

A U T O N E T I C S

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RECOMP II TECHNICAL BULLETIN NO. 24

**TITLE:** THE USE OF THE RECOMP PLOTTER WITH THE  
RECOMP II.

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**PURPOSE:** To explain the operation and use of the  
RECOMP Plotter

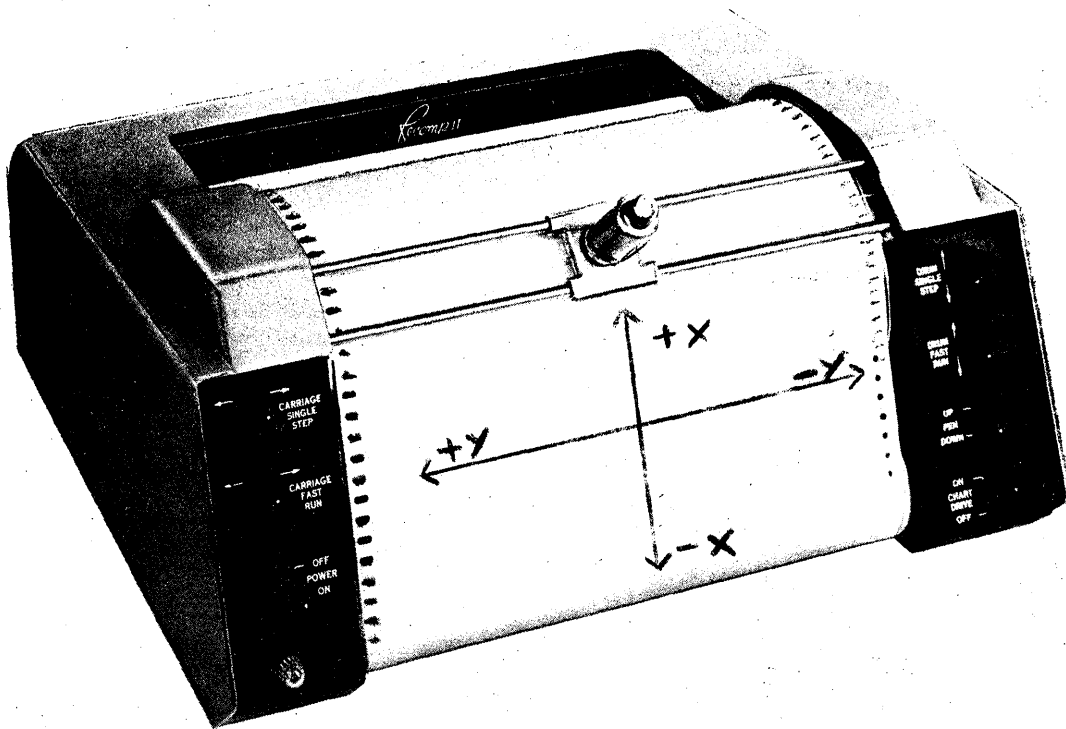
**CONTENTS:**

1. A description of the Plotter and manual controls.
2. Installation of paper.
3. A definition of Plotter coordinates.
4. Direct output to the Plotter by the RECOMP II.
5. Output to the Plotter through Adapter 560 R.
6. Subroutines for the Plotter.

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## I. A DESCRIPTION OF THE PLOTTER AND MANUAL CONTROLS

As shown in the above figure, seven operating controls and one indicator lamp are mounted on the front panel of the instrument. Their functions are described in the following paragraphs.

### 1.1 POWER ON/OFF

The power on/off switch connects 115-volt a-c power from connector J 7 on the rear panel of the recorder to the cooling fan and the power supply transformer. A neon indicator, located directly below the switch, is lighted whenever the switch is on.

### 1.2 CARRIAGE FAST RUN

The carriage fast run switch allows the pen carriage to be stepped rapidly to the left (+y) at the rate of 120 steps/second. The switch may be used to move the carriage to any desired area of the graph, or for operational checkout of the carriage control circuits and the carriage step motor.

### 1.3 CARRIAGE SINGLE STEP

The carriage single step switch allows the pen carriage to be moved in single step (1/100 inch) increments either to the left (+y) or right (-y). This control in combination with the drum single step control, permits the operator to accurately align the carriage on a point or fixed coordinate on a graph.

### 1.4 CHART DRIVE ON/OFF

The chart drive on/off switch allows the operator to disable the front and rear chart takeup motors. This permits the use of single sheets of graph paper in place of the paper rolls supplies with the instrument.

### 1.5 PEN UP/DOWN

The pen up/down switch provides a mean of manually raising and lowering the pen from the surface of the drum.

Note: When the instrument is first turned on, or when the pen is removed and replaced when the carriage is in the up position, the pen may remain down even when the switch is turned to the up position. When this occurs, turn the switch first to the down position, then to the up position.

### 1.6 DRUM FAST RUN

The drum fast run switch allows the drum to be stepped rapidly up (-x) or, down (+x), at the rate of 120 steps/seconds. The switch is used in the same manner as the carriage fast run control to move the pen to any desired area of the graph or for operational checkout of the drum control circuits and the drum step motor.

### 1.7 DRUM SINGLE STEP

The drum single step switch allows the drum to be moved in single step (1/100 inch) increments either up (-x) or down (+x). This control, in combination with the carriage single step control, permits the operator to accurately align the pen on a point or fixed coordinate on the graph.

## II. INSTALLATION OF PAPER

### 2.1 INSTALLATION OF CHART ROLL

To install a roll of chart paper in the instruments, proceed as follows:

- a. Set the power switch to off.

## 2.1 (Continued).

- b. Remove the pen assembly from the carriage by loosening the knurled nut at the bottom of the pen holder and lifting the assembly out of the carriage. CAUTION - USE CARE NOT TO DROP THE PEN ASSEMBLY OR ANY OF ITS PARTS. The assembly is constructed of soft steel to close tolerances for optimum performance.
- c. Rotate the right rear paper spool by hand until the drive key is pointed upward.
- d. Hold the new roll of chart paper so that the key slot in the core is pointing upward. Place the roll against the spring loaded left rear idler spool and force the spool to the left.
- e. Lower the paper roll into the paper well and slide the right end onto the drive spool. Make certain the drive key engages the key slot in the core.
- f. Install a paper roll core on the two front spools below the drum, in the same manner as the paper roll.
- g. Pull a short length of paper off the roll, slide the end under the carriage rods and fasten to the front side of the core with two or three short pieces of tape. Wind one or two turns of paper onto the core. Make certain the drum sprockets are properly meshed with the sprocket holes on both sides of the paper.

## 2.2

## INSTALLATION OF SINGLE SHEET GRAPH PAPER

Single sheets of paper,  $8\frac{1}{2}$  x 11 inches or 11 x 17 inches, may be used for plotting in place of the chart roll. To install a single sheet of graph paper, proceed as follows:

- a. Set the power and chart drive switches to off.
- b. Remove the pen assembly from the carriage.
- c. Slide the graph paper sheets under the carriage rods onto the drum surface.
- d. Fasten the top edge of the paper to the drum with two or three short pieces of tape. Rotate the drum by hand, keeping the paper smooth and flat against the drum surface. Fasten the bottom edge

## 2.2 (d) (Continued).

of the paper in the same manner as the top.

- e. When removing the paper, the reverse sequence should be followed and any remaining tape adhesive should be cleaned from the drum surface with acetone or a good commercial grade of cleaning solvent.

III. A DEFINITION OF PLOTTER COORDINATES

In order to describe the movement of the Plotter, an arbitrary coordinate is described as shown on the Figure on page 1.

- +x is the direction in which a line is drawn when the drum moves down.
- x is the direction in which a line is drawn when the drum moves up.
- +y is the direction in which a line is drawn when the carriage moves to the left.
- y is the direction in which a line is drawn when the carriage moves to the right.

IV. DIRECT OUTPUT TO THE PLOTTER BY THE RECOMP II4.1 SETTING OF THE PUNCH-EXTERNAL SWITCH

Impulses are given to the plotter through the use of a command which would normally cause an output to the punch. For this reason the switch located next to the punch unit on the computer desk must be rotated clockwise from the normal "punch" position to the "external" position.

4.2 A DESCRIPTION OF THE EFFECT OF THE OUTPUT COMMAND

- a. Output is 5 bits at a time through the F register.
- b. When the plotter receives this 5 bit code, the bits are given the following interpretations:

$$\begin{array}{ccccc} \frac{R/L}{5} & \frac{+Y}{4} & \frac{-Y}{3} & \frac{+X}{2} & \frac{-X}{1} \end{array}$$

Bit 1 will cause the pen to move 1 increment in the -x direction.  
Bit 2 will cause the pen to move 1 increment in the +x direction.

## 2.2 (b) (Continued).

Bit 3 will cause the pen to move 1 increment in the -y direction.

Bit 4 will cause the pen to move 1 increment in the +y direction.

Bit 5 will cause the pen to lower.

If bit 5 is not present, the pen will raise.

- c. Each output will cause the pen either to raise or to lower and simultaneously to move in a specified direction.
- d. A diagonal movement of the pen may be caused by outputting the appropriate bit in the x direction and y direction simultaneously.
- e. The length of each movement will be 1/100th inch in the direction specified. If the impulse is along a diagonal, the pen will move 1/100th inch in each direction giving a total movement of 2/100 inch.
- f. If two conflicting bits are present (e.g. 1 and 2, or 3 and 4), the action of the plotter is unpredictable.
- g. After giving a command which lowers the pen from its raised position, approximately 40 milliseconds or two disk revolutions should be allowed to elapse before moving the pen in order for the pen to have time to come in contact with the paper.

## 4.3

## A DESCRIPTION OF THE FORM OF THE OUTPUT COMMAND

- a. Below is a list of plotter commands and their effect.

<u>Command</u>	<u>Effect</u>
74 0000.0	pen up
74 0001.0	pen up -x
74 0002.0	pen up +x
74 0004.0	pen up -y
74 0010.0	pen up +y
74 0005.0	pen up -x-y
74 0011.0	pen up -x+y

4.3 (a) (Continued).

<u>Command</u>	<u>Effect</u>
74 0006.0	pen up +x-y
74 0012.0	pen up +x+y
74 0020.0	pen down
74 0021.0	pen down -x
74 0022.0	pen down +x
74 0024.0	pen down -y
74 0030.0	pen down +y
74 0025.0	pen down -x-y
74 0031.0	pen down -x+y
74 0026.0	pen down +x-y
74 0032.0	pen down +x+y

- b. Movement of the plotter may also be effected by picking up the appropriate bit pattern in the A Register and performing the command 74 776X.0 where X is the number of impulses to be output.

<u>Value of X</u>	<u>Impulses out</u>
0	8
1	1
2	2
3	3
4	4
5	5
6	6
7	7

V. OUTPUT OF THE PLOTTER THROUGH THE CALCOMP ADAPTER 560 R

5.1 SETTING THE PUNCH-EXTERNAL SWITCH

Impulses are given to the Plotter through the use of a command which would normally cause an output to the punch. For this reason, the switch located next to the punch unit on the computer desk must be rotated clockwise from the normal "punch" position to the "external" position.

5.2 A DESCRIPTION OF THE EFFECT OF THE OUTPUT COMMAND

- a. Output is 5 bits at a time through the F Register.

$\bar{5} \quad \bar{4} \quad \bar{3} \quad \bar{2} \quad \bar{1}$

- b. When the Plotter receives this 5 bit code, the following motion will result:

## 5.2. (b) (Continued).

<u>CODE</u>	<u>MOTION</u>
10001	The pen will raise
10010	The pen will lower
00011	A step in the +x direction
01100	A step in the -x direction
00110	A step in the +y direction
01001	A step in the -y direction
00111	A step in the +x+y direction
01011	A step in the +x-y direction
01110	A step in the -x+y direction
01101	A step in the -x-y direction

- c. The length of each pen movement will be  $1/100$ th inch in the direction specified. If the impulse is along a diagonal, the pen will move  $1/100$ th inch in each direction giving a total of  $2/100$ th inch.
- d. With any other bit configuration, the action of the Plotter is unpredictable.
- e. After giving the command which lowers the pen, approximately 40 milliseconds or two disk revolutions should be allowed to elapse before moving the pen in order for the pen to have time to come in contact with the paper.

## 5.3

## A DESCRIPTION OF THE FORM OF THE OUTPUT COMMAND

- a. Below is a list of the plotter commands and their effect.

<u>Command</u>	<u>Effect</u>
74 0021.0	Raise pen
74 0022.0	Lower pen
74 0003.0	+ x
74 0014.0	- x
74 0006.0	+ y
74 0011.0	- y
74 0007.0	+ x + y
74 0013.0	+ x - y
74 0016.0	- x + y
74 0015.0	- x - y

- b. Movement of the plotter may also be effected by picking up the appropriate bit pattern in the A register and performing the command 74 776X.0 where X is the number of impulses to be output:



## 5.3 b. (Continued)

<u>Values of X</u>	<u>Impulses out</u>
0	8
1	1
2	2
3	3
4	4
5	5
6	6
7	7

6. SUBROUTINES FOR THE PLOTTER

The above sections describe the basic plotter and its control. However, in order to facilitate plotting, subroutines are available which will generate an output to the plotter. Among these are:

## 6.1 AN-070 PLOTTER SUBROUTINE LINE GENERATOR (FIXED POINT)

This subroutine generates an output to move the plotter pen a given number of increments in each direction in as straight a line as possible. (The number of increments to be moved is given in fixed point notation.)

## 6.2 AN-071 PLOTTER SUBROUTINE LINE GENERATOR (FLOATING POINT)

This subroutine is the same as AN-070, except that the number of increments to be moved is given in floating point notation.

## 6.3 AN-072 POINT PLOTTER SUBROUTINE (FIXED POINT)

This subroutine accepts parameters defining a Cartesian coordinate system and generates an output to move the plotter pen to a given point in this coordinate system. The coordinates of the point are given in fixed point notation at an arbitrary binary point.

## 6.4 AN-073 POINT PLOTTER SUBROUTINE (FLOATING POINT)

This subroutine is the same as AN-072, except that the coordinates of the point are given in floating point notation.