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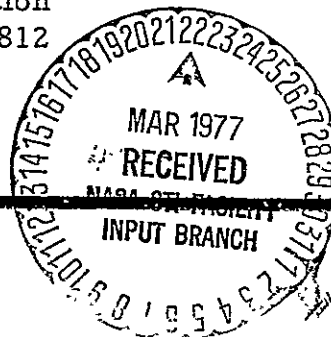
FINAL REPORT
WIND INFORMATION DISPLAY
SYSTEM USER'S MANUAL

January 27, 1977

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 M&S COMPUTING, INC.



PREFACE

The Wind Information Display System (WINDS) User's Manual provides a detailed description for using WINDS to collect, store, and process wind-shear data received from laser doppler velocimeter systems. WINDS was developed for NASA at Marshall Space Flight Center (Contract No. NAS8-32024) to store and process wind-shear data for use by NASA analysts.

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1. INTRODUCTION

The Wind Information Display System (WINDS) provides flexible control through system-user interaction for collecting wind-shear data, processing this data in real time, displaying the processed data, storing raw data on magnetic tapes, and post-processing raw data. The data is received from two asynchronous laser doppler velocimeters (LDV's) and includes position, velocity, and intensity information. The raw data is written onto magnetic tape for permanent storage and is also processed in real time to depict wind velocities in a given spacial region.

The interactive capability enables the user to make real time adjustments in processing data and, thereby, provides a better definition of wind shears. Displaying the wind-shear information in real time produces a feedback capability to the LDV system operator, allowing adjustments to be made in the collection of raw data. Therefore, both raw data and processing can be continually upgraded during testing to improve wind-shear studies. The post-analysis capability permits the analyst to perform in-depth studies of test data.

WINDS is composed of both PDP-11 support software and M&S Computing application software running under control of the PDP-11 Operating System.

1.1 PDP-11 Support Software

The PDP-11 support software consists of system programs designed by Digital Equipment Corporation (DEC) to support the PDP-11 user during execution of application programs. Specifically, the PDP-11 software is the Resource Sharing Executive Real-Time Operating System (RSX-11M).

1.2 M&S Computing Application Software

The M&S Computing application software includes programs that control collecting, storing, processing, and displaying data and several utility programs. Specifically, the application software components are:

- o Wind Information Display System (WINDS)
- o Write Two End-of-Files (W2EFS)
- o Write Two End-of-Files (W2EFNR)

A detailed description of the application software is given in Sections 3 and 4 of this document.

1.3 Hardware Configuration

The hardware configuration (see Figure 1-1) required by WINDS is:

- o Digital Computer, PDP-11 Series Model 35 with 48K memory and 16-bit words - DEC.
- o Two Magnetic Disk Units, RK05 - DEC.
- o Magnetic Tape Unit, TU10 - DEC.
- o Graphics Display Terminal, 4014 Series Terminal with 613 Monitor - Tektronix, Inc.
- o Hard Copy Device, 4610 Series - Tektronix, Inc.
- o Graphics Data Tablet, HW-1-11, Summagraphics.

Operation of WINDS hardware is discussed in Section 2 of this document.

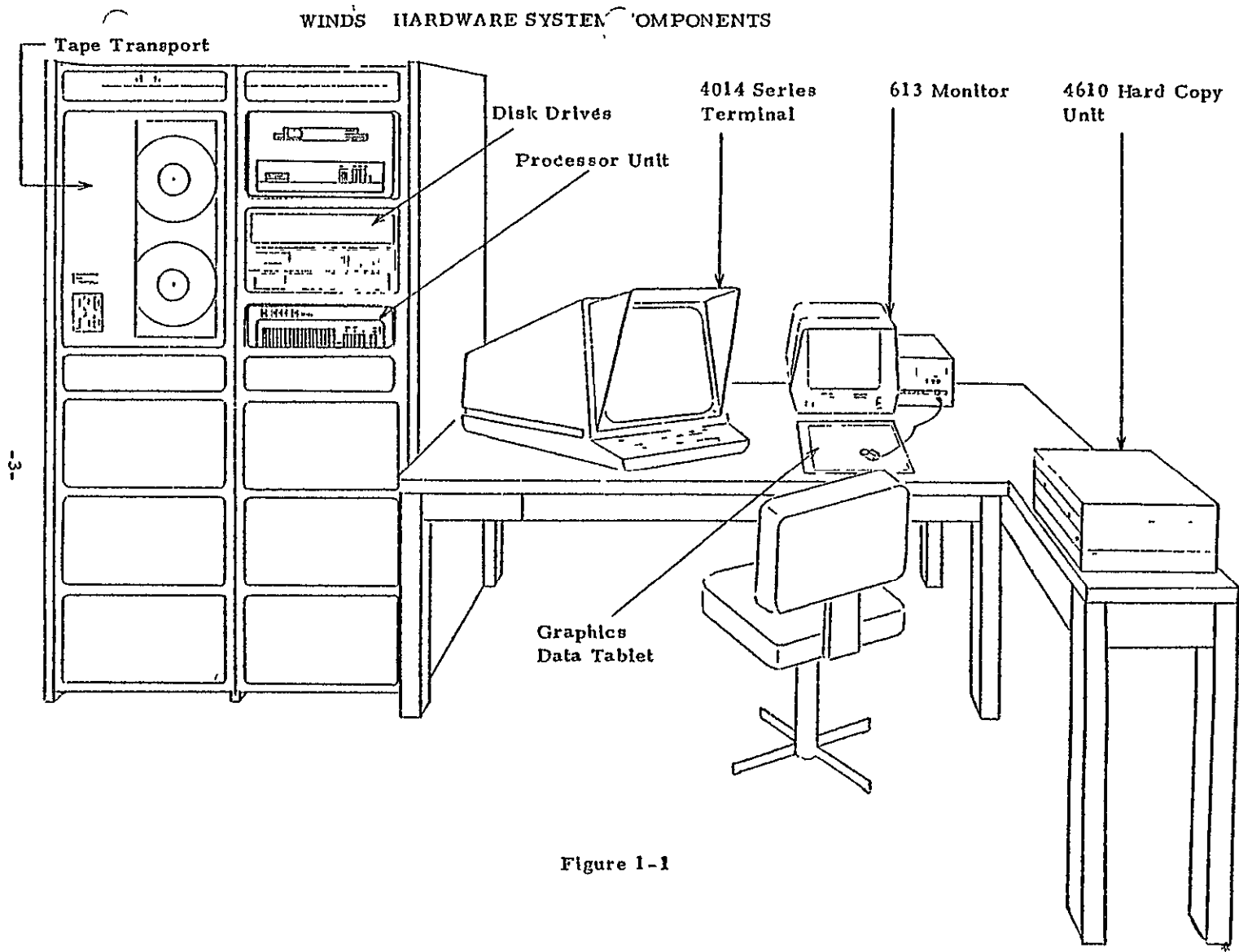


Figure 1-1

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2. SYSTEM START-UP PROCEDURE

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

2.1 Starting WINDS 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

WINDS 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 WINDS. The user simply causes the processor to begin running that program and RSX-11M is automatically loaded. The procedure for doing that follows:

PDP-11/35

1. Place the ENABLE/HALT switch in the HALT position (down).
2. Load the switch register with 773010 (octal) (see Figure 2-1).

DISK DRIVE CONTROLS AND INDICATORS

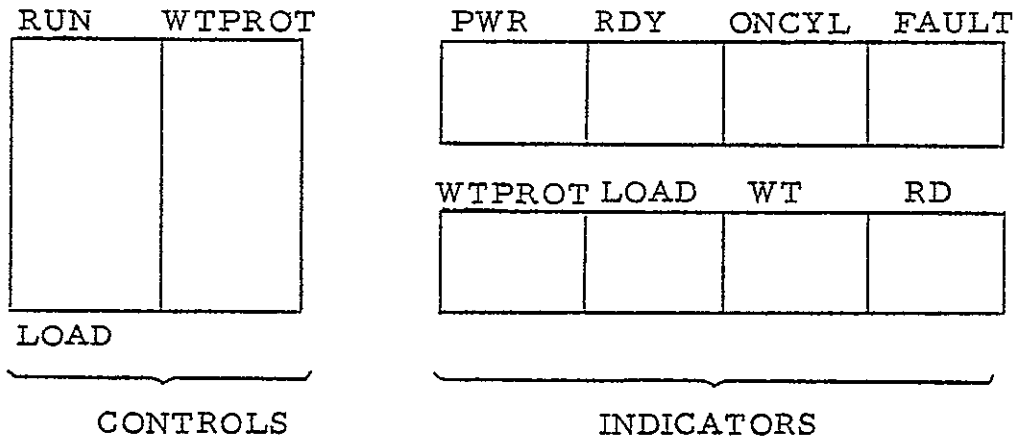


Figure 2-2

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: = SYO:...

>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:

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

- o 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.
- o 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 WINDS(RETURN)
```

requests WINDS to be run. Sections 3 and 4 describe how the user proceeds from this point. Figure 2-3 shows a correct log-in entry.

CORRECT LOG-IN PROCEDURE

```
PSX-11M 08 48K MAPPED -- Indicates RSX is loaded  
>RED DK0:=SY0:  
>MOU DK0:  
>MOU DK1:  
>RUN WINDS -- User request to run WINDS
```

-10-

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

Figure 2-3

2.1.4 Using the Tape Transport

A magnetic tape is not absolutely essential for operation of WINDS, 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:

- o Place the PWR ON/OFF switch in the PWR ON position.
- o Place the START/STOP switch in the STOP position.
- o Place the ON LINE/OFF LINE switch in the OFF LINE position.
- o 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.
- o 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.
- o Place the FWD/REW/REV switch in the FWD position.
- o Place the LOAD/BR REL switch in the LOAD position. The tape is loaded into the vacuum columns and the LOAD indicator is illuminated.
- o Place the START/STOP switch in the START position. The tape is advanced to the load point and the LD PT indicator is illuminated.
- o Ensure that the UNIT SELECT thumbwheel is in position 0 for storing data and position 0 for reading data (post-processing).
- o Place the ON LINE/OFF LINE switch in the ON LINE position.

TAPE TRANSPORT CONTROLS AND INDICATORS

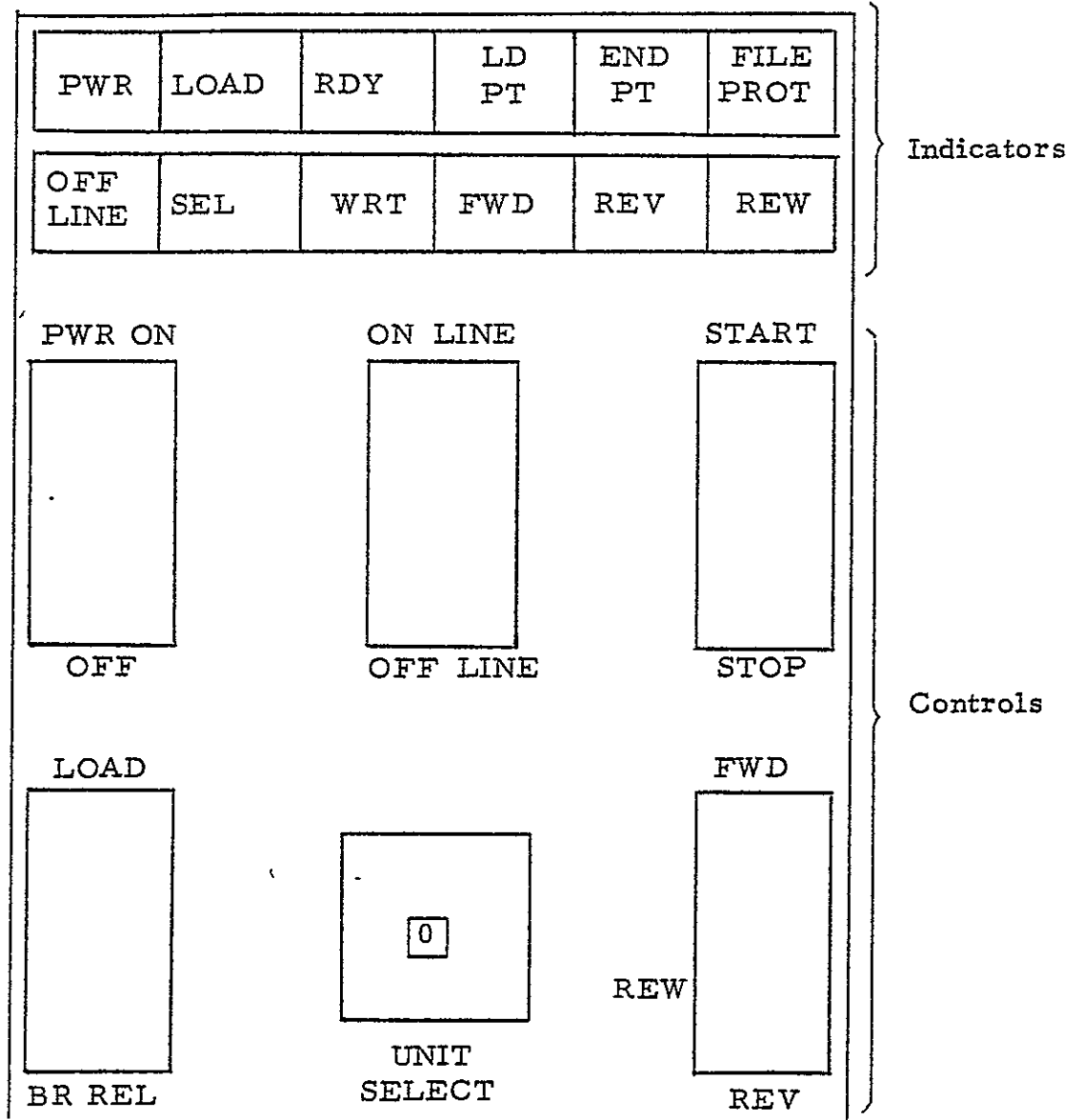


Figure 2-4

THREADING THE TAPE TRANSPORT

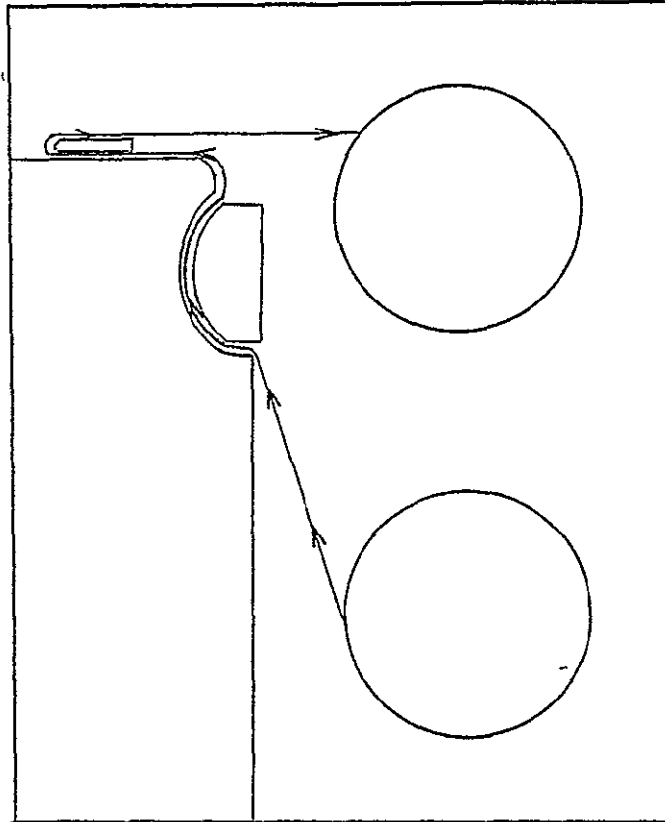


Figure 2-5

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.

2.1.5 Graphics Data Tablet

For all normal WINDS operations, the graphics data tablet controls should be set as follows:

POWER - in

PUSHBUTTONS

STREAM SWITCH - in

LEVER STREAM RATE - high-range

Figure 2-6 illustrates the console controls and indicators of the data tablet. A quick check on tablet operation is: when the cursor is on the tablet surface, the PROX indicator is lighted and when the cursor button is pressed, the ZAXIS indicator is lighted.

2.2 Recovering WINDS 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:

- o Reboot the system as described in Section 2.1.3.
- o Disregard messages that appear on the screen.
- o 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:

- o Place the HALT switch down.
- o Mount the ROLLIN tape on Unit 0 and place tape unit on-line.

DATA TABLET CONSOLE

-15-

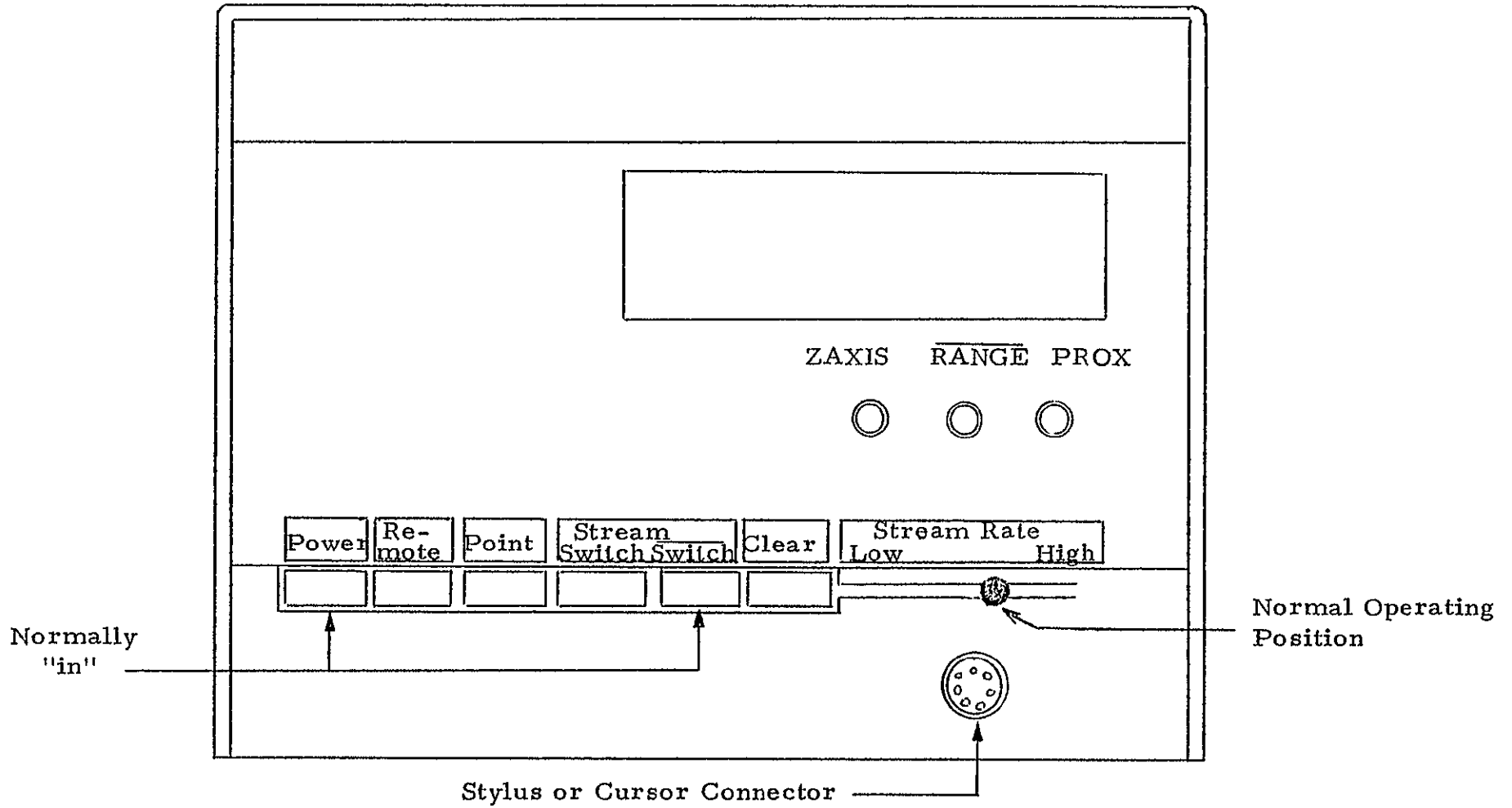


Figure 2-6

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

The message ROLLIN V07

#

will appear.

- o Type/RW to rewind the tape.

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

3. THE WIND INFORMATION DISPLAY SYSTEM

3.1 Functions of WINDS

The functions of WINDS are:

- o To receive data from the laser doppler velocimeter systems.
- o To store this raw data on magnetic tape if tape recording is active.
- o To provide real time processing of data to determine wind velocities over the scan area.
- o To display wind velocity information on terminal screens.
- o To provide post-processing capability for laser wind-shear data that was recorded on tape.

3.2 Operation of WINDS

After applying power to the system and loading the RSX-11 Monitor as described in Section 2, WINDS may be executed by typing RUN WINDS in response to the prompt >. This command will cause the RSX-11M Monitor to load WINDS into memory and give control to WINDS.

The operation of WINDS is controlled through user interaction with a set of graphic displays generated by WINDS. The graphic displays are:

- o Primary Control (Display 11) (see Figure 3-1).
- o System Parameter Control (Display 21) (see Figure 3-2).
- o Processing Area Selection (Display 24) (see Figure 3-3).
- o Data Display Selection (Display 26) (see Figure 3-4).
- o Data Processing Control (Display 39) (see Figure 3-5).

Depending on which options are selected from the above displays, data will be output in one or a combination of the following methods:

- o Unprocessed data recorded on magnetic tape.
- o Display of raw wind-shear information in tabular form.

PRIMARY CONTROL (DISPLAY 11)

INITIALIZATION

FILE NUMBER ----

INITIAL FRAME NUMBER ----

DATE (TAPE SEARCH ONLY) -----

RECORDING (LASER ONLY) ACTIVE INHIBIT

SELECT DATA SOURCE

ACTIVE

INHIBIT

LASER

TAPE

SELECT NEXT DISPLAY

PROCESSING AREA SELECTION

DATA DISPLAY SELECTION

TERMINATE

Figure 3-1

SYSTEM PARAMETER CONTROL (DISPLAY 21)

VAN 1

ACTIVE

INHIBIT

TRANSLATOR ON

TRANSLATOR OFF

VAN 2

ACTIVE

INHIBIT

TRANSLATOR ON

TRANSLATOR OFF

SELECT LASER HARDWARE CONSTRAINT TO BE INPUT

ANGLE LIMITS
 @ MINIMUM @ MAXIMUM
 RANGE LIMITS
 @ MINIMUM @ MAXIMUM

@ INTEGRATION INTERVAL
 @ VAN SEPARATION

ANGLE LIMITS
 @ MINIMUM @ MAXIMUM
 RANGE LIMITS
 @ MINIMUM @ MAXIMUM

@ INTEGRATION INTERVAL

ENTER CONSTRAINT VALUE _____

CURRENT VALUES IN EFFECT ARE

MINIMUM= ANGLE LIMITS
 MAXIMUM=

MINIMUM= RANGE LIMITS
 MAXIMUM=

INTEGRATION INTERVAL=

VAN SEPARATION=

MINIMUM= ANGLE LIMITS
 MAXIMUM=

MINIMUM= RANGE LIMITS
 MAXIMUM=

INTEGRATION INTERVAL=

RETURN TO PRIMARY CONTROL DISPLAY

Figure 3-2

PROCESSING AREA SELECTION (DISPLAY 24)

SET AREA LIMITS

AREA	FROM	TO
@ 1	ALTITUDE ---- FT.	---- FT.
@ 2	DISTANCE ---- FT.	---- FT.
@ 3		

SET NUMBER OF COLLECTION BINS ---- (1875 MAXIMUM)

CALCULATE SIZE OF BIN @

LIMITS IN EFFECT (UNITS IN FEET) ARE

AREA	FROM	TO	FROM	TO
1	ALTITUDE		DISTANCE	
2	ALTITUDE		DISTANCE	
3	ALTITUDE		DISTANCE	

SIZE OF COLLECTION BIN FT.

RETURN TO PRIMARY CONTROL DISPLAY

Figure 3-3

DATA DISPLAY SELECTION (DISPLAY 2B)

SELECT CONTROL OPTIONS

UPDATE RATE ON DEMAND AUTOMATIC (SEC)

 AUTOMATIC HARDCOPY YES NO

SELECT DISPLAYS

	PRIMARY	ALTERNATE
TABULAR RAW DATA (BOTH VANS)	<input type="text"/>	<input type="text"/>
TABULAR STATISTICAL (BOTH VANS)	<input type="text"/>	<input type="text"/>
WIND PROFILE (BOTH VANS)	<input type="text"/>	<input type="text"/>
TWO DIMENSIONAL FLOW FIELD	<input type="text"/>	<input type="text"/>
LINE OF SIGHT FLOW FIELD		
VAN 1	<input type="text"/>	<input type="text"/>
VAN 2	<input type="text"/>	<input type="text"/>

SELECT NEXT OPERATION

DATA PROCESSING CONTROL

 RETURN TO PRIMARY CONTROL DISPLAY

 BEGIN PROCESSING

 ONLY DISPLAY TABULAR DATA

Figure 3-4

DATA PROCESSING CONTROL (DISPLAY)

SIZE OF COLLECTION BIN IN FEET 5

DATA PROCESSING BIN SIZE AS A MULTIPLE OF COLLECTION BIN SIZE

1	<input type="text"/>	BIN SIZE IN FEET
4	<input type="text"/>	
16	<input type="text"/>	

DATA DISPLAY BIN SIZE AS A MULTIPLE OF COLLECTION BIN SIZE

1	<input type="text"/>	BIN SIZE IN FEET
4	<input type="text"/>	
16	<input type="text"/>	
64	<input type="text"/>	
256	<input type="text"/>	

RETURN TO DATA DISPLAY SELECTION

Figure 3-5

- o Display of line of sight wind velocities.
- o Display of two-dimensional wind velocities.
- o Display of wind profiles.
- o Display of Statistical Summary Information about wind profiles.

Note: During real time processing, wind-shear information is determined from raw data received from the LDV systems. However, during post-analysis processing, wind-shear information is determined from data that was previously stored on magnetic tape.

3.3 Program Control Through User Interaction with Displays

The user directs the flow of WINDS by interacting with the various displays as they are placed on the screen. (Figure 3-6 shows the interactive flow of control through the WINDS.) There are two ways by which the displays indicate that an input is to be made. They are:

- o A box () or an @ indicating a choice of options.
- o A _ _ _ _ indicating an alphanumeric input field.

If a default value for an option exists, it is indicated by parallel lines drawn through the box or rectangle. When another choice is made, the lines are drawn to indicate it. To select an option, the cursor is moved on the data tablet until the cross-hair appears over the desired choice on the terminal screen and the cursor button is pressed. If a default value exists for an alphanumeric input field, it will be indicated by filling the field with the alphanumeric representation of the default value. To input a field value the alphanumeric value is typed on the keyboard and the (RETURN) key is depressed.

3.3.1 Primary Control (Display 11)

The primary control display is divided into the following major sections:

- o Initialization.
- o Select Data Source.
- o Select Next Display.
- o Terminate.

FLOW OF CONTROL FOR WIND

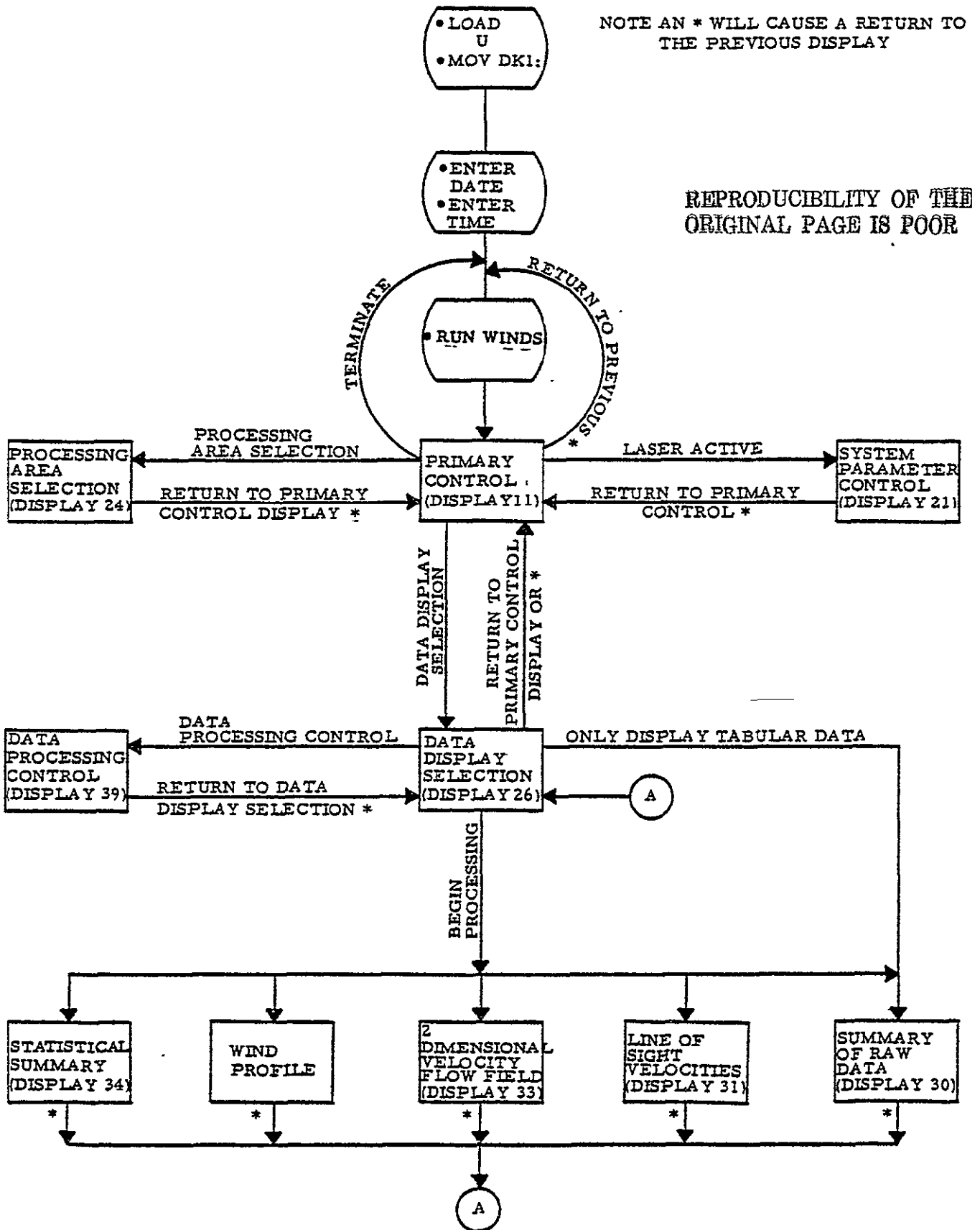


Figure 3-6

Choices made in each of these sections determine the subsequent action of WINDS.

The choices, defaults, and inputs presented to the user under the "Initialization" section are:

- o File Number:
 - This is a 4-character input field and the desired numeric value for file number should be entered.
 - No spaces are allowed.
 - Entries should be in the form 0001, 0020, 2000, etc.
 - The default value is 1.
 - Terminate entry with (RETURN) key. Note that entry must be terminated before the next input field can be accessed. If there is no entry and it is desired to access the next input field, simply press the (RETURN) key.

- o Initial Frame Number:
 - This is a 4-character input field and the desired numeric value for the initial frame in this file should be entered.
 - No spaces are allowed.
 - Entries should be in the form 0001, 0020, 2000, etc.
 - The default value is 0.

- o Date:
 - This is a 8-character input field and the date should be entered in the form 11-20-76 for November 11, 1976.
 - No spaces are allowed.
 - Date should be entered only when a tape search on date is desired.

- o Recording:
 - This option is applicable only when data is being received from the lasers.
 - Selection of active box determines that the data will be recorded on tape.
 - Selection of the inhibit box determines that data will not be recorded on tape.

- o If the RSX-11M Operating System has just been booted without running WINDS, the default value is recording inhibited. If WINDS has been operated and terminated by either selecting the terminate box or keying-in an "*" when the Primary Control (Display 11) was on the screen and the system was not rebooted, the default value will be the value in effect when WINDS was terminated.

The choices and defaults presented to the user under the "Select Data Source" section are:

- o Laser Active:
 - In response to this choice, WINDS sets a flag to activate data acquisition from the LDV when processing is initiated. WINDS then places the SYSTEM PARAMETER CONTROL (Display 21) on the screen.

- o Laser Inhibit:
 - In response to this choice, WINDS sets a flag to indicate that data acquisition from the LDV is not to be activated when processing is initiated.

- o Tape Active:
 - In response to this choice, WINDS sets a flag to indicate that data is to be obtained from tape input when processing is initiated.

- o Tape Inhibit:
 - In response to this choice, WINDS sets a flag to indicate that data for processing is not to be obtained from tape input.

- o If both lasers and tape are inhibited when processing is initiated, data for processing will be generated by the GENRET subroutine.
- o If the RSX-11M Operating System has just been booted without running WINDS, the default values are laser, and tape inhibited. If WINDS has been operated and terminated by either selecting the terminate box or keying-in an "*" when the Primary Control (Display 11) was on the screen and the system was not rebooted, the default values will be the values which were in effect when WINDS was terminated.

The choices presented to the user under the "Select Next Display" section are:

- o Processing Area Selection.
- o Data Display Selection.

There are no defaults for these choices and when an option is chosen the corresponding display is placed on the screen.

The only choice presented to the user under the terminate section is to terminate. The selection of the option causes WINDS to terminate operation and return control to the RSX-11M Operating System.

3.3.2 System Parameter Control (Display 21)

The System Parameter Control Display is placed on the screen when the Laser Active Option is chosen on the Primary Control Display. This display is divided into the following sections:

- o A laser selection that determines which LDV's are active and whether or not that they have translated data.
- o Select Laser Hardware Constraint to be Input.
- o Current Values in Effect Are.
- o Return to Primary Control Display.

The choices and defaults presented to the user under the laser selection are:

- o Van 1
 - Active.
 - Inhibit.
 - Translator On.
 - Translator Off.
- o Van 2
 - Active.
 - Inhibit.
 - Translator On.
 - Translator Off.
- o If the RSX-11M Operating System has just been booted without running WINDS, the default values are both vans active with translators on. If WINDS has been operated and terminated by either selecting the terminate box or keying-in an "*" when the Primary Control (Display 11) Display was on the screen and the system was not rebooted, the default values will be the values which were in effect when WINDS terminated.

The choices and defaults presented to the user under the "Select Laser Hardware Constraint To Be Input" section are divided into a column for each van. Van 1 is the left column. The constraints are:

- o Angle Limits:
 - Minimum.
 - Maximum.
- o Range Limits:
 - Minimum.
 - Maximum.

- o Integration Interval.
- o Van Separation.

These values are input by selecting the constraint that is desired to be entered using the cursor and then typing the entry in the field labeled ENTER Constraint Value.

- o The Constraint Value is a 4-character input field.
- o No spaces are allowed.
- o Entries should be in the form 0001, 0020, 2000, etc.
- o Angle limits are input in degrees.
- o Range limits are input in feet.
- o Integration intervals are input in milliseconds.
- o Van separation is input in feet.
- o After a constraint has been input, another constraint may be input or the original constraint may be changed by repeating the above sequence.
- o If the RSX-11M Operating System has just been booted without running WINDS, the default values for both vans are as follows:

-	Minimum angle	3 (degrees)
-	Maximum angle	60 (degrees)
-	Minimum range	50 (feet)
-	Maximum range	300 (feet)
-	Integration interval	8 (ms)
-	Van separation	300 (feet)
- o If WINDS has been operated and terminated by either selecting the terminate box or keying-in an "*" when the Primary Control (Display 11) Display was on the screen and the system was not rebooted, the default values will be the values which were in effect when WINDS terminated.

"The Current Values In Effect Are" section informs the user of the current angle limits, range limits, integration intervals, and van separation values. These values are placed on the screen in the refresh mode and are updated as soon as a value is changed. The units of the parameters are the same units for this parameter under the constraint input section.

"The Return To Primary Control Display" section contains one option box. When this box is selected, WINDS places the Primary Control Display on the screen.

3.3.3 Processing Area Selection (Display 24)

This display is placed on the screen by selecting it from the Primary Control Display and is divided into the following sections:

- o Set Area Limits.
- o Set Number of Collection Bins.
- o Calculate Size of Bin.
- o Limits In Effect (Units In Feet) Are.
- o Return To Primary Control Display.

The "Set Area Limits" section allows the user to define up to three areas in space from which he will collect and process returns. The user first chooses the area which he wants to define by selecting the appropriate option with the cursor and then inputs the altitude and distance constraints according to the following rules:

- o The input fields are 4-character fields.
- o Numbers should be entered as 0001, 0020, 2000, etc.
- o No spaces are allowed.
- o Distance is relative from Van 1.
- o Terminate entry with RETURN key.
- o If the RSX-11M Operating System has just been booted without running WINDS, the default is no area limits and WINDS will collect and process data in the area of intersection of the laser scans or within the angle and range limits of a single LDV if one van is inhibited. If WINDS has been operated and terminated by either selecting the terminate box or

keying-in an "*" when the Primary Control (Display 11) was on the screen and the system was not rebooted, the default values will be the values which were in effect when WINDS terminated.

The "Set Number of Collection Bins" section enables the user to define the number of collection bins that WINDS will use. The maximum is 1870.

- o This is a 4-character input field.
- o Numbers should be entered 0001, 0010, 2000, etc.
- o No spaces are allowed.
- o Terminate entry with RETURN key.
- o If the RSX-11M Operating System has been booted without running WINDS, the default is 1870 bins. If WINDS has been operated and terminated by either selecting the terminate box or keying-in an "*" when the Primary Control (Display 11) was on the screen and the system was not rebooted, the default value will be the value in effect when WINDS terminated.

The "Calculate Size of Bin" option when chosen will cause WINDS to calculate a bin size based on the area from which data is to be collected and processed and the number of collection bins desired.

The "Limits In Effect (Units In Feet) Are" section informs the user of current collection and processing area definitions and current bin size.

Selecting the option box "Return To Primary Control Display" causes WINDS to place the Primary Control Display on the screen.

3.3.4 Data Display Selection (Display 26)

This display is divided into the following sections:

- o Select Control Options.
- o Select Displays.
- o Select Next Operation.

The options, inputs, and defaults presented to the user under the "Select Control Options" sections are:

- o Update Rate On Demand.
- o Automatic (Sec).
 - This is a 4-character input field.
 - Entries should be in the form 0005, 0010, 0060, etc.
 - No spaces are allowed.
 - Units are seconds.
 - Terminate entry with RETURN key.
- o Automatic Hard Copy.
 - Yes - automatic hard copy chosen.
 - No - automatic hard copy not chosen.
- o If the RSX-11M Operating System has just been booted without running WINDS, the defaults are update rate on demand and automatic hard copy no. If WINDS has been operated and terminated by either selecting the terminate box or keying-in an "*" when the Primary Control (Display 11) was on the screen and the system was not rebooted, the default values will be the values which were in effect when WINDS terminated.

The "Select Displays" section enables the user to select two output displays. If the display is selected as primary, it will be placed on the 4014 screen when processing is initiated and if it is selected as alternate it will be placed on the 613 screen. The options, defaults, and restrictions are:

- o Tabular Raw Data (Both Vans):
 - In response to this choice, WINDS will place the Summary of Raw Data (Display 30) display on the screen.
 - If one van is inhibited, data from the other van is still output.
 - When software simulated data is being used, there will be no output to this display.

- o Tabular Statistical (Both Vans):
 - In response to this choice, WINDS will place the Statistical Summary (Display 34) on the screen.
 - Both vans must be active.
 - Wind Profile must also be chosen.
- o Two-Dimensional Flow Field:
 - In response to this choice, WINDS will place the Two-Dimensional Velocity Flow Field (Display 33) on the screen.
 - Both vans must be active.
- o Line of Sight Flow Field:
 - Van 1.
 - Van 2.
 - In response to either or both of these choices, WINDS will place the Line of Sight Velocity Flow Field (Display 31) on the screen for the chosen van(s).
- o Restrictions:
 - If Wind Profile (both vans) is chosen, the only other choices for displays are Tabular Statistical (Both Vans) or Tabular Raw Data (Both Vans).
 - If Two-Dimensional Flow Field is chosen, Tabular Raw Data (Both Vans) must be selected for the other screen.
- o If the RSX-11M Operating System has just been booted without running WINDS, the defaults are wind profile or the primary screen and tabular statistical data on the secondary screen. If WINDS has been operated and terminated by either selecting the terminate box or keying-in an "*" when the Primary Control (Display 11) was on the screen and the system was not rebooted, the default values will be the values which were in effect when WINDS terminated.

The "Select Next Operation" section enables the user to direct the flow of WINDS to the next desired function. There are no defaults for this section. The choices are:

- o Data Processing Control:
 - Selection of this option causes WINDS to place the Data Processing Control (Display 39) display on the screen.

- o Return To Primary Control Display:
 - Selection of this option causes WINDS to place the Primary Control (Display 11) display on the screen.

- o Begin Processing:
 - Selection of this option causes WINDS to initiate data input from either laser, tape, or the software simulation subroutine, record the data on tape if applicable, process this data and display the selected output. Data displays will be updated either on demand (keying-in an "!"), or after a fixed time, depending on the choice made under the Select Control Options section. To exit from the collection-processing mode, the user enters an "*" from the keyboard which will cause WINDS to place the Data Display Selection (Display 26) on the screen.

- o Only Display Tabular Data:
 - Selection of this option causes WINDS to initiate data input from laser, record the data on tape if applicable, and display Raw Tabular Data. This option is not applicable when using either the software simulation subroutine or tape as a data source.

3.3.5 Data Processing Control (Display 39)

This display is entered by selecting its option on the Data Display Selection (Display 26) display and enables the user to determine the size of processing and display bins as multiples of collection bin size. Collection bins are used to store data for processing and correspond to areas in the laser scan. A processing bin corresponds to the area for which correlations of data from both vans are to be made. In effect, a processing bin corresponds

to the area over which the user assumes that the wind has a constant velocity to enable this velocity to be determined from the solution of simultaneous equations. A display bin corresponds to the area in a scan for which one vector that is the average of all wind vectors determined within this area will be displayed.

The Data Processing Control (Display 39) display choices and defaults are:

- o Display Processing Bin Size as a Multiple of Bin Size:
 - 1.
 - 4.
 - 16.
 - The size of the processing bin in feet is shown in refresh mode and is updated when changed.
- o Data Display Bin Size as a Multiple of Collection Bin Size:
 - 1.
 - 4.
 - 16.
 - 64.
 - 256.
 - The size of the display bin in feet is shown in refresh mode and is updated when changed.
- o Return to Data Display Selection:
 - When this option is selected, WINDS places the Data Display Selection (Display 26) display on the screen.
- o Default values are one for both the processing bin size and the display bin size.

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4. M&S COMPUTING APPLICATION UTILITIES

These programs are to be used in conjunction with WINDS. They are..

- o Write Two End-of-Files (W2EFS).
- o Write Two End-of-Files with No Rewind (W2EFNR).

4.1 W2EFS Utility Program

W2EFS is a utility program that is used to write two end-of-files on a tape mounted on Unit 0 and then rewind the tape. Its uses are:

- o To initialize new tape for data collection.
- o To place two end-of-files on a tape when the machine has to be rebooted before the Record Inhibit or the Terminate options were chosen.

To run W2EFS type:

≥RUN W2EFS (RETURN)

4.2 W2EFNR Utility Program

W2EFNR is a utility program that is used to write two end-of-files on a tape mounted on Unit 0 and not to rewind the tape. Its use is to place two end-of-files on a tape when the machine has to be rebooted before either the Record Inhibit or the Terminate options were chosen.

To run W2EFNR type:

≥RUN W2EFNR (RETURN)

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5. SPECIAL KEYBOARD INPUTS TO WINDS

The two special keyboard interrupts and their functions are:

- o An "!" signals WINDS to update output displays.
- o An "*" aborts the current operation and causes WINDS to place the previous control display on the screen. If the Primary Control (Display 11) display is on the screen, an "*" causes WINDS to terminate.

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6. RSX-11M OPERATING SYSTEM ERROR MESSAGES

If the RSX-11M issues an error message, the operator should reload RSX-11M into memory as instructed in Section 2.1.3.

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7. SPECIAL INSTRUCTIONS CONCERNING TAPES

- o When storing data on a tape, set the tape dial unit to 0.
- o When reading data from a tape, set the tape dial unit to 0.
- o New data tapes must be initialized by writing two contiguous end-of-files before they can be used to store data. To write the two end-of-files, mount the tape, set the tape dial unit to 0, and execute W2EFS.
- o While creating a raw data tape, if WINDS is terminated other than by selecting the Terminate option from the Primary Control (Display 11) display, before the tape Inhibit has been chosen, the tape should not be moved until W2EFS or W2EFNR has been loaded and executed.
- o During post-analysis a data tape may be searched according to File Number, Frame Number, and Date, or any combination of these. It is not necessary to rewind the tape to search but it may be expedient to do so in some cases.

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8. PROGRAM OUTPUT

Program output is divided into the major divisions of magnetic tape and graphic displays. Magnetic tape output is 9-track 800 bpi and consists of a tape containing raw data from the LDV systems.

8.1 Raw Data Tape

This data tape is generated in real time and contains raw data in counts that are received from the LDV's. The breakdown of the tape follows (see Figure 8-1).

- o Variable number of records for each file.
- o The first record for each file is a header record as shown below.

<u>Word</u>	<u>Contents</u>
1	File number.
2-4	Date.
5-9	Time in seconds.
10-99	Not used.
100-101	Van separation in counts. — .
102-103	Maximum scan angle for Van 1 in radians.
104-105	Minimum scan angle for Van 1 in radians.
106-107	Maximum range for Van 1 in counts.
108-109	Minimum range for Van 1 in counts.
110-111	Maximum scan angle for Van 2 in radians.
112-113	Minimum scan angle for Van 2 in radians.
114-115	Maximum range for Van 2 in counts.
116-117	Minimum range for Van 2 in counts.
118	Status of Van 1 laser.

TAPE STRUCTURE

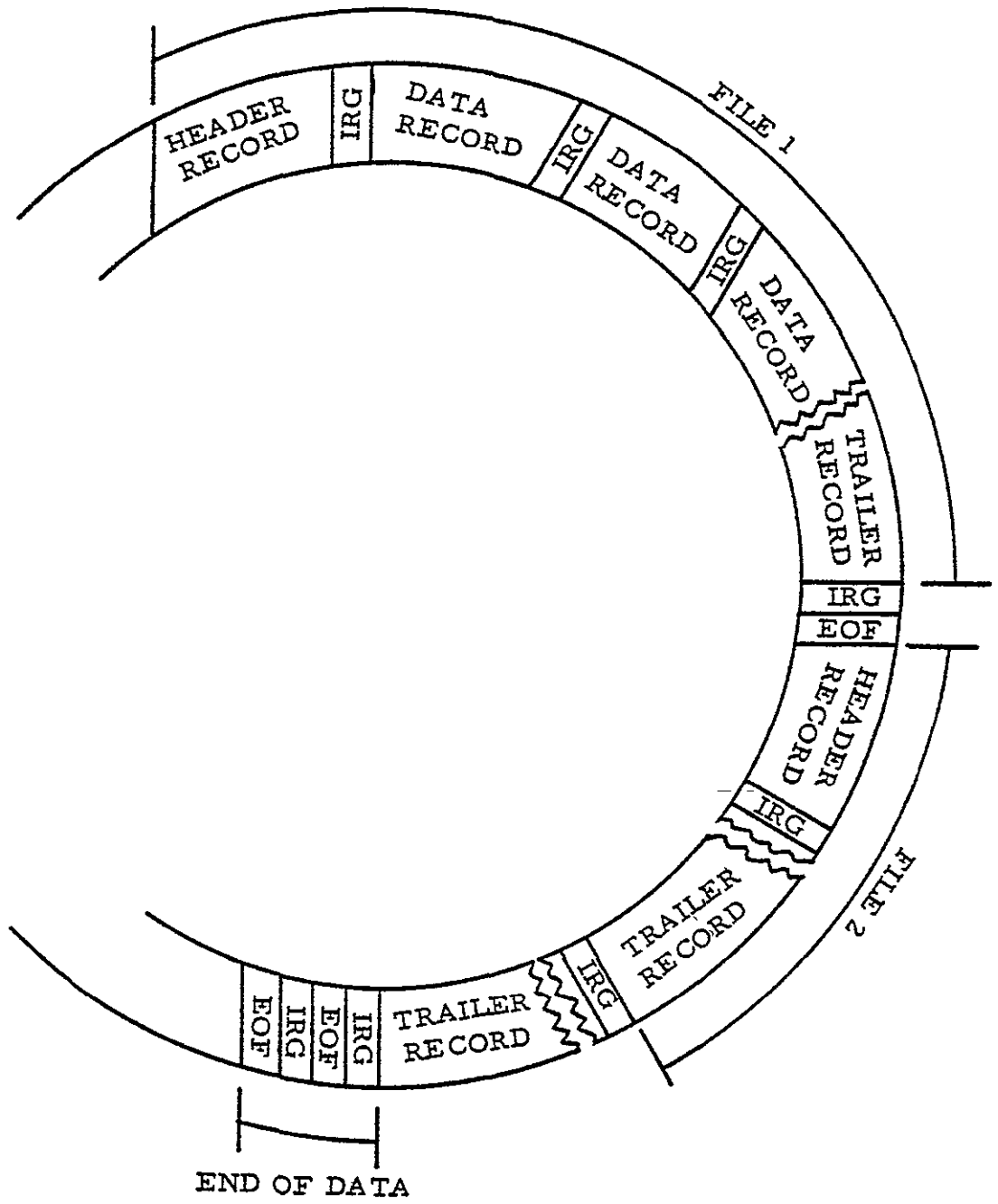


Figure 8-1

<u>Word</u>	<u>Contents</u>
119	Status of Van 1 translator.
120	Status of Van 2 laser.
121	Status of Van 2 translator.
122-123	Angular rate for Van 1.
124-125	Angular rate for Van 2.
126-127	Range rate for Van 1.
128-129	Range rate for Van 2.
130-131	Range integration interval for Van 1.
132-133	Range integration interval for Van 2.

- o There are a variable number of data records containing 15-256 word blocks (3840 words). Each block contains an 8-word header (as shown in Figure 8-2) and 62 4-word data entries formatted as follows:

- Word 9

- Bits 0-9 X coordinate in counts.
 - Bits 10-15 not used.

- Word 10

- Bits 0-9 Y coordinate in counts.
 - Bits 10-15 not used.

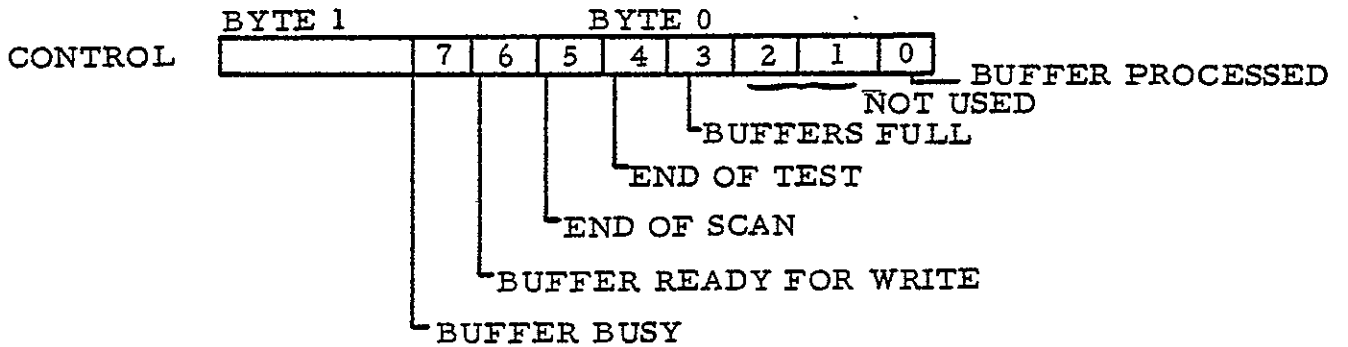
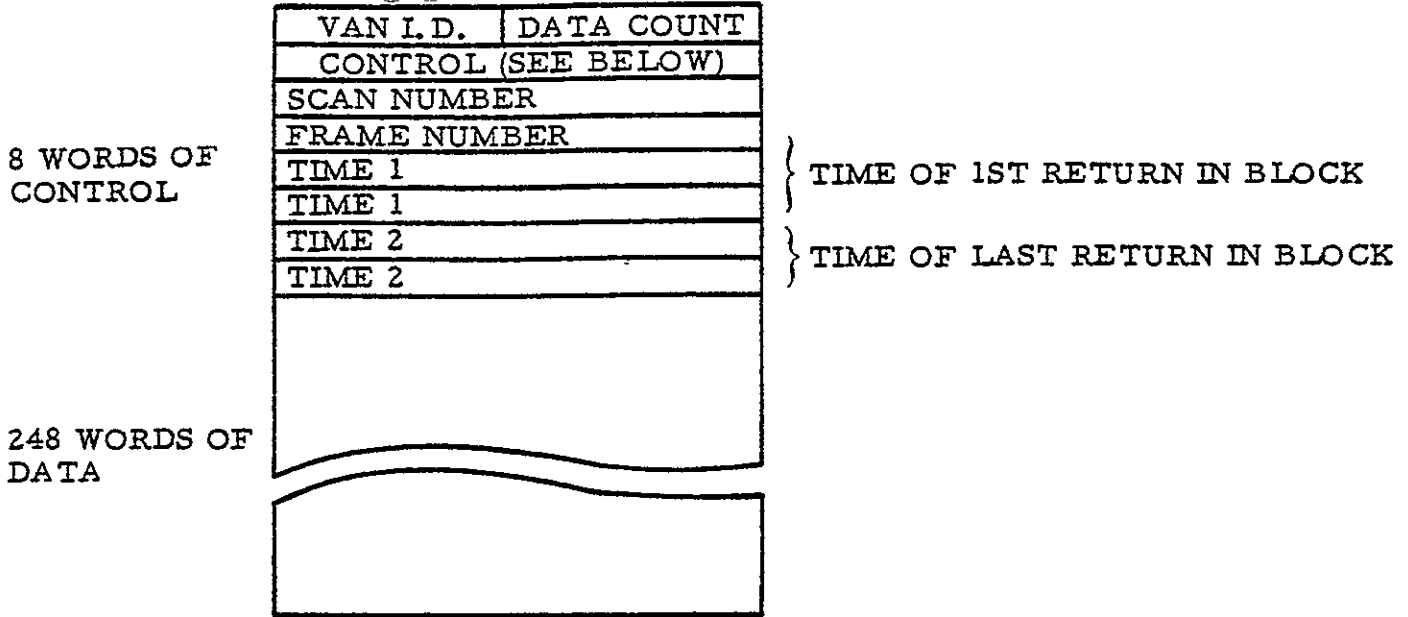
- Word 11

- Bits 7-14 intensity - the highest amplitude in an integration interval.
 - Bits 0-6 the number of cells over the velocity and amplitude thresholds.

- Word 12

- Bits 8-15 V_{pk} - the highest velocity above the velocity and amplitude thresholds.

DATA BUFFER FORMAT



VAN I.D. IS 1 FOR VAN 1 AND -1 FOR VAN 2.

Figure 8-2

Bits 0-7 V_{\max} - the velocity obtained in the cell with the highest amplitude.

- Words (13-256) are repeats of the above sequence for different laser returns.

- o The last record for each file is a trail record defined as shown below:

<u>Word</u>	<u>Contents</u>
1	File number.
2-9	Date, Time.
10	Number of scans for Van 1.
11	Number of scans for Van 2.
12	Not used.
13	Number of non-error buffers.
14	Number of errors output.

- o Each file is ended with one end-of-file mark.
- o The last file on tape is ended with two end-of-file marks.

8.2 Displays

The second major output division is the generation of displays on the 613 and 4014 screens. All of the output displays have a header which contains the following information:

- o File Number - tape file number of data being displayed.
- o Frame Number - frame number of data being displayed.
 - Not applicable for Summary of Raw Data (Display 30).
- o Date - date on which data was collected.
- o Time - time at which data was collected.

- o Source - indicates the origin of the input data that is being used to generate the displayed output data.
 - L - input source is from the LDV's in real time.
 - T - input source is from a data tape.
 - S - input source is software simulated data.
- o TCODE - indicates the translate status for the vans.
 - 1 indicates that the translator is on in Van 1, but off for Van 2.
 - 2 indicates that the translator is on in Van 2, but off in Van 1.
 - B indicates that the translator is on in both vans.
 - N indicates that the translator is off in both vans.
- o Velocity Scale - is a line whose length represents a velocity magnitude of 50 feet/second.
 - This parameter is applicable only for the flow field displays.
- o Number of Processing Bins for which Correlations Found - indicates the number of processing bins that contained laser returns from both vans.
 - Applicable only on the Statistical Summary (Display 34) display.
- o Total Number of Processing Bins - indicates the total number of processing bins that were formed.
 - Applicable only on the Statistical Summary (Display 34) display.

The output displays are as follows:

- o Summary of Raw Data (Display 30) (Figure 8-3):
 - This display contains additional header information which includes the scan angle and range limits for each van.

SUMMARY OF RAW DATA (DISPLAY 30)

FILE NO. 0 DATE 1/20/77 TIME 11/31/0 SOURCE L TOODE 1
 VAN 1 ANGLE LIMITS VAN 2 ANGLE LIMITS
 MINIMUM 3 MAXIMUM 60 MINIMUM 2 MAXIMUM 60
 VAN 1 RANGE LIMITS VAN 2 RANGE LIMITS
 MINIMUM 88 MAXIMUM 700 MINIMUM 88 MAXIMUM 700
 VAN SEPARATION 700

FRAME	SCAN	NPNTS	PK V	PPNTS	FRAME	SCAN	NPNTS	PK V	PPNTS
0	1	267	15	0	0	-1	315	18	0
1	2	229	16	0	2	-2	309	19	0
2	3	267	16	0	2	-3	315	19	0
3	4	230	15	0	3	-4	310	20	0
4	5	267	16	0	4	-5	315	20	0
5	6	229	17	0	5	-6	309	21	0
5	7	267	17	0	6	-7	315	21	0
6	8	229	17	0	7	-8	309	19	0
7	9	267	16	0	8	-9	315	17	0
8	10	229	15	0	9	-10	310	17	0
9	11	267	15	0	10	-11	315	18	0
9	12	230	14	0	11	-12	309	18	0
10	13	267	16	0	12	-13	315	18	0
11	14	229	19	0	13	-14	248	19	0
12	15	267	17	0	14	-15	377	19	0
12	16	229	17	0					
13	17	267	16	0					
14	18	167	15	0					

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Figure 8-3

- Below all header information the screen is divided into two halves with Van 1 information displayed on the left and Van 2 information on the right.

The headings for the data columns are:

- FRAME - a frame is a combination of scans or partial scans such that identical frame numbers from the two vans indicated time correlated data.

 - SCAN - indicates how many frames of data have been received from the lasers for this execution of WINDS. The number of frames received may be greater than the scan number since some frames will be discarded because the lasers and/or recording for the two lasers systems have become separated in time by more than half the time required for a laser to complete its scan.
 - NPNTS - indicates the number of points that were received in a frame.
 - PK V - indicates the maximum of the first peak velocity in each 256-word block of data received during a frame.
 - PPNTS - indicates the number of points that were placed in the collection bins for each frame.
- o Line of Sight Velocity Flow Field (Display 31) (Figure 8-4):
- An additional entry in the header information indicates from which van the input data user to calculate the displayed information was received.
 - Line of sight wind velocities are plotted as a function of altitude and distance from the van sending the input data.
 - The tail of the velocity vector indicates the point in space at which the wind velocity was determined. The direction of the vector gives direction of the wind when translated data is used. The length of the vector represents the magnitude of the wind velocity and has the same scale that is used to indicate distance and altitude.

LINE OF SIGHT VELOCITY FLOW FIELD (DISPLAY 31)

FILE NO. 1 DATE 0/11/0 TIME 15.35.32 SOURCE L TOODE B
FRAME NO. 1 VAN 1 VELOCITY SCALE (50 FT/SEC)

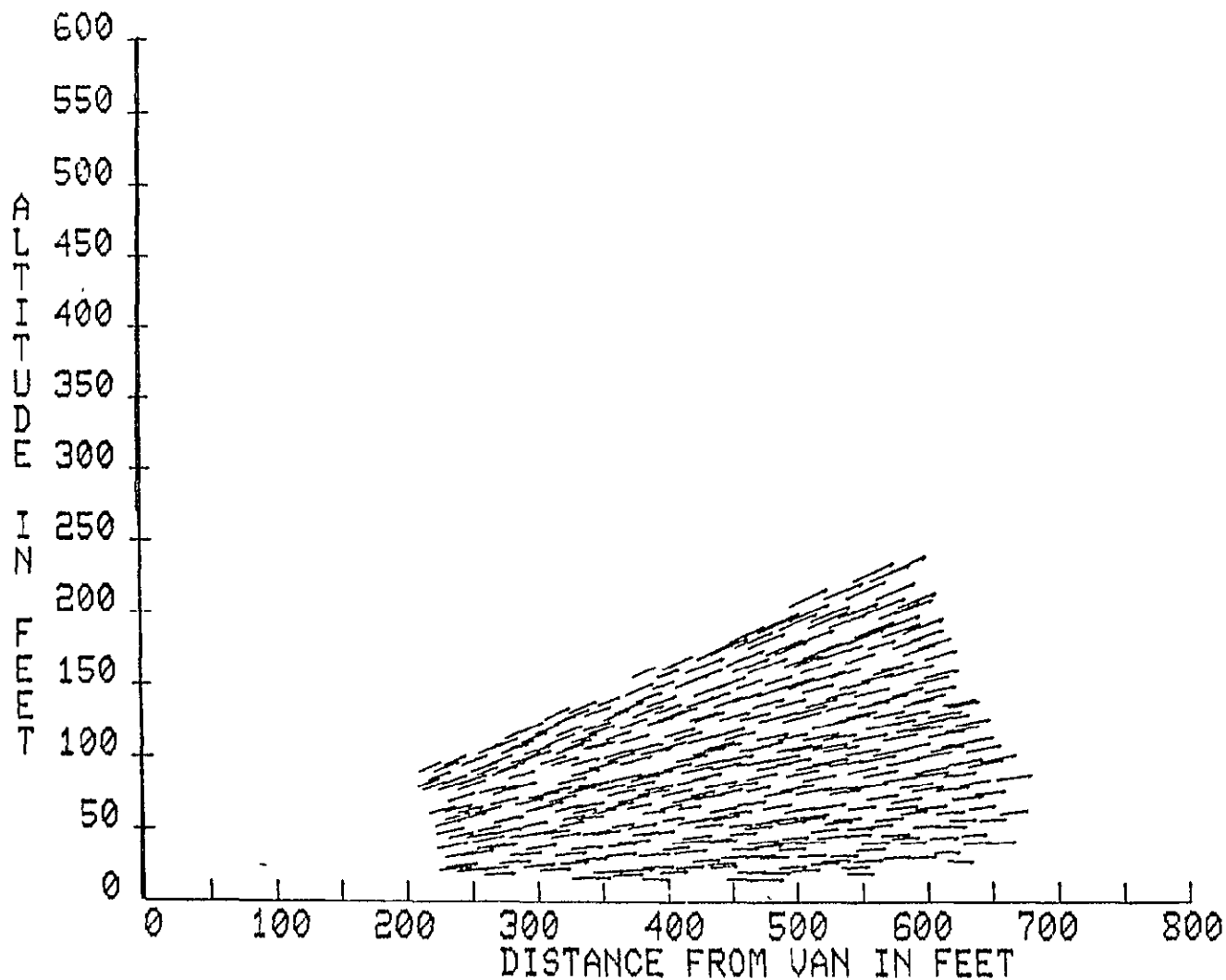


Figure 8-4

- o Two-Dimensional Velocity Flow Field (Display 33) (Figure 8-5):
 - Two-dimensional wind velocities are plotted as a function of altitude and distance from Van 1.
 - The tail of the vector indicates the point in space for which the wind velocity was determined. The direction of the vector gives the direction of the wind when translated data is used. The length of the vector represents the magnitude of the wind velocity and has the same scale as the distance and altitude.
- o Statistical Summary (Display 34) (Figure 8-6):
 - This display gives statistical information about the Wind Profile (Display 35) display.

The column headings are:

- Altitude slice - indicates the altitude slice. Wind profile plots are divided into thirty, 20-foot altitude slices.
- Number of bins - indicates how many collection bins within this altitude slice received laser returns.
- Maximum X-Vel - indicates the maximum horizontal wind velocity that was found in this altitude slice.
- Minimum X-Vel - indicates the minimum horizontal wind velocity that was found in this altitude slice.
- Maximum Y-Vel - indicates the maximum vertical wind velocity that was found in this altitude slice.
- Minimum Y-Vel - indicates the minimum vertical wind velocity that was found in this altitude slice.
- X STD DEV - indicates the standard deviation for the horizontal velocities within an altitude slice.
- Y STD DEV - indicates the standard deviation for the vertical velocities within an altitude slice.

2 DIMENSIONAL VELOCITY FLOW FIELD (DISPLAY 33)

FILE NO. 1 DATE 10/19/76 TIME 0.610 SOURCE S TCODE B
FRAME NO. 0 VELOCITY SCALE (50 FT/SEC)

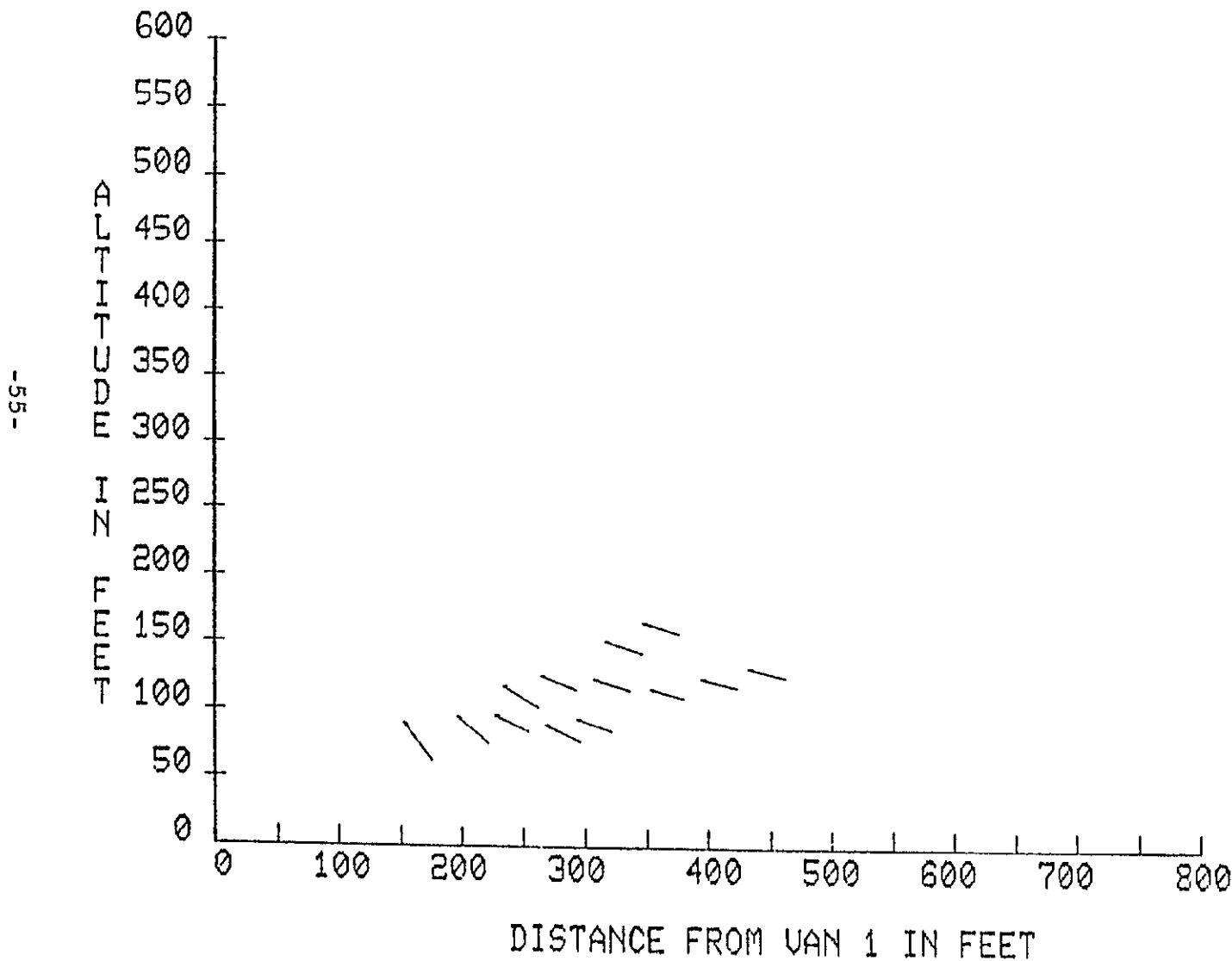


Figure 8-5

STATISTICAL SUMMARY (DISPLAY 3.4)

FILE NO. 0 DATE 1/20/77 TIME 11 31:33 SOURCE L TCODE 1
 FRAME NO. 1
 NUMBER OF PROCESSING BINS FOR WHICH CORRELATIONS FOUND 7
 TOTAL NUMBER OF PROCESSING BINS 133

ALTITUDE SLICE	NUMBER OF BINS	MAXIMUM X-VEL	MINIMUM X-VEL	MAXIMUM Y-VEL	MINIMUM Y-VEL	X STD DEV	Y STD DEV	AVERAGE X VEL	AVERAGE Y VEL
1	0	32000	32000	32000	32000	0	0	0	0
2	0	32000	32000	32000	32000	0	0	0	0
3	1	-18	-18	1	1	0	0	-18	1
4	1	-18	-18	2	2	0	0	-18	2
5	1	-18	-18	0	0	0	0	-18	0
6	1	-19	-19	1	1	0	0	-19	1
7	1	-20	-20	0	0	0	0	-20	0
8	1	-20	-20	0	0	0	0	-20	0
9	1	-23	-23	0	0	0	0	-23	0
10	0	32000	32000	32000	32000	0	0	0	0
11	0	32000	32000	32000	32000	0	0	0	0
12	0	32000	32000	32000	32000	0	0	0	0
13	0	32000	32000	32000	32000	0	0	0	0
14	0	32000	32000	32000	32000	0	0	0	0
15	0	32000	32000	32000	32000	0	0	0	0
16	0	32000	32000	32000	32000	0	0	0	0
17	0	32000	32000	32000	32000	0	0	0	0
18	0	32000	32000	32000	32000	0	0	0	0
19	0	32000	32000	32000	32000	0	0	0	0
20	0	32000	32000	32000	32000	0	0	0	0
21	0	32000	32000	32000	32000	0	0	0	0
22	0	32000	32000	32000	32000	0	0	0	0
23	0	32000	32000	32000	32000	0	0	0	0
24	0	32000	32000	32000	32000	0	0	0	0
25	0	32000	32000	32000	32000	0	0	0	0
26	0	32000	32000	32000	32000	0	0	0	0
27	0	32000	32000	32000	32000	0	0	0	0
28	0	32000	32000	32000	32000	0	0	0	0
29	0	32000	32000	32000	32000	0	0	0	0
30	0	32000	32000	32000	32000	0	0	0	0

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Figure 8-6

- Average X-Vel - gives the average horizontal velocity for the altitude slice.
 - Average Y-Vel - gives the average vertical velocity for the altitude slice.
- o Wind Profile (Display 35) (Figure 8-7):
- This display shows the average horizontal and vertical cross-wind as a function of altitude.
 - There are thirty 20-foot altitude slices.
 - The crossed lines represent the wind velocity for each altitude slice.
 - The length of the horizontal line of the crossed lines represents the standard deviation for the wind velocity for the altitude slice.

WIND PROFILE (DISPLAY 35)

FILE NO. 1 DATE 10/19/76 TIME 0.842 SOURCE S TOODE 1
FRAME NO. 15

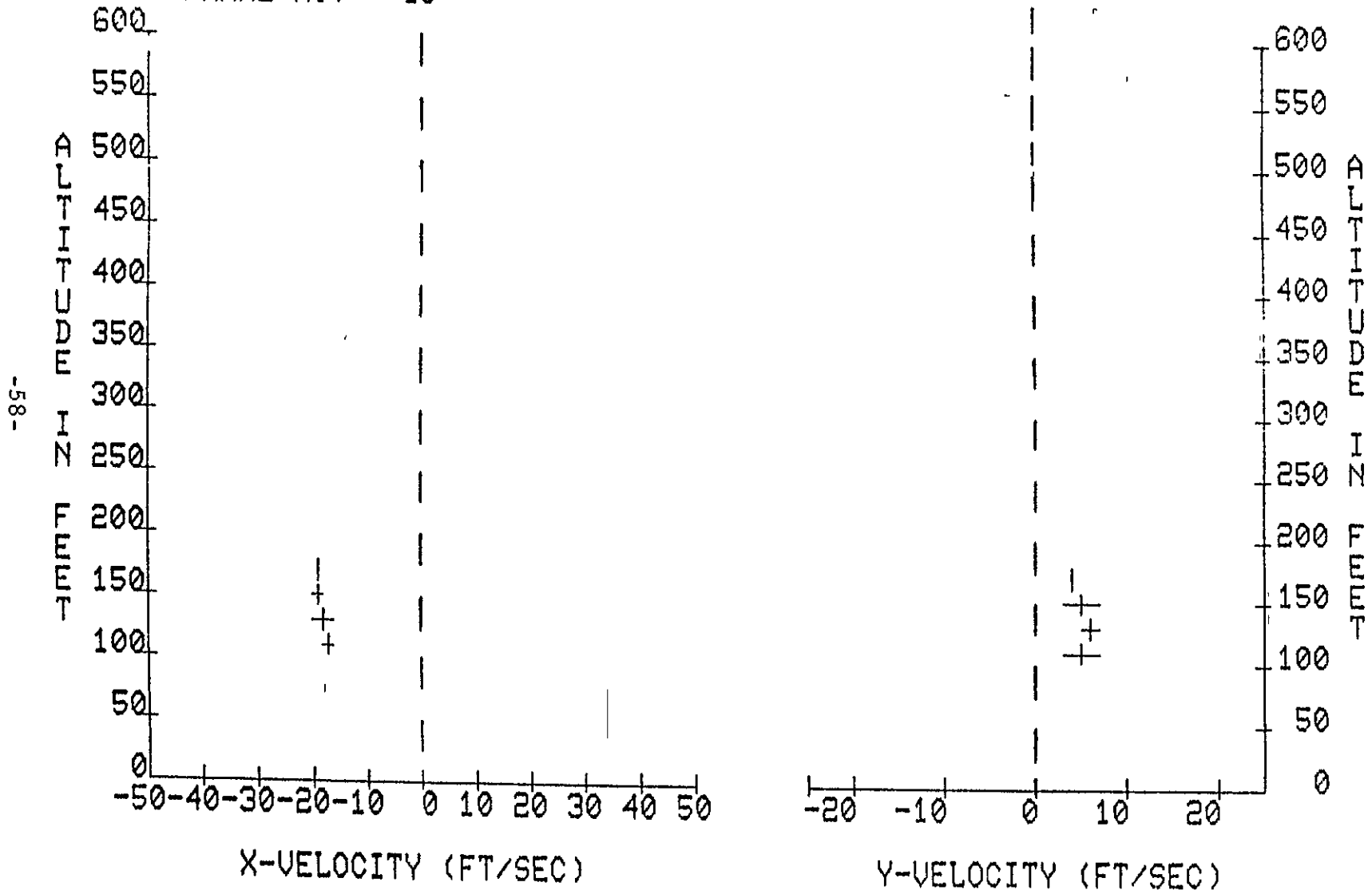


Figure 8-7