

## PUNCHED PAPER TAPE ENTRY TO G-15

Many devices exist in various forms which are currently used for preparation of data for subsequent electronic digital computation. One of the most efficient methods is to prepare the data in the form of punched paper tape for high speed entry to an electronic digital computer.

Information is buffered upon entry to the G-15 and transferred to the main memory in blocks four words (116 binary bits) long. Data is accepted one character at a time and stored in a 116 bit register. Most character codes occupy 4 bit positions; - however, the sign is entered as a one bit code. As the characters are entered they may be considered to appear at the right hand end (least significant digit position) of the register and slide or shift to the left as the succeeding characters are entered. This process may be halted at any time and the information transferred to main memory, line 19.

In Figure 1 is an illustration showing all the codes which can be punched on standard 5/8" wide punched paper tape. The codes are divided into three groups which have been numbered 1, 2, and 3.

- a. The first group of characters are the standard decimal characters zero through nine.

<u>G-15 Number Codes</u>	Tape Code			
	5	4	3	2 1
0	0			o
1	0			o o
2	0			o o
3	0			o o o
4	0			o o o
5	0			o o o o
6	0			o o o o
7	0			o o o o o
8	0 0			o
9	0 0			o o

- b. This group in reality is considered by the computer in the same category with the decimal characters, the two groups comprising a set of 16 characters or codes which are called hexadecimal characters.

<u>G-15 Number Codes</u>	Tape Code			
	5	4	3	2 1
U	0 0			o o
V	0 0			o o o
W	0 0 0			o
X	0 0 0			o o
Y	0 0 0			o o o
Z	0 0 0			o o o o

- c. These characters are considered by the computer as operation codes resulting in various types of operation within the computer. Each of the characters will be described in detail later.

#### G-15 Control Codes

Minus Sign	o o 0
Carriage return	o o
Tabulate	o o o
Stop	0 o
Reload	0 o 0
Period	0 o o
Wait	0 o o o
Space	(Blank)

The number codes are self-explanatory. They represent the digits in the base 16 number system. For purely decimal input, only the first ten codes, 0-9 are used.

#### FORMAT OF THE TAPE:

In creating a tape by some off-line unit for use by the G-15 input circuits, it is necessary to follow certain rules as follows:

- a. Numerical information may be punched on the tape as a series of characters chosen from the 16 numerical codes described as (a) and (b) above. If the information is decimal the first group is all that is used. If a given quantity is made up of a number of decimal digits to be punched on the tape the most significant digit should be punched first, or punched so that the computer reads it first, and the least significant digit last.
- b. If the quantity is represented by a series of binary digits, they must first be split in groups of four binary digits, each group referred to as a sexadecimal digit. The groups are then punched on the tape as sexadecimal characters, most significant digit first as in decimal.
- c. If a given quantity has a plus or minus sign associated with it, the sign may be entered either as just another binary bit in some sexadecimal digit, or a sign character may be created. If the sign is negative, the negative character in (c) above must be used; if the sign is positive, it may be left out all together or a space code (in section c. above) may be used. When reading the space code the computer does nothing; it does not recognize a space code. Following the use of a sign code, a CR (Carriage Return) code or tab code must be inserted before the next sign code, reload code or stop code is entered. The CR or tab codes may be entered before any other characters or at any time following other characters.

- d. There is a limit of 29 hexadecimal digits that can be entered in succession without the use of reload code shown in the third group above (c). Less than 29 hexadecimal digits may be entered but a lower limit of 21 characters of all types exists if the tape being prepared is to be read on the Bendix photoreader.
- e. The characters which comprise each group of 21 to 29 characters may represent more than one quantity at the discretion of the person designing the equipment to produce the tape.
- f. A maximum number of 27 reload codes (27 groups of 29 hexadecimal characters) may be entered into the computer at one time at the end of which a stop code must be used. This stop code is normally substituted for the last reload code in the block. It is possible to eliminate the use of reload codes altogether if a stop code is used in lieu of the reload code.
- g. If the tape is to be read on the Bendix photoreader, a length of blank tape must follow the stop code. This blank tape or leader must be at least four inches long and if the blocks are fairly long, at least 6 inches of leader must be left.
- h. The character for decimal point is not recognized by the computer as a meaningful character.
- i. The character labeled "wait code" is recognized by the computer as a zero code. In other words, a zero character has two possible codes.

In certain instances, it is desirable to create the tape in reverse order from that in which the computer will read the tape. For example, it may be desirable to punch the least significant digit first. This has been done and the rules to follow are in general in reverse order from those mentioned above. The stop code is punched first and then the least significant digits, etc. CR and tab codes must precede sign codes.

Since a five hole code can exist in 32 combinations of which only 24 have been discussed, the remaining codes may under certain conditions be used to signal other equipment.

The following notes apply:

1. The fifth hole punched signals numerical input, and all 16 of these codes are used.
2. Absence of fifth hole signals control codes. The eight control codes do not use the fourth hole and, presence or absence of 4th hole punch does not alter the effect of the code. Therefore the fourth hole may be used as an independent signal to other equipment reading G-15 tapes.

In particular, the following three codes may be used without affecting the G-15.

5 4 3 0 2 1

0 0  
0 0 0  
0 0 0 0

Thus using the normal photo-electric tape reader on the G-15, the following precautions to tape format apply.

- a. Stop codes should be followed by 6" blank tape.
- b. A Reload or Stop Code should not appear less than 20 codes (2" of tape) from a preceding reload code. (This is because a reload or stop code signals transfer from the 4 word buffer register to Main Memory, and random access to Main Memory may not occur oftener than 16 times per second from this register).
- c. Only the 116 bits of information, usually represented by 28 four bit number codes and 4 one bit sign codes, immediately preceding a reload or stop code will be transferred to Main Memory. Extra bits beyond this number are lost.

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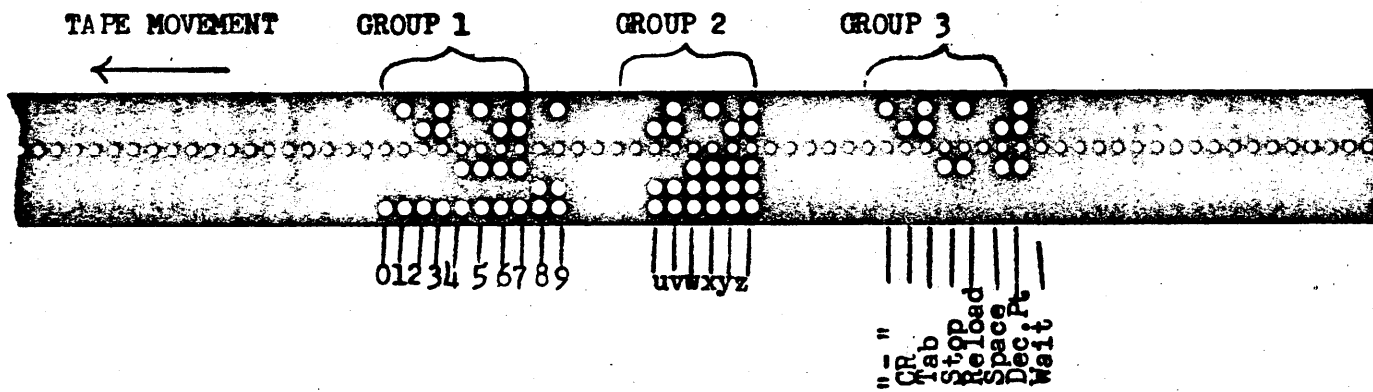


FIGURE 1