CHAPTER 6 SOFTWARE

6.1 Drawing Sequence

To cause the GDC to execute drawing of lines, circles, rectangles, etc., the CPU must generate commands and parameters that can be interpreted by the GDC based on data obtained from a coordinate generator such as a digitizer. The CPU performs the steps which are outlined as follows:

(1) Selects line types such as solid line or broken line and selects graphics character dot information. (TEXTW command)

(2) Selects the dot modification mode such REPLACE. (WRITE command)

(3) Determines the drawing start point and calculates the drawing start absolute address. (CSRW command)

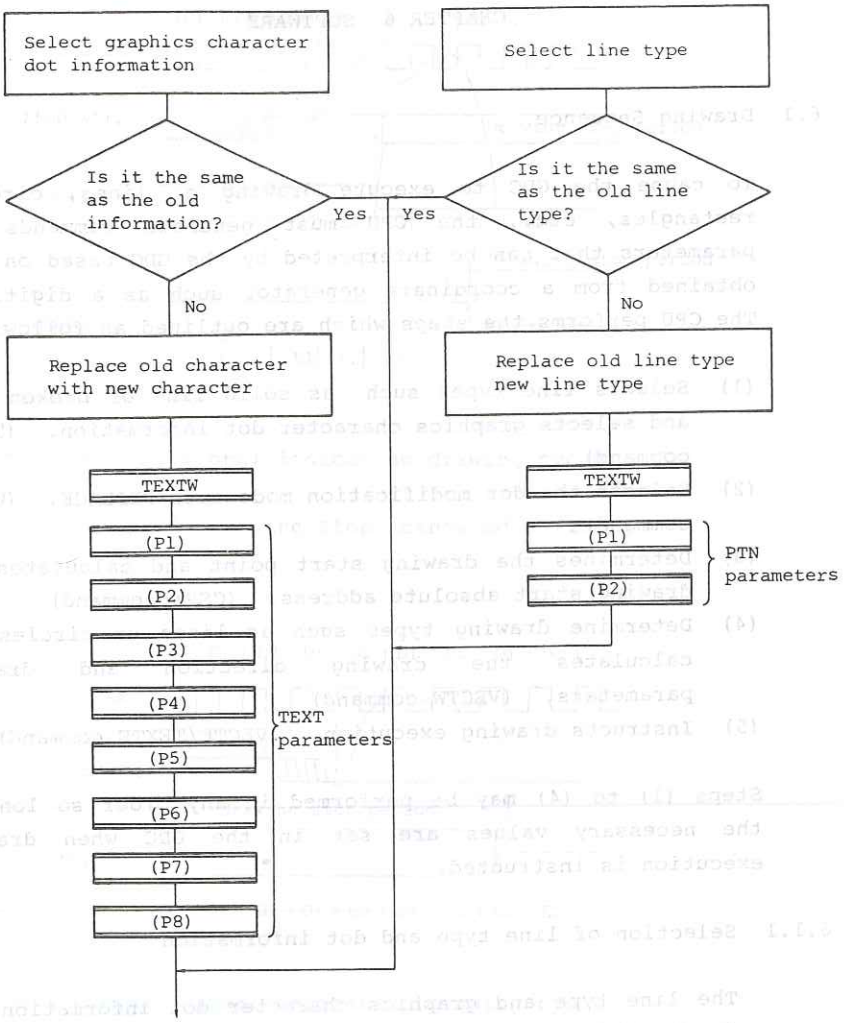
(4) Determine drawing types such as lines or circles and calculates the drawing direction and drawing parameters. (VECTW command)

(5) Instructs drawing execution. (VECTE/TEXTE command)

Steps (1) to (4) may be performed in any order so long as the necessary values are set in the GDC when drawing execution is instructed.

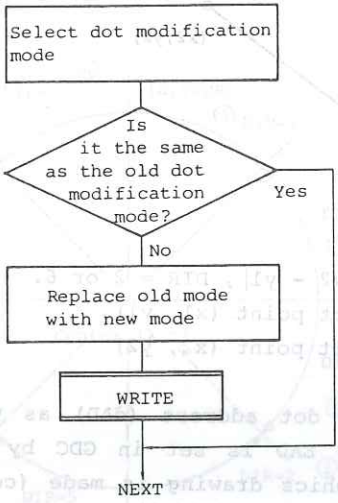
6.1.1 Selection of line type and dot information

The line type and graphics character dot information set in the GDC are stored before drawing because new values are set only when a change is made. Line type and dot information are stored in the same internal RAM. Note that old dot information is erased when a new line type is set. The total drawing speed including CPU processing time is improved by reducing the number of commands and parameters sent to the GDC.


Select graphics character dot information
Is it the same as the old information?
Yes
No
Replace old character with new character
TEXTW
(P1)
(P2)
(P3)
(P4)
(P5)
(P6)
(P7)
(P8)
TEXT parameters
Select line type
Is it the same as the old line type?
Yes
No
Replace old line type new line type
TEXTW
(P1)
(P2)
PTN parameters
NEXT

6.1.2 Selection of dot modification mode

As in 6.1.1, the old dot modification mode is stored.

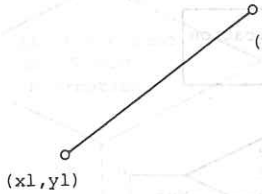


The dot modification mode is set in the low-order two bits of the WRITE command MOD. If the command is not followed by parameters, the dot modification mode is only rewritten. Thus, word, high byte, or low byte may be selected for WRITE command WLH.

6.1.3 Calculation of drawing start absolute address

Any given point is defined to be the drawing start point along with the determination of drawing direction, and the absolute address is calculated as described in 4.3.3.

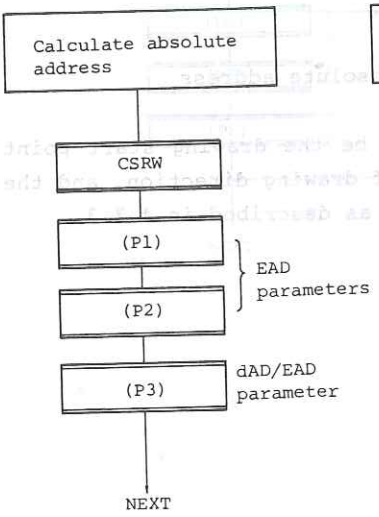
Example:



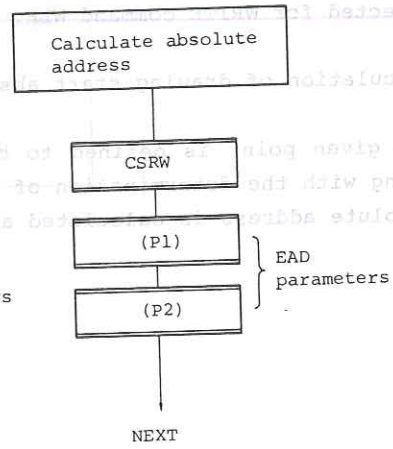
When $|X2 - X1| > |y2 - y1|$, DIR = 2 or 6.
When DIR = 2 start point (x1, y1)
When DIR = 6 start point (x2, y2)

If this example, dot address (dAD) as well as drawing execution address EAD is set in GDC by using the CSRW command when graphics drawing is made (containing TEXT). EAD is setting GDC by using the CSRW command when characters are drawn.

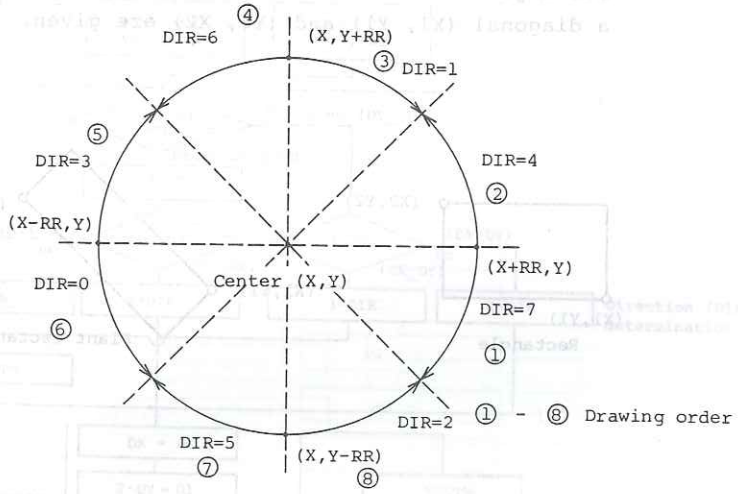
During graphics control
(dot address must be set)



During character control



When an arc or sector is drawn, the drawing start point is set at a distance of ±RR in the X direction and ±RR in the Y direction from the center coordinates (X, Y) . (RR is the radius.)



If drawing is started at the point (X+RR, Y) in direction 7 (DIR=7), the second octant is drawn starting at the same drawing point (X+RR, Y) in DIR=4, and the third octant is drawn starting at the drawing point (X, Y+RR) in direction 1. In this manner, the fourth to last octants are drawn in order as shown above.

In drawing made in this order, the direction can be easily found by incrementing by 5 or decrementing by 3.

6.1.4 Calculation of drawing direction and drawing parameters

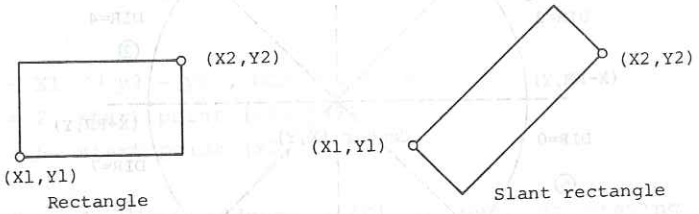
(1) Line drawing

Fig. 6-1 shows a general flow when the drawing

direction is limited to 0 to 3 in line interpolation between the two points (X1, Y1) and (X2, Y2).

(2) Rectangle drawing

Fig. 6-2 and 6-3 show the general flow for drawing a rectangle and slant rectangle when the two points on a diagonal (X1, Y1) and (Y2, X2) are given.



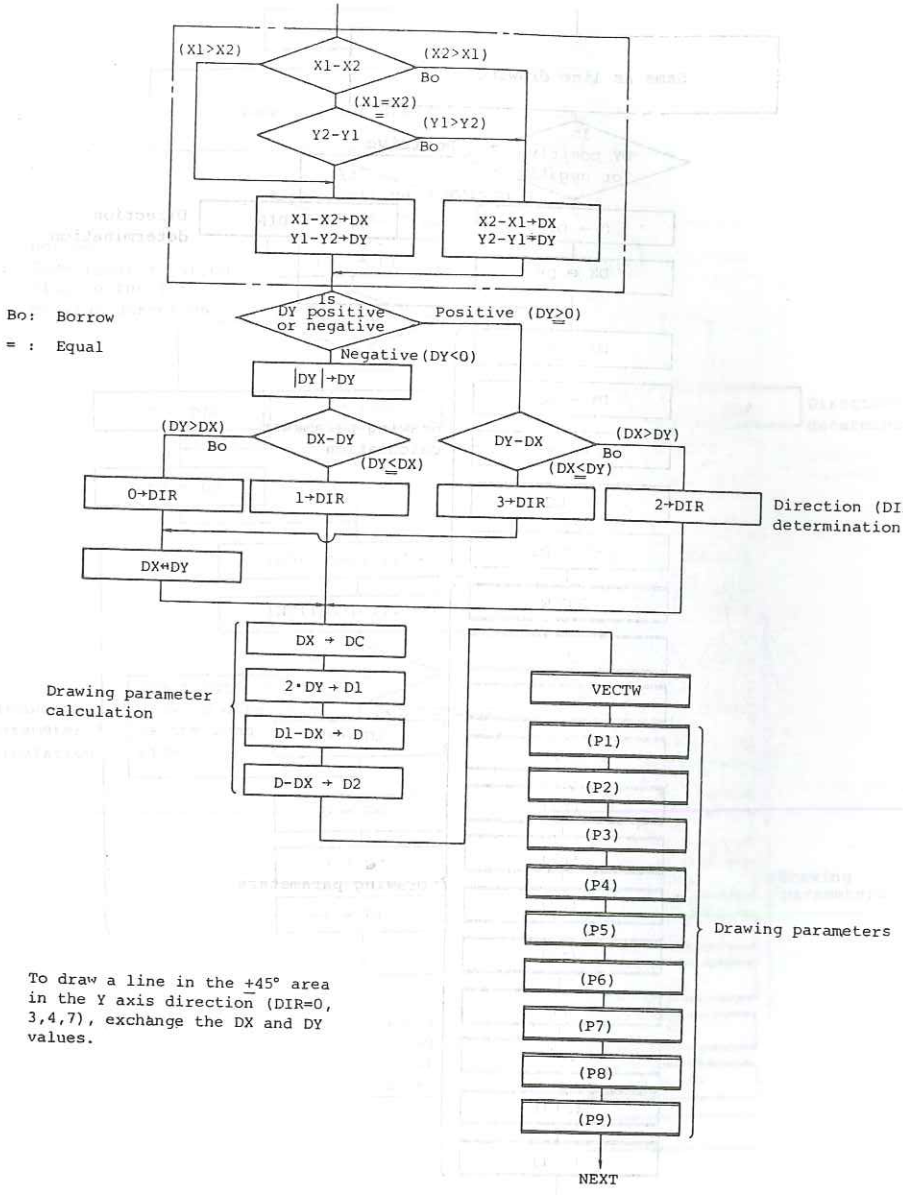


Fig. 6-1 Line Drawing

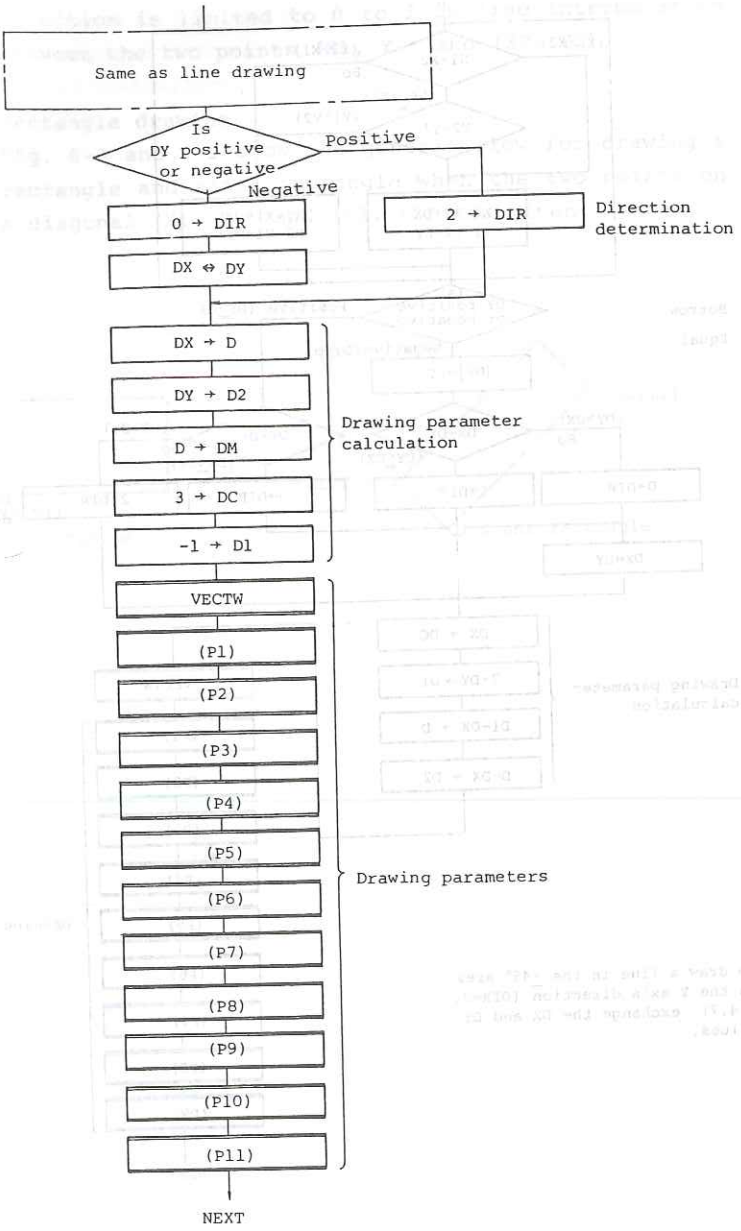


Fig. 6-2 Rectangle Drawing

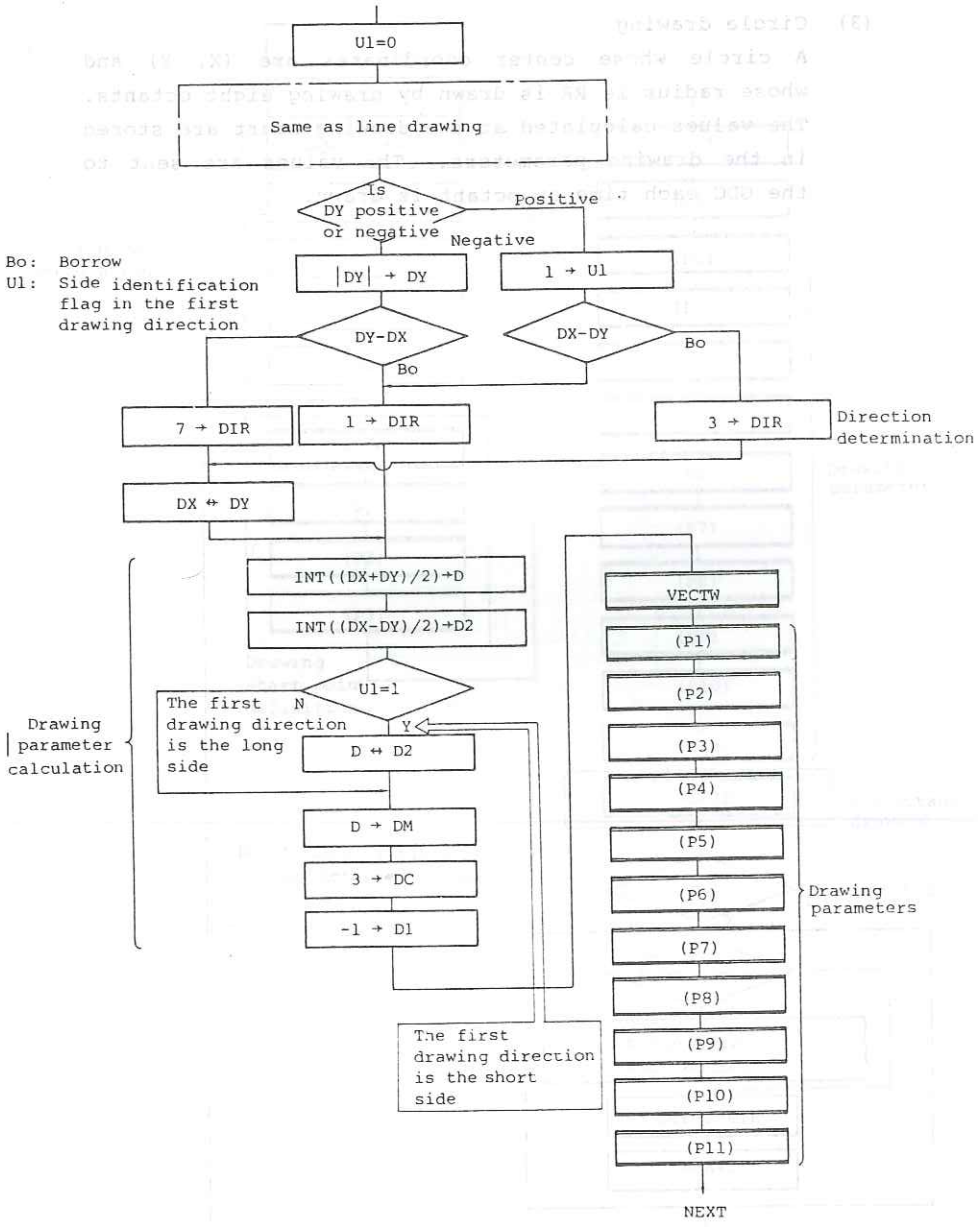


Fig. 6-3 Slant Rectangle Drawing

(3) Circle drawing

A circle whose center coordinates are (X. Y) and whose radius is RR is drawn by drawing eight octants. The values calculated at the drawing start are stored in the drawing parameters. The values are sent to the GDC each time an octant is drawn.

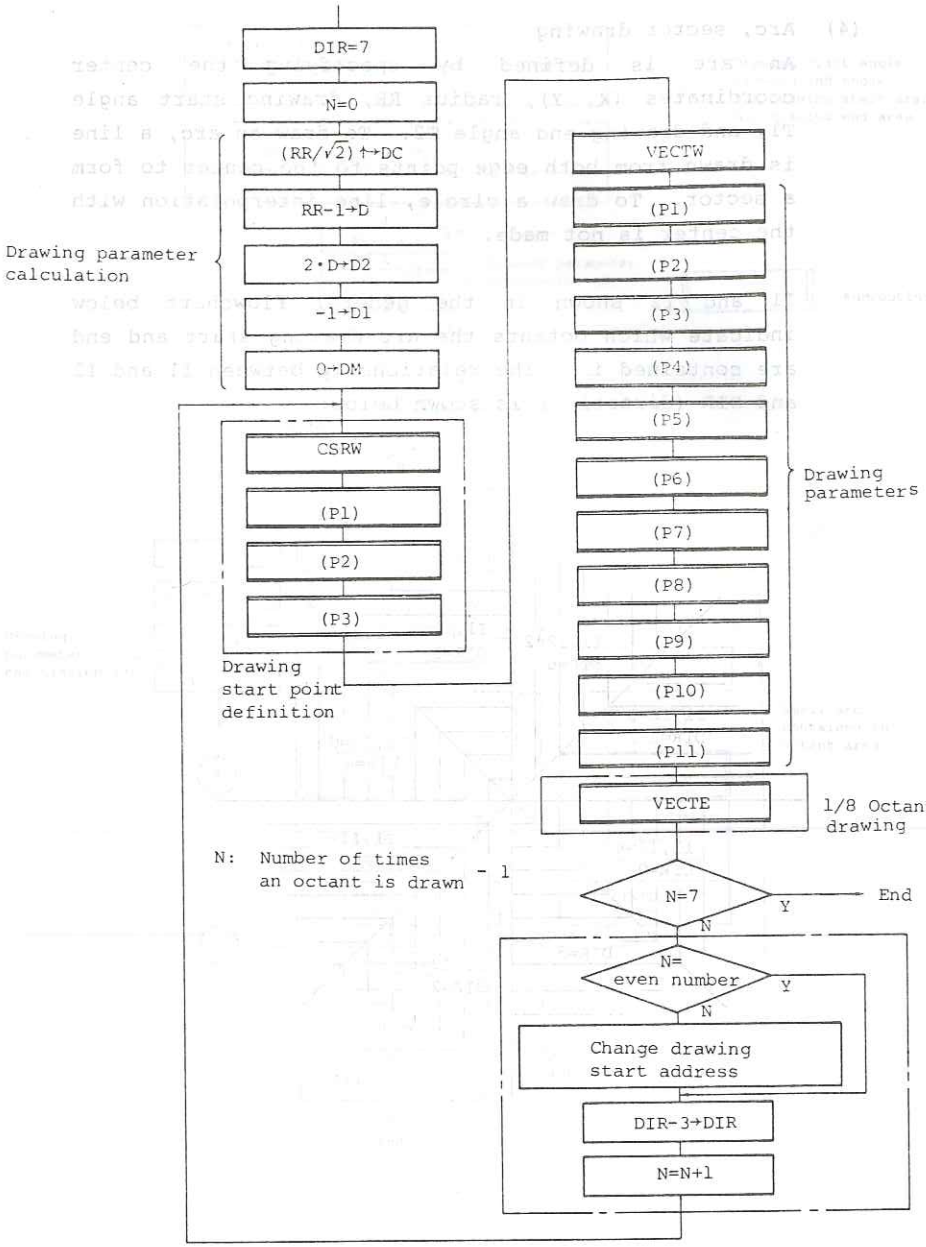
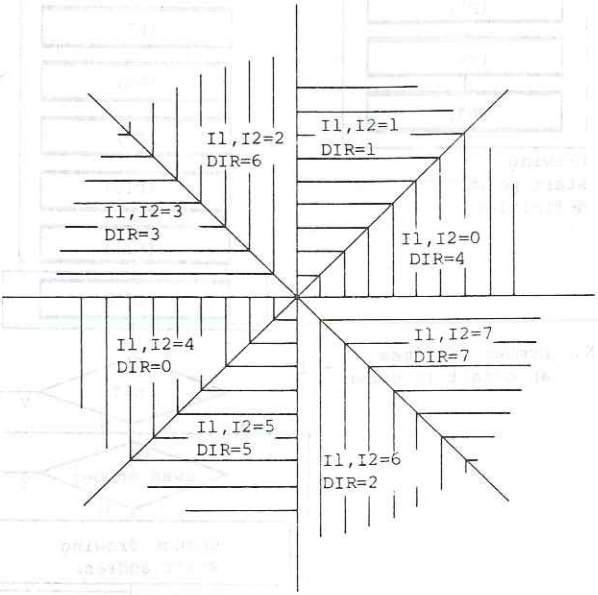


Fig. 6-4 Circle Drawing

(4) Arc, sector drawing

An arc is defined by specifying the center coordinates (X, Y), radius RR, drawing start angle T1, and drawing end angle T2. To draw an arc, a line is drawn from both edge points to the center to form a sector. To draw a circle, line interpolation with the center is not made.

I1 and I2 shown in the general flowchart below indicate which octants the arc drawing start and end are contained in. The relationship between I1 and I2 and DIR (direction) is shown below:



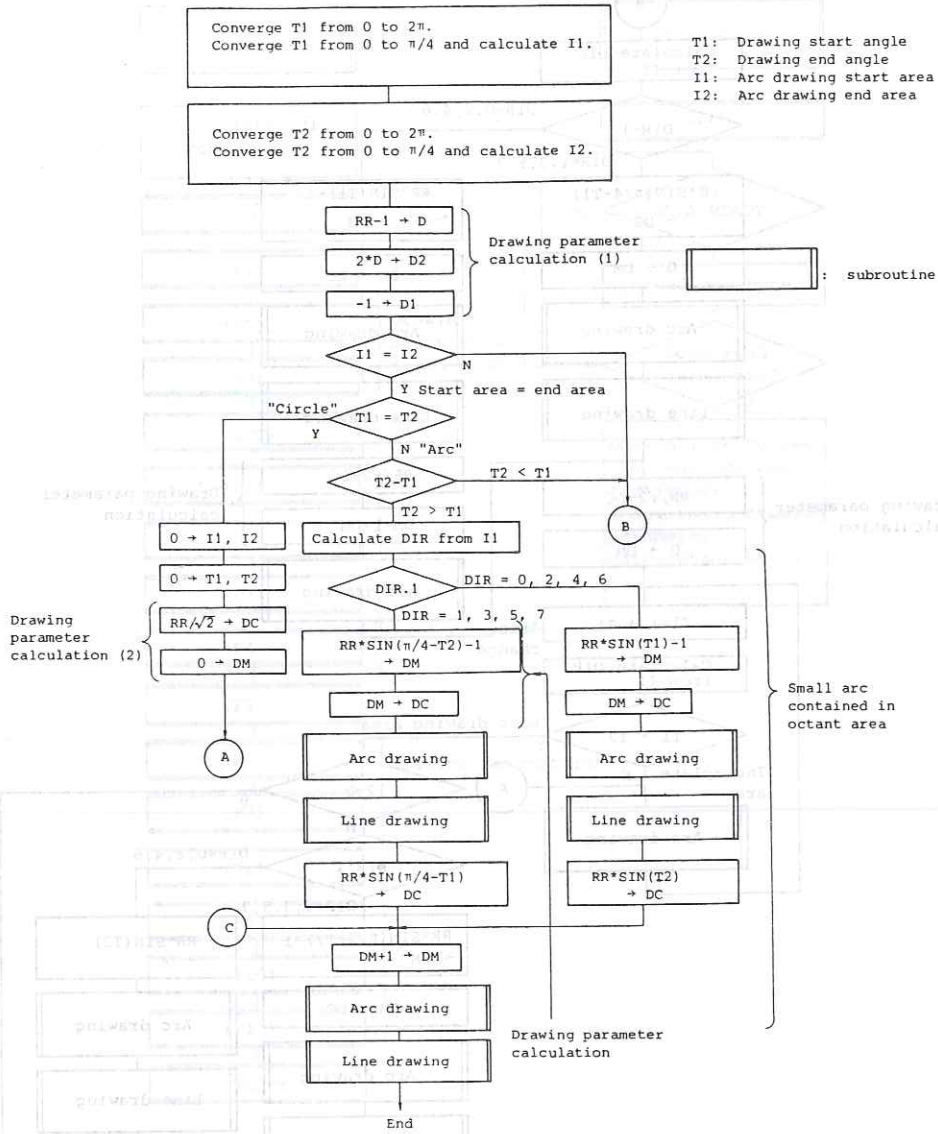


Fig. 6-5 Arc, Sector Drawing (1)

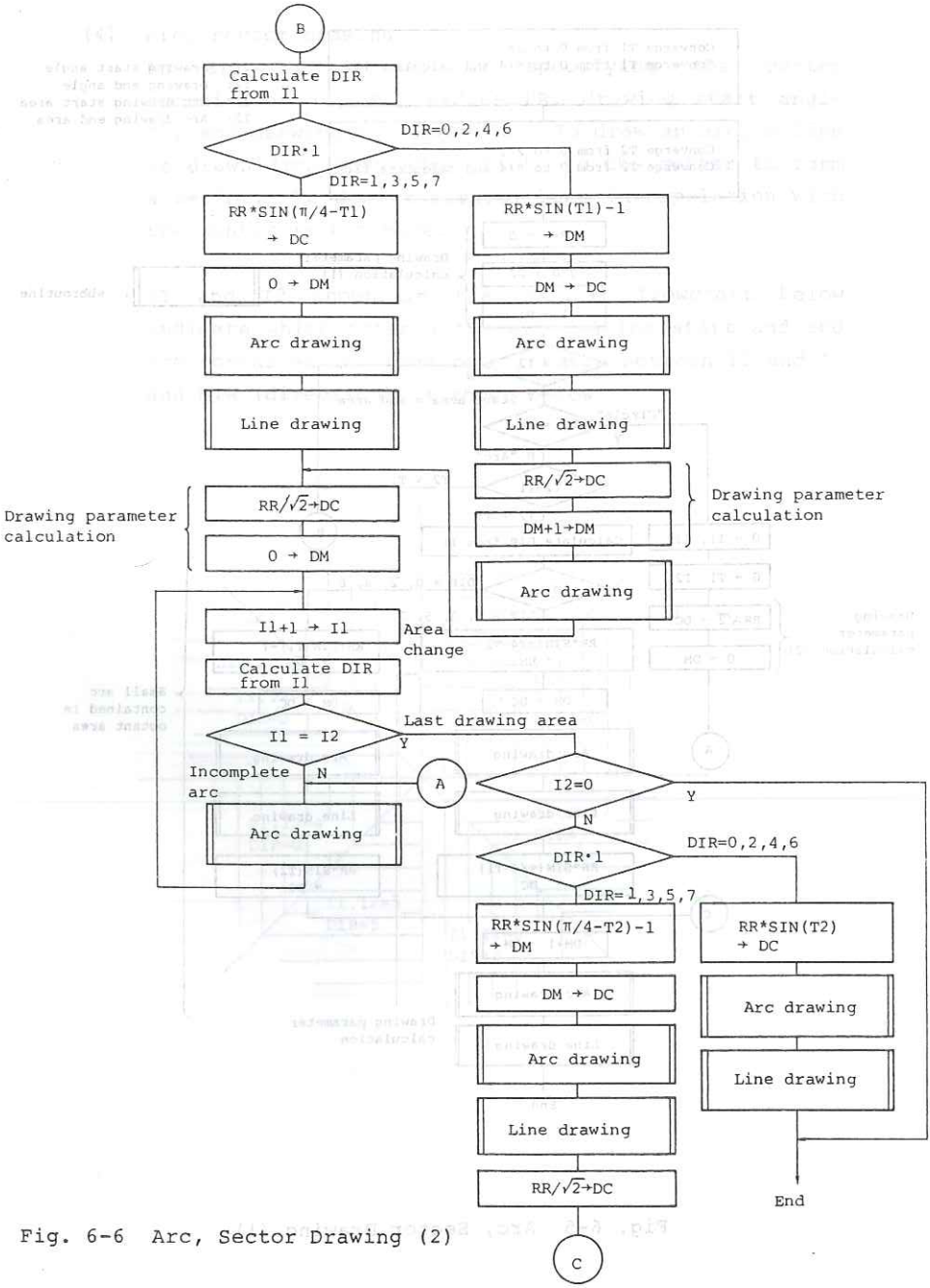


Fig. 6-6 Arc, Sector Drawing (2)

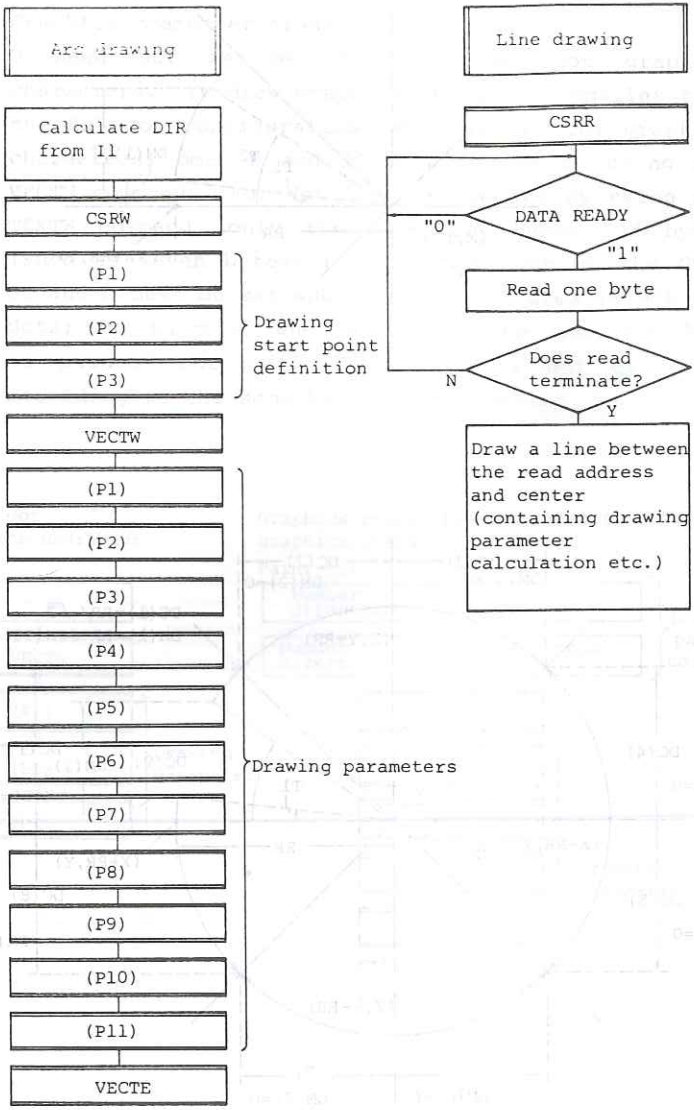


Fig. 6-7 Arc, Sector Drawing (3)

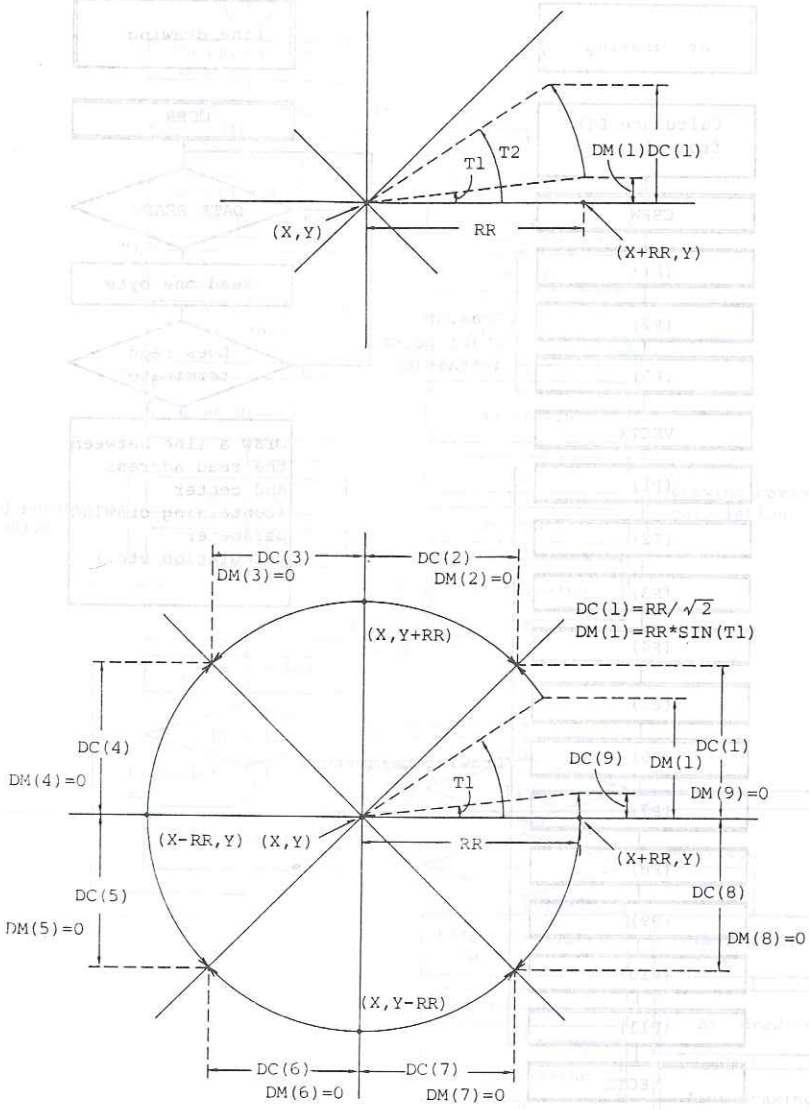
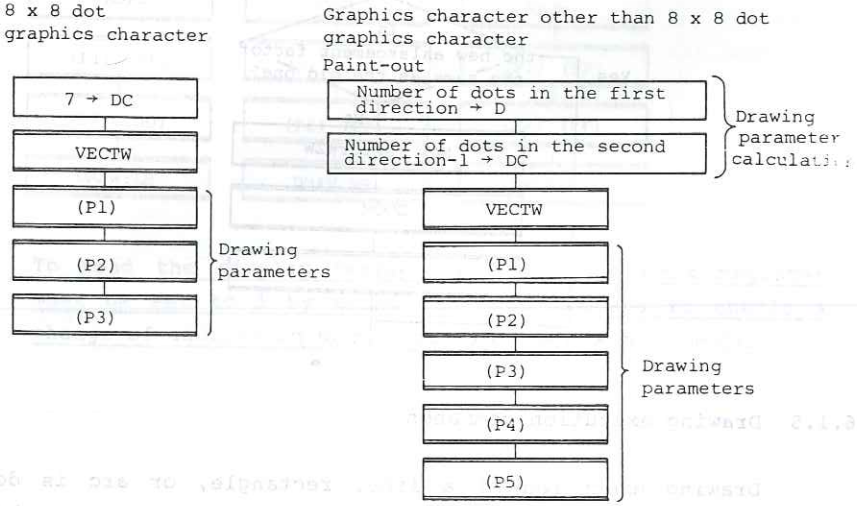
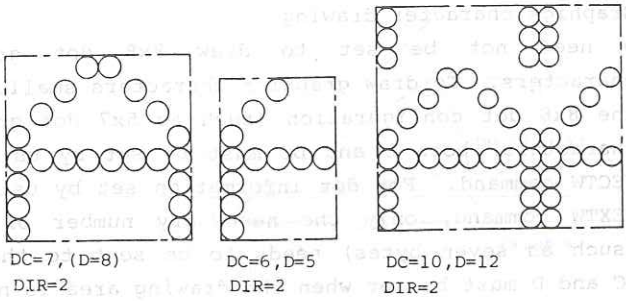


Fig. 6-8 Arc, Sector Drawing (4)

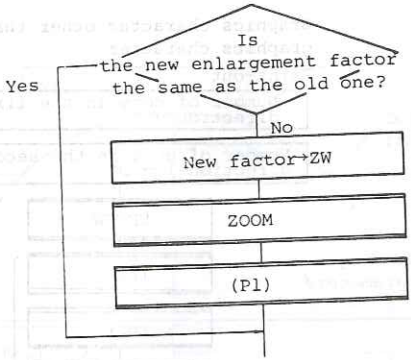
(5) Graphics character drawing

D need not be set to draw 8x8 dot graphics characters. To draw graphics characters smaller than the 8x8 dot configuration (such as 5x7 dot graphics characters) both D and DC must be set by using the VECTW command. For dot information set by using the TEXTW command, only the necessary number of bytes (such as seven bytes) needs to be sent to the GDC. DC and D must be set when the drawing area is not 8x8 dots; for example, when a larger area than 8x8 dots is painted out in a form such as dot or hatch according to the same 8x8 dot information.





Graphics character drawing can be enlarged. The enlargement factor is set in the GDC only when it is changed.



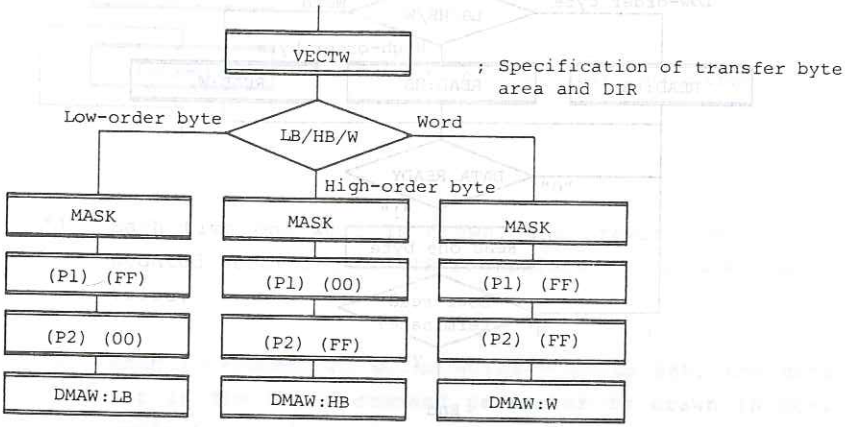
6.1.5 Drawing execution commands

Drawing execution of a line, rectangle, or arc is done by using the VECTE command. Drawing execution of graphics characters is done by using the TEXTE command.

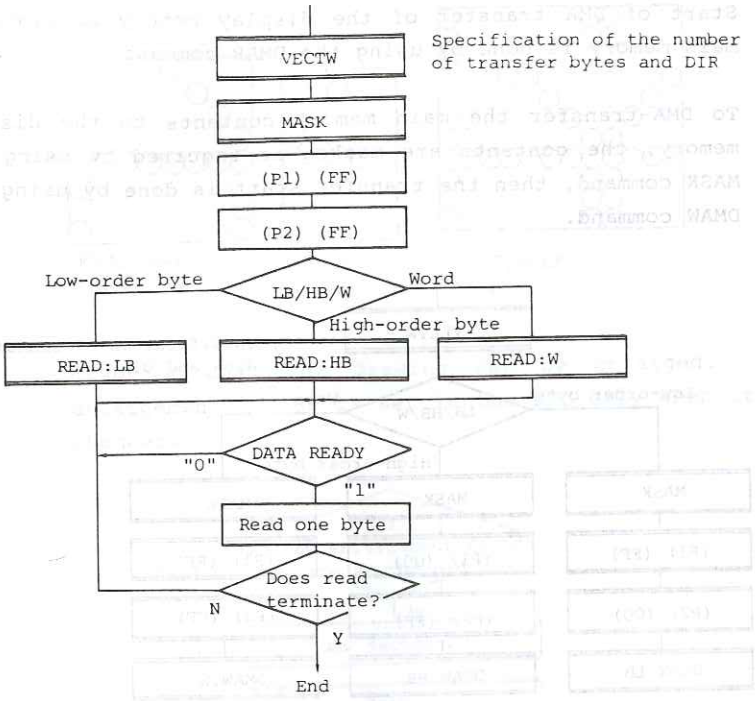
To draw a character code in the character mode (write into the display memory), drawing execution is done by inputting a parameter (character code) following the WRITE command.

Start of DMA transfer of the display memory contents to main memory is done by using the DMAR command.

To DMA-transfer the main memory contents to the display memory, the contents are masked as required by using the MASK command, then the transfer start is done by using the DMAW command.

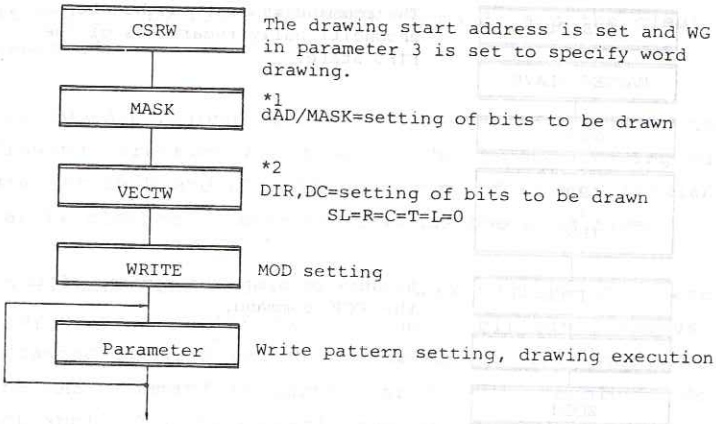


To read the display memory contents, the mask register must be set to 1 by using the MASK command to enable a change of address in word units in the graphics mode.



6.1.6 One word drawing in graphics mode

Writing any desired pattern in word units in the graphics mode is enabled as in the character mode by setting CSRW command WG to 1.

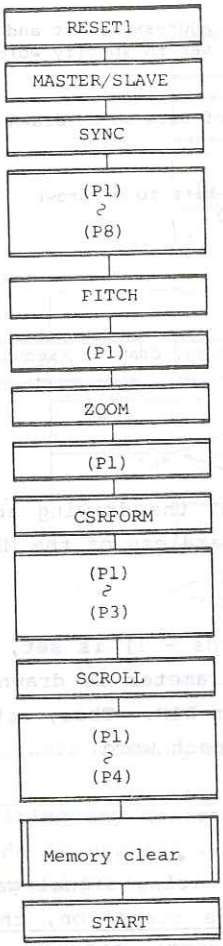


*1 Each time one word is drawn, the drawing address is updated according to DIR regardless of the MASK setup value.

*2 When (DC=number of write words - 1) is set, the data set in the WRITE command parameter is drawn in DC+1 words in the direction set in DIR. Thus, set DC to 0 to write different data for each word.

6.2 Initialization Flowchart

All parameters required for synchronizing signal generation and display are set. When power is turned on, the output pin state is undefined until the RESET1, RESET2, or RESET3 command is issued. The RESET1, RESET2, or RESET3 command is sent to the GDC unconditionally without detecting the FIFO state.



The command is sent to the GDC unconditionally regardless of the FIFO state.

Be sure to place the command after the SYNC command.

When the screen is split, increment parameters according to the number of areas into which the screen is split.

Output the command during VBLAND

6.3 Display Memory Clear Flowchart

This section describes one-dimensional clear during character control by using the WRITE command and two-dimensional clear during graphics control when graphics characters are drawn. For the one-dimensional clear, the number of clear words is set in DC. Memory of up to 16K words can be cleared by sending commands one at a time. To clear memory that exceeds 16K words, the clear start address

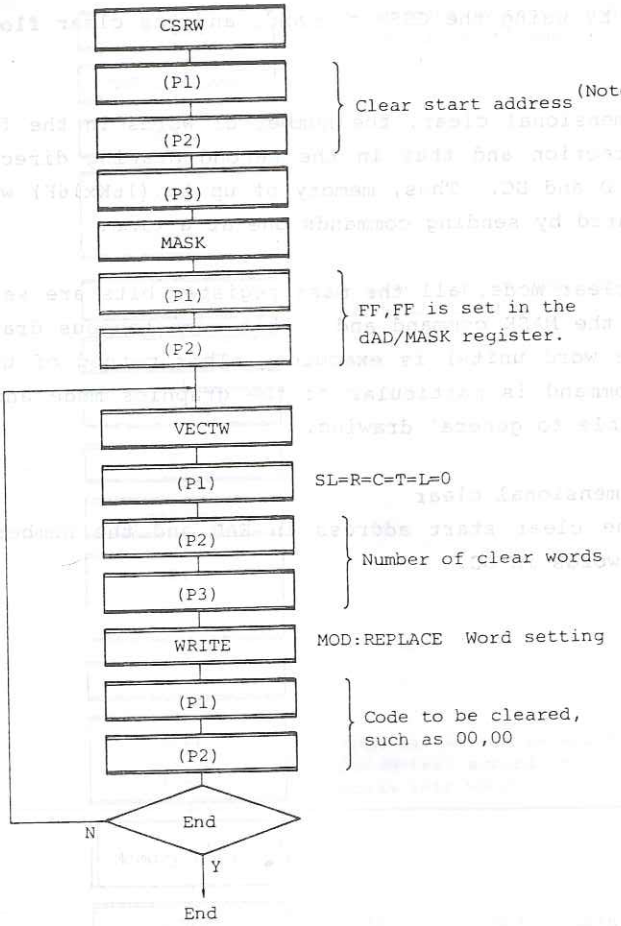
is changed by using the CSRW command, and the clear flow is repeated.

For two-dimensional clear, the number of words in the first drawing direction and that in the second drawing direction are set in D and DC. Thus, memory of up to (16Kx16K) words can be cleared by sending commands one at a time.

In either clear mode, all the mask register bits are set to 1 by using the MASK command and 16-bit simultaneous drawing (drawing in word units) is executed. This method of using the MASK command is particular to the graphics mode and is not applicable to general drawing.

(1) One-dimensional clear

Wet the clear start address in EAD and the number of clear words in DC.



Any desired data can be set by setting the values in the WRITE command parameters.

Note: To write the WRITE command parameters unaltered into the display memory during graphics control (in the graphics mode or when DGD=1 in the character and graphics mix mode), set WG in the third parameter of CSRW to 1, then set MASK to FFH.