

PDP-1 COMPUTER  
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PDP-7

OPERATION OF THE PDP-1 OFF-LINE FLEXOWRITERS

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## OPERATION OF THE PDP-1 OFF-LINE FLEXOWRITERS

The flexowriter is an electric typewriter with attached paper tape reader and punch mechanisms as illustrated in Figure 1. It is used for preparing, printing, editing and reproducing English programs for the PDP-1 computer. Binary tapes may also be reproduced. The important operating controls are indicated in Figure 1. Before using the flexowriter, the user should be sure that:

1. an adequate supply of blank paper tape is present.
2. the paper is correctly inserted in the carriage and the paper release lever is in its released position. (toward the user)
3. the punch-on switch is in the desired position.

When finished, the user is expected to turn off the power switch, discard any typescripts or tape which are not needed, and leave the room in a neat condition.

### The Flexowriter Code

For each character of the flexowriter keyboard and each machine function such as carriage return and backspace, there corresponds a unique two-octal-digit code. These code values are given at the end of this memo in alpha-numeric sequence and by code value. Each octal digit is associated with a group of three hole positions across the tape as shown in Figure 2. Column 8 contains a parity check bit for the entire line, that is, the bit in column 8 is used to assure that there will always be an odd number of holes in any undeleted punched line. An even number of holes indicates an error. The relation between the octal digit and punching in a group of three hole positions is given in Figure

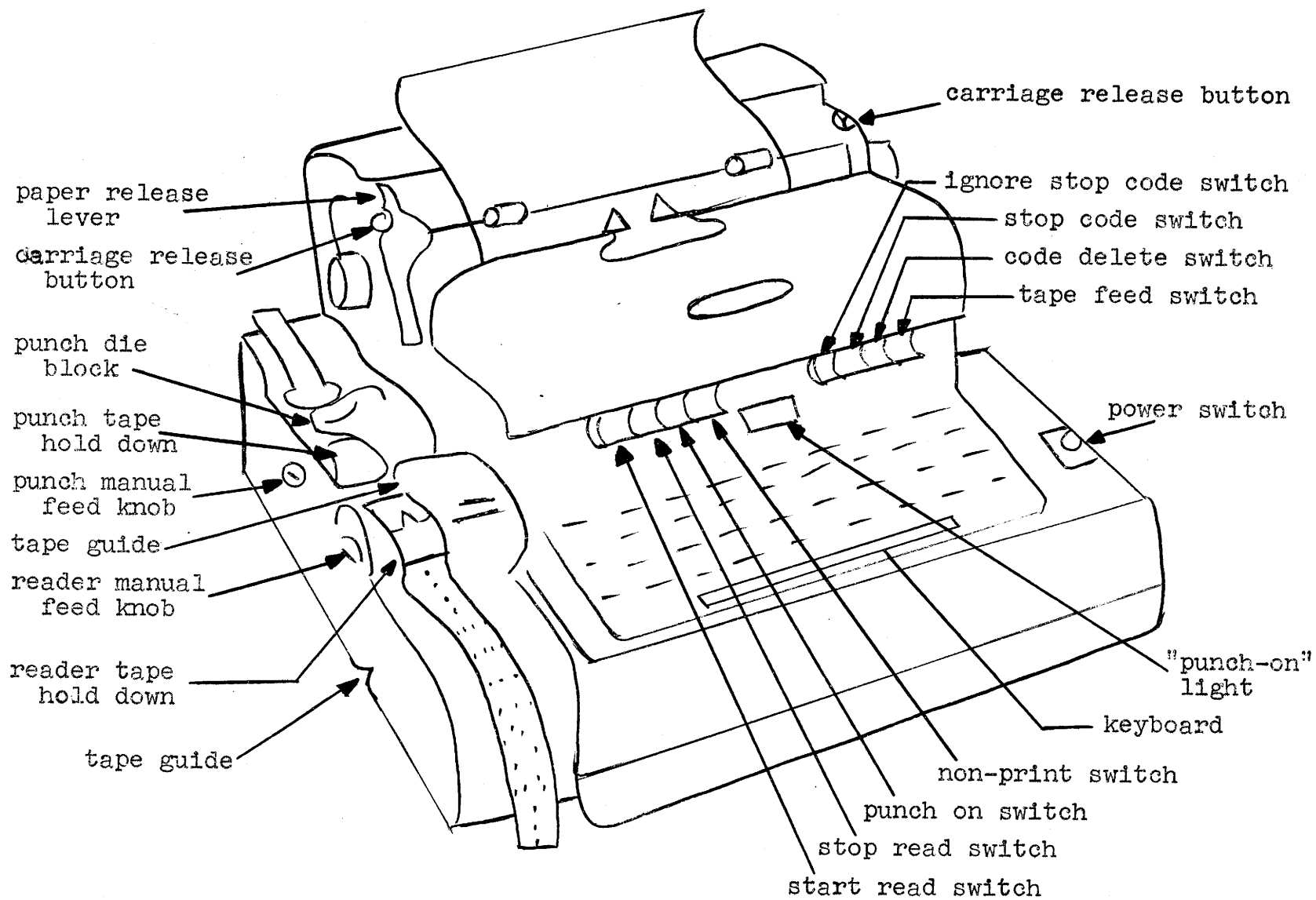
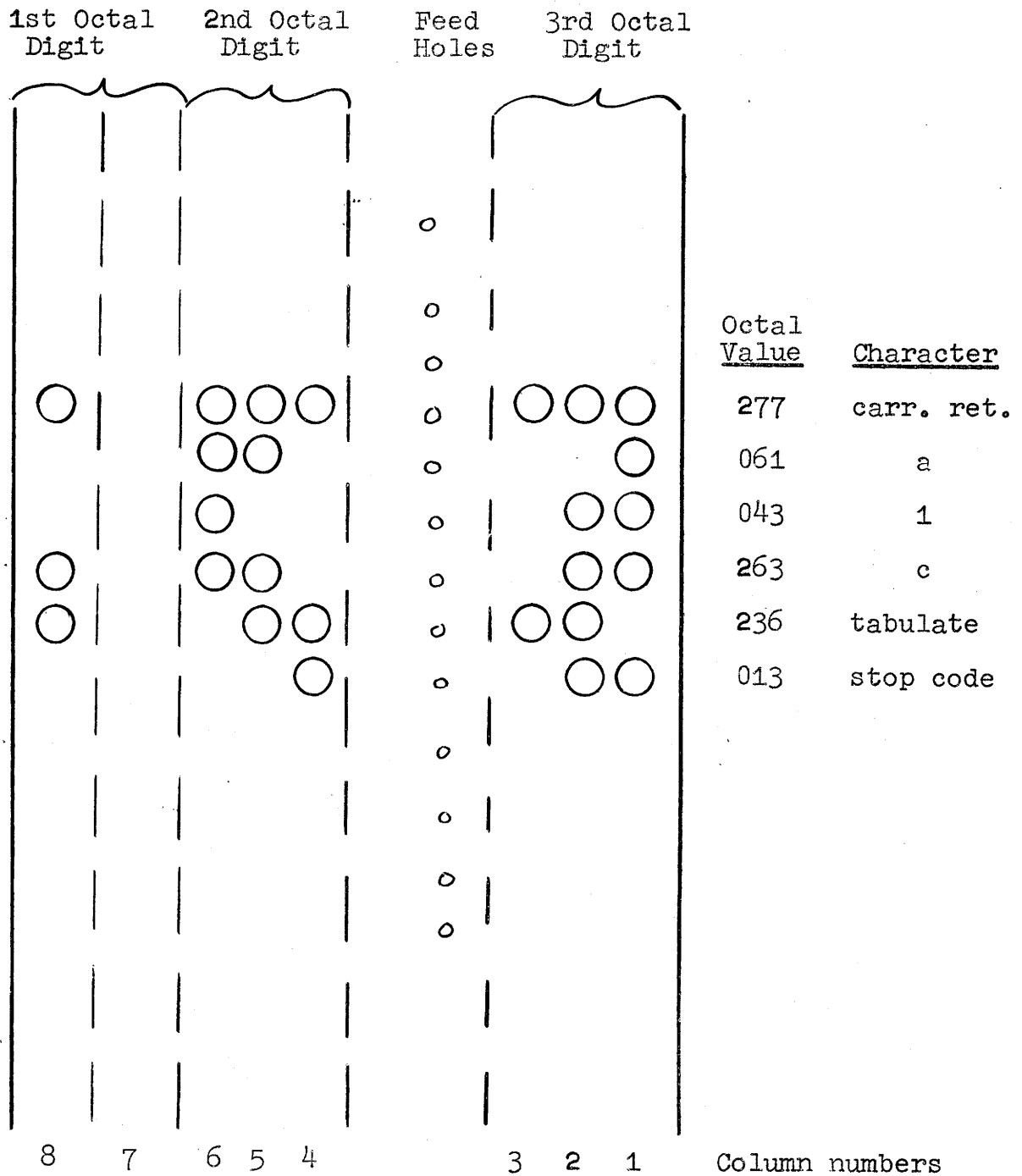


FIGURE 1  
The Flexowriter



Note: Column 8 is the parity check position. A hole in column 7 deletes the character.

FIGURE 2

Interpretation of Punched Tape

3. These illustrations assume that the reader is seated at the flexowriter keyboard with the tape correctly placed in the reader or punch.

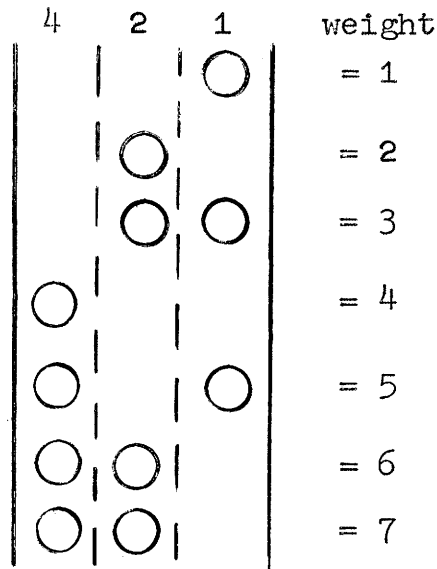


FIGURE 3

Interpretation of a group of three hold positions as an octal digit

Tape Preparation

For preparing a punched paper tape from a manuscript program, the flexowriter controls should be set as follows:

punch on switch	down
ignore stop code	no effect

The user should first feed approximately twelve inches of blank tape (by pressing the tape feed switch) before starting to type. If this is not done, it will be difficult if not impossible to place the tape properly in the PDP-1 tape reader.

It must be remembered that every key struck by the typist will produce the corresponding coded line on the tape being punched. Hence, if it is desired to move the carriage without punching, it must be done manually by means of the carriage release buttons, or by lifting the punch on switch and using the tabulation key or space bar.

The machine functions carriage return, and tabulate require more time than the other characters and functions, and no interlock is built in to prevent typing during their execution. Therefore, the user must wait after typing a tab or carriage return, or the machine is very apt to jam.

When a typing error is made, the faulty characters may be nullified by using the code delete switch. The last character punched always appears partly emerged from under the punch die block. Turning the manual punch feed knob back one notch will align the last character punched with the punch pins again. Pressing the delete switch will punch a hold in column 7, which causes the character to be ignored by assembly programs such as MACRO.

For ease in editing long programs, it is recommended that the program tape be divided into sections each of which is terminated by a stop code followed by several inches of tape feed. A convenient length for a section is one page of typescript. This division makes it possible to edit a tape by duplicating only those sections in which there are changes, and splicing these into the original tape as described later.

### Obtaining a Print Out

To print a copy of a program for verification or record, the set up is:

punch on switch	up
ignore stop code switch	as desired

Place the tape to be printed in the reader mechanism being careful that the tape is properly placed with respect to the tape guides. It is easiest to place the tape in the reader by a lateral motion with the reader tape hold down released. The printing operation is started by pressing and releasing the start read switch. The flexowriter will continue printing the sequence of characters on the tape until the stop switch is depressed or a stop code is encountered on the tape.

### Editing a Program Tape

Although a number of editing tricks will save time in certain special cases, the usual editing procedure is to reproduce the portions of the program tape requiring changes, making insertions and deletions as necessary. The controls should be set exactly as for tape preparation, except the ignore stop code switch will have the effect described below.

Place the tape to be edited in the reader as described above, and press the start read switch. The flexowriter will type the contents of the tape in the reader, which will then be punched into the reproduced tape.

It is important to note the following points. First, blank tape and deletes are ignored by the reader in this mode. Therefore, if tape feed is desired at convenient points in the reproduced tape,

it must be inserted manually. This may be done by pressing the start read switch which will stop the duplication, and holding it down while punching tape feed with the tape feed switch. When the start read switch is released, the duplication process will be resumed. Secondly, when a stop code is read, the duplication will automatically stop unless the ignore stop code switch is down. Pressing the start read switch will resume the duplication. In either case the stop code will not be reproduced. If a stop code is to be retained, it must be reinserted manually by pressing the stop-code switch.

When a point is reached in the duplication where a deletion or insertion is to be made, the quickest and surest way of stopping the reader at a specific point is to press the start read switch. Of course, it must be remembered that the reader will start again unless the stop read switch is held down at the time start read is released. When the reader has stopped, the character over the reader pins is the next character to be read. Thus a deletion may be made by manually advancing the tape in the reader with the reader manual feed knob until the next character to be reproduced is above the reader pins. An alternative procedure is to lift the punch on switch and read the portion to be deleted without punching. This will, of course, give a less useful typescript unless care is taken to cross out all printing not actually punched in the reproduced tape.

#### Reproducing Without Printing

Straight reproduction of a binary or English program tape may be accomplished with the following set up:



punch on switch	down
ignore stop code switch	as desired

Place the tape in the reader mechanism as before and push the non-print switch. This will cause the tape to be read and reproduced without printing. Reading may be stopped by pressing the non-print switch with exactly the same effect as pressing the start read switch. The stop read switch has the same functions as before. In this mode, all lines will be reproduced exactly including blank tape, stop codes, deleted lines, and codes to which no typewriter character or function are assigned, and no typing will occur. If a stop code is read and the ignore stop code switch is up, the flexowriter will punch the stop code before stopping.

### Splicing

Splicing of two sections of paper tape may be done with cellophane tape and scissors as follows: Overlap the ends of the two tapes, aligning the feed holes as a check that both tapes are oriented properly. Cut diagonally. Attach a short length of cellophane tape to one end as shown in Figure 4, then press the second end down on the exposed cellophane tape to make a butt joint. A second piece of cellophane tape may be pressed on top to make a stronger and more permanent splice. Trim the cellophane tape even with the edges at the paper tape. Splices should only be made where there is no information punched in the tape or faulty reading will occur.

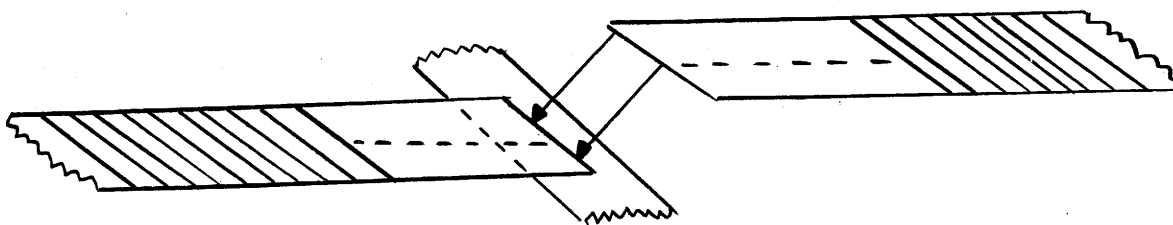


FIGURE 6

Making a Splice

PDP-1 FLEXOWRITER CODE

ALPHANUMERIC CODES BY CHARACTER

Character		Holes	FIO-DEC	Concise
Lower	Upper	87654321	Code	Code
a	A	00110001	61	61
b	B	00110010	62	62
c	C	10110011	263	63
d	D	00110100	64	64
e	E	10110101	265	65
f	F	10110110	266	66
g	G	00110111	67	67
h	H	00111000	70	70
i	I	10111001	271	71
j	J	10100001	241	41
k	K	10100010	242	42
l	L	00100011	43	43
m	M	10100100	244	44
n	N	00100101	45	45
o	O	00100110	46	46
p	P	10100111	247	47
q	Q	10101000	250	50
r	R	00101001	51	51
s	S	10010010	222	22
t	T	00010011	23	23
u	U	10010100	224	24
v	V	00010101	25	25
w	W	00010110	26	26
x	X	10010111	227	27
y	Y	10011000	230	30
z	Z	00011001	31	31
0	→ (right arrow)	00010000	20	20
1	" (double quotes)	00000001	01	01
2	' (single quote)	00000010	02	02
3	~ (not)	10000011	203	03

Character		Holes	FIO-DEC	Concise
Lower	Upper	87654321	Code	Code
4	▷ (implies)	00000100	04	04
5	∨ (or)	10000101	205	05
6	∧ (and)	10000110	206	06
7	< (less than)	00000111	07	07
8	> (greater than)	00001000	10	10
9	↑ (up arrow)	10001001	211	11
(	[	00101111	57	57
)	]	10101101	255	55
-	(non-spacing overstrike and vertical)	10101110	256	56
-	+ (minus and plus)	00101100	54	54
.	- (non-spacing middle dot and underline)	00100000	40	40
,	=	10011011	233	33
.	× (period and multiply)	00111011	73	73
/	?	10010001	221	21
Lower Case		10111010	272	72
Upper Case		10111100	274	74
Space		10000000	200	00
Backspace		00111101	75	75
Tab		10011110	236	36
Carriage Return		10111111	277	77
Tape Feed		00000000	00	00
Red*		----	--	35
Black*		----	--	34
Stop Code		00001011	13	--
Delete		01000000	100	--

\* Used on type-out only, not on keyboard

PDP-1 FLEXOWRITER CODE

ALPHANUMERIC CODES BY CONCISE CODE

Concise Code	FIO-DEC Code	Holes 87654321	Character	
			<u>Lower</u>	<u>Upper</u>
00	00	00000000	Tape Feed	
--	100	01000000	Delete	
00	200	10000000	Space	
01	01	00000001	1 " (double quotes)	
02	02	00000010	2 ' (single quote)	
03	203	10000011	3 ~ (not)	
04	04	00000100	4 ⊃ (implies)	
05	205	10000101	5 ∨ (or)	
06	206	10000110	6 ∧ (and)	
07	07	00000111	7 < (less than)	
10	10	00001000	8 > (greater than)	
11	211	10001001	9 ↑ (up arrow)	
--	13	00001011	Stop Code	
20	20	00010000	0 → (right arrow)	
21	211	10010001	/ ?	
22	222	10010010	s S	
23	23	00010011	t T	
24	224	10010100	u U	
25	25	00010101	v V	
26	26	00010110	w W	
27	227	10010111	x X	
30	230	10011000	y Y	
31	31	00011001	z Z	
33	233	10011011	, =	

ALPHANUMERIC CODES BY CONCISE CODE CONTINUED

Concise Code	FIO-DEC Code	Holes 87654321	Character	
			<u>Lower</u>	<u>Upper</u>
34	--	----	black*	
35	--	----	red*	
36	236	10011110	tab	
40	40	00100000	• _	(non-spacing middle dot and underline)
41	241	10100001	j J	
42	242	10100010	k K	
43	43	00100011	l L	
44	244	10100100	m M	
45	45	00100101	n N	
46	46	00100110	o O	
47	247	10100111	p P	
50	250	10101000	q Q	
51	51	00101001	r R	
54	54	00101100	- +	(minus and plus)
55	255	10101101	) ]	
56	256	10101110	-	(non-spacing over-strike and vertical)
57	57	00101111	( [	
61	61	00110001	a A	
62	62	00110010	b B	
63	263	10110011	c C	
64	64	00110100	d D	
65	265	10110101	e E	
66	266	10110110	f F	

ALPHANUMERIC CODES BY CONCISE CODE CONTINUED

Concise Code	FIO-DEC Code	Holes 87654321	Character	
			<u>Lower</u>	<u>Upper</u>
67	67	00110111	g	G
70	70	00111000	h	H
71	271	10111001	i	I
72	272	10111010	Lower Case	
73	73	00111011	. x (period and multiply)	
74	274	10111100	Upper Case	
75	75	10111101	Backspace	
77	277	10111111	Carriage Return	

\* Used on type-out only, not on keyboard