The Cassette Utility Programs

1.0   INTRODUCTION

The Cassette Utility Programs are a group of programs designed to help in the preparation of programs for the PDP-8 Computer. They consist of an Editor program, two tabulator programs, a page format program, a binary duplicator and a binary tape assembler and disassembler which are described in later sections. The minimum complement of equipment to use these programs is a PDP-8 computer, a teletypewriter, a high speed reader, and two cassette recorders. This program can utilize a high speed punch if one is available.

1.1   THE EXECUTIVE PROGRAM

The cassette utility programs are loaded by typing L, UPC followed by a carriage return using the library executive. The program will automatically start. If it is necessary to restart the program the starting address is 200. The computer will then type the question INPUT, to which the operator must answer P for paper tape or C for left hand cassette recorder indicating the source program. Upon receiving a satisfactory answer the computer will type the question OUTPUT, to which the operator must answer P (paper tape or tele-typewriter) or C (right hand cassette recorder) to indicate the output device. The computer then proceeds to the execution mode which is indicated by the flashing of all the lights in the accumulator in unison. Any of the utility programs may now be selected by typing the corresponding letter on the teletypewriter. Whenever a program is terminated control is returned to the executive program.

The executive program only responds to the letters indicated below, all other keys are ignored. The computer executes the following program when the corresponding keys are struck.

        B - Bin to QK program (See sec. 5.1)
        D - Duplicator program (See sec. 6.0)
        E - Editor program (See sec. 2.0)
        F - Fortran tabulator program (See sec. 4.1)
        L - Type a section of leader (See sec. 7.1)
        N - Editor program alternate entry (See sec. 2.0)
        P - Page format program (See sec. 3.0)
        Q - QK to Bin program (See sec. 5.2)
        S - Skip a block (See sec. 7.2)
        T - Tabulator for assembly language program (See sec. 4.2)
        Z - Terminate program (See sec. 7.3)

There are two switch register options to all programs.

Bit 11 determines whether the output is to be on the high speed punch or the teletypewriter. In the "one" position the output is on the high

speed punch. In the "zero" position the output is on both. If low speed output only is desired, the high speed reader should be turned off and the switch placed in the zero position. This switch may be thrown at any time.

This option is ignored if the output is on cassette. In this case all commands are echoed on the teletypewriter.

Bit 10 controls the optional halt in various programs. In the "one" position   the program will stop the computer at an optional halt, while in the "zero" position optional halts are ignored.

2.0   THE EDITOR PROGRAM

The editor program is used to correct a symbolic program by copying it over and making necessary changes under teletype control. The program to be edited is placed on the high speed reader or left hand cassette recorder and a corrected tape is produced on either the high or low speed punch by the switch register selection bit 11 described in section 1.1 or the right hand cassette recorder. This program may be entered from the executive program by either typing an E or an N while in the executive program.

Typing an E is the normal entry into the editor program. The program will then type a section of leader (200 code), read a section of the tape to be edited into the computer memory buffer,. and insure that the tapes begin with a carriage return and line feed. Then the computer waits for a primary command described below. Typing an N enters the editor program without producing leader, or reloading the buffer. In both cases correct entry into the editor program is indicated by the flashing in unison of the lower six bits of the accumulator.

2.1   THE PRIMARY COMMANDS

In the command mode of the editor program the computer ignors any key typed except

        C - copy mode
        E - erase mode
        L - type trailer and return to executive program
        N - load new source
        R - rewind source cassette
        T - type mode (teletype is now the source) .
        X - abort program return to executive program.

These are the primary commands. Once they are typed the computer waits for a secondary command. At this point typing a rubout returns the program to the command mode and a new primary command may be typed.

Typing a C will eventually cause the computer to copy the tape to be edited onto the edited tape until a prearranged point determined by the secondary command. Typing an E "erases"* the tape to be edited until a prearranged point; while typing a T permits new material to be typed onto the

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*In reality, the tape is not erased, but the portion to be "erased" is not transferred to the edited tape.

edited tape from the teletypewriter. Typing on N initializes a new source program. When the source program is on cassette a R will cause the cassette to be rewound. Typing an L indicates that the editing is finished, the computer then punches the trailer on the edited tape and returns control to the executive program. An X is used to abort the program and return to the executive program.

2.2   THE SECONDARY COMMANDS

The secondary command must follow immediately after the primary command. They can be X (see sec. 2.4) a - (minus sign), an I (see sec. 2.3), or a decimal number and delimiter. Typing a rubout before the secondary command is delimited permits a new secondary command to be entered, and typing two rubouts permits a new primary command to be entered.

If the secondary command is a number then it is interpreted as a desire to perform the primary command for that many lines. Thus C7 copies 7 lines, E5 erases 5 lines, and T3 permits 3 lines to be entered from the teletypewriter. A line for the purposes of this program must have less than 128 characters. If one attempts to copy a line with more than that many characters, the computer will type LINE TOO LONG.

In the case of all T commands an additional delimiter of a line feed is necessary. This permits an editing tape to be prepared so that an operator does not have to be present while the editing is in process. The editing tape is placed in the teletypewriter reader and controls the process. This is the preferred mode of operation especially when editing cassettes.

2.3   THE IDENTIFICATION MODES

The identification mode is useful in editing longer programs where it is impractical to count the number of lines until the desired place is reached. To get into this mode immediately after typing the primary command type either a minus sign or an I. This is followed by a tag. The computer then performs the primary command until it gets to the line that begins with the tag. If a minus sign had been typed then the computer returns to the command mode, but if an I has been typed then the computer performs the primary command on this line as well. Thus if it is desired, to copy everything up to the line but not including the line number 300 the command would be C-300. However if it is desired to copy that line as well the command would be CI300.

The minus mode does not work in the T mode, however, if you wish to type a group of lines the last one being numbered 300 you would give the command TI300 followed by a carriage return and line feed.

A tag may consist of any combination of numbers, letters, *, or /, and is terminated by any other symbol such as a space or a carriage return. Typing a rubout immediately after the I or minus sign returns the program to the command mode. Typing a rubout after a tag has been typed but not delimited permits one to type another tag. Leading spaces before a tag are ignored. However if one types CI followed, say, by a comma, then the computer copies until if finds a line that has no tag, that is, a line that begins with a symbol other than a space, letter, number, / or *.

2.4   THE CHARACTER MODE

If a primary command is followed by an X, then the number typed is interpreted as so many symbols rather than lines. For example, CX5 will copy 5 characters from a line. In the character mode the end of a line will not be exceeded. For example typing EX1000 will erase all the symbols on a line up to but not including the carriage return and line feed.

The X may be immediately followed by an I than a tag entered. Now the primary command will be executed on the line until that tag is found. The primary command will also be executed on the tag and the delimiter. Thus if it is desired to copy a line up to the word AND one would type CXI AND.

2.5   NEW TAPES

The editor program may be used to merge two tapes together by copying the tape to the end, then place the second tape on the reader, type an N and copying it to the end.

3.0   PAGE FORMAT

The purpose of this program is to obtain hard copy, cut up into page sized formats for reports, etc. Place the source tape to be formatted in the input device. This program may be selected by typing P while in the executive mode. The program then goes into the command mode and the first six bits of the accumulator will flash. If it is desired to begin the program with leader, as in the case of preparing a tape rather than obtaining a listing an L should be typed before typing P.

The commands available in the page format program are as follows:

B - begin the output with page 1
E - end a page completely
L - type a section of leader and go to the Executive
N - load new source
P - begin program with page number other than 1
R - rewind cassette
S - skip a section of source tape between leader codes.
X - go to Executive

3.1 THE B OR P COMMAND

When it is desired to start the page format program the operator can type a B for begin. The program will then type out one page of text and number it page one. When this finished there is an optional halt to permit the operator to remove the page from the teletypewriter. If it is desired to cut the program into page size sheets at a later time this halt may be omitted as described in section 1.1 for Bit 10.

If it is desired to start numbering the first page some number other than one, such as the case when a listing is an appendix to a report, then instead of typing B, type P followed by the number of the first page. P1 performs the same task as B.

3.2 THE N, E AND L COMMANDS

At the conclusion of the page formatting of a tape there are several alternatives. If one types an E, the computer finishes off the page. On the other hand if a second tape is to be formatted immediately following the preceeding text, place this tape on the high spaced reader and type an N. In any case the computer remains in the command mode of the page format program until an L or an X is typed causing a return command to the executive program with or without a section of trailer.

4.0 THE TABULATOR PROGRAMS

The tabulator programs are designed to align the programs in columns to make them more readable and to facilitate spotting errors. They are called by typing:

F - fortran tabulator
T - assembly language tabulator

4.1 FORTRAN TABULATOR

This program standardizes the format of fortran programs written for the PDP-8. Excess spaces are eliminated except in hollarith statements where they are used for formatting. To use this program place source tape in the input device and type an F. A formatted tape is produced on the chosen output device (see section 1.1) and the control is returned to executive.

4.2 ASSEMBLY LANGUAGE TABULATOR

This program is written for the formats used in PAL and MACRO. One feature of this program is that comments which would be too long in pass 3 of PAL are automatically shortened by starting a new line. To use this program type a T after the source tape has been placed in either the high speed reader or the left hand cassette drive.

5.0 QK LANGUAGE

The QK programs are translator programs from binary to QK and back. They are designed to help identify and edit binary tapes directly. For short programs this is a fast way of preparing a binary tape since all one does is type the sequency of octal instructions and a binary tape is produced in one pass.

5.1 BIN TO QK

If one places a binary or RIM Format source tape on the input device and types a B a QK tape is produced. The format of the tape is the location followed by its contents both in octal. This symbolic tape may now be edited and then a new binary tape produced as described in the following section. For binary tapes the checksum is typed at the end. This must be edited out before converting back to binary.

The output of this program is in one of two formats. If bit 2 is in the "zero" position a continuous tape is prepared. This tape can be edited and then converted back to a binary tape with the QK-BIN program. If bit 2 is in the "one" position then the output is in page format.

5.2 QK TO BIN

If one places a QK source tape on input device and types a $\bar{Q}$ either a binary or RIM format tape is produced depending on the setting of bit 10 on the switch register (0 = BIN, 1 = RIM). The format of QK is less restrictive than that produced by the BIN to QK program. For example, leading zeroes may be omitted in octal designations. For entering quantities in successive location, instead of typing a new location number, simply type a period. Also, for the remainder of a line after the instruction has been delimited, comments may be typed until the end of the line. Similarly, lines that are comments without numbers on then are ignored. No termination character is needed at the end of a program. Trailer is used to identify the end.

The following QK formats will produce the same binary tape:

```
        0200        5205
        0201        7402
        0202        3333
        0205        1201
        0206        5201
and
        200         5205        COMMENT
             COMMENT
        .7402
        .3333
   205                1201
        .5201
```

6.0   DUPLICATOR PROGRAM

        This program is used to duplicate a binary tape. Place the tape
to be duplicated in the input device and type a D. The program checks
for reader error by computing the checksum. If an error has occurred, the
computer will type "BINARY CHECKSUM ERROR" and will halt before typing
the trailer. In copying a RIM tape the computer will halt because these
tapes do not have a checksum at the end, therefore at this point press
continue and the computer will finish the tape and return to the executive
program.

7.0   The three other commands L,S,Z for the executive mode will now
be discussed.

7.1   THE L COMMAND

        The L command types a section of leader and remains in the execution
mode. An L typed in the editor or page format program has the same effect.

7.2   THE S COMMAND

        When several source programs, in either binary or ASC11, or on a
tape or cassette separated leader, typing an S will advance the source to
the next program. The same effect is achieved when an S is typed in the
page format program, however, control remains in the page format program after
the execution of the command.

7.3   THE Z COMMAND

        After one has finished using the utility program one should type
a Z. This will rewind any cassettes that have been used and then halt the
computer. When the computer halts at the end of a Z command, it is possible
to return to the Library Executive by placing the Library Cassette in the
left hand tape drive and pressing CONTINUE.

8.0   CASSETTE ERROR

        If there is some error in the process of writing on or reading from
the cassettes, due to the cassette itself or the recorder, the computer will
type CASSETTE ERROR and then will halt.

PALC

        PALC is a version of PAL III which uses the cassette recorders. A
symbolic program or cassette is prepared using the Cassette Utility Program
according to the instruction in the PAL III manual. PALC is then loaded
using the library system. The computer will then come to a halt at location
200. The cassette containing the symbolic program is placed on the left
hand recorder and a blank cassette is placed on the right hand cassette and
the continue button is depressed. The computer will now execute all three
passes of PAL III, rewind the cassettes and halt. If it is desired to omit
pass 3, then the contents of location 245 should be changed from 5266 to 7000,
location 241 should be changed from 7710 to 7600.

At the conculsion of the program the right hand cassette will have the output in the following form: the symbol table, pass 3, and the binary tape. The utility program can now be used on the output cassette to format a binary paper tape and to obtain page formatted pass 3 output.

If for some reason the PALC fails to rewind the cassettes before terminating, start the computer in location 212. <u>Never remove the cassettes from the recorders unless they are rewound.</u>