/OR REVIEW THE CURRENT PARAMETER VALUES.

KEY-IN	SPECIFY
S	DATA SOURCE
P	X-Y PLOT
T	TABULAR DATA
C	CALCULATION VALUES
X	SCREEN SELECTION
G	BEGIN PROCESSING
Q	STOP

TYPE IN HELP FOR ASSISTANCE DISPLAYS.

Figure 3-1

3.2.1 Operator Assistance Displays (Key-in HELP)

If during the query/response session the operator requires assistance in determining the proper response, he may key-in the word "HELP" which will cause the display shown in Figure 3-2 to be presented.

The "HELP" displays provide tutorial information about the WISP system and the options which are available to the operator for the graphical display of data and for general keyboard usage. Figures 3-3 through 3-6 present the various assistance displays. Upon leaving the HELP mode, the operator response to the query previous to HELP mode entry is required.

3.2.2 Data Source Selection (Key-in S)

Three data sources are available to the WISP system: LASER, TAPE, and DUMMY. The default source is LASER. The full complement of WISP queries for each data source will be presented below, although not all queries will appear each time the character "S" is entered.

3.2.2.1 LASER Data Source

Selection of LASER as a data source sets the WISP operating mode to real time. Upon execution of the "G" key-in, the laser is enabled and collection of data from the laser signal processor ensues.

Query

DATA SOURCE IS SET FOR LASER DATA. OK?

Query

NEXT SCAN NUMBER IS 1. OK?

Query

DO YOU WANT MANUAL ANGLE SELECTION?

If the response is "YES", three queries will appear requesting the angle data (see Section 3.2.3).

Query

NO DATA WILL BE RECORDED. OK?

If data recording is selected, tape positioning information will be requested, followed by:

Query

ENTER TAPE LABEL - UP TO 80 CHARACTERS.

WIND SHEARS - OPERATING INFORMATION

THERE ARE SEVERAL INFORMATION DISPLAYS THAT ARE AVAILABLE TO YOU. THESE DISPLAYS ARE LISTED IN THE TABLE BELOW. TO SELECT A DISPLAY JUST TYPE IN THE APPROPRIATE KEY-IN CHARACTER, THEN PRESS THE RETURN KEY.

KEY-IN	DISPLAY CONTENT
P	PLOT OPTIONS, X-Y VARIABLES
S	SPECIAL MODES (DUMP,STORE,ETC.)
K	KEYBOARD USAGE
G	GENERAL USAGE

TO RETURN TO THIS DISPLAY FROM ANY OF THE INFORMATION DISPLAYS, TYPE IN THE LETTER R

TO LEAVE THE HELP MODE, TYPE IN THE LETTER Q

Figure 3-2

PLOT ... PLOT ...
... 17 PARAMETERS AVAILABLE FOR ... ...-FILES

	KEY-IN	KEY-OUT	PARAMETER
1	IN	INT-PEAK	PEAK INTENSITY
2	SW	SPEC-WTH	SPECTRUM WIDTH
3	VP	VEL-PEAK	PEAK VELOCITY
4	PH	VPK-HOR	PEAK VELOCITY - HOR. COMPONENT
5	PV	VPK-VER	PEAK VELOCITY - VER. COMPONENT
6	VM	VEL-MAX	MAXIMUM VELOCITY
7	MH	VMAX-HOR	MAX. VELOCITY - HOR. COMPONENT
8	AP	PITCH	PITCH
9	SR	SL RANGE	SLANT RANGE
10	GR	GR RANGE	GROUND RANGE
11	AL	ALTITUDE	ALTITUDE
12	M0	ZERO-MOM	ZEROTH MOMENT
13	M1	FIRS-MOM	FIRST MOMENT
14	M2	SECN-MOM	SECOND MOMENT
15	VA	VARIANCE	VARIANCE OF MOMENTS
16	SD	S. DEV	STANDARD DEVIATION
17	TM	TIME	TIME

THE KEY-IN IS USED TO SPECIFY A PARAMETER. THE KEY-OUT IS USED BY WIND SHEARS TO SPECIFY A PARAMETER.

PLOT OPTIONS ARE..
X AND Y AXIS LIMITS
X-Y PLOT SCREEN SELECTION
MANUAL OR AUTOMATIC UPDATE
DATA COLLECTION MODE (SCAN OR TIME)
COLLECTION INTERVAL FOR TIME MODE

TYPE IN R TO RETURN TO PRIOR DISPLAY.

Figure 3-3

```
WIND SHEARS - SPECIAL OPTIONS
KEY-IN  TO GET                PARAMETERS FOR NEXT ENTRY
------  -- ---                ---------- --- ---- -----
  $D    DUMP OF COMMON        DUMP LIMITS (FORMAT IS 2I4) AS
                              SUBSCRIPTS OF NDATE. A MISSING
                              UPPER LIMIT WILL DUMP ONE LINE.
  $S    STORE IN COMMON       SUBSCRIPT AND VALUE (FORMAT I4,06)
                              OPERATOR MUST RESPOND YES TO NEXT
                              QUESTION FOR STORE TO TAKE PLACE.
                              A SUBSCRIPT OF ZERO WILL EXIT THIS
                              MODE.
  $E    EVENT FLAG            RESPONSE TO NEXT QUESTION IS CODE
                              AND FLAG NO. (FORMAT A1,I2)
              CODES ARE:      C  FOR CLEAR EVENT FLAG
                              R  FOR READ EVENT FLAG
                              S  FOR SET EVENT FLAG
                              D  FOR DECLARE SIGNIFICANT EVENT
                              Q  FOR LEAVE THIS MODE.
  $R    REQUEST A TASK        TASK NUMBER (FORMAT I1) WHERE
                              1  IS PLOT TASK
                              2  IS DCAD TASK
                              3  IS HIDE TASK
  $Q    STOP                  THIS WILL CAUSE THE DISPLAY
                              CONTROL PROGRAM TO STOP.

PRESS RETURN TO GO BACK TO THE PRIOR DISPLAY.
```


Figure 3-4

WIND SHEARS - KEYBOARD USAGE

A YES RESPONSE MAY BE MADE IN ONE OF FOUR WAYS:
1- PRESSING THE RETURN KEY (NO TYPE IN)
2- TYPING Y
3- TYPING YE
4- TYPING YES

A NO RESPONSE MAY BE MADE IN ONE OF TWO WAYS:
1- TYPING N
2- TYPING NO

ALPHABETIC RESPONSES REQUIRE AT MOST TWO CHARACTERS EXCEPT FOR THE TAPE LABEL ENTRY. THUS DE IS SUFFICIENT FOR DEFAULT.

INTEGER RESPONSES ARE MADE BY TYPING IN NUMERIC FIELDS SEPARATED BY COMMAS. BLANKS ARE IGNORED. THUS 0006,1 IS THE SAME AS 6 ,+ 1
MINUS SIGNS ARE ALLOWED. NOTE THAT INTEGER RESPONSES TO SPECIAL MODES FOLLOW FORTRAN RULES.

TYPING MISTAKES CAN BE CORRECTED BY USING THE RUB OUT KEY. EACH PUSH OF THIS KEY REMOVES ONE CHARACTER STARTING WITH THE LAST CHARACTER TYPED. AN ENTIRE LINE OF TYPE IN MAY BE REMOVED BY USING A CONTROL U.

PRESS RETURN TO RETURN TO THE PRIOR DISPLAY.

Figure 3-5

WIND SHEARS - GENERAL USAGE

THE WIND SHEARS PROGRAM USES THE 4014 CRT FOR DISPLAYS, TABULAR DATA, AND COMMUNICATING WITH THE OPERATOR. THE OPERATOR SETS THE VARIABLES AND CONDITIONS THAT WILL PRODUCE THE DESIRED RUN BY TYPING AT THE KEYBOARD. THE WIND SHEARS PROGRAM WILL PROMPT THE OPERATOR FOR SPECIFIC VALUES. THE OPERATOR THEN RESPONDS WITH HIS ENTRY. THIS INTERCHANGE TAKES THE FORM OF QUESTIONS (FROM THE PROGRAM) AND ANSWERS (FROM THE OPERATOR). AN ANSWER MAY BE ONE OF THE FOLLOWING:

YES
NO
DEFAULT
(VALUE) WHERE THE VALUE MAY BE ALPHANUMERIC SUCH AS LASER OR NUMERIC SUCH AS 47

IF A QUESTION MAY BE ANSWERED WITH DEFAULT THE QUESTION WILL SO STATE.

ONCE THE RUN HAS BEEN ESTABLISHED, DATA COLLECTION AND PLOTTING WILL START (IF REQUESTED). IF THE OPERATOR WISHES TO MAKE CHANGES TO ANY RUN PARAMETERS HE MAY REGAIN CONTROL OF THE DISPLAY UNIT BY TYPING IN THE THREE CHARACTERS COP. THIS WILL CAUSE ANY PLOTTING TO CEASE AND THE CRT CONTROL PROGRAM WILL START RUNNING. THIS WILL NOT INTERFERE WITH DATA COLLECTION OR DATA RECORDING THAT MAY BE GOING ON AT THAT TIME.

PRESS THE RETURN KEY TO RETURN TO THE PRIOR DISPLAY.

Figure 3-6

The acceptable response is any string of up to 80 alphanumeric characters, or CR which inserts all blanks. The tape label is intended to help the operator locate the desired file (on a multifile tape). This feature is particularly useful during post analysis of the data. If recording is selected, the display shown in Figure 3-7 is presented to allow tape positioning. Upon entry of "QT" or "PF" from the tape control display, control is returned to the control program.

3.2.2.2 TAPE Data Source

Selection of TAPE as a data source sets WISP to the post analysis mode. Data input is expected from data tapes recorded during real-time operations. The data collection task is inhibited during this mode.

Query

DATA SOURCE IS SET FOR TAPE DATA. OK?

A "YES" response causes the tape control display (Figure 3-7) to appear, at which time the operator may manually position the tape to the desired spot for processing, or he may specify tape search parameters. If tape search is requested, an information display will appear informing the operator of the action to take to halt the tape motion. The tape search may be halted at any time by throwing sense switch 0 on the computer console.

3.2.2.3 DUMMY Data Source

A real-time simulator has been provided which generates predictable patterns for display. This data source may be used to confirm computer operation or as a training and familiarization tool, or both.

Query

DATA SOURCE IS SET FOR DUMMY DATA. OK?

Query

BLOCK COUNT IS 10000. OK?

Note: The simulator requires that a non-zero block count be entered.

The acceptable response is an integer number up to 32767.

```
**** TAPE INPUT REQUEST ****

  KEY-IN      FUNCTION
  ------      --------

   HELP       OBTAIN ASSISTANCE
   DH         DISPLAY FILE HEADER
   FD         SPACE TO DBL END-OF-FILE
   FF         FORWARD SPACE FILE
   BF         BACKSPACE FILE
   FR         FORWARD SPACE RECORDS
   BR         BACKSPACE RECORDS
   SR         SEARCH TAPE REQUEST
   RW         REWIND THE TAPE
   SS         PROCESS SAME SCAN
   PF         PROCESS THIS FILE
   QT         TERMINATE REQUEST
```

Figure 3-7

Query

BLOCK SPACING IS 10 TICKS. OK?

Note: The simulator runs on the basis of line clock ticks (60 per second). A spacing of 10 ticks is equivalent to a LASER data rate of 6 frames a second.

The acceptable response is an integer number up to 32767.

Query

PULSE WIDTH IS 8. OK?

The acceptable response is the integer 2, 4, or 8.

Note: The simulator allows any of the three pulse widths operational on the laser.

The following three queries allow entry or review of angle information:

Query

ELEVATION ANGLE IS 0 DEGREES. OK?

PITCH ANGLE IS 0 DEGREES. OK?

AZIMUTH ANGLE IS 0 DEGREES. OK?

The acceptable response is an integer specifying the desired angle in degrees.

The queries for data recording are then displayed. The text and response(s) are identical to those for the LASER data source.

3.2.3 X-Y Plot Selection (Key-in P)

The WISP system provides an extremely flexible X-Y plot package for the graphic display of data obtained during real-time operations, or for analysis during post processing studies. Figure 3-3 presents the Plot Specification parameters available for graphic representation. An additional feature provided by the WISP plot package is the capability to plot two dependent variables versus two independent variables, provided

the respective variables in X and Y have similar axis extents. Only one axis in X and one axis in Y are provided.

A detailed description of the PLOT task is presented in Section 5.

3.2.3.1 X-Y Plot Queries/Responses

Query

A PLOT IS REQUESTED. OK? or

NO PLOT IS REQUESTED. OK?

If the query "NO PLOT IS REQUESTED. OK?" is answered "YES" the following query appears:

NO FILTER PLOT IS REQUESTED. OK?

A "NO" response to this query causes the line "FILTER PLOT IS REQUESTED. OK?" to appear. Answering "YES" terminates the plot request query sequence and causes the primary control display (Figure 3-1) to appear.

Query

X-Y PLOT IS SL RANGE VS VEL-MAX. OK?

This plot selection is provided as the default. Any desired X, Y pair may be selected by answering "NO" to this query. A "NO" response causes the next two queries to appear.

Query

X IS SL RANGE. ENTER YES OR ONE OF THESE. IN, SW, VP, PH, PV, VM, MH, MV, SR, GR, AL, M0, M1, M2, VA, SD, TM.

Query

Y IS VEL-MAX. ENTER YES OR ONE OF THESE. IN, SW, VP, PH, PV, VM, MH, MV, SR, GR, M0, M1, M2, VA, SD, TM.

Query

DO YOU WANT TO PLOT A SECOND FUNCTION?

A "YES" response causes the previous three queries to appear in order.

Query

X AXIS MIN AND MAX ARE 0 TO 30000. OK? (YES, NO, DEFAULT)

Query

Y AXIS MIN AND MAX ARE - 30 TO 30. OK? (YES, NO, DEFAULT)

Query

DATA COLLECTION IS BY SCAN. OK?

Normal scanning consists of up to 200 range cells dependent upon the range increment selected on the control panel of the processor.

Query

DATA COLLECTION IS AT CONSTANT RANGE. OK?

Fixed range cell processing may occur by setting the processor to "MANUAL." This query provides for time plots rather than scan plots.

Query

ENTER START AND STOP TIMES (IN SECONDS) FOR PLOT.

Two integer numbers between 0 and 32767 separated by commas must be entered for either automatic or manual updating to occur.

Query

UPDATE MODE IS AUTO. OK?

A positive (YES) response to the last query will cause the primary control display (Figure 3-1) to appear.

3.2.4 Tabular Data Selection (Key-in T)

The selection of tabular data will cause the computed values of each frame to be output to the display. A default condition of no tabular data has been implemented to increase the processing time available to the vector plot routines. An example of tabular data output is provided in Figure 3-8.

Query

NO TABULAR DATA IS SELECTED. OK?

3.2.5 Calculation Values Selection (Key-in C)

The calculation values selection provides for manual control of either the intensity threshold, or the velocity threshold, or both thresholds. Thresholding is accomplished as follows:

- Intensity thresholding - All intensities equal to or falling below the threshold "T" are rejected and are not included in the calculations. T units are counts ranging from 0 to 512.

- Velocity thresholding - Two velocity thresholds are provided to permit "zeroing in" on specific wind velocities. The LO velocity threshold rejects all returns whose computed velocity is less than that specified. The HI velocity threshold rejects all returns whose computed velocity is greater than that specified.

3.2.5.1 Queries/Response(s)

Query

INTENSITY THRESHOLD IS 0. OK?

Query

LO VELOCITY THRESHOLD IS 0. OK?

Query

HI VELOCITY THRESHOLD IS 30. OK?

EXAMPLE OF TABULAR DATA OUTPUT

ID	ELEV	AZMTH	PTCH	RANGE	IPK	N	VPK	VMX	M0	M1	M2	VAR	TIME	SCAN
63	0	0	0	9300	40	20	-25	-1	35	0	231	231	21 51 26	5
63	0	0	0	9450	41	20	-25	-1	35	0	233	233	21 51 26	5
64	0	0	0	9600	41	20	-25	17	35	0	232	232	21 51 27	5
65	0	0	0	9750	41	20	-25	9	35	0	228	228	21 51 27	5
66	0	0	0	9900	39	20	-25	-1	33	0	227	227	21 51 27	5
67	0	0	0	10050	37	20	-25	-9	34	0	231	231	21 51 27	5
68	0	0	0	10200	40	20	-25	9	34	0	228	228	21 51 27	5
69	0	0	0	10350	36	20	-25	9	32	0	238	238	21 51 27	5
70	0	0	0	10500	40	20	-25	9	33	0	234	233	21 51 28	5
71	0	0	0	10650	40	20	-25	-1	35	0	227	227	21 51 28	5
72	0	0	0	10800	38	20	-25	19	34	0	234	234	21 51 28	5
73	0	0	0	10950	41	20	-25	-1	35	0	230	230	21 51 28	5
74	0	0	0	11100	41	20	-25	-1	35	0	226	225	21 51 28	5
75	0	0	0	11250	42	20	-25	9	36	0	227	227	21 51 29	5
76	0	0	0	11400	40	20	-25	-1	33	0	228	228	21 51 29	5
77	0	0	0	11550	40	20	-25	9	34	0	232	232	21 51 29	5
78	0	0	0	11700	38	20	-25	9	34	0	233	233	21 51 29	5
79	0	0	0	11850	40	20	-25	-1	34	0	229	229	21 51 29	5
80	0	0	0	12000	38	20	-25	-1	33	0	227	227	21 51 29	5
81	0	0	0	12150	40	20	-25	-1	34	0	230	230	21 51 30	5
82	0	0	0	12300	39	20	-25	17	34	0	230	230	21 51 30	5
83	0	0	0	12450	40	20	-25	-1	34	0	230	230	21 51 30	5
84	0	0	0	12600	40	20	-25	9	34	1	231	230	21 51 30	5
85	0	0	0	12750	43	20	-25	22	35	1	236	234	21 51 30	5
86	0	0	0	12900	42	20	-25	-1	35	0	226	226	21 51 30	5
87	0	0	0	13050	41	20	-25	22	35	0	233	233	21 51 31	5
88	0	0	0	13200	38	20	-25	9	33	0	241	241	21 51 31	5
89	0	0	0	13350	38	20	-25	-1	33	0	230	230	21 51 31	5
90	0	0	0	13500	39	20	-25	-1	35	0	232	232	21 51 31	5
91	0	0	0	13650	40	20	-25	-1	34	0	228	228	21 51 31	5
92	0	0	0	13800	40	20	-25	9	34	0	225	225	21 51 32	5
93	0	0	0	13950	41	20	-25	-1	35	0	224	224	21 51 32	5
94	0	0	0	14100	37	20	-25	-1	33	0	227	227	21 51 32	5
95	0	0	0	14250	39	20	-25	6	34	0	234	234	21 51 32	5
96	0	0	0	14400	38	20	-25	22	33	0	237	237	21 51 32	5
97	0	0	0	14550	4									

Figure 3-8

3.2.6 Screen Selection (Key-in X)

The screen selection options provide the capability of specifying to which screen the desired output is to be directed. Additionally, character size selection is provided to allow enhanced readability of control displays. The default character size is 2 (next to smallest).

3.2.6.1 Queries/Response(s)

Query

X-Y PLOT IS ON SCREEN 1. OK?

TABULAR DATA IS ON SCREEN 2. OK?

CONTROL DISPLAY IS ON SCREEN 1. OK?

Query

CHARACTER SIZE IS 2. OK?

The character size may be altered by responding with an integer number between one and four inclusive.

A positive (YES) response to the last query will cause the primary control display (Figure 3-1) to appear.

3.2.7 Begin Processing Section (Key-in G)

There are no queries associated with this section. The "G" command initiates the data collection and processing tasks and terminates the control program.

3.2.8 Stop Selection (Key-in Q)

The Quit command causes the control program to terminate the data collection and processing tasks, and then terminates the control program.

3.2.9 Magnetic Tape Positioning Commands

The display(s) and commands presented in this paragraph pertain only to positioning the magnetic tape prior to initiating data collection or to initial positioning and subsequent repositioning of the tape during post mission analysis.

The tape control display is shown in Figure 3-7. The commands are self-explanatory. Improper entries are discarded and the request reissued.

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4. DATA COLLECTION

Data collection is performed by the task DCAD which is initiated by the control program upon receipt of a "G" command from the operator. The following description details the operations performed by the DCAD task, and includes details of the calculations performed on the data prior to recording and/or display.

4.1 Data Collection Program Description

Upon entry and upon completion of the processing of each frame of data, DCAD monitors the status of magnetic tape recording. If recording is requested and in progress, DCAD checks the status of the laser. If it is on, DCAD waits for the start of the next frame. If it is off, DCAD initiates the DR-11 interface and the DL-11 interface, then waits for the start of the next frame. If recording is requested and not in progress, DCAD initiates the data recording. If recording is in progress and has been requested to terminate by operator command (through the control program), DCAD completes the current record and closes the file, then waits for the start of the next frame.

DCAD is event driven; that is, event flags set by other tasks (COP, DR-11 driver) cause specific operations to occur. Five event flags control the execution of the task. They are event flags 36-40.

Event flag 36, if set, will cause termination of the data collection tasks. If recording of data to magnetic tape was in progress, the record currently being collected will be tagged as the final record and the file will be closed. DCAD then sets event flag 35 to terminate the PLOT task and terminates.

If event flag 37 is set, DCAD will pause or suspend execution. No further data from the laser is accepted until event flag 38 is set, which effects a resumption of the data collection from the point of suspension.

Event flag 39 is set by the DR-11 driver each time the start of frame bit is detected. When flag 39 is set, DCAD interrogates the DL-11 driver to obtain the current laser orientation in elevation, pitch, and azimuth. This data is stored in the unused portion of the frame prefix for comparison with the laser orientation from the previous frame.

Event flag 40 is set by the DR-11 driver after the 100th word of each frame has been transferred. Laser orientation is checked to determine whether the beam position has changed from the previous frame. Data parameters for the frame are then calculated as follows:

- Slant Range (R_s) = Time (μsec) *150 meters/μsec (4.1.1)

If a filter plot was requested, calculations are terminated. Otherwise the calculations proceed as follows:

- Maximum Velocity (defined as that velocity represented by the filter containing the maximum intensity)
  $(VMX) = C * N$ (4.1.2)

  where C is a constant determined by the pulse width.
  N is the filter number.

- Peak Velocity (defined as that velocity represented by the filter farthest from an imaginary center).
  $(VPK) = C * N_F$ (4.1.3)

  where C is as defined above.
  N_F is the filter number farthest from the imaginary center filter.

- Peak Intensity (IPK) = The maximum intensity of the filters. (4.1.4)

- Spectrum Width (ICT) = The count of all filters containing intensities which exceed the intensity threshold. (4.1.5)

Compute the zero, first, and second moments, variance, and standard deviation as follows:

$$M0 = \sum_{i=1}^{n} In_{(i)} \tag{4.1.6}$$

for those intensities exceeding the thresholds;

$$M1 = \frac{\sum_{i=1}^{n} V_{(i)} \; In_{(i)}}{M0} \tag{4.1.7}$$

for those intensities exceeding the thresholds, and where $V_{(i)}$ represents the velocity equivalent of the ith filter in meters/second times 10;

$$M2 = \frac{\sum_{i=1}^{n} V^2_{(i)} \; In_{(i)}}{M0} \tag{4.1.8}$$

for those itensities exceeding the threshold and where $V^2_{(i)}$ represents the square of the velocity equivalent of the ith filter in meters/second times 10;

$$VAR = \frac{\sum_{i=1}^{n} V^2_{(i)} In_{(i)}}{\sum_{i=1}^{n} In_{(i)}} - \left(\frac{\sum_{i=1}^{n} V_{(i)} In_{(i)}}{\sum_{i=1}^{n} In_{(i)}} \right)^2 \qquad (4.1.9)$$

where V^2, In, and V are as defined for equations 4.1.6, 4.1.7, and 4.1.8;

$$S.\ Dev = \sqrt{VAR} \qquad (4.1.9a)$$

$$M0\ (normalized) = \frac{M0}{ICT} \qquad (4.1.10)$$

where ICT represents the count of filters containing intensity data.

Next determine the sine and cosine of the true elevation angle (Beta) which is a composite of the sine of the elevation angle (Theta) times the cosine of twice the pitch angle (Phi).

$$SIN\beta = SIN\theta * COS2\phi \qquad (4.1.11)$$

$$COS\beta = SQRT\ (1 - SIN^2\beta) \qquad (4.1.12)$$

The values of Altitude (ALT), Ground Range (R_G), Horizontal Projection and Vertical component of VPK (VPK_H, VPK_V) and VMX (VMX_H, VMX_V) may now be determined using the following definitions:

- $VPK_H = VPK \,/\, COS\beta$ (4.1.13)
- $VPK_V = VPK * SIN\beta$ (4.1.14)
- $VMX_H = VMX \,/\, COS\beta$ (4.1.15)
- $VMX_V = VMX * SIN\beta$ (4.1.16)
- $ALT = Rs * SIN\beta$ (4.1.17)
- $R_G = Rs * COS\beta$ (4.1.18)

DCAD now monitors the range to dynamically determine data mode as being either normal scan (ranges increasing each frame out to maximum range) or time scan (range fixed). Scans are incremented by one of the following:

- o In normal scan mode:
  - The range from the current frame is less than the range from the previous frame.
  - The range from the current frame is equal to the range from the previous frame at which time a mode change occurs.
  - The processed frame count exceeds 200.
- o In time mode:
  - The range of the current frame is not equal to the range of the previous frame at which time a mode change occurs.

If recording has been selected, DCAD checks to see if the data buffer is ready to be written. If so, DCAD writes the data record and awaits the next event flag; if not, it awaits the next event flag. DCAD (through the DR-11 interface) monitors the status of the manual data quality bit. If the manual data quality is tagged as "bad," the DR-11 software will reject the current frame and all subsequent frames until the data is again tagged as "good." The check for data quality is performed once at the beginning of each frame of data. If the data quality is "good" at the time of the check and then becomes "bad," the frame is processed as though it were "good."

4.2 Data Tape Format

Table 4-1 lists the format of the data record for magnetic tape recording of the data. The data buffer contains 32 blocks of 120 words each, equivalent to 32 frames of data as it is received from the laser plus the calculated data. Each data record consists of 16 blocks. Upon termination of recording, DCAD ensures that an even number of data records have been written, facilitating post processing of the data.

DATA TAPE FORMAT

Record	Word	Description
1		Tape Header Record
	1	File Number
	2-5	Date of Creation
	6-46	ASCII File Description
2-n		Data Records
	1	Fortran Forward Pointer (link to next block)
	2	Macro Forward Pointer (link to next block)
	3	Code word 0 = Busy (set by interrupt handler) 1 = Completed by interrupt handler 2 = Calculations completed 3 = Empty (initialized condition only) 4 = Last processed block
	4	Scan Number
	5-24	Frame Prefix
	5-7	Frame Sync
	8	Number of integrations/filter polarity/ data quality
	9-10	BCD Run Number
	11-12	BCD Frame Count
	13	Pulse Width/BCD Range (MSB)
	14	BCD Range (LSB)
	15	Intensity Threshold
	16	Flag Used for angle comparisons
	17	Lo Velocity Threshold
	18	Hi Velocity Threshold
	19	Elevation Angle
	20	Pitch Angle
	21	Azimuth Angle
	21-23	Time (minutes/ticks)
	24	Decimal Frame Count (0-200)
	25-104	Filter Values
	105	Computed Peak Intensity
	106	N - Velocity Spectrum Density
	107	Peak Velocity (m/sec * 10)
	108	Peak Velocity (Horizontal Projection)
	109	Peak Velocity (Vertical Component)
	110-112	Maximum Velocity (see words 107-109)
	113	Slant Range (Meters)
	114	Ground Range (Meters)

Table 4-1

DATA TAPE FORMAT
(Continued)

Record	Word	Description
	115	Altitude (Meters)
	116	Normalized Zero Moment
	117	Normalized First Moment
	118	Normalized Second Moment
	119	Variance of Moments
	120	Standard Deviation of Moments
N+1		EOF

Table 4-1
(Continued)

5. DATA DISPLAY

The WISP system includes a versatile plot package (PLOT) which provides graphic display of a wide variety of related functions. Information required by the PLOT task to construct the desired X, Y plot is obtained from the control program via operator input. Figure 3-3 presents the operator assistance display which describes each of the functions that may be plotted and provides additional information regarding the plot parameters.

The plot package allows the selection of two dependent variables. These will be plotted against one or two independent variables, provided the respective variables in X and Y have similar axis extents. Only one axis in X and one axis in Y are provided.

Figures 5-1 through 5-5 provide samples of the versatility of the plot package. These functions are generated by the simulation package included in the WISP system.

Figures 5-6 through 5-8 represent a special plot feature called a filter plot.

5.1 PLOT Program Description

5.1.1 Real-time Processing

During real-time operations, the PLOT program determines the plot type and performs the following based on the plot type:

- For X, Y graphs - obtain the precalculated data value for the function(s) being plotted, compute X, Y screen coordinates, and output the graph.
- For tabular data - obtain all precalculated values, build a formatted character string, and output.
- For filter plot - quantize the data contained in the 80 filters (40 or 20 depending upon pulse width) according to Table 5-1, and output the line.

5.1.2 Post Processing

During off-line processing (data source is TAPE), the PLOT program performs as above with the exception that all data calculations are performed anew using thresholds as specified by the operator.

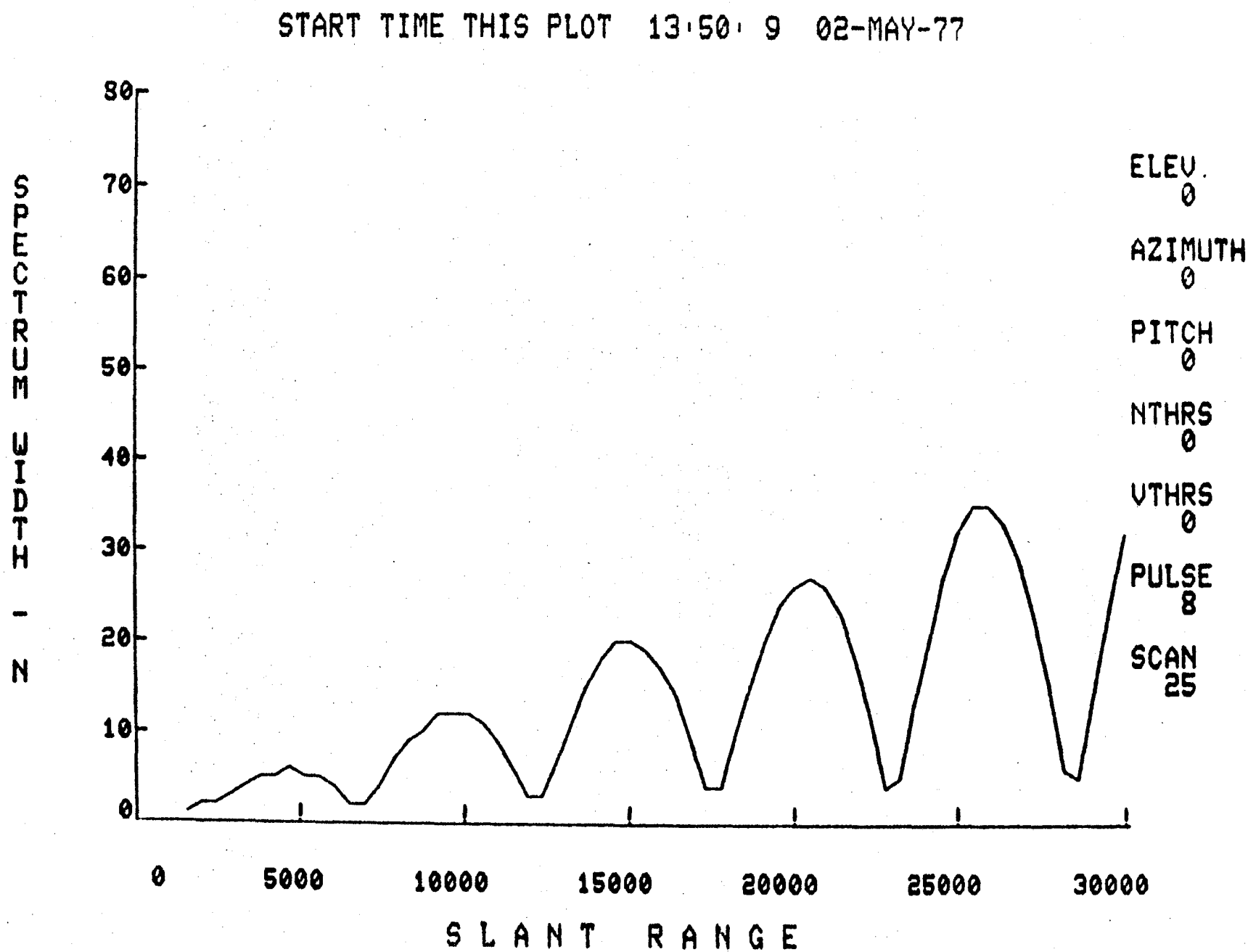
START TIME THIS PLOT 13:50: 9 02-MAY-77
SPECTRUM WIDTH - N
80
70
60
50
40
30
20
10
0
0
5000
10000
15000
20000
25000
30000
SLANT RANGE
ELEV.
0
AZIMUTH
0
PITCH
0
NTHRS
0
VTHRS
0
PULSE
8
SCAN
25

Figure 5-1

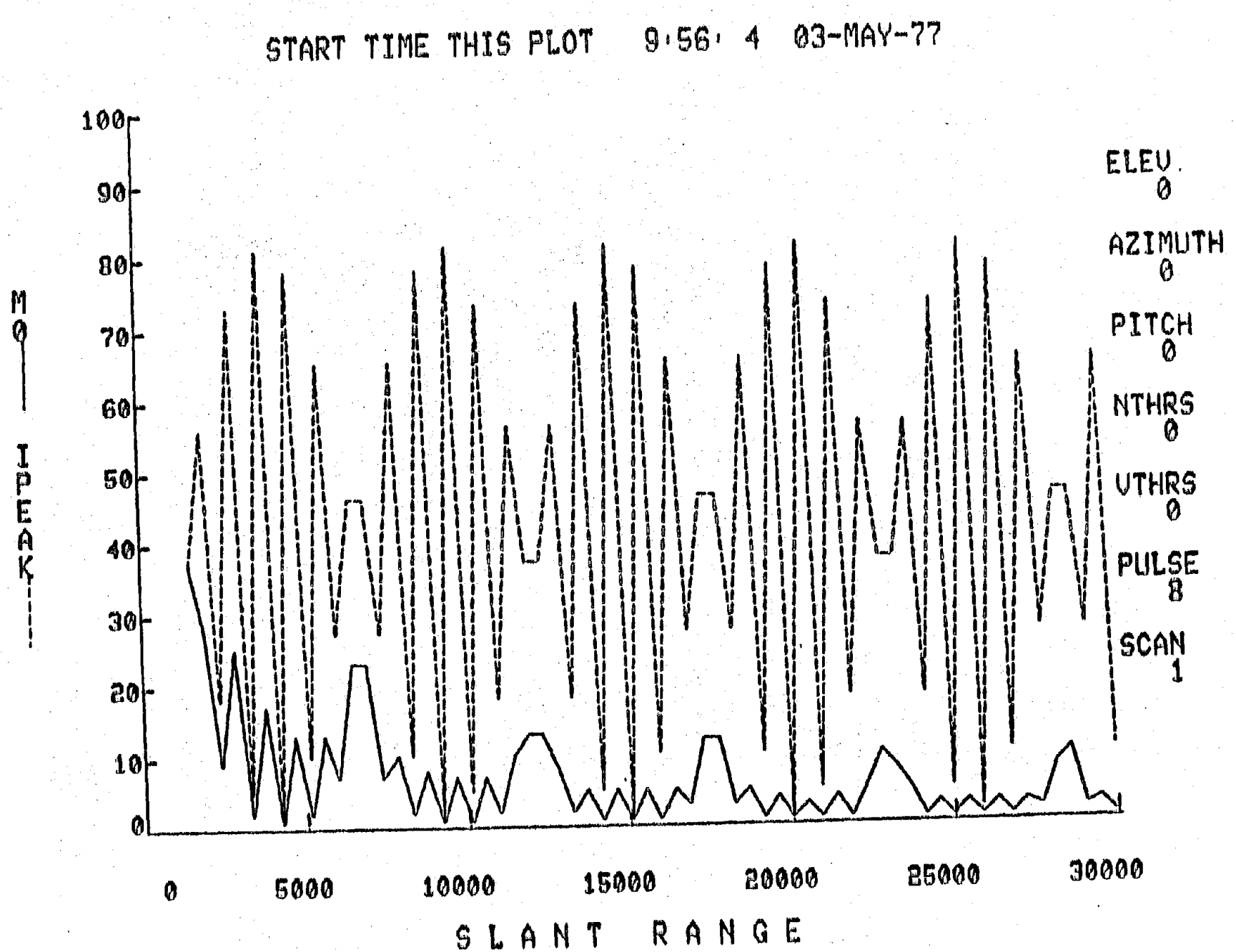
START TIME THIS PLOT 9:56: 4 03-MAY-77
M0 IPEAK
100
90
80
70
60
50
40
30
20
10
0
0
5000
10000
15000
20000
25000
30000
SLANT RANGE
ELEV.
0
AZIMUTH
0
PITCH
0
NTHRS
0
VTHRS
0
PULSE
8
SCAN
1

Figure 5-2

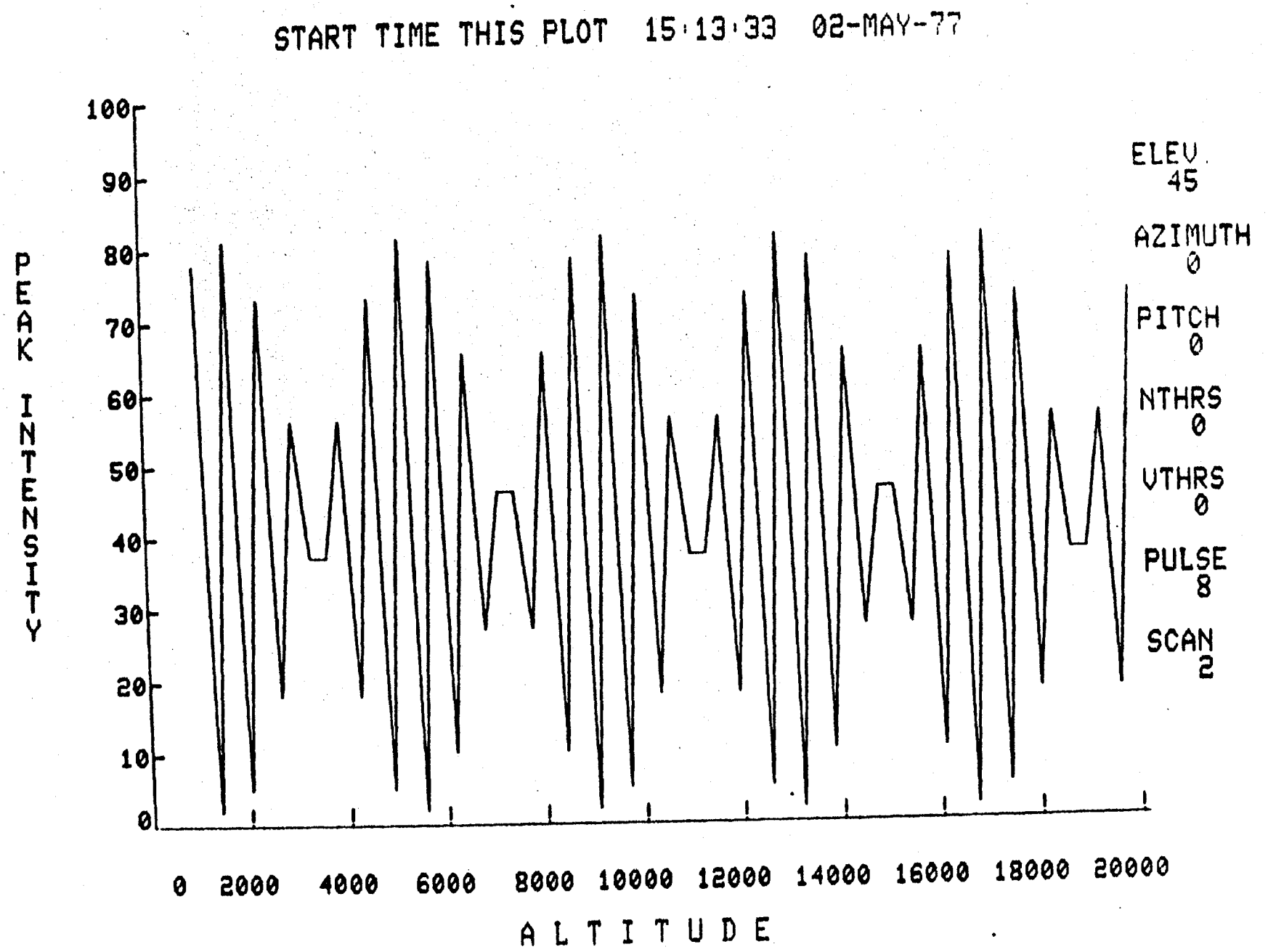
START TIME THIS PLOT 15:13:33 02-MAY-77
PEAK INTENSITY
100
90
80
70
60
50
40
30
20
10
0
0 2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
ALTITUDE
ELEV
45
AZIMUTH
0
PITCH
0
NTHRS
0
VTHRS
0
PULSE
8
SCAN
2

Figure 5

PLOT PACKAGE EXAMPLE 4

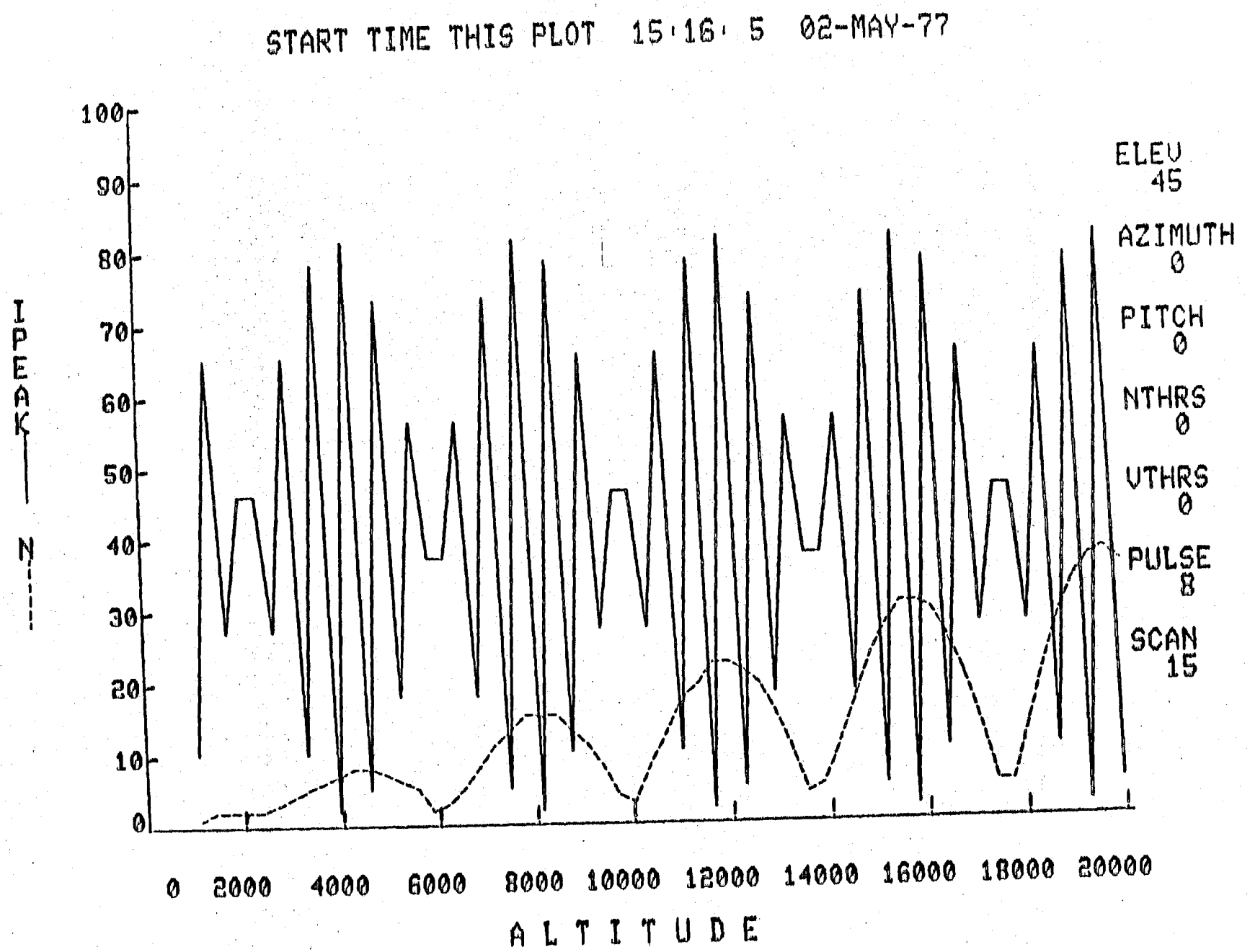

Figure 5-4

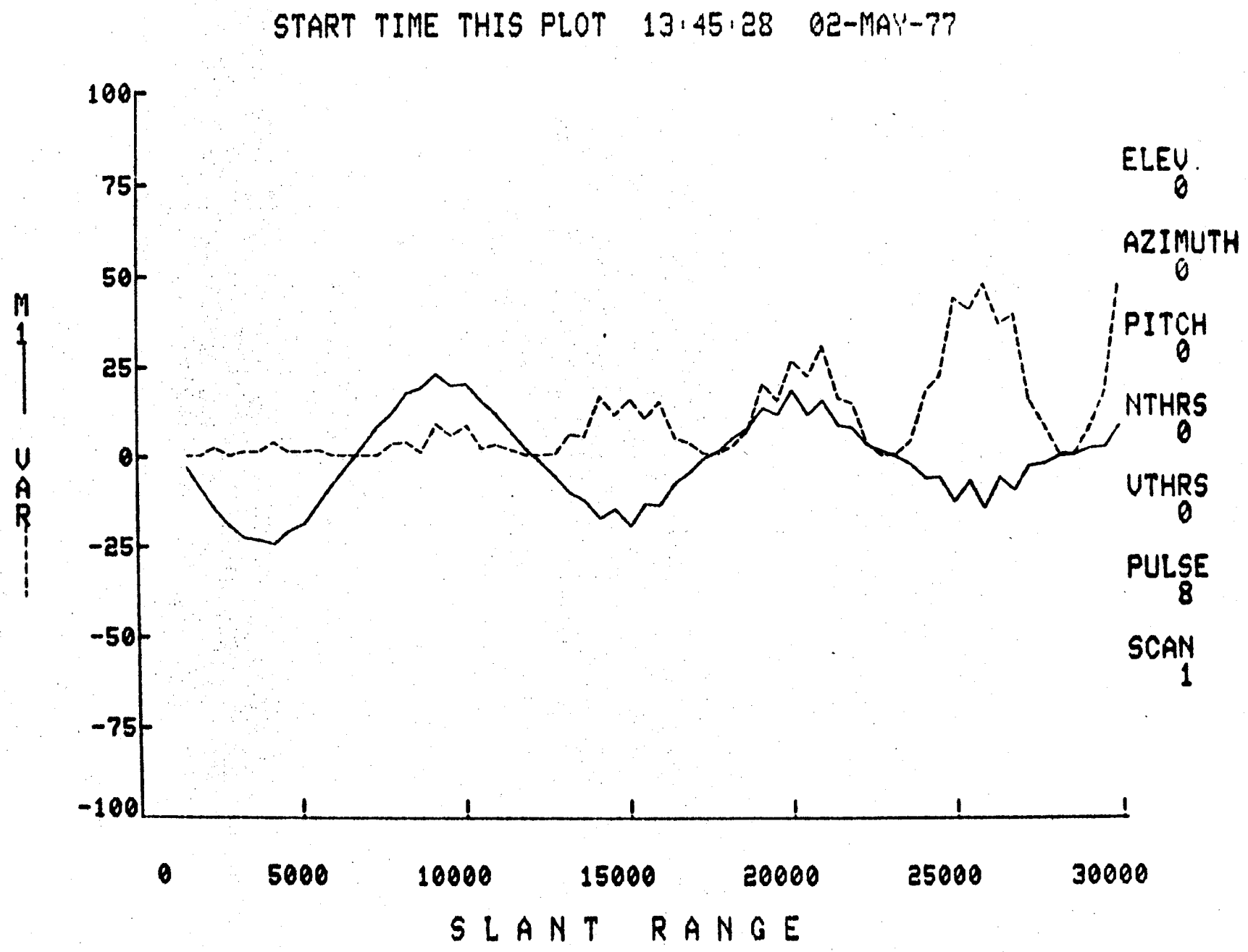
START TIME THIS PLOT 13:45:28 02-MAY-77
100
75
50
25
0
-25
-50
-75
-100
M 1 ---- VAR
0
5000
10000
15000
20000
25000
30000
SLANT RANGE
ELEV
0
AZIMUTH
0
PITCH
0
NTHRS
0
UTHRS
0
PULSE
8
SCAN
1

Figure [illegible]

FILTER PLOT OF 20 FILTERS (2 μSEC PULSE WIDTH)

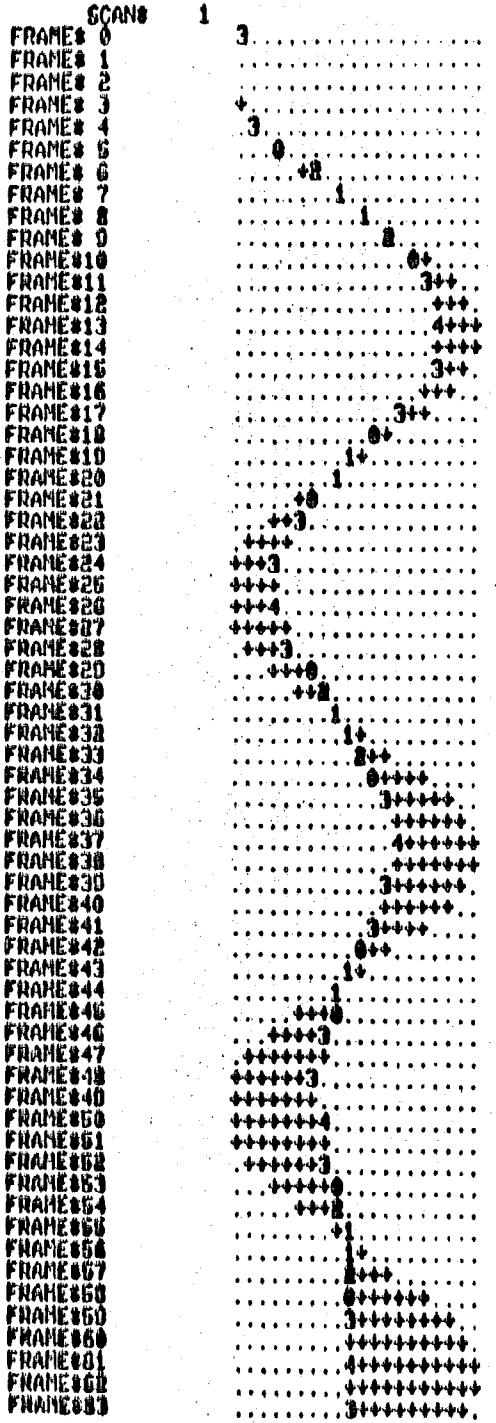

Figure 5-6

FILTER PLOT OF 40 FILTERS (4 μSEC PULSE WIDTH)

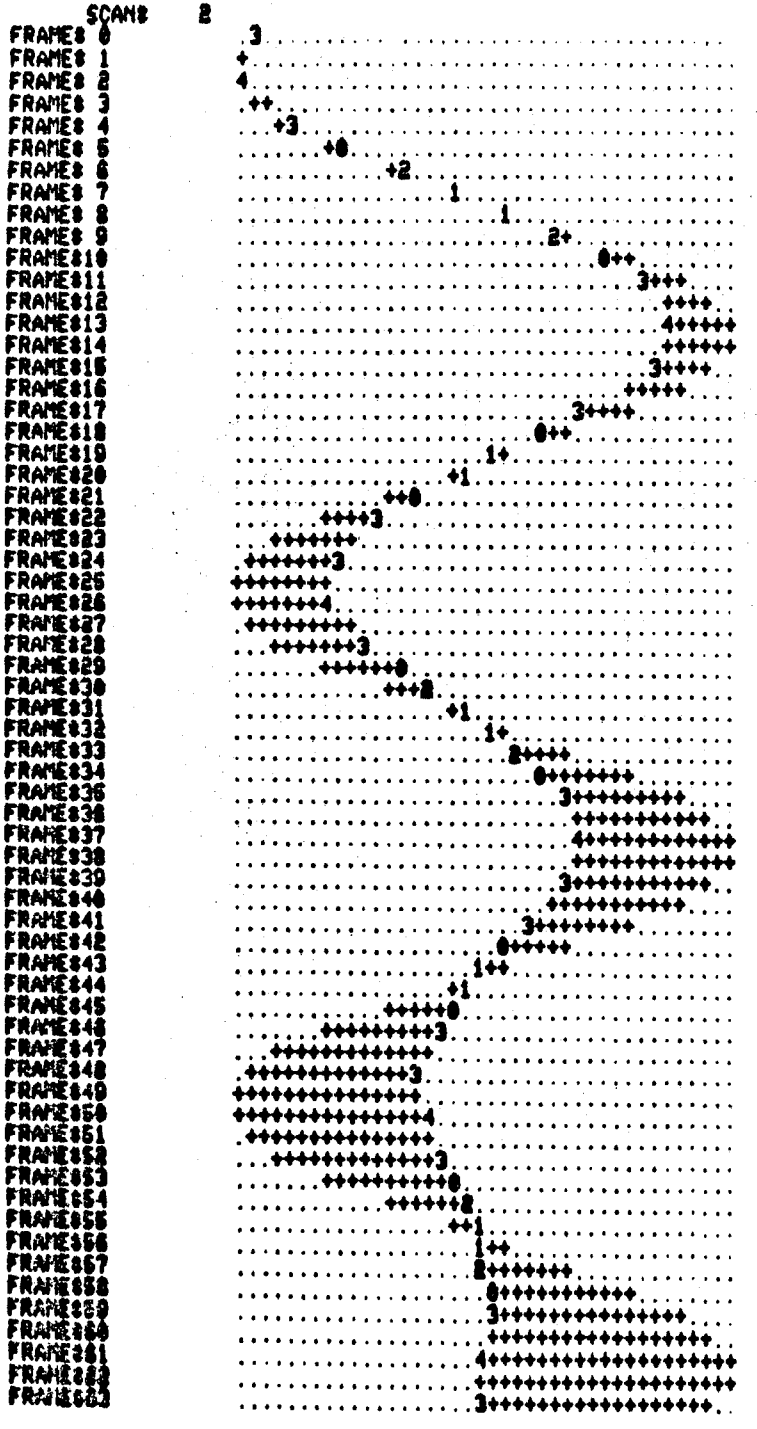

Figure 5-7

FILTER PLOT OF 80 FILTERS (8 μSEC PULSE WIDTH)

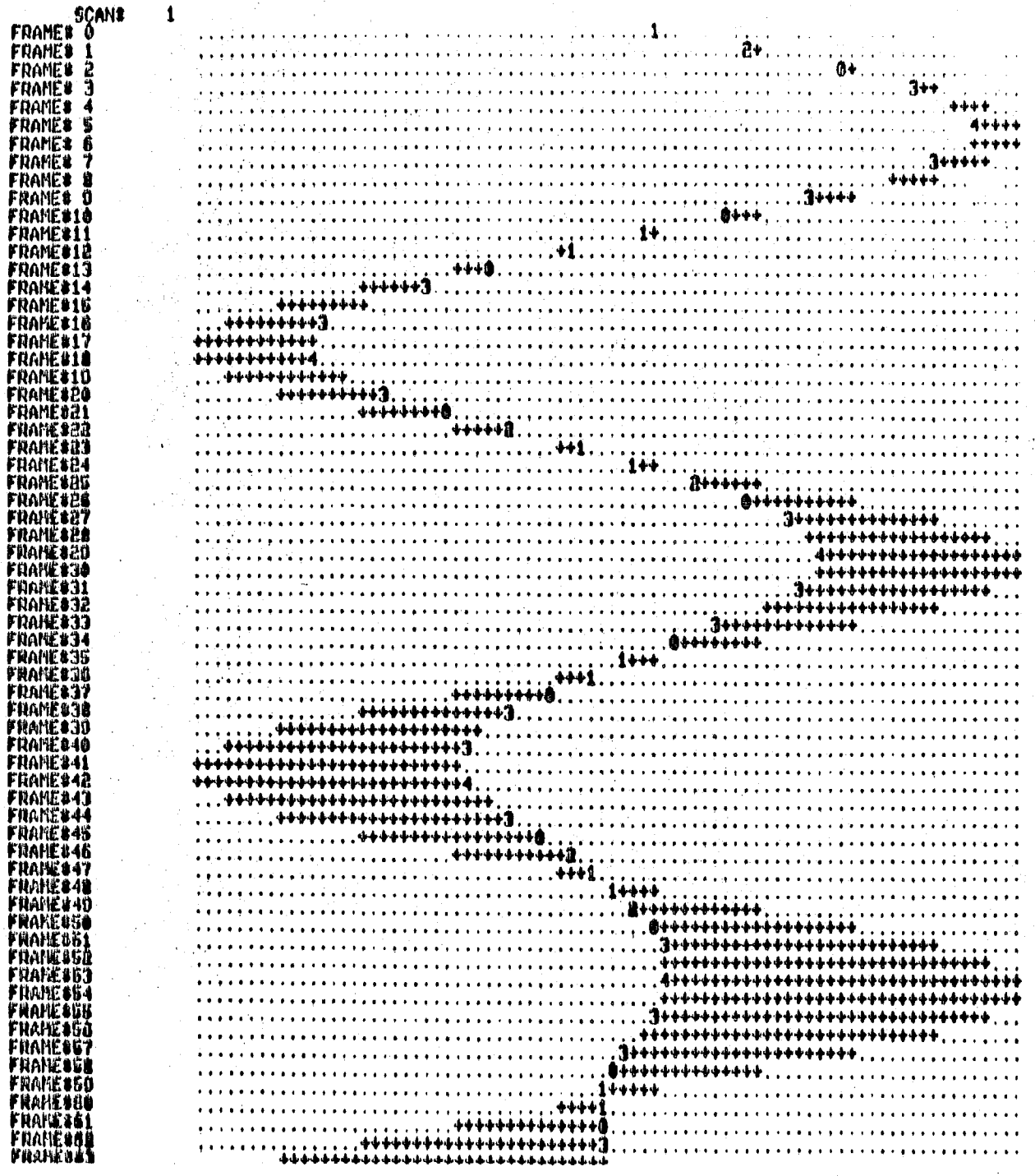

Figure 5-8

INTENSITY QUANTIZATION LEVELS

Filter Value	Character
0-1	. (Period)
2-32	+
33-64	0
65-96	1
97-128	2
129-160	3
161-192	4
193-224	5
225-256	6
257-288	7
289-320	8
321-352	9
353-384	*
385-416	#
417-448	$
449-480	@
481-512	@

Table 5-1

6. TAPE DUMP PROGRAM DESCRIPTION

The Tape Dump Task (TDUMP) provides the capability to produce formatted or unformatted dumps of raw laser data from magnetic data tapes produced by the WISP system during real-time operations. The type of dump desired is operator-selectable. Several dump types may be selected at one time to produce a comprehensive set of data for analysis.

6.1 TDUMP Detailed Description

6.1.1 Program Initiation and Termination

TDUMP is initiated by the command:

RUN TDUMP (CR)

TDUMP may be terminated at any point in the query/response sequence by typing:

Q(CR)

TDUMP may also be terminated during the execution of the dump (if in manual paging mode) by the same method.

6.1.2 Dump Parameter Selection

TDUMP provides several raw data dump formats as outlined in Table 6-1. Default selections are as follows:

Dump Format	Screen Selection
File Headers	1
Frame Headers	1
Frame Prefix	1
Filter Values	1
Calculated Data	1
Filter Plot	2

6.1.3 Tape Manipulation

On entry, and upon subsequent restarts, TDUMP requests whether the tape should be positioned. The following queries appear:

RAW DATA DUMP FORMATS

DUMP FORMAT	DESCRIPTION
Octal	Provides unformatted dump of each record in octal representation.
Decimal	Provides unformatted dump of each record in decimal representation.
Hexadecimal	Provides unformatted dump of each record in hexadecimal representation.
File Header	Provides ASCII dump of each file header record.
Frame Header	Provides formatted dump of each block header within a data record. The block header contains pointers and scan count information.
Frame Prefix	Provides formatted dump of 20 words of prefix information preceding the filter data.
Filter Values	Provides formatted dump of 80 filter values.
Calculated Data	Provides formatted dump of any results of calculations performed on the block of data during real-time operations.
Filter Plot	Provides formatted dump of quantized filter values (same as filter plot produced in real time).

Table 6-1

Query	Response
REWIND?	"Y" or CR cause tape to be rewound. "N" skips rewind.
SEARCH?	"Y" or CR causes search parameters to be requested. "N" skips search.

The tape may be searched for file number, scan number, or time, or any combination of the three.

6.1.4 Automatic Updating

TDUMP allows either manual page updating or auto-paging. Manual updating is achieved by depressing the RETURN key (CR) after a page has been filled. Auto-paging will cause n pages to be successively printed, where n is an integer entered in response to the query "AUTO-PAGING?".

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7. 3-D DISPLAY SYSTEM DESCRIPTION

Six tasks are included in the 3-D display system. The initialization task (INIT3D) creates a working file on disk. A second task (WF3D) reads laser data from magnetic tape and writes into the disk work file. The data in the work file can be rotated and viewed using separate rotation and plotting tasks (ROTATE, PLOT3D). Hidden line removal is done on the data in the work file by the file processing task (HLINE). A final task (RESET) is provided to replace hidden lines in the work file in order that additional rotations may be done on this data. Figure 7-1 provides examples of the 3-D plots.

7.1 INIT3D Detailed Description

INIT3D is run once to create and clear a 2000-block Direct Access File on DK1. INIT3D should not be run if this file already exists on DK1.

INIT3D is initiated by the command:

RUN INIT3D (CR)

INIT3D will terminate when initialization is complete.

7.2 WF3D Detailed Description

7.2.1 Program Initiation

WF3D is initiated by the command:

RUN WF3D (CR)

7.2.2 Tape Manipulation

On entry, WF3D requests whether the tape should be positioned. The following queries appear:

Query	Response
REWIND?	"Y" or CR causes tape to be rewound. "N" skips rewind.
SEARCH?	"Y" or CR causes search parameters to be requested. "N" skips search.

7.2.3 Writing the 3-D File

WF3D will transfer n frames of filter data from the tape to the 3-D file, where n is an integer entered in response to the request "ENTER #FRAMES < 250."

7.2.4 Termination

WF3D will terminate after the requested frames are written to disk.

7.3 ROTATE Detailed Description

7.3.1 Program Initiation

ROTATE is initiated by the command:

RUN ROTATE (CR)

7.3.2 Rotating Data in the 3-D File

ROTATE allows 2 axis coordinate transformations to be performed on the data in the 3-D file. First the data is rotated n degrees about the vertical axis, then the data is rotated m degrees about the horizontal axis, where n and m are integers entered in response to the request "ENTER ROTATION AND PITCH IN DEGREES (2I3)." All rotations are with respect to the viewing axis and about viewing center.

7.3.3 Termination

ROTATE terminates after the coordinate transformation is complete.

7.4 PLOT3D Detailed Description

7.4.1 Program Initiation

PLOT3D is initiated by the command:

RUN PLOT3D (CR)

7.4.2 Displaying the Data in the 3-D File

PLOT3D scales and displays the data in the 3-D file on the 4014 CRT. Automatic scaling is selected by responding to the query "AUTOMATIC SCALING?" with a "Y" or CR. Alternatively, manual scaling can be

selected. In this case, PLOT3D will request that a scaling code 1-9 be entered. After scaling is selected PLOT3D will display the scaling code and plot center. The plot can now be started by entering a "Y" or CR in response to the query "OK?"; any other entry will allow scaling to be re-selected. Figures 7.1 - 7.3 provide samples of 3-D filter plots.

7.4.3 Termination

PLOT3D will terminate after the display is complete.

7.5 HLINE Detailed Description

7.5.1 Program Initiation

HLINE is initiated by the command:

RUN HLINE (CR)

7.5.2 Hidden Line Removal

HLINE modifies the data in the 3-D file to remove hidden lines. No operator input is required. During hidden line removal one line of numeric values will be displayed each time two frames are compared for visibility. For n frames of data a maximum of $\frac{(n-1)(n)}{2}$ lines will be displayed before hidden line removal is complete. During this display, margin control on the 4014 terminal should be turned off so the program will not stop when the page is full.

7.5.3 Termination

HLINE terminates when hidden line processing is complete.

7.6 RESET Detailed Description

7.6.1 Program Initiation

RESET is initiated by the command:

RVN RESET (CR)

7.6.2 Restoring Hidden Lines

RESET removes the modifications made by HLINE on the 3-D file. No operator input is required.

7.6.3 Termination

RESET terminates automatically after file restoration is complete.

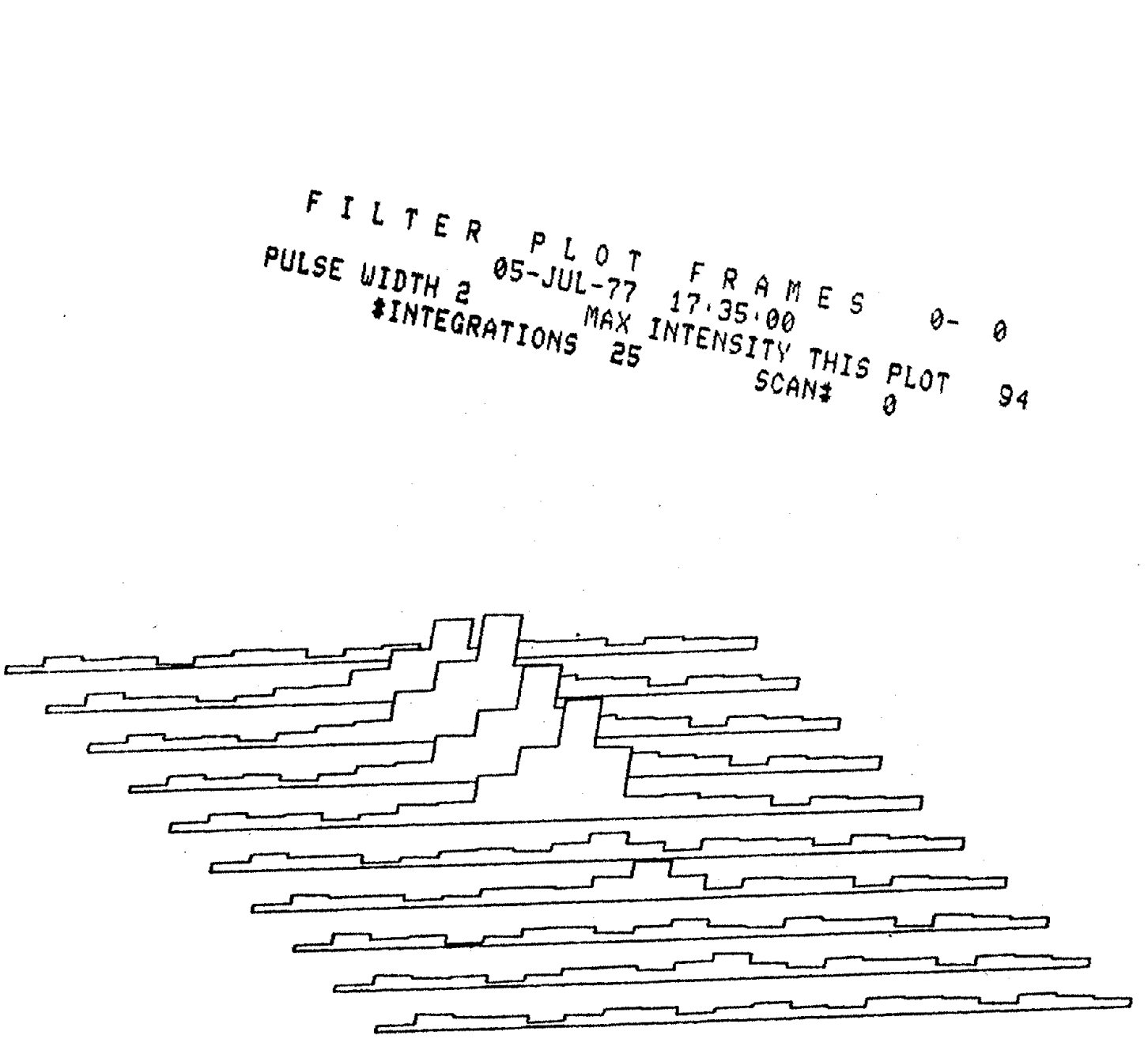
F I L T E R P L O T F R A M E S 0- 0
PULSE WIDTH 2 05-JUL-77 17:35:00
#INTEGRATIONS 25 MAX INTENSITY THIS PLOT 94
SCAN# 0

Figure 7-1

APPENDIX A

GLOBAL DATA DEFINITIONS

```
      BLOCK DATA

C     G L O B A L    C O M M O N

      COMMON /ITC/ NDATE(5), NCNFG(3), NPLFG(3), NCLFG(3), NDSRC   ,
     1   NPLOT   , NXTYP   , NYTYP   , NXMIN   , NXMAX   , NYMIN   ,
     2   NYMAX   , NSCTP   , NTABD   , NSCRP   , NSCRT   , NMODE   ,
     3   NPTIM   , NBEG1   , NBEG2   , NTIM1   , NTIM2   , NYTAB   ,
     4   NPNXT   , NCNXT   , NSCAN   , NTHRS   , NVTHS   , NDONT   ,
     5   NPBEG   , NPEND   , LUNCR   , NTOPN   , NPREC   , NXLOC   ,
     6   NANG1   , NANG2   ,NANG3    , NRNGE   , NPSCN   , NSTAT(3),
     7   LUNMT   , LUNDR   , LUNKL   , LUNTI   , NTAPE   , ISTAT(4),
     8   NRECD   , NHCNT   , NHTIM   , NRESV(9),
     A   NTHDR(46)  , NBLOK(3840)
      EQUIVALENCE                ( NSCR, NCNFG(2) ), (NSIZ, NCNFG(3) ),
     1   (LOT , LUNTI ), ( LIT , LUNTI )
```

C O M M O N V A R I A B L E D E F I N I T I O N S

NAME	ITEM NO.	DEFINITION
NDATE(5)	1	DATE OF THE RUN
NCNFG(3)	6	LOCAL FLAGS FOR THE CONTROL TASK
NPLFG(3)	9	LOCAL FLAGS FOR THE PLOT TASK
NCLFG(3)	12	LOCAL FLAGS FOR THE COLLECTION TASK
NDSRC	15	DATA SOURCE 1 = LASER 2 = TAPE 3 = DUMMY
NPLOT	16	X-Y PLOT FLAG 0 = NO X-Y PLOT 1 = X-Y PLOT NEEDED
NXTYP	17	X AXIS VARIABLE 1 = PEAK INTENSITY 2 = VELOCITY SPECTRUM DENSITY (N) 3 = PEAK VELOCITY 4 = PEAK VELOCITY - HORIZONTAL COMPONENT 5 = PEAK VELOCITY - VERTICAL COMPONENT 6 = MAXIMUM VELOCITY 7 = MAXIMUM VELOCITY - HORIZONTAL COMPONENT 8 = MAXIMUM VELOCITY - VERTICAL COMPONENT 9 = SLANT RANGE

10 = GROUND RANGE
11 = ALTITUDE
12 = ZEROTH MOMENT
13 = FIRST MOMENT
14 = SECOND MOMENT
15 = VARIABLE OF MOMENTS
16 = STANDARD DEVIATION
17 = TIME

NYTYP 18 Y AXIS VARIABLE
SEE NXTYP FOR VALUES

NXMIN 19 X AXIS LOWER LIMIT

NXMAX 20 X AXIS UPPER LIMIT

NYMIN 21 Y AXIS LOWER LIMIT

NYMAX 22 Y AXIS UPPER LIMIT

NSCTP 23 TYPE OF DATA COLLECTION REQUIRED
1 = NORMAL SCAN
2 = TIME

NTABD 24 TABULAR DATA FLAG
0 = NO TABULAR DATA REQUIRED
1 = TABULAR DATA IS REQUIRED

NSCRP 25 SCREEN NUMBER FOR X-Y PLOT
1 = PRIMARY SCREEN
2 = SECONDARY SCREEN

NSCRT 26 SCREEN NUMBER FOR TABULAR DATA
1 = PRIMARY SCREEN
2 = SECONDARY SCREEN

NMODE 27 UPDATE MODE FOR X-Y PLOT
1 = AUTOMATIC
2 = MANUAL

NPTIM 28 PLOT SPAN IN TIME

NBEG1 29 START TIME OF PLOT - WORD 1

NBEG2 30 START TIME OF PLOT - WORD 2

NTIM1 31 TIME OF CURRENT PLOT - WORD 1

NTIM2 32 TIME OF CURRENT PLOT - 2

NYTAB 33 LAST Y COORDINATE FOR TABULAR PLOT

NPNXT 34 NEXT BLOCK POINTER FOR THE PLOT TASK

NCNXT 35 NEXT BLOCK POINTER FOR THE COLLECTION TASK

NSCAN	36	CURRENT SCAN NUMBER FOR THE COLLECTION TASK
NTHRS	37	THRESHOLD VALUE
NVTHS	38	LO VELOCITY THRESHOLD VALUE
NDONT	39	NBLOK READY FLAG FOR PLOT PROGRAM 0=NBLOK NOT RE
NPBEG	40	PLOT START TIME - IN SECONDS
NPEND	41	PLOT END TIME - IN SECONDS
LUNCR	42	HI VELOCITY THRESHOLD VALUE
NTOPN	43	FLAG TO INDICATE THE INPUT TAPE IS OPEN 0 = NOT OPEN 1 = OPEN
NPREC	44	PHYSICAL RECORD COUNT PAST THE STARTING RECORD FOR POST PROCESSING
NXLOC	45	FILE NUMBER
NANG1	46	ELAVATION ANGLE FOR CURRENT PLOT
NANG2	47	AZIMUTH ANGLE FOR CURRENT PLOT
NANG3	48	PITCH ANGLE FOR CURRENT PLOT
NRNGE	49	RANGE (IF FIXED) FOR CURRENT PLOT
NPSCN	50	SCAN NUMBER OF CURRENT PLOT
NSTAT(3)	51	0 = INACTIVE 1 = ACTIVE 2 = PAUSED 3 = STOPPING NSTAT(1) IS FOR PLOT NSTAT(2) IS FOR DCAD NSTAT(3) IS FOR HIDE
LUNMT	54	LUN FOR MAG TAPE
LUNDR	55	LUN FOR DR-11
LUNKL	56	LUN FOR KL-11
LUNTI	57	LUN FOR TERMINAL
NTAPE	58	TAPE SELECTED FLAG 0 = NOT SELECTED 1 = SELECTED
ISTAT(4)	59	STATUS BLOCK FOR MT I/O

NRECD	63	DCAD TAPE WORD
NHCNT	64	BLOCK COUNT FOR THE HIDE TASK
NHTIM	65	TIME BETWEEN BLOCKS (FOR HIDE TASK)
NRESV(1)	66	PULSE WIDTH FOR THE HIDE TASK
NRESV(2)	67	ELEVATION ANGLE FOR THE HIDE TASK
NRESV(3)	68	PITCH ANGLE FOR THE HIDE TASK
NRESV(4)	69	AZIMUTH ANGLE FOR THE HIDE TASK
NRESV(5)	70	PULSE WIDTH FOR PLOT LEGEND
NRESV(6)	71	FLAG FOR FILTER DISPLAY REQUEST
NRESV(7)	72	SECOND PLOT FUNCTION X-AXIS TYPE
NRESV(8)	73	SECOND PLOT FUNCTION Y-AXIS TYPE
NRESV(9)	74	MANUAL ANGLE SELECTION FLAG
NTHDR(46)	75	TAPE HEADER BLOCK WORD 1 FILE NUMBER WORDS 2-6 DATA WORDS 7-46 TITLE
NBLOK(3840).	121	BLOCK TABLE

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D A T A B L O C K F O R M A T

SECTION	OFFSET	VARIABLE
HEADER		
DATA		
	0	FORTRAN FORWARD POINTER
	1	MACRO FORWARD POINTER
	2	CODE 0 = IN USE BY INTERRUPT HANDLER 1 = COMPLETED BY INTERRUPT HANDLER 2 = COMPLETED BY COLLECTION TASK 3 = EMPTY BLOCK
	3	SCAN NUMBER
PREFIX		
DATA		
	4	START FRAME BIT AND FRAME SYNCH
	5	FRAME SYNCH
	6	FRAME SYNCH
	7	NO. INTEGRATIONS(BCD)/POLARITY SENSE/DATA QUALITY
	8	RUN NUMBER - FIRST BYTE
	9	RUN NUMBER - NEXT 2 BYTES

10	FRAME COUNT - FIRST HALF
11	FRAME COUNT - SECOND HALF
12	PULSE WIDTH/RANGE(MSB)
13	RANGE - NEXT 2 DIGITS
14	INTENSITY THRESHOLD
15	ANGLE EQUAL FLAG
16	LO VELOCITY THRESHOLD
17	HI VELOCITY THRESHOLD
18	ELEVATION
19	PITCH
20	AZIMUTH
21	TIME - MINUTES
22	TIME - TICKS
23	FRAME NUMBER IN SCAN
FILTER DATA	
24	FILTER NO. 1 OUTPUT
25	FILTER NO. 2 OUTPUT
.	
.	
.	
103	FILTER NO. 80 OUTPUT
CALCULATED DATA	
104	PEAK INTENSITY
105	N - VELOCITY SPECTRUM DENSITY
106	PEAK VELOCITY
107	PEAK VELOCITY - HORIZONTAL PROJECTION
108	PEAK VELOCITY - VERTICAL COMPONENT
109	MAXIMUM VELOCITY
110	MAXIMUM VELOCITY - HORIZONTAL PROJECTION
111	MAXIMUM VELOCITY - VERTICAL COMPONENT
112	SLANT RANGE
113	GROUND RANGE
114	ALTITUDE
115	ZEROTH MOMENT
116	FIRST MOMENT
117	SECOND MOMENT
118	VARIANCE OF MOMENTS
119	STANDARD DEVIATION

E V E N T F L A G S

EVENT FLAG NO.	NAME	SETTING TASK	CLEARING TASK
33	FRAME-CALC	DCAD	PLOT
34	PLOT-RESTART	COP	PLOT
35	PLOT-STOP	COP	PLOT

```
                36  DCAD-STOP       COP         DCAD
                37  DCAD-PAUSE      COP         DCAD
                38  DCAD-RESTART    COP         DCAD
                39  FRAME-START     DR11        DCAD
                40  FRAME-END       DR11        DCAD
                41  HIDE-RUN        COP         HIDE
```



```
0004            END
```

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APPENDIX B

(To Be Supplied)

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