IBM

Customer Engineering

Manual of Instruction

1620

Data Processing System, Model 2

1626 Plotter Control Unit

1627 Plotter Feature

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CONTENTS

IBM 1626 Control Unit and
IBM 1627 Plotter Models 1 and 2

INTRODUCTION

This additional Features Manual describes the 1620 I/O circuitry as it applies to the IBM 1626-1627. A complete description of the IBM 1626 Plotter Control Unit and the IBM 1627 Model 1 and Model 2 Plotters is contained in the IBM Customer Engineering Instruction Reference Manual, Form 227-5721.

The 1626 Control Unit is connected between the 1620 and 1627. As such it accepts 1620 output data and translates it into appropriate plotter commands. The 1626 is designed to accept output data in the paper tape code format. Thus, the 1626 is connected to the 1620 paper tape punch output channel. This fact precludes the use of the IBM 1621 in conjunction with the IBM 1626-1627.

OPERATION

Data from 1620 core storage is transferred serially (by digit) to the 1626 where it is translated into 1627 commands. These commands are then converted into drawing movements by the 1627 Plotter.

The actual recording is produced by incremental movement of the pen on the paper surface (y-axis) and by incremental movement of the paper under the pen (x-axis). The pen is mounted in a carriage that travels horizontally across the paper as viewed from the front of the plotter. The vertical plotting motion is achieved by rotation of the pin feed drum, which also acts as a platen (Figure 1-1).

The drum and the pen carriage are bi-directional; that is, the paper moves up and down and the pen moves left and right. Control is also provided to lower the pen or raise the pen from the paper surface. The pen remains in the up or down state until directed to change to the opposite status.

The drum and pen-carriage movements and the pen status are controlled by digits transferred to the 1626 Plotter Control Unit by a 1620 output instruction. Each digit is decoded into a directional signal and relayed to the 1627 Plotter. Each signal to the plotter causes a 1/100" incremental movement of the pen carriage and/or paper, or pen up or a pen down movement. The motion or action resulting from each digit in the output record is shown in Figure 1-2.
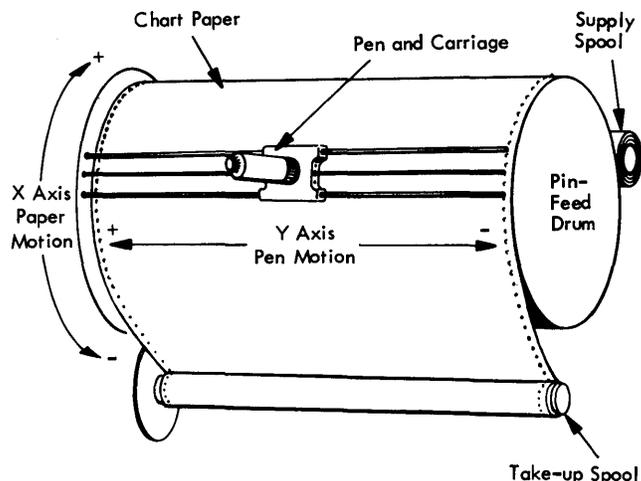

Figure 1-1. Paper and Pen Motions

Instructions

The plotter is controlled by the following instructions:
  * Dump Numerically, Op Code 35
    Write Numerically, Op Code 38
    Write Alphamerically, Op Code 39

The P-address of the instruction defines the high-order core storage position of the output record. The plotter is selected by Q_8Q_9 digits of 02. Op codes 38 and 39 are terminated by a record mark or a group mark. Op code 35 is terminated by the output of the last position of a core storage module (output of data at address 19999, 39999, or 59999).

Positive or negative numerical characters, in either one-digit numerical form or two-digit alphameric form may be used in the output record. The use of other characters can cause either conflicting commands or no command to be sent to the plotter. Only the absolute value of the digit is translated as a plotter command (the sign does not affect the direction of plotter action. Table 1)

* If Op Code 35 is used, there should be no record marks in the data transmitted to the 1626. Record marks cause conflicting plotter commands.

2   3   4

+x

+y   -y

1   5

-x

8   7   6
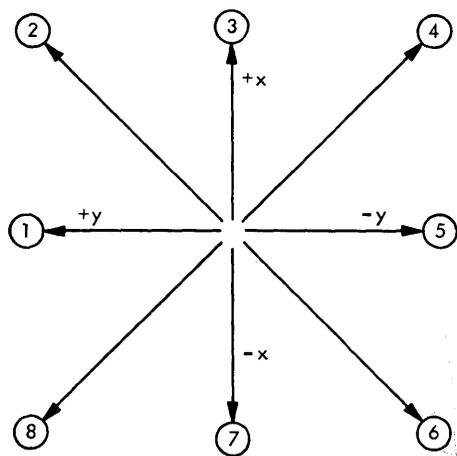
Pen
9 - Raise Pen
0 - Lower Pen

NOTE: The encircled numerical figures are the 1620 characters
that correspond to the indicated direction of plotting movement
as viewed from the front of the plotter. Normally, graphs are
plotted so that their horizontal axes are, in reality, the X axis
as shown above.

Figure 1-2.   Output Record Control Digit

Table 1.   Proper Output Characters

Numerical Character Op Code 35 or 38	Alphameric Character Op Code 39	Plotter Action
0, $\bar{0}$	70	Lower Pen
1, $\bar{1}$	71, 51	+y Increment
2, $\bar{2}$	72, 52	+x, -y Increment
3, $\bar{3}$	73, 53	+x Increment
4, $\bar{4}$	74, 54	+x, -y Increment
5, $\bar{5}$	75, 55	-y Increment
6, $\bar{6}$	76, 56	-x, -y Increment
7, $\bar{7}$	77, 57	-x Increment
8, $\bar{8}$	78, 58	-x, +y Increment
9, $\bar{9}$	79, 59	Raise Pen

Operating Modes

An output record of 3's or 7's produces a paper move-
ment by the plotter along the x-axis. An output record
of 1's or 5's produces a pen movement by the plotter
along the y-axis. The digits 2, 4, 6, or 8 in an out-

put record produces simultaneous motion of paper and
pen which results in a diagonal movement (Figure 1-2).
The distance moved diagonally is 1.4 times a hori-
zontal or vertical movement.

Single Character (Overlap) Mode

The P-address of a write instruction can refer to any
size record, but by using single-character records,
each successive increment can be computed while the
previous increment is being drawn. In this manner,
1620 computation instructions for the next increment
or other processing are "overlapped" with plotting
operations.

For example, a Write Numerically instruction
and a data record consisting of the digit five followed
by a record mark (5 ‡) produces the result shown in
Figure 1-3. This operation requires 3.3 miliseconds
(ms) for the 1627, Model 1, or 5 ms for the 1627,
Model 2. However, the 1620 CPU is not held up, but
is disconnected and allowed to proceed to the next in-
struction 200 microseconds (μ sec) after the write
plotter instruction is initiated.

If a second 1620 plotter instruction is attempted
before completion of a previous plotter operation, the
1620 waits until the plotter can accept the next com-
mand. Plotter instructions that occur more than 3.3
ms apart, operate the plotter properly, but at less
than the maximum rate of 300 increments per second
(1627 Model 1 speed). Both 1627 models require 100
ms for pen status change (0 or 9 in the output record).

1/100"

Start   Finish

(assume pen in down status)
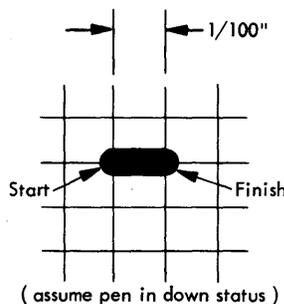
Figure 1-3.   Plotter Result for Data of 5 ‡

Multiple Character Record (Nonoverlap) Mode

When a record in core storage consists of more than
one character, only the last character can be over-
lapped with processing. For example, a record con-
sisting of 05555922077779‡ is translated as follows:
lower pen, move pen four increments in the -y direc-
tion, raise pen, move two increments diagonally (+x,
+y), lower pen, move drum four increments in the -x

(paper-up motion) direction, raise pen. The plotter result is shown in Figure 1-4.

In the foregoing example, the 1620 will interlock (wait for the plotter). The duration is approximately 330 ms with the 1627 Model 1 Plotter or 350 ms with the 1627 Model 2. Timing is computed as shown in Table 2.

Motion during time pen was raised.

1/100"

Start

Finish
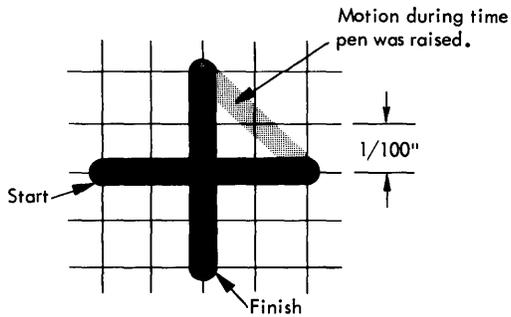
Figure 1-4. Plotter Result for Data of
05555922077779‡

Table 2. Timing

Output Record Characters	1627-1 Plotting Time	1627-2 Plotting Time
0	100 ms	100 ms
5555	13	20
9	100	100
22	7	10
0	100	100
7777	13	20
9	0.3* ms	0.3* ms
	333.3 ms	350.3 ms

*Approximately 99.7 ms are available for 1620 processing before the 1627 can act on another plotting instruction.

WRITE NUMERICALLY (CODE 38-WN)

The 1626 block diagram for Op Codes 35, 38, and 39 and the function charts contained in the 1620 System Diagrams are used to supplement the following circuit description.

Objective

- Transmit numerical information, including flag bits, from the memory location designated by the P-address (OR-2) and successively higher memory locations to the output device specified by the Q_8 and Q_9 digits of the instruction.

Functions

During I-cycles, the Q_8 and Q_9 digits of the instruction are placed in the Digit/Branch register and decoded to specify the output device. The plotter is specified by 02.

The digits of output data are transmitted serially from the memory location designated by the P-address (OR-2) and successively higher memory locations to the selected output device. Flag bits in memory with digits of output data are recorded with the digits by the output device.

Alphabetic characters, special characters, and numerical characters that have been stored in memory as two adjacent digits because the computer was in alphameric mode, are recorded by the output device as two numerical digits.

The write operation leaves output data unchanged in memory.

Transmission of a numerical character of output data to the plotter requires plotter motion corresponding to the paper tape code for the specific digit.

The Write Check latch is turned on when the following condition exists:

A character with incorrect parity is presented to the output device by the output translator.

If the Write Check latch is turned on with the plotter as the output device, the plotter is stopped after the corresponding plotter motion is complete.

With the plotter as the output device, the write operation is terminated by one of the following:
1. Sensing a record mark from memory. Termination of the write operation directs the computer to enter the I-cycles for the next instruction in sequence.
2. Pressing the Release key on the console. The write operation is terminated immediately, and the computer stops. Pressing the Start key on the console is then required to restart the computer.

Circuit Objectives

Write Latch (11.83.03.1-10.01.51.1).
1. Turned on by I-6.
2. Turned off by I/O Exit (Record Mark detected).
3. Block "Run Clock" control.
4. Turn on (T17D2) I/O Memory Control latch during I-6 time.

I/O Memory Control A (11.83.08.1-10.01.53.1).
1. Turned on by the following:
   a. Write Latch (T1702) during I-6 time to set first output character into MBR.
   b. Response Gate latch for second and subsequent output characters.
2. Turned off during the cycle following its turn on.
3. Turn on Run Clock latch for one machine cycle.
4. Read OR-2.
5. Write OR-2 incremented 1.
6. Turn on Character Gate latch.
7. Gate Output Translator to allow the select channel digit to punch on the paper tape punch.

I/O Memory Control Latch B (11.83.08.1-10.05.53.1).
1. Turned on by I/O Memory Control Latch A (T11D4).
2. Turned off during following cycle (T2D3).
3. Turn on Write Check latch if an even parity character is detected.
4. Develops a service response to turn on the Go latch when the output character is available in MBR.

Go Latch (11.82.12.1-10.01.68.1).
1. Turned on by service response (I/O Memory Control B).
2. Turned off by P3 Response.
3. Gates the output translator.

Response Gate Latch (11.83.16.1-10.01.53.1).
1. Turned on by a P3 response signal from the plotter.
2. Turned off (T2D3) during the cycle following its turn on.
3. Raise I/O response to turn on I/O Memory Control latch if Write latch is still on (record mark not yet detected).
4. Turn on Release latch if a record mark is detected on the select channel.

Release Latch (11.11.08.1-10.01.49.1).
1. Turned on by a Response Gate latch during a plotter write operation when a record mark (punch EOL) character is detected on the select channel.
2. Turned off by I-cycle Reset.
3. Turns off Write Latch to block further writing of data.

Write Check Latch (11.83.24.1).
1. Turned on by the write VRC error circuits if an even number of bits are presented to the output translator.
2. Turned off by either of the following conditions:
   a. Depression of Check Reset key on console.
   b. When tested by a Branch Indicator or Branch No Indicator operation.
3. Turn on the Write Check light.
4. Gate Write Check indicator circuits that can be tested to cause branching.

DUMP NUMERICALLY (CODE 35--DN)

The 1626 block diagram and the function charts in the 1620 Systems Diagrams are used to supplement the following circuit description.

Objectives

● Transmit numerical information including flag bits and record marks, from memory starting at the location designated by the P address (OR-2) and continuing through location 19999.

Functions

The Dump Numerically operation, Code 35, differs from Write Numerically operation, Code 38, only as follows:
1. Sensing of a record mark in memory does not terminate the dump operation. (Record marks in memory cause conflicting plotter commands.)
2. The dump operation is terminated when the digit in memory location 19999 has been transmitted to the plotter.

Termination of the dump operation directs the computer to enter the I-cycles for the next instruction in sequence.

The content of every memory location of the first module is recorded by the plotter if the P address of the dump instruction is 00000.

Circuit Objectives

See Write Numerically (Code 38 - WN).

WRITE ALPHAMERICALLY (CODE 39 - WA)

The 1626 block diagram and the function charts contained in the 1620 System Diagrams are used to supplement the following circuit descriptions.

Objectives

● With the computer in alphameric mode, transmit characters stored as two adjacent digits from the memory locations designated by the P-address (OR-2) and successively higher pairs of memory locations.

● Decode each two-digit memory character into the proper numerical, alphabetic, or special character.

● Record the information on the plotter.

Functions

During the I-cycles, the Q_8 and Q_9 digits of the instruction are placed in the Digit/Branch register and decoded to specify the output device. The plotter is specified by 02.

Output characters are transmitted serially from memory as two adjacent digits beginning at the memory locations designated by the P-address minus 1 and the P-address (OR-2) and continuing with suc-

cessively higher pairs of memory locations. Each 2-digit memory character is decoded into the proper numerical, alphabetic, or special character by the output translator and presented to the plotter.

The P-address of the instruction must designate the odd-numbered memory location at which the numerical digit of the first character to be transmitted is stored. The zone digit of the first character is located at the next lower memory address (P minus 1) which is an even address. Increment plus 2 is used to provide memory addresses for successive characters.

If an even-numbered memory location is erroneously designated by the P-address, data presented to the plotter is incorrect and parity errors may occur.

Output data may consist of a random mixture of numerical and alphabetic characters which exist in memory as two-digit characters. If an attempt is made to write a record containing single-digit numerical characters by means of this instruction, invalid combinations of disassociated numerical digits are the result and parity errors may occur.

Flag bits existing in memory locations from which an output record is written are not transmitted to the plotter. The write operation leaves output data unchanged in memory.

Transmission of a character of output data to the plotter requires plotter motion corresponding to the paper tape code for the specific character. A space is ignored by the plotter.

The Write Check latch is turned on when the following condition exists:

> A character with incorrect parity is presented to the plotter by the output translator.

If the Write Check latch is turned on with the plotter as the output device, the plotter is stopped after the corresponding plotter motion is complete.

With the plotter as the output device, the write operation is terminated by one of the following:

1. Sensing a record mark at an odd memory address. Termination of the write operation directs the computer to enter the I-cycle for the next instruction in sequence.

2. Pressing the Release key on the console. The write operation is terminated immediately and the computer stops. Pressing the Start key on the console is required to restart the computer.

Circuit Objectives

See Write Numerically (Code 38).

1620
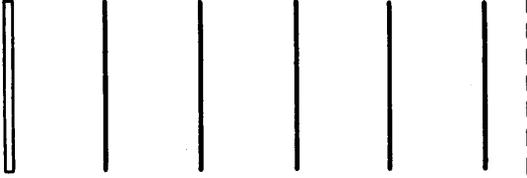
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