How to use the MINIDEK

With the Digital Equipment Corporation PDP-8 Family Computers

PART I

HOW TO USE THE MINIDEK

PART I

Direct comments concerning this manual to

TENNECOMP SYSTEMS, INCORPORATED • OAK RIDGE, TENNESSEE

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INTRODUCTION

The Tennecomp TP-1371 MiniDek Digital Tape Recorder is a low-price, easy to operate cartridge tape recorder intended mainly for use with mini-computers to enhance the loading of programs and to provide low-cost storage space for data. The tape system may be divided into three principal parts:

1. The Tape Transport
2. Read/Write Amplifiers and associated electronics for assembling and disassembling data written on tape, and the necessary circuitry to control the movement of the tape.
3. The interface between the tape recorder and the particular mini-computer to which the tape is connected.

The detailed operation of the transport and the description of the electronics are given in Part II of the MiniDek Manual. This manual is primarily concerned with "How to Use the MiniDek", rather than "How it works". Installation instructions are also included as an attachment to this manual.

Transport

The tape transport is illustrated in Figure 1. Tape cartridges are inserted in the slot on the front of the transport. A WRITE PERMIT PIN in the cartridge permits data to be stored on the tape. A "file protect" lamp on the frontpanel indicates when an attempt is made to write on a cartridge which does not have a pin in place. The MiniDek utilizes continuous-loop cartridges popular in the broadcasting industry for their reliability and ease of handling. Standard program cartridges have a capacity of 4096 (4K) computer words on each of their four tracks.

A track select switch on the front panel permits any track to be selected manually, or allows the unit to be placed in automatic status so that the track number can be selected by program control. If the track select switch is on track 1, 2, 3, or 4, the manual selection overrides the automatic selection. When the computer is started, track 1 will be selected if the switch is placed in the AUTO position.

The MiniDek utilizes a 4-track head, but only 1 track is used at a time. Information is recorded using a "phase encoded" format. Information may be organized in many ways on the tape by the software. The minimum unit of information which may be written is a 12-bit word.

Other cartridges are available with the following capacities:

	Capacity Words/Track	Words/Cartridge	Approximate Access Time
"1K Tape"	1K	4K	6 sec.
"4K Tape"	4K	16K	15 sec.
"16K Tape"	16K	64K	55 sec.
"32K Tape"	32K	128K	115 sec.
	64K	256K	210 sec.

The speeds and density of the TP-1371 Transport pertinent to this manual are:

Tape speed: 7.5 inches/sec.
Transfer Rate: Approximately 4000 bits/sec.
Recording density: Approximately 600 bits/inch
Start/Stop Time: Several hundred millisec.

The following "How to Use the MiniDek" section outlines the standard programming operations. The section on "programming" gives the details of the instruction set for those who may wish to write their own programs. Finally, the program listings are given for the benefit of those who may wish to make modifications or extensions to the existing programs.

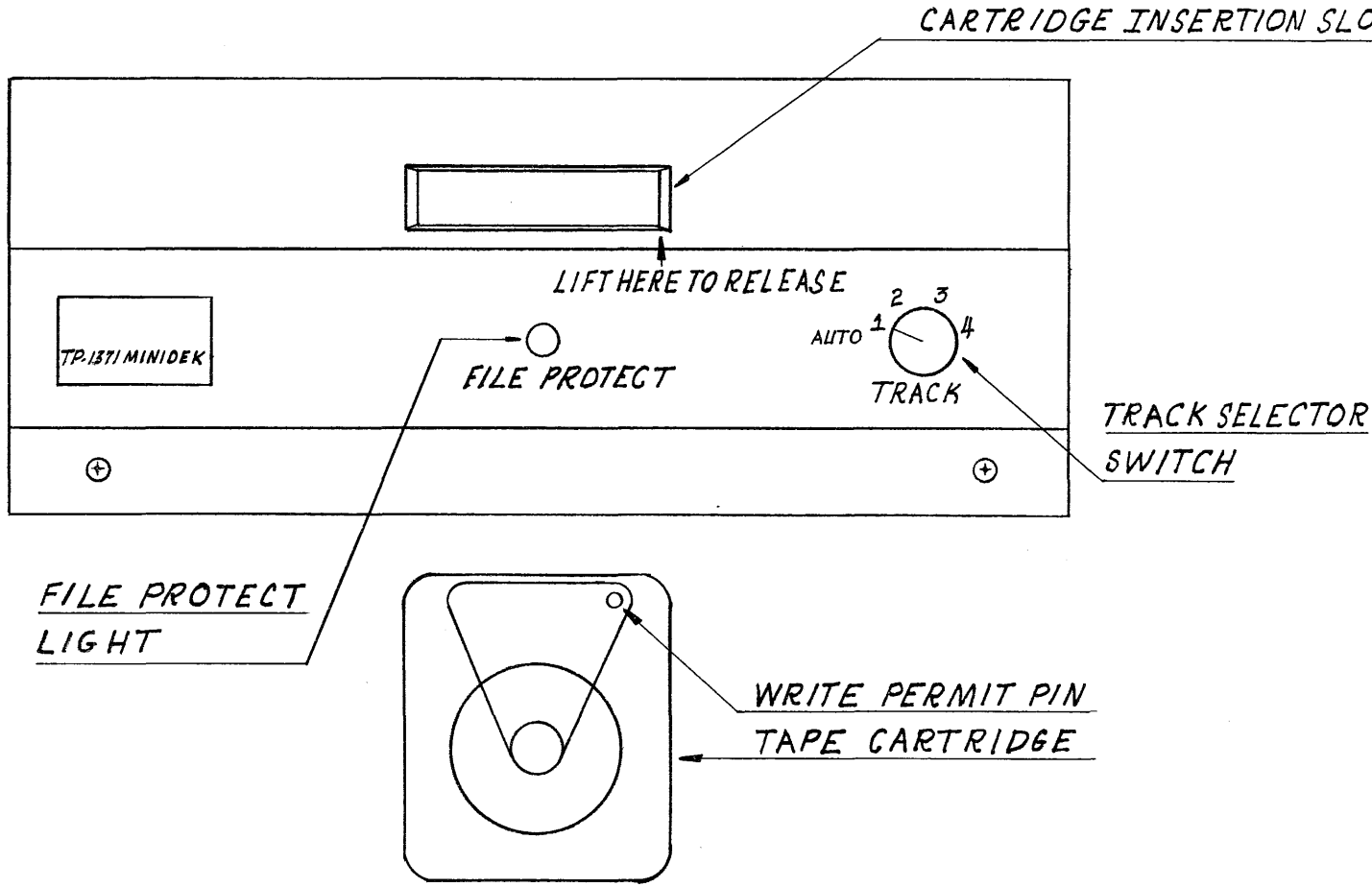

Figure 1

REVISIONS	TENNECOMP SYSTEMS, INC.		
	TP-1371 FRONT PANEL CONTROLS		
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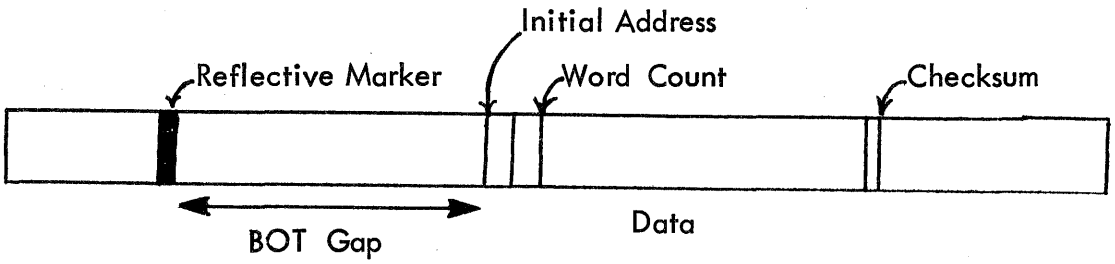
How to DUMP Programs onto the MiniDek
And LOAD Programs from the MiniDek

Three basic programs—RECORD, READ, and SHORT BINARY LOADER—are provided which enable the user to build up libraries of programs. The FORMAT of the tapes produced by the RECORD routine is as follows:



The initial address and word count are used by the READ routine to load the program without the necessity of any switch operations.

In order to DUMP a program onto the MiniDek, the following steps are necessary:

1. First, read the desired program into the computer. You may use the normal BINARY LOADER, the SHORT BINARY LOADER, or some other existing loading program.
2. Now load the MiniDek RECORD program into the computer, using the standard RIM loader. You can also load the RECORD program directly from the MiniDek by use of the READ program described below if RECORD has been dumped onto a cartridge. RECORD may be used to dump itself.
3. Set the computer front panel switches to 7700, press the load address switch, and start.
4. The computer will halt. Key in the Initial Address of the core region to be dumped and hit CONTINUE. The program will halt again. Now key in the Final Address and hit CONTINUE. The selected core region will now be dumped onto the selected track of the MiniDek. If 31 pages of program (all but the last page) are to be dumped, use IA=0000 and FA=7577. Do not dump the MiniDek read program, which normally resides from 7600 upwards, or a read error will be produced when the read program reads itself and changes variable locations.

In order to LOAD a program from the MiniDek into the core, the following steps are necessary:

1. First, load the READ program by means of the standard RIM Loader. Now, you can load any program which has been dumped on a Mini-Dek cartridge. For convenience, the standard programs, such as EDITOR, ASSEMBLER, RECORD, FOCAL, etc., are customarily kept on a cartridge so that they may be quickly retrieved.
2. Insert a cartridge into the slot on the front of the MiniDek and select the desired program by use of the track select switch.
3. Start the computer at location 7600. The program will be loaded from the cartridge and the program will halt with a checksum error (if any) in the accumulator. The normal condition is for the computer to halt with the accumulator all zeroes.

How to Use EDIT-8
With Modifications for the MiniDek

The MiniDek EDIT-8 operates exactly like EDIT-8 (DEC-08-ESAC-PB, 2/4/70), except that the high speed reader and punch routines have been replaced with MiniDek routines. The switch options which normally refer to the high speed reader and punch (SWITCH-10 and SWITCH-11) now refer to output and input from the MiniDek. Other options function normally. In particular:

SWITCH-10 = 0 Teletype Output
= 1 MiniDek Output

SWITCH-11 = 0 Teletype Input
= 1 MiniDek Input

When using the MiniDek, the text is edited in the normal way, except that it is necessary to insure that a $ text delimiter appear as the last element in the text. In order to save the text on the MiniDek, the P command is given with the High Speed Output Option selected (SWITCH 10 up). The P command will affect a halt. Pressing Continue will produce the text. In order to input the text from the MiniDek, the R command is given with the High Speed Input Option selected (SWITCH-11 up).

The normal operation of the editor is to punch or read one character at a time. However, with the MiniDek, the text is organized in blocks of 574 (octal) characters. The P command puts characters into a block. When the block is full (or when the $ is encountered), the whole block is dumped onto the MiniDek. The R command causes an entire block to be read from the Mini-Dek, and EDIT-8 takes one character at a time from the block in the normal way.

The steps in using the MiniDek EDIT-8 are:

1. Read in the Tennetape Editor Program using the binary loader (or load it in from the MiniDek if you have previously dumped the EDIT-8 program on a cartridge).
2. Insert the tape cartridge in the MiniDek front panel slot. Make sure that the WRITE PERMIT PIN is in place.
3. Set the track select knob to the desired track.
4. Set the computer front panel switches to 200 and press the load address switches.
5. Refer to the EDIT-8 manual for the correct switch options and EDITOR operation.

The space available for text in the Editor has been reduced somewhat. The capacity of the 4K EDIT-8 is inadequate to handle large programs in one pass, anyway. The PAUSE pseudo-command of the PAL-III assembler allows the text to be edited in several segments and assembled together. This feature will work correctly with the MiniDek.

The use of the PAUSE feature is illustrated below:

```
*200
BEGIN,      CLA
...
...
...
PAUSE
$

...
...
...
PAUSE
$

...
...
...
$
```

First Text Segment

Last Text Segment

It is often convenient to use Tracks 1, 2, 3, and 4 of the same cartridge for text for a long program. More than one cartridge may be used if necessary.

How to Use PAL-III
With Modifications for the MiniDek

The MiniDek PAL-III operates exactly like PAL-III (DEC-08-ASCI-PB, 4/13/70), except that the high speed reader option of PAL-III has been replaced with a MiniDek read program. Information is brought from the MiniDek in blocks, and PAL-III takes character at a time from the block, just as it would from the high speed reader. A $ in the text signifies the end of the last block.

1. Read in the modified PAL-III program using the binary loader (or load it from the MiniDek if you have previously dumped the PAL-III program on a cartridge).
2. Insert the tape cartridge in the MiniDek front panel slot.
3. Set the track select knob to the desired track.
4. Set the computer front panel switches to 200 and press the load address knob.
5. Refer to the PAL-III manual for the correct switch options for Pass I. (Any reference to the high speed reader will be equated to tape input.) For Pass I with output on the low speed Teletype, put all Console Switches to 0 except Switch 1.
6. Press Start. The text will be read in from the MiniDek, and the computer will halt to await switch settings for the next pass. If a long program is being assembled which occupies more than one track, turn to the next track and push continue. (See "How to Use the Edit-8" for instructions on how to use the PAUSE pseudo-command for assembly of long programs in several sections.)

How to Use the Short Binary Loader

The Short Binary Loader is an abbreviated version of the normal DEC binary loader. It has been shortened to approximately $\frac{1}{2}$ page length so that it can share the last page of memory with another program. The only serious restriction is that programs may be loaded into 1 field of memory only. The starting location is 7700.

The flashing of the console lights is more animated than the old binary loader; however, the checksum feature and the loading of multiple programs works exactly the same.

The steps in the operation of the Short Binary Loader are:

1. Toggle the RIM LOADER into core memory using the console switches. The locations and corresponding instructions for both the low-speed reader and the high speed reader are given below for reference:

	Instructions	
Location	Low-Speed Reader	High-Speed Reader
7756	6032	6014
7757	6031	6011
7760	5357	5357
7761	6036	6016
7762	7106	7106
7763	7006	7006
7764	7510	7510
7765	5357	5374
7766	7006	7006
7767	6031	6011
7770	5367	5367
7771	6034	6016
7772	7420	7420
7773	3776	3776
7774	3376	3376
7775	5356	5357

2. Set the Switch Register to 7756 and press Load Address.
3. Put the Short Binary Loader in the reader (whichever reader designated in the RIM Loader).
4. Depress Start. The Short Binary Loader will be read into memory.

To read binary tapes on the ASR-33 Teletype:

1. Set the computer front panel switches to 7700 and press the load address switch.
2. Put the binary tape to be read into the reader and set the reader to start.
3. Depress Start on the computer front panel.

After the tape has been read in and the computer has halted, check the accumulator. A zero in the accumulator indicates a valid read.

The Short Binary Loader may also be used to read binary tapes on the high-speed reader if the following modifications are made:

	Change Instruction	
Location	From	To
7703	6034	6012
7705	6036	6016
7711	6031	6011
7713	6034	6012
7715	6036	6012
7742	6032	6014
7743	6031	6011
7745	6034	6012

How to Use 4K FOCAL*
With MiniDek Text Storage

It is a time-consuming operation to read FOCAL text into FOCAL by means of punched paper tape or to punch text from FOCAL onto punched paper tape.

FOCAL has been modified to allow the entire text region to be dumped onto the MiniDek or to be read from the MiniDek. Several pointers are included with the text to inform FOCAL of the length of the text.

Text transfer is initiated by means of a modified LIBRARY command with sub-command of IN or OUT followed by a track number (1, 2, 3, or 4).

The steps in using 4K FOCAL with MiniDek Text Storage are:

1. Load the standard RIM LOADER into computer.
2. Load a BINARY LOADER into computer.
3. Load the standard binary tape for FOCAL-69 into the computer using the binary loader.
4. Load the MiniDek FOCAL Overlay into the computer using the binary loader.
5. FOCAL may now be started and initialization questions answered according to the wishes of the user.

NOTE: Steps 1 through 5 need only be done one time. The initialized FOCAL with overlay may be dumped onto the MiniDek and read in whenever desired with the MiniDek READ routine in only one quick step.

6. Now you may prepare a FOCAL program in the normal manner.
7. Insert a 1K cartridge in the front slot of the MiniDek (A 4K cartridge will work all right, too). After the program is checked out, it may be saved as follows by typing:

L OUT 1	To save on Track 1
L OUT 2	To save on Track 2
L OUT 3	To save on Track 3
L OUT 4	To save on Track 4

8. To read the program text back into FOCAL, type:

L IN 1	To read from Track 1
L IN 2	To read from Track 2
... etc.	...

Note that when text is read into FOCAL using the LIBRARY IN command, all variables are erased. This is necessary, since the variables, the text, and the "push down list" share memory from locations 3206 (octal) to 5377 (octal), and the text might overlap the variables if the variables are retained.

An alternative way of saving FOCAL programs with the MiniDek is to dump the entire FOCAL program, including text and variables from location 0001 (octal) to 7577 (octal) onto a 4K cartridge.

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HOW TO USE THE FILE SOFTWARE FOR THE MINIDEK

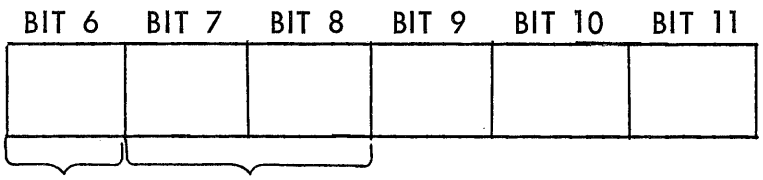
WRITE: The Write subroutine will record data records on tape in the following format:

RECORD GAP	CODE	N WORDS	• • • DATA • • •	CHECKSUM

1. The calling program must establish the identifying code to be recorded in the subroutine location called CODE.
2. Set up the calling sequence:

```
TAD SETUP
JMS WRITE
IA
FA
(ERROR RETURN)
(NORMAL RETURN)
```

where SETUP is the track and transport selection word. The following bit configurations should be used to indicate the track and transport desired (all other bits being zero).



Transport	Track
0 = transport 1	00 = track 1
1 = transport 2	01 = track 2
	10 = track 3
	11 = track 4

IA is the initial address from which data will be recorded. FA is the final address through which data will be recorded.

Upon execution, control will return to Error Return if, while recording, the end of tape was encountered. The tape will be spaced to the beginning of tape.

If the End of Tape was not reached, control will come back to Normal Return.

READ: The READ subroutine will read a fixed-length data record into memory with the identifying code of the record left in the accumulator.

Use the following calling sequence:

```
TAD SETUP
JMS READ
IA
FA
(ERROR RETURN)
(NORMAL RETURN)
```

where SETUP is the track and transport selection word. SETUP will have the same format as described in the WRITE subroutine.

IA is the first address into which data will be read.

FA is the last address into which data will be read.

If an error occurs during the execution of a READ, return from the subroutine will be to ERROR RETURN, at which place a decision must be made as to which type of an error was encountered. This may be accomplished by comparing the contents of the location called ERROR with the three error indicator words. The errors which may occur and their respective error indicator words are as follows:

a. Checksum Error - READ + 45_8

(The checksum on tape differs from the checksum calculated during reading.)

b. Size Error - READ + 111_8

(This error may occur when the tape was not in an inter-record gap when READ was called or when the size of the file on tape differs from the size called for.) The tape will be spaced to the next inter-record gap.

c. End-of-Tape Error - READ + 104_8

(The End-of-Tape was encountered during the READ operation. The READ is aborted and the beginning-of-tape found.)

If none of these conditions exist, return will be to NORMAL RETURN.

SEARCH: The SEARCH subroutine will search for a record with a particular identifying code specified in the calling sequence.

1. The calling program must establish the track and transport selection word (SETUP) using the same bit configuration as previously used in the WRITE and READ subroutine.

2. Set up the calling sequence as follows:

```
TAD CODE
JMS SEARCH
IA
FA
(ERROR RETURN)
(NORMAL RETURN)
```

where CODE is the identifying code of the record being searched for and IA and FA are the initial and final addresses of that record.

If an Error occurs during the SEARCH operation, return will be to ERROR RETURN. Any of the error conditions specified in the READ subroutine may cause an error condition; this will be indicated by a zero in the accumulator. If the code could not be found and the end-of-tape was encountered, there will be a -1 in the accumulator.

A normal return indicates a successful search.

SPACE: The SPACE subroutine will space forward an indicated number of records.

Set up the calling sequence as follows:

```
TAD +N
JMS SPACE
(NORMAL RETURN)
```

where +N is the number of records to be skipped.

REWIND: The REWIND subroutine will rewind either of the transports indicated by SETUP* after a read or write operation.

Set up the calling sequence as follows:

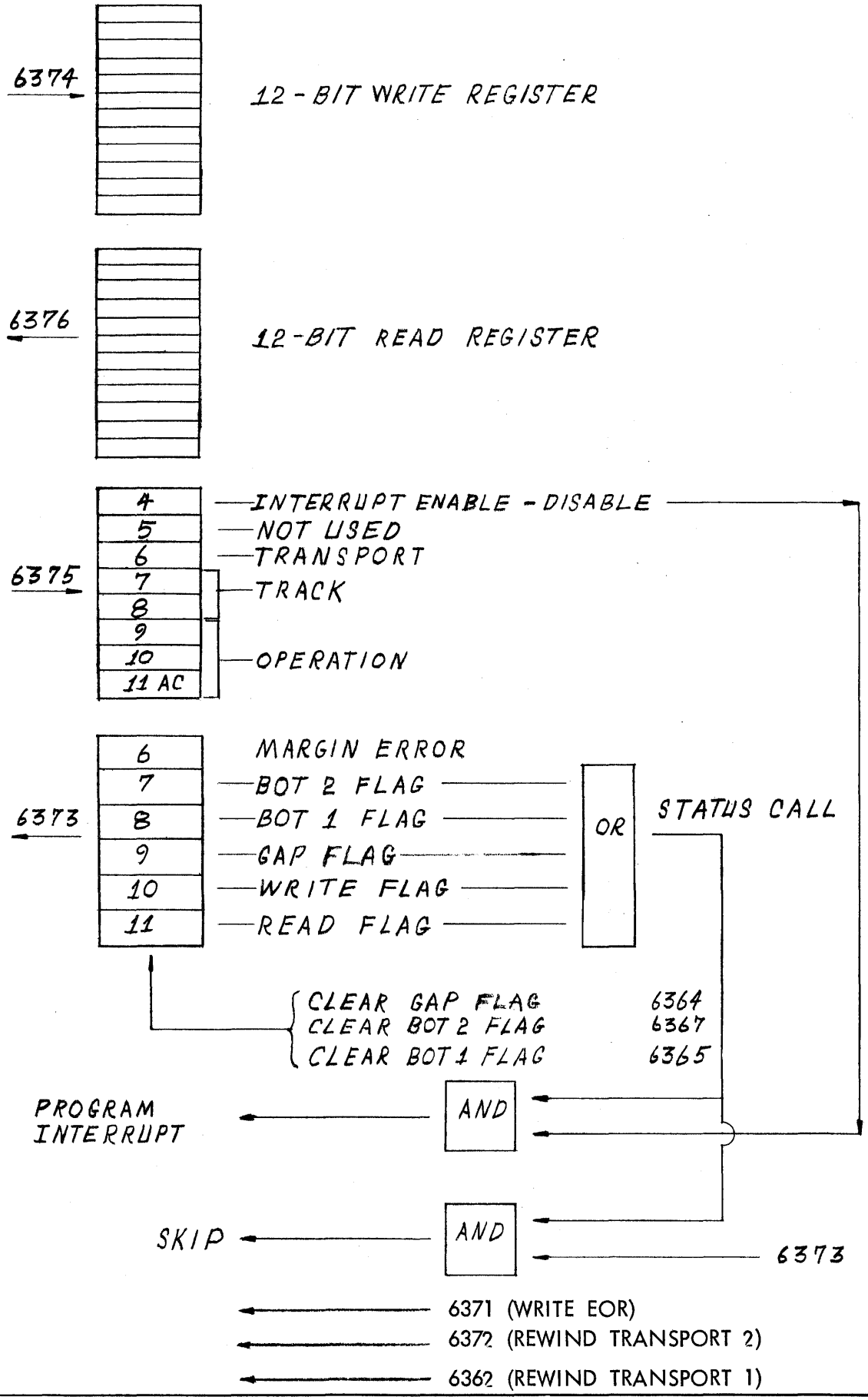
```
TAD SETUP
JMS REWIND
(NORMAL RETURN)
```

where SETUP is the track and transport selection word.

---

* It is recommended that words commonly used by the subroutines, such as SETUP, CODE, and CNTROL, be located on page 0 for mutual accessibility by all programs.

The following diagram illustrates the software interface logic:



In general with the two-transport TP-1372 option, only one transport may be in operation at any one time. There is one exception: One transport may be rewound using its rewind instruction (page 4.0), while the other transport is being controlled through the command register.

List of Instructions for the PDP-8 Family:

1. SKP ON STATUS CALL TRUE AND READ STATUS REG — 6373

   Skip if one of the flags is high (RD FLAG, WRT FLAG, GAP FLAG, BOT1 FLAG, BOT2 FLAG). The content of the status register is unconditionally transferred to the accumulator.

2. CLR & LOAD COMMAND REG — 6375

   The command register is cleared and then loaded with the 8 least significant bits of the accumulator.

3. W.E.O.R. — 6371

   An end-of-record is written on tape. The end of record is 4" of tape saturated in the reference direction. When the end-of-record gap has been completed, the gap flag is set, which clears the operation code portion of the command register and stops the motor.

4. WRT WORD TRANSFER & CLEAR WRT FLAG — 6374

   The information in the accumulator is transferred to the write shift register, and the WRT FLAG bit in the status register is cleared.

5. RD BUFFER & CLEAR RD FLAG — 6376

   The accumulator is cleared, the content of the read buffer register is transferred to the accumulator, and the RD FLAG bit in the status register is cleared.

6. CLEAR GAP FLAG — 6364

   The gap flag in the status register is cleared (Note that when the gap flag is set, the operation code portion of the command register is cleared and the motor is stopped).

7. REWIND TRANSPORT 1 — 6362

   This command rewinds the indicated transport. When the BOT marker is detected by the BOT sensor, the BOT 1 bit in the status register is raised and the transition of the BOT 1 status register bit sets the BOT 1 FLAG.

8. REWIND TRANSPORT 2 — 6372

   Same as above, except refers to Transport #2 with TP-1372 option.

9. CLEAR BOT1 FLAG 6365

The beginning of tape flag of transport one is cleared. Note, however, that SPLICE 1 bit in the status register remains set as long as the splice marking the beginning of tape is detected (BOT1 FLAG is a D-type flip-slop set with the leading edge of the signal from the beginning of tape sensor).

10. CLEAR BOT2 FLAG 6367

The beginning of tape flag of transport #2 is cleared. Note that splice 2 bit in the status register remains set as long as the splice marking the beginning of tape is detected (BOT2 FLAG is a D-type flip-flop set with the leading edge of the signal from the beginning of tape sensor). THIS INSTRUCTION IS NECESSARY WITH TP-1372 OPTION ONLY.

Programming Aids:

If additional software is desired, standard guidelines for programming such software are recommended for some of the basic operations; for example:

Reading: To read a block of data, the transport and track must first be selected and loaded into the command register at the same time the read mode is loaded. After a 200 ms. mode delay, a wait for the read ready flag is initiated. When the read flag comes up, the word may be read into memory, and likewise for successive words until the word count has been exhausted. At this point, a gap is expected and a wait for the gap flag is begun. When the gap flag is set, the tape will stop; or if the read mode is reloaded into the command register, begin to stop, but then resume motion. (See flow chart, OP 1)

Recording: To record a block of data, the transport, track number, and write mode must be selected by loading the command register with the proper value. After a 300 ms. mode delay, a wait for the write ready flag is begun. When the write flag is sensed, the word may be transferred to tape. For each word thereafter, the write flag must be found before a word can be transferred. After all words have been recorded, an end-of-record gap is written, after which a wait for the gap flag is initiated. When the gap flag is sensed, the tape will stop. To begin the tape motion for the next block, the command register must be reloaded with the write mode, the selected transport, and desired track.

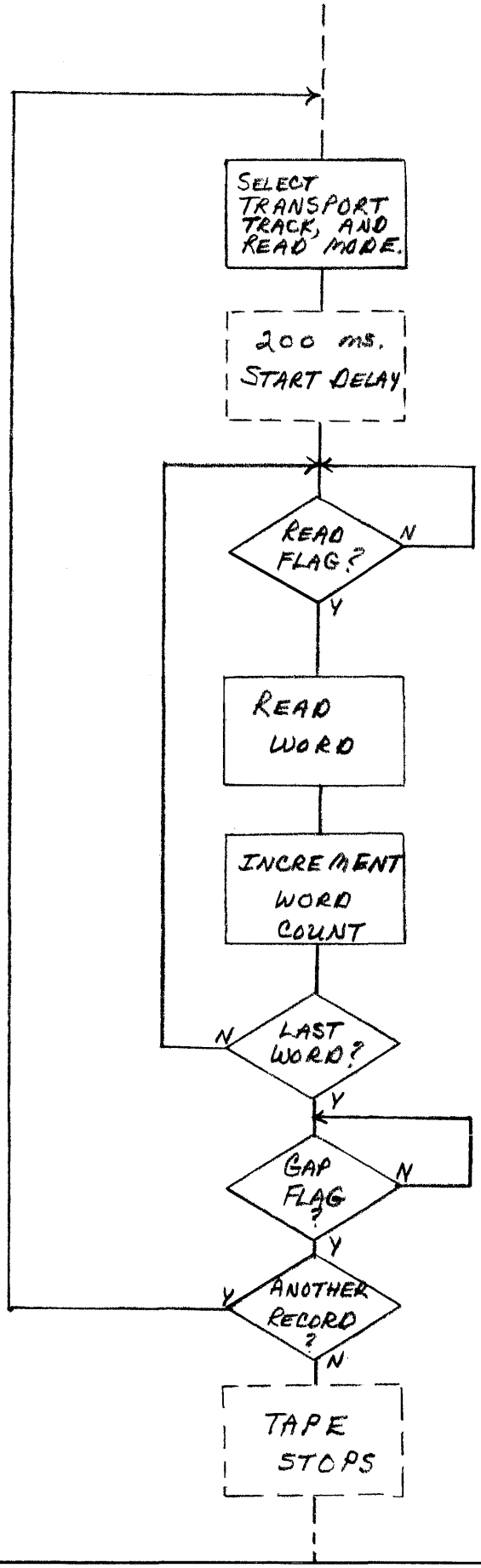
The tape may be allowed to continue movement between blocks, in which case it is not necessary to wait for the gap flag after writing the end-of-record gap. In this case, as before, the write mode, transport, and track number must be reselected before the next block may be recorded. (See flow chart OP 2)

Track Selecting: To auto-select a track, the command register must be loaded with the bit assignment corresponding to the track number to be selected. This must be done simultaneously with any operation code that is loaded into the command register.

Stopping the Tape: To stop the tape in the read mode, the command register may be set to the NOP mode for the proper track and transport. However, when reading blocks of data, the detection of the inter-record gap will stop the tape. So if counting the number of words while reading a record, after the last word is read a wait for the gap flag should be initiated. When the flag comes up, the tape will stop (or begin to stop). After the detection of the gap flag, it should be cleared; otherwise, further tape operations are inhibited.

Interrupt Processing: The most important consideration involved when under an interrupt is efficient time usage. A minimum amount of waiting should occur before returning to the real-time program. As in the case of a mode delay, this delay time should be used for real-time processing. (See flow charts OP 3 and OP 4.)

OP 1



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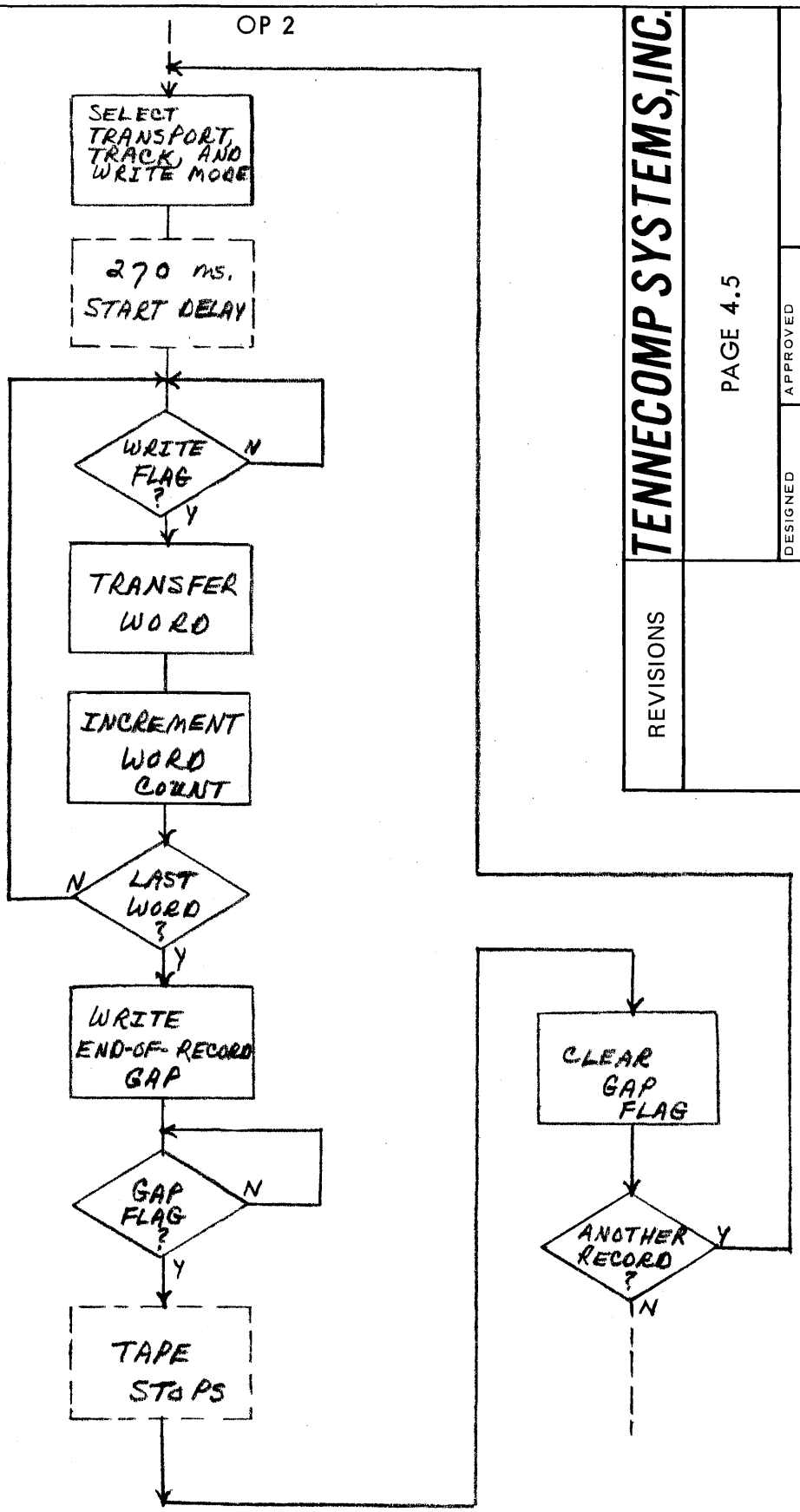

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