

# DESKTOP SIGN MAKER

# **CAMM-1**

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MODEL PNC-1000

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## OPERATION MANUAL

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2-4

## — Thanks and Wishes —

Thank you very much for purchasing the Roland DG desktop sign marker CAMM-1. In order for you to use your CAMM-1 correctly for a long time and familiarize yourself with its performance sufficiently, we recommend that you read this operation manual.

- If you find some abnormality on your CAMM-1, immediately turn off the power switch and see this operation manual.

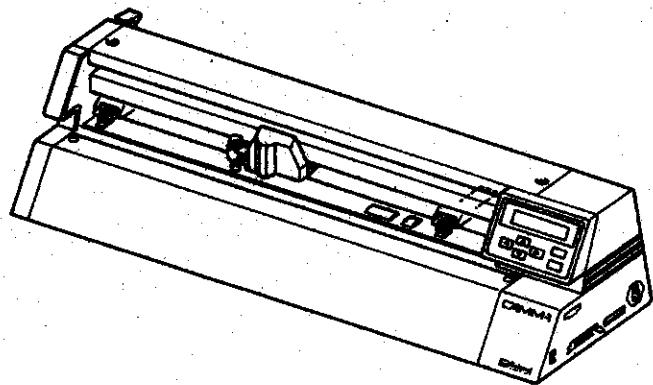
This operation manual consists of two parts: Part 1 and Part 2.

- In Part 1, you will go through a broad description of your CAMM-1, precautions in handling your CAMM-1 and how to operate your CAMM-1. This entire part is important for you to operate your CAMM-1 with safety and correctly, so you need to read this part.
- In Part 2, you will go through how to program for your CAMM-1. If you want to program yourself, you need to read this part. If not, you do not need to read this part.
- In appendices, you will find Display Menu Flowchart, List of Commands, etc.

## — Self Test —

Your CAMM-1 has the self test function. Execute this function to see that your CAMM-1 operates properly. For the self test procedure, refer to 2.8 OPERATION CHECK in CHAPTER 2, Part 1.

# Part1



**DESKTOP SIGN MAKER**  
**CAMM-1**

MODEL PNC-1000

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**OPERATION MANUAL**



Part I

## INTRODUCTION

1



# 1.1 GENERAL DESCRIPTION OF THE FEATURES

INTRODUCTION

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## ① Cutting Sheet and Creating POP Art

CAMM-1 is the desktop machine for exclusive use in cutting sheets and creating POP art for shopwindow and in-store advertisements.

## ② Cutting Speed and Resolution

CAMM-1 cuts characters and symbols in a sticker sheet in 10 mm increments at the speed of 20~150 mm/sec and at the software resolution of 0.025 mm/step.

## ③ Roland DG XY Plotter Pens are Usable

CAMM-1 is able to use Roland DG water based fiber tipped pens and POP art pens for use with Roland DG XY plotters and is equipped with the pen force control knob. With this knob, you are allowed to control pen forces according to the cutters and pens.

## ④ In addition to the cutting of 450 mm to 500 mm wide sheets, CAMM-1 draws on ISO A2 and A3 plotting media. (ANSI C and ANSI B size plotting media can also be loadable.)

## ⑤ Intelligent Commands

The CAMM-GL<sup>III</sup> of CAMM-1 has compatibility with Roland DG XY plotters and CAMM series. Because of this, it is able to perform high-quality sheet cuttings with commercial software and simple program.

## ⑥ Outlined Font Data

CAMM-1 has outlined character fonts for alphanumeric letters and symbols and is able to draw outlined characters changing the size, angle and slant. Also, it easily cuts outlined characters on a sheet with a simple program.

## ⑦ Useful Replot Function

CAMM-1 has an 8K-byte replot buffer for saving cutting data. By selecting Replot Mode, CAMM-1 repeats the same cutting with the data save in the replot buffer as many times as you want. Since the contents of the replot buffer remain in effect even if the power switch is turned off, it is very useful when you want to have the same cutting again.

## ⑧ Off-line Cutting Function

Since CAMM-1 has the off-line cutting function, you can let your CAMM-1 cut a label string by setting up to 20 characters while viewing the display. In this case, you do not need to have a computer in your system because your CAMM-1 is able to do the label string cutting.

## ⑨ Internal Memory for Settings

Since always CAMM-1 internally saves settings such as communication protocol to a computer, sheet size, cutting speed, etc., you are allowed to restart the cutting operation with the same conditions as before even if you turn off the power.

**(10) Interactive Display**

CAMM-1 is equipped with a background illuminated display. You can type in 40 characters on two lines (20 characters on one line each) of the display and easily set each function interactively while viewing the display.

**(11) Two Types of Interfaces**

CAMM-1 is standard equipped with both Centronics and RS-232C interfaces and can widely be connected to various computers according to your system configuration.

# 1.2 PRECAUTIONS IN HANDLING YOUR CAMM-1

## INTRODUCTION

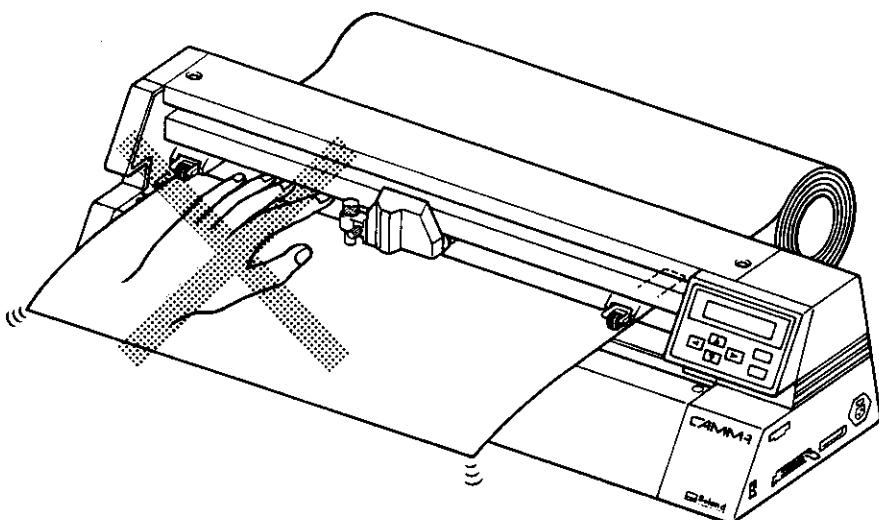


Fig. 1-1

Pay careful attention so that your fingers, hair, etc., are not entangled into your CAMM-1 during operation.

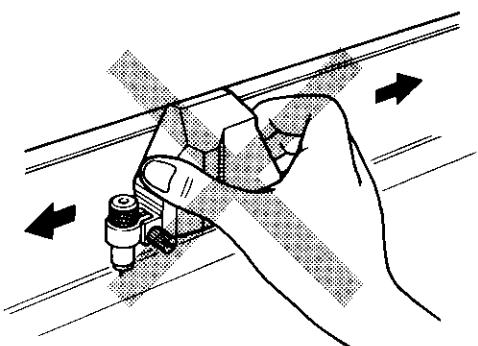


Fig. 1-2

Do not move the tool carriage with your hand.

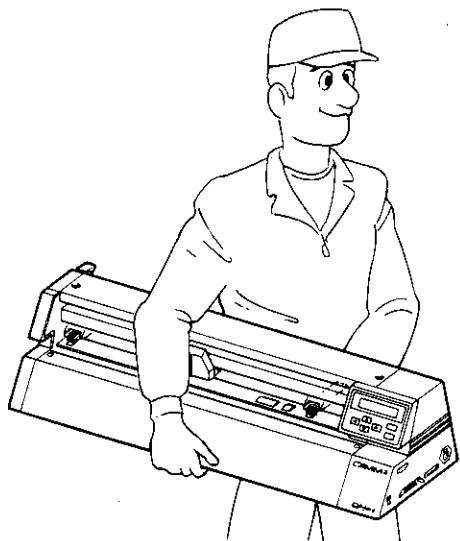


Fig. 1-3

When you carry your CAMM-1, hold the center portion with your both hands instead of the both edges.

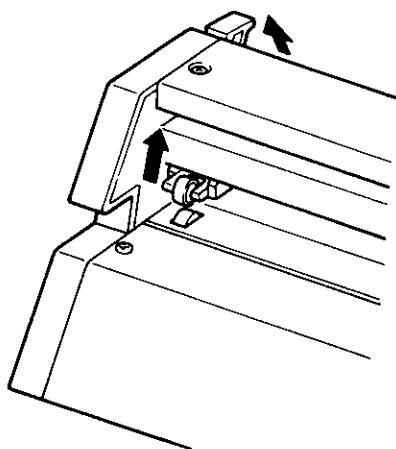


Fig 1-4

When you do not use your CAMM-1, always leave the pinch roller up. If the pinch roller is down (or the sheet loading lever is down), it may be deformed to cause the sheet to become slippery and thereby deteriorate the finishing quality.

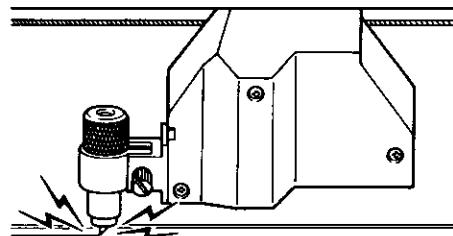


Fig 1-5

Do not hold the sheet loading lever down without setting a sheet. If a cutter is attached, it may damage the platen.

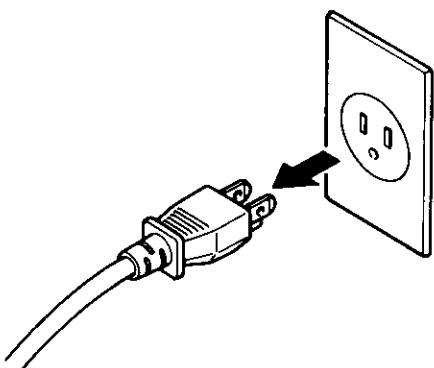


Fig 1-6

When you do not use your CAMM-1, always plug off the power cord from the electric outlet.

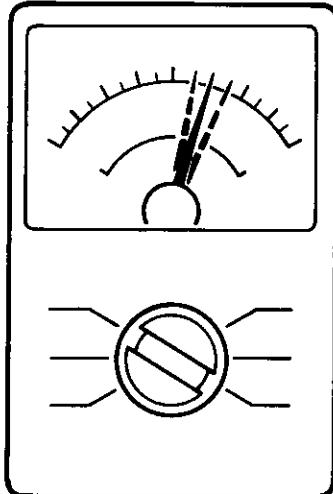


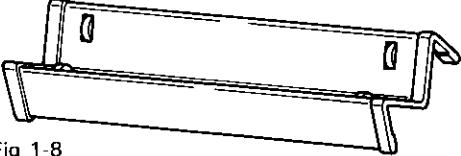
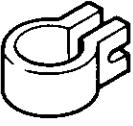
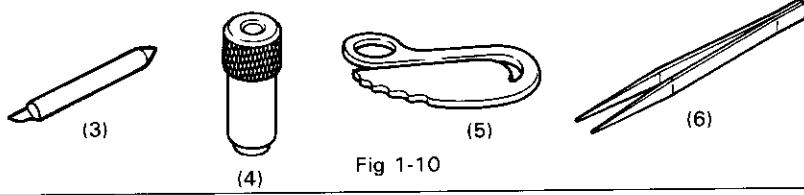
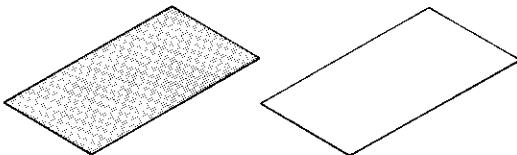
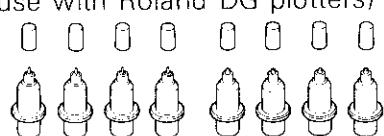
Fig 1-7

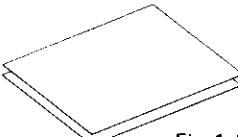
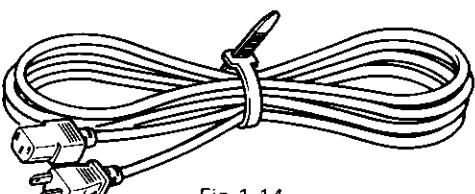
Use your CAMM-1 at the rated power voltage within  $\pm 10\%$ .

# 1.3 CONFIRMATION OF THE ACCESSORIES

## INTRODUCTION

The following items should be contained in the package of CAMM-1 as accessories. Before getting started, check to see that all accessories have been contained without lacking. If you find any one is lacking, contact to your local sales store.

1) Sheet roller base	 Fig 1-8	1
2) Tool holder	 Fig 1-9	10
3) Sheet cutter (Cemented carbide) 4) Cutter pen 5) Sheet separator (for sheet separation) 6) A pair of tweezers (for sheet peeling)	 (3) (4) (5) (6) Fig 1-10	1 1 1 1
7) Sheet for test, 460mm × 850mm size 8) Application tape for test, 450mm × 850mm size	 Fig 1-11	2 1
9) Water based fiber tipped pen, 0.3mm (in common use with Roland DG plotters) 10) Water based POP art pen, 2.0mm (in common use with Roland DG plotters)	 Fig 1-12	4 4

11) A2 size high quality paper for test	2
 Fig 1-13	
12) Power cord	1
 Fig 1-14	
13) Operation manual (this one)	1
14) Dust cover	1

No connecting cable for use in between your computer and CAMM-1 is supplied as an accessory. If you do not have one, 2.4 THE CONNECTION PROCEDURE OF THE COMPUTER in CHAPTER 2, Part 1 and CHAPTER 9 THE CONNECTION PROCEDURES OF COMPUTERS, Part, and purchase the appropriate connecting cable for your computer.

The accessory cutter, sticker sheets, POP art pens and A2 size coating papers are supplied for use in checking to see that your CAMM-1 operates properly. For actual operations, select the correct items that satisfy your purposes reading CHAPTER 5 INFORMATION ABOUT CUTTERS AND SHEETS, Part 1 and CHAPTER 7 DRAWING ON THE PLOTTING MEDIUM, Part 1.

Roland DG optional items are available from your local sales store.

## 1.4.1 The Front View

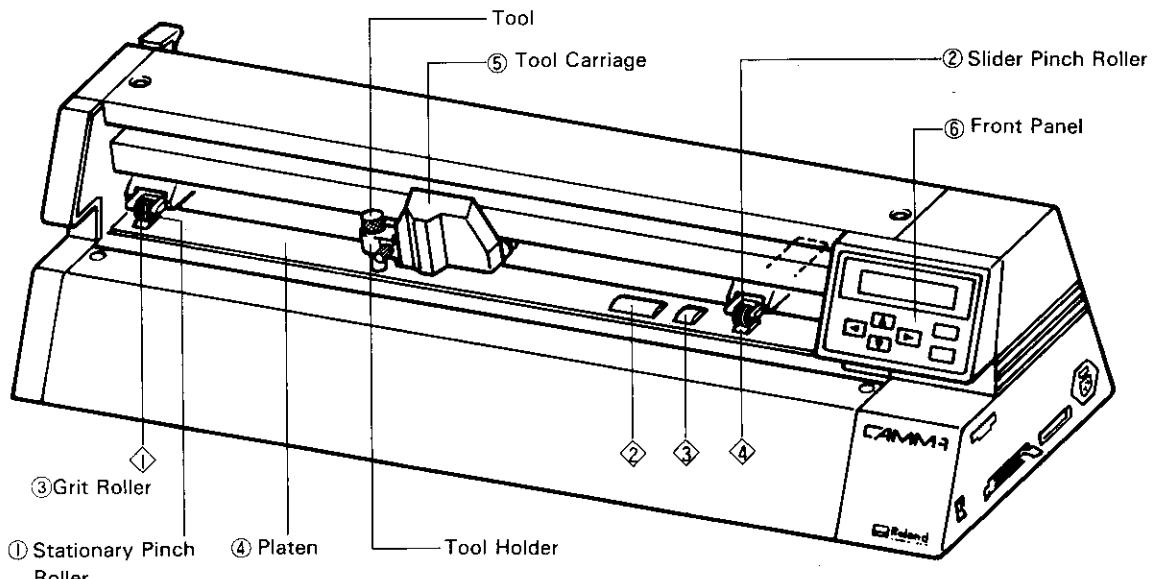


Fig 1-15

### ① Stationary Pinch Roller

Pushes the sheet against the grit roller during cutting (plotting).

### ② Slider Pinch Roller

Pushes the sheet against the grit roller during cutting (plotting). You slide it to the adequate position when you change the sheet size.

### ③ Grit Roller ①②③④

Rolls the sheet back and forth during cutting (plotting).

### ④ Platen

Hold the sheet in a certain form to obtain a cutting (plotting) surface.

### ⑤ Tool Carriage

Moves with a tool over the platen to the right and left and moves the tool up and down.

### ⑥ Front Panel

Consists of panel keys and a display for use in setting various operations and functions.

## 1.4.2 The Rear View

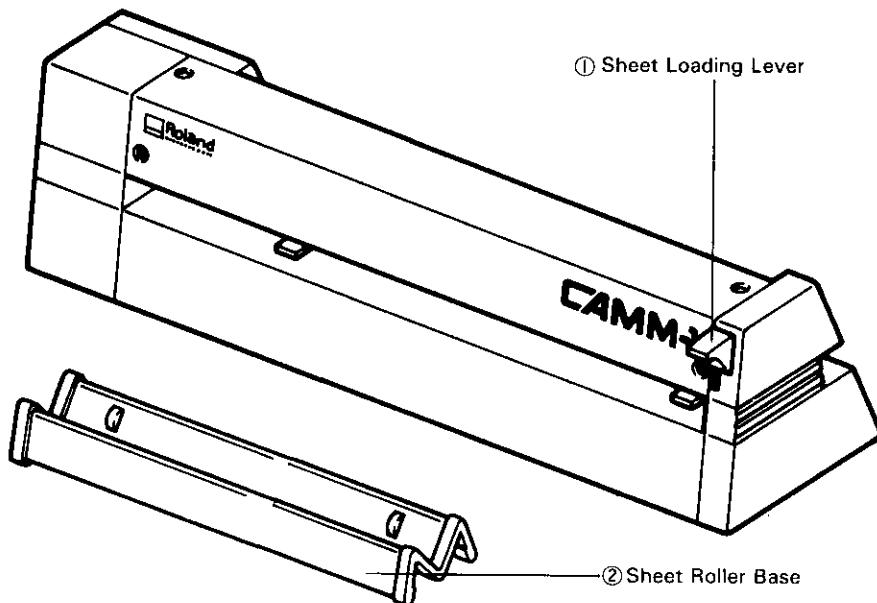


Fig 1-16

### ① Sheet Loading Lever

Moves the pinch roller up and down when you load and unload the sheet (plotting medium). Holding down the lever lets the pinch roller go down and fixes the sheet (plotting medium). Holding up the lever lets the pinch roller go up and frees the sheet (plotting medium).

### ② Sheet Roller Base

Allows you to put rolled sheet on it. You need to pull out the sheet in some length necessary for cutting with your hands beforehand.

### 1.4.3 The Side View

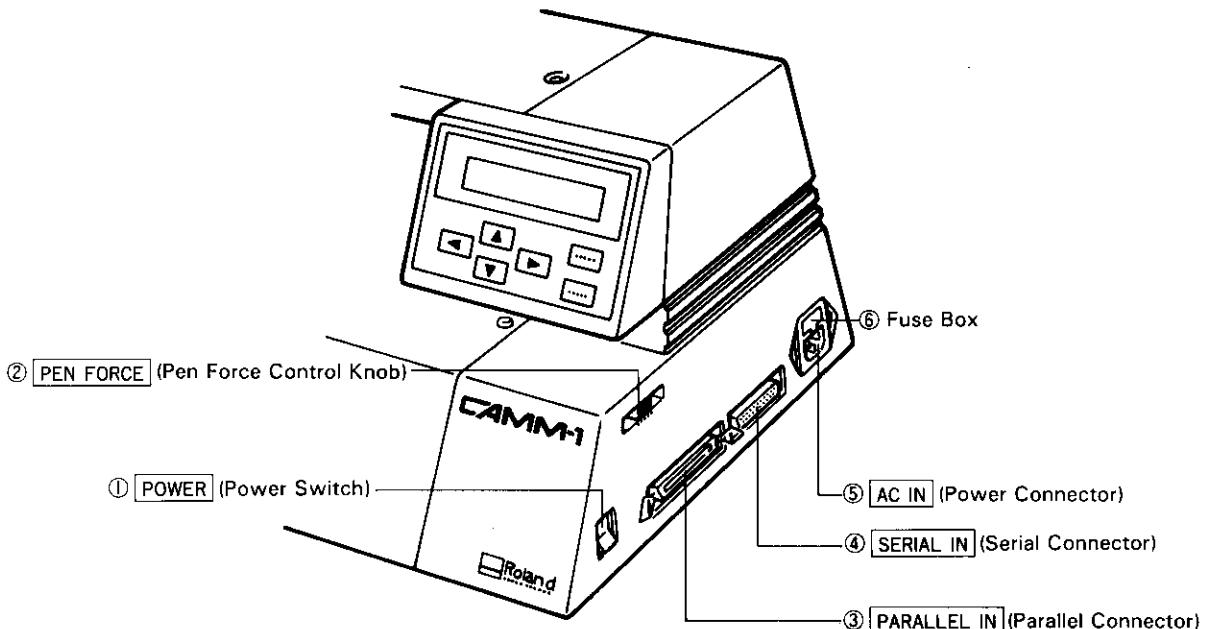


Fig 1-17

#### ① [POWER](Power Switch)

Pressing the position marked  turns on the power and pressing the position marked  turns off the power.

#### ② [PEN FORCE](Pen Force Control Knob)

Sets the appropriate force to a tool (cutter or pen) you use.

#### ③ [PARALLEL IN](Parallel Connector)

Connects a Centronics interface for connecting your CAMM-1 to the computer.

#### ④ [SERIAL IN](Serial Connector)

Connects an RS-232C interface for connecting your CAMM-1 to the computer.

#### ⑤ [AC IN](Power Connector)

Connects the accessory AC power cord.

#### ⑥ Fuse Box

Will be broken to protect your CAMM-1 if a sudden change in the voltage occurs or if overload is applied. Replace the broken fuse with new one referring to 8.7 THE FUSE REPLACEMENT PROCEDURE in CHAPTER 8, Part 1.

### 1.4.4 The Front Panel

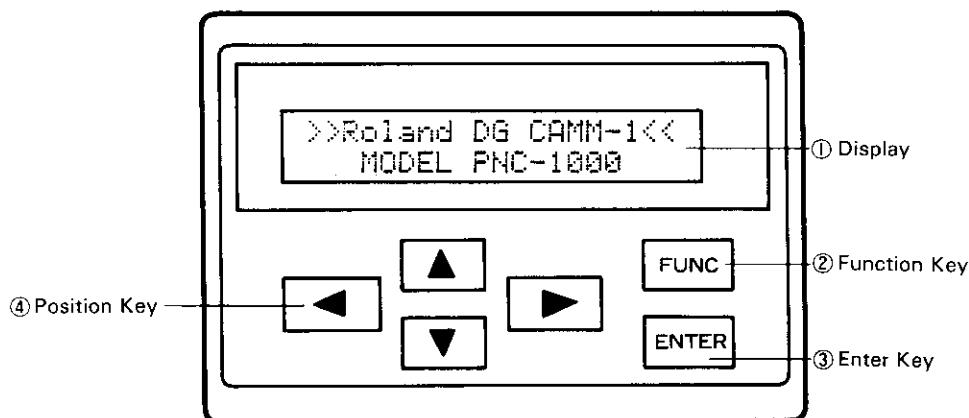


Fig 1-18

#### ① Display (Liquid Crystal Panel)

Displays various menus, the coordinates of a cutter (pen) and error messages.

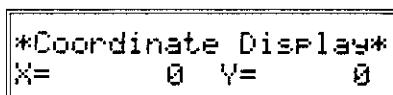
#### ② [FUNC](Function Key)

Pressing this key displays menus in order. Since the menus are looped, they go round to their original places.

#### ③ [ENTER](Enter Key)

Pressing this key determines the menu item displayed in the current menu.

#### ④ [◀▶▼▲](Position Keys)



When the above display is appearing, pressing these keys moves the cutter (pen) to their respective arrow directions. Pressing two adjacent keys simultaneously moves the cutter to their diagonal direction. In addition, when the display is appearing, [◀] and [▶] keys are also used to select the menu item from the current menu. [▼] and [▲] keys are also used to display the values and/or conditions being currently displayed in order.

Part 1

**BEFORE GETTING STARTED****2**



## **2.1 THE SET-UP PROCEDURE OF YOUR CAMM-1**

**BEFORE GETTING STARTED**

Your CAMM-1 is factory-installed to the operating conditions described in the table of 3.5 THE FACTORY DEFAULTS in CHAPTER 3, Part 1. If these conditions are inconvenient to your actual operations, correct them to your settings referring to the setting procedure below. Your CAMM-1 may not operate at all if wrong conditions have been set.

### **Rudimentary Set-up Procedure**

Note that you should follow this set-up procedure only when you use your CAMM-1 connecting to the computer for the first time.

To set up your CAMM-1, proceed as follows:

<b>Item</b>	<b>Remarks</b>	<b>Page</b>
Assemble CAMM-1 ↓	Place sheet roller base	2.2
Connect computer ↓	Select [Parallel] or [Serial]	2.4/9.1 /9.2
Connect AC power cord ↓	Use accessory AC power cord	2.5
Turn on power ↓	Turn on power switch	2.5
Set interface ↓	Set by front panel	4.3 (1)-2
Change command mode ↓	Fit to your software	4.3 (1)-1
Set protocol ↓	Set only for [Serial]	4.3 (1)-2
Perform self test ↓	Check to see CAMM-1 operation	2.8

↓ Usually you start setting up here to have routine cutting operations.

(Turn on power) ↓		2.5
Attach tool ↓	Attach to tool carriage	2.6
Adjust pen force ↓	Fit cutter (pen) specification	5.1/7.3
Set sheet size ↓	Set both pinch roller and front panel	4.3 (1)-3
Load sheet ↓	Align sheet with reference line and hold down sheet loading lever	2.7
(Set some values) ↓	(Change cutting speed, character set, etc., if necessary.)	4.3
Send cutting data from computer	Start cutting	6.2

You will later on go through the set-up procedure of your CAMM-1 to the computer up to the operation check procedure. And you will learn how to cut a self test pattern using a sheet for test.

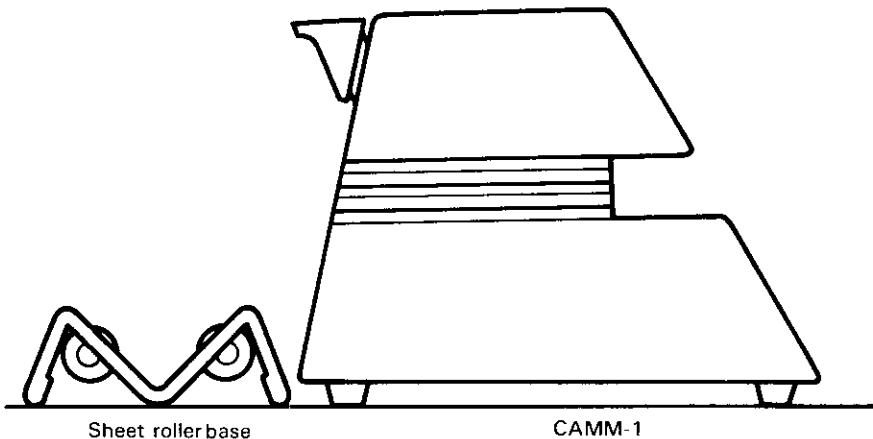
## 2.2 THE ASSEMBLING PROCEDURE OF YOUR CAMM-1

BEFORE GETTING STARTED

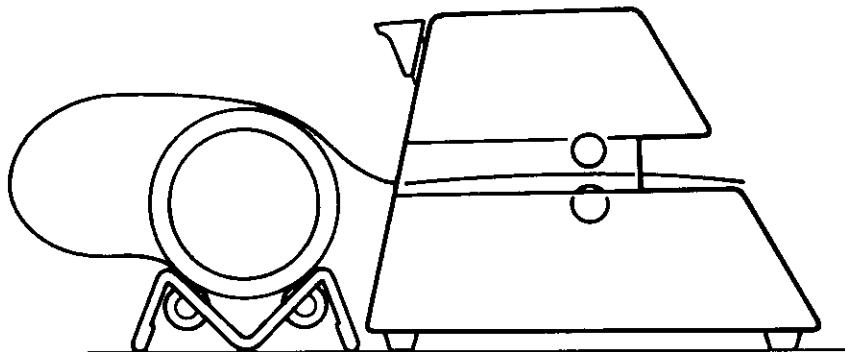
Prepare the following items.

- CAMM-1
- Sheet Roller Base

Place CAMM-1 and sheet roller base on a flat table as illustrated below.



You are allowed to put rolled sheet on the sheet roller base. In this case, you need to pull out the sheet in some length necessary for cutting with your hands beforehand as illustrated below.



## 2.3 THE SET-UP PROCEDURE OF YOUR CAMM-1 AND PRECAUTIONS

BEFORE GETTING STARTED

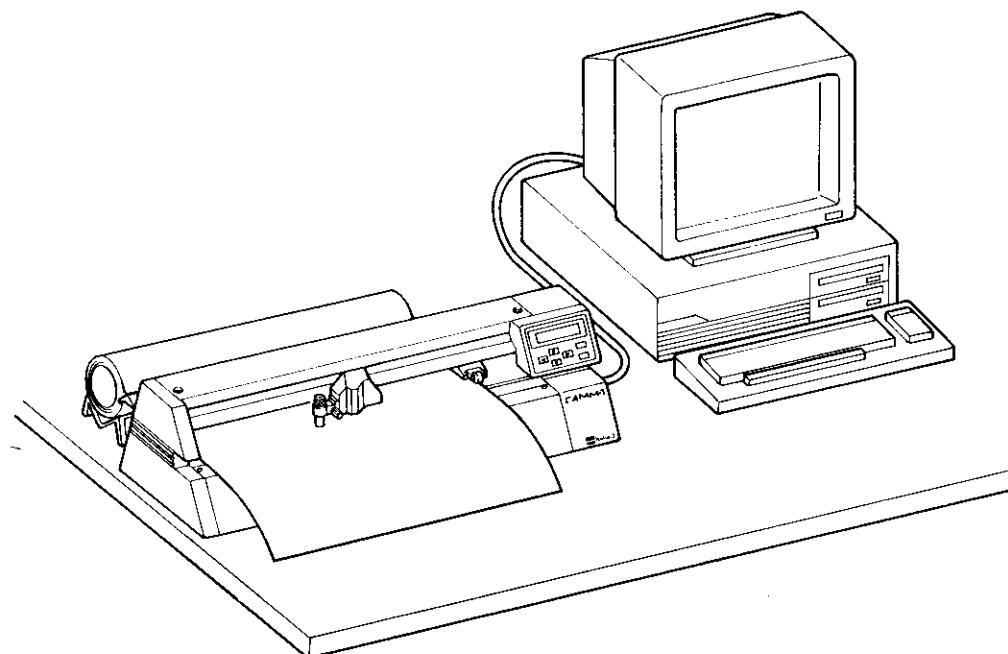


Fig. 2-1

Place your CAMM-1 on a flat, durable table as illustrated.

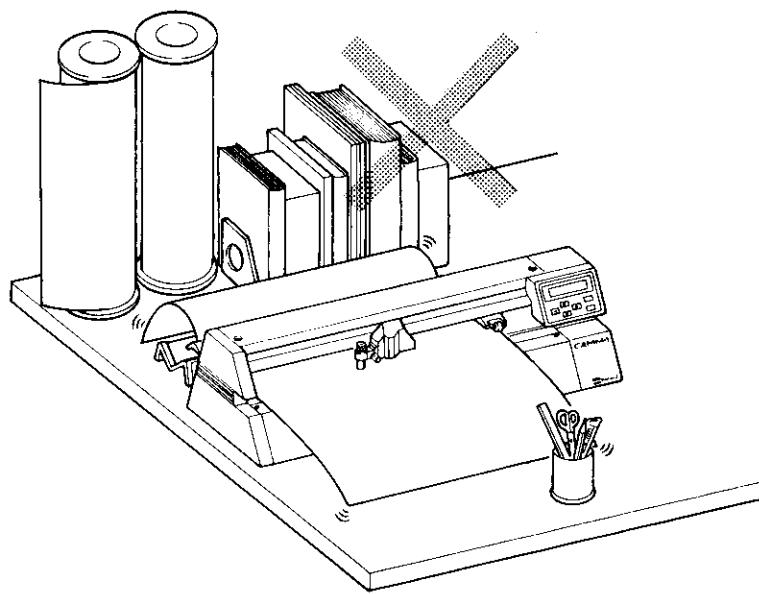


Fig. 2-2

Since your CAMM-1 does cutting operations by moving a sheet, do not place any objects in front of and behind (at least 80cm) your CAMM-1 so that the sheet moves freely.

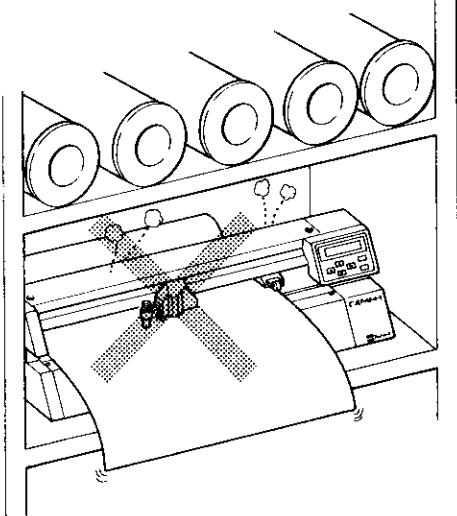


Fig. 2-3

Since your CAMM-1 generates some heat during operation, do not set it in a place of bad heat dissipation.

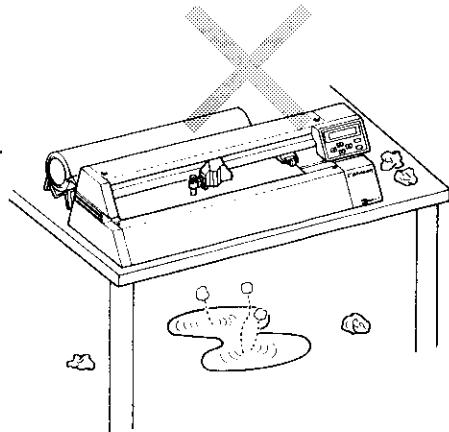


Fig. 2-4

Avoid using in a place of high humidity or in a dusty place.

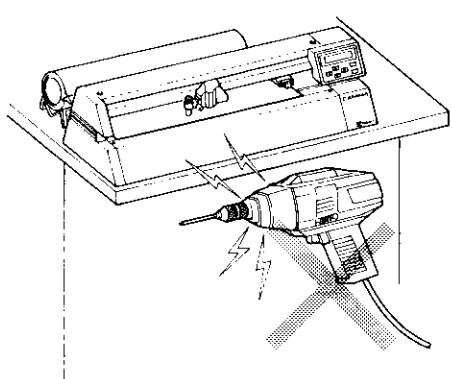


Fig. 2-5

Avoid using in a place of excessive electric noise.

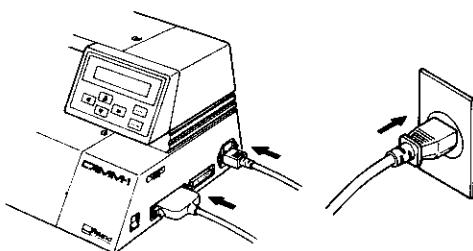


Fig. 2-6

Plug the power cord and I/O cable between your CAMM-1 and computer securely so that they are not unplugged off or that they do not cause a contact failure during operation.

## 2.4 THE CONNECTION PROCEDURE TO THE COMPUTER

BEFORE GETTING STARTED

### 2.4.1 General Information

Your CAMM-1 is equipped with the following two types of interfaces, and you are allowed to select either one of the interfaces to connect your CAMM-1 to the computer. After connection, you need to set the same communication protocol to the computer, software and CAMM-1.

- Parallel Connection (Centronics Interface)
- Serial Connection (RS-232C Interface)

Select either one of the interfaces to fit the specifications of the computer and software. In the following sections, you will learn how to connect each interface in detail. (For the setting procedure of your CAMM-1, refer to 4.3.1 (1)-2 Set Interface in CHAPTER 4, Part 1.)

### 2.4.2 Parallel Connection (Centronics Interface)

A parallel interface (Centronics interface) is by nature used in many computers as an interface for a printer. This is because it has less setting requirements and its specifications are almost standardized, so that you can easily connect it. However, its data transmission is unidirectional from the computer to your CAMM-1, but not from your CAMM-1 to the computer. For more information on the specifications of a parallel interface, refer to 4.1 THE SPECIFICATIONS OF PARALLEL INTERFACE in CHAPTER 4, Part 2.

#### ● To connect a parallel interface, proceed as follows:

- ① Select the correct connecting cable and connect it between your computer and CAMM-1.  
For this connecting cable, refer to ① List of Options, APPENDIX A, and select the correct one to fit your computer.  
With your computer and CAMM-1 tuned off, connect the connecting cable between the printer connector of your computer and the **PARALLEL IN** connector of your CAMM-1. Then fix it with hooks on both side.

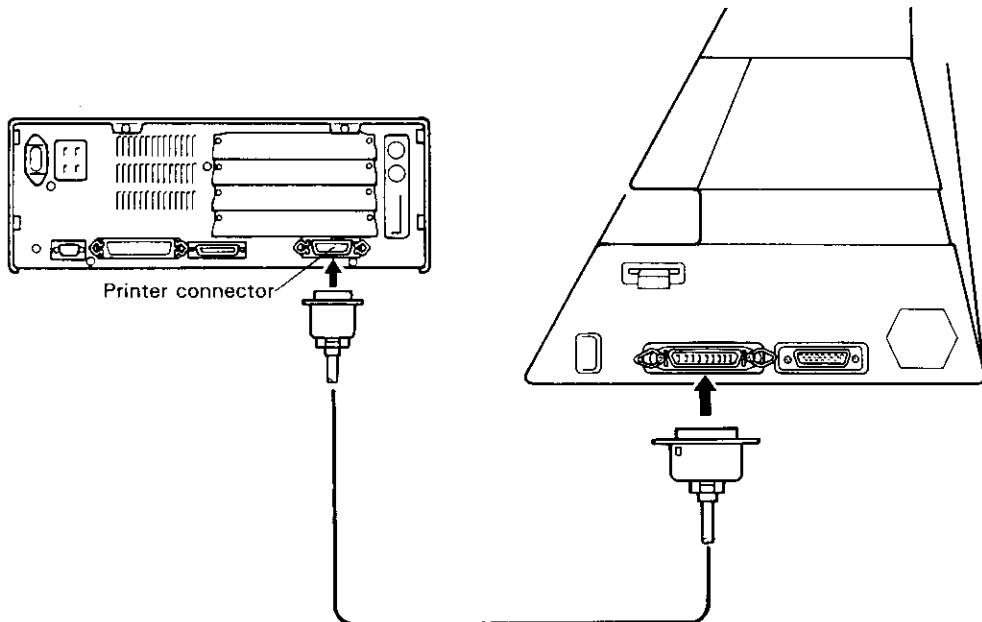


Fig. 2-7

- ② Turn on the power following 2.5 THE CONNECTION PROCEDURE OF THE POWER SOURCE and proceed with interface setting by the front panel of your CAMM-1. Set to [Parallel] referring 4.3 (1)-2 Set Interface in CHAPTER 4, Part 1, and CHAPTER 9 THE CONNECTION PROCEDURES TO COMPUTERS, Part 2.



For setting your computer and software, refer to their respective operation manuals. If you make your own program, use OPEN "LPT1:", PRINT #1," LPRINT to format your program so that data is output to the parallel port of your computer. (These statements vary depending on the computers and software.)

## 2.4.3 Serial Connection (RS-232C Interface)

A serial interface (RS-232C interface) is by nature a data communication standard and allows for bi-directional data communication between your computer and CAMM-1 if connected. This means that your CAMM-1 is able to send back the coordinates of the current cutter (pen), the tool up/down information of the tool carriage, the error contents if occurred, the current status data of your CAMM-1 to your computer. It is therefore more useful than a parallel interface.

For the specifications of a serial interface, refer to 4.2 THE SPECIFICATIONS OF SERIAL INTERFACE in CHAPTER 4, Part 2.

- **To connect an RS-232C interface, proceed as follows:**

- ① With your computer and CAMM-1 turned off, connect a connecting cable between the [RS-232C] connector of your computer and the **SERIAL IN** connector of your CAMM-1. Then fix it with screws on both sides.

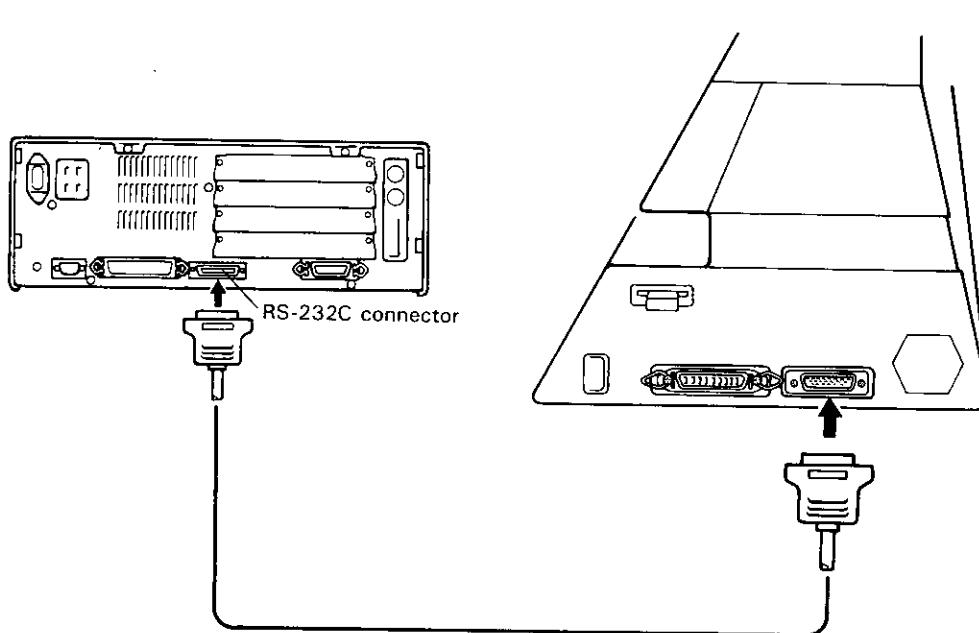


Fig. 2-8

- ② Turn on the power following 2.5 THE CONNECTION PROCEDURE OF THE POWER SOURCE and proceed with interface setting by the front panel of your CAMM-1. Set to [Serial] referring to 4.3 (1)-2 Set Interface in CHAPTER 4, Part 1, and CHAPTER 9 THE CONNECTION PROCEDURES OF COMPUTERS, Part 1. In addition, you need to set communication protocols to this interface. For this, refer to the same chapters.

## 2.5 THE CONNECTION PROCEDURE OF THE POWER SOURCE

BEFORE GETTING STARTED

### 2.5.1 Connect the Power Cord

Before connecting the power cord, check to see that:

- Your CAMM-1 is OFF.
- The sheet loading lever is up and the pinch roller is also up.
- Your CAMM-1 is connected to your computer correctly.

If there is nothing wrong, connect the accessory AC power cord between **AC IN** and an AC electric outlet as illustrated below.

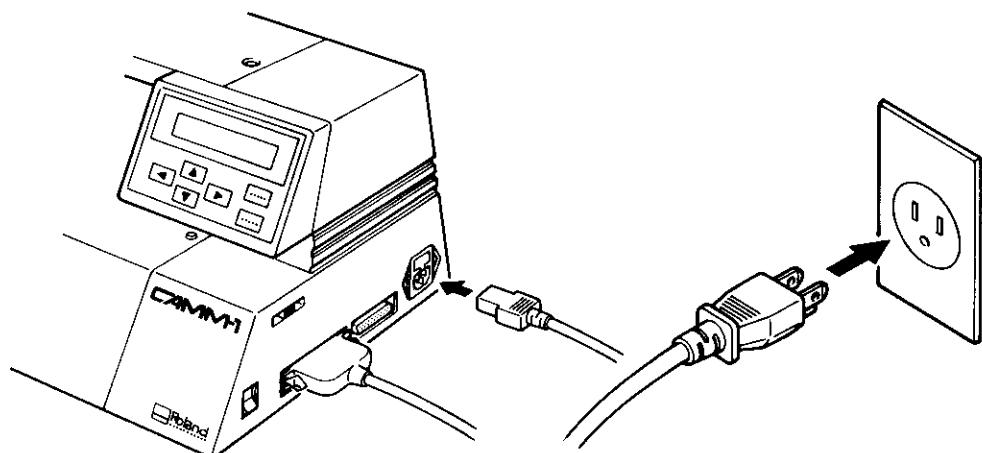


Fig. 2-9

### 2.5.2 Turn on the Power

Pressing the position marked [1] of the power switch turns on ON and initializes your CAMM-1. Then the tool carriage automatically moves to the right.  
(Pressing the position marked [0] turns OFF your CAMM-1.)

After power-on, your CAMM-1 enters Set-up Mode following Opening Message.

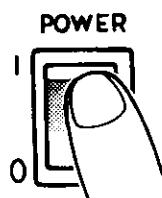


Fig. 2-10

Opening Message  
(Displayed for about 3 seconds)

>>Roland DG CAMM-1<<  
MODEL PNC-1000

Set-up Mode Main Menu

>>Set Configuration <<  
COMMAND INPUT SIZE

## 2.6 THE ATTACHMENT PROCEDURE OF CUTTER (CUTTING PEN)

BEFORE GETTING STARTED

You need to attach a cutter (pen) to the tool holder and the tool holder to the tool carriage. Prepare the following items.

- Tool Holder
- Cutter (Pen)
- Cutting pen

To attach a cutter (pen), proceed as follows:

- ① Attach a cutter to the cutting pen. Pay attention so that the cutter edge is not damaged.
- ② Attach a cutting (pen) to the tool holder as illustrated below. Remember that the tool holder has its upper and lower sides for attachment.

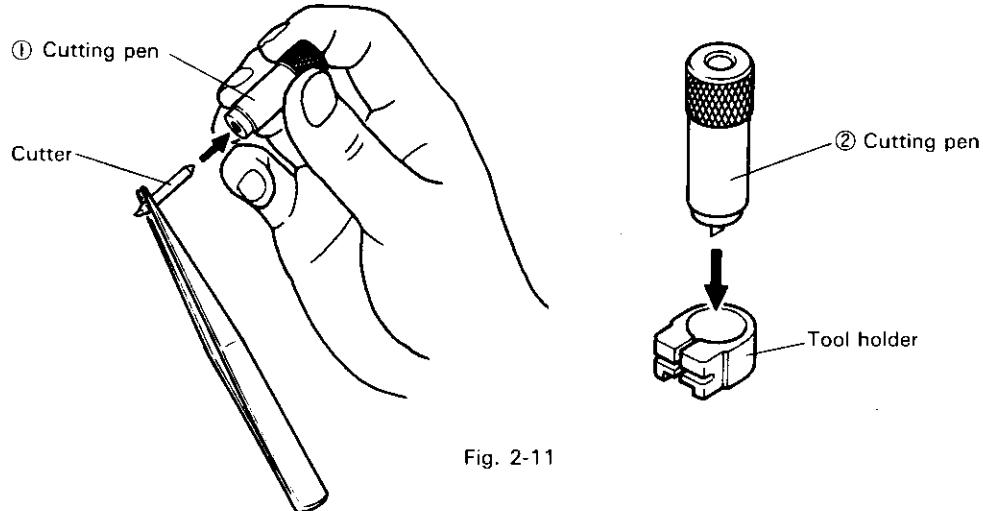


Fig. 2-11

- ③ Attach the tool holder to the tool carriage. Pay careful attention not to damage the platen of your CAMM-1 with the cutting (pen) edge. The cutter edge is very sharp and delicate to break if excessive force is applied. Also, the damaged platen catches the sheet to cause rough movements.

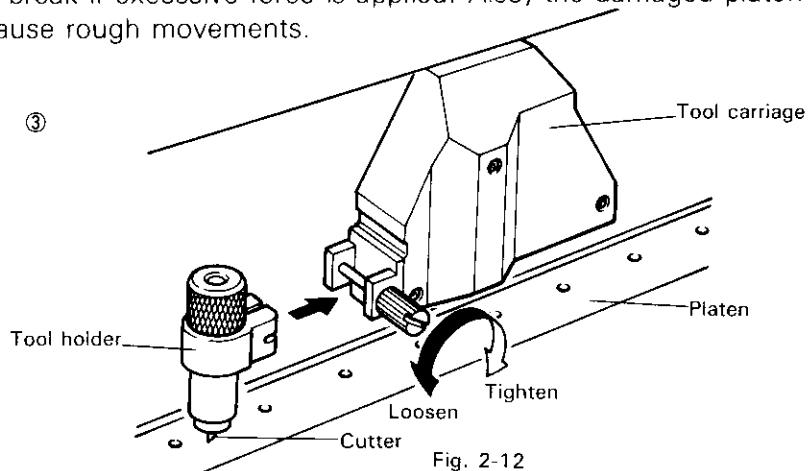


Fig. 2-12

## 2.7 THE LOADING AND UNLOADING PROCEDURE OF SHEET

BEFORE GETTING STARTED

### 2.7.1 Loading the Sheet

#### NOTE

Before loading the sheet, set the same communication protocols to the computer and interface. You cannot set them after loading. If you want to set after loading, you need to unload the sheet and set the communication protocols. Once set, the communication protocols remain in effect even if you turn off the power, because they are saved. You do not need to set again.

For the setting procedure of communication protocols, refer to 4.3 (1)-2 Set Interface in CHAPTER 4, Part 1.

- To load the sheet, proceed as follows:

Be sure that the sheet loading lever is up and also that the pinch roller is up. If the pinch roller is not up, hold the sheet loading lever down to raise the pinch roller up. (The pinch roller is up when shipped from the factory.)

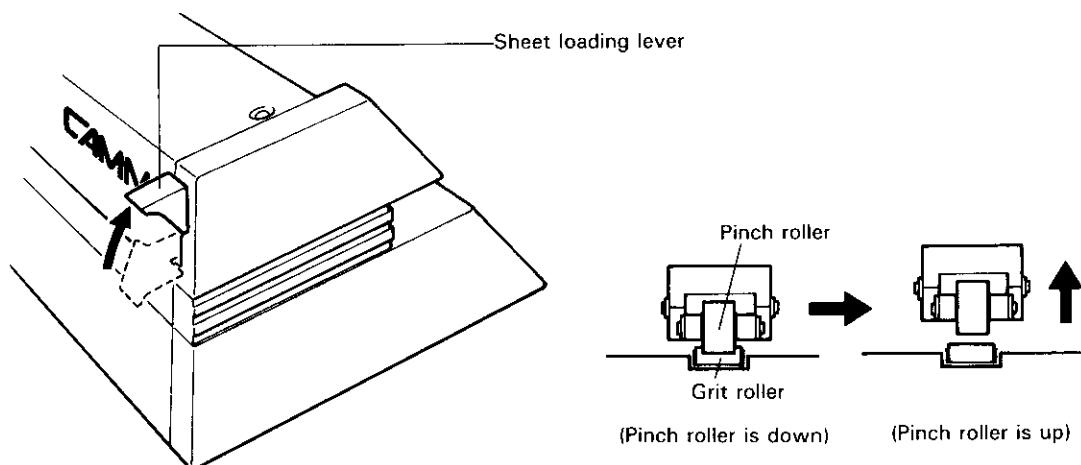


Fig. 2-13

There are four grit rollers. Slide the pinch roller to over the appropriate grit roller according to the size of sheet to be loaded.

When you load the accessory sheet (460 mm wide) for test, set the pinch roller at position ③ of the following illustration. (The pinch roller is set at ③ when shipped from the factory.) When you load sheets (plotting media) of other sizes, refer to 3.3 SOME DIFFERENCES BETWEEN THE SHEET SIZES in CHAPTER 3, Part 1.

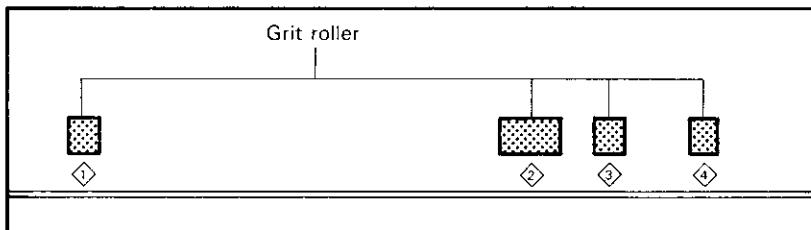


Fig. 2-14

The pinch roller moving lever is located on the rear panel of the body. While watching the positions of the slider pinch roller and grit roller, push the pinch roller moving lever vertically and slide the pinch roller to the right and left.

The slider pinch roller has been assembled tightly to maintain the cutting accuracy. You need somewhat strong force to slide it.

Release your hand from the lever when the pinch roller rests on the grit roller.

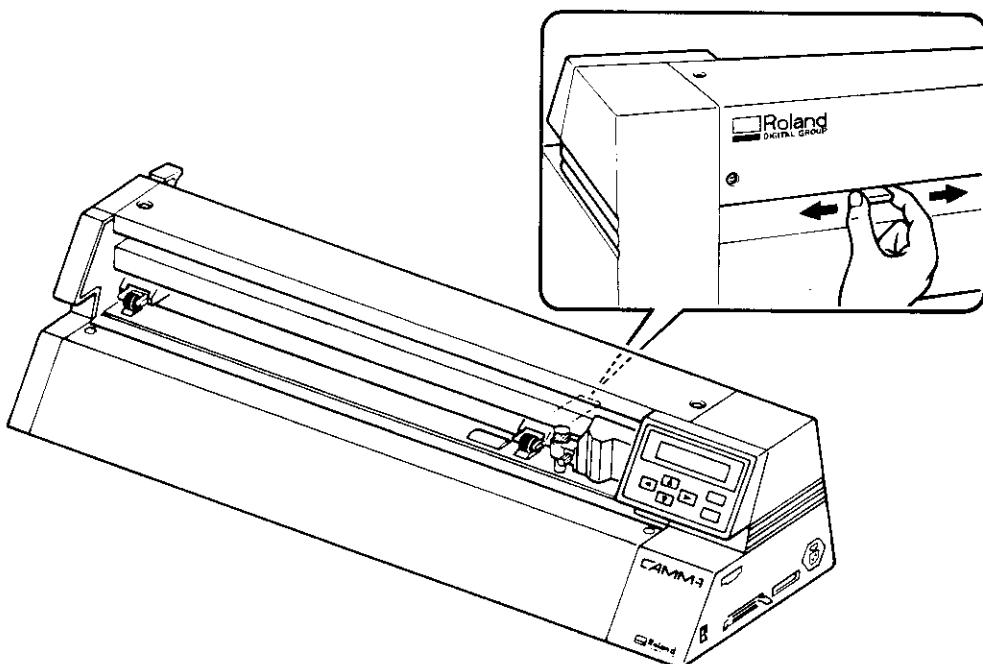


Fig. 2-15

For setting to grit rollers ③ and ④ set the pinch roller at the center of those grits as illustrated below. If the pinch roller is off the center, it cannot hold the sheet (plotting medium).

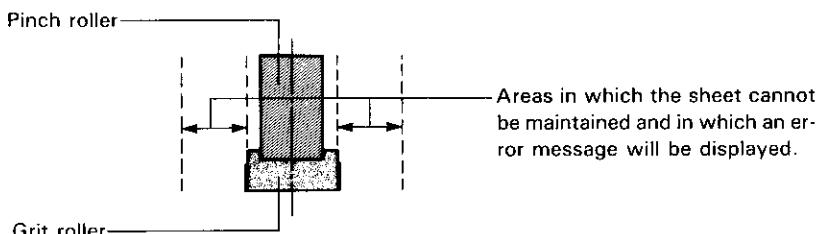


Fig. 2-16

When you load ISO A3 or ISO A2 size sheet, you need to set the slider pinch roller over the grit roller ② However, you also need to set it as illustrated in I.

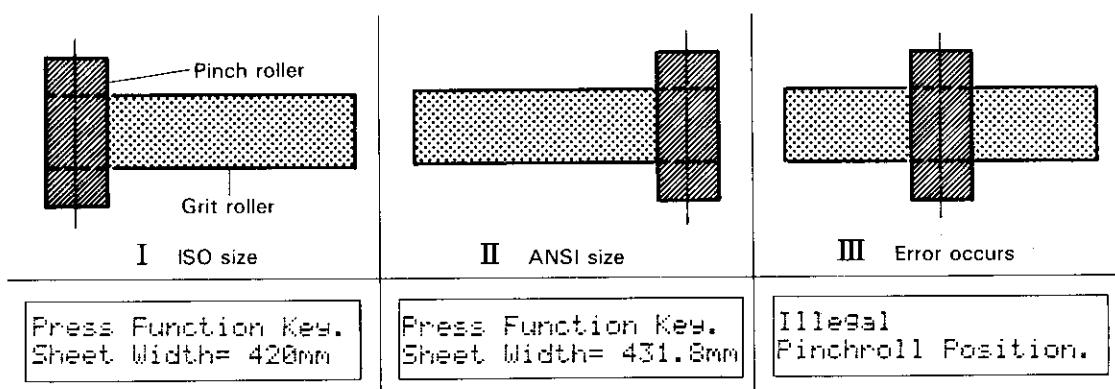


Fig. 2-17

**NOTE**

Your CAMM-1 automatically identifies whether the slider pinch roller is in place at the time of sheet loading. When the slider pinch roller is in place, press **[FUNC]** key to move the tool carriage to the origin. If not, a warning messages will appear on the display. In such a case, hold up the sheet loading lever and go through the setting procedure of the pinch roller again.

When you load ANSI B, ANSI C, etc., position the pinch roller to II.

When you set the slider pinch roller as illustrated in II, the cutting area will be automatically expanded and the ISO size will be changed to ANSI C or ANSI B size.

If you load sheets (plotting media) of other sizes, refer to 3.3 SOME DIFFERENCES BETWEEN THE SHEET SIZES in CHAPTER 3, Part 1.

Insert the sheet between the grit roller and pinch roller from the back of your CAMM-1.

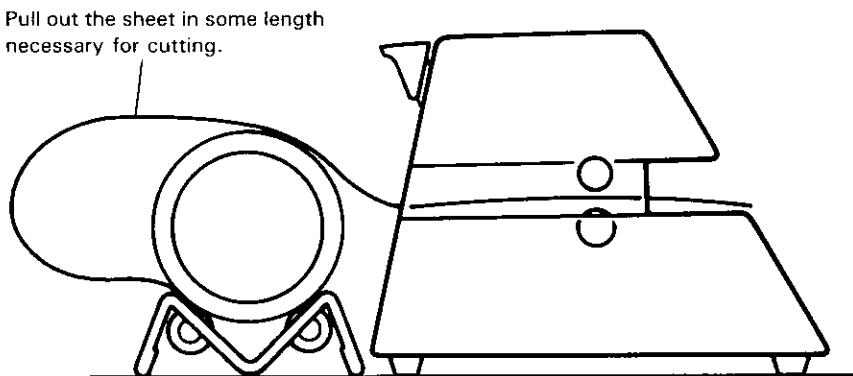


Fig. 2-18

Align the left edge of the sheet with the reference line.  
Align the front edge of the sheet with the reference line.  
Check to see that the sheet is not slipped off from the reference line.

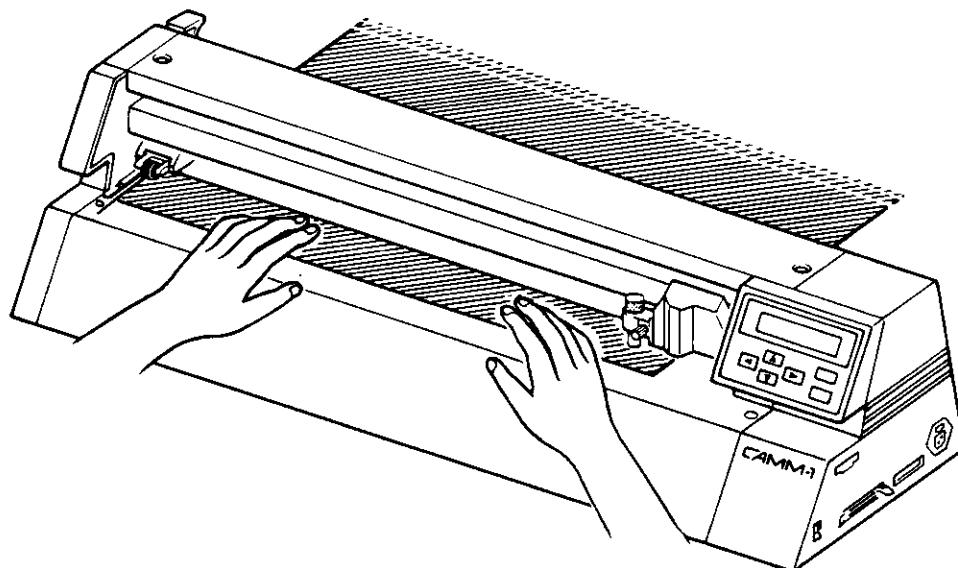


Fig. 2-19

Hold down the sheet loading lever.

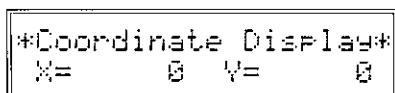
**CAUTION**

When you hold down the sheet loading lever, and press **FUNC** key in succession, the sheet starts moving for sheet loading.

Then the pinch roller goes down to push the sheet against the grit roller. And the following prompt message appears on the display.

Press Function Key.  
Sheet Width= 420mm

Press [FUNC] key, which lets the tool carriage to move to the origin. If the following message appears on the display, it means that you have just completed sheet loading.



**CAUTION**

- When you do not use your CAMM-1, always leave the pinch roller up. If the pinch roller is down (or the sheet loading lever is down), it will be deformed and thereby makes the sticker sheet slippery and deteriorate the cutting quality.
- Your CAMM-1 automatically interprets that sheet is loaded if you hold down the sheet loading lever. If you hold down the sheet loading lever without loading sheet, your CAMM-1 will try to cut without sheet. If a cutter has been attached at this point, the cutter as well as CAMM-1 will be damaged.

## 2.7.2 Cut the Sheet with Sheet Separator

A separate cutter is supplied as an accessory. You use this cutter to separate the sheet. To separate the sheet, push the sheet forward and cut it where you want to cut using the accessory sheet separator as illustrated below. To push the sheet forward, use the sub-function, [PAGE], of the [Move Sheet] function. For this function, refer to 4.3 (4)- 1 [PAGE] Move to Sheet Cutting Point in CHAPTER 4, Part 1.

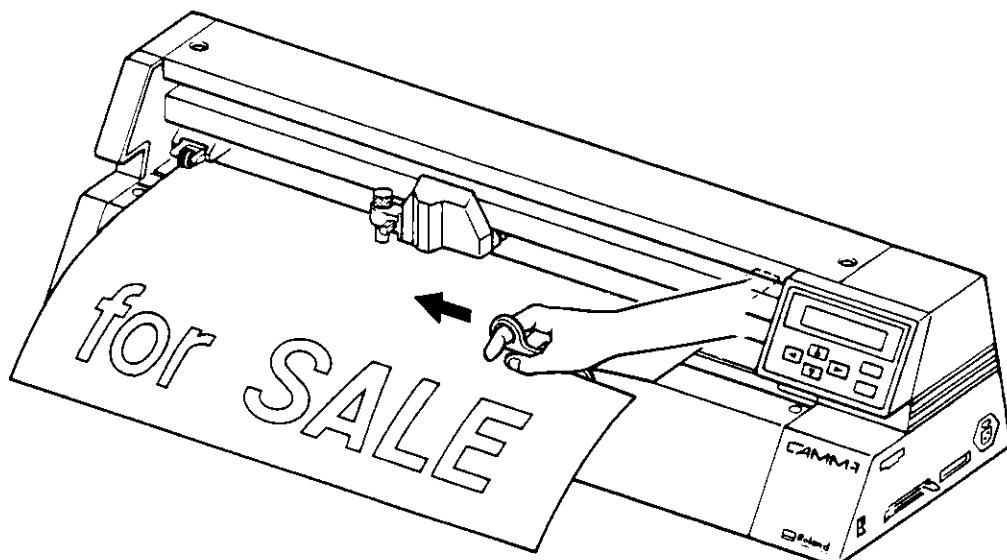
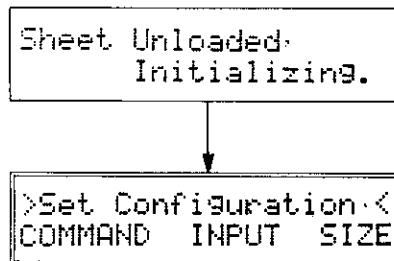


Fig. 2-20

### 2.7.3 Initialization at the Sheet Unloading

The pinch roller goes up when holding up the sheet loading lever. After this, pull out the sheet. Then the following messages will appear in succession on the display. At the same time, your CAMM-1 will be initialized to the same status as it is turned on.



What will be initialized are as follows:

Item	Condition
CAMM-1	Enters Set-up mode
I/O buffer	Cleared
Status	Initialized at the same status as you send the IN or DF command

Note: The factory defaults will not be initialized.

For more information, refer to 3.5 THE FACTORY-INSTALLED DEFAULTS in CHAPTER 3, Part 1.

## 2.8 OPERATION CHECK

### BEFORE GETTING STARTED

Your CAMM-1 is equipped with the self test function with which you are allowed to verify that your CAMM-1 operates properly. Following the self test procedure below, check to see that your CAMM-1 operates correctly. You need sheet and cutter for this self test. Use the accessory sheet and cutter. Remember that incorrect handling of your CAMM-1 will cause unexpected cutting operations to damage the cutter, sheet, and the mechanical portions of your CAMM-1. Before getting started, read the entire Part 1 of this operation manual carefully. You are also allowed to perform a self test without attaching a cutter to verify the operation only.

#### Operation Check Procedure

- ① Turn on the power switch while pressing ▲ key.
- ② The tool carriage moves to the right end. Attach a cutter.
- ③ Load a sheet and hold down the sheet loading lever.
- ④ Your CAMM-1 starts cutting as illustrated below.



Fig. 2-21

If your CAMM-1 does not cut a self test pattern correctly, contact to your local sales store.



## DESCRIPTION OF THE FUNCTIONS

3



The command system loaded in your CAMM-1 is CAMM-GL<sup>III</sup>.

The CAMM-GL<sup>III</sup> is divided into [mode1] commands and [mode2] commands. You select and use either one of the two. The mode1 and mode2 commands are characterized as follows:

mode1 commands:

- ① Consists of 23 types of commands
- ② Easy to program because each command is in a complete form and so is not affected by others
- ③ Cannot define parameters at a high level
- ④ Has compatibility with Roland DG DXY plotters
- ⑤ Has compatibility with the CAMM-GL I of Roland DG computer aided modeling machine, CAMM-3
- ⑥ Has compatibility with the CAMM-GL II of Roland DG computer aided engraving machine, CAMM-2
- ⑦ Can use mode2 commands by calling
- ⑧ Can specify machine coordinates in the unit of 1/40mm (0.025mm)

mode2 commands:

- ① Consists of 56 types of commands
- ② Needs to combine some commands relative to one operation
- ③ Takes a little time to program
- ④ Can define at a high level (e.g., expansion, compression, move origin, window clipping, character slant, etc.)
- ⑤ Has compatibility with the RD-GL commands of Roland DG plotters
- ⑥ Can specify machine coordinates in the unit of 1/40mm (0.025mm)

(The CAMM-GL<sup>III</sup> is set in mode1 when shipped from the factory.)

**What you need to do for commands**

An instruction that lets your CAMM-1 to operate is called a 'command'. For example, in mode1, the C command is used to cut a circle. In mode2, the CI command is used to cut the same circle. They are sent from the computer to your CAMM-1 as follows:

**C 10000,5000,2000,0,360,I** ..... mode1 command  
**PU 10000,5000; CI 2000,I;** ..... mode2 command

The both commands cut straight lines (chords) to create a circle with the radius of 2000 around the center coordinates (10000,5000) in 1 degree increments from 0° up to 360°.

When you use software for exclusive use with your CAMM-1, you do not need to familiarize yourself with detailed knowledge about commands at all, because the software automatically sends commands from the computer to your CAMM-1. You only need to check which mode to use and set mode1 or mode2 to your CAMM-1.

Your CAMM-1 has the following two coordinate systems as X-Y-axes coordinate systems.

**Machine Coordinate System:**

The mechanical coordinate system of your CAMM-1.

The [unit] of the machine coordinate system is 0.025 mm, one unit.

For example, 40 units ( $0.025 \times 40$ ) are equal to 1 mm.

**User Coordinate System:**

A Coordinate system that the user is allowed to set at will with respect to the machine coordinate system.

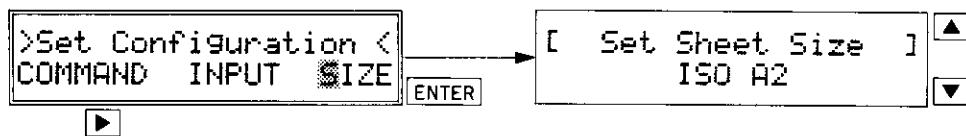
In mode1, the user is allowed to set an origin at an arbitrary position and set coordinate units to that origin with the <sup>^</sup>IP and <sup>^</sup>SC commands in mode1 and with the IP and SC commands in mode2.

For more information, refer to DESCRIPTION OF THE mode1 COMMANDS in CHAPTER 2, Part 2.

### 3.3 SOME DIFFERENCES BETWEEN THE SHEETS SIZES

#### DESCRIPTION OF THE FUNCTIONS

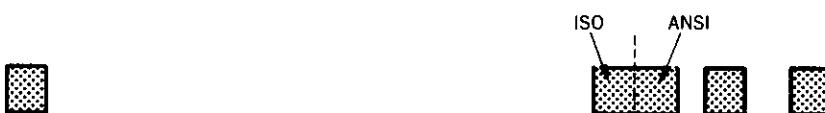
The SIZE, one of the three sub-menus of 4.3 (1) > Set Configuration ≥ menu in CHAPTER 4, Part 1, has four sub-functions available for you to select: [ISO A2] Mode, [ISO A3] Mode, [FREE-Y] Mode and [EXPAND-X] Mode. You select one from the four.



The SIZE is not for you to specify sheet (plotting medium) sizes, but for you to specify modes, for example, the cutting (drawing) direction of a sheet (plotting medium). That is, you are allowed to specify an optimum sheet size mode.

We have explained that the SIZE has the four sub-functions [ISO A2] Mode, [ISO A3] Mode, [FREE-Y] Mode and [EXPAND-X] Mode, but actually it has six sub-functions including [ANSI C] and [ANSI B]. This is because changing the position of the slider pinch roller changes [ISO A2] to [ANSI C] and [ISO A3] to [ANSI B], respectively.

When you load a sheet, your CAMM-1 identifies where the slider pinch roller has been set. However, when the slider pinch roller is set over the grit roller (the longest one), ISO automatically changes to ANSI, depending on whether the sticker sheet is set at the left edge or at the right edge. Once set, ISO (or ANSI) is saved in memory of your CAMM-1. This means that if you try to change the SIZE by moving the pinch roller after you changed the mode you set from ISO to ANSI, the sub-functions [ANSI C], [ANSI B], [FREE-Y] and [EXPAND-X] will appear on the display.



Here are some differences:

- [1] Sheet (plotting medium) setting direction
- [2] XY-axes direction
- [3] Pinch roller position
- [4] Origin position
- [5] Cutting area size

These five items are mutually affected, so we will explain them in detail in the following sections.

### 3.3.1 The Sheet Setting Direction and Axis Direction

In this section, the explanation will first begin with three differences [1], [2] and [3] described in the previous section (3.3).

- [1] Sheet (plotting medium) setting direction,
- [2] X-Y-axes direction
- [3] Pinch roller position

As illustrated below, the X-Y-axes directions of each available sheet in their respective modes are factory-installed. The setting directions of ISO A3 and ISO A2 sizes can be rotated by 90°, and the cutting axis can be rotated by 90° accordingly.

When you set the sheet, move the slider pinch roller to over grit rollers matching each sheet (plotting medium) size.

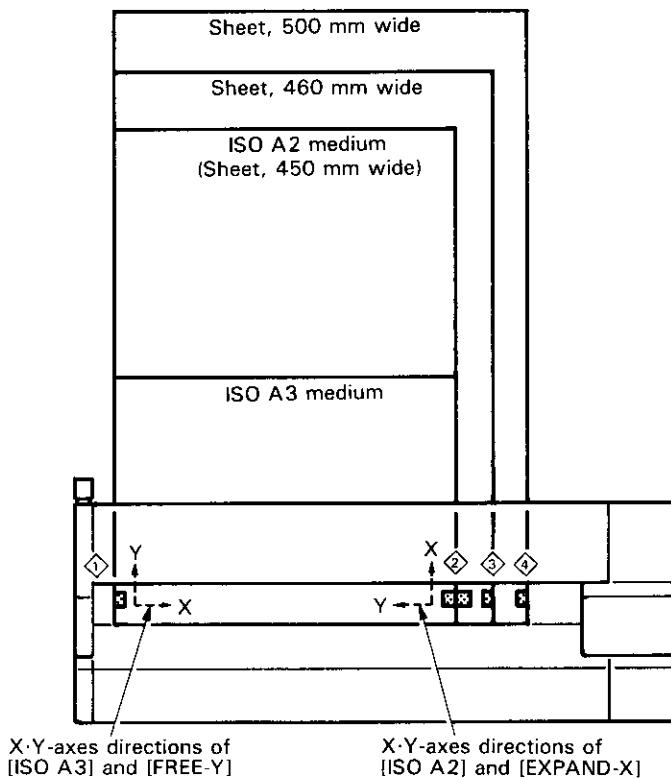
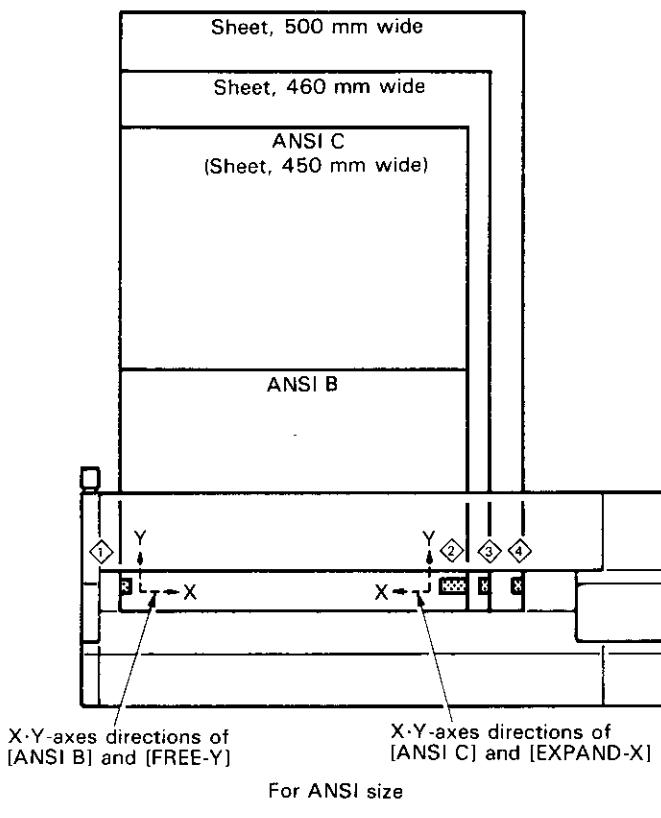


Fig. 3-1

## DESCRIPTION OF THE FUNCTIONS



### 3.3.2 The Origin and Cutting Area

In this section, the explanation will begin with the rest of the differences [4] and [5] described in the previous section (3.3).

[4] Origin position

[5] Cutting area size

As already explained, the sub-menu, SIZE, covers the following six functions: [ISO A3] Mode, [ISO A2] Mode, [FREE-Y] Mode, [EXPAND-X] Mode, [ANSI B] Mode and [ANSI C] Mode, which are:

#### I [ISO A3] Mode

(When, a 420mm × 297mm plotting medium is loaded.)

When you select [ISO A3] mode, the cutting (plotting) area will be set as illustrated below. Note that the slider pinch roller is allowed to place over any one of the three grit rollers on the right-hand side. So, you just set it according to the sheet (plotting medium) you load. When you use an ISO A3 size sheet medium, move the slider pinch roller to over grit roller ②.

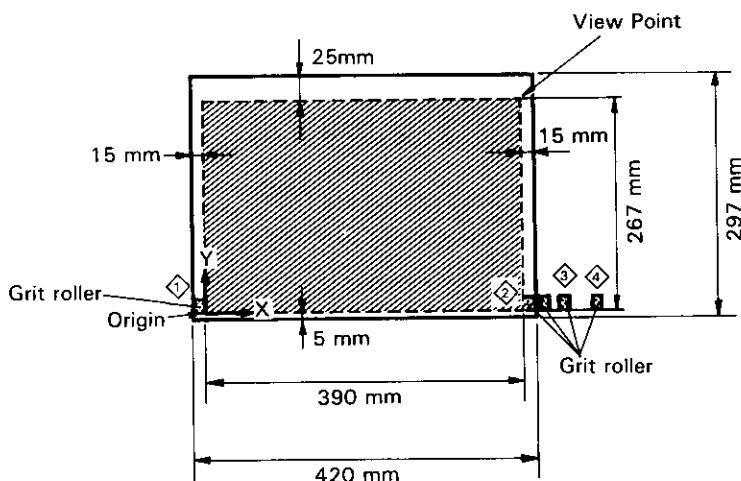


Fig. 3-3

The shaded area is the cutting (plotting) area of this mode.

ISO A3 Mode is the best choice mode for use in plotting on an ISO A3 size medium outputting data from CAD software for use with your plotter. That is, it is a mode for ISO A3 size plotters.

## II [ISO A2] Mode

(When, a 594mm × 420mm plotting medium is loaded.)

When you select [ISO A2] mode, the cutting (plotting) area will be set as illustrated below. Note that the slider pinch roller is allowed to place over any one of the three grit rollers on the right-hand side. So, you just set it according to the sheet (plotting medium) you load. When you use an ISO A2 size sheet medium, move the slider pinch roller to the left-side edge of grit roller ②. When setting to positions ③ or ④, the origin, P1 and P2 automatically move, followed by ③ or ④.

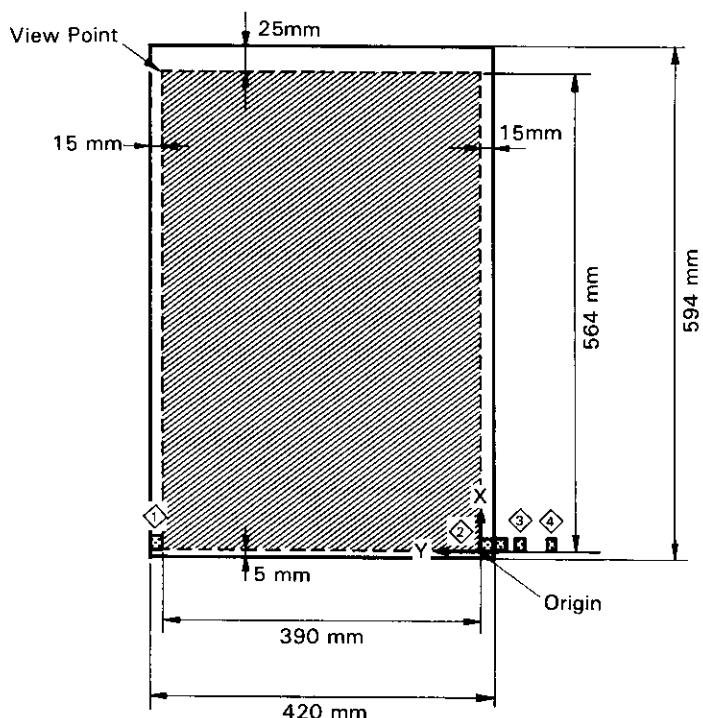


Fig.3-4

The shaded area is the cutting (plotting) area of this mode.

[ISO A2] Mode is the best choice mode for use in plotting on an ISO A2 size sheet medium outputting data from CAD software for use with your plotter. That is, it is a mode for ISO A2 size plotters.

### III [FREE-Y] Mode

The cutting area varies depending on the pinch roller positions as illustrated below. When you select [FREE-Y] Mode, your CAMM-1 automatically detects where the pinch roller is currently located.

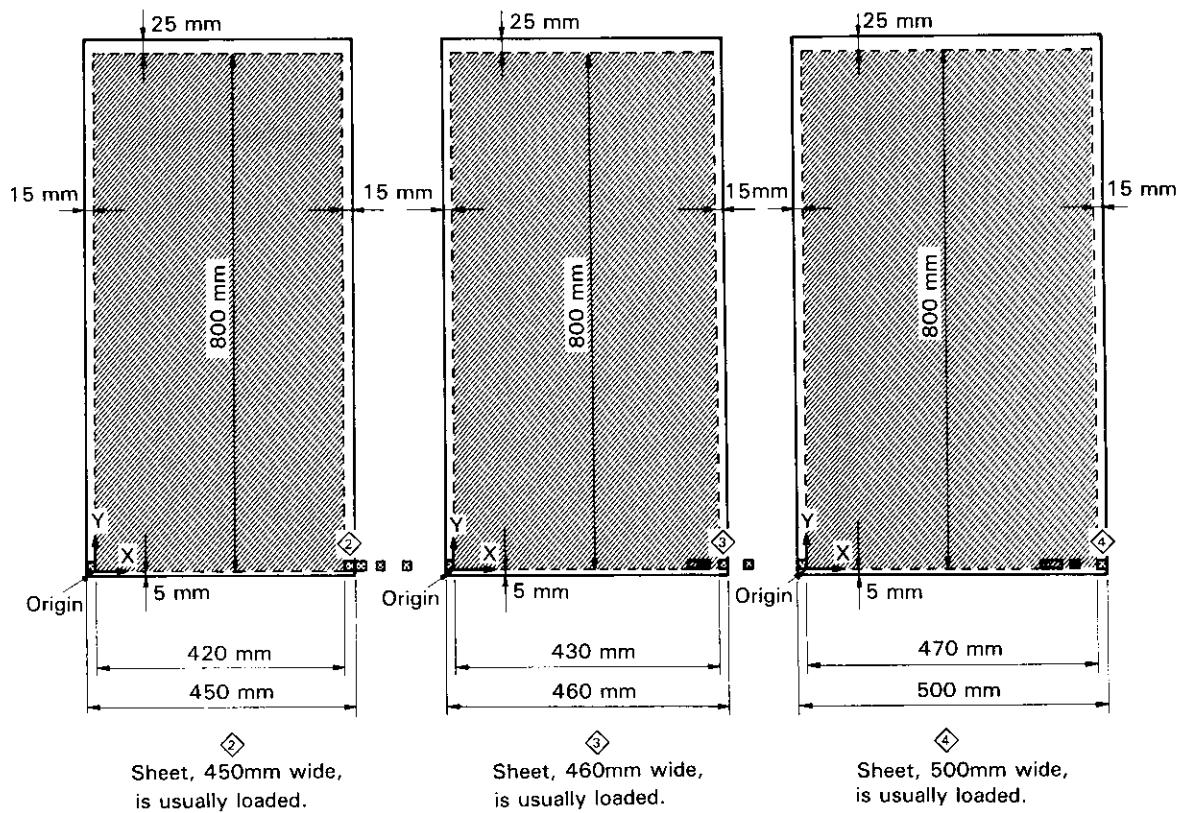


Fig.3-5

Each shaded areas are the cutting (plotting) areas of this mode.

[FREE-Y] Mode is suited for the traverse cutting of a label string with respect to the body of your CAMM-1. The cutting (plotting) area of this mode is wider than the widths of ISO A2 and ISO A3 size media. When you use ISO A2 and ISO A3 size media, you need to send data smaller than the widths of those media. Otherwise, the media slip off from the platen to make the plotting impossible.

To push out the sheet after cutting, use one of the sub-menus, [PAGE], of \*Move Sheet\* menu or the !PG command. When you specify [PAGE] or send the !PG command, the sheet is automatically pushed out some page length forward, which depends on the sheet length you cut. You are now allowed to cut off the label cut area with the accessory sheet separator if you want. After this, a new origin is automatically set near the label cut area.

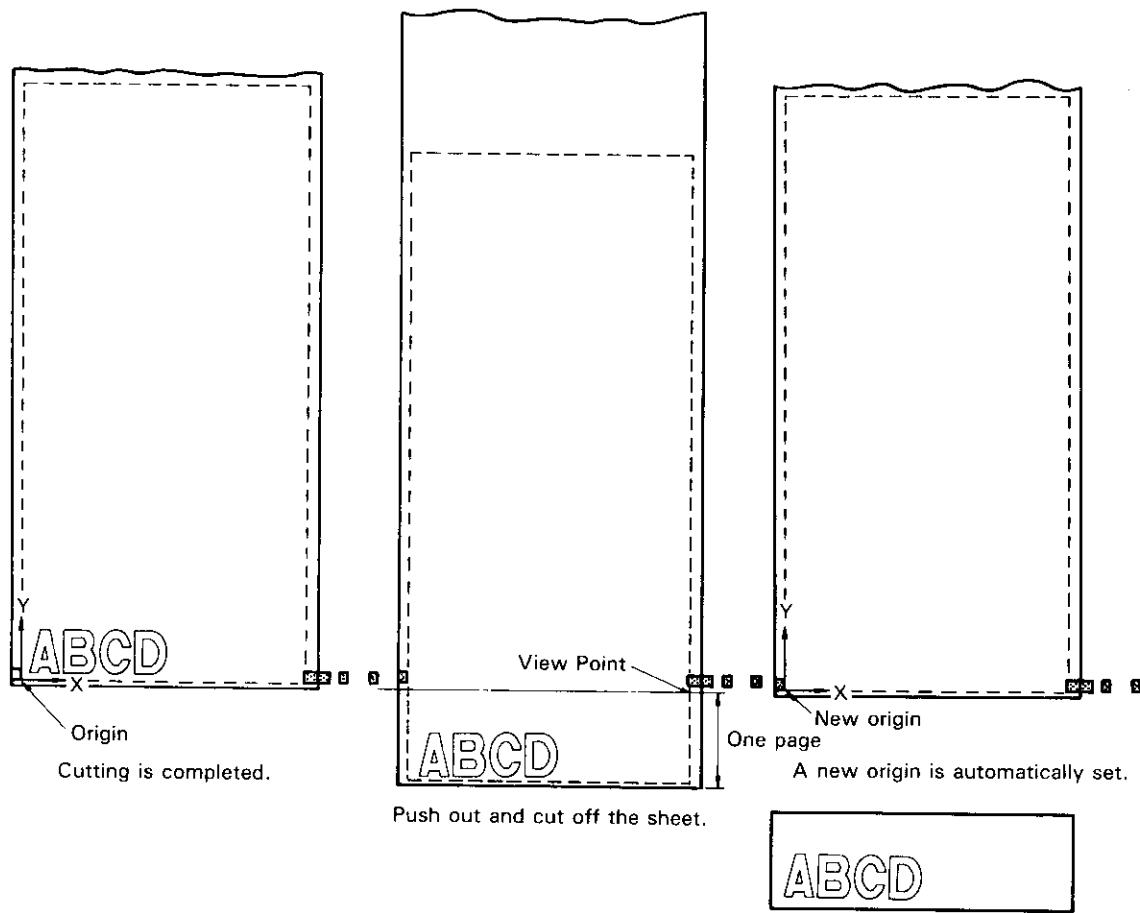


Fig. 3-6

Example: [FREE-Y] Mode Cutting

#### IV [EXPAND-X] Mode

The cutting area varies depending on the pinch roller positions as illustrated below. When you select [EXPAND-X] Mode, your CAMM-1 automatically detects where the pinch roller is currently located.

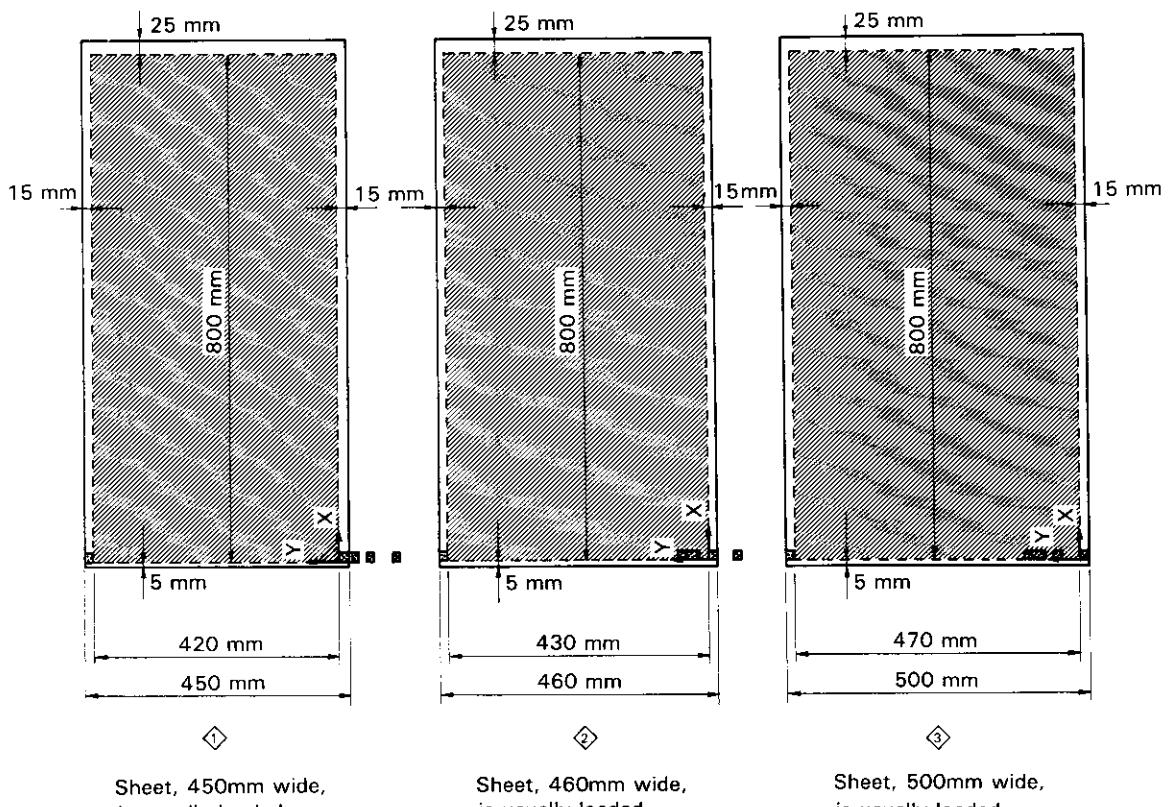


Fig.3-7

Each shaded areas are the cutting (plotting) areas of this mode.

[EXPAND-X] mode is suited for the orthogonal cutting of a label string with respect to the body of your CAMM-1. The cutting (plotting) area of this mode is wider than the widths of ISO A2 and ISO A3 size media. When you use ISO A2 and ISO A3 size media, you need to send data smaller than the widths of those media. Otherwise, the media slip off from the platen to make the cutting impossible.

To push out the sheet after cutting, use one of the sub-menus, [PAGE], of \*Move Sheet\* menu or the !PG command. When you specify [PAGE] or send the !PG command, the sheet is automatically pushed out forward in some page length, which depends on the sheet length you cut. You are now allowed to cut off the label cut area with the accessory sheet separator if you want. After this, a new origin is automatically set near the label cut area.

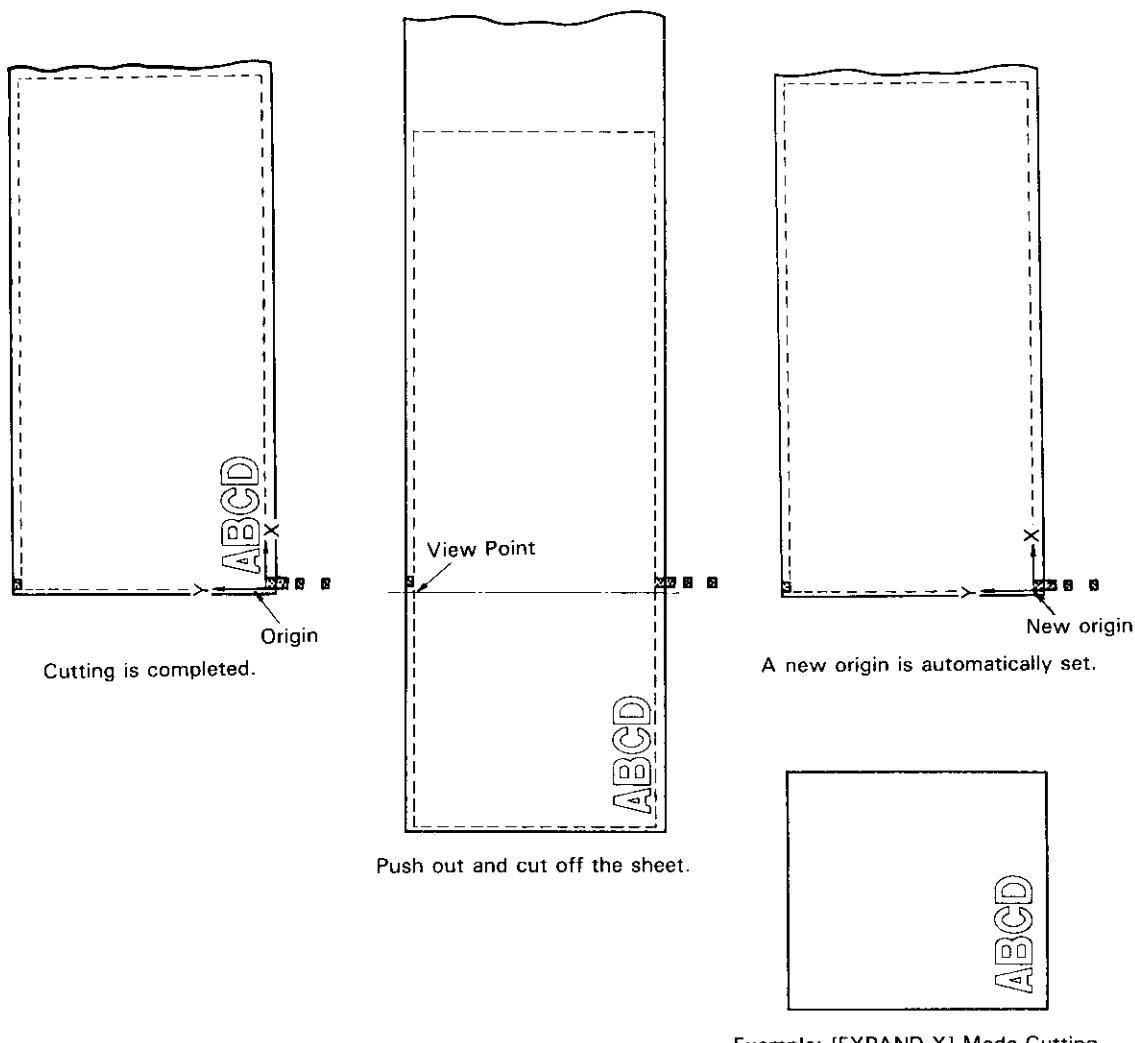


Fig.3-8

### V [ANSI B] Mode

(When a 431.8mm × 297.4mm sheet medium is loaded.)

When you select [ANSI B] mode, the cutting (plotting) area varies as illustrated below. The slider pinch roller is allowed to place over any one of the three grit rollers on the right-hand side. You just set it according to the sizes of sheet media you load.

When you use an ANSI B size sheet, move the slider pinch roller to the right-side edge of grit roller ②.

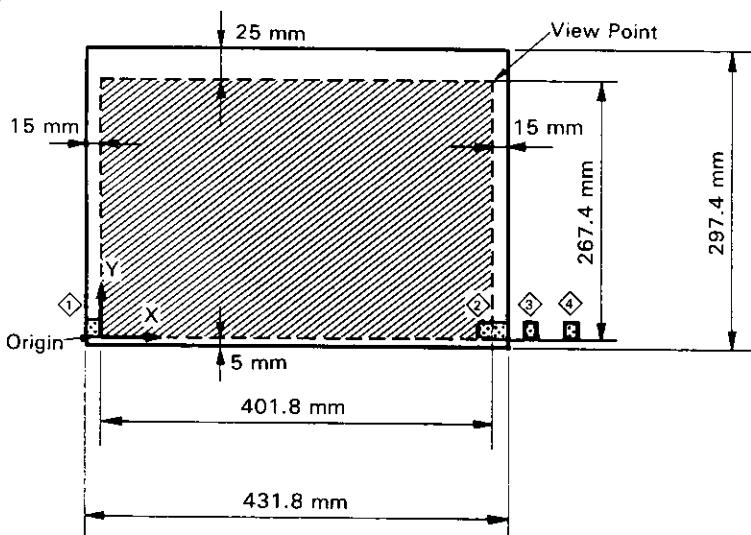


Fig. 3-9

The shaded area is the cutting (plotting) area of this mode.

[ANSI B] Mode is the best choice mode for use in plotting on an [ANSI B] size sheet outputting data from CAD software for use with your plotters. That is, it is a mode for [ANSI B] size plotters.

## VI [ANSI C] Mode

(When a 558.8mm × 431.8mm sheet medium is loaded.)

When you select [ANSI C] mode, the cutting (plotting) area varies as illustrated below. The slider pinch roller is allowed to place over any one of the three grit rollers on the right-hand side. You just set it according to the sizes of sheets you load.

When you use ANSI C size sheet, move the slider pinch roller to over grit roller ②.

When setting to positions ③ or ④, the origin, P1 and P2 automatically move, followed by ③ or ④.

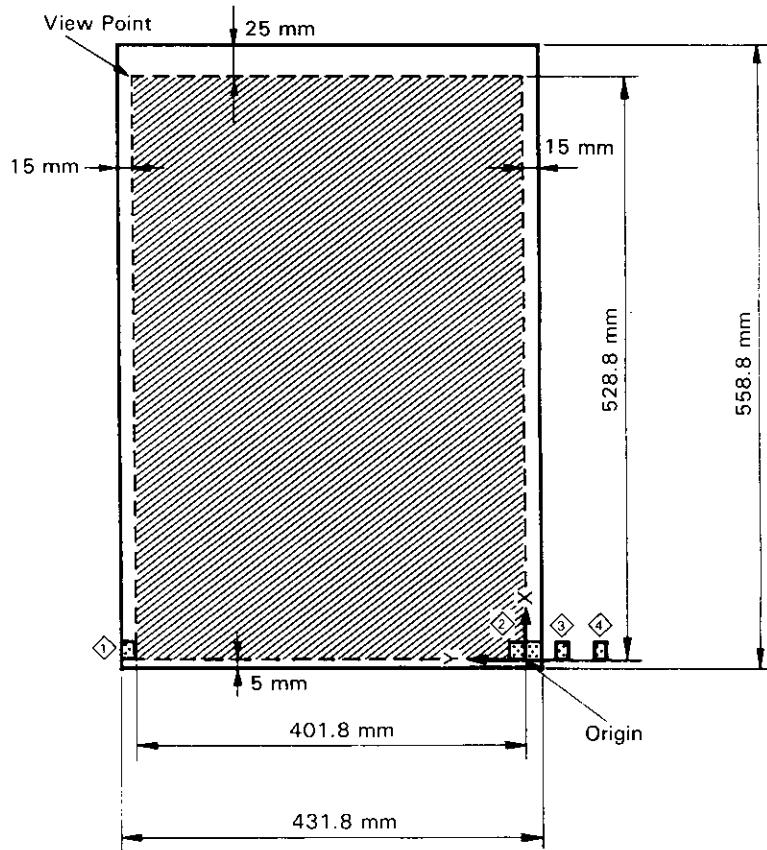


Fig. 3-10

The shaded area is the cutting (plotting) area.

[ANSI C] mode is the best choice mode for use in plotting on an [ANSI C] size sheet medium outputting data from CAD software for use with your plotter. That is, it is a mode for [ANSI C] size plotters.

The coordinates within ISO and ANSI are as follows:

For the coordinates of P1 and P2, refer to the section of IP Command in mode2, Part 2.

**ISO Pinch roller position**

		Media size	Lower-left coordinates	Upper-right coordinates	P1 default	P2 default
<b>ISO A2</b>	②	420 mm × 594 mm	0,0	22560,15600	600,600	21960,15000
	③	460 mm × 594 mm	0,0	22560,17200	..	..
	④	500 mm × 594 mm	0,0	22560,18800	..	..
<b>ISO A3</b>	②	420 mm × 297 mm	0,0	15600,10680	600,600	15000,10080
	③	460 mm × 297 mm	0,0	17200,10680	..	..
	④	500 mm × 297 mm	0,0	18800,10680	..	..
<b>FREE-Y</b>	②	420 mm × 830 mm	0,0	15600,32000	600,600	15000,10080
	③	460 mm × 830 mm	0,0	17200,32000	..	..
	④	500 mm × 830 mm	0,0	18800,32000	..	..
<b>EXPAND-X</b>	②	420 mm × 830 mm	0,0	32000,15600	600,600	21960,15000
	③	460 mm × 830 mm	0,0	32000,17200	..	..
	④	500 mm × 830 mm	0,0	32000,18800	..	..

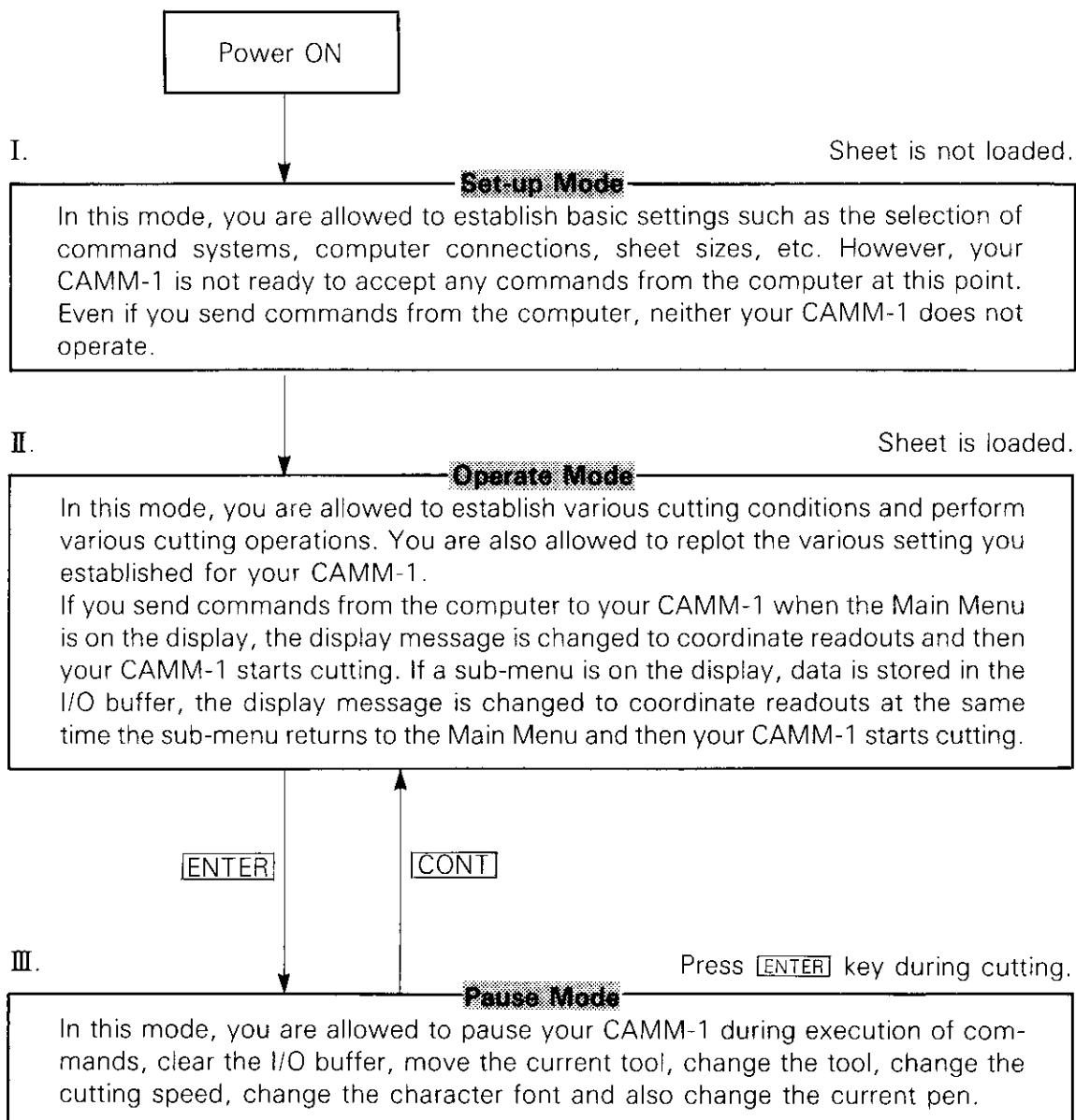
**ANSI Pinch roller position**

		Media size	Lower-left coordinates	Upper-right coordinates	P1 default	P2 default
<b>ANSI C</b>	②	431.8 mm × 558.8 mm	0,0	21152,16072	600,600	20552,15472
	③	460.0 mm × 558.8 mm	0,0	21152,17200	..	..
	④	500.0 mm × 558.8 mm	0,0	21152,18800	..	..
<b>ANSI B</b>	②	431.8 mm × 279.4 mm	0,0	16072,9976	600,600	15472,9376
	③	460.0 mm × 279.4 mm	0,0	17200,9976	..	..
	④	500.0 mm × 279.4 mm	0,0	18800,9976	..	..
<b>FREE-Y</b>	②	431.8 mm × 830 mm	0,0	16072,32000	600,600	15472,9376
	③	460.0 mm × 830 mm	0,0	17200,32000	..	..
	④	500.0 mm × 830 mm	0,0	18800,32000	..	..
<b>EXPAND-X</b>	②	431.8 mm × 830 mm	0,0	32000,16072	600,600	20552,15472
	③	460.0 mm × 830 mm	0,0	32000,17200	..	..
	④	500.0 mm × 830 mm	0,0	32000,18800	..	..

### 3.4 THE SET-UP MODE, OPERATE MODE AND PAUSE MODE

DESCRIPTION OF THE FUNCTIONS

Your CAMM-1 has three modes called Set-up Mode, Operate Mode and Pause Mode. By turning on the power, loading and unloading the sheet and pressing [FUNC] key on the front panel, your CAMM-1 enters Set-up Mode, moves from Set-up Mode to Operate Mode and moves from Operate Mode to Pause Mode. This mode transfer operation is explained below. (Refer to CAMM-1 Display Flowchart, APPENDIX E)



After power-on, your CAMM-1 enters Set-up Mode after the Opening Message is displayed for about 3 seconds.

When you load a sheet, your CAMM-1 enters Operate Mode. You are now allowed to send commands from the computer to your CAMM-1 to start cutting. If you press [ENTER] key during cutting, your CAMM-1 enters Pause Mode.

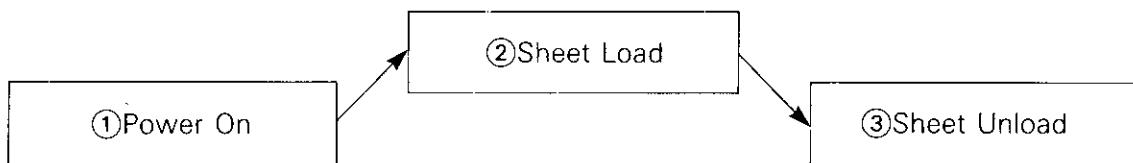
- ① Items such as cutting (plotting) speed, communication protocols between the computer and your CAMM-1, etc., that you can set to your CAMM-1 are called parameters. When you set such items, the parameters and the current settings are displayed.
- ② Parameters become active when you set. You do not need to reset them by booting. Also, those parameters are saved in memory of your CAMM-1 even if you turn off the power and remain in effect until you update them.  
(For the items to be saved, refer to 3.5 THE FACTORY-INSTALLED DEFAULTS.)
- ③ If you hold down [FUNC] key and turn on the power, you are allowed to reset all of the parameters you changed to the factory-installed defaults.

### 3.5 THE FACTORY-INSTALLED DEFAULTS

#### DESCRIPTION OF THE FUNCTIONS

Your CAMM-1 has internal memory to save various settings. Once saved, the settings will not be lost even if you turn off the power. This means that you can restart the same cutting operation again at the same time you turn on the power.

Among settings, you are allowed to change some settings by sending commands from the computer to your CAMM-1. Settings that can be saved in memory are the settings you set by the front panel only, but the settings you changed by commands cannot be saved in memory. This will be explained schematically below.



- ① At power-on, the settings saved in memory become active.
- ② When you load a sheet, your CAMM-1 becomes ready to accept commands from the computer. If you send some command like the one that changes the current settings, your CAMM-1 operates on new settings.
- ③ When you unload the sheet, the settings you changed by commands are lost and the settings you set by the front panel are returned to be active (or the settings at the time of power-on become active if you have not changed any settings by the front panel).

The factory-installed defaults are as follows:

Main Menu	Sub-menu	Option
<b>Configuration</b>	COMMAND INPUT STP DAT PTY BAND SIZE	mode1, mode2 PARALLEL, SERIAL 1, 2 7, 8 NON, EVN, ODD 15, 300, 600, 1200, 2400, 4800, 9600 ISO A2(A2), ISO A3(A3), FREE-Y, EXPAND-X (ANSI C, ANSI B)
<b>Parameters</b>	TOOL SPEED FONT  P-CH	CUTTER, PEN(1)~PEN(8) 1 ~ 15(cm/s) STEP 1(cm/s) OUTL., VECT. ANSI ASCII(1), ANSI ASCII(2), French/German, Scandinavian, Spanish, Special, JIS ASCII Roman, Katakana ISO I.R.V, ISO Swedish, Swedish Names, ISO Norway(1), ISO German, ISO French, ISO U.K, ISO Italian, ISO Spanish, ISO Portugal, ISO Norway(2) But there is no combination of [OUTL.] and [KATAKANA]. IGNORE, EFECTIVE
<b>Manual Cutting</b>	INPUT SIZE	ASCII 20 characters 30 (10 ~ 500(mm) STEP 1(mm))

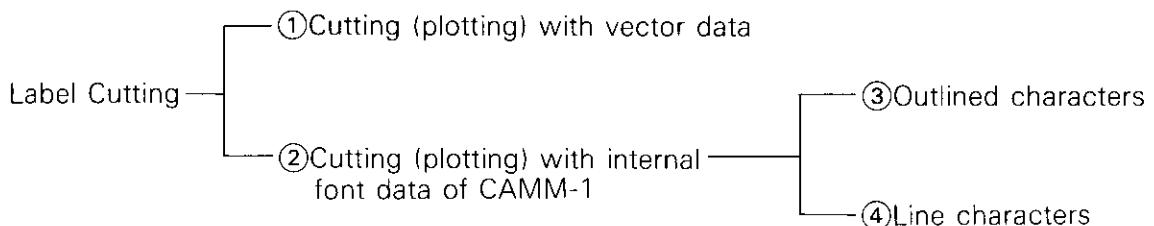
The shaded parameters are the factory-installed defaults.

After you changed the settings by the front panel, you are allowed to reset those settings to the factory-installed defaults by holding down **[FUNC]** key and turning on the power if you want. Remember that all of the settings are reset to the factory-installed defaults in this case.

## 3.6 THE CUTTING OF A LABEL STRING

### DESCRIPTION OF THE FUNCTIONS

The cutting of a label string is broadly divided into two ways, which are:



Method ① is to cut (plot) a single character one by one assuming it as a graphics. For example, the letter [A] is made up with three straight lines combined. If you want to cut this letter, you need to send three pieces of straight line data from the computer. This data is called vector data. Suppose that one character is designed with about 10 pieces of data. If you want to cut (plot) 10 characters as a string at once, you need to send 100 pieces of data. It means that this method takes too large data to cut (plot) a label string.

Method ② is to cut (plot) a label string with the internal character data of your CAMM-1, which is called font data. You just need to specify characters to cut (plot) in this method. In general, one character is designed with one piece of data. If you want to cut 10 characters, you just send 10 pieces of data only. It means that this method takes small data to cut (plot) a label string.

When you cut (plot) a label string with commercial software, you just select either Method ① or Method ②.

In addition, when you use Method ②, you are also allowed to select either ③ Outlined character or ④ Line character. Outline character mode is suited for use in cutting on sheets, and line character mode is suited for use in plotting on plotting media.

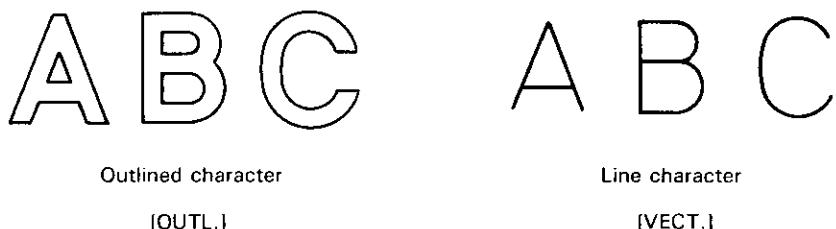


Fig.3-11

You are allowed to select [CUTTER] or any pen from [PEN(1)~{8}] as a tool.

You are allowed to select any pen from [PEN(1)~{8}]. When you select [CUTTER], ③Outlined character will be automatically entered.

### The I/O Buffer and The Replot Buffer

#### [The I/O Buffer]

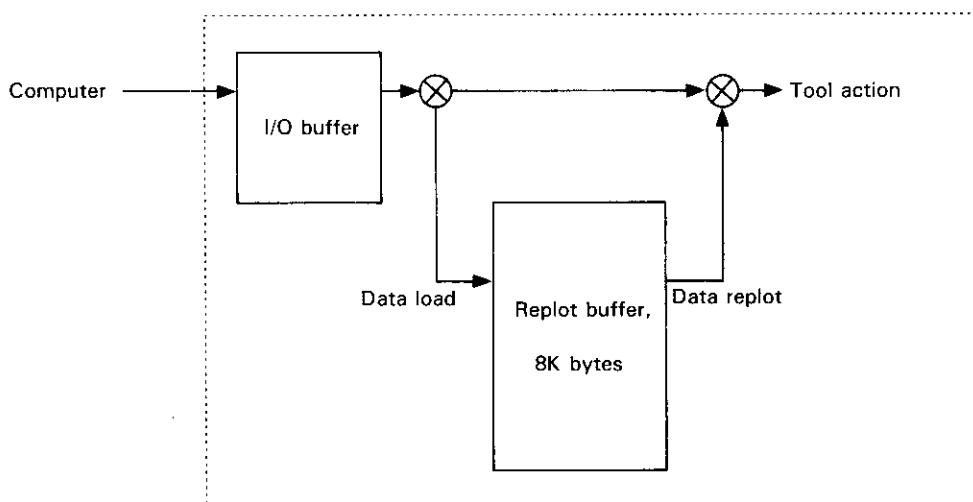
The operation speed of your CAMM-1 is slower than the computer's throughput speed. The computer therefore cannot move to another data processing until your CAMM-1 completes its entire operation. To reduce this computer waiting time, your CAMM-1 has a 1K-byte I/O buffer and performs cutting operations while storing data from the computer in this I/O buffer. Because your CAMM-1 stores all data in the I/O buffer even when it does not complete its entire cutting operation, the computer is able to complete the data processing pertaining to your CAMM-1 to reduce the waiting time.

To clear the I/O buffer, you just specify [BUF-CLR] on the front panel or turn off the power. Refer to 4.3 (6)②BUF-CLR of [Pause On] menu in CHAPTER 4, Part 1.

#### [The Replot Buffer]

Your CAMM-1 has another 8K-byte buffer called the replot buffer in addition to the I/O buffer. Your CAMM-1 is able to store data from the computer in this replot buffer once and output (replot) that data as any number of times as you want. It is also able to add another data to the previous data. The replot buffer is therefore very useful when you want to repeat the same cutting. The data in the replot buffer will not be lost even if you turn off the power, so that you are allowed to restart the same cutting again and again.

To clear the replot buffer, you just load new data. For more information, refer to 4.3 (5)-①REPLOT of \*Replot Mode\* in CHAPTER 4, Part 1.



Conceptual Data Flowchart

Fig. 3-14

Your CAMM-1 first stores data in the I/O buffer when it is sent from the computer. In Replot Mode, the remaining data in the I/O buffer continues to be sent to the replot buffer even if a data transfer from the computer is completed. The data load is therefore not completed instantaneously. It takes about 20 seconds to transfer 1K-byte data form the I/O buffer to the replot buffer.

Part I

## THE OPERATION PROCEDURE

4

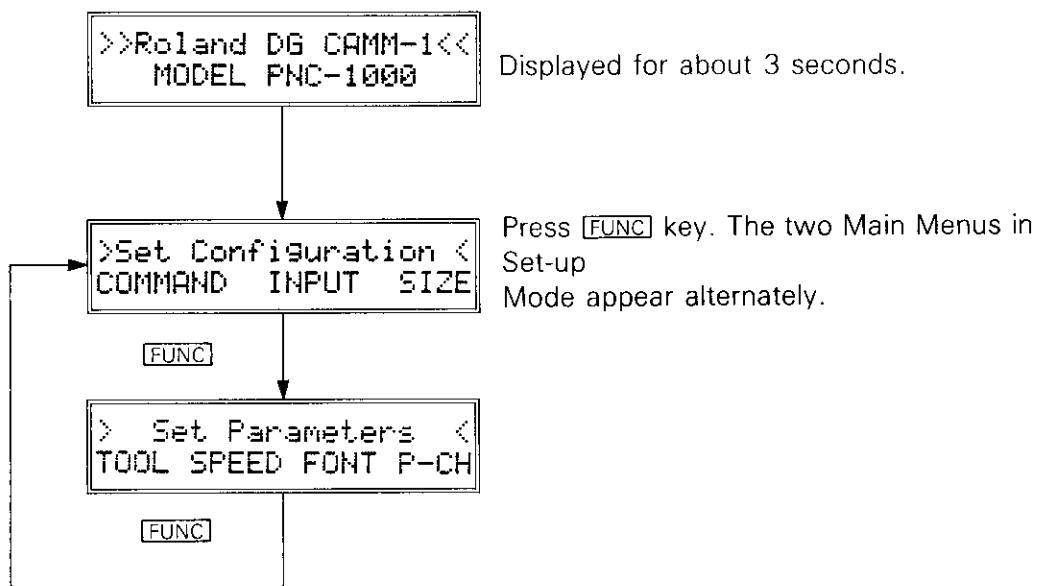
1-4



## 4.1 THE MAIN MENUS AND SUB-MENUS

### THE OPERATION PROCEDURE

With no sheet loaded, turning on the power switch lets the Opening Message appears on the display for about three seconds. The Opening Message and the two Main Menus in Set-up Mode look like this:

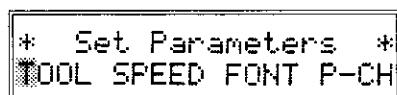


To display a sub-menu, move the highlighted cursor bar to the menu item you want to select using **◀** and **▶** keys and press **[ENTER]** key. Here's an sub-menu example.

Example: [ Set Command Mode ]  
model

There are seven display patterns, which are briefly explained below.

### Main menu display



This display is for one of the Main Menus. Asterisks (\*) are placed at the both sides of each Main Menu as illustrated. The Main Menus are looped. So, to move to the next Main Menu, press [FUNC] key.

Move the highlighted cursor bar to a function with **◀** and **▶** keys and press **[ENTER]** key, which takes you to the sub-menu display corresponding to the function.

### Sub-menu display

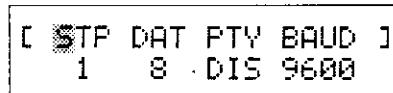


These displays are sub-menu examples. In these menu displays, you are allowed to change settings. Large parentheses ([ ]) are placed at the both side of each sub-menu as illustrated.

To display settings you can change, press **▲** and **▼** keys. To determine or make the setting you want to set active, press **[ENTER]** key.

If you press **[FUNC]** key without pressing **[ENTER]** key, the current setting is returned to the previous one. If you press **[FUNC]** key again, the next sub-menu appears without changing the current setting.

### Message that does not appear when not necessary



If you have selected [Parallel] Connection for the interface you want to use, [SERIAL] does not appear on the display because there is no need to set communication protocols for [SERIAL] Connection.

---

Coordinate display

---

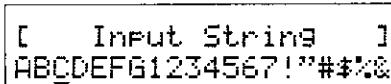


When you load a sticker sheet to let your CAMM-1 enter Operate Mode, \*Coordinate Display\* indicating where the cutter is currently located appears. This display is also on during cutting.

---

Input string display

---

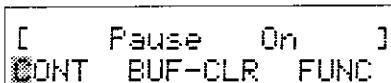


When you want to have manual cutting, you are allowed to input a label string with up to 20 characters.

---

Pause mode display

---

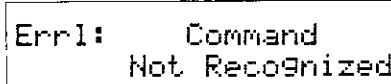


When you press [ENTER] key during cutting (plotting), Pause Mode enters and pauses the current cutting (plotting) operation. At this point, you are allowed to change various settings.

---

Error and warning messages

---



If an error occurs, its corresponding error message appears on the display. Pressing [FUNC] key clears the error message only, but not the error. To clear the error, send "IN;" "OE;" commands or unload the sheet.

---

# 4.3 THE OPERATION PROCEDURE OF YOUR CAMM-1

## THE OPERATION PROCEDURE

In this section, you will learn the operation procedure of your CAMM-1 when you execute each menu in detail. Each option menu will be explained under six items such as mode, function, option, default, equivalent command and save. Lets take a brief look at each item:

Mode	: indicates in which mode you can execute the function.
Function	: explains what type of function it is.
Option	: indicates what you can select from the current menu. And available sub-menus.
Default	: indicates a factory default. You are allowed to return your setting to this factory default by holding down [FUNC] key and turning on the power.
Equal command	: indicates the commands with which you can specify the same functions.
Save	: indicates "Yes" and "No" to save panel settings in non volatile memory.

(1)	>Set Configuration< COMMAND INPUT SIZE	<b>Set System Configuration</b>
-----	---	---------------------------------

Mode	: Set-up Mode
Function	: sets basic system configuration of your CAMM-1
Option	: [COMMAND] select command system [INPUT] select interface [SIZE] select sheet size

(1)-1	<b>COMMAND</b>	<b>Set Command System</b>
-------	----------------	---------------------------

Default	: mode1
Equal command	: none
Save	: yes
Option	: mode1 and mode2

### [Explanation]

Changes [mode1] and [mode2] alternately if you press **▲** and **▼** keys. You are allowed to determine the mode you just selected by pressing **ENTER** key. Pressing **FUNC** key takes you to the next sub-menu display without changing modes.

[mode1] has compatibility with the DXY-GL commands loaded in Roland DG plotters. Also, it has compatibility with the CAMM-GLI of CAMM-3 and with the CAMM-GLII(mode1) of CAMM-2.

[mode2] has compatibility with the RD-GL commands of Roland DG plotters. Also, it has compatibility with the CAMM-GLII(mode2) of CAMM-2.

[ Set Command Mode ]  
mode1

<b>(1)-2</b>	<b>INPUT</b>	<b>Set Interface</b>
--------------	--------------	----------------------

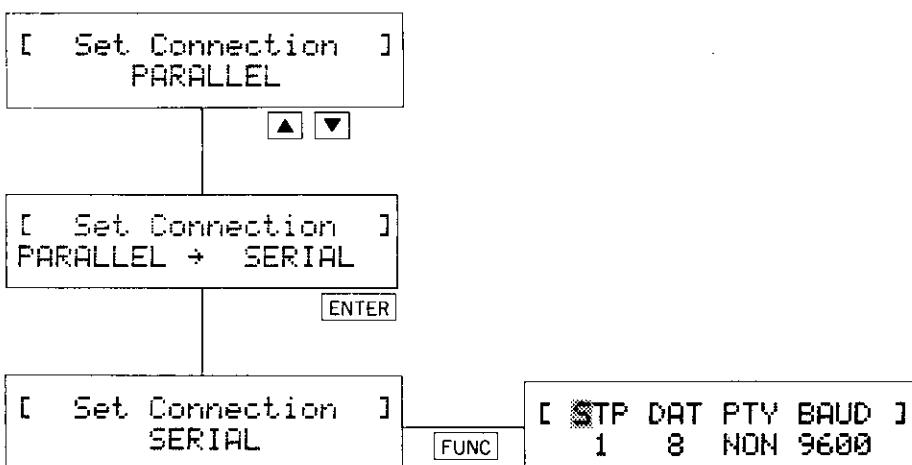
Default : [PARALLEL]  
 Equal command : none  
 Save : yes  
 Option : [PARALLEL]/[SERIAL]

**[Explanation]**

Sets an interface between your CAMM-1 and the computer. When you set Serial Connection, you also need to set communication protocols.

Press **▲** and **▼** keys to select either [PARALLEL] or [SERIAL]. You just select the same interface kind as the one connected to the computer. For the connection procedure to the computer, refer to 2.4 THE CONNECTION PROCEDURE TO THE COMPUTER in CHAPTER 2, Part 1.

When you select Serial Connection, this sub-menu automatically moves to [STP DAT PTY BAUD] sub-menu for setting communication protocols. What you need to set are as described Table 4-1. To set, use **▲**, **▼**, **◀** and **▶** keys.



<b>STP</b>	<b>DAT</b>	<b>PTY</b>	<b>BAUD</b>
STOP	DATA BIT	PARUTY CHEAK	BAND RATE
1 bit	8 bit	NONE	9600
2 bit	7 bit	ODD	4800
		EVEN	2400
			1200
			600
			300
			150

Table 4-1

<b>(1)-3</b>	<b>SIZE</b>	<b>Set Sheet Mode</b>
--------------	-------------	-----------------------

Default : [ISO A2]  
 Equal command : none  
 Save : yes  
 Option : [ISO A2], [ISO A3], [FREE-Y], [EXPAND-X]  
           ([ANSI C], [ANSI B])

#### [Explanation]

Specifies a mode of the sheet you selected for your CAMM-1. When you select ISO A2 or ISO A3 Mode, move the slider pinch roller to over the right-side edge of the left end grit roller among three on the right-hand side. (A2 and A3 size sheets cannot be fixed on the two right-hand side grit rollers. Neither, ANSI C and ANSI B size sheet media cannot be fixed.)

When you select [FREE-Y] or [EXPAND-X] Mode, the slider pinch roller is allowed to be placed over any one of the three grit rollers. You just set it according to the widths of sheets you load.

If you set the slider pinch roller at the ANSI position and load a sheet, your CAMM-1 is changed from ISO Mode to ANSI Mode. From now on, [ANSI C] and [ANSI B] will be displayed instead of [ISO A2] and [ISO A3].

When you plot with a POP art pen on an A2 or A3 size sheet medium, you usually select [ISO A2] or [ISO A3] Mode ([ANSI C] or [ANSI B] for C or B size) and set the slider pinch roller over the left-hand side grit roller among three (over the right-hand side grit roller for C or B size). And, when you use a 460mm sheet, you just set the slider pinch roller over the center grit roller among three. When you use a 500mm sheet, you just set the slider pinch roller over the right-hand side grit roller among three. Also, set these sheets to either [FREE-Y] or [EXPAND-X] Mode.

(2)	* Set Parameters *	Set Tool Parameter
-----	--------------------	--------------------

Mode : Set-up Mode, Operate Mode  
Function : sets cutting (plotting) conditions  
Option : [TOOL] set tool type  
[SPEED] set cutting (plotting) speed  
[FONT] select character font  
[P-CH] handl over pen change command

(2)-1	TOOL	Set Cutter (Pen)
-------	------	------------------

[ Set Tool ]  
TOOL:CUTTER

Default : [CUTTER]  
Equal command : IST  
Save : yes  
Option : [CUTTER], [PEN(1)], [PEN(2)], [PEN(3)],  
[PEN(4)], [PEN(5)], [PEN(6)],  
[PEN(7)], [PEN(8)]

**[Explanation]**

Displays [CUTTER] and eight pens from [PEN(1)] through [PNE(8)] when you press **▲** and **▼** keys. You are allowed to determine what you selected by pressing [**ENTER**] key. Pressing [**FUNC**] key takes you to the next sub-menu without changing any options. When you want to cut a sheet with a cutter, select [CUTTER]. When you use a pen, select a pen from the eight pens. In this case, your CAMM-1 starts plotting at the speed corresponding to the pen you selected when pen change commands (J,SP) are sent from the computer. So, you need to set a pen speed beforehand in (2)-2 [ Set Speed ] sub-menu below. And, if the pen number you set here is different from the pen number you specified with (2)-4 [Pen Change Command] sub-menu below when you set [EFFECTIVE] in [Pen Change Command] sub-menu, Pause Mode for a pen change enters. So, change the pen and press [**ENTER**] key to clear Pause Mode. However, if you set [CUTTER], [Pen Change Command] sub-menu is ignored.

The cutter tip is misaligned with the center axis, and if you connect two straight lines, some misalignment occurs at the intersection point. But if you select [CUTTER], this misalignment is automatically offset. This misalignment is not offset by any pen and the plotting quality is reduced. Set correctly to fit the tool you selected.

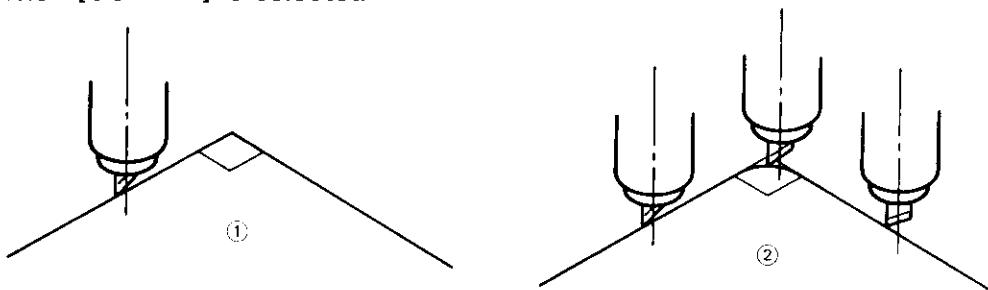
**--When [CUTTER] is selected --**

Fig. 4-1

If you move the cutter as illustrated in Fig. 4-1, the corner is rounded as illustrated in ② because the cutter is rotated. [CUTTER] offsets this tool movement. When you select any pen from [PEN], no tool offset is performed.

<b>(2)-2</b>	<b>SPEED</b>	<b>Set Cutting Speed</b>
--------------	--------------	--------------------------

Default : [CUTTER : SPEED:15cm/s], [PEN(X):SPEED:15cm/s]  
 Equal command : VS  
 Save : yes  
 Option : [CUTTER, PEN(1)~PEN(8)], [SPEED:2~15cm/s]

**[Explanation]**

Set cutting (plotting) speeds to [CUTTER] and eight pens from [PEN(1)] through [PEN(8)]. If the VS command that changes pen speeds is sent, the tool speed currently set in [Set Tool] sub-menu is newly set. But if you unload the sheet and enter Set-up Mode, the cutting (plotting) speed set by the VS command will be lost and returned to the speed you set here.

<b>(2)-3</b>	<b>FONT</b>	<b>Set Character Set</b>
--------------	-------------	--------------------------

Default : [OUTL.], [ANSI ASCII(1)]  
 Equal command : CA, CS, !SF  
 Save : yes  
 Option : [OUTL.], [VECT.], [ANSI ASCII(1)], [ANSI ASCII(2)],  
           [French/German], [Scandinavian], [Spanish],  
           [JIS ASCII], [ROMAN], [KATAKANA], [ISO I.R.V.],  
           [ISO Swedish], [Swedish Names][ISO Norway(1)],  
           [ISO German], [ISO French], [ISO U.K.], [ISO Italian],  
           [ISO Spanish], [ISO Portugal],  
           [ISO Norway(2)]

**[Explanation]**

Outlined and line characters are available with respect to 19 character sets. Here, you select one character set from the 19 characters and assumes it as the default. And, the character set you set here is set to both standard and alternate character sets. If the CA or CS command that changes character sets is sent, a new character set will be established. But if you unload the sheet and enter Set-up Mode, or if the IN or DF command is sent, the character set you set by the CA or CS command will be lost and returned to the character set you set here.

For the character sets, refer to 1.3.4 5 LABELING Command in CHAPTER 1, Part 2.

**(2)-4****P-CH****Handle Pen Change Command**

Default : [IGNORED]  
 Equal command : none  
 Save : yes  
 Option : [IGNORED] for ignoring pen change commands  
           [EFFECTIVE] for entering Pause Mode

**[Explanation]**

Sets how your CAMM-1 handles the pen change commands, J of mode1 and SP of mode2, sent from the computer.

When you set [IGNORED], your CAMM-1 ignores the pen change commands. When you select [EFFECTIVE], your CAMM-1 displays as show below and pauses if it receives a pen change command.

[      Pause      On      ]  
 Pen Change Received!

Replace the pen and press [ENTER] key to proceed with the cutting operation.

However, if you have selected [CUTTER] in [Set Tool] sub-menu, your CAMM-1 ignores the pen change commands.



Since the command system of your CAMM-1 has compatibility with Roland DG XY plotters, you are allowed to operate your CAMM-1 with CAD software for use with XY plotters. You can attach eight pens to an XY plotter and also set which pen the XY plotter uses to plot. But if a pen change command (J command of mode1 or SP command of mode2) is sent when you are using CAD software on your CAMM-1, your CAMM-1 cannot replace any pens. To cope with such a situation, [Pen Change Command] menu is used.

**(3)**

\* Manual Cutting \*

STRING SIZE OUTPUT

**Set Manual Cutting Mode**

- Mode : Operate Mode  
 Function : cuts a label string with 20 characters by CAMM-1 only  
 Option : [STRING] Input String  
           [SIZE] Set Character Size  
           [OUTPUT] Output String

**(3)-1****STRING****Create Label String**

- Default : Space equivalent to 20 characters  
 Equal command : none  
 Save : yes  
 Option : [ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz uvwxyz'@!'"#\$%&()'\*,.-./;,<=>?[<]>^-[{}]-0123456789]

**[Explanation]**

Creates a label string with up to 20 characters or symbols described in Option above. As the default, space equivalent to 20 characters is provided. To type in characters, press **▲** and **▼** key. Characters then appear on the display in order. Whenever a necessary character appears, press **►** key and move to another necessary character. When you want to place space between characters, insert space where you want. There is no need to fill the space with characters. You can insert space at any place you want. Your CAMM-1 will not cut space any way. Here is an example.

Example: Type in "for SALE".

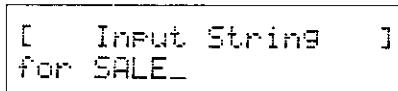
[      Input String      ]
_____

Press **▲** key to display "f".

If the letter f appears, press **►** key to move the underbar to the right. To return the underbar back, press **◀** key.

[      Input String      ]
f_____

Similarly, press **▲** and **▼** keys to display **□**.  
In turn, type in [r SALE].



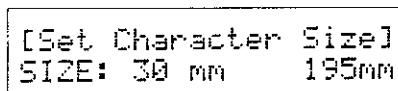
When you are finished typing in a character string, press **[ENTER]** key to make the character string active.

<b>(3)-2</b>	<b>SIZE</b>	<b>Set Character Width</b>
--------------	-------------	----------------------------

Default : 30  
Equal command : None  
Save : yes  
Option : 10mm~500mm

#### **[Explanation]**

Sets the width of one character in a label string you cut manually in the unit of mm.



Width of one character    Width of a label string

Press **▲** and **▼** keys to display a value you want to set. Press **[ENTER]** key to determine the value.

When you are finished changing, press **[FUNC]** key.

#### **NOTE**

In manual cutting mode, the character size is not be affected by command-using setting changes. This means that the characters are not changed by the S, SI, SR and SL commands.

**(3)-3****OUTPUT****Cut Label String****[Explanation]**

Cuts the label string you created in [Input String] sub-menu. Press **ENTER** key, and then a label string appears. If you accept the label string, press **ENTER** key again to determine. Then your CAMM-1 starts cutting from the current cutter position as the reference point. Pressing **FUNC** key takes you to the next sub-menu without cutting.



Fig. 4-2

**(4)**

[	Move Sheet	]
PAGE	VIEW	ORIGIN

**Sheet Move Functions**

Mode

: Operate Mode

Function

: moves sheet temporarily

Option

: [PAGE] for moving to sheet separate point and  
setting new origin

[VIEW] for moving to view point

[ORIGIN] for moving to origin

**(4)-1****PAGE****Push Sheet Forward**

Equivalent command : !PG

**[Explanation]**

Pushes out the sheet one-full page forward after the cutting (plotting) is completed. You are now allowed to cut off the sheet with the accessory sheet separator. One-full page plus 84 mm (=19mm + 65mm) is pushed out. 19 mm is the extra length which is automatically inserted between the current and next pages. 65 mm is part of the next page, but pushed out so that you can cut off with ease. When you move the tool carriage after separating, this 65 mm is pushed back and a coordinate origin is newly set. Then the next page (which becomes the current page now) starts moving for new cutting.

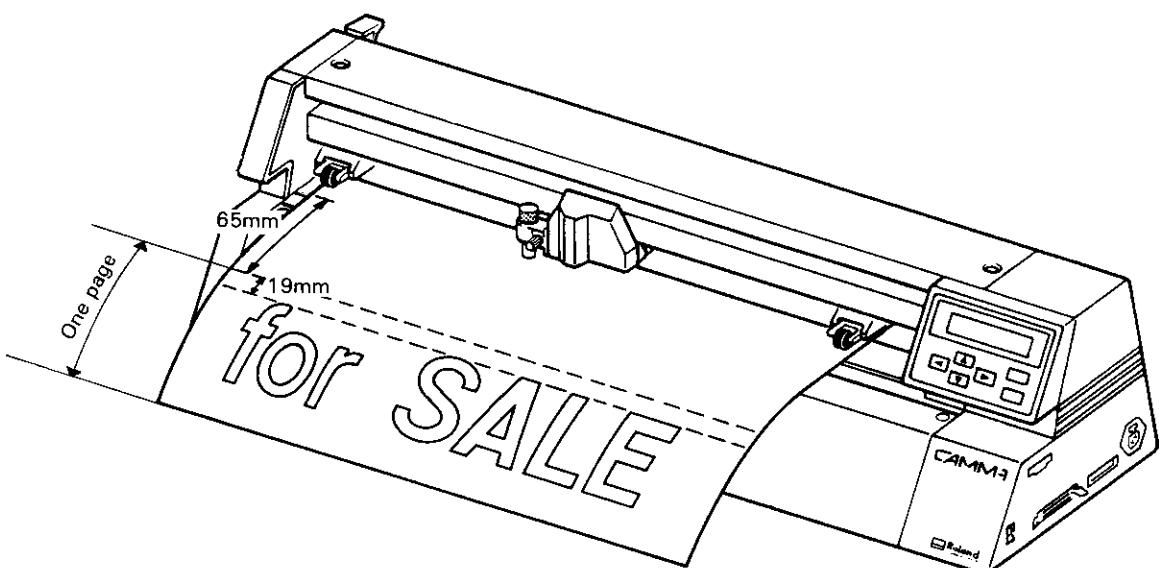
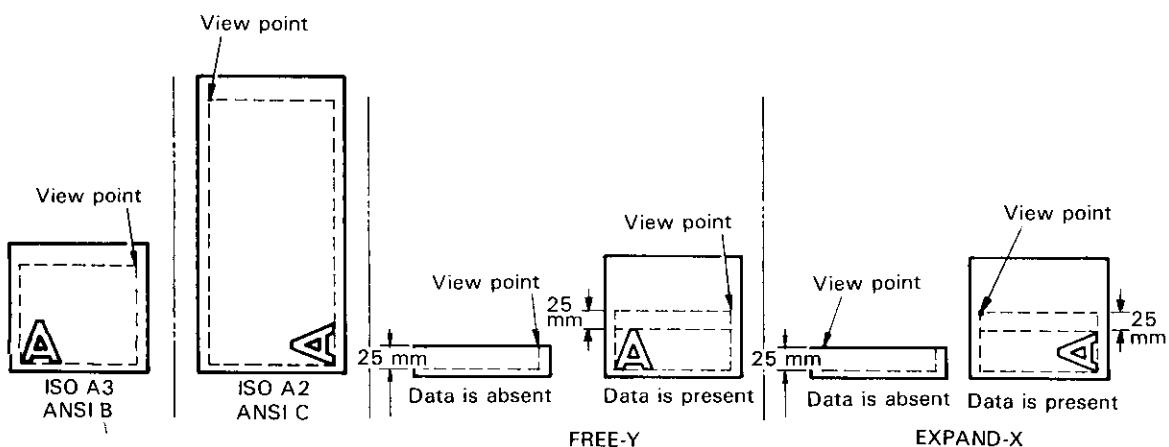


Fig. 4-3

<b>(4)-2</b>	<b>VIEW</b>	<b>Move to View Point</b>
--------------	-------------	---------------------------

**[Explanation]**

Moves the tool carriage to View Point and pushes out the sheet forward. You are now allowed to check to see how the current cutting (plotting) is going on on the way. The coordinates of View Point are the maximum values of X-axis and Y-axis in the cutting area. However, when you select [FREE-Y] or [EXPAND-X] Mode, it is the maximum values of the area cut + 25mm. Therefore, if nothing has been cut, View Point will be set as follows:

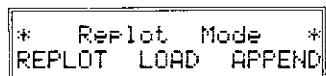


View Point According to Various Sheet Sizes

**(4)-3****ORIGIN****Move to Origin****[Explanation]**

Moves the current tool to the origin.

The position of the origin varies depending on the sheet sizes. For more information, refer to 3.3 SOME DIFFERENCES BETWEEN THE SHEET SIZES in CHAPTER 3, Part 1.

**(5)****Set Replot Function**

Mode

: Operate Mode

Function

: replots data stored in replot buffer

Option

- : [REPLOT] for replotting data
- : [LOAD] for loading replot data
- : [APPEND] for appending data to replot buffer data

**(5)-1****REPLOT****Replot Data****[Explanation]**

Replots the data stored (loaded) in the replot buffer. You are allowed to set a cutter (pen) and replot the data.

Since your CAMM-1 has an 8K-byte replot buffer and stores cutting (plotting) data in the replot buffer. By replotting the replot buffer data many times, you are allowed to perform the same cutting as any number of times as you want. Once loaded, the data

is saved in memory of your CAMM-1, and you can have the same cutting again and again even if you disconnect your CAMM-1 from the computer. Also, since the data will not be lost even if you turn off the power, you can restart the same cutting after turning on the power.

If no data is loaded in the replot buffer, the following warning message appears and blinks on the display for about 3 seconds. In this case, load data.

Replot Buffer is  
Empty, Load Data.

The replot buffer data is cleared if you load new data. There is another way to clear the replot buffer data. That is to hold down [FUNC] key and turn on the power (equivalent to resetting your CAMM-1 to the factory-installed defaults). Remember that in this case all of the current settings will be returned to the factory-installed defaults.

<b>(5)-2</b>	<b>LOAD</b>	<b>Load Data to Replot Buffer</b>
--------------	-------------	-----------------------------------

**[Explanation]**

Loads data in the replot buffer.

No cutting is performed on the way of data loading. If you load data when some data remain in the replot buffer, this new data will be overwritten over the remaining replot buffer data from the beginning.

Load Mode: Send Data

Requests data sending if you select [LOAD] sub-menu.

Now Loading Data...

Displays how data is loading in the replot buffer when you send data from the computer.

Memory Full !  
Stop Sending Data

Displays this error message if the 8K-byte replot buffer is fully occupied.

When this error message appears, first stop the data transmission from the computer and then press [FUNC] key of your CAMM-1. If you press [FUNC] key without stopping the data transmission, you cannot clear the error. Although the data remains in the replot buffer even when this error message appears, the last data will be destroyed to become an abnormal form in most cases. We cannot guaranty further replot operations. In addition, your CAMM-1 loads data in the replot buffer while checking to see whether the coming data is correct. If an error occurs in the data, your CAMM-1 displays the following error message and stops the data loading.

Replot Data Error Stop Sending Data
--

When this error message appears, first stop the data transmission from the computer and then press [FUNC] key of your CAMM-1. If you press [FUNC] key without stopping the data transmission, you cannot clear the error.

<b>(5)-3</b>	APPEND	<b>Load Additional Data to Existing Data</b>
--------------	--------	--

#### [Explanation]

Loads additional data to the existing replot buffer data. The additional data is combined with the existing data to integrate into a piece of data.  
Similar to the case of LOAD, your CAMM-1 displays error messages if an error occurs in the data, or if the replot buffer is overflowed. In such a case, first stop the data transmission from the computer and then press [FUNC] key to clear the error.

Now Loading Data... 
--

Displays how additional data is loading to the existing replot buffer data when you send data from the computer.

Memory Full! Stop Sending Data
-----------------------------------

Displays the error message if the 8K-byte replot buffer is fully occupied.

First stop the data transmission from the computer and then press [FUNC] key to clear the error.

<b>(6)</b>		<b>Pause Current Cutting</b>
------------	--	------------------------------

- Mode : Operate Mode, Replot Mode  
 Function : stops cutting (plotting) operation temporarily and changes settings.  
 Option : [CONT] for clearing Pause Mode (or continuing Operate Mode)  
           [BUF-CLR] for clearing I/O buffer  
           [FUNC] for selecting other sub-menus

**[Explanation]**

Enters Pause Mode to stop the current cutting (plotting) operation if you press **[ENTER]** key during cutting (plotting).

In reality, your CAMM-1 does not stop immediately after you press **[ENTER]** key. It continues to cut up until the end point of the current vector data and stops there with the tool up. You are also allowed to pause on the way of replotting if you want.

<b>(6)-1</b>	<b>CONT</b>	<b>Continue Current Cutting</b>
--------------	-------------	---------------------------------

**[Explanation]**

Clears Pause Mode and continues the current cutting (plotting) operation.

<b>(6)-2</b>	<b>BUF-CLR</b>	<b>Clear I/O Buffer</b>
--------------	----------------	-------------------------

Equivalent command : ESC. K (Serial Connection only)

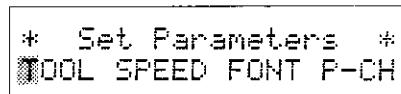
**[Explanation]**

Clears the cutting (plotting) data stored in the I/O buffer.

When you want to stop the current cutting (plotting) operation on the way during cutting, stop the cutting operation by [Pause On] menu to clear the I/O buffer. If you select [BUF-CLR] during replotting, the replot buffer will not be cleared, but your CAMM-1 interrupts the replotting on the way and returns to the Main Menu.

<b>(6)-3</b>	<b>FUNC</b>	<b>Set Other Functions During Pause</b>
--------------	-------------	---

Option : [Move Sheet] [Set Parameters]

**[Explanation]**

Allows you to have a temporary sheet move and a parameter change which you can do routinely in Pause Mode.

You are also allowed to see how the cutting is going on and change the cutting conditions during cutting (plotting). For these procedures, refer to each section in this operation manual.

<b>(7)</b>		<b>Other Functions</b>
------------	--	------------------------

<b>(7)-1</b>	<b>COMMAND INPUT SIZE</b>	<b>Verify Default Conditions</b>
--------------	---------------------------	----------------------------------

**[Explanation]**

Allows you to verify the current conditions you set in Set-up Mode if you hold down ▲ key and press **FUNC** key when Main Menu displays other than [Coordinate Display] are appearing in Operate Mode.

Example



After you verify the default conditions, press **▲ + FUNC** key. This takes you to the previous display.

<b>(7)-2</b>	X = 100mm Y = 200mm	<b>Change Coordinate Unit</b>
--------------	---------------------	-------------------------------

Default : [1/40mm] unit

#### [Explanation]

Allows you to change the unit of coordinates to mm if you hold down **ENTER** key and press **▲** key when [Coordinate Display] is appearing in Operate Mode. Hold down **ENTER** key and press **▼** key to return mm to the [1/40mm] unit.

Example



Any decimal unit figures are cut off.

<b>(7)-3</b>		<b>Tool Up/Down</b>
--------------	--	---------------------

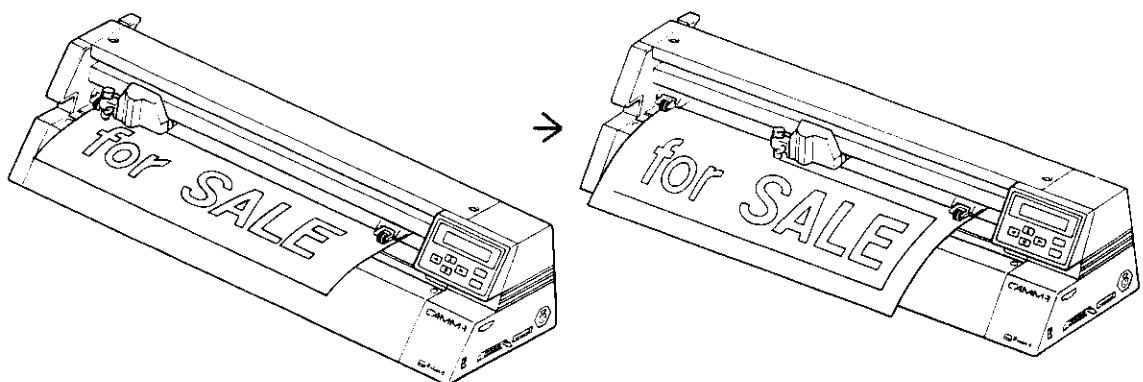
To move the tool down temporarily, press **▼** key while pressing **ENTER** key in Operate Mode when the tool coordinates are appearing on the display. To move the tool up, press **▼** key again while pressing **ENTER** key.

If a tool up command is sent when you are using this function to move the tool down, the tool will move up. (Example: M, PU;, etc.)

This function is useful when you want to cut around the character stickers already cut as illustrated below.

## THE OPERATION PROCEDURE

---





**Part I**

## **INFORMATION ABOUT CUTTERS AND SHEETS**

**5**

**1-5**



## 5.1.1 The Types of Cutters

The following cutters are available for use with your CAMM-1.

Part name	Cutter name	Remark	Available cutting length
ZEC-U1005	Cemented carbide cutter	A set of 5 cutters	3000 mm
ZEC-S1003	Sapphire cutter	A set of 3 cutters	8000 mm

The cutter supplied with your CAMM-1 is a cemented carbide cutter.

Cutters are all expendable goods. Sooner or later the cutter currently under use becomes dull as cutting continues. If you increase the pen force, the sharpness may be recovered a little bit, but it may not be as sharp as a new one. So, when you find it does not cut well, replace it with a new one.

The available cutting lengths of the cutters vary greatly depending on the conditions of sheet such as thickness, hardness, adhesive material, etc. If you increase the pen force, the cutter wears out faster. So, set it to the appropriate value.

## 5.1.2 The Replacement Procedure of Cutters

As described below, pull out the cutter using the accessory tweezers.

Then insert a new cutter using the accessory tweezers also. At this point, do not touch the cutter edge with the accessory tweezers. This is because the cutter edge is very delicate and is broken easily even by very little impact. As a result, cutting may not be performed.

## INFORMATION ABOUT CUTTERS AND SHEETS

---

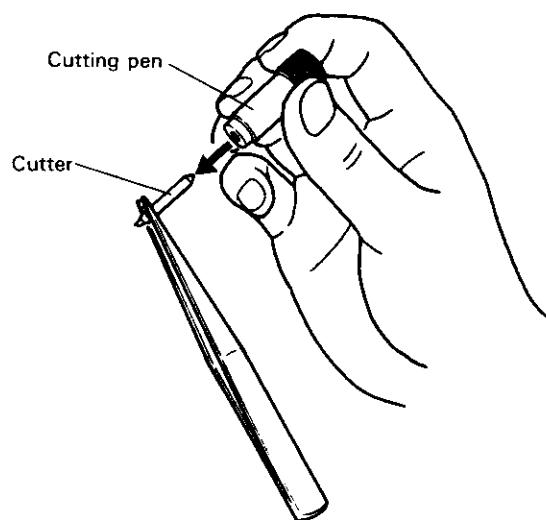


Fig. 5-1

#### 5.2.1 The Types of Sheets

The accessory test sheet are the same as those of Design Sheet DS Series (46cm × 20m) by SUMITOMO 3M. Your CAMM-1 is able to cut equivalent sheets. If you want to purchase roll sheet, contact to SUMITOMO 3M or its agency.

In addition, your CAMM-1 is suited for sheets with the following conditions. If you use other than the one we specified, meet the following conditions.

Material : vinyle chloride

Thickness : below 0.12mm

Width : 46cm or 50cm

#### CAUTIONS

- Sheets other than the above may not be suitable for your CAMM-1 eve if they are made by the same manufacturer.
- Depending on the materials of sheet and its base, the sheet may be separated from its base and produce bubbles and wrinkles during cutting, especially when the cutting temperature and speed, as well as, how you handle are fell on.
- Too wide and too narrow sheet cannot be loaded to your CAMM-1.
- Too long sheet (with too big roll diameter) cannot be put on the sheet roller base.
- Too hard sheet cannot be cut.

SUMITOMO 3M application sheet, 91cm × 100mm, is also suited. We do not sell application sheet only. If you want to use this application sheet, contact to SUMITOMO 3M or its agency.



Part I

## THE CUTTING PROCEDURE OF SHEETS

6

1-6



## 6.1 SOME TASKS BEFORE GETTING STARTED

### THE CUTTING PROCEDURE OF SHEETS

In this chapter, you will learn in detail the step-by-step procedures of actual cutting using an accessory sheet supplied for test as well as of affixing the character stickers you cut on. The explanation given here assumes that your system is configured with the following conditions. If your computer and software are different, or if the connecting cable between your CAMM-1 and computer is different, you need to change them to re-configure your system so that you can execute a cutting operation. The conditions are:

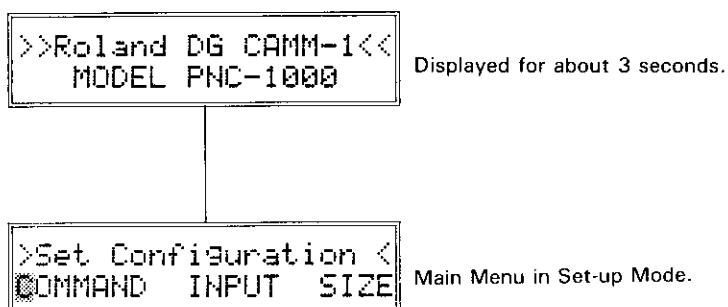
- Computer ..... IBM-PC, PC/XT, PC/AT
- Software..... BASIC
- Cable ..... XY-RS-13,33(PC/XT,PC) 14,23(PC/AT)
- Interface ..... Serial (RS-232C) Connection
- Protocol..... 9600 baud, None parity, 8 bits, 1 bit
- Command mode ..... mode1
- Sheet size..... FREE-Y Mode

Before getting started, check to see that:

- CAMM-1 is set up correctly.
- CAMM-1 is OFF.
- CAMM-1 is connected to the computer correctly.

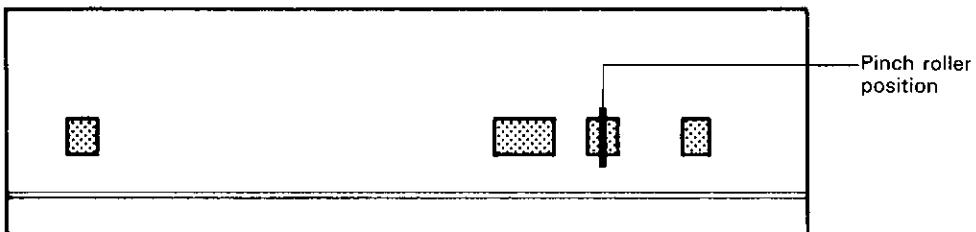
If there is no problem, turn on the computer and boot BASIC. Then proceed with the following step-by-step procedure.

- ① Hold down **FUNC** key and turn ON the power switch of your CAMM-1. Then the Main Menu in Set-up Mode appears followed by the Opening Message, which look like this:



- ② Set [COMMAND], [INPUT] and [SIZE] referring to 4.3 \*Set Configuration\* menu in CHAPTER 4, Part 1 following the table below. The width of the accessory sheet you use here is 460mm.

Item	Sub-menu	Remarks
[COMMAND]	[Mode 1]	Test program has been written in mode1 commands.
[INPUT]	[SERIAL]	Test program has been written so that it is output from a SERIAL (RS-232C) interface. 9600,NONE,8,1
[SIZE]	[FREE-Y]	This mode is suited for cutting characters horizontally.



- ③ Attach a cutter to the tool holder. In turn attach the tool holder to the tool carriage.  
 ④ Insert the sheet into your CAMM-1 from the back, align it with the reference line, hold down the sheet loading lever and press [FUNC] key to load the sheet.  
 ⑤ Then the following \*Coordinate Display\* menu appears.

*Coordinate Display*		
X=	0.Y=	0

## 6.2 THE SHEET CUTTING OPERATION

### THE CUTTING PROCEDURE OF SHEETS

- ⑥ Type in a program to the computer and execute the program as follows:

```
100 '***** CAMM-1 CHECK *****
110 OPEN "COM1:9600,N,8,1,CS65535,DS65535" AS #1
120 PRINT #1,"^IN"
130 PRINT #1,"^VS10"
140 PRINT #1,"^SI4,5"
150 PRINT #1,"^PA0,1000"
160 PRINT #1,"PDESKTOP"
170 PRINT #1,"H"
```

#### [Explanation]

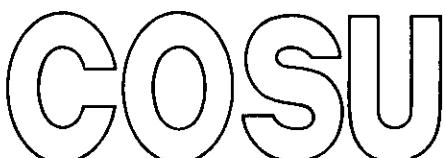
Line

- 110      Opens the SERIAL (RS-232C) port.
- 120      Initializes your CAMM-1.
- 130      Sets the cutting speed to 10cm/sec.
- 140      Sets the character size to horizontal 4cm x vertical 5cm.
- 150      Moves the cutting start point so that the lower parts of characters are not cut.\*
- 160      Cuts a label string "DESKTOP".
- 170      Returns to Home position.

About \*

Character fonts, including arc portions, like the letters C and O are designed slightly larger than the others in order to align visual balance with respect to the sizes of characters. Because of this, if you start cutting a label string from XY origin (0,0), the lower parts (arc portions) of those characters are cut off.

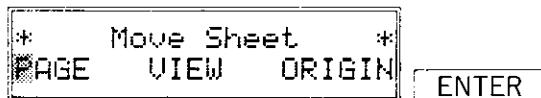
Example:



To prevent this, move the cutter slightly to the + side of Y axis beforehand.

## THE CUTTING PROCEDURE OF SHEETS

- ⑦ Press **[FUNC]** key once to display \*Move Sheet\* menu. Be sure the cursor lights up on PAGE and press **[ENTER]** key.



- ⑧ The current cutting page is pushed out forward. Separate it with the accessory sheet separator.

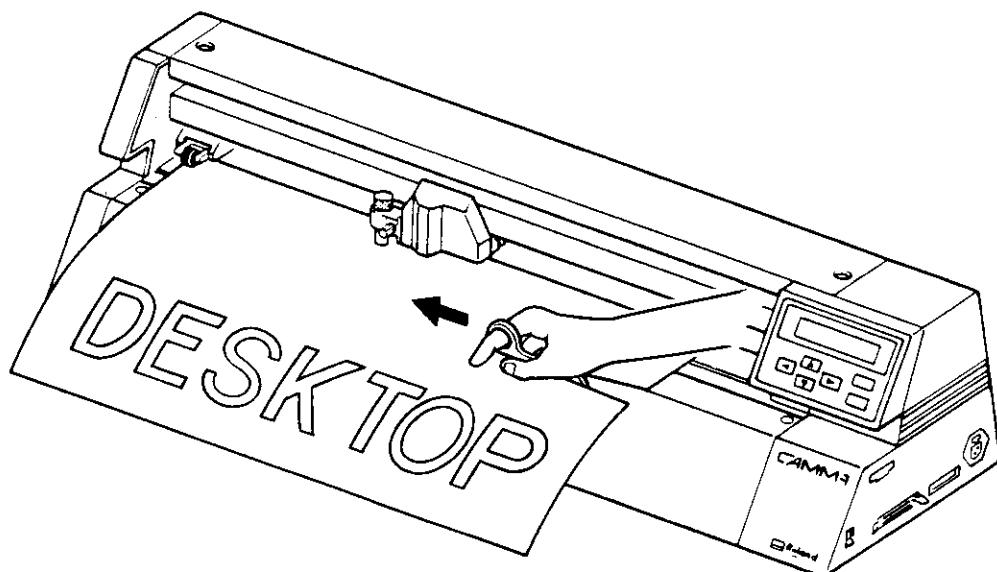
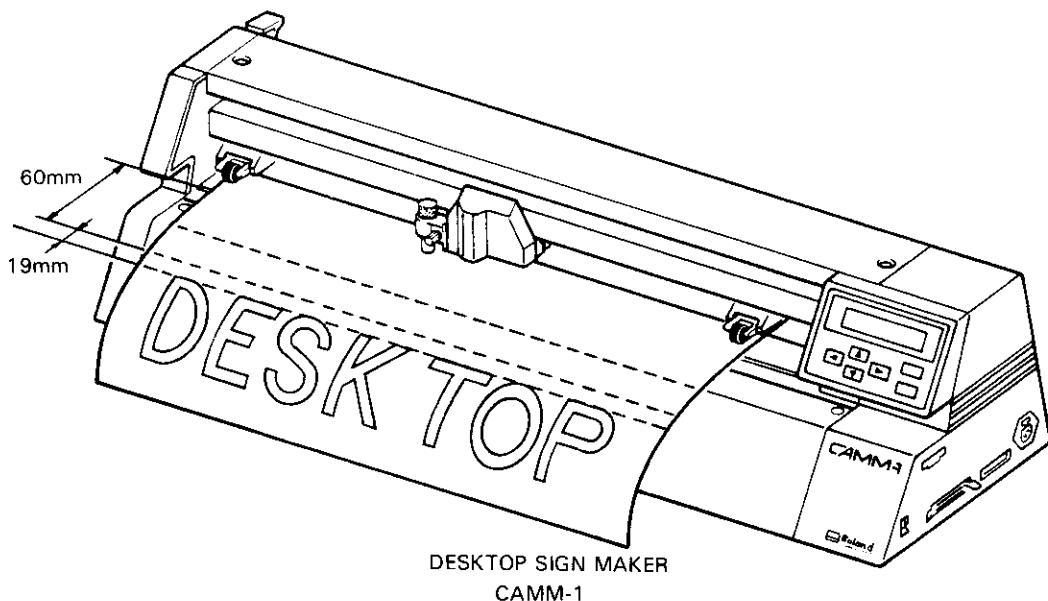


Fig. 6-1

## 6.3 THE APPLICATION SHEET CUTTING OPERATION

THE CUTTING PROCEDURE OF SHEETS

- ⑨ Put the separated sheet on a flat table and cut around the character stickers with a cutter as illustrated below. Do not cut hard so that the base of the sheet is not cut off.



Fig. 6-2

- ⑩ Peel unnecessary part of the sheet with the accessory tweezers as illustrated below. Pay attention when you peel detailed portions.

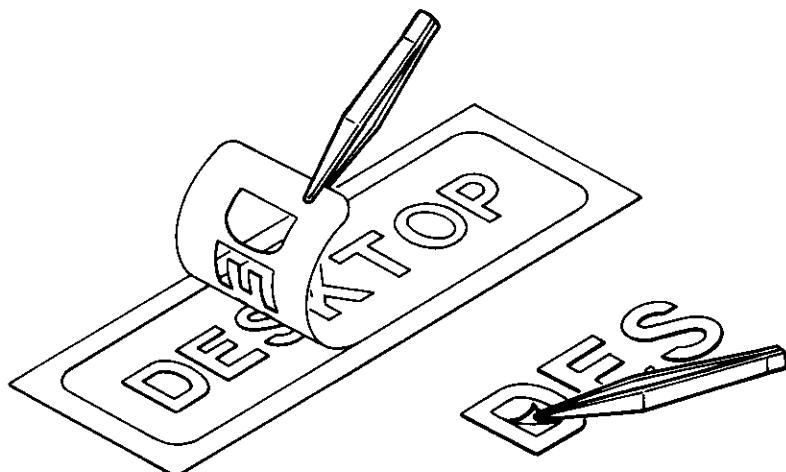


Fig. 6-3

## THE CUTTING PROCEDURE OF SHEETS

---

- ⑪ Cut an application sheet to a proper size and affix it on the character stickers so that the character stickers are adhered to the application sheet as illustrated below.

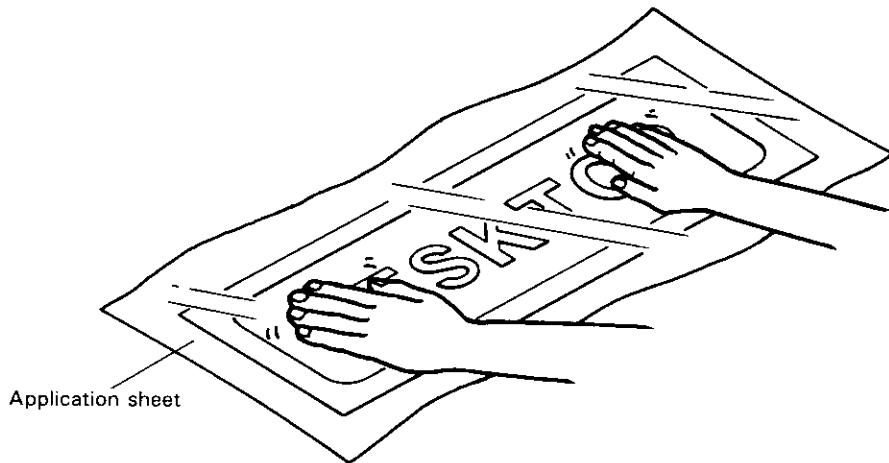


Fig. 6-4

- ⑫ Cut off the application sheet to make it about the same sheet size as illustrated below.

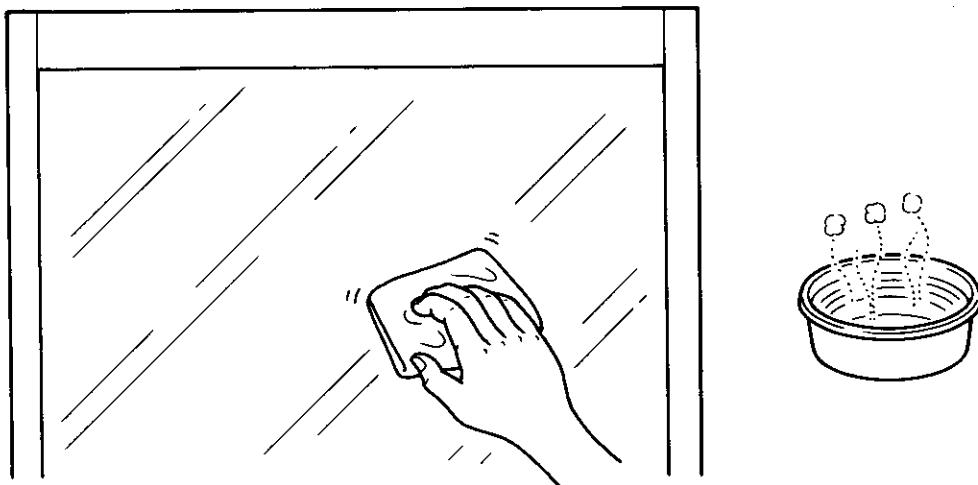


Fig. 6-5

## 6.4 THE SHEET AFFIXING OPERATION

### THE CUTTING PROCEDURE OF SHEETS

- ⑬ Clean up the place on which you affix the sheet.



(E.g., window glass in this case. Remove dust and oil with warm water.)

Fig. 6-6

- ⑭ In this case, it is a good idea to draw a reference line with a water based fiber tipped pen on the back side beforehand so that you can affix character stickers at the level with ease.

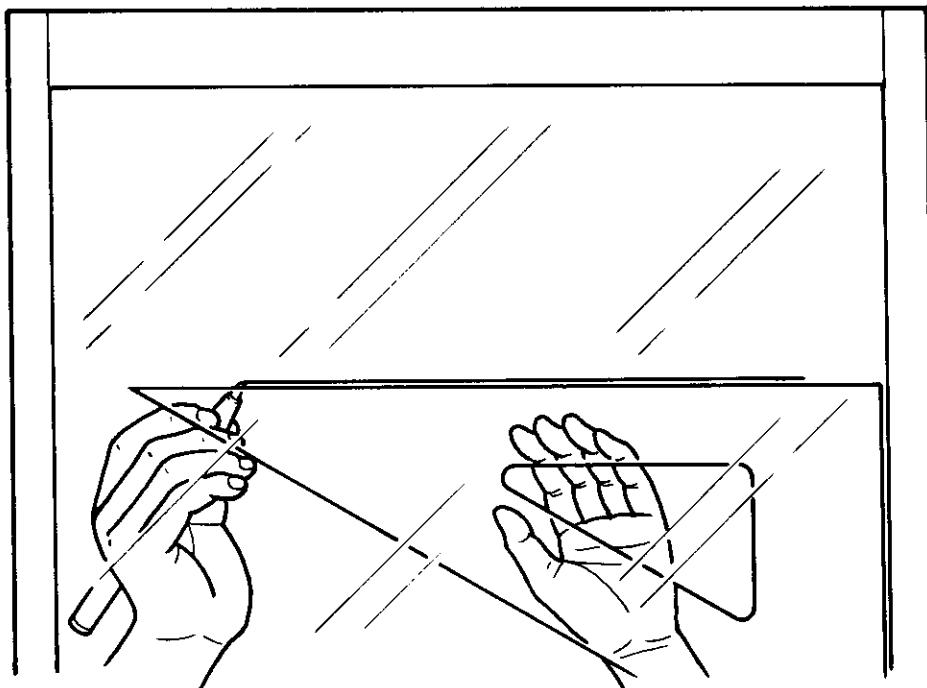


Fig. 6-7

## THE CUTTING PROCEDURE OF SHEETS

- ⑯ Peel the application sheet together with the character stickers from the sheet. Pay attention so that the character stickers are slipped off.

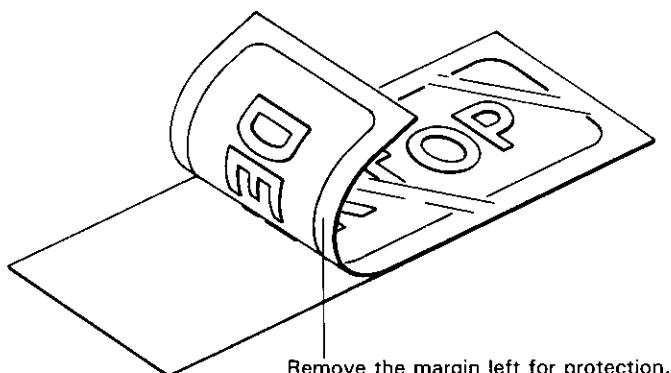


Fig. 6-8

- ⑰ Position the character stickers in place carefully and affix them gently from one side. Pay attention so that bubbles and wrinkles are not produced.

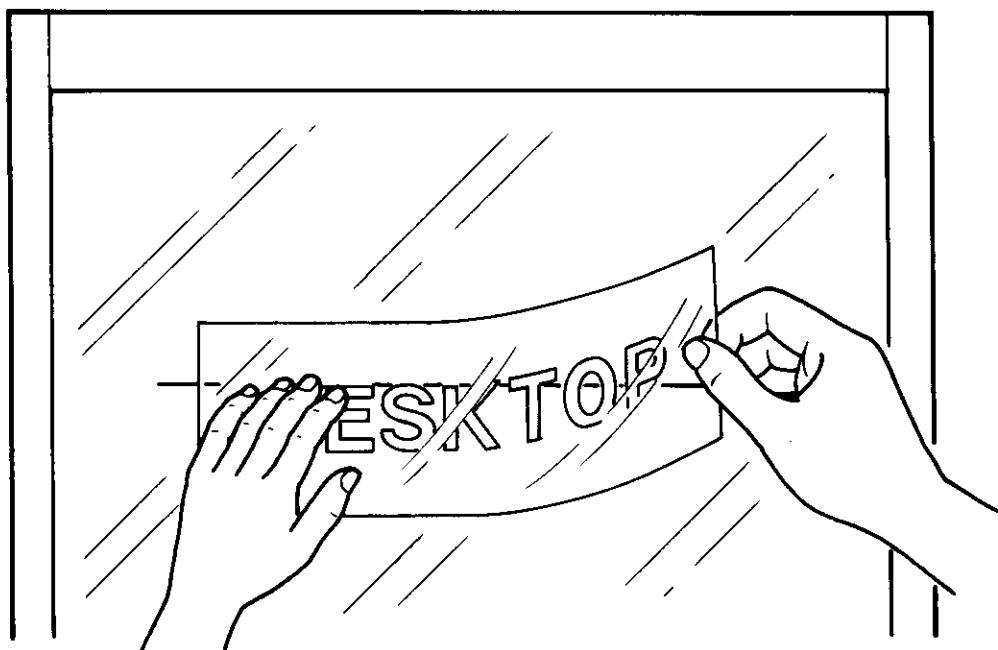


Fig. 6-9

- ⑯ Rub over the application sheet with soft cloth to affix the character stickers on as illustrated below. If bubbles are produced, use a needle to break the bubbles and take out air.

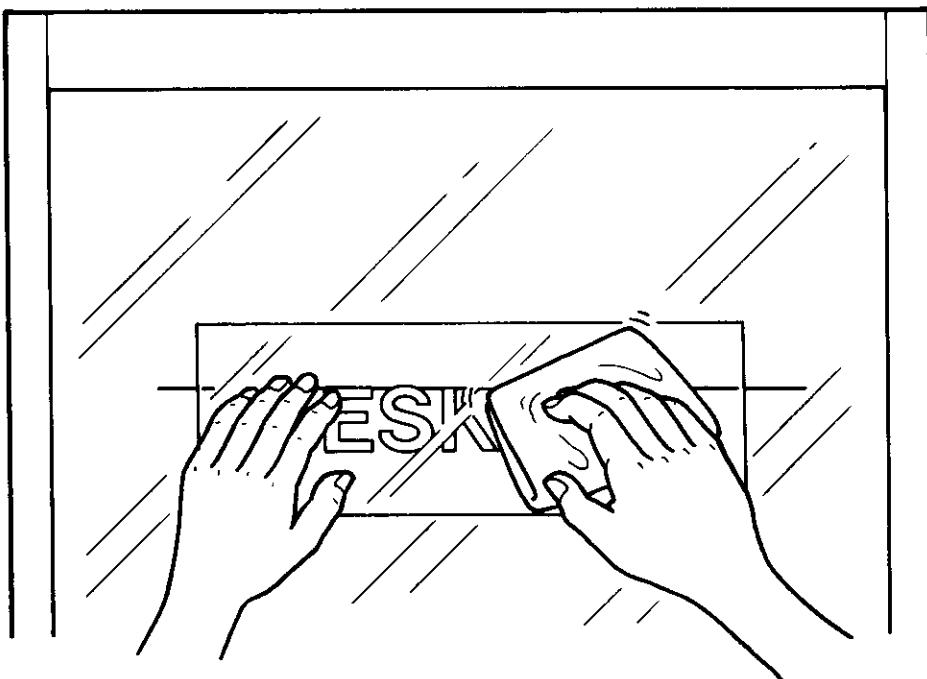


Fig. 6-10

- ⑰ Peel the application sheet gently as illustrated below.

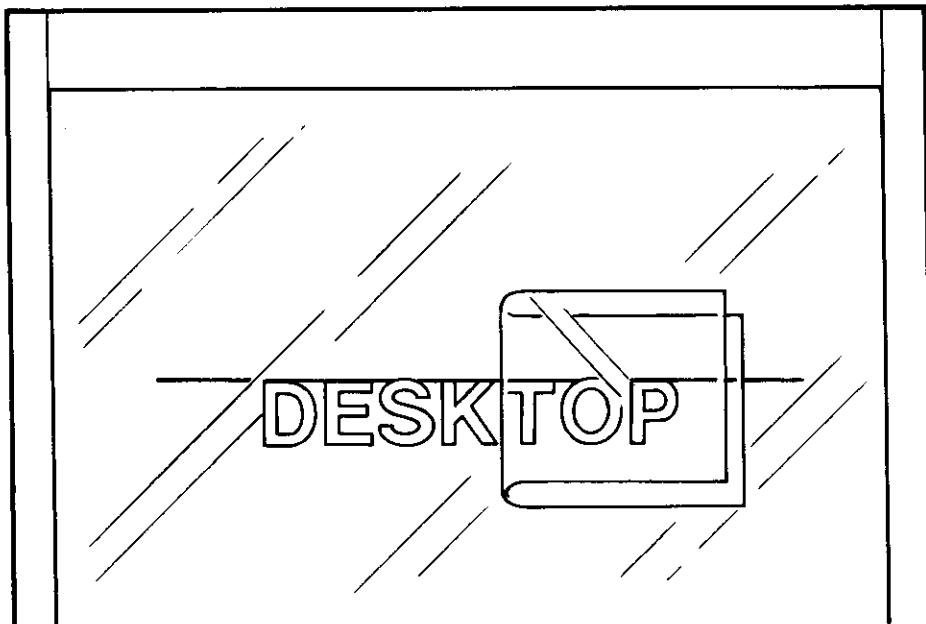


Fig. 6-11



It is convenient for saving if you leave some extra margin around the character stickers. If no margin is left, some dust and oil may easily get in between the sheet and application sheet, reducing the adhesive strength.

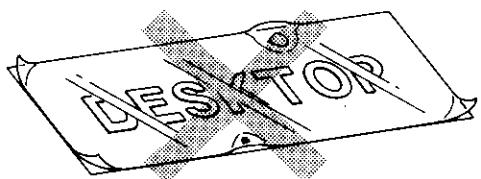


Fig. 6-12

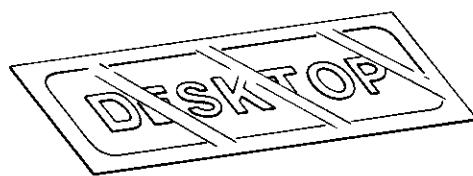


Fig. 6-13

Part I

## DRAWING ON PLOTTING MEDIA

7

1-7



# 7.1 SOME TASKS BEFORE GETTING STARTED

## DRAWING ON PLOTTING MEDIA

Since your CAMM-1 some functions to operate like a paper moving type pen plotter, you are allowed to use your CAMM-1 as an A2 or A3 size (C,B SIZE) plotter when you select [ISO A2] or [ISO A3] Mode ([ANSI C],[ANSI B] mode). However, it does not have functions of high speed plotting, automatic pen change, pen dry protector, etc., which a high level plotter requires. In other words, the design concepts of your CAMM-1 differ from those of a high speed drafting plotter.

The settings for drawing on plotting media in Set-up Mode are as follows:

Default	Function	Plotting Media Setting
[SIZE]	Paper size	ISO A2, ISO A3 (ANSI C, ANSI B) (FREE-Y, EXPAND-X)
[TOOL]	Tool	PEN(1) (~PEN(8))
[SPEED]	Drawing speed	Match pen's specification 15cm/s for water based fiber tipped pen
[FONT]	Character font	VECT. (OUTL.)
[P-CH]	Pen change command	EFFECTIVE (IGNORED)

Table 7-1

### About [SIZE]

You select one of the following four modes according to the plotting media you use with your CAMM-1.

[FREE-Y], [EXPAND-X], [ISO A2], [ISO A3], (ANSI C, ANSI B)

Usually, you select [FREE-Y] or [EXPAND-X] Mode for sticker sheets and [ISO A2] or [ISO A3] Mode ([ANSI C],[ANSI B] mode) for plotting media. But you can also select [FREE-Y] or [EXPAND-X] Mode for plotting media. In this case, attach a pen to the pen (tool) carriage and let your CAMM-1 draw on a medium. You are also allowed to see how the drawing is going on on the way for your actual cutting in the future if you want. Of course, you are naturally allowed to cut an A2 or A3 size sheet.

The cutting area of your CAMM-1 is larger than ISO A2 and ISO A3 size sheet media. If you send data larger than the cutting area when you selected [FREE-Y] and [EXPAND-X] Modes for [ISO A2] and [ISO A3] size sheet media, the sheet media would be disconnected from your CAMM-1.

#### About [TOOL]

You set the first tool attached to the tool carriage of your CAMM-1. [TOOL] include cutter and pen. You just select [CUTTER] when you want to cut a sheet. [CUTTER] automatically offsets some cutter's inherent misalignment occurred in cutting. [PEN(1)] (~[PEN(8)]) is one of the software settings to which we appended compatibility between your CAMM-1 holding only one pen and Roland DG plotters holding eight pens at once. If a pen change command is sent from the computer, the plotters automatically replace the pens, but your CAMM-1 does not perform automatic pen replacement. It pauses for your pen replacement or ignores the pen change command. You are allowed to set this function by [P-CH].

#### About [SPEED]

Assuming you replace eight pens on a plotter with respect to your CAMM-1, you need to set appropriate pen speeds to all eight pens from [PEN(1)] through [PEN(8)].

#### About [FONT]

Usually, you select [OUTL.] for cutting outlined characters on a sheet and [VECT.] for drawing line characters on a plotting medium.

#### About [P-CH]

The plotting software for a plotter sends a pen change command to a plotter and the plotter changes pen color and size by replacing the current pen with another one. But your CAMM-1 copes with such a situation by that you set [EFFECTIVE] or [IGNORED] before you send a pen change command from the computer to your CAMM-1.

#### Other Settings

Similar to sheet cutting, you need to set the same settings (communication protocol, command mode, etc) to the software, computer and CAMM-1.

## 7.2 THE DRAWING PROCEDURE

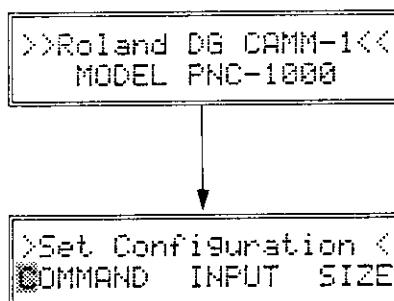
### DRAWING ON PLOTTING MEDIA

Before getting started, check to see that:

- CAMM-1 is set up correctly.
- CAMM-1 is OFF.
- CAMM-1 is connected to the computer correctly.

If there is no problem, turn on the computer and boot the software (or BASIC, application program, etc). Then proceed with the following step-by-step procedure.

- ① Hold down [FUNC] key and turn On the power switch of your CAMM-1. Then the Main Menu in Set-up Mode appears followed by the Opening Message, which look like this:



- ② Set the following items referring to CHAPTER 4 THE OPERATION PROCEDURE, Part 1. Since an accessory sheet media you use for test is A2 size coating paper, you need to set as follows:

Item	Settings	What You Should Do
[COMMAND]	Mode1	Match to commercial software if you use
[INPUT]	[PARALLEL]	Match to the interface connected to the computer
[SIZE]	[ISO A2]	Use A2 size coating paper for test
[TOOL]	[PEN(1)]	(Match to the software)
[SPEED]	[15]	Match to the pen you use
[FONT]	[VECT.]	Draws line characters
[P-CH]	[EFFECTIVE]	Pauses by a pen change command for pen replacement

Table 7-2

- ③ Attach a pen to the tool holder and then attach the tool holder to the tool carriage.
- ④ Insert a paper into your CAMM-1 from the back (or front), align it with the reference line, hold down the sheet loading lever and press **[FUNC]** key to load the medium.

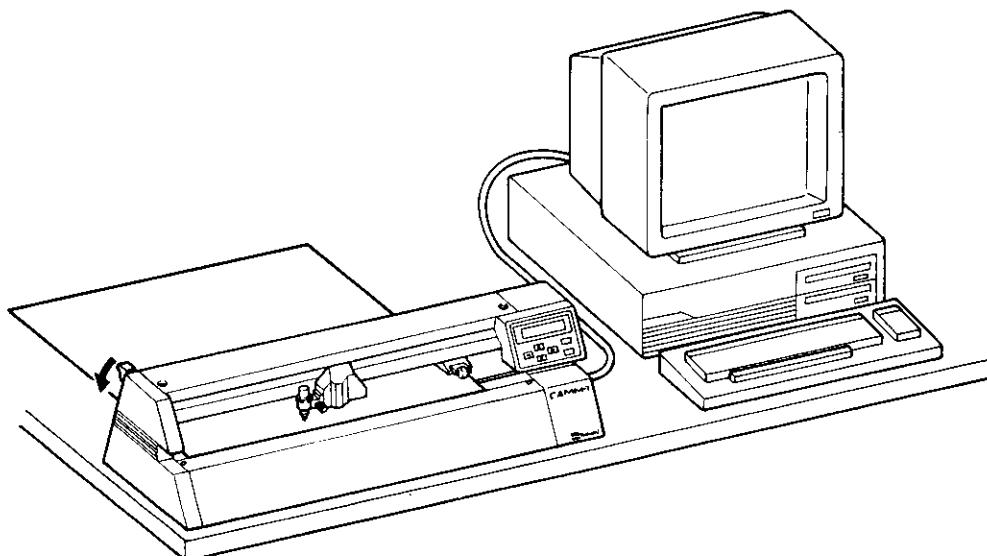
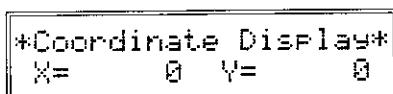


Fig. 7-1

- ⑤ Then the following \*Coordinate Display\* menu appears.



Now, you are just finished loading the medium. Send drawing data from the computer to your CAMM-1. If you do not have commercial software, type in the following program to the computer and run. (This is an example of IBM BASIC.) If you have another computer model, change it to fit your computer.

```
10 OPEN "LPT1:" AS #1
20 PRINT #1, "m0,100"
30 PRINT #1, "^SS"
40 PRINT #1, "!sf0"
50 PRINT #1, "s45"
60 '*****
70 FOR I=1 TO 8
80 PRINT #1, "J";I
90 PRINT #1, "^CS";I
100 PRINT #1, "PABCDEFGHIJKLMNPQRSTUVWXYZ"
110 PRINT #1, "M0, ";1800*I
120 NEXT I
130 '*****
140 PRINT #1, "J0"
```

On line IO, the parallel port is opened. To open the serial port, change the format in the appropriate form.

After the plotting is completed, fit a pen cap over the pen to prevent from drying.

## 7.3 INFORMATION ABOUT PENS

### DRAWING ON PLOTTING MEDIA

Two types of pens are available for your CAMM-1, and each pen is available in different colors. Select the appropriate pen to fit your purposes and the type of a pen you use referring to the following description.

The pen speed and force given followed by the caption of each pen is the optimum pen speed and force.

Water based fiber tipped pens are all expendable goods. Increase their pen forces when they draw scratchy lines or when the pen tips become rough. If increasing pen force is no use, replace with a new one.

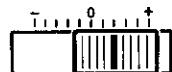
<b>7.3.1</b>	<b>Water Based Fiber Tipped Pen</b>	<b>Pen speed: 150mm/s</b>	
--------------	-------------------------------------	---------------------------	---

This is the easiest pen to use. It runs ink well and draws at a high speed. Eight colors are available (black, red, blue, green, brown, purple, pink, orange). Two tip sizes are available: 0.3mm and 0.6mm. Since the pen provides uniform filling, it is good for graphs and preliminary drawings if you combine them with high quality paper.

Option	Tip Size (mm)	Contents
<b>XD-4SPA-WNG</b>	0.3	A set of four blacks
<b>XD-4SPB-WNG</b>	0.3	Black, red, blue, green
<b>XD-4SPC-WNG</b>	0.3	Orange, pink, brown, purple
<b>XD-4SPA-WWG</b>	0.6	A set of four blacks
<b>XD-4SPB-WWG</b>	0.6	Black, red, blue, green
<b>XD-4SPC-WWG</b>	0.6	Orange, pink, brown, purple

Table 7-3

If ink does not run well, increase the pen force gradually.

**7.3.2****Water Based Fiber Tipped Pen for POP Art****Pen speed: 150mm/s**

This 2mm tip pen is for use in drawing thick lines. Eight colors are also available (black, red, blue, green, brown, purple, pink, orange). Since this pen handles filling in a short time, it is best use for POP art. Where uniform line widths are required or when ink goes down, the pen speed and force above may not draw out sufficient performance. In such a case, decrease the pen speed and increase the pen force to a maximum.

Option	Tip Size (mm)	Contents
<b>XD-4SPA-WBG</b>	2.0	A set of four blacks
<b>XD-4SPD-WBG</b>	2.0	A set of four reds
<b>XD-4SPE-WBG</b>	2.0	A set of four blues
<b>XD-4SPF-WBG</b>	2.0	A set of four greens
<b>XD-4SPG-WBG</b>	2.0	A set of four oranges
<b>XD-4SPH-WBG</b>	2.0	A set of four pinks
<b>XD-4SPI-WBG</b>	2.0	A set of our browns
<b>XD-4SPG-WBG</b>	2.0	A set of four purples

Table 7-4

## **7.4 INFORMATION ABOUT PLOTTING MEDIA**

### **DRAWING ON PLOTTING MEDIA**

High quality paper and tracing paper are available for your CAMM-1 as options.

#### **7.4.1 High Quality Paper (Chart Paper)**

This is the same type of paper as those for use with copy machine and printer. Although this paper is the most economical, it tends to blur and undertake expansion and compression. Therefore it may not be good for high quality drawings.

Option	Size	Quantity
A2-J100	A2	100
A3-J100	A3	100

Table 7-5

#### **7.4.2 Tracing Paper**

This is best choice paper for use in drafting. It does not run ink well and has bad coloring in the case of water based fiber tipped pen. It may be used as diazoreproduce.

Option	Size	Quantity	Weight (g/m <sup>2</sup> )
A2-T100	A2	100	75
A2-T100	A3	100	75

Table 7-6

**Part I**

## **TROUBLESHOOTING**

**8**

**1-8**



Your CAMM-1 lets error messages appear on the display if it cannot continue the normal operation further or if the communication protocols for Serial Connection are not correct. Depending on the errors, your CAMM-1 continues to execute some commands. However, because any command at the time of error occurrence cannot be executed, further cutting operations are not guaranteed.

When an error message or warning message is appearing on the display, refer to 8.5 List of Error Messages or 8.6 List of Warning Messages in this chapter before advancing further.

### 8.1.1 The Types of Errors

Errors are divided into the following four categories:

	Error	Cause
①	Command error	Incorrect commands or out-of-range parameters are sent
②	Device control command error	Incorrect device control commands or out-of-range parameters are sent
③	Protocol error	Incorrect protocols are set for Serial Connection
④	External error	Tool carriage is slipped off due to external force.

Table 8-1

For errors ① and ②, error messages are displayed.

For error ③, the following four phenomena occur.

- An error message is displayed
- Cutting is partly incorrect
- Some operation is done, but cutting suddenly becomes abnormal
- No operation is done

For error ④, the tool carriage or sheet is slipped off from the origin due to strong external force applied during cutting (plotting). In this case, you need to turn off and on the power again to restart the cutting operation from the beginning. No error message is displayed.

## 8.1.2 How to Solve the Error

### ① Command Error

The following items are thinkable as causes of the command error.

- Executed an incorrect command
- Input out-of-range parameters
- Input the incorrect number of parameters
- Forgot to input parameters, delimiter and terminator

You need to check whether data sent from the computer is correct. If you execute the "OE" command when you are using Serial Connection, you are allowed to clear the command error and know the error contents. For the error contents, see the "OE" Command section in CHAPTER 3 DESCRIPTION OF THE mode2 COMMANDS, Part 2.

Also, you are allowed to clear the error message by pressing [FUNC] key on the front panel. To clear the error completely, you just send the "IN" or "OE" command or unload the sheet.

### ② Device Control Command Error

An error occurs if the device control command is not correct when Serial Connection is used between the computer and CAMM-1. It is called a device control command error. You are allowed to clear this error by executing ESC. E command and know the error contents.

Also, you are allowed to clear the error message by pressing [FUNC] key on the front panel. To clear the error completely, you just send the ESC. E command or unload the sheet.

### ③ Protocol Error

An error occurs if the communication protocols of the computer and CAMM-1 are not the same when Serial Connection is used between the computer and CAMM-1. It is called a protocol error. You just match the communication protocols referring to 4.3 (1)-③[Set Connection] in CHAPTER 4, Part 1 or the computer (software) operation manual. To clear the error, you just unload the sheet. (Although you are also allowed to clear the error with the ESC. E command, you cannot change the setting unless you unload the sheet.)

### ④ External Error

You may inadvertently touch the pen carriage with your hand or with some object during cutting, which causes the pen carriage to slip off from the origin. In such a case, you need to turn off and on the power switch again to restart the cutting operation from the beginning.

## **8.2 WHAT YOU SHOULD DO IF YOUR CAMM-1 HAS SOMETHING WRONG**

TROUBLESHOOTING

---

All settings are correct, but your CAMM-1 does not operate correctly. In such a case, you just perform a self test.

Your CAMM-1 has the function with which you can check to see that it operates correctly. Refer to 2.8 OPERATION CHECK in CHAPTER 2, Part 1. If this test is successfully done, your CAMM-1 should be normal.

If the self test is not successfully done, contact to your local sales store.

## **8.3 ABOUT DEVICE TIMEOUT ERROR OF THE COMPUTER**

### **TROUBLESHOOTING**

If the computer is not allowed to send data to your CAMM-1 for a long time because of some reasons, it sometimes interprets that its peripheral is not connected and interrupts the program on the way. This is called a device timeout error.

In spite of the fact that your CAMM-1 is not receiving all data from the computer on the way of cutting operation, the computer interrupts data output. In such a case, a device timeout error may be the cause.

Your CAMM-1 has a 1K-byte data (I/O) buffer and continues to receive data until the data buffer is full. Once the data buffer is full, your CAMM-1 lets the computer wait data sending until it is ready to receive further data. Depending on the computers, some computers has limitations on this waiting time. If your CAMM-1 does not try to receive data within the waiting time, the computer interprets that your CAMM-1 is not connected and outputs an error message to interrupt the program. And a device timeout error occurs.

## 8.4 LIST OF ERROR MESSAGES

### TROUBLESHOOTING

Error message	Possible cause	Action from CAMM-1
<b>Err1: Command Not Recognized</b>	Err1: Unidentifiable commands being executed Example: PRINT # 1, "z"	Ignore
<b>Err2: Wrong Number of Parameters</b>	Err2: Wrong number of parameters being input Example: PRINT # , "M100,200,300" "M100,200"	Use the first two parameters.
<b>Err3: Bad Parameter</b>	Err3: Parameters out of the range being used Example: PRINT # 1, "M100000000,100" PRINT # 1, "T"	Ignore
<b>Err5: Unknown Character Set</b>	Err5: Unusable characters being specified Example: PRINT # 1, "CS100;"	Ignore

Table 8-2

The error messages shown in Table 8-2 correspond to error codes that can be known using the OE command in mode2.

These error messages are to show up on the display in order to indicate that an error is occurring in the data being sent, but not for stopping cutting (plotting) operations and/or disabling the next operation.

In any case, pressing the **[FUNC]** key clears the error messages.

Note that pressing **[FUNC]** only does not clear an error completely and CAMM-1 still remembers that error code internally. This means that even if an error occurs continually, CAMM-1 will not display that error. Complete error clearance can be accomplished by sending the OE or IN command, or by turning off the power switch.

For other error messages (ESC.E error), refer to ESC.E Command.

## 8.5 LIST OF WARNING MESSAGES

### TROUBLESHOOTING

Replot Buffer is  
Empty, Load Data.

This warning message will blink for two seconds if data is replotted in replot mode when the replot buffer is empty, and it will return to the main display of replot mode.

Memory Full !  
Stop Sending Data

This warning message will show up when the 8K-byte replot buffer becomes full during data loading in replot mode. To clear this message, stop data transmission from the computer and press [FUNC]. Remember that data transmission must be stopped first, otherwise the tool axis may start moving.

For more details, refer to 4.3.6 Replot buffer.

Replot Data Error  
Stop Sending Data

This warning message will show up if data which CAMM-1 cannot interpret is sent during data loading in replot mode. To clear this message, press [FUNC], but remember that data transmission from the computer must be stopped first, otherwise the message cannot be cleared.

Also remember that if this message is displayed, the previous data and newly loaded data have already been destroyed, and so do not replot again.

This warning message will show up if the pinch roller is not in place.

Position the pinch roller in place and load sheet (medium) again.

## 8.6 THE FUSE REPLACEMENT PROCEDURE

### TROUBLESHOOTING

The fuse may be broken if overloads or sudden power voltage fluctuations occur. If the display does not light up in yellow even when you turn on the power switch, it signifies that the fuse is broken. Replace the broken fuse with a new one.

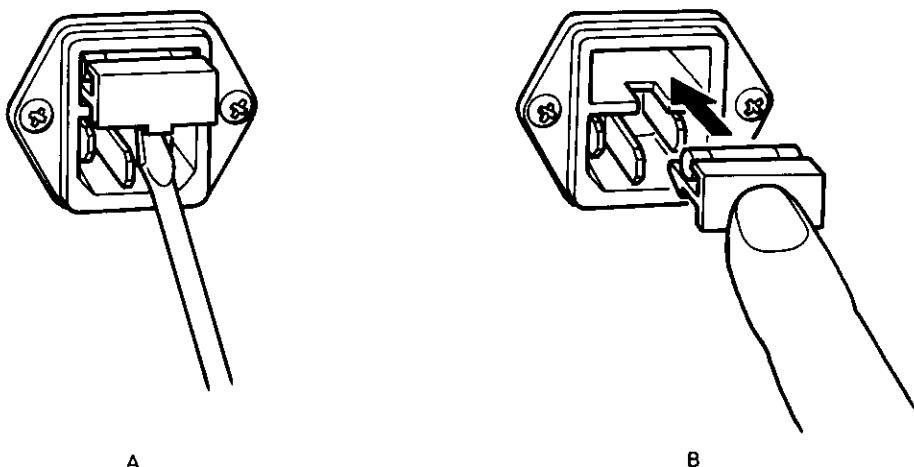


Fig. 8-1

The fuse box is provided together with the power connector. Plug off the power cord and remove the fuse box using a negative screw driver as illustrated above.

Replace the broken fuse with a new one of the same type and insert it in place.



## THE CONNECTION PROCEDURES OF COMPUTERS

9

1-9



## 9.1 GENERAL DESCRIPTION

### THE CONNECTION PROCEDURES OF COMPUTERS

Your CAMM-1 should operate if you use the appropriate cables and connect them to your computer, CAMM-1 and software correctly. In case your CAMM-1 does not operate properly, read the setting procedures of this section and perform operation checks.

Here is a sample connection. The BASIC program is to operate the tool carriage and sheet as illustrated in Fig. 9-1. And, it displays the model name of your CAMM-1 (1000) on the computer display when Serial Connection is used.

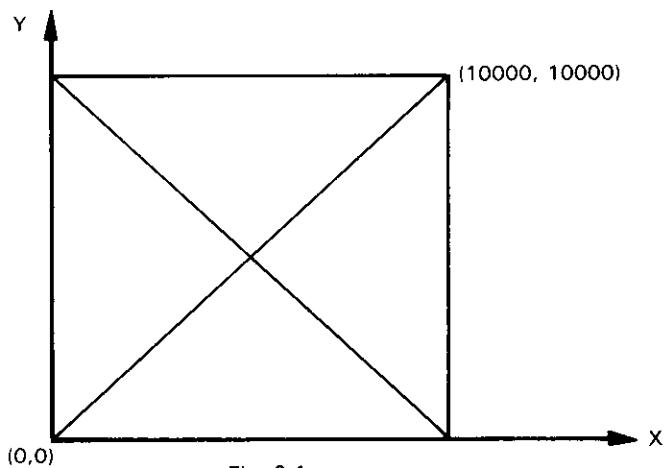


Fig. 9-1

The tool carriage and sheet (plotting medium) operate correctly, and no error messages appear on the display of your CAMM-1. It means that your CAMM-1 has been connected properly.

If the BASIC program works correctly, it means that there are no problems on your CAMM-1 and the connecting cable as well as interface between your CAMM-1 and computer. If you find something wrong, perform a self test referring 2.8 OPERATION CHECK in CHAPTER 2, Part 1.

#### NOTE

- Here, we will explain the setting procedure using a typical computer, IBM PC. If you have another computer model, reset your computer and change the program following the operation manual of your computer if necessary.
- The setting procedure of your CAMM-1 and computer here is provided for operation checks only. If you want to use commercial software, reset what you need to set following the operation manual of the software.

- Set your CAMM-1

[For Parallel Connection]

- ① Turn on the power while pressing [FUNC] key to return your CAMM-1 to the factory-installed default conditions.
- ② Change the current command mode to [mode2].
- ③ Set [SIZE] according to the sheet (plotting medium) you load.
- ④ Set the sheet and enter Operate Mode.

[For Serial Connection]

- ① Turn on the power while pressing [FUNC] key to return your CAMM-1 to the factory-installed default conditions.
- ② Then the Main Menu in Set-up Mode appears. Set the current command mode to [mode2].
- ③ Select [SERIAL] from [INPUT] menu and press [ENTER] key. If you press [FUNC] key in succession, \*Set Connection\* menu appears. Then press [ENTER] key to determine communication protocols (STOP BIT 1, DATA BIT 8, PARITY NONE, BAUDRATE 9600 will be set).
- ④ Set [SIZE] according to the sheet (plotting medium) you load.
- ⑤ Set the sheet (plotting medium) and enter Operate Mode.

### [Parallel Connection]

Roland DG Optional Cable: XY-IPC

- ① Turn on the power of the computer and boot MS-DOS.
- ② Boot BASIC, write the following program and run.

```
10 LPRINT "IN;PA0,0,10000,0,10000,10000,0,10000,0,0;"  
20 LPRINT "PA10000,0,0,10000,10000,10000,0,0;"  
30 END
```

### [Serial Connection]

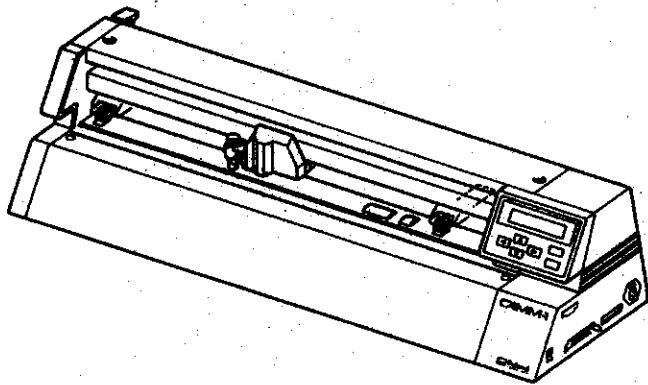
Roland DG Optional Cable: XY-RS-13,33(PC/XT,PC)  
XY-RS-14,34(PC/AT)

- ① Turn on the power of the computer and boot MS-DOS.
- ② Boot BASIC, write the following program and run.

```
10 OPEN "COM1:9600,N,8,1" AS #1  
20 PRINT #1,"IN;PA0,0,10000,0,10000,10000,0,10000,0,0;"  
30 PRINT #1,"PA10000,0,0,10000,10000,10000,0,0;"  
40 PRINT #1,"OI;"  
50 INPUT #1,ID$  
60 PRINT ID$  
70 END
```



# Part2

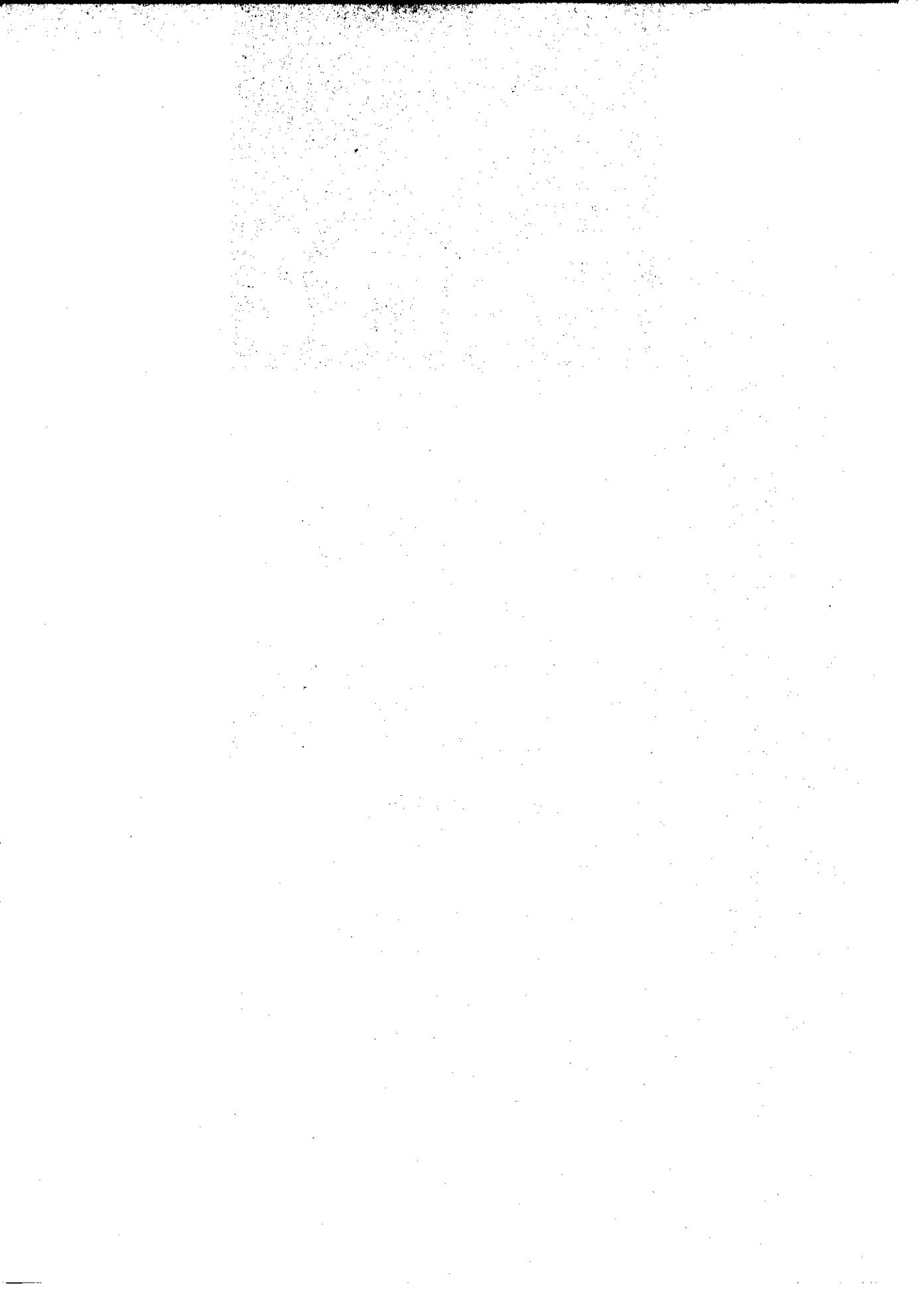


**DESKTOP SIGN MAKER**  
**CAMM-1**

MODEL PNC-1000

---

**OPERATION MANUAL**



Part 2

## **GENERAL DESCRIPTION OF THE CAMM-GLIII**

1

2-1



# 1.1 THE COMMAND SYSTEM

## GENERAL DESCRIPTION OF THE CAMM-GL<sup>III</sup>

The command loaded in your CAMM-1 is the CAMM-GL<sup>III</sup>.

The CAMM-GL<sup>III</sup> has compatibility with Roland DG plotters and modeling machines and has two types of command systems, which are:

- mode1 ..... Has two types: one-letter command and three-letter command beginning with ! which is in common use with mode2.  
These commands are independent to each other and therefore let you have cutting (plotting) operation with ease.  
You are allowed to use mode2 commands by calling.  
mode1 has compatibility with the DXY-GL commands of Roland DG plotters DXY Series and also Roland DG modeling machine CAMM-3 and engraving machine CAMM-2.  
The unit of coordinates is 1/40mm.
  
- mode2 ..... Has two types: two-letter command and three-letter command beginning with ! which is in common use with mode1.  
To operate CAMM-1 efficiently, mode2 is systematically organized. Each command has great freedom so that you are allowed to establish detailed settings to individual operations of your CAMM-1.  
mode2 has compatibility with the RD-GL commands of Roland DG plotters DXY Series and also mode2 of Roland DG engraving machine CAMM-2.  
The unit of coordinates is 1/40mm.

The following commands are loaded in Roland DG plotters but not loaded in your CAMM-1. However, when these commands are sent, your CAMM-1 does not occur errors but ignores them. This means that you are permitted to use software for use with plotters. Those commands are:

DC, DP, OD, RO, PS, ES, CC, IFC, !MC, !PZ, !VZ

\* Some of these commands use parameters but ignore even if you input. However, they occur errors if you input the incorrect number of parameters. (This is because they do not judge the parameter range.) And they are able to receive the SP command. For more information, refer to (2)-4 [Pen Change Command], CHAPTER 4 THE OPERATION PROCEDURE, Part 1.

### 1.2.1 The Format of the mode1 Commands

Each mode1 command is divided into the following four elements. You format each mode1 command with those four elements.

- Command
- Parameter
- Delimiter
- Terminator

Here is a typical format of a mode1 command as an example.

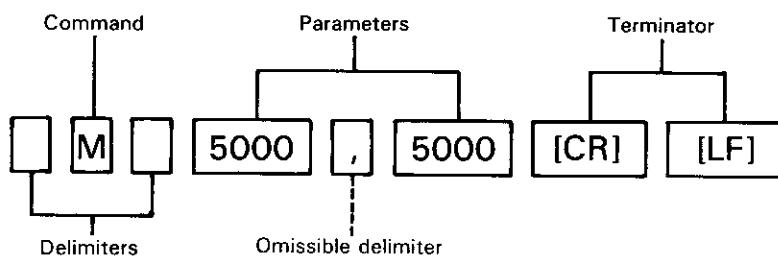


Fig. 1-1

- Command

mode1 commands are written in one letter or three letters beginning with ! and instruct your CAMM-1 what to set and how to operate. The example of Fig. 1-1 denotes that the tool moves to the coordinates followed by the command.

- Parameter

Parameters are input as coordinate values and/or characters that each command requires. The example of Fig. 1-1 denotes that the tool moves to the coordinates (5000,5000).

The meanings of parameters vary depending on the commands. There are three types of commands: the first is without parameters, the second requires parameters and the third is with parameters but you can omit parameters.

The allowable parameter range varies depending on the commands. Also, + signs can be omitted from numerical parameters. The initial or default values are set to the commands from which you can omit parameters if you omit. Depending on the commands, some commands require you to input parameters as dummy even if the parameters have no meanings.

- Delimiter

Delimiters are used as separators between a command and a parameter as well as between two parameters.

If you input a command and a parameter and also more than two parameters in succession without delimiters, your CAMM-1 cannot interprets which is a single parameter, especially between more than two parameters. To prevent this, you need to input delimiters as separators.

For delimiters, you are allowed to use either space “ ” or comma “,”.

You can omit a delimiter between a command and a parameter because your CAMM-1 understands it, but you cannot omit delimiters between more than two parameters. So, you can format in the following ways.

**M 5000 5000**

**M5000,5000**

**M5000 5000**

However, in this operation manual, the following format is used as the basic format for the sake of simplicity.

**D5000,5000**

- Terminator

Terminator indicates the end of one command. You cannot omit the terminator from any command, but can omit only when you input another command followed by the first command in succession.

For the terminator, you are allowed to use [CR] (CHR\$(13)) and [LF] (CHR\$(10)).

In the case of mode2, you just use a semicolon “;” for a terminator.

**NOTE**

- Pay attention when you input parameter signs with respect to a command. If you input parameter signs incorrectly, an error occurs.

Example:

Data format

CAMM-1 interprets

CAMM-1 interprets  
after error treatment

```
[M - 300,200] --->[M][0][300][200] --->[M][0][300]
[M -300,+ 200]--->[M][-300][0][200]--->[M][-300][0]
```

Your CAMM-1 interprets space as a delimiter and displays an error message because the number of parameters is now three. And it takes the first two parameters.

- In case any terminator is not sent, your CAMM-1 sometimes fails to operate. For example, if you send the following data, CAMM-1 does not understand whether the last D 100,200 is D 100,200 or D 100,2008 until the last data or terminator is sent. And it continues to wait until the last data or terminator is sent.

```
M 0.0[CR][LF]PD 1000,1000[CR][LF]M 500,700[CR][LF]D
100,200
```

The terminator tells your CAMM-1 the terminal point of a series of data.

- Sometimes you do no need to think about terminators. If you, for example, type in like ① below when you use IBM BASIC, data like ② will automatically be sent from the parallel port (printer terminal). This is effective for mode1.

① LPRINT "M1000,1000"

② [M][1][0][0][0][.][1][0][0][0][CR][LF]

## 1.2.2 Formats in BASIC

When you send the example of Fig. 1-1 from the computer to your CAMM-1, you are allowed to format it in BASIC in the following two ways since Parallel and Serial Connections are available. Typical formats are:

LPRINT "M5000,5000;" (Parallel Connection)

OPEN "COM1:9600,N,8,1" AS #1 (Serial Connection)  
PRINT #1,"M5000,5000;"

For Serial Connection, you need to set the same communication protocols (baud rate, data bit length, stop bit length, parity check) to the computer and CAMM-1 and open the RS-232C port with "OPEN" statement beforehand.

Also, you are allowed to change parameters to variables. For example, if you change the following parameters to variables

10 LPRINT "M1000,2000;"

you can rewrite as follows:

10 X=1000,Y=2000  
20 LPRINT "M";X;",";Y;";"

And, you can rewrite line 20 as follows:

20 LPRINT "M";X;" ";Y;";"	Use space instead of comma
20 LPRINT "M";X,Y;";"	Separate variables with comma
20 LPRINT "M"X,Y;";"	Omit semicolon between command and variable

Moreover, you can write label parameters as follows:

```
10 B$="ABCDabcd"  
20 LPRINT "P";B$;" ";"
```

ABCDabcd

Fig. 1-2

```
10 X=1000,Y=2000  
20 LPRINT "P";X;Y;" ";"
```

1000 2000

Fig. 1-3

These formats vary depending on the computer models and BASICs. Refer to the operation manual of your computer or BASIC.

### 1.3.1 The Types of the mode2 Commands

mode2 has 56 commands and is broadly divided into the following six categories.

- INITIALIZE Command ..... Defaults the entire system
- COORDINATE CONTROL Command ..... Sets scaling points and window, etc.
- TOOL CONTROL Command ..... Controls pen speed, move, cutting (plotting), etc.
- ENHANCEMENT CUTTING (PLOTTING) Command ..... Enhances various cutting (plotting) operations
- LABELING Command ..... Cuts (plots) labels
- OUTPUT Command ..... Outputs data from CAMM-1

For actual cutting (plotting), you combine the above commands to write a program.

### 1.3.2 The Format of the mode2 Commands

Each mode2 command is divided into the following four elements. You format each mode2 command with those four elements. A typical format is given below as an example.

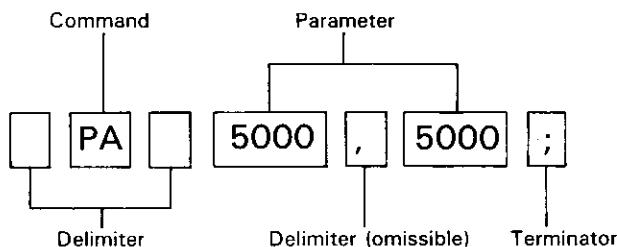


Fig. 1-4

- Command

mode2 commands instruct your CAMM-1 what to set and how to operate. There are two types of commands: two-letter command and three-letter command beginning with !. You are allowed to type in either small letters or capital letters. The example of Fig. 1-4 denotes that the tool moves to the coordinates specified by the parameters.

- Parameter

Parameters can be input as coordinate values and/or characters that each command requires. The example of Fig. 1-1 denotes that the tool moves to the coordinates (5000,5000). There are three types of commands, which are:

- Command without parameters
- Command that requires parameters
- Command with omissible parameters

Depending on the commands, the meaning and range of parameters vary. You can omit + signs from numerical parameters. The initial or default values are set to the commands from which you can omit parameters if you omit.

- Delimiter

Delimiters are used as separators between a command and a parameter as well as between two parameters.

For a delimiter, you are allowed to use either space " " or comma ",".

You can omit a delimiter between a command and a parameter, but cannot omit delimiters between more than two parameters. That is, you can format in the following ways.

```
PA 5000 5000;  
PA5000,5000;  
PA5000 5000;
```

However, in this operation manual, the following format is used as the basic format for the sake of simplicity.

```
PA5000,5000;
```

- Terminator

Terminator indicates the end of one command. You can omit the terminator only if you input another command followed by the first command in succession. For the terminator, you are allowed to use a semicolon ";".

However, since the LB and WD commands interpret a semicolon as a label, you need to use [ETX] (CHR\$(3)) as a label terminator.

In the case of mode2, you just use a semicolon ";" for a terminator.

**NOTE**

- Pay attention when you input parameter signs with respect to a command. If you input parameter signs incorrectly, an error occurs.

Example:

Data format

CAMM-1 interprets

CAMM-1 interprets  
after error treatment

[PA- 300,200] --->[PA][0][300][200] --->[PA][0][300]  
 [PA-300,+ 200]--->[PA][-300][0][200]--->[PA][-300][0]

Your CAMM-1 interprets space as a delimiter and displays an error message because the number of parameters is now three. That is, it takes the first two parameters.

- If any terminator is not sent, your CAMM-1 sometimes fails to operate. For example, if the following data is sent, your CAMM-1 does not understand whether the last PD100,200 is PD100,200 or PD100,2008 until the last data or terminator is sent. And it continues to wait until the last data or terminator is sent.

**PU 0,0;PD 1000,1000;PU 500,700;PD 100,200**

The terminator tells your CAMM-1 the terminal point of a series of data. In the case of mode2, you just use a semicolon ";" for a terminator.

### 1.3.3 Formats in BASIC

When you send the example of Fig. 1-4 from the computer to your CAMM-1, you are allowed to format it in BASIC in the following two ways because Parallel and Serial Connections are available. Typical formats are:

LPRINT "PA5000,5000;" (Parallel Connection)

OPEN "COM1:9600,N,8,1" AS #1 (Serial Connection)  
 PRINT #1,"PA5000,5000;"

For Serial Connection, you need to set the same communication protocols (baud rate, data bit length, stop bit length, parity check) to the computer and your CAMM-1 and open the RS-232C port with "OPEN" statement beforehand.

Also, you are allowed to change parameters to variables. For example, if you want to change the following parameters to variables,

```
10 LPRINT "PA1000,2000;"
```

you can rewrite as follows:

```
10 X=1000,Y=2000  
20 LPRINT "PA";X;",";Y;";"
```

And you can rewrite line 20 as follows:

```
20 LPRINT "PA";X;" ";Y;";" Use space instead of comma  
20 LPRINT "PA";X,Y;";" Separate variables with comma  
20 LPRINT "PA"X,Y;";" Omit semicolon between variables
```

Moreover, you can write label parameters in the following ways.

```
10 B$="ABCDabcd"  
20 LPRINT "LB";B$;CHR$(3)
```

ABCDabcd

Fig. 1-5

```
10 X=1000,Y=2000  
20 LPRINT "LB";X;Y;CHR$(3)
```

1000 2000

Fig. 1-6

## 1.3.4 The Command Organization

### 1 INITIALIZE Command

The DF and IN commands return the settings (filling space, character size, etc.) you changed by commands to their default values. The IN command brings your CAMM-1 to the same status as you turn off the power. It is therefore good practice to send these commands at the beginning of data.

The default command	DF
The initialize command	IN
The input mask command	IM

### 2 COORDINATE CONTROL Command

This command establishes settings pertaining to coordinate unit, origin, and cutting area.

#### 2-1 SCALING

The coordinate system of your CAMM-1 can be divided into two: machine coordinate system and user coordinate system. Setting user coordinates is called scaling.

By scaling, you are allowed to set, compress and expand coordinate units.

The coordinate parameters of a command follow the machine coordinate system until you scale. After you scaled, your CAMM-1 performs cutting (plotting) operation following the user coordinate system.

- Machine Coordinate System

Machine coordinates are the initialized coordinate system of your CAMM-1 and predetermined by the settings of each sheet (plotting medium) size.

The unit of the machine coordinate system is 0.025mm, one unit. When you want to specify 1 mm, you just specify 40 units ( $0.025\text{mm} \times 40 = 1\text{mm}$ ). (For example, 1 inch ≈ 1016 machine coordinate units)

- User Coordinate System

Coordinate system that you are allowed to set a coordinate origin and coordinate units at will with respect to the machine coordinate system is called user coordinate system. When you set user coordinates, further coordinate parameters of any commands will follow the user coordinate system.

If you specify coordinates out of the allowable parameter range, an error occurs. When you set user coordinates, you should pay attention so that the cutting (plotting) area does not go out the allowable parameter range.

- Setting Scaling Points P1 and P2

Scaling points P1 and P2 are the reference points for scaling (or setting user coordinates). Scaling is done by setting P1 and P2 at any points and executing the SC command that determines the coordinate values of each point. Note that scaling is not completed at the stage of setting P1 and P2. The IP command is used to set P1 and P2.

For example, if you send the following data with the IP command.

**"IP100,150,4000,2500;"**

P1 is set to (100,150) and P2 is set to (4000,5000). At this point, the coordinate values of the parameters must be the machine coordinates of your CAMM-1. Although the coordinate system at this point is the user coordinate system even when you re-scale, the parameter values must still be machine coordinates.

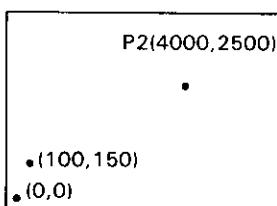


Fig. 1-7

If you set P1 only, P2 will automatically be set at a point moved the same distance as P1. For example, if you send the following data after you execute the above example and set P1 and P2,

**"IP 0,0;"**

P1 will be set to (0,0) and P2 will be set to (3900,2350).

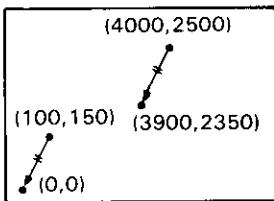


Fig. 1-8

- Scaling by the SC Command

The SC command determines the user coordinate values of each P1 and P2 specified at arbitrary points. For example, if you send the following data,

```
"IP100,150,4000,2500;"  
"SC0,1,0,1;"
```

P1 at the machine coordinates (100,250) is changed to the user coordinates (0,0), and P2 at the machine coordinates (4000,2500) is changed to the user coordinates (1,1). (Note that the parameter sequence of the SC command differs from that of the IP command.) Of course, user coordinates are also set outside P1 and P2. The coordinate values for further cutting (plotting) follow the user coordinate system.

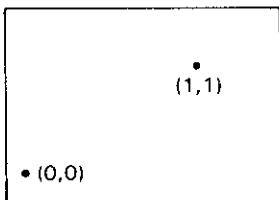


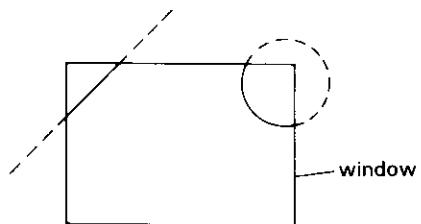
Fig. 1-9

In this manner, you are allowed to combine the IP and SC commands to set any points to any coordinates. And by setting those points to your convenient values, you can reduce your programming work.

The input P1 & P2 command The scaling command	IP SC
--	----------

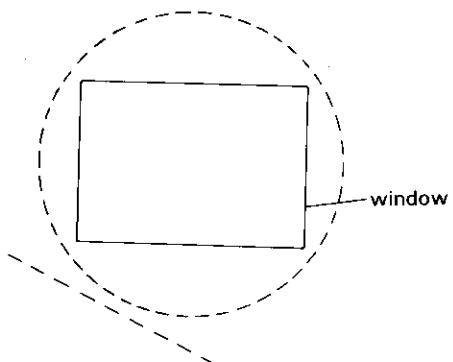
## 2-2 Window

A cutting (plotting) area set by the IW command is called a window. Commands that try to cut (plot) outside a window do not result in an error, but your CAMM-1 does not cut (plot) any data outside the window. The default value of a window is the maximum cutting (plotting) area.



Dotted line cannot be cut (plotted) when trying to cut (plot) the outside of a window.

Fig. 1-10



No cutting (plotting) occurs when trying to cut (plot) the outside of a window only.

Fig. 1-11

The Input window command

IW

### 3 TOOL CONTROL Command

#### 3-1 Move Tool

If cutting (plotting) is simple, you are allowed to cut (plot) with a tool control command only. A simple example is given in [EXAMPLE 1-1] below, which is to cut (plot) a straight line from (1000,2000) to (4000,8000).

#### [EXAMPLE 1-1]

```
10 LPRINT "PA;"  
20 LPRINT "PU1000,2000;"  
30 LPRINT "PD4000,8000;"
```

(Explanation)

Line 10      Specifies absolute coordinates.

Line 20      Moves to (1000,2000) with the tool up.

Line 30      Moves to (4000,8000) with the tool up. (Straight line cutting (plotting))

- Absolute Coordinates vs. Relative Coordinates

There are two ways of specifying coordinates: absolute coordinates that express the coordinates of a point you will specify in the distance from the origin (0,0), and relative coordinates that express the coordinates of a point you will specify in the distance from the current tool position. For example, [EXAMPLE 1-1] sets absolute coordinates on line 10. If you use relative coordinates here, you can rewrite line 30 as follows:

```
30 LPRINT "PR;PD3000,6000;"
```

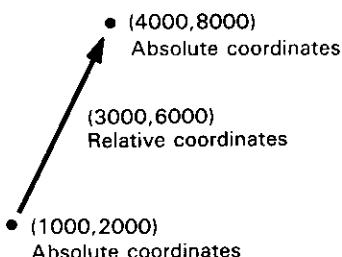


Fig. 1-12

This line 30 specifies relative coordinates with the PR command. From now on, further coordinates will be specified in relative coordinates. The tool position on line 20 is at (1000,2000). Because of this, in order to cut up to the relative coordinates (4000,8000), you just send the relative coordinates (3000,6000) in the distance from the current tool position. To return the relative coordinates to the absolute coordinates, you need to send the PA command.

Commands in mode2 that would change the coordinates after commands were sent to absolute or relative coordinates are the PA and PR commands only. Commands other than the PA and PR commands do not change coordinates and remain the coordinates intact. The coordinates are set in absolute coordinates at the time of sheet loading.

The plot absolute command	PA
The plot relative command	PR
The tool up command	PU
The tool down command	PD

### **3-2 Set Tool Function**

As a function pertaining to tooling, there is a command called the velocity select command. You use this command to set tool speeds and also you are allowed to set tool speeds from the front panel.

The velocity select command	VS
-----------------------------	----

## 4 ENHANCEMENT CUTTING (PLOTTING) Command

### 4-1 Commands that Enhance Cutting

You are allowed to cut (plot) complicated graphics with a tool control command only, but mode2 has many commands for use in cutting (plotting) complicated graphics. For example, when you want to cut (plot) a rectangle, you may send a cut line command four times to cut the profile of that rectangle. But you have the option to send the edge rectangle command, EA, once to cut the profile of that rectangle. This is much easier than sending a cut line command four times and makes programming easier.

Among cutting (plotting) commands, some commands actually cut (plot) and some other commands do not actually cut (plot) but establish various settings for cutting (plotting). For example, lets take a look at the rectangle filling command, RA. The filling pattern of this command is set by the FT command. That is, you first determine the filling pattern with the FT command (which does not cut (plot)) and then send the RA command to cut (plot).

The edge rectangle absolute command	EA
The edge rectangle relative command	ER
The shade rectangle absolute command	RA
The shade rectangle relative command	RR
The circle command	CI
The arc absolute command	AA
The arc relative command	AR
The edge wedge command	EW
The shade wedge command	WG
The fill type command	FT
The pen thickness command	PT
The line type command	LT
The tick length command	TL
The X-tick command	XT
The Y-tick command	YT

## 5 LABELING Command

### 5-1 Cut (Plot) and Set Labels

The LB command is used for label cutting (plotting). When you send the LB command, your CAMM-1 enters label mode and starts cutting a label string followed by the LB command as you input. For example, if you send the following data

```
LPRINT "LBABCDabcd";CHR$(3)
```

your CAMM-1 starts cutting (plotting) "ABCDabcd" from the current tool position. The [ETX] (CHR\$(3)) above is the label terminator and input at the end of the label string to clear label mode. If you omit the label terminator, your CAMM-1 interprets further commands as part of the label string if they are sent. To change the label terminator, use the DT command.

The character sets used by the LB command are those specified by the CS, SS, CA and SA commands and also listed in List of Character Sets, APPENDIX D.

The character codes of characters that can be cut (plotted) are those from CHR\$(33) through CHR\$(126). On the other hand, among the characters that cannot be cut (plotted) and control characters from CHR\$(0) through CHR\$(32), the following characters have a special role in the cutting (plotting) of characters. Other control characters are ignored.

[ETX]	(CHR\$(3))	: terminates label mode
[BS]	(CHR\$(8))	: moves one-full character to the left
[HT]	(CHR\$(9))	: moves half of a character to the left
[LF]	(CHR\$(10))	: goes down one line
[VT]	(CHR\$(11))	: goes up one line
[CR]	(CHR\$(13))	: moves to line head
[SO]	(CHR\$(14))	: selects alternate character set
[SI]	(CHR\$(15))	: selects standard character set

Also, you are allowed to set character size (SI, SR), cutting direction (DI, DR), character slant (SL), etc., with regard to characters you want to cut (plot).

The label command	LB
The absolute character size command	SI
The relative character size command	SR
The absolute direction command	DI
The relative direction command	DR
The character slant command	SL
The user defined character command	UC
The symbol mode command	SM
The define label terminator command	DT
The character plot command	CP

## 5-2 Character Sets

Your CAMM-1 has 19 types of character sets (0~4, 6~9, 30~39) and is able to cut (plot) characters by selecting [VECT.] for line characters or [OUTL.] for outlined characters. When you send the same character code, your CAMM-1 sometimes cuts (plots) different characters if you changed the character set. This is because your CAMM-1 cuts (plots) character fonts other than English.

You are allowed to specify two arbitrary character sets as standard and alternate character sets beforehand. Specify the standard character set with the CS command and the alternate character set with the CA command. Specify character set numbers with the parameters followed by the commands. If no parameters are input or when your CAMM-1 is initialized, the character sets you specified by the front panel are specified to both standard and alternate character sets. The SS and SA commands are used to select character sets you actually use. Also, the SS command (SS;) or [SI] (CHR\$(15)) can be used to select the standard character set, and the SA command (SA;) or [SO] (CHR\$(14)) can be used to select the alternate character set.

This is summarized into the following schematic diagram.

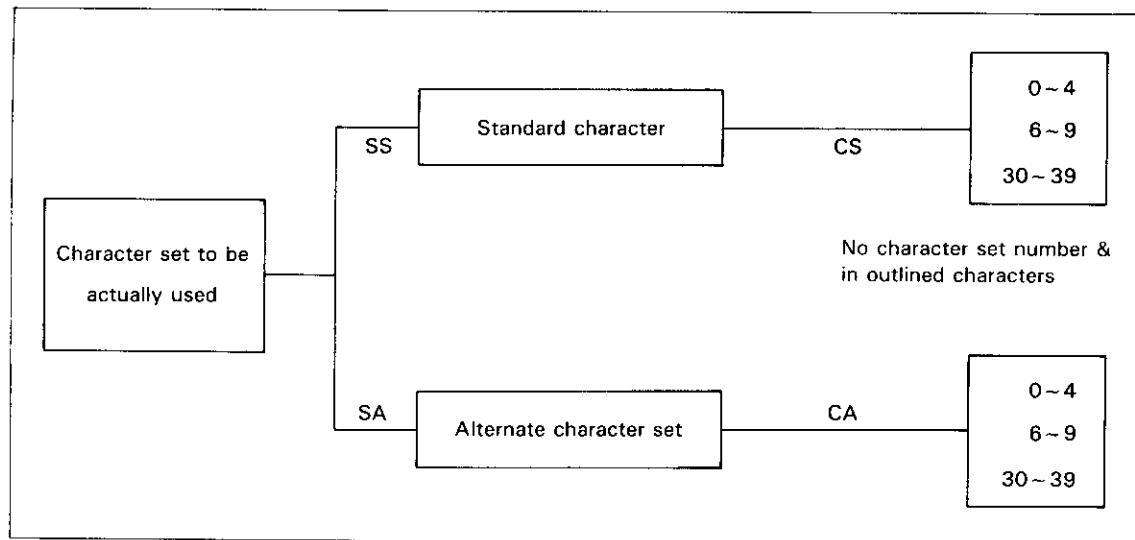


Fig. 1-13

That is, if you specify different character sets to the standard and alternate character sets, respectively, at the beginning of a program, you are allowed to change the character sets with the SS and SA commands. Also, if you input [SI] (CHR\$(15)) or [SO] (CHR\$(14)) in the parameters of the LB command, you are allowed to cut (plot) mixing two types of characters within only one LB command.

A simple program for such mixed character cutting (plotting) is given below.

### [EXAMPLE 1-2]

```

10 LPRINT "CS0;"  

20 LPRINT "CA7;"  

30 LPRINT "LB";CHR$(15);"ABC";CHR$(14);"ABC";CHR$(3)  

40 END

```

#### (Explanation)

- Line 10      Specifies character set 0 to the standard character set.
- Line 20      Specifies character set 7 to the alternate character set.
- Line 30      Cuts (plots) "ABC" in both standard and alternate character sets.

In the alternate character set, "ABC" correspond to "êôû". So, your CAMM-1 cuts (plots) as follows:

ABCêôû

The standard character set command	CS
The select standard set command	SS
The alternate character set command	CA
The select alternate set command	SA

### **5-3 Display a Label String**

Depending on the commands, you are allowed to display a label string. Also, you are allowed to set key functions freely by checking which key has been pressed when Serial Connection is used. For the characters that can be displayed, refer to List of Display Character Codes, APPENDIX B.

You just display a label string with the WD command. Although function keys do not work as displayed before, you can set key functions freely because you are allowed to know which key has been pressed with the !OK command. (Serial Connection only)

[EXAMPLE 1-3] displays a label string, moves the tool to an arbitrary position, and cuts (plots) the label string at that position if you press [ENTER] key. To terminate the program, press [FUNC] key.

#### **[EXAMPLE 1-3]**

```

100 OPEN "COM1:9600,N,8,1" AS #1
110 PRINT #1,"IN;PA0,0;""
120 PRINT #1,"WDCUTTING START OK ? ABCDEFG";CHR$(3)
130 PRINT #1,"!OK;""
140 INPUT #1,K
150 IF K=1 THEN GOTO 180 ELSE IF K<>32 THEN GOTO 130
160 PRINT #1,"LBABCDEFG";CHR$(3)
170 PRINT #1,"SP0;WD";CHR$(3)
180 CLOSE
190 END

```

CUTTING START OK ?  
ABCDEG

ENTER

The write to display command	WD
------------------------------	----

## 6 OUTPUT Command

When you send an output command to your CAMM-1, your CAMM-1 makes its information corresponding with that output command ready to output to the computer. The information includes the coordinate values of the current tool position and tool up/down status at that position, error codes, etc. And your CAMM-1 displays the information. The information output varies from Serial Connection to Parallel Connection. For Serial Connection, your CAMM-1 outputs its status data to the computer and, at the same time, displays that data. For Parallel Connection, your CAMM-1 displays its status data only. You use output commands when you need status data of your CAMM-1 for cutting (plotting). A sample program is given in [EXAMPLE 1-4] below.

### [EXAMPLE 1-4]

```
100 OPEN "COM1:9600,N,8,1" AS #1
110 PRINT #1,"OP;"
120 INPUT #1,P1X,P1Y,P2X,P2Y
130 PRINT P1X,P1Y,P2X,P2Y
```

#### (Explanation)

- Line 100   Opens the RS-232C port.
- Line 110   Sends the OP command to output the coordinate values of scaling points P1 and P2.
- Line 120   Reads the coordinate values of each point.
- Line 130   Outputs the coordinate values on the computer display.

The output actual point command	OA
The output commanded position command	OC
The output P1 & P2 command	OP
The output window command	OW
The output hard-clip limits command	OH
The output factor command	OF
The output identification command	OI
The output option parameter command	OO
The output error command	OE
The output status command	OS



## DESCRIPTION OF THE mode1 COMMANDS

# 2

- Parenthesized parameters in • Format are allmissible parameters. When they are omitted, they are set to their default values parenthesiz- ed in • Parameter.
- Parameter ranges in • Parameter are the values that result in error if they are exceed- ed. Note that some values have no meanings and some other values are ignored even if they are within the allowable parameter range.
- In • Example, a typical sample BASIC pro- gram is given. Change it according to your computer if necessary. PRINT #1 and INPUT #1 indicate the RS-232C port's data input/out- put. In this case, you need to open the RS-232C port from the beginning.
- All character (ASCII) codes use decimal.
- All character codes are marked as CHR\$ to denote they are character codes.
- Control characters are marked like [ESC] (CHR\$(27)) or [ESC].
- Three-letter mode1 commands beginning with ! are in common use with mode2 commands. And you are allowed to call all mode2 com- mands with the ^ command.



<b>H</b>	Home	<b>Move to User Origin</b>
----------	------	----------------------------

- **Format**

H

- **Parameter**

None

- **Explanation**

Raises the tool up at the current position and moves from the current tool position to the user origin (0,0) and also clears the error if an error occurs in your CAMM-1.

- **Example**

```
10  '*** H COMMAND***  
20  OPEN "LPT1:" AS #1  
40  PRINT #1,"H"
```

<b>D</b>	Draw	<b>Cut (Plot) Absolute Line</b>
----------	------	---------------------------------

- **Format**

D x<sub>1</sub>, y<sub>1</sub>, x<sub>2</sub>, y<sub>2</sub>, ... x<sub>n</sub>, y<sub>n</sub>

- **Parameters**

x<sub>n</sub> : absolute X-axis coordinate     $-(2^{26}-1) \sim + (2^{26}-1)$

y<sub>n</sub> : absolute Y-axis coordinate     $-(2^{26}-1) \sim + (2^{26}-1)$

- **Explanation**

Lowers the tool down at the current position and cuts (plots) a straight line from the current tool position to the coordinates you specified in the sequence of (x<sub>1</sub>,y<sub>1</sub>) (x<sub>2</sub>,y<sub>2</sub>) ... (x<sub>n</sub>,y<sub>n</sub>).

Coordinates are all absolute coordinates. Any number of {X-axis coordinate, Y-axis coordinate} pairs can be specified. Decimal parameter figures are cut off. + parameter signs can be omitted.

When the parameters are within the allowable range but out of the cutting (plotting) area, the tool stops on the limits of the cutting area and goes up. Then the tool starts moving again when it enters the effective cutting (plotting) area.

A D command with no parameter, without the allowable range or with only one parameter results in an error. A D command with an odd number of parameters executes the parameters from the first one by one and results in an error at the last parameter.

● **Example**

```
10  '*** D COMMAND***  
20  OPEN "LPT1:" AS #1  
40  PRINT #1, "M1000,1000"  
50  PRINT #1, "D1000,2000,2000,2000,2000,1000,1000,1000"  
60  PRINT #1, "H"
```

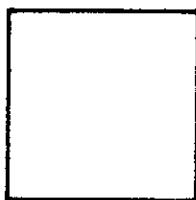


Fig. D-1

<b>M</b>	<b>Move</b>	<b>Tool-up Move to Absolute Coordinate Point</b>
----------	-------------	--

- **Format**

M x<sub>1</sub>,y<sub>1</sub>,x<sub>2</sub>,y<sub>2</sub>, ... x<sub>n</sub>,y<sub>n</sub>

- **Parameters**

x<sub>n</sub> : absolute X-axis coordinate - (2<sup>26</sup>-1) ~ + (2<sup>26</sup>-1)

y<sub>n</sub> : absolute Y-axis coordinate - (2<sup>26</sup>-1) ~ + (2<sup>26</sup>-1)

- **Explanation**

Moves the tool from the current tool position to the coordinates you specified with the tool up in the sequence of (x<sub>1</sub>,y<sub>1</sub>) (x<sub>2</sub>,y<sub>2</sub>) ... (x<sub>n</sub>,y<sub>n</sub>).

Coordinates are all absolute coordinates. Any decimal parameter figures are cut off.  
+ parameter signs can be omitted.

When the parameters are within the allowable range but out of the cutting (plotting) area, the tool does not move. Then the tool starts moving again when it enters the effective cutting (plotting) area.

An M command with no parameter, within the allowable range or with only one parameter results in an error. An M command with an odd number of parameters executes the parameters from the first one by one and results in an error at the last parameter.

- **Example**

```

10 '*** M COMMAND ***
20 OPEN "LPT1:" AS #1
40 PRINT #1,"M0,1000,1000,1000,1000,0,0,0"
50 PRINT #1,"H"
```

	<b>I</b>	<b>Relative Draw</b>	<b>Cut (Plot) Relative Line</b>
--	----------	----------------------	---------------------------------

● **Format**

|  $\Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2, \dots \Delta x_n, \Delta y_n$

● **Parameters**

$\Delta x_n$  : relative X-axis coordinate  $-(2^{26}-1) \sim + (2^{26}-1)$

$\Delta y_n$  : relative Y-axis coordinate  $-(2^{26}-1) \sim + (2^{26}-1)$

● **Explanation**

Cuts (plots) a straight line from the current tool position up to the coordinates specified by the differences ( $\Delta x_1$ ) of X and ( $\Delta y_1$ ) of Y and then cuts (plots) another straight line up to the coordinates specified by the difference ( $\Delta x_2, \Delta y_2$ ) of X and Y.

Coordinates are all absolute coordinates. Any number of (X-axis coordinate, Y-axis coordinate) pairs can be specified.

Any decimal parameter figures are cut off. + parameter signs can be omitted. However, when the parameters are within the allowable range but if the specified coordinates are out of the  $-(2^{26}-1) \sim + (2^{26}-1)$  range, an error occurs.

An I command with an odd number of parameters executes the parameters from the first one by one and results in an error at the last parameter.

● **Example**

```

10  '*** I COMMAND ***
20  OPEN "LPT1:" AS #1
40  PRINT #1,"M1000.1000"
50  PRINT #1,"I0,1000,1000,0,0,-1000,-1000,0"
60  PRINT #1,"H"

```

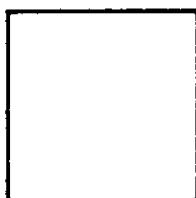


Fig. I-1

**R****Relative Move****Tool-up Move to Relative Coordinate Point**

- **Format**

R  $\Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2, \dots \Delta x_n, \Delta y_n$

- **Parameters**

$\Delta x_n$  : relative X-axis coordinate  $-(2^{26}-1) \sim +(2^{26}-1)$

$\Delta y_n$  : relative Y-axis coordinate  $-(2^{26}-1) \sim +(2^{26}-1)$

- **Explanation**

Moves with the tool up from the current tool position up to the coordinates specified by the differences ( $\Delta x_1$ ) of X and ( $\Delta y_1$ ) of Y and then moves with the tool up up to the coordinates specified by the difference ( $\Delta x_2, \Delta y_2$ ) of X and Y.

Coordinates are all relative coordinates.

Any decimal parameter figures are cut off. + parameter signs can be omitted. However, when the parameters are within the allowable range, but if the specified coordinates are out of the  $-(2^{26}-1) \sim +(2^{26}-1)$  range, an error occurs.

An R command with an odd number of parameters executes the parameters from the first one by one and results in an error at the last parameter.

- **Example**

```

10  ' ***  R COMMAND ***
20  OPEN "LPT1:" AS #1
40  PRINT #1,"R0,1000,1000,0,0,-1000,-1000,0"
50  PRINT #1,"H"
```

<b>L</b>	<b>Line Type</b>	<b>Specify Line Type</b>
----------	------------------	--------------------------

- **Format**

L p

- **Parameter**

p : line pattern -5 ~ +5 (Default: 0)

- **Explanation**

Specifies the types of cutting (plotting) lines.

When you use the D and I commands for straight line cutting (plotting), the C, E and G commands for circle cutting (plotting), the K command for division line cutting (plotting) and the T command for hatching, the line type specified by the L command and the pitch specified by the B command become active.

Depending on the parameters p, you are allowed to select 11 types of line patterns.

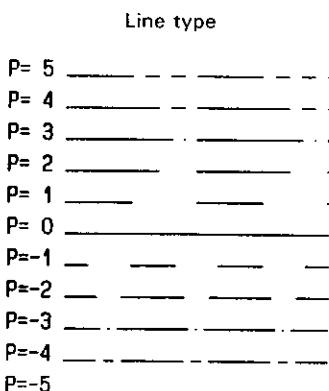


Fig. L-1

Depending on the positive or negative value of the parameter p, the positions of start and end points vary.

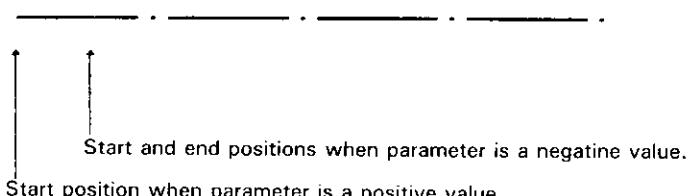
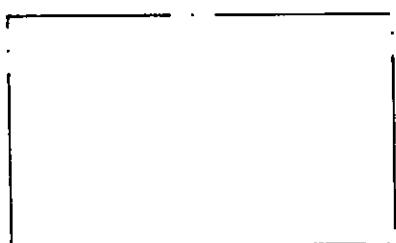


Fig. L-2

For example, if you specify a positive parameter ( $p = 3$ ) when you cut (plot) a rectangle with an alternate long and short dash line, the start point of that line varies depending on the lengths of lines as illustrated in Example 1. But if you specify a negative parameter ( $p = -3$ ), you are allowed to align the start and end points symmetrically matching to the lengths of lines as illustrated in Example 2. In this case, the cutting (plotting) pitch may be slightly changed.



Example 1



Example 2

Fig. L-3

Any parameters out of the  $-5 \sim +5$  range are ignored if specified, and the previous value is reset again. The default value ( $p=0$ ) is solid line.

You can input the L command and the B command (broken line pitch) in any order in a program.

Once specified, the line pattern of this command remains in effect until you turn off the power or until you re-specify with the L command or ^LT command (mode2).

### ● Example

```

100  '*** L COMMAND ***
110  OPEN "LPT1:" AS #1
130  P=-5
140  FOR I=0 TO 10
150      PRINT #1,"M1500, ";800+600*I
160      PRINT #1,"L";P
170      PRINT #1,"S8PP=";P
180      P=P+1
190      PRINT #1,"I5000,0"
200  NEXT I
210  PRINT #1,"H"

```

<b>B</b>	<b>Line Scale</b>	<b>Specify Broken Line Pitch</b>
----------	-------------------	----------------------------------

- **Format**

B I

- **Parameter**

I : pitch length       $0 \sim (2^{26} - 1)$   
 (Default: 1.5% of a diagonal line between P1 and P2)

- **Explanation**

Sets the pitch lengths of the broken line, alternate long and two short dashes line and alternate long and short dash line you specified by the L command.

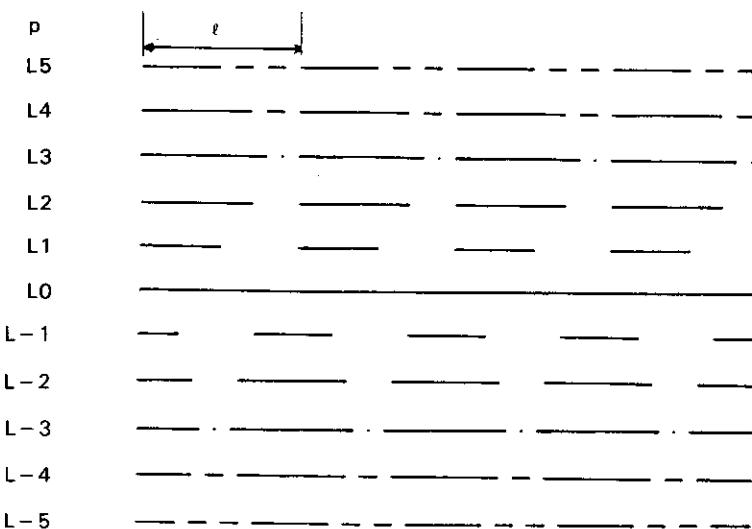


Fig. B-1

If you set a parameter larger than the length of a cutting (plotting) line, the line is cut (plotted) in a solid line.

If a negative parameter is specified by the L command, the pitch length is slightly changed because it is adjusted so that the integer number of patterns enter a cutting (plotting) interval.

Once set, the pitch length of this command remains in effect until you turn off the power or until you re-specify with the B command or ALT command (mode2).

- Example

```

100 ' *** B COMMAND ***
110 OPEN "LPT1:" AS #1
130 L=500
140 FOR I=0 TO 4
150     PRINT #1,"M1500, ";1500+1000*I
160     PRINT #1,"L2"
170     PRINT #1,"B";L
180     PRINT #1,"S8PL=";L
190     L=L+500
200     PRINT #1,"I5000.0"
210 NEXT I
220 PRINT #1,"H"

```

L= 2500 \_\_\_\_\_ .

L= 2000 \_\_\_\_\_ .

L= 1500 \_\_\_\_\_ .

L= 1000 \_\_\_\_\_ .

L= 500 \_\_\_\_\_ .

Fig. B-2

X	Axis	Cut (Plot) Coordinate System
---	------	------------------------------

- Format

X p, q, r

- Parameters

p	: coordinate axis	0, 1
q	: tick interval	$-(2^{26}-1) \sim +(2^{26}-1)$
r	: number	$0 \sim (2^{26}-1)$

### ● Explanation

Cuts (plots) a coordinate axis and ticks parallel to X axis or Y axis from the current tool position.

The parameter p specifies both X axis and Y axis. Y axis is specified when  $p=0$ , and X axis is specified when  $P=1$ . An X command with parameters other than 0 and 1 result in an error.

The parameter q specifies tick intervals. When you specify a negative value, you are allowed to cut (plot) ticks on a coordinate axis in negative directions (lower direction from the current tool position when  $p=0$  and to the right from the current tool position when  $p=1$ ).

The parameter q specifies the number of ticks to be cut (plotted).

From the parameters q and r, any decimal parameter figures are cut off.

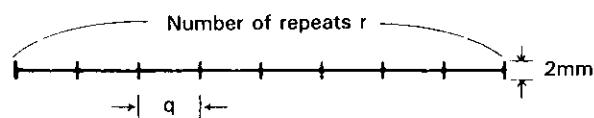


Fig. X-1

### ● Example

```

100 ' *** X COMMAND ***
110 OPEN "LPT1:" AS #1
130 FOR N=0 TO 1
140   FOR I=-300 TO 300 STEP 600
150     PRINT #1,"M5000,4000"
160     PRINT #1,"X";N;",";I;"10"
170   NEXT I
180 NEXT N
190 PRINT #1,"H"

```

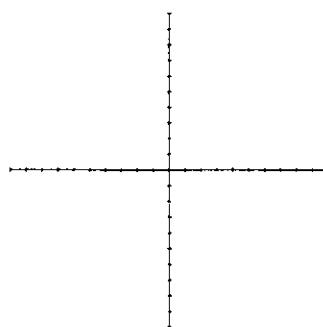


Fig. X-2

<b>P</b>	Print	<b>Cut (Plot) Character</b>
----------	-------	-----------------------------

- **Format**

P C<sub>1</sub> C<sub>2</sub> ... C<sub>n</sub>

- **Parameter**

C<sub>n</sub> : character

- **Explanation**

Cuts (plots) characters, symbols or variables followed by the P command.

Characters until [CR] (CHR\$(13)) is sent are effective. The S command can be used to change sizes of characters or symbols to be cut (plotted). The tool starts cutting (plotting) a character assuming the lower-left corner of the character as the current tool position and moves one-full character to the right after execution.

Usually, outlined characters are used for sticker sheet cutting, and line characters are used for drawing on plotting media. Set those characters by the front panel or referring to the SS, CS, SA and CA commands of mode2.

Any data or part outside the cutting (plotting) area cannot be cut (plotted), but data inside the cutting (plotting) area are cut (plotted).

The characters to be actually cut (plotted) are those character sets selected at the time of cutting (plotting).

- **Example**

```

100 ' *** P COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1, "M1500,3500"
140 PRINT #1, "S35";"PP Command"
150 PRINT #1, "H"

```

A large, stylized outline of the letters 'P' and 'Command' is displayed. The 'P' is a simple vertical shape with a horizontal stroke. The word 'Command' is written in a lowercase sans-serif font, with the 'C' being particularly large and prominent.

Fig. P-1

**S****Alpha Scale****Set Character Size**

- **Format**

S n

- **Parameter**

n : character size    0 ~ + (2<sup>26</sup> - 1) (Default: 61)

- **Explanation**

Sets the character sizes specified by the P and N commands.

Once set, the character size of this command remains in effect until you reset. Depending on the parameters, the character size and character spacing are calculated in terms of the following formulas.

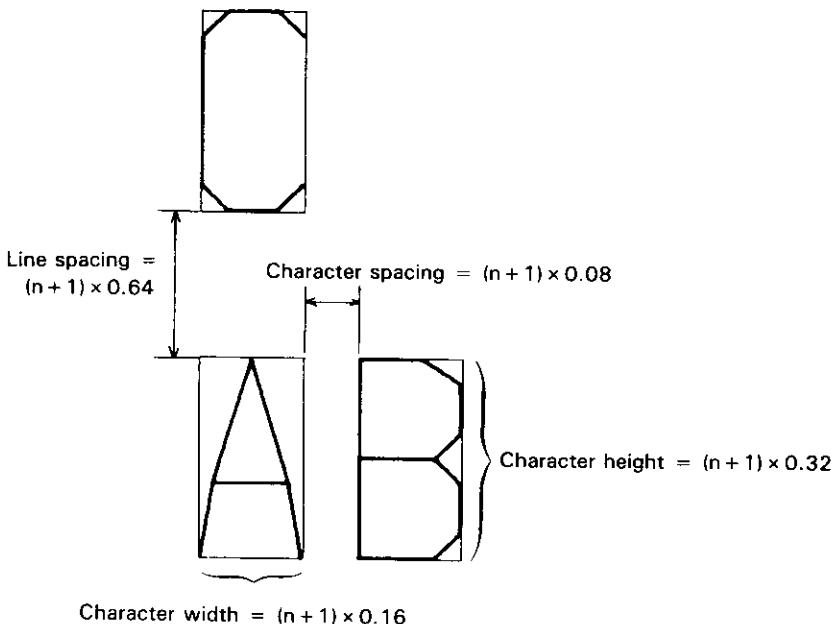


Fig. S-1

[VECT.] --- Line characters

Character height :  $(n + 1) \times 0.32\text{mm}$

Character width :  $(n + 1) \times 0.16\text{mm}$

Character spacing :  $(n + 1) \times 0.08\text{mm}$

Line spacing :  $(n + 1) \times 0.64\text{mm}$

Any out-of-range parameters are ignored, and the previous value is reset again.

- Example

```
100 ' *** S COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1, "M700,1500"
140 FOR I=5 TO 25 STEP 5
150     PRINT #1, "S";I
160     PRINT #1, "PS";I
170 NEXT I
180 PRINT #1, "S3"
190 PRINT #1, "H"
```

s 5 S 10 S 15 S 20 S 25

Fig. S-2

[OUTL.] --- Outlined characters

Character height :  $(n + 1) \times 50/62\text{mm}$

Character width :  $(n + 1) \times 25/62\text{mm}$

Character spacing : appropriate value (varies depending on characters)

Line spacing : appropriate value (varies depending on characters)

s s S 10 S 15 S 20 S 25

Fig. S-3

<b>Q</b>	<b>Alpha Rotate</b>	<b>Specify Character Rotate Angle</b>
----------	---------------------	---------------------------------------

- **Format**

Q n

- **Parameter**

n : rotation angle 0~3 (Default: 0)

- **Explanation**

Sets the cutting (plotting) angle of the characters specified by the P and N commands. Once set, the cutting angle of this command remains in effect until you reset. The parameter is an integer, and any decimal parameter figures are cut off. Any out-of-range parameters are ignored, and the previous value is reset again. Depending on the parameters, the rotation angle varies as illustrated in Fig. Q-1.

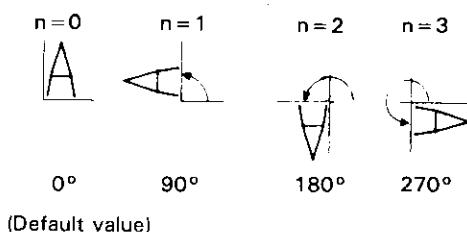


Fig. Q-1

- **Example**

```

100 '*** Q COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"S10"
140 FOR I=0 TO 3
150     PRINT #1,"M5000,4000"
160     PRINT #1,"Q";I
170     PRINT #1,"P Roland DG"
180 NEXT I
190 PRINT #1,"Q0"
200 PRINT #1,"H"

```

## DESCRIPTION OF THE mode1 COMMANDS

---

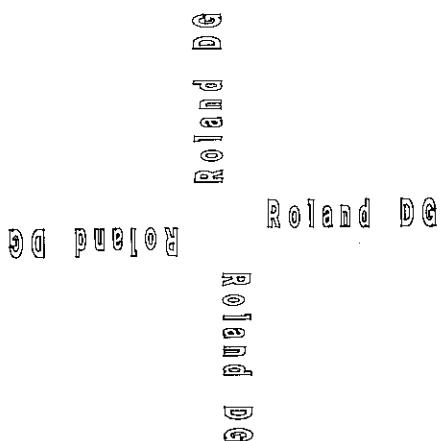


Fig. Q-2

<b>N</b>	Mark	<b>Cut (Plot) Special Symbol</b>
----------	------	----------------------------------

- **Format**

N n

- **Parameter**

n : special symbol 1~15

- **Explanation**

Cuts (plots) the special symbols described in Table N-1 around the current tool position when line character [VECT.] has been selected. But it ignores and does not cut (plot) when outlined character [OUTL.] has been selected. After cutting a symbol, the tool does not move to the next character position like the P command. The symbol size can be changed by the S command.

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Special symbol	□	○	△	+	×	◊	↑	×	✗	✗	✗	✗	*	✗	✗

Table N-1

Any data or part outside the cutting (plotting) area cannot be cut (plotted), but data inside the cutting (plotting) area is cut (plotted).

- **Example**

```

100 '*** N COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"S25":PRINT #1,"M500,3000"
140 FOR I=1 TO 15
150   PRINT #1,"N";I:PRINT #1,"R600,0"
160 NEXT I
170 PRINT #1,"S3"
180 PRINT #1,"H"

```



Fig. N-1

**C****Relative Circle****Cut (Plot) Arc****● Format**

`C x, y, r,  $\theta_1$ ,  $\theta_2$  [, $\theta_d$ ]`

**● Parameters**

$x, y$	: center coordinates	$-(2^{26}-1) \sim + (2^{26}-1)$
$r$	: radius	$-(2^{26}-1) \sim + (2^{26}-1)$
$\theta_1$	: start angle	$-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$
$\theta_2$	: end angle	$-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$
$\theta_d$	: chord tolerance	$-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$ (Default: $5^\circ$ )

**● Explanation**

Cuts (plots) an arc with the radius  $r$  from the start angle  $\theta_1$  to the end angle  $\theta_2$  around user coordinates  $(x,y)$  at the chord tolerance  $\theta_d$ .

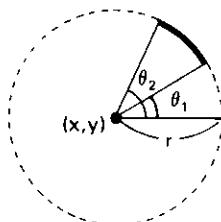


Fig. C-1

The parameters  $x$ ,  $y$  and  $r$  are expressed in user coordinates, and the parameters  $\theta_1$ ,  $\theta_2$  and  $\theta_d$  are expressed in degrees ( $^\circ$ ) as illustrated in Fig. C-1. + parameter signs can be omitted. When  $\theta_1 < \theta_2$ , an arc is cut (plotted) in a counterclockwise direction. When  $\theta_1 > \theta_2$ , an arc is cut (plotted) in a clockwise direction.

Since an arc is cut (plotted) with many straight lines (chords), its chord tolerance is expressed in  $\theta_d$ . The chord tolerance  $\theta_d$  is compensated for the value that divides the center angle ( $\theta_2 - \theta_1$ ) into even angles.

In addition, a polygon can be cut (plotted) with the chord tolerance  $\theta_d$ . For example, if  $\theta_d$  is  $60^\circ$  for a circle ( $360^\circ$ ), a hexagon will be cut (plotted). If  $\theta_d$  is  $45^\circ$ , an octagon will be cut (plotted).

**● Example**

● Example

```
100 '*** C COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"C5000,4000,3000,0,360"
140 PRINT #1,"C5000,4000,2000,360,0"
150 PRINT #1,"H"
```

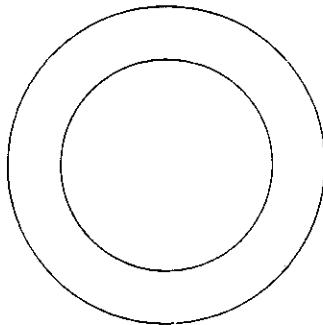


Fig. C-2

**E****Relative Circle****Cut (Plot) Arc from Tool Position**

- **Format**

**E r,  $\theta_1$ ,  $\theta_2$  (,  $\theta_d$ )**

- **Parameters**

r	: radius	$-(2^{26}-1) \sim + (2^{26}-1)$
$\theta_1$	: start angle	$-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$
$\theta_2$	: end angle	$-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$
$\theta_d$	: chord tolerance	$-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$ (Default: 5°)

- **Explanation**

Like the C and G commands, cuts (plots) a circle or an arc. But it cuts (plots) an arc with the radius r up to the end angle  $\theta_2$  at the chord tolerance  $\theta_d$  so that the current tool position becomes the start angle  $\theta_1$ .

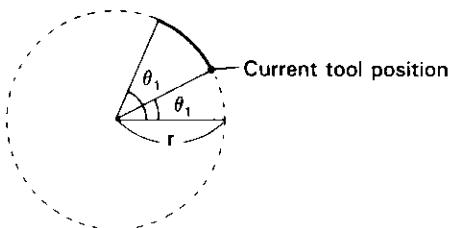


Fig. E-1

Since the current tool position is the start point of a circle or an arc, this command is useful when you cut (plot) circles or arcs in succession.

The parameter r is expressed in user coordinates, and the parameters  $\theta_1$ ,  $\theta_2$  and  $\theta_d$  are expressed in degrees (°) as illustrated in Fig. E-1. + parameter signs can be omitted. When  $\theta_1 < \theta_2$ , a circle or an arc is cut (plotted) in a counterclockwise direction. When  $\theta_1 > \theta_2$ , a circle or an arc is cut (plotted) in a clockwise direction.

Since an arc is cut (plotted) with many straight lines (chords), its chord tolerance is expressed in  $\theta_d$ . The chord tolerance  $\theta_d$  is compensated for the value that divides the center angle ( $\theta_2 - \theta_1$ ) into even angles.

Also, a polygon can be cut (plotted) with the chord tolerance  $\theta_d$ . For example, if  $\theta_d$  is 60° for a circle (360°), a hexagon will be cut (plotted). If  $\theta_d$  is 45°, an octagon will be cut (plotted).

- **Example**

● Example

```
100 '*** E COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"M5000,4000"
140 FOR I=0 TO 330 STEP 30
150   PRINT #1,"E1800,";I;",";360+I
160 NEXT I
170 PRINT #1,"H"
```

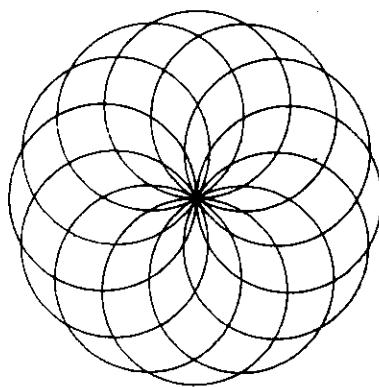


Fig. E-2

<b>A</b>	Circle center	<b>Specify G &amp; K Center Coordinates</b>
----------	---------------	---

- **Format**

A x, y

- **Parameters**

x, y : center coordinates  $-(2^{26}-1) \sim +(2^{26}-1)$  (Default: x = 0, y = 0)

- **Explanation**

Sets the center point of a circle or an arc to be cut (plotted) by the G or K command. Once set, the center coordinates (x,y) of this command remain in effect until you reset in user coordinates. + parameter signs can be omitted.

Any out-of-range parameters are ignored, and the previous value is reset again. If you specify coordinates out of the cutting (plotting) area, the G and K commands may not cut (plot) any circle or arc at all.

<b>G</b>	A + Circle	<b>Cut (Plot) Arc Around A-Command Center</b>
----------	------------	---

- **Format**

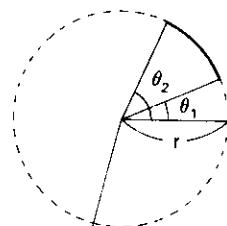
G r,  $\theta_1$ ,  $\theta_2$  (,  $\theta_d$ )

- **Parameters**

r : radius	$-(2^{26}-1) \sim +(2^{26}-1)$
$\theta_1$ : start angle	$-(2^{26}-1)^\circ \sim +(2^{26}-1)^\circ$
$\theta_2$ : end angle	$-(2^{26}-1)^\circ \sim +(2^{26}-1)^\circ$
$\theta_d$ : chord tolerance	$-(2^{26}-1)^\circ \sim +(2^{26}-1)^\circ$ (Default: $5^\circ$ )

- **Explanation**

Cuts (plots) an arc with the radius r from the start angle  $\theta_1$  to the end angle  $\theta_2$  at the chord tolerance  $\theta_d$  around the point you specified by the A command.



(x,y) specified by A command

Fig. G-1

Remember that the A command must have been executed at this point.

The parameter  $r$  is expressed in user coordinates, and the parameters  $\theta_1$ ,  $\theta_2$  and  $\theta_d$  are expressed in degrees ( $^\circ$ ) as illustrated in Fig. F-1. + parameter signs can be omitted. When  $\theta_1 < \theta_2$ , an arc is cut (plotted) in a counterclockwise direction. When  $\theta_1 > \theta_2$ , an arc is cut (plotted) in a clockwise direction.

Since an arc is cut (plotted) with many straight lines (chords), its chord tolerance is expressed in  $\theta_d$ . The chord tolerance  $\theta_d$  is compensated for the value that divides the center angle ( $\theta_2 - \theta_1$ ) into even angles.

Also, a polygon can be cut (plotted) with the chord tolerance  $\theta_d$ . For example,  $\theta_d$  is  $60^\circ$  for a circle ( $360^\circ$ ), a hexagon will be cut (plotted). If  $\theta_d$  is  $45^\circ$ , an octagon will be cut (plotted).

### ● Example

```

100  '*** G COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"A5000,4000"
140  PRINT #1,"G2000,0,360"
150  PRINT #1,"H"

```

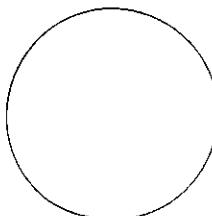


Fig. G-2

**K****A + %****Cut (Plot) Division Line**

- **Format**

K n, l<sub>1</sub>, l<sub>2</sub>

- **Parameter**

n	: division line angle	$-(2^{26}-1) \sim +(2^{26}-1)$
l <sub>1</sub>	: division line end point distance	$-(2^{26}-1) \sim +(2^{26}-1)$
l <sub>2</sub>	: division line start point distance	$-(2^{26}-1) \sim +(2^{26}-1)$

- **Explanation**

Cuts (plots) division lines and leader lines to the circle or arc you cut by the A and G commands.

Remember that the A command must have been executed at this point.

The parameter n specifies the angle of division lines. You are allowed to specify division line angles in percentage from  $-9101\%$  to  $+9101\%$  assuming 12 o'clock position as 0% and one  $360^\circ$  turn as 100%. You can omit + parameter signs. When the parameter n is positive, the division line angle is n% angle in a clockwise direction. When the parameter n is negative, the division line angle is n% in a counterclockwise direction.

The parameter l<sub>1</sub> specifies the distance from the center point of a circle to the end point of a division or leader line. The parameter l<sub>2</sub> specifies the distance from the center point of a circle to the start point of a division or leader line. That is, the length of a leader line is  $(l_1 - l_2)$ .

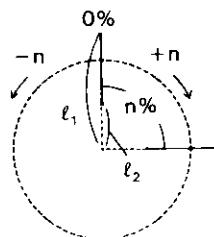


Fig. K-1

When  $l_1 = \text{circle's radius}$  and  $l_2 = 0$ , a division line is cut (plotted) to a circle. When  $l_1 > \text{circle's radius}$  and also  $0 < l_2 < \text{circle's radius}$ , a leader line is cut (plotted) from the inside to the outside of a circle.

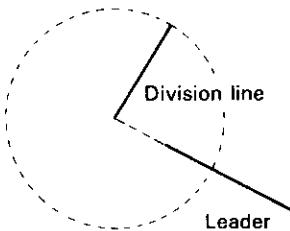


Fig. K-2

● Example

```
100  *** K COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"A5000,4000"
140  PRINT #1,"G2000,0,360"
150  A=0
160  FOR X=1 TO 5
170      READ B
180      A=A+B
190      PRINT #1,"K",A; ",2000,0"
200  NEXT X
210  PRINT #1,"H"
220  DATA 35,25,20,15,5
```

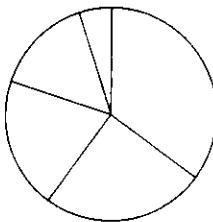


Fig. K-3

**T****Hatching****Cut (Plot) and Hatch Rectangle**

● **Format**

`T n, x, y, d, t`

● **Parameters**

n	: hatching pattern	0~3
x, y	: rectangle size	$-(2^{26}-1) \sim + (2^{26}-1)$
d	: hatching spacing	$-(2^{26}-1) \sim + (2^{26}-1)$
t	: hatching angle	1~4

● **Explanation**

Hatches a rectangle from the current tool position assuming as the start point.

The parameter n specifies hatching patterns and rectangle types as described below.  
Any decimal parameter figures are cut off.

- n = 1 ——— hatching only
- n = 2 ——— rectangle cutting (plotting) only
- n = 3 ——— hatching and rectangle cutting (plotting)
- n = 0 ———

The parameters x, y specify the lengths of a rectangle in X-axis direction and in Y-axis direction, respectively.

The parameter d specifies hatching spacings. Even when you cut (plot) a rectangle only (n = 2), you need to input this parameter as a dummy.

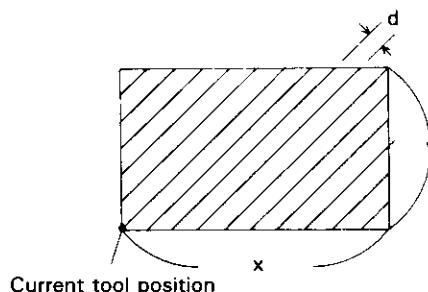


Fig. T-1

The parameter t specifies hatching angles. Four parameters from 1 through 4 are available, which correspond to  $0^\circ$ ,  $45^\circ$ ,  $90^\circ$  and  $135^\circ$ , respectively, as illustrated in Fig. T-2. If you specify out-of-range parameters, the T command is ignored. You need to input this parameter as a dummy even when you cut (plot) a rectangle only.

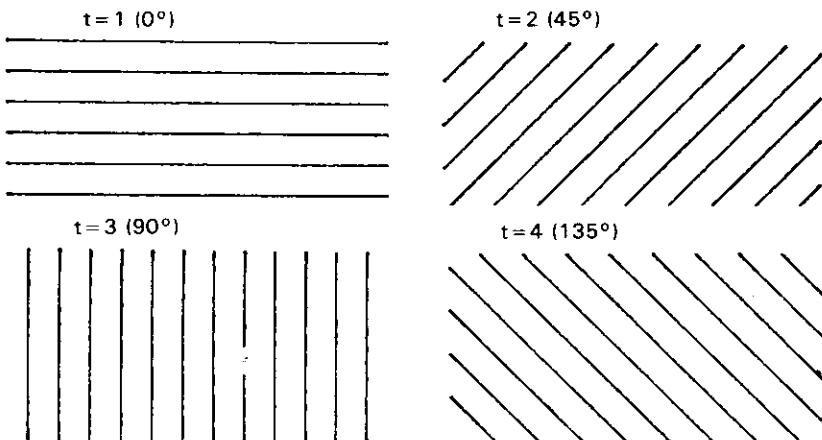


Fig. T-2

#### ● Example

```
100 '*** T COMMAND1 ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"M1000,1000"
140 PRINT #1,"T3,8000,5657,500,2"
150 PRINT #1,"H"
```

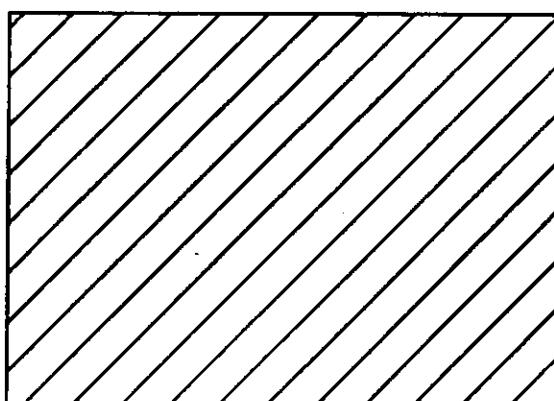


Fig. T-3

- **Example**

```

100 *** T COMMAND2 ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"M1000,1000"
140 PRINT #1,"T3,8000,6000,1000,3"
150 PRINT #1,"T1,8000,6000,500,1"
160 PRINT #1,"H"

```

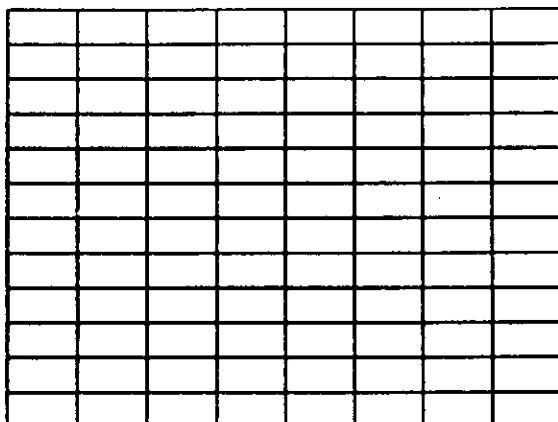


Fig. T-4

^		Call mode2
---	--	------------

- **Format**

^ m2

- **Parameter**

m2 : [mode2 command and its parameters] [terminator]

- **Explanation**

Calls a mode2 command when a command has been set to mode1 from the front panel. To call a mode2 command, you just add a ^ sign to the head of a mode2 command when you write. You can use mode1 commands and mode2 commands together in a program.

- **Example**

```

100 '*** ^ COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"M1000,4000"
140 PRINT #1,"^SL0.4;"
150 PRINT #1,"S50"
160 PRINT #1,"PRoland"
170 PRINT #1,"^SL;"
180 PRINT #1,"S3"
190 PRINT #1,"H"

```

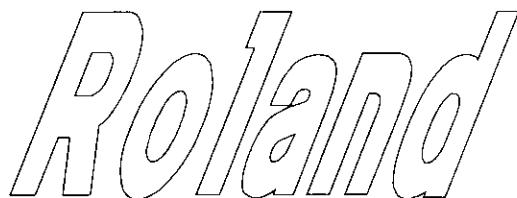


Fig. A-1

<b>!NR Command</b>	<b>Not Ready</b>
--------------------	------------------

- **Format**

!NR

- **Parameter**

None

- **Explanation**

Pauses in the same status as you press [ENTER] key during operation.

In this status, your CAMM-1 does not operate even if a new command is sent. If you select [CONT] from the front panel to clear Pause Mode, your CAMM-1 starts cutting (plotting) from the next command followed by the !NR command if any.

- **Example**

```

10 '*** !NR COMMAND ***
20 FOR I=1 TO 20
30 LPRINT "PA0,0;"
40 LPRINT "PA1000,1000;"
50 IF I=10 THEN LPRINT "!NR"
60 NEXT I

```

**!OK Command****Output Key****● Format**

!OK;

**● Parameter**

None

**● Explanation**

For Serial Connection, outputs the sum of bit values of pressed panel keys in ASCII as follows.

Sum of key bit values [TERM]

The [TERM] is the output terminator of the RS-232C port.

The bit values of each panel key are as follows:

Bit value	Bit No.	Panel key
1	1	[FUNC]
2	2	[▶]
4	3	[◀]
8	4	[▲]
16	5	[▼]
32	6	[ENTER]
64	7	None
128	8	None

Table !OK-1

These panel keys are those when the !OK command was sent and have nothing to do with previously pressed ones.

The !OK command outputs 0 when no key is pressed.

When [FUNC] and [▲] keys are pressed, the !OK command outputs 17 (=1+16).

By displaying a label string with the WD command (mode2) and checking panel keys with the !OK command, you are allowed to freely set panel key functions.

The !OK command is ignored when Parallel Connection is used.

- Example

```

10 '*** !OK COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"!OK"
40 INPUT #1,K
50 IF K=0 THEN 30
60 PRINT K

```

!PG Command	Page Feed
-------------	-----------

- Format

!PG n

- Parameter

n: -800 ~ +800

- Explanation

Pushes out the current sheet by the parameter n only and sets a new origin. The unit of this parameter is mm, and decimal parameter figures are acceptable.

If you omit the parameter n, one-full page is pushed out. At this time, 84mm (= 19mm + 65mm) is also pushed out as an extra margin. 19mm is an extra margin, automatically inserted between pages. 65mm is a width, pushed out temporarily to make sheet separation convenient. If you specify [VIEW] or [ORG] from the front panel or send a command to specify a tool carriage move after sheet cutting, your CAMM-1 first pushes the sheet back 65mm and then starts operating again. The length of one page varies depending on how you set [SIZE] in 4.3 (1) \* Set Configuration \* menu in CHAPTER 4, Part 1.

Sheet size	Sheet length to be pushed out
ISO A2	583 (564 + 19)
ISO A3	286 (267 + 19)
FREE-Y	Max. Y-axis coordinate value + 20
EXPAND-X	Max. X-axis coordinate value + 20

Sheet size	Sheet length to be pushed out
<b>ANSI C</b>	527.8 (508.8 + 19)
<b>ANSI B</b>	268.4 (249.4 + 19)

Table !PG-1

- Example

```
10 '*** !PG COMMAND ***
20 LPRINT "M0,1000"
30 LPRINT "PABC"
40 LPRINT "!PG300"
50 LPRINT "M0,1000"
60 LPRINT "PDEF"
70 LPRINT "!PG"
```

**!SF Command****Select Font Type****● Format**

**!SF n, m;**

**● Parameters**

n : character type      0,1,2 (Default: value set by front panel)  
 m: character spacing    0 ~ (2<sup>26</sup> - 1)

**● Explanation**

Specifies character type and character spacing.

The meaning of the parameter m varies depending on the value of the parameter n as follows:

<b>n</b>	<b>Character type to be selected</b>	<b>m function</b>	<b>m</b>
<b>0</b>	Line character	None	Ignores
<b>1</b>	Outlined character	Spacing absolute	Absolutely specifies character spacing in cm
<b>2</b>	Outlined character	Spacing relative	Specifies character spacing in m% of character height

Table !SF-1

Usually, you select line character for plotting and outlined character for cutting. However, outlined character becomes active when [CUTTER] has been selected for [TOOL].

**● Example**

```

10 *** !SF COMMAND ***
20 LPRINT "S50"
30 LPRINT "M0,1000"
40 LPRINT "!SF0,0"
50 LPRINT "PABC"
60 LPRINT "!SF1,3"
70 LPRINT "PABC"
80 LPRINT "!SF2,50"
90 LPRINT "PABC"

```

A B C A B C

## !ST Command

## Select Tool

- **Format**

!ST n;

- **Parameter**

n: 0,1 (Default: value set by front panel)

- **Explanation**

Sets Operate Mode of your CAMM-1. Plot Mode enters when the parameter n is 0. Cutting Mode enters when the parameter n is 1. In Cutting Mode, some inherent misalignment of cutter axis occurs, but that misalignment is perfectly offset at both start and end points of every vector.

- **Example**

```
10 *** !ST COMMAND ***
20 LPRINT "!ST1;"
```



## **DESCRIPTION OF THE mode2 COMMANDS**

# **3**

mode2 is a group of commands systematically organized in order for you to operate your CAMM-1 efficiently. Each command is a high level language and has great freedom to allow you to establish detailed settings to individual operations of your CAMM-1.

When you want to write your own program, you need to read this chapter to familiarize yourself with basic knowledge and the functions of each mode2 command.

In this chapter, each command is written in BASIC as an example. Change the written format according to your computer if necessary.

- All character codes are marked as CHR\$ to denote they are character codes.
- Control characters are marked, for example, as [ESC] (CHR\$(27)) or [ESC].



**AA Command****Arc Absolute****● Format**AA  $x, y, \theta_c, (\theta_d);$ **● Parameters**

$x, y$  : center coordinates  
 $\theta_c$  : center angle  
 $\theta_d$  : chord tolerance

$-(2^{26}-1) \sim + (2^{26}-1)$   
 $-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$   
 $-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$  (Default: 5°)

**● Related Commands**

AR, CI, LT

**● Explanation**

Cuts (plots) an arc around any point specified by the absolute coordinates ( $x, y$ ). Assuming the current tool position as the start point, cuts (plots) an arc by only the angle specified by the center angle  $\theta_c$  with the current tool status (up/down).

This command is useful when you want to cut (plot) an arc followed by a straight line.

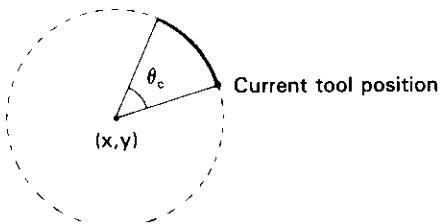


Fig. AA-1

Since an arc is cut with many straight lines (chords), its chord tolerance is expressed in  $\theta_d$ . The chord tolerance  $\theta_d$  is compensated for the value that divides the center angle  $\theta_c$  into even angles. The center angle is set to 0° if it is below 0° and to 180° if it is over 180°. Also, if the chord tolerance  $\theta_d$  is too small and mechanically impossible to accept, your CAMM-1 compensates it for the smallest possible value. If 0° is specified to  $\theta_d$ , your CAMM-1 cuts (plots) the smoothest circle. If you omit  $\theta_d$ , the default value 5° will be set.

An AA command with less than two parameters results in error (2) and this command is ignored. An AA command with more than five parameters also results in error (2), but the first four parameters remain in effect. An AA command with out-of-range parameters results in error (3) and this command is ignored.

As illustrated below, you are allowed to not only cut (plot) a circle or an arc but also cut (plot) any polygon by changing the chord tolerance  $\theta_d$ . For example, if  $\theta_d$  is  $60^\circ$ , a hexagon will be created. If  $\theta_d$  is  $45^\circ$ , an octagon will be created.

● Example

```
100 '*** AA COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"PA;PU7000,6000;""
140 FOR I=1 TO 3
150     READ A:D=360/A
160     PRINT #1,"PD;AA5000,4000,360,;"D;""
170 NEXT I
180 DATA 8,5,3
```

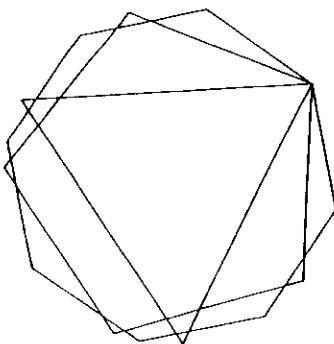


Fig. AA-2

**AR Command****Arc Relative****● Format**AR  $\Delta x$ ,  $\Delta y$ ,  $\theta_c$  (,  $\theta_d$ );**● Parameters**

$\Delta x$ , $\Delta y$ : relative center coordinates	$-(2^{26}-1) \sim + (2^{26}-1)$
$\theta_c$ : center angle	$-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$
$\theta_d$ : chord tolerance	$-(2^{26}-1)^\circ \sim + (2^{26}-1)^\circ$ (Default: 5°)

**● Related Commands**

AA, CI, LT

**● Explanation**

Assuming the current tool position as the start point, cuts (plots) an arc around any point specified by the relative coordinates ( $\Delta x$ ,  $\Delta y$ ) from the current tool position by only the angle specified by the chord tolerance  $\theta_d$  with the current tool status (up/down).

This command is useful when you want to cut (plot) an arc followed by a straight line.

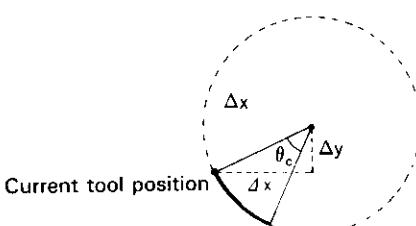


Fig. AR-1

Since an arc is cut with many straight lines (chords), its chord tolerance is expressed in  $\theta_d$ . The chord tolerance  $\theta_d$  is compensated for the value that divides the center angle  $\theta_c$  into even angles. The center angle is set to 0° if it is below 0° and to 180° if it is over 180°. Also, if the chord tolerance  $\theta_d$  is too small and mechanically impossible to accept, your CAMM-1 compensates it for the smallest possible value. If 0° is specified to  $\theta_d$ , your CAMM-1 cuts (plots) the smoothest circle. If you omit  $\theta_d$ , the default value 5° will be set.

An AR command with less than two parameters results in error (2) and this command is ignored. An AR command with more than five parameters also results in error (2), but the first four parameters remain in effect. An AR command with out-of-range parameters results in error (3) and this command is ignored.

- **Example**

```
100 '*** AR COMMAND ***
110 OPEN "LPT1:" AS #1
130 FOR DY=-3000 TO -1000 STEP 1000
140 PRINT #1,"PA;PU5000,7000;"
150 PRINT #1,"PD;AR0,;DY;,360,10;"
160 NEXT DY
```

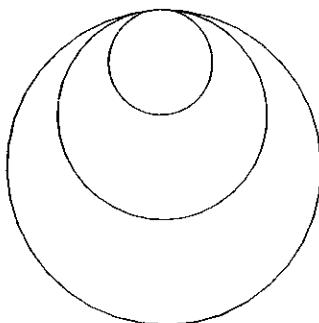


Fig. AR-2

CA Command	Alternate Character Set
------------	-------------------------

- **Format**

CA n;  
CA:

- **Parameter**

n: character set number 0~4, 6~9, 30~39 (Default: value set by front panel)  
(Character set number 8 is not included in outlined character sets.)

- **Related Commands**

CS, SA, SS

- **Explanation**

Selects one of the character sets from List of Character Sets, APPENDIX D, and specifies it as an alternate character set.

The parameter n specifies a character set number. Any decimal parameter figures are cut off.

A CA command without any parameter sets the character set you specified by the front panel.

To specify an alternate character set to the character table to be actually cut (plotted), you just execute the SS command or send [SO] (CHR\$(14)) within the LB command.

A CA command with more than two parameters results in error (2), but the first parameter remains in effect. A CA command with an out-of-range parameter results in error (3 or 5) and this command is ignored.

- **Example.**

```

10 '*** CA COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA1000,1000;"
40 PRINT #1,"CS0;CA7;"
50 PRINT #1,"SS;"
60 PRINT #1,"LBy=";CHR$(3)
70 PRINT #1,"SA;"
80 PRINT #1,"LB";CHR$(120);CHR$(3)
90 PRINT #1,"SS;"
100 PRINT #1,"LBx+1";CHR$(3)

```

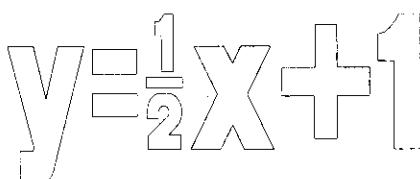


Fig. CA-1

**CI Command****Circle****• Format**CI r (,  $\theta_d$ );**• Parameters**

r : radius

–(2<sup>26</sup> – 1) ~ + (2<sup>26</sup> – 1) $\theta_d$  : chord tolerance–(2<sup>26</sup> – 1)<sup>o</sup> ~ + (2<sup>26</sup> – 1)<sup>o</sup> (Default: 5<sup>o</sup>)**• Related Commands**

AA, AR, LT

**• Explanation**

Cuts (plots) a circle with the radius r centered at the current tool position at the chord tolerance  $\theta_d$  in a counterclockwise direction. + parameter signs can be omitted.

Since an arc is cut with many straight lines (chords), its chord tolerance is expressed in  $\theta_d$ . The chord tolerance  $\theta_d$  is compensated for the value that divides the center angle  $\theta_c$  into even angles. The center angle is set to 0<sup>o</sup> if it is below 0<sup>o</sup> and to 180<sup>o</sup> if it is over 180<sup>o</sup>. Also, if the chord tolerance  $\theta_d$  is too small and mechanically impossible to accept, your CAMM-1 compensates it for the smallest possible value. If 0<sup>o</sup> is set to  $\theta_d$ , your CAMM-1 cuts (plots) the smoothest circle. If  $\theta_d$  is omitted, the default value 5<sup>o</sup> will be set.

A CI command with more than three parameters results in error (2), but the first two parameters remain in effect. A CI command with out-of-range parameters results in error (3) and this command is ignored.

As illustrated below, you are allowed to not only cut (plot) a circle but also cut (plot) any polygon by changing the chord tolerance  $\theta_d$ . For example, if 60<sup>o</sup> is set to  $\theta_d$ , a hexagon will be created. If 45<sup>o</sup> is set to  $\theta_d$ , an octagon will be created.

**• Example**

```

100  *** CI COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"PA;PU5000,4000;""
140  FOR R=800 TO 2400 STEP 800
150      PRINT #1,"CI";R;""
160  NEXT R

```

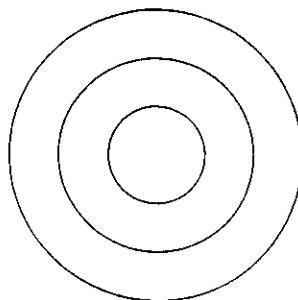


Fig. CI-1

<b>CP Command</b>	<b>Character Plot</b>
-------------------	-----------------------

- **Format**

CP  $n_x$ ,  $n_y$ ;  
CP;

- **Parameters**

$n_x$ : number of characters in X-axis direction –  $(2^{26} - 1) \sim + (2^{26} - 1)$   
 $n_y$ : number of characters in Y-axis direction –  $(2^{26} - 1) \sim + (2^{26} - 1)$

- **Related Commands**

DI, DR, SI, SR

- **Explanation**

Moves the tool any specified character cells with the current tool status (up/down). A character cell is the area of one-full character including the spacing between characters. For the character cell and character size, refer to the section of SI Command.

This command moves the tool to the right or in an upper direction when the parameter values are positive and to the left or in a lower direction when the parameter values are negative. However, these moving directions vary depending on the character cutting (plotting) directions as illustrated in Fig. CP-1. Also, even when the parameters are the same, the tool moving distance increases as the current character size increases.

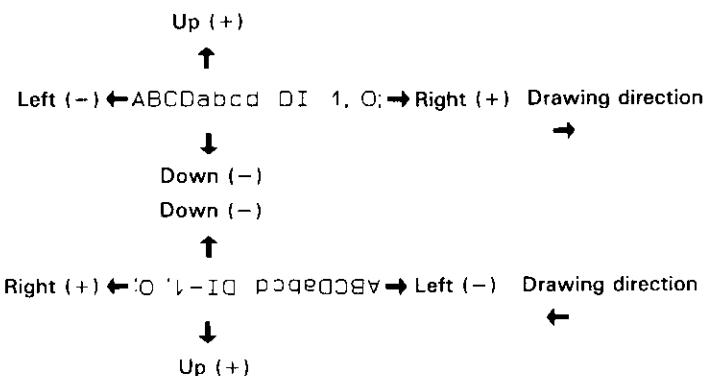


Fig. CP-1

A CP command without parameters moves the tool one-full character down from the position at which the tool stayed before the start of cutting (plotting). (This is the same as [CR] and [LF] are executed.)

Since the CP command specifies the amount of tool movements in the number of characters, it is much useful for character cutting (plotting) than the PA and PR commands.

A CP command with only one parameter results in error (2) and this command is ignored. A CP command with more than three parameters also results in error (2) and this command is ignored. Also, any tool moving distance exceeds  $(2^{26}-1)$  or any tool moving to coordinates exceeding  $-(2^{26}-1) \sim +(2^{26}-1)$  results in error (3), and they are ignored.

### ● Example

```

100  '*** CP COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"IN;PA1500,6500;"
140  PRINT #1,"SI1,1.5;"
150  PRINT #1,"LBCP COMMAND";CHR$(3)
160  PRINT #1,"CP-10,-2;PR0,0;"
170  PRINT #1,"LBTHE";CHR$(3)
180  PRINT #1,"CP;LBCHARACTER";CHR$(3)
190  PRINT #1,"CP;LBPLLOT";CHR$(3)
200  PRINT #1,"CP;LBCPCOMMAND,CP";CHR$(3)

```

## CP COMMAND

THE  
CHARACTER  
PLOT  
CPCOMMAND,CP

Fig. CP-2

### CS Command

### Standard Character Set

- **Format**

CS n;  
SC

- **Parameter**

n: character set number      0~4, 6~9, 30~39 (Default: Value set by front panel)  
(Character set number 8 is not included in outlined character sets.)

- **Related Commands**

CA, DI, SA, SS

- **Explanation**

Select one of the character sets from List of Character Sets, APPENDIX D, and specifies it as a standard character set.

Any decimal parameter figures are cut off.

A CA command without any parameter sets the character set you set by the front panel to the standard character set.

To specify the standard character set to the character table to be actually cut (plotted), you just execute the SS command or send [SI] (CHR\$(15)) within the LB command.

A CS command with more than two parameters results in error (2), but the first one parameter remains in effect. A CS command with an out-of-range parameter results in error (3 or 5) and this command is ignored.

- **Example**

```
10 '*** CS COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA1000,1000;"
40 PRINT #1,"CS1;"
50 PRINT #1,"SS;"
60 PRINT #1,"LBtan({/3)=¥3";CHR$(3)
```



Fig. CS-1

DF Command	Default
------------	---------

- **Format**

DF;

- **Parameter**

None

- **Related Command**

IN

- **Explanation**

Without changing the positions of scaling points P1 and P2, returns character size, character slant, etc., to the following default conditions.

Function	Equivalent command	Contents
<b>Alternate character set</b>	CA;	Set by front panel
<b>Standard character set</b>	CS;	Set by front panel
<b>Character direction</b>	DI;	Horizontal to right
<b>Character direction</b>	DR;	Horizontal to right
<b>Label terminator</b>	DT;	[ETX] (CHR\$(3))
<b>Hatching pattern</b>	FT;	bi-directional filling
<b>Hatching spacing</b>	FT;	1% of diagonal line to P1,P2
<b>Hatching angle</b>	FT;	Horizontal
<b>Error mask bit value</b>	IM;	223
<b>Window</b>	IW;	Maximum cutting area
<b>Cutting line type</b>	LT;	Solid line
<b>Cutting line pitch length</b>	LT;	4% of diagonal line to P1,P2
<b>Coordinate mode</b>	PA;	Absolute coordinates
<b>Tool size</b>	PT;	0.3mm
<b>Scaling</b>	SC;	Not scaled
<b>Character size</b>	SI;	Width: 3.8cm Height: 5cm
<b>Character slant</b>	SL;	0°
<b>Symbol mode</b>	SM;	OFF
<b>Character set</b>	SS;	Standard character set
<b>Tick length</b>	TL;	X axis: 0.5% of (P2x - P1x) Y axis: 0.5% of (P2y - P1y)
<b>Tool feed rate</b>	VS;	Set by front panel
<b>Select font</b>	!SF;	Set by front panel

Table DF-1

● Example

```

10 *** DF COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1, "DF;"
```

**DI Command****Absolute Direction****● Format**

DI run, rise;  
DI;

**● Parameters**

run: X-axis directional vector –  $(2^{26} - 1) \sim + (2^{26} - 1)$  (Default: 1)  
rise: Y-axis directional vector –  $(2^{26} - 1) \sim + (2^{26} - 1)$  (Default: 0)

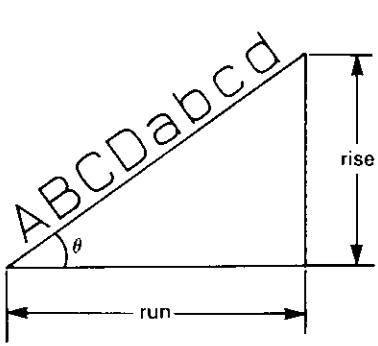
**● Related Command**

DR, LB

**● Explanation**

Specifies a character cutting (plotting) direction, which is determined regardless of the positions of scaling points P1 and P2.

The relation between the two parameters (run and rise) and the cutting (plotting) direction when you specify is as illustrated in Fig. DI-1.



	run	rise
0°	1	0
45°	1	1
90°	0	1
135°	-1	1
180°	-1	0
225°	-1	-1
270°	0	-1
315°	1	-1

Fig. DI-1

When  $\text{rise} = 0$ , it sets the default horizontal cutting (plotting) direction. When  $\text{run} = 0$ , it sets the default vertical cutting (plotting) direction.

When the angle  $\theta$  of your desirable cutting (plotting) direction is known, you just execute "DI";cosθ;" ";"sinθ;" ";".

A DI command without parameters defaults to "DL1,0;" (horizontal).

The cutting (plotting) direction you set by the DI command remains in effect unless you execute a new DI or DR command or unless you execute the IN or DF command to default it.

Parameter signs are determined by your decision of which direction you cut (plot) when you take the current tool position as the origin, which are illustrated in Fig. DR-2.

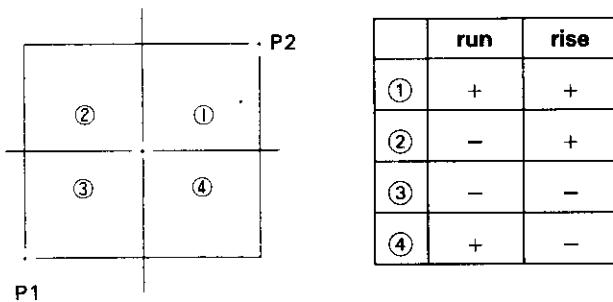


Fig. DR-2

A DR command with only one parameter results in error (2) and this command is ignored. A DR command with more than three parameters also results in error (2), but the first two parameters remain in effect. A DR command with out-of-range parameters (or when the parameters run and rise are all 0) results in error (3) and this command is ignored.

#### ● Example

```

100 **** DI COMMAND ****
110 OPEN "LPT1:" AS #1
130 PRINT #1,"IN;PA4300,4000;"
140 PRINT #1,"SI0.65,1.3;"
150 PRINT #1,"DI1,1;LB -- 45deg";CHR$(13);CHR$(3)
160 PRINT #1,"DI0,1;LB -- 90deg";CHR$(13);CHR$(3)
170 PRINT #1,"DI-1,1;LB --135deg";CHR$(13);CHR$(3)
180 PRINT #1,"DI-1,0;LB --180deg";CHR$(13);CHR$(3)
190 PRINT #1,"DI-1,-1;LB --225deg";CHR$(13);CHR$(3)
200 PRINT #1,"DI0,-1;LB --270deg";CHR$(13);CHR$(3)
210 PRINT #1,"DI1,-1;LB --315deg";CHR$(13);CHR$(3)
220 PRINT #1,"DI;LB --DI COMMAND";CHR$(3)

```

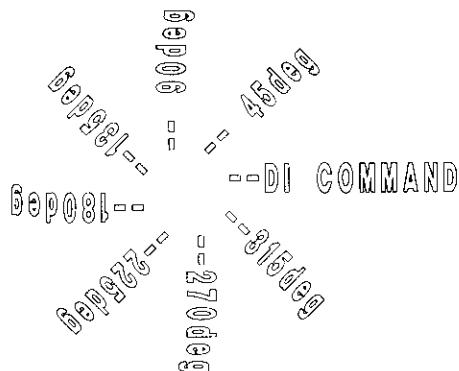


Fig. DI-3

<b>DR Command</b>	<b>Relative Direction</b>
-------------------	---------------------------

- **Format**

DR run, rise

DR

- **Parameter**

run : X-axis directional vector  $-(2^{26}-1) \sim +(2^{26}-1)$  (Default: 1)

rise : Y-axis directional vector  $-(2^{26}-1) \sim +(2^{26}-1)$  (Default: 0)

- **Related Commands**

DI, LB

- **Explanation**

Specifies a character cutting (plotting) direction. The parameter run is specified in percentage (%) between scaling points P1 and P2, ( $P2x - P1x$ ). The parameter rise is specified in percentage (%) between scaling points P1 and P2, ( $P2y - P1y$ ). The relation between the parameters run and rise is as illustrated in Fig. DR-1, but you should pay attention that the cutting (plotting) direction varies depending on the positions of P1 and P2.

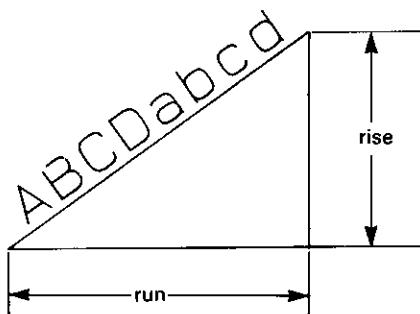


Fig. DR-1

When  $\text{rise} = 0$ , it sets the default horizontal cutting (plotting) direction. When  $\text{run} = 0$ , it sets the default vertical cutting (plotting) direction.

A DR command without parameters defaults to "DR1,0;" (horizontal).

The cutting (plotting) direction you set by the DR command remains in effect unless you execute a new DI or DR command or unless you execute the IN or DF command to default it.

Parameter signs are determined by your decision of which direction you cut (plot) when you take the current tool position as the origin, which is illustrated in Fig. DR-2.

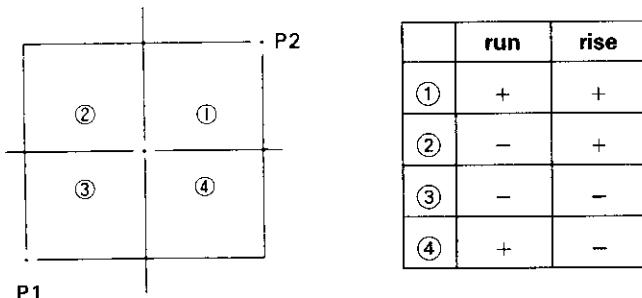


Fig. DR-2

A DR command with only one parameter results in error (2) and this command is ignored. A DR command with more than three parameters also results in error (2), but the first two parameters remain in effect. A DR command with out-of-range parameters (or when the parameters run and rise are all 0) results in error (3) and this command is ignored.

- Example

```
10 '*** DR COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;"
40 PRINT #1,"IP0,0,5000,10000;" 
50 PRINT #1,"PA1000,1000;" 
60 PRINT #1,"SI;DR1,1;LBDR1,1(1)";CHR$(3)
70 PRINT #1,"CP;IP0,0,10000,5000;" 
80 PRINT #1,"SI;DR1,1;LBDR1,1(2)";CHR$(3)
```

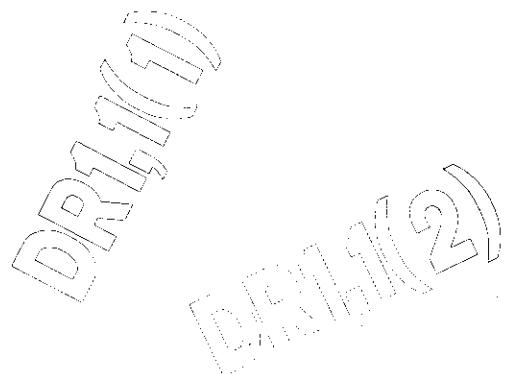


Fig. DR-3

DT Command	Define Label Terminator
------------	-------------------------

- Format

DT t;  
DT;

- Parameter

t: label terminator (Default: [ETX] (CHR\$(3)))

- Related Commands

LB, WD

**● Explanation**

Defines a label terminator that can clear label cutting (plotting) mode and display mode. This command is also used to define other label terminators when the default label terminator [ETX] (CHR\$(3)) cannot be used.

All characters (symbols) other than [NULL] (CHR\$(0)) and [ENQ] (CHR\$(5)), can be defined as label terminators. But in the case of control characters, their natural functions will be executed. And in the case of characters that can be cut (plotted), they will be simply cut (plotted). That is, if you define [LF] (CHR\$(10)) as a label terminator, your CAMM-1 will perform line feed (moves one line down) along with clearing label cutting (plotting) mode. And if you use the letter "Z" as a label terminator, your CAMM-1 will cut (plot) the letter "Z" at the end of a label string along with clearing label cutting (plotting) mode. It is therefore a good idea to specify a control character as a label terminator.

Even if you execute a DT command without parameter, the current label terminator cannot be returned to the default label terminator [ETX] (CHR\$(3)). DT; command just defines this semicolon ";" as a label terminator. To return it to the default label terminator [ETX] (CHR\$(3)), you need to use the DF or IN command or execute "DT";CHR\$(3);";". A DT command with more than two parameters results in error (2), but the first one parameter is defined as the label terminator of this command.

**● Example**

```
10 '*** DT COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;"
40 PRINT #1,"DT";CHR$(1)
```

**EA Command****Edge Rectangle Absolute****● Format**

EA x, y;

**● Parameter**x: absolute X-axis coordinate diagonal to rectangle  $-(2^{26}-1) \sim +(2^{26}-1)$ y: absolute Y-axis coordinate diagonal to rectangle  $-(2^{26}-1) \sim +(2^{26}-1)$ **● Related Commands**

ER, RA, RR

**● Explanation**

Cuts (plots) a rectangle diagonal to the point you specified, as absolute XY coordinates, assuming the current tool position as the start point, which is illustrated in Fig. EA-1.

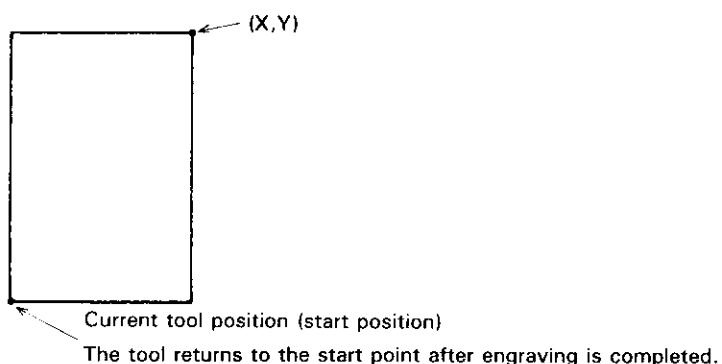


Fig. EA-1

Depending on the parameter values with respect to the current tool position, the rectangle cutting (plotting) direction and position vary as illustrated in Fig. EA-2.

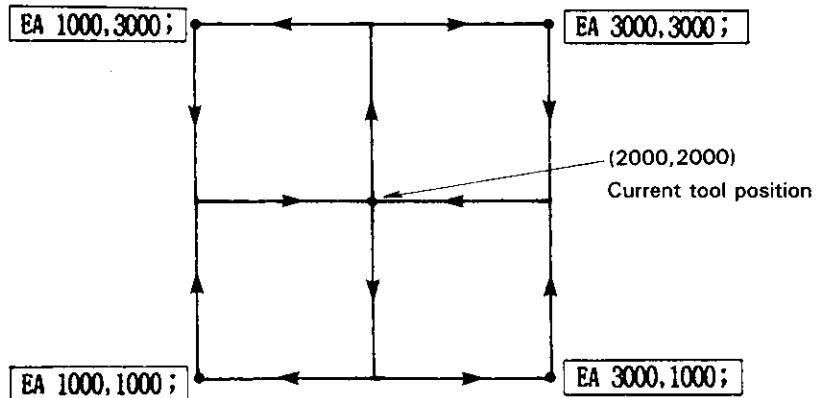


Fig. EA-2

An EA command with only one parameter results in error (2) and this command is ignored. An EA command with more than three parameters cuts (plots) a rectangle with the first two parameters and results in error (2). An EA command with out-of-range parameters results in error (3) and this command is ignored.

- Example

```
100  '*** EA COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"PA;PU2000,2000;"
140  PRINT #1,"EA8000,6000;"
```

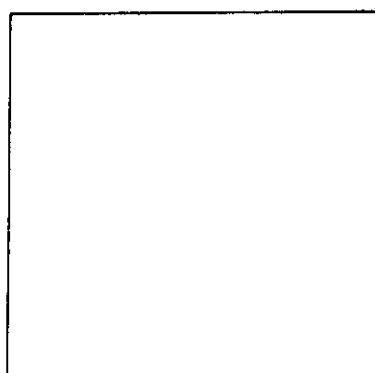


Fig. EA-3

**ER Command****Edge Rectangle relative****● Format**ER  $\Delta x$ ,  $\Delta y$ ;**● Parameters** $\Delta x$ : relative X-axis coordinate diagonal to rectangle  $-(2^{26}-1) \sim +(2^{26}-1)$  $\Delta y$ : relative Y-axis coordinate diagonal to rectangle  $-(2^{26}-1) \sim +(2^{26}-1)$ **● Related Commands**

EA, RA, RR

**● Explanation**

Cuts (plots) a rectangle diagonal to any point determined by the relative X-axis directional distance and the relative Y-axis directional distance assuming the current tool position as the start point. After cutting (plotting), the tool moves back to the start point, which is illustrated in Fig. ER-1.

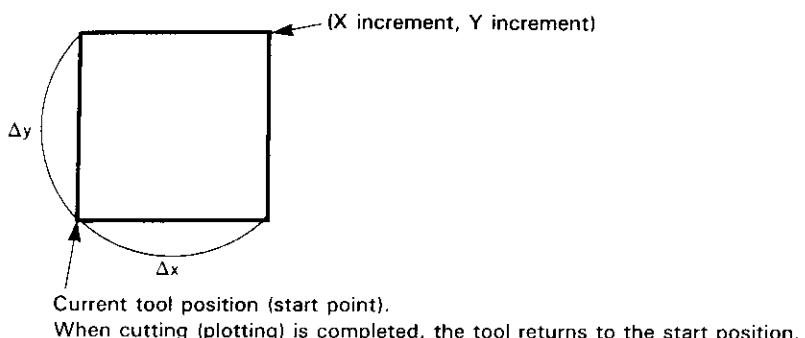


Fig. ER-1

Depending on the parameter values with respect to the current tool position, the rectangle cutting (plotting) direction and position vary as illustrated in Fig. ER-2.

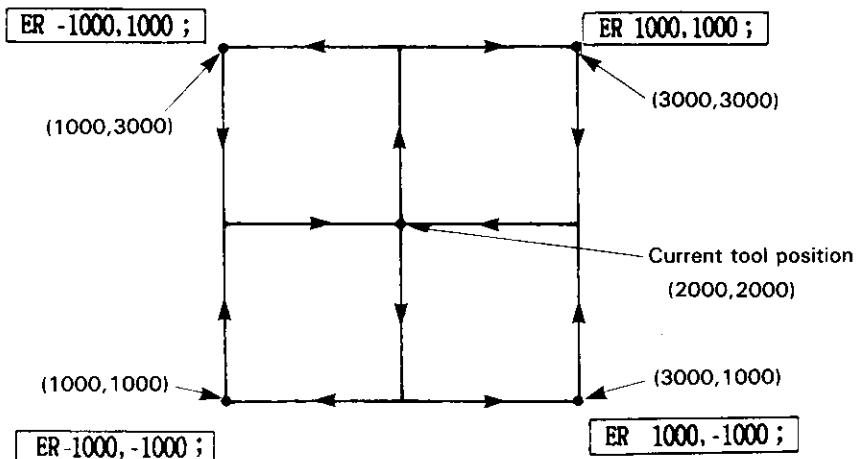


Fig. ER-2

An ER command with only one parameter results in error (2) and this command is ignored. An ER command with more than three parameters cuts (plots) a rectangle with the first two parameters and also results in error (2). An ER command with out-of-range parameters results in error (3) and this command is ignored.

- Example

```

100  '***  ER COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"PA;PU2000,2000;"
140  PRINT #1,"ER6000,4000;"
```

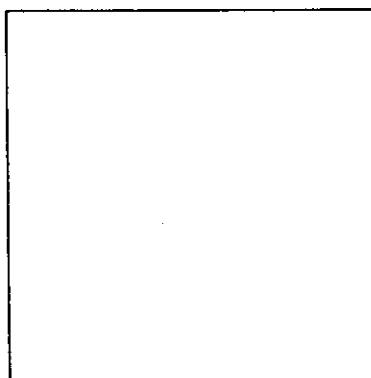


Fig. ER-3

**EW Command****Edge Wedge****● Format**EW r,  $\theta_1$ ,  $\theta_c$  (,  $\theta_d$ );**● Parameters**

r : radius

–  $(2^{26} - 1) \sim + (2^{26} - 1)$  $\theta_1$  : start angle–  $(2^{26} - 1)^\circ \sim + (2^{26} - 1)^\circ$  $\theta_c$  : center angle–  $(2^{26} - 1)^\circ \sim + (2^{26} - 1)^\circ$  $\theta_d$  : chord tolerance–  $(2^{26} - 1)^\circ \sim + (2^{26} - 1)^\circ$  (Default:  $5^\circ$ )**● Related Command**

WG

**● Explanation**

Cuts (plots) a wedge assuming the current tool position as the center point. After cutting (plotting), the tool moves back to the start point, which is illustrated in Fig. EW-1.

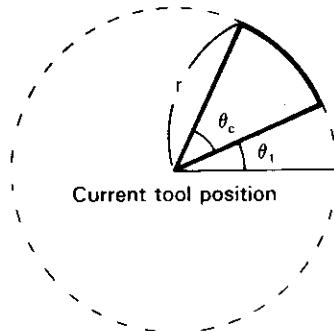


Fig. EW-1

Since an arc is cut with many straight lines (chords), its chord tolerance is expressed in  $\theta_d$ . The chord tolerance is compensated for the value that divides the center angle  $\theta_c$  into even angles, which continues up to 90 divisions. For example, even if you set  $\theta_d$  below  $4^\circ$  when  $\theta_c = 360^\circ$ ,  $4^\circ$  will be set. That is,  $360^\circ \div 4^\circ = 90$  (divisions). Any  $\theta_d$  between  $0^\circ$  and  $180^\circ$  is effective. But  $\theta_d$  is set to  $0^\circ$  if it is below  $0^\circ$  and to  $180^\circ$  if it is over  $180^\circ$ . When you set  $0^\circ$  to  $\theta_d$ , you will have the smoothest circle. If you omit  $\theta_d$ , the default value  $5^\circ$  will be set.

Remember that depending on the positive or negative radius value, the position of a reference point varies. Also, depending on the positive or negative center angle value, the way of taking an angle from the reference point varies.

Depending on the parameter signs, the cutting (plotting) direction varies as illustrated in Fig. EW-2.

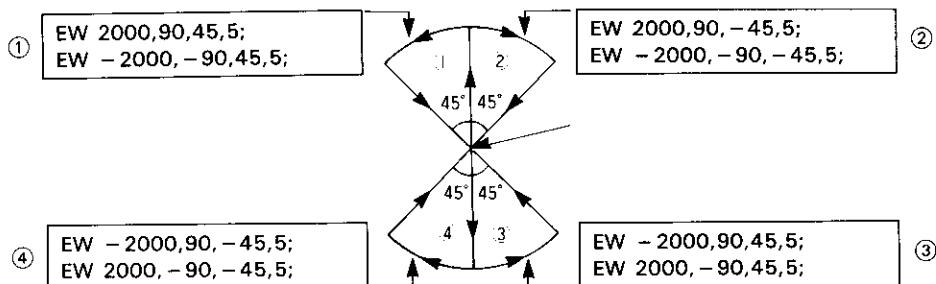


Fig. EW-2

An EW command with out-of-range parameters results in error (3) and this command is ignored. An EW command without parameters does not result in an error, but this command is ignored. An EW command with only one or two parameters also results in error (2) and this command is ignored. An EW command with more than five parameters also results in error (2), but the first four parameters remain in effect.

#### ● Example

```

100  '***  EW COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"PA;PU5000,4000;"
140  FOR I=1 TO 4
150    READ A$
160    PRINT #1,"EW";A$
170  NEXT I
180  DATA "-3500,-90,45,5","-3500,-90,-45,5"
190  DATA "3500,-90,-45,5","3500,-90,45,5"

```

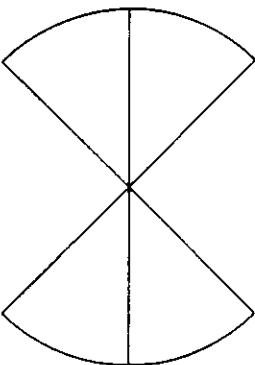


Fig. EW-3

FT Command	Fill Type
------------	-----------

- **Format**

FT n (, d (,  $\theta$ ));  
FT;

- **Parameters**

n : pattern	1 ~ 5	(Default: 1)
d : spacing	$\sim + (2^{26} - 1)$	(Default: $(P2x - P1x) \times 0.01$ )
$\theta$ : angle	$-(2^{26} - 1)^\circ \sim + (2^{26} - 1)^\circ$	(Default: $0^\circ$ )

- **Related Commands**

LT, PT, RA, RR, WG

- **Explanation**

Specifies fill type and hatching pattern, which become active when you use the RA, RR and WG commands.

[n: pattern]

The following five patterns are available. Any decimal parameter figures are cut off.

- 1: unidirectional filling
- 2: bi-directional filling
- 3: hatching by parameter d
- 4: cross hatching by parameter d
- 5: ignored

When the parameter n is 1 or 2, the parameter d is ignored. The value of the parameter d you set by the tool size command, PT, is set regardless of whether scaling is present or absent.

When the parameter n is 3 or 4, the tool hatches with the line type you specified by the LT command. And when the line type is solid line, the hatching is bi-directional. When the line type is other lines, the hatching is unidirectional.

[d: spacing]

When the parameter n is 1 or 2, the parameter d is ignored.

When the parameter n is 3 or 4, hatching is specified in user coordinate units. The value of this hatching spacing is the one specified by user coordinate parameter d.

When you do not specify the parameter d at this time, the latest d you specified by the FT command immediately before this time is set. And if this d is used in the program for the first time, it is set to the default value (1% of x coordinates between scaling points P1 and P2). When you specify 0 to d, it is ignored, and the tool size specified by the PT command at that time is applied.

[θ: angle]

Hatching can be specified in 45° increments by the line slant at hatching. The specification of 0,90 and 45 hatches horizontally, vertically and at 45° direction with their respective lines.

If no angle is specified, the latest angle you specified by the FT command immediately before this time is applied. And if this angle is used in the program for the first time, the default value 0° (horizontal) is set.

An FT command with more than four parameters results in error (2), but the first three parameter remain in effect. An FT command with out-of-range parameters results in error (3) and this command is ignored. And the latest parameters you set by the FT commands immediately before this time become active. If no parameters have not been set, the default values will be set.

- **Example**

```

10 '*** FT COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"PT0.3;"
40 PRINT #1,"PA500,1000;"
50 PRINT #1,"FT1,0,0;"
60 PRINT #1,"RR500,500;"
70 PRINT #1,"PA1000,1000;"
80 PRINT #1,"FT4,100,45;"
90 PRINT #1,"RR500,500;"
```



Fig. FT-1

<b>IM Command</b>	<b>Input Mask</b>
-------------------	-------------------

- **Format**

IM e;  
IM;

- **Parameter**

e : error mask value      0 ~ 255 (Default: 223)

- **Related Command**

OE

- **Explanation**

Tells your CAMM-1 to display which error on the panel display if an error occurs in your CAMM-1.

The error mask value e is the sum of error mask bit values (error numbers of Table IM-1) from which you want to know error occurrence. When the error of the bit you set occurs, this command tells your CAMM-1 to display its error message. For example, the default error mask bit value 223 (= 128 + 64 + 16 + 8 + 4 + 2 + 1) displays an error when the errors excluding error number 6 occurs. Error numbers 4, 6, 7 and 8 are not used.

Error mask bit value	Error No.	Meaning
<b>1</b>	1	Unrecognizable command was executed
<b>2</b>	2	Incorrect number of parameters
<b>4</b>	3	Out-of-range parameters
<b>8</b>	4	(Unused)
<b>16</b>	5	Incorrect character set number
<b>32</b>	6	(Unused)
<b>64</b>	7	(Unused)
<b>128</b>	8	(Unused)

Table IM-1 (Error Mask)

When an error is being displayed, you are allowed to know the meaning of the error with the OE command. When your CAMM-1 is at the default or initialized conditions, the error mask bit value is 223.

An IM command with more than two parameters results in error (2), but the first one parameter remains in effect. An IM command with out-of-range parameters results in error (3) and this command is ignored.

#### ● Example

```

10 '*** IM COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IM222;" 
40 PRINT #1,"XX;"
```

<b>IN Command</b>	<b>Initialize</b>
-------------------	-------------------

- **Format**

IN;

- **Related Command**

DF

- **Explanation**

Initializes your CAMM-1. The IN command does the same thing as the DF command and also does the following setting.

- (1) Moves tool up (PU;)
- (2) Initializes scaling points P1, P2 (IP;)
- (3) Clears error and sets the bit 3 of the status byte (See OS Command)

- **Example**

```
10 *** IN COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;"
```

<b>IP Command</b>	<b>Input P1 &amp; P2</b>
-------------------	--------------------------

- **Format**

IP P1<sub>x</sub>, P2<sub>y</sub> (, P2<sub>x</sub>, P2<sub>y</sub>);  
IP;

- **Parameters**

P1 <sub>x</sub>	: X-axis coordinate of P1	0 ~ + (2 <sup>26</sup> - 1)
P1 <sub>y</sub>	: Y-axis coordinate of P1	0 ~ + (2 <sup>26</sup> - 1)
P2 <sub>x</sub>	: X-axis coordinate of P2	0 ~ + (2 <sup>26</sup> - 1)
P2 <sub>y</sub>	: Y-axis coordinate of P2	0 ~ + (2 <sup>26</sup> - 1)

- **Related Command**

SC

- **Explanation**

Sets scaling points P1 and P2.

The coordinates of scaling points P1 and P2 are specified in machine coordinates.

The default parameter values vary depending on the sheet sizes (values set by the front panel).

The IP command is used to set P1 and P2 at arbitrary points or used to return P1 and P2 to their default values.

P1 and P2 are the positions that relate the machine coordinates of CAMM-1 with user coordinates having random scale the user can determine. The user coordinates are specified by the SC command.

If P2 is not specified in the IP command, the P2 position automatically moves the same distance in the same direction as P1 moves. That is, the value of ( $P2_x - P1_x$ ) and the value of ( $P2_y - P1_y$ ) become the same before and after the IP command without P2 was executed. If you set P1 so that P2 is out of the range, error (3) occurs. And P2 is set on the limits of the effective setting area.

An IP command with only one or three parameters results in error (2) and this command is ignored. An IP command with more than five parameters also results in error (2), but the first four parameter remain in effect. An IP command with out-of-range parameters results in error (3) and this command is ignored.

- **Example**

```
10 *** IP COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA0,0;"
40 PRINT #1,"IP0,0,2000,1000;""
50 PRINT #1,"SC0,100,0,100;""
60 PRINT #1,"EA100,100;"
```

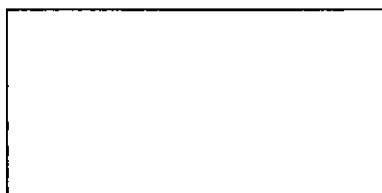


Fig. IP-1

IW Command	Input Window
------------	--------------

- **Format**

IW LLx, LLy, URx, URy;  
IW;

- **Parameter**

The default parameter values and the parameter range are the maximum cutting (plotting) area, but they vary depending on the sheet sizes set by the front panel. Even if parameters are set out of the cutting (plotting) area, an error does not occur as long as they are within the range of  $0 \sim + (2^{26} - 1)$ .

- **Related Command**

OW

- **Explanation**

Sets a cutting (plotting) area or window.

Any window follows the four parameters. If no parameters are specified, a window is set to the maximum cutting area of each sheet size.

The four parameters are interpreted as machine coordinates if they have not been scaled and as user coordinates if they have been scaled. And the four parameters become XY coordinates of the lower-left corner and the upper-right corner of a window. If the lower-left corner value of X1 is larger than the upper-right corner value of X2, or if the lower-left corner value of Y1 is larger than the upper-right corner value of Y2, the IW command always replace them with each other to make  $X1 < X2$  and  $Y1 < Y2$ .

At the time of power-on or when the IN or DF command is executed, the window is set to the default values.

The IW command sets a cutting (plotting) area when you want to cut (plot) only part of the many cuts (drawings) on a piece of sheet (plotting medium).

An IW command with more than five parameters results in error (2), but the first four parameters remain in effect. An IW command with less than three parameters also results in error (2) and this command is ignored. An IW command with out-of-range parameters results in error (3) and this command is ignored.

- **Example**

```

10 '*** IW COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;IW1000,1000,2000,2000;"
40 PRINT #1,"PA1500,1500;"
50 PRINT #1,"CI550;"
```

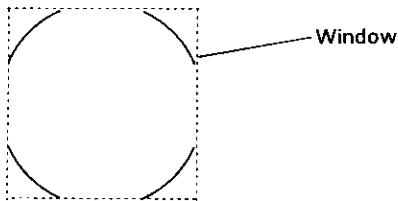


Fig. IW-1

LB Command	Label
------------	-------

- **Format**

LB c1 c2 ... cn [label terminator]

- **Parameter**

cn : character

- **Related Commands**

CA, CP, CS, DT, DI, DR, SA, SI, SL, SR, SS

- **Explanation**

Cuts (plots) characters until receiving the label terminator defined by the DT command. Since the cutting (plotting) is started from the current tool position, you need to move the tool to your desired position with the PA, PR or CP command or by the front panel before you execute the LB command.

Any data or part outside the cutting (plotting) area cannot be cut (plotted).

The character sets used by the LB command are those character codes from CHR\$(33) through CHR\$(126). For character set selection, refer to 1.3.4 5-2 Character Sets in CHAPTER 1, Part 2.

The character cutting (plotting) direction is the one set by the DI or DR command, the character size is the one set by the SI or SR command, and the character slant is the one set by the SL command.

When the DT command is omitted, the label terminator is the default [ETX] (CHR\$(3)). Remember that if you forget to enter a label terminator at the end of a label string when you use the LB command, the LB command interprets further commands as part of the label string.

● Example

```
10 '*** LB COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"PA1000,1000;""
40 PRINT #1,"LBLABEL COMMAND";CHR$(3)
```

## LABEL COMMAND

Fig. LB-1

**LT Command****Line Type****● Format**

LT n (, l);  
LT;

**● Parameter**

n : pattern number	- 6 ~ + 6	(Default: solid line)
l : 1 pitch length	0 ~ ( $2^{26} - 1$ ) (%)	(Default: 1.5%)

**● Related Command**

AA, AR, CI, EA, ER, PA, PD, PR, RA, RR, WG

**● Explanation**

Specify a cutting line type.

The following six line types are available. An LT command without the parameter n specifies the default solid line.

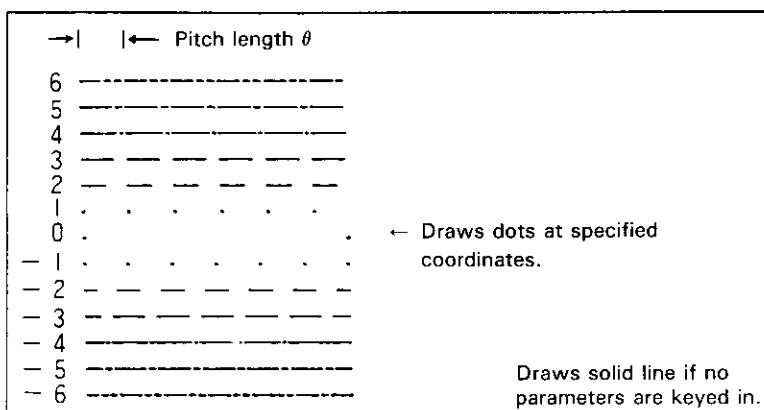


Fig. LT-1

When the pattern number is negative, a solid line is cut (plot) from the middle of the pattern as illustrated in Fig. LT-1. And the pitch length is compensated for so that the integer number of patterns enters a specified zone. Any decimal pattern number figures are cut off. Pattern examples by the differences of pattern number signs are illustrated in ● Example.

The 1 pitch length parameter l is expressed in percentage of the diagonal line to scaling points P1 and P2. If you omit this parameter, the default value 1.5% is set.

The line type selected by the LT command becomes effective with the following commands.

AA, AR, CI, EA, ER, PA, PD, PR, RA, RR, WG

An LT command with more than three parameters results in error (2), but the first two parameters remain in effect. An LT command with out-of-range parameters results in error (3) and this command is ignored.

● Example

```
10 ' *** LT COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;IP0,0,10000.10000;" 
40 PRINT #1,"LT5;" 
50 PRINT #1,"PA;PU0,1500;" 
60 PRINT #1,"PR;PD2000,0,0,1000,-2000,0,0,-1000;PU;" 
70 PRINT #1,"LT-5;" 
80 PRINT #1,"PA;PU0,0;" 
90 PRINT #1,"PR;PD2000,0,0,1000,-2000,0,0,-1000;PU;"
```

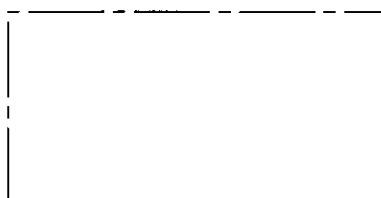


Fig. LT-2

**OA Command****Output Actual Point****● Format**

OA;

**● Parameter**

None

**● Related Command**

OC

**● Explanation**

Makes the current tool position ready to output in machine coordinates.

When an RS-232C interface is used, your CAMM-1 makes the following three values ready to output in ASCII and, at the same time, display the values if it receives the OA command.

X, Y, T [TERM]

OA:	X=	2547
	Y=	1745 T=0

The X and Y are integer coordinate values in machine coordinates even if they have been scaled. A negative (–) sign is output to a negative coordinate, and the leading 0 and positive (+) sign are omitted. The X and Y become the lower-left corner values of the maximum cutting (plotting) area at the time of power-on. The T denotes the current tool status, and it becomes 0 at the time of tool up and 1 at the time of tool down. The [TERM] is the output terminator of the RS-232C port. For more information, refer to the section of 3.4.1 The Handshake Commands in CHAPTER 3, Part 2.

Since this command allows you to move the tool manually to any position at which you want to cut characters and plot drawings and know the coordinates of that position, it is easy to position the tool and set a window.

**● Example**

```

10  '*** OA COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"OA;"
40  INPUT #1,X,Y,T
50  PRINT X,Y,T

```

OC Command	Output Commanded Position
------------	---------------------------

- **Format**

OC;

- **Parameter**

None

- **Related Command**

OA

- **Explanation**

Makes the current tool position ready to output in user coordinates.

When receiving the OC command, your CAMM-1 makes the following three values ready to output in ASCII and, at the same time, display the values.

X, Y, T [TERM]

OC:	X=	10	
	Y=	10	T=0

The X and Y are user coordinates if they have been scaled and CAMM-1's machine coordinates if they have not been scaled, all of which are values up to the forth decimal and are integer numbers within the range of  $-(2^{26}-1) \sim +(2^{26}-1)$ . A negative (-) sign is output to a negative coordinate, and the leading 0 and positive (+) sign are omitted. The T denotes the current tool status. It becomes 0 at the time of tool up and 1 at the time of tool down. The [TERM] is the output terminator of the RS-232C port. Unlike the OA command, this tool position is a theoretical tool position. Therefore the OC command outputs a theoretical tool position out of the cutting (plotting) area.

- **Example**

```

10  '*** OC COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"OC;"
40  INPUT #1,X,Y,T
50  PRINT X,Y,T

```

OE Command	Output Error
------------	--------------

- **Format**

OE;

- **Parameter**

None

- **Related Command**

IM, OS

- **Explanation**

When receiving the OE command, your CAMM-1 makes an error code ready to output in the following ASCII form and, at the same time, distinguishes the error message from the display.

Error code [TERM]

OE:	Error Number
	1

The [TERM] is the output terminator of the RS-232C port. When the output is completed, the bit 5 of the status byte is cleared. (See OS Command.)

The error codes are defined as follows and are the same numbers as will be displayed.

Error No.	Meaning
0	No error
1	Unrecognizable command was executed
2	Incorrect number of parameters
3	Out-of-range parameters (Unused)
5	Incorrect character set numbers (Unused)
6	(Unused)
7	(Unused)

Table OE-1 (Error Codes)

- **Example**

```

10  '***  OE COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"OE;"
40  INPUT #1,E
50  PRINT E

```

OF Command	Output Factor
------------	---------------

- **Format**

OF;

- **Parameter**

None

- **Related Command**

OH

- **Explanation**

When the OF command is executed, your CAMM-1 always outputs the following values.

40,40 [TERM]

OF: Machine Units x, y= 40, 40
-----------------------------------

That is, these values indicate that 40 machine units exist in a 1mm × 1mm area in both X-axis and Y-axis directions of your CAMM-1. The [TERM] is the output terminator of the RS-232C port.

- **Example**

```

10  '***  OF COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"OF;"
40  INPUT #1,X,Y
50  PRINT X,Y

```

**OH Command****Output Hard-Clip Limits****● Format**

OH;

**● Parameter**

None

**● Explanation**

When receiving the OH command, your CAMM-1 outputs the integer coordinates of LL and UR in the following ASCII form and, at the same time, display the coordinates.

LLx, LLy, URx, URy [TERM]

OH: LL=	0,	0
UR=	22560,	17200

A negative (–) sign is output to a negative coordinate, and the leading 0 and positive (+) sign are omitted. The maximum cutting (plotting) area varies depending on the sheet sizes. The user sets a window within the maximum cutting (plotting) area with the IW command and determines the cutting (plotting) area. The output contents by the OH command is not affected by the IW command. The [TERM] is the output terminator of the RS-232C port.

**● Example**

```

10  '*** OH COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"OH;"
40  INPUT #1,LLX,LLY,URX,URY
50  PRINT LLX,LLY,URX,URY

```

**OI Command****Output Identification****● Format**

OI;

**● Parameter**

None

**● Explanation**

With the OI command, you are allowed to know the model name of your CAMM-1 being currently connected to the computer.

When receiving the OI command, your CAMM-1 outputs the model name from the RS-232C port and, at the same time, display it as follows.

1000 [TERM]

OI: Model Name
1000

The [TERM] is the output terminator of the RS-232C port.

**● Example**

```
10 *** OI COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OI;"
40 INPUT #1,N$
50 PRINT N$
```

**OO Command****Output Option Parameter****● Format**

OO;

**● Parameter**

None

**● Explanation**

When receiving the OO command, your CAMM-1 separates the following eight integers with commas, makes the eight integers ready to output and, at the same time, display them.

OO: Option Parameter  
0,0,0,0,1,0,0,0

0,0,0,0,1,0,0,0 [TERM]

└ indicates the presence of a circle or arc command.

The [TERM] is the output terminator of the RS-232C port.

**● Example**

```
10  '***  OO COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"OO:"
40  INPUT #1,01,02,03,04,05,06,07,08
50  PRINT 01,02,03,04,05,06,07,08
```

OP Command	Output P1 & P2
------------	----------------

- **Format**

OP;

- **Parameter**

None

- **Related Commands**

IP, OS

- **Explanation**

Outputs the coordinates of scaling points P1 and P2 and, at the same time, display the coordinates.

When receiving the OP command, your CAMM-1 outputs the following four coordinates in ASCII codes and display the coordinates.

P1<sub>x</sub>, P1<sub>y</sub>, P2<sub>x</sub>, P2<sub>y</sub> [TERM]

OP: P1= 600, 600
P2= 17800, 21960

These coordinate values are integer numbers in machine coordinates. For more information, refer to the section of IP Command. The [TERM] is the output terminator of the RS-232C port.

When the output from your CAMM-1 is completed, the bit 1 of the status byte is cleared. (See OS Command.)

Since this command allows you to know the coordinates of P1 and P2 you have set, it is useful to set a window within the area of P1 and P2 and also perform the conversion of user coordinates and machine coordinates.

- **Example**

```

10  '*** OP COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"OP;"
40  INPUT #1,P1X,P1Y,P2X,P2Y
50  PRINT P1X,P1Y,P2X,P2Y

```

OS Command	Output Status
------------	---------------

- **Format**

OS;

- **Parameter**

None

- **Related Commands**

OE, OP

- **Explanation**

Outputs the status byte value indicative of the CAMM-1 status and display the value. This command is useful in the debugging of a program. No parameters are necessary.

OS:	Status Byte
	24

Your CAMM-1 has data to indicate its internal status. This data consists of eight bits from 0 through 7, which are called the status byte. When receiving the OS command, your CAMM-1 converts the status byte value to decimal from 0 through 255 and makes the converted value ready to output in integer in the following ASCII form.

Status byte decimal conversion [TERM]

The [TERM] is the output terminator of the RS-232C port.  
Each bit of the status byte is defined as follows:

Bit value	Bit No.	Meaning
<b>1</b>	0	Tool down
<b>2</b>	1	Scaling point P1 or P2 was changed (Cleared by OP command)
<b>4</b>	2	Unused (always 0)
<b>8</b>	3	Initialized (Cleared by OS command)
<b>16</b>	4	Ready to receive data (always 1)
<b>32</b>	5	Error is being occurred (Cleared by OE command)
<b>64</b>	6	Unused (always 0)
<b>128</b>	7	Unused (always 0)

Table OS-1

At the time of power-on, the status byte is 24 in decimal. This is because the bits 3 and 4 of the status byte (must be initialized and be ready to receive data) have been set. That is,  $24(=8+16)$ .

After executing the OS command, the bit 3 of the status byte is cleared.

#### ● Example

```

10  '*** OS COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"OS;"
40  INPUT #1,S
50  PRINT S

```

<b>OW Command</b>	<b>Output Window</b>
-------------------	----------------------

- **Format**

OW;

- **Parameter**

None

- **Related Command**

IW

- **Explanation**

When receiving the OW command, your CAMM-1 makes the coordinate values of the lower-left corner and upper-right corner of the window you set by the IW command ready to output in ASCII codes and also display the coordinates.

OW: LL= 0, 0 UR= 22560, 17200
----------------------------------

The coordinate values are machine coordinates of your CAMM-1 if scaling was not done at the time of executing the IW command and user coordinates if scaling was done at the time of executing the IW command. The sequence of the integer coordinate values output from your CAMM-1 is as follows:

LLx, LLy, URx, URy [TERM]

The [TERM] is the output terminator of the RS-232C port.

When you want to know the window size, you are allowed to execute the OW command to read that value on the computer size.

- **Example**

```

10  '*** OW COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"OW;"
40  INPUT #1,XLL,YLL,XUR,YUR
50  PRINT XLL,YLL,XUR,YUR

```

**PA Command****Plot Absolute****● Format**

PA x<sub>1</sub>, y<sub>1</sub>(, x<sub>2</sub>, y<sub>2</sub>, ...);  
Pa;

**● Parameters**

x<sub>n</sub> : absolute X-axis coordinate - (2<sup>26</sup> - 1) ~ + (2<sup>26</sup> - 1)  
y<sub>n</sub> : absolute Y-axis coordinate - (2<sup>26</sup> - 1) ~ + (2<sup>26</sup> - 1)

**● Related Commands**

PD, PR, PU

**● Explanation**

Sets absolute coordinates and also moves the tool in absolute coordinates.

A PA command without parameters is to set absolute coordinates. Absolute coordinates are to indicate a position in the distance from the coordinate origin (0,0). By this, the parameters of further PD or PU command will be interpreted as expressed in absolute coordinates.

A PA command with parameters sets absolute coordinates as well as moves the tool to any point specified by its parameters. The tool status (up/down) at this time remains the same as the one immediately before receiving the PA command. That is, your CAMM-1 does nothing but moves the tool only if the tool is up and starts cutting (plotting) if the tool is down.

The parameters X and Y are a pair in two, and you are allowed to input a multiple number of pairs.

A PA command with an odd number of parameters interprets XY coordinates from the first one by one, moves the tool and results in error (2) at the last parameter. (Even if an error occurs, further cutting (plotting) command will be executed successfully.)

A PA command with out-of-range parameters results in error (3), and all parameters of further commands will be ignored.

**● Example**

```

100 *** PA COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"IN;"
140 PRINT #1,"PA1000,2000;"
150 PRINT #1,"PD1000,6000,5000,6000,5000,2000,1000,
2000;"
160 PRINT #1,"PU6000,2000;"
170 PRINT #1,"PA;PD6000,6000,9000,6000,9000,2000,6000,
```

```
2000;"  
180 PRINT #1,"PU20000,14000;"
```

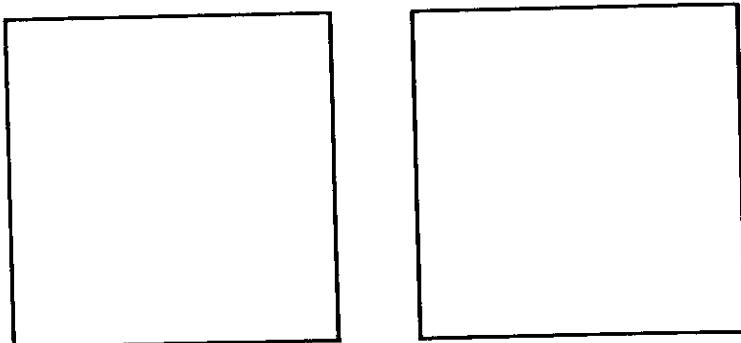


Fig. PA-1

<b>PD Command</b>	<b>Tool Down</b>
-------------------	------------------

- **Format**

PD;  
PD x<sub>1</sub>, y<sub>1</sub> (, x<sub>2</sub>, y<sub>2</sub>, ...);

- **Parameter**

x <sub>n</sub>	: X-axis coordinate	- (2 <sup>26</sup> - 1) ~ + (2 <sup>26</sup> - 1)
y <sub>n</sub>	: Y-axis coordinate	- (2 <sup>26</sup> - 1) ~ + (2 <sup>26</sup> - 1)

- **Related Commands**

PA, PR, PU

- **Explanation**

A PD command without parameters moves the tool down. A PD command with parameters moves the tool with the tool down to the point specified by the parameters. But this tool moving position varies depending on the absolute coordinates or the relative coordinates. The tool moving position becomes absolute coordinates if the PA command was input before and relative coordinates if the PR command was input before. Since the parameters are set to absolute coordinates at the time of power-on or when they are defaulted by the DF or IN command, the parameters are interpreted as absolute coordinates when you use the PD command without inputting any PA and PR commands. If a point is specified outside a window, the PD command moves the tool to the window limits and raises it there.

The parameters X and Y are a pair in two, and you are allowed to input a multiple number of pairs.

A PD command with an odd number of parameters interprets XY coordinates from the first one by one, moves the tool and results in error (2) at the last parameter. (Even if an error occurs, further cutting (plotting) commands will be executed successfully.) A PD command with out-of-range parameters results in error (3), and all parameters of further commands will be ignored.

#### ● Example

```
10 '*** PD COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;"
40 PRINT #1,"PU2000,1000;PD2000,3000;"
50 PRINT #1,"PU1000,2000;PD3000,2000;"
```

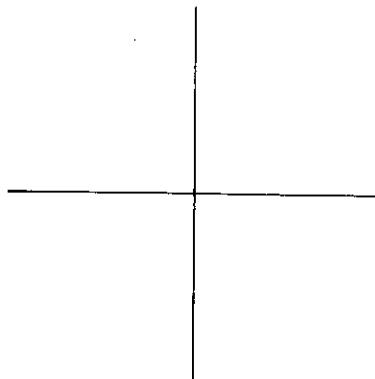


Fig. PD-1

<b>PR Command</b>	<b>Plot Relative</b>
-------------------	----------------------

#### ● Format

PR  $\Delta X_1, \Delta Y_1$  (,  $\Delta X_2, \Delta Y_2$ , ...);  
PR;

#### ● Parameters

$\Delta X_n$  : relative X-axis coordinate       $-(2^{26}-1) \sim + (2^{26}-1)$   
 $\Delta Y_n$  : relative Y-axis coordinate       $-(2^{26}-1) \sim + (2^{26}-1)$

- **Related Commands**

PA, PD, PU

- **Explanation**

A PR command without parameters is to set relative coordinates. Relative coordinates are to indicate a position in the distance from the current tool position. By this, the parameters of further PD and PU commands will be interpreted as expressed in relative coordinates.

A PR command with parameters sets relative coordinates as well as moves the tool by only the distance specified by its parameters. The tool status (up/down) at this time remains the same as the one immediately before receiving the PR command. That is, your CAMM-1 does nothing but moves the tool only if the tool is up and starts cutting (plotting) if the tool is down.

The coordinates at the time of power-on and after executing the IN or DF command are the same as executing the PA command, you need to execute the PR command when you want to set XY coordinates in relative coordinates.

The parameters are a pair in two, and you are allowed to input a multiple number of pairs. A PR command with an odd number of parameters interprets XY coordinates from the first one by one, moves the tool and results in error (2) at the last parameter. (Even if an error occurs, further cutting (plotting) commands will be executed successfully.) A PR command with out-of-range parameters results in error (3), and all parameter of further commands will be ignored.

- **Example**

```

100  '*** PR COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"IN;"
140  PRINT #1,"PA1000,2000;
150  PRINT #1,"PD;PR0,4000,4000,0,0,-4000,-4000,0;""
160  PRINT #1,"PU5000,0;""
170  PRINT #1,"PD0,4000,3000,0,0,-4000,-3000,0;""

```

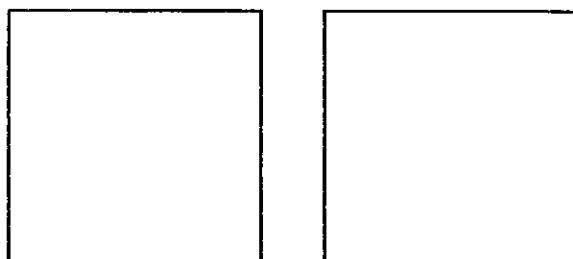


Fig. PR-1

These are the same rectangles as the ones cut (plotted) in the section of PA Command.  
Relative  $\Delta x, \Delta y$  coordinates are set at each points.

PT Command	Tool Thickness
------------	----------------

- **Format**

PT d;  
PT;

- **Parameter**

d: tool tip size                    0.1 ~ 5.0mm (Default: 0.3mm)

- **Related Commands**

FT, RA, RR, WG

- **Explanation**

Specifies a tool tip size for use in filling.

The unit of the parameter d is mm. If no tool tip size is specified, the default value 0.3mm will be set. When the filling patterns (FT1, FT2) by the FT command has been selected, the setting by this command becomes effective.

The PT command is effective to the tool being used at that time only. The tool tip size you set will be invalid if you execute the SP command and becomes the default value 0.3mm until you reset it with the PT command.

A PT command with more than two parameters results in error (2), but the first one parameter remains in effect. A PT command with an out-of-range parameter results in error (3) and this command is ignored.

- **Example**

```

100  '*** PT COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"FT1,0.45;"
140  PRINT #1,"PT4;"
150  PRINT #1,"PA;PU2000,2000;"
160  PRINT #1,"RA6000.5000;"
```



Fig. PT-1

<b>PU Command</b>	<b>Tool Up</b>
-------------------	----------------

- **Format**

PU;  
PU x<sub>1</sub>, y<sub>1</sub> (, x<sub>2</sub>, y<sub>2</sub>, ...);

- **Parameters**

x <sub>n</sub>	: X-axis coordinate	$-(2^{26}-1) \sim + (2^{26}-1)$
y <sub>n</sub>	: Y-axis coordinate	$-(2^{26}-1) \sim + (2^{26}-1)$

- **Related Commands**

PA, PD, PR

- **Explanation**

A PU command without parameters moves the tool up only. A PU command with parameters moves the tool to any point specified by its parameters. But this tool moving point specified by the parameters varies depending on the absolute coordinates or the relative coordinates. The tool moving point becomes absolute coordinates if any PA command was not input before and relative coordinates if any PR command was input before.

Since the coordinates are set to absolute coordinates at the time of power-on if they were defaulted by the IN or DF command, the coordinates are interpreted as absolute coordinates when you use the PU command without inputting any PA and PR commands. If a point is specified outside a window, the tool moves to the window limits and stops there.

The parameters X and Y are a pair in two, and you are allowed to input a multiple number of pairs.

A PU command with an odd number of parameters interprets XY coordinate pairs from the first one by one, moves the tool and results in error (2) at the last parameter. (Even if an error occurs, further cutting (plotting) commands will be executed successfully.) A PU command with out-of-range parameters results in error (3), and all parameters of further commands will be ignored.

- **Example**

```
10 '*** PU COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;"
40 PRINT #1,"PU2000,1000;PD2000,3000;"
50 PRINT #1,"PU1000,2000;PD3000,2000;"
```

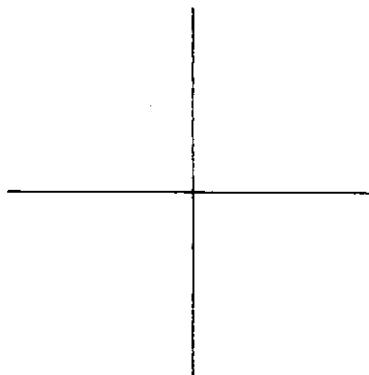


Fig. PU-1

**RA Command****Shade Rectangle Absolute****● Format**

RA x, y;

**● Parameters**

x: absolute X-axis coordinate diagonal to rectangle

 $-(2^{26}-1) \sim +(2^{26}-1)$ 

y: absolute Y-axis coordinate diagonal to rectangle

 $-(2^{26}-1) \sim +(2^{26}-1)$ **● Related Commands**

EA, ER, RR

**● Explanation**

Hatches the inside of a rectangle diagonal to the position of specified X-axis coordinate value and Y-axis coordinate value assuming the current tool position as the start point, which is illustrated in Fig. RA-1.

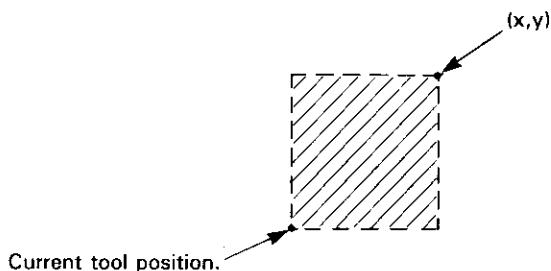


Fig. RA-1

After hatching is completed, the tool returns to the origin. For hatching, your CAMM-1 cuts (plots) with the effective settings (hatching pattern, spacing, angle) set by the FT and PT commands at that time.

An RA command with only one parameter results in error (2) and this command is ignored. An RA command with more than three parameters also results in error (2), but the first two parameters remain in effect. An RA command with out-of-range parameters results in error (3) and this command is ignored.

- **Example**

```

100 '*** RA COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"FT3,200,45;"
140 PRINT #1,"PA;PU2000,2000;" 
150 PRINT #1,"RA6000,5000;"
```

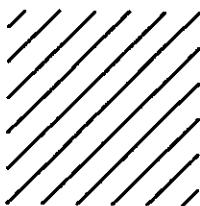


Fig. RA-2

<b>RR Command</b>	<b>Shade Rectangle Relative</b>
-------------------	---------------------------------

- **Format**

RR,  $\Delta x$ ,  $\Delta y$ ;

- **Parameters**

$\Delta x$ : relative X-axis coordinate diagonal to rectangle

$-(2^{26}-1) \sim + (2^{26}-1)$

$\Delta y$ : relative Y-axis coordinate diagonal to rectangle

$-(2^{26}-1) \sim + (2^{26}-1)$

- **Related Commands**

EA, ER, RA

- **Explanation**

Cuts (plots) the inside of a rectangle diagonal to the position of relative X-axis coordinate value and relative Y-axis coordinate value assuming the current tool position as the start point, which is illustrated in Fig. RR-1.

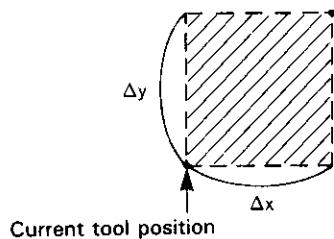


Fig. RR-1

After hatching is completed, the tool returns to the start point. For hatching, your CAMM-1 cuts (plots) with the effective settings (hatching pattern, spacing, angle) set by the FT and PT commands at that time.

An RR command with only one parameter results in error (2) and this command is ignored. An RR command with more than three parameters also results in error (2), but the first two parameters remain in effect. An RR command with out-of-range parameters results in error (3) and this command is ignored.

- **Example**

```
100  '***  RR COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"FT4,300,90;"
140  PRINT #1,"PA;PU2000,2000;"
150  PRINT #1,"RR4000,3000;"
```

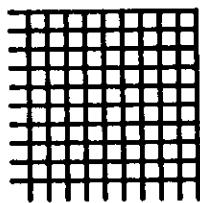


Fig. RR-2

<b>SA Command</b>	<b>Select Alternate Set</b>
-------------------	-----------------------------

- **Format**

SA;

- **Parameter**

None

- **Related Commands**

CA, CS, SS

- **Explanation**

Specifies alternate character set.

After the SA command is executed, the character set specified by the CA command is used in actual cutting (plotting). Also, you are allowed to specify standard character set by sending [SO] (CHR\$(14)) within the LB command.

This character set remains in effect until you select standard character set with the SS command or [SI] (CHR\$(15)) or until you default it with the DF or IN command. No parameters are necessary for the SA Command.

- **Example**

```

10 '*** SA COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA1000,1000;"
40 PRINT #1,"CS0;CA7;"
50 PRINT #1,"SS;"
60 PRINT #1,"LBy=";CHR$(3)
70 PRINT #1,"SA;"
80 PRINT #1,"LB";CHR$(120);CHR$(3)
90 PRINT #1,"SS;"
100 PRINT #1,"LBx+1";CHR$(3)

```

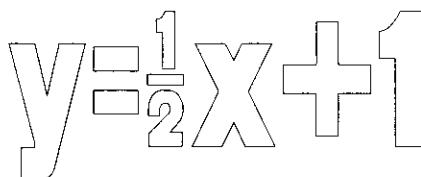


Fig. SA-1

<b>SC Command</b>	<b>Scaling</b>
-------------------	----------------

- **Format**

SC Xmin, Xmax, Ymin, Ymax;  
SC;

- **Parameters**

Xmin: user X-axis coordinate of P1       $-(2^{26}-1) \sim +(2^{26}-1)$   
 Xmax: user X-axis coordinate of P2       $-(2^{26}-1) \sim +(2^{26}-1)$

Ymin: user Y-axis coordinate of P1       $-(2^{26}-1) \sim +(2^{26}-1)$   
 Ymax: user Y-axis coordinate of P2       $-(2^{26}-1) \sim +(2^{26}-1)$

- **Related Command**

IP

- **Explanation**

An SC command with parameters sets user coordinates so that the position of scaling point P1 becomes Xmin, Ymin and so that the position of scaling point P2 becomes Xmax, Ymax. Once set, the user coordinates remain in effect until they are re-scaled with a new SC command or until they are returned to machine coordinates with an SC command without parameters. The parameters of cutting (plotting) commands during that time are all interpreted as user coordinates.

An SC command without parameters clears the scaling, and all parameters of further cutting (plotting) commands will be returned to machine coordinates.

An SC command with one to three parameters results in error (2) and this command is ignored. An SC command with more than five parameters also results in error (2), but the first four parameters remain in effect. An SC command with out-of-range parameters results in error (3) when Xmin = Xmax or when Ymin = Ymax, and this command is ignored.

- **Example**

```

10 *** SC COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA0,0;" 
40 PRINT #1,"IP0,0,1000,1000;SC0,100,0,100;" 
50 PRINT #1,"EA100,100;" 
60 PRINT #1,"IP0,0,3000,2000;SC0,100,0,100;" 
70 PRINT #1,"EA100,100;" 

```

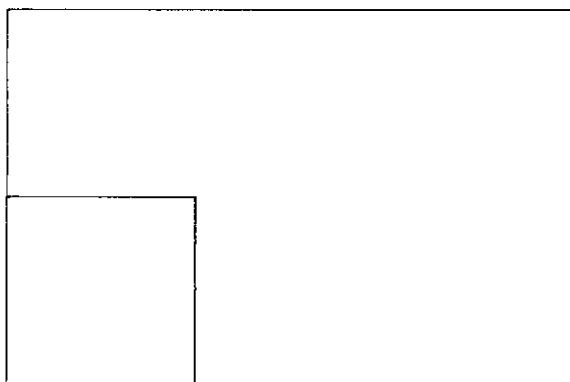


Fig. SC-1

**SI Command****Absolute Character Size****● Format**

SI w, h;  
SI;

**● Parameters**

w : character width       $-(2^{26}-1) \sim + (2^{26}-1)$ (cm) (Default: 3.8(cm))  
 h : character height       $-(2^{26}-1) \sim + (2^{26}-1)$ (cm) (Default: 5(cm))

**● Related Commands**

SR, DI, DR, LB

**● Explanation**

By specifying character width and height with the two parameters w and h, sets an absolute character size. The relation between character width, character height and character cell is illustrated in Fig. SI-1

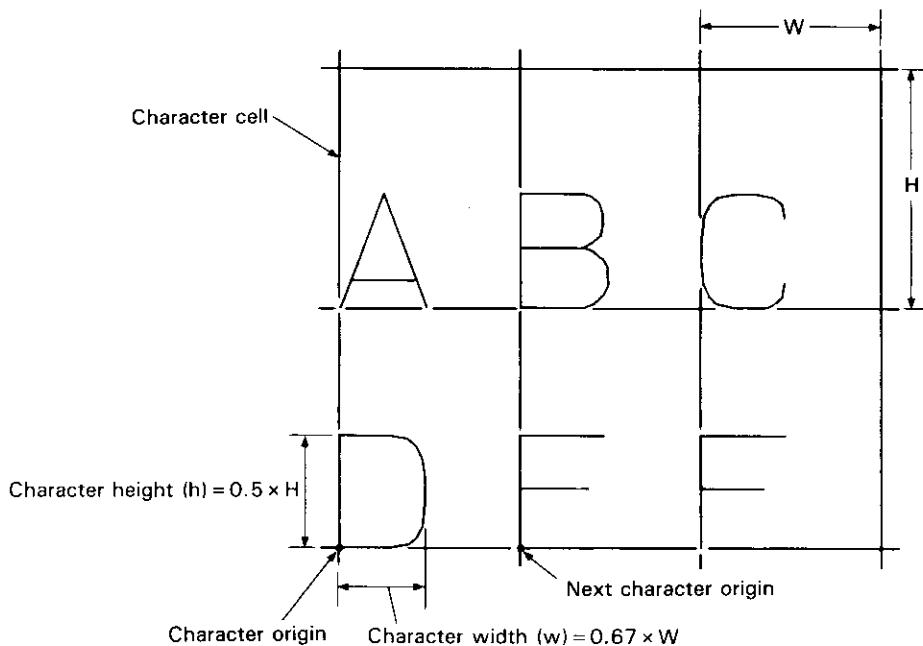


Fig. SI-1

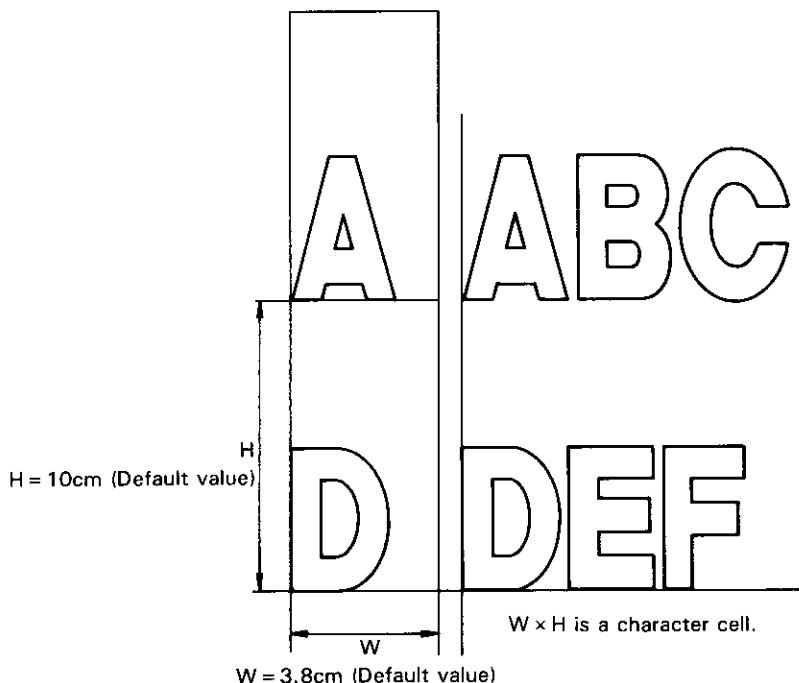


Fig. SI-2

Fig. SI-1,2 is an example of the output result when the next program is executed.

```
"LB"ABC";[CR][LF];"DEF";CHR$(3)
```

For [VECT.], characters are cut at the width of each character cell even if they are input in succession. For [OUTL.], each spacing between characters is automatically adjusted if characters are input in succession.

If you set a character size with the SI command, the size of the characters to be cut (plotted) will not be changed even when you scale by the IP, SC and IW commands or by the front panel.

An SI command without parameters is defaulted.

An SI command with only one parameter results in error (2) and this command is ignored. An SI command with more than three parameters also results in error (2), but the first two parameters remain in effect. An SI command with out-of-range parameters results in error (3) and this command is ignored.

- **Example**

```

10 '*** SI COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA1000,1000;"
40 PRINT #1,"SI0.3,0.4;"
50 PRINT #1,"LB0.3x0.4cm";CHR$(3)
60 PRINT #1,"SI0.5,1;"
70 PRINT #1,"LB0.5x1.0cm";CHR$(3)

```

0.3 x 0.4 cm 0.5 x 1.0 cm

Fig. SI-3

<b>SL Command</b>	<b>Character Slant</b>
-------------------	------------------------

- **Format**

SL tan $\theta$ ;  
SL;

- **Parameter**

tan $\theta$  : character slant  $-(2^{26}-1) \sim +(2^{26}-1)$  (Default: 0)

- **Related Commands**

DI, DR, LB

- **Explanation**

Specifies a character slant with the tan $\theta$  value from the perpendicular as illustrated in Fig. SL-1. An SL command without any parameter defaults to 0 (no slant).

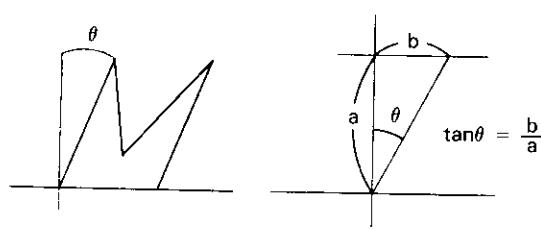


Fig. SL-1

The parameter range is within  $-(2^{26}-1) \sim +(2^{26}-1)$ . To cut (plot) easy-to-see characters, it is a good idea to set the parameter  $\tan\theta$  within  $\pm 0.4$  for the default characters and within  $\pm 0.8$  for large characters.

The character slant set by the SL command remains in effect until the IN or DF command and a next SL command are executed.

An SL command with more than two parameters results in error (2), but the first one parameter remains in effect. An SL command with an out-of-range parameter results in error (3) and this command is ignored.

- **Example**

```

10 '*** SL COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA1000,1000;"
40 PRINT #1,"SL0;" 
50 PRINT #1,"LBSL0";CHR$(3)
60 PRINT #1,"SL0.4;" 
70 PRINT #1,"LBSL0.4";CHR$(3)
80 PRINT #1,"SL0.8;" 
90 PRINT #1,"LB0.8";CHR$(3)

```

Fig. SL-2

<b>SM Command</b>	<b>Symbol Mode</b>
-------------------	--------------------

- **Format**

SM s;  
SM;

- **Parameter**

s: character or symbol CHR\$(33) ~ CHR\$(58), CHR\$(60) ~ CHR\$(126)  
(Default: Clears symbol mode)

- **Related Commands**

DI, DR, PA, PD, PU, PR, SI, SL, SR

### ● Explanation

Sets symbol mode or symbols. Symbol mode is effective only when line character [VECT.] has been selected and is ignored when outlined character [OUTL.] has been selected. When you specify only one character with the SM command, the SM command cuts (plots) the specified character or symbol around any point specified by the PA, PR, PU or PD command. And once set, the character remains in effect until you specify a new character or until you clear symbol mode. The parameter is limited in use for only one character or symbol that can be cut (plot).

Even if you specify a new character with the SM command in symbol mode, it does not clear symbol mode but the character is changed only. To clear symbol mode, you need to execute an SM command without any parameter ("SM;"). Also, you are allowed to clear symbol mode with the IN or DF command.

The characters to be cut (plotted) are affected by the character size commands (SI, SR), character slant command (SL) and cutting (plotting) direction commands (DI, DR). The characters that can be specified are those from CHR\$(33) through CHR\$(126), but semicolon (;) and (CHR\$(59)) are interpreted as terminators. Therefore you cannot specify them as symbols. Also, you cannot specify control characters as symbols.

The following sample program is an example that symbols or characters are cut (plotted) at each point of polygonal lines.

### ● Example

```

100  '*** SM COMMAND ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"IN;PA1000,500;"  

140  PRINT #1,"PD1000,500,1000,7500,9000,7500,9000,500,  

     1000,500;PU;"  

150  FOR I=1 TO 3
160      READ S$  

170      PRINT #1,"SI0.7,1.2;SM";S$;""
180      X=2000
190      FOR L=1 TO 4
200          READ Y
210          PRINT #1,"PA";X;".";Y;"";PD;""
220          X=X+2000
230      NEXT L
240      PRINT #1,"PU;"  

250  NEXT I
260  END

```

```

270 DATA *,1000,2500,6000,6900
280 DATA R,6300,1700,1300,3000
290 DATA G,4800,4000,3000,1500

```

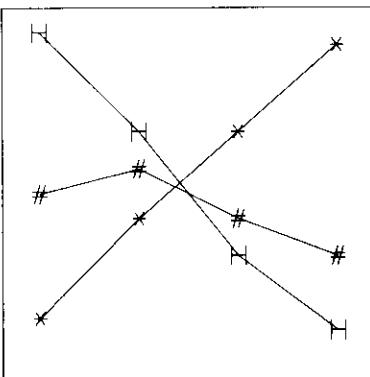


Fig. SM-1

## SR Command

## Relative Character Size

- Format

SR w, h;  
SR;

- Parameters

w	: character width	$-(2^{26}-1) \sim + (2^{26}-1)$ (%) (Default: 3.8(cm))
h	: character height	$-(2^{26}-1) \sim + (2^{26}-1)$ (%) (Default: 5(cm))

- Related Commands

DI, DR, SI, LB

- Explanation

Sets a character size in proportion to the distance between scaling points P1 and P2. As described in the following formulas, the character width and height are set in percentage between the x-axis and y-axis coordinates of scaling points P1 and P2.

An SR command without parameters is defaulted and also set to the default values above no matter where scaling points P1 and P2 are located at this point and even if P1 and P2 have been scaled.

$$\text{Character width} = (P2_x - P1_x) \times (\text{width parameter } w/100)$$

$$\text{Character height} = (P2_y - P1_y) \times (\text{height parameter } h/100)$$

An SR command with only one parameter results in error (2) and this command is ignored. An SR command with more than three parameters also results in error (2), but the first two parameters remain in effect. An SR command with out-of-range parameters results in error (3) and this command is ignored.

- **Example**

```

10 '*** SR COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA1000,1000;" 
40 PRINT #1,"SR0.75,1.5;" 
50 PRINT #1,"LB0.75x1.5";CHR$(3)
60 PRINT #1,"SI1.1;" 
70 PRINT #1,LB1x1";CHR$(3)

```

0 . 7 5 x 1 . 5 1 X 1

Fig. SR-1

<b>SS Command</b>	<b>Select Standard Set</b>
-------------------	----------------------------

- **Format**

SS;

- **Parameter**

None

- **Related Commands**

CA, CS, SA

- **Explanation**

Specifies standard character set.

After executing the SS command, the character set specified by the CS command is used in actual cutting (plotting). Also, you are allowed to specify standard character set by sending [SI] (CHR\$(15)) within the LB command.

This character set remains in effect until you select alternate character set with the SA command and [SO] (CHR\$(14)) or until you default it with the DF or IN command. No parameters are necessary for the SS command.

- **Example**

```

10 '*** SS COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA1000,1000;"
40 PRINT #1,"CS1;"
50 PRINT #1,"SS;"
60 PRINT #1,"LBtan({/3)=¥3";CHR$(3)

```

Fig. SS-1

TL Command	Tick Length
------------	-------------

- **Format**

TL Ip (, Im);  
TL;

- **Parameters**

Ip: tick length in positive direction      0~( $2^{26}-1$ ) (%) (Default: 0.5(%))  
Im: tick length in negative direction      0~( $2^{26}-1$ ) (%) (Default: 0.5(%))

- **Related Commands**

IP, XT, YT

- **Explanation**

Sets the length of ticks to be cut (plotted) by the XT and YT commands.  
Positive directional ticks are those cut (potted) in an upper direction on X axis and those cut (plotted) in a right-hand side direction on Y axis. Negative directional ticks are those cut (potted) in a lower direction on X axis and those cut (plotted) in a left-hand side direction on Y axis.

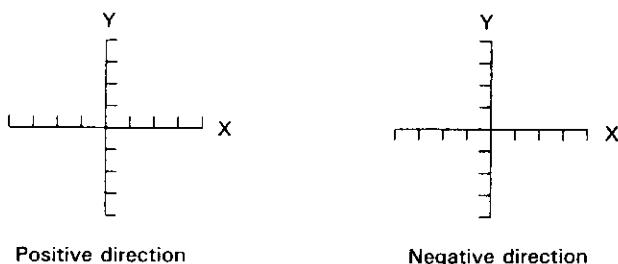


Fig. TL-1

The parameter values as tick lengths are percentage of  $(P2_y - P1_y)$  for the XT command and percentage of  $(P2_x - P1_x)$  for the YT command. The parameter range is from 0 to  $(2^{26} - 1)$ . If the parameters are all 0 or omitted, no ticks are cut (plotted). When the parameters are 100, ticks of the length in XY-axes direction between P1 and P2 are entered. This parameter value (100) is used for entering separate lines on a table rather than entering ticks.

Remember that since the tick lengths are percentage with respect to the length of XY-axes direction set by P1 and P2, the lengths of X axis and Y axis vary when the area set by P1 and P2 is not square.

When your CAMM-1 is initialized by the DF or IN command or when a TL command without parameters is executed, the tick lengths are defaulted to 0.5% of  $(P2_x - P1_x)$  and  $(P2_y - P1_y)$ .

When you specify the positive directional tick length only, the negative directional tick length is set to 0.

The TL command remains in effect until a new TL command or the IN or DF command is executed.

A TL command with more than three parameters results in error (2), but the first two parameters remain in effect. A TL command with out-of-range parameters result in error (3) and this command is ignored.

- **Example**

```

10 *** TL COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;PA1000,1000;PD;" 
40 FOR I=1 TO 10
50   PRINT #1,"TL2,0;XT;PR40,0;" 
60   PRINT #1,"TL1,0;" 
70   FOR J=1 TO 4
80     PRINT #1,"XT;PR40,0;" 
90   NEXT J
100 NEXT I
110 PRINT #1,"TL2,0;XT;"
```



Fig. TL-1

UC Command	User Defined Character
------------	------------------------

- **Format**

UC (c, )  $\Delta x_1$ ,  $\Delta y_1$ , (c, ) ... ( $\Delta x_n$ ,  $\Delta y_n$ , ) ... ;  
UC;

- **Parameters**

c : tool control value	$-(2^{26}-1) \sim -99, +99 \sim +(2^{26}-1)$
$\Delta x_n$ : number of X-axis directional moving units	$-99 \sim +99$
$\Delta y_n$ : number of Y-axis directional moving units	$-99 \sim +99$

- **Related Command**

None

### ● Explanation

Cuts (plots) a character by designing.

The UC command has three parameters: tool control value, the number of X-axis direction moving units and the number of Y-axis directional moving units. The tool control value is to move the tool up and down. The tool control value moves the tool up when it is below -99, moves the tool down when it is over +99 and is interpreted as the number of moving units when it is within the range of -99 ~ +99.

Since the tool always goes up when your CAMM-1 receives the UC command, your CAMM-1 cannot cut (plot) a character unless you enter at least one tool-down parameter in the UC command. Also, the tool goes up when the UC command is finished, then moves to the lower-left corner of one next character cell, and finally returns back to the same pen status (up/down) as the one before the UC command was executed. The numbers of X-axis and Y-axis directional moving units specify the amount of horizontal or vertical tool moves in the number of grid units. The numbers of X-axis and Y-axis directional moving units are larger than -99 and smaller than +99 and can be decimal figures.

The grid units that indicate the amount of tool moves are what a character cell is parted horizontally and vertically (horizontal 6 × vertical 16). A normal character is cut (plotted) in a dotted area (horizontal 4 × vertical 8) as illustrated in Fig. UC-1. If you define a character so that it enters in there, you will have the character of the normal size.

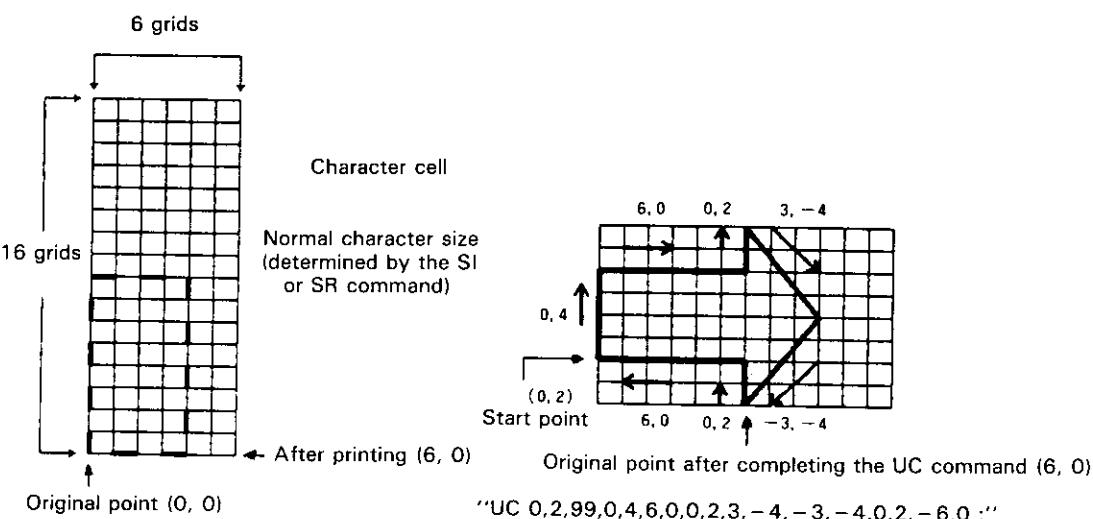


Fig. UC-1

A character to be defined by the UC command is not necessarily accommodated into a character cell. You are allowed to define any size character. However, after cutting (plotting) by the UC command, the tool moves one-full character cell from the start point and then stops there with the tool up just as it cuts (plots) a normal character. So, you should remember that if the character you defined cannot be accommodated in a character cell, it may be overlapped on the next character unless you move the tool with the PA, PR or CP command.

A UC command with an odd number of moving unit parameters results in error (2) and ignores the last parameter. A UC command with out-of-range parameters stops when it reaches those parameters in a program.

- **Example**

```
100  '*** UC COMMAND ***
110 OPEN "LPT1:" AS #1
130 PRINT #1,"IN;PA3000,2500;"
140 PRINT #1,"SI5,9;UC0,2,99,0,4,6,0,0,2,3,-4,-3,-4,0,
2,-6,0;"
```

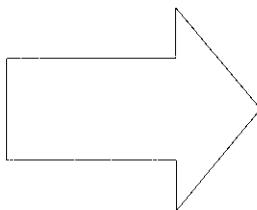


Fig. UC-2

<b>VS Command</b>	<b>Velocity Select</b>
-------------------	------------------------

- **Format**

VS v (, n);  
VS;

- **Parameters**

v: tool speed      2 ~ 15(cm/sec) (Default: value set by front panel)  
n: tool number      0, 1 ~ 8

- **Related Command**

None

- **Explanation**

Sets and changes the tool speed.

A VS command without parameters returns all tool speeds to the values set by the front panel.

Depending on the parameters, you are allowed to specify tool speeds in 1cm/sec increments from 2cm/sec up to 15cm/sec. When the parameter v is below 2, 2cm/sec is set. When the parameter v is over 15, 15cm/sec is set.

Also, by specifying a tool number, you are allowed to change the speed of that tool only if you want. If you omit the parameter n, it is effective to all tools. The tool number 0 is for a cutter, and the tool numbers from 1 through 8 are for pens. And if you omit a tool number, the current tool speed of your CAMM-1 is changed.

A VS command with more than three parameters results in error (2), but the first two parameters remain in effect. A VS command with out-of-range parameters results in error (3) and this command is ignored.

- **Example**

```
10 '*** VS COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;VS10;"
```

WD Command	Write To Display
------------	------------------

- **Format**

WD c<sub>1</sub> c<sub>2</sub> ... c<sub>n</sub> [label terminator]

WD [label terminator]

- **Parameter**

c<sub>n</sub>: character      CHR\$(32) ~ CHR\$(127), CHR\$(160) ~ CHR\$(223)

- **Related Commands**

DT, !OK

### ● Explanation

The WD command continues to display a label string followed by WD in the display of your CAMM-1 until it receives the label terminator defined by the DT command. For the characters to be displayed, refer to List of Display Character Codes, APPENDIX B. When the DT command is omitted, the label terminator is the default [ETX](CHR\$(3)). If a WD command without any parameter ("WD";CHR\$(3)) is sent, your CAMM-1 exits keyboard mode, and the current display returns to the previous display.

As long as characters by the WD command are displayed, each key does not work as usual. You are allowed to know with the !OK command which key has been pressed. (Serial Connection only)

Out-of-range control characters are ignored.

The maximum number of characters that can be displayed is 40 (20 characters × 2 lines). Characters are first displayed from the upper line and then displayed on the lower line if the first 20 characters are exceeded. Any characters more than 41 are ignored.

If an error occurs, its error message has priority to be displayed. But by pressing **[FUNC]** key, that message display returns to the display by the WD command, and the label string by the WD command is displayed.

If the WD command is sent when an error message is displayed, the error message remains displayed because of priority. But if you clear that error by the OE command or press **[FUNC1]** key, your CAMM-1 enters the display by the WD command, and the label string by the WD command is displayed.

### ● Example

```

100  '*** WD COMMAND ***
110  OPEN "COM1:9600,N,8,1" AS #1
120  PRINT #1,"IN;PA2000,2000;""
130  PRINT #1,"WD ^ CIRCLE    v RECT    < TRIANG   >
      *END*";CHR$(3)
140  PRINT #1,!OK;""
150  INPUT #1,K
160  IF K=16 THEN 210
170  IF K=8 THEN 220
180  IF K=4 THEN 230
190  IF K=2 THEN 240
200  GOTO 140
210  PRINT #1,"CI1000,5;":GOTO 140
220  PRINT #1,"CI1000,90;":GOTO 140
230  PRINT #1,"CI1000,120;":GOTO 140

```

**240 PRINT #1, "WD";CHR\$(3):END**

## WG Command

## Shade Wedge

- **Format**

WG r,  $\theta_1$ ,  $\theta_c$  [,  $\theta_d$ ];

- **Parameters**

r	: radius	$-(2^{26}-1) \sim +(2^{26}-1)$
$\theta_1$	: start point	$-(2^{26}-1)^\circ \sim +(2^{26}-1)^\circ$
$\theta_c$	: center angle	$-(2^{26}-1)^\circ \sim +(2^{26}-1)^\circ$
$\theta_d$	: chord tolerance	$-(2^{26}-1)^\circ \sim +(2^{26}-1)^\circ$ (Default: 5°)

- **Related Commands**

EW, FT, LT, PT

- **Explanation**

Hatches the inside of a wedge centered at the current tool position.

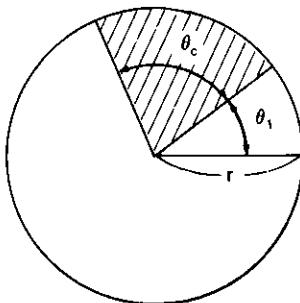


Fig. WG-1

Hatching pattern, spacing and angle follow the values set by the FT and PT commands. Remember that the position of a reference point varies depending on the positive or negative radius value. Also, the way of taking an angle from the reference point varies depending on the positive or negative value of the center angle.

The chord tolerance  $\theta_d$  specifies the smoothness of an arc and is compensated for the value that divides the center angle  $\theta_c$  into even angles. The center angle is set to 0° if it is below 0° and to 180° if it is over 180°. Also, if the chord tolerance  $\theta_d$  is too small and mechanically impossible to accept, your CAMM-1 compensates it for the smallest possible value. When you set 0° to  $\theta_d$ , you will have the smoothest arc. If you omit  $\theta_d$ , the default value 5° will be set.

After hatching is finished, the tool returns back to the start point.

A WG command with less than two parameters results in error (2) and this command is ignored. A WG command with more than five parameters also results in error (2), but the first four parameters remain in effect. A WG command with out-of-range parameters results in error (3) and this command is ignored.

- **Example**

```
100  '***  WG COMMAND ***  
110  OPEN "LPT1:" AS #1  
130  PRINT #1,"PA;PU5000,4000;"  
140  PRINT #1,"FT3,150,0;"  
150  PRINT #1,"WG3000,90,45;"  
160  PRINT #1,"FT3,150,90;"  
170  PRINT #1,"WG-3000,90,-45;"  
180  PRINT #1,"FT3,150,135;"  
190  PRINT #1,"WG-3000,90,45;"
```

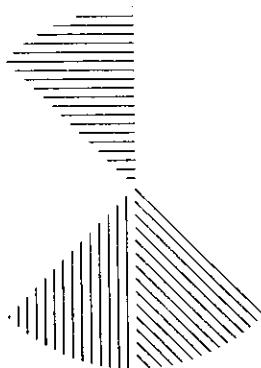


Fig. WG-2

**XT Command****X-Tick****● Format**

XT;

**● Parameter**

None

**● Related Commands**

TL, YT

**● Explanation**

Cuts (plots) ticks on X axis in reference with the current tool position.

Although you are allowed to change the length of ticks with the TL command, the default X-axis tick length is 0.5% of  $(P2_x - P1_x)$  in both positive and negative directions, respectively.

**● Example**

[Example 1]

```

100  *** XT COMMAND NO.1 ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"IN;PA1000,4000;PD;XT;"
140  FOR I=1 TO 10
150      PRINT #1,"PR800,0;XT;"
160  NEXT I

```

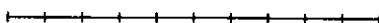


Fig. XT-1

Enters ticks while cutting (plotting) X-axis.

[Example 2]

```

100  *** XT COMMAND NO.2 ***
110  OPEN "LPT1:" AS #1
130  PRINT #1,"IN;PA1000,4000;PD;"
140  PRINT #1,"PR8000,0;XT;PU;"
150  FOR I=1 TO 10
160      PRINT #1,"PR-800,0;XT;"

```

**170 NEXT I**

Cuts (plots) the same as [Example 1], but cuts (plots) X axis first and then enters ticks on it.

**YT Command****Y-Tick**

- Format**

YT;

- Parameter**

None

- Related Commands**

XT, TL

- Explanation**

Cuts (plots) ticks on Y axis in reference with the current tool position. Although you are allowed to change the length of ticks with the TL command, the default Y-axis tick length is 0.5% of  $(P2_x - P1_x)$  in both positive and negative directions, respectively. See [Example 1] and [Example 2] of XT Command.

**!NR Command****Not Ready**

- Format**

!NR;

- Parameter**

None

- Explanation**

Pauses in the same status as you press [ENTER] key during operation.

In this status, your CAMM-1 does not operate even if a new command is sent. If you select [CONT] from the front panel to clear Pause Mode, your CAMM-1 starts cutting (plotting) from the next command followed by the !NR command if any.

- **Example**

```
10 '*** !NR COMMAND ***  
20 FOR I=1 TO 20  
30 LPRINT "PA0,0;"  
40 LPRINT "PA1000,1000;"  
50 IF I=10 THEN LPRINT "!NR;"  
60 NEXT I
```

<b>!OK Command</b>	<b>Output Key</b>
--------------------	-------------------

- **Format**

!OK;

- **Parameter**

None

- **Explanation**

For Serial Connection, outputs the sum of bit values of pressed panel keys in ASCII as follows.

Sum of key bit values [TERM]

The [TERM] is the output terminator of the RS-232C port.

The bit values of each panel key are as follows:

Bit value	Bit No.	Panel key
1	1	[FUNC]
2	2	[▶]
4	3	[◀]
8	4	[▼]
16	5	[▲]
32	6	[ENTER]
64	7	None
128	8	None

Table IOK-1

These panel keys are those when the !OK command was sent and have nothing to do with previously pressed ones.

The !OK command outputs 0 when no key is pressed.

When [FUNC] and [▲] keys are pressed, the !OK command outputs 17 (=1+16).

By displaying a label string with the WD command (mode2) and checking panel keys with the !OK command, you are allowed to freely set panel key functions.

The !OK command is ignored when Parallel Connection is used.

#### ● Example

```

10  '*** !OK COMMAND ***
20  OPEN "COM1:9600,N,8,1" AS #1
30  PRINT #1,"!OK;"
40  INPUT #1,K
50  IF K=0 THEN 30
60  PRINT K

```

<b>!PG Command</b>	<b>Page Feed</b>
--------------------	------------------

- **Format**

!PG n

- **Parameter**

n: -800 ~ +800

- **Explanation**

Pushes out the current sheet by the parameter n only and sets a new origin. The unit of this parameter is mm, and decimal parameter figures are acceptable.

If you omit the parameter n, one-full page is pushed out. At this time, 84mm (= 19mm + 65mm) is also pushed out as an extra margin. 19mm is an extra margin, automatically inserted between pages. 65mm is a width, pushed out temporarily to make sheet separation convenient. If you specify [VIEW] or [ORG] from the front panel or send a command to specify a tool carriage move after sheet cutting, your CAMM-1 first pushes the sheet back 65mm and then starts operating again. The length of one page varies depending on how you set [SIZE] in 4.3 (1) \* Set Configuration \* menu in CHAPTER 4, Part 1.

Sheet size	Sheet length to be pushed out
<b>ISO A2</b>	583 (564 + 19)
<b>ISO A3</b>	286 (267 + 19)
<b>FREE-Y</b>	Max. Y-axis coordinate value + 20
<b>EXPAND-X</b>	Max. X-axis coordinate value + 20

Sheet size	Sheet length to be pushed out
<b>ANSI C</b>	537.8 (518.8 + 19)
<b>ANSI B</b>	268.4 (249.4 + 19)

Table !PG-1

- Example

```

10 *** !PG COMMAND ***
20 LPRINT "PA;PU0,1000;" 
30 LPRINT "LBABC";CHR$(3)
40 LPRINT "!PG300;" 
50 LPRINT "PU0,1000;" 
60 LPRINT "LBDEF";CHR$(3)
70 LPRINT "!PG;" 

```

<b>!SF Command</b>	<b>Select Font</b>
--------------------	--------------------

- Format

**!SF n, m;**

- Parameters

n : character type      0,1,2 (Default: value set by front panel)  
m: character spacing      0~(2<sup>26</sup> - 1)

- Explanation

Specifies character type and character spacing.

The meaning of the parameter m varies depending on the value of the parameter n as follows:

<b>n</b>	<b>Character type to be selected</b>	<b>m function</b>	<b>m</b>
<b>0</b>	Line character	None	Ignores
<b>1</b>	Outlined character	Spacing absolute	Absolutely specifies character spacing in cm
<b>2</b>	Outlined character	Spacing relative	Specifies character spacing in m% of character height

Table !SF-1

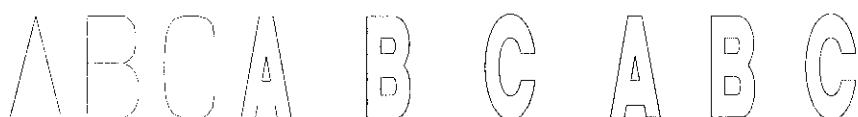
Usually, you select line character for plotting and outlined character for cutting. However, outlined character becomes active when [CUTTER] has been selected for [TOOL].

- Example

```

10 '*** !SF COMMAND ***
20 LPRINT "SI1.2,1.7;" 
30 LPRINT "PA;PU0,1000;" 
40 LPRINT "!SF0,0;" 
50 LPRINT "LBABC";CHR$(3) 
60 LPRINT "!SF1,3;" 
70 LPRINT "LBABC";CHR$(3) 
80 LPRINT "!SF2,50;" 
90 LPRINT "LBABC";CHR$(3)

```



<b>!ST Command</b>	<b>Select Tool</b>
--------------------	--------------------

- Format

!ST n;

- Parameter

n: 0,1     (Default: value set by front panel)

- Explanation

Sets Operate Mode of your CAMM-1. Plot Mode enters when the parameter n is 0. Cutting Mode enters when the parameter n is 1. In Cutting Mode, some inherent misalignment of cutter axis occurs, but that misalignment is perfectly offset at both start and end points of every vector.

- Example

```

10 '*** !ST COMMAND *** 
20 LPRINT "!ST1;" 

```

## **ABOUT INTERFACE**

# **4**

This chapter discusses the specifications of each interface and the handshakes in serial connection (RS-232C).



## 4.1 PARALLEL (CENTRONICS) CONNECTION

ABOUT  
INTERFACE

Since the parallel input connector of CAMM-1 is in compliance with Centronics specifications, it can be used in conjunction with printer cables of almost any computers. For connecting cables of each computer manufacturer available for CAMM-1, refer to LIST OF OPTION ① Connecting Cables, Appendix C.

### 4.1.1 Specifications of Parallel Interface

#### ● About the parallel input connector

Use DDK 57-30360, AMP 552234-1 or equivalent to connect this input connector. On the body of CAMM-1, BURNDY MRD-36SB-180 or equivalent should have been equipped.

NC	36	18	HIGH**
HIGH *	35	17	GND
NC	34	16	GND
GND	33	15	NC
HIGH *	32	14	NC
NC	31	13	HIGH *
GND	30	12	GND
	29	11	BUSY
	28	10	ACK
HIGH *	27	9	D 7
GND	26	8	D 6
	25	7	D 5
	24	6	D 4
	23	5	D 3
	22	4	D 2
	21	3	D 1
	20	2	D 0
	19	1	STROBE

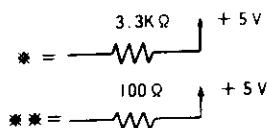
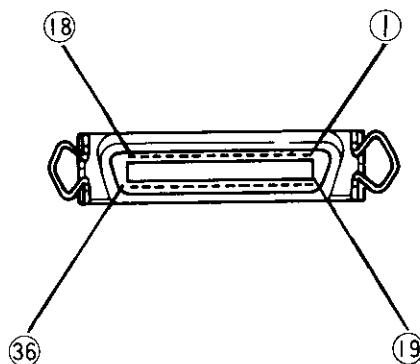


Fig. 4-1

- **About input/output signal lines**

The input and output of each connector are as described in Fig. 4-2. IC used on CAMM-1 is one specified or equivalent.

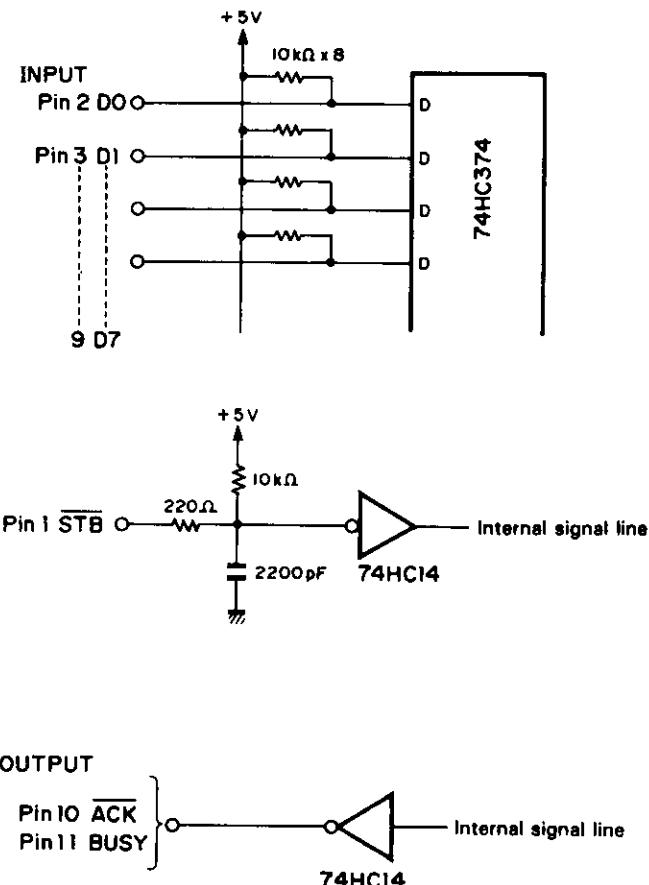
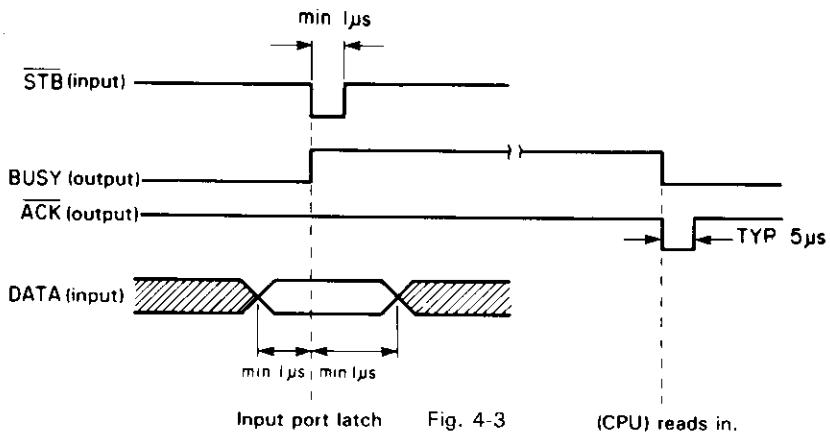


Fig. 4-2

- **I/O Signal Timing Chart**



Connecting cables of each manufacturer for connection to the computer with Serial Interface (RS-232C) are as described in Appendix C. LIST OF OPTION ① Connecting Cables. If using CAMM-1 with other than those computers or in different conditions, refer to the following discussions.

In addition, for the handshakes of RS-232C, refer to 4.3 About Handshakes.

### 4.2.1 Specifications of Serial Interface

#### • About the serial connector

Use JAE DB-25pA-XX or equivalent. On the body of CAMM-1, BURDY MDS25SB-115 or equivalent should have been equipped.

Terminal No.	Signal	Pin connection
1	FG	
2	TXD	
3	RXD	
4	RTS	
5	CTS	
6	DSR	
7	SG	
8	NC	
9	NC	
10	NC	
11	NC	
12	NC	
13	NC	
14	S.TXD	
15	NC	
16	S.RXD	
17	NC	
18	NC	
19	NC	
20	DTR	
21	NC	
22	NC	
23	NC	
24	NC	
25	NC	

The diagram shows a rectangular DB-25 pin connector. Pin 13 is located at the top left, pin 25 is at the bottom left, and pin 14 is at the bottom right. Dashed lines connect these three pins to specific pins on the connector's body. Pin 13 connects to the 13th pin from the left, pin 25 connects to the 25th pin from the left, and pin 14 connects to the 14th pin from the left.

Fig. 4-4

- The description of each signal line is given in Table 4-1.

Pin No.	Code	Description	I/O
1	FG	Protective connecting cable and be connected to the frame of a computer. This has been connected to the frame of CAMM-1.	[Com]
2	TXD	Transmission data: data output from CAMM-1 to the computer. Be connected to the receiving data line of the computer. SPACE = "0" = + 12V MARK = "1" = - 12V	[Output]
3	RXD	Receiving data: line through which CAMM-1 receives data from the computer. Be connected to the transmission line of the computer. SPACE = "0" = + 3V ~ + 25V MARK = "1" = - 3V ~ - 25V	[Input]
4	RTS	Shows transmission request. Always outputs ON(+ 12V) from CAMM-1 to the computer.	[Output]
5	CTS	Signal to tell data transmit acceptance and inputs it from the computer to CAMM-1. CAMM-1 is ready to output data when this signal is ON(+ 3V ~ + 25V) and cannot output data when OFF(- 3V ~ - 25V). If not connected, CAMM-1 is always ON in its inside.	[Input]
6	DSR	Data set ready: be connected to a line that, by nature, tells a modem is ready to operate. Inputs from the computer to CAMM-1. If not connected, there is no problem in normal use of CAMM-1 like CTS.	[Input]
7	SG	Ground wire for signal lines and is connected to the circuit ground wire inside CAMM-1.	[Com]
20	DTR	Data terminal ready signal: tells the equipment is ready to transmit and receive data. If CAMM-1 is set so that the hardware handshake is performed using ESC.@ command, this controls ON(+ 12V)/OFF (- 12V) according to the remaining buffer capacity. If CAMM-1 is set so that the hardware handshake is not performed using ESC.@ command, it is always ON(+ 12V). Handshake is available if CTS and DSR are connected. However, the computer must have a function to monitor the above signal lines and stop data output.	[Output]

Table 4-1

The following paragraphs include the types of serial (RS-232C) handshakes and how CAMM-1 handshakes with the computer.

If the data processing speed of CAMM-1 is slower than data transmission speed when cutting (plotting) data is sent from the computer, CAMM-1 will miss some of that data. To receive all data, CAMM-1 determines the acceptability of data transmission in accordance with the remaining capacity of the input/output (I/O) buffer. This mode is called a handshake.

CAMM-1 supports three types of handshakes: hardware handshake, Xon/Xoff and ENQ/ACK.

The hardware handshake uses the DTR pin of RS-232C only for handshaking purposes, and CAMM-1 tells the computer whether it is now ready to receive data. In handshake modes other than this, CAMM-1 handshakes with the computer by transmitting a certain character from the same pin as for data.

In addition to the three types of handshakes, software checking handshake that sends data while checking the remaining buffer capacity of CAMM-1 from the computer side using device control commands will also be discussed.

### (NOTES)

- In each [Example], typical example in BASIC is given. Change them in accordance with the computer you use, if necessary. In addition, "PRINT #1," and "INPUT #1," denote the input and output of RS-232C. Remember that if RS-232C is used, RS-232C port must have been opened before its use.
- All of the character codes (ASCII) use decimal numbers.
- For character codes, CHR\$ is used to denote they are character codes.
- Control characters are noted like [ESC] (CHR\$(27)) or [ESC].
- For device control commands, refer to 4.4 Device Control Commands.

### 4.3.1 Hardware Handshake

CAMM-1 has a function to switch the DTR pin to High/Low in accordance with the remaining buffer capacity. The DTR pin is No.20 pin of RS-232C.

A hardware handshake is available if the computer has a function to stop data output when data input is Low at either CTS or DSR pin of RS-232C. An example of connection for handshaking is shown in Fig. 4-5. Use this connection for IBM-PC's.

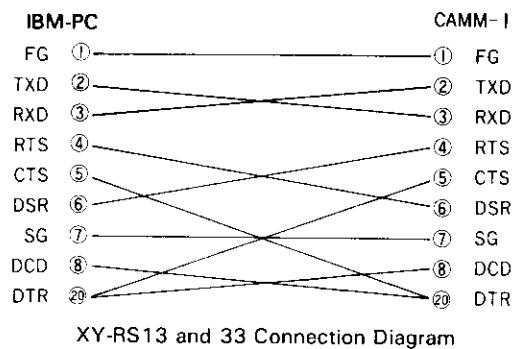
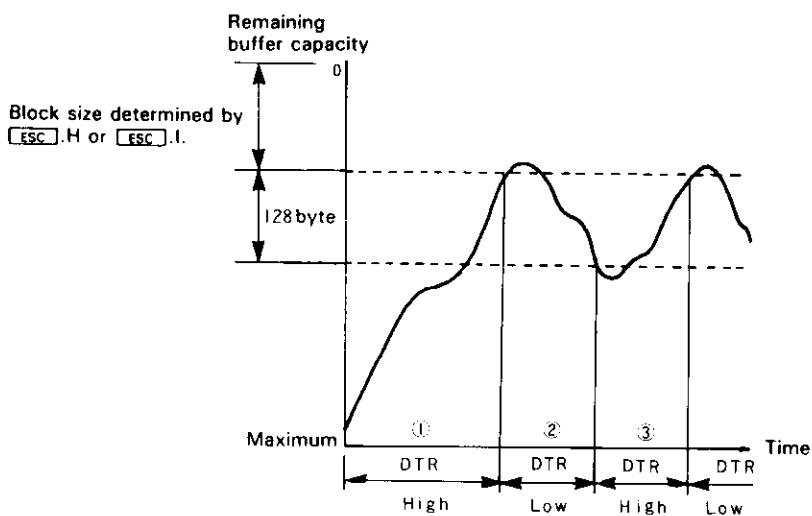


Fig. 4-5

Fig. 4-6 describes how the remaining buffer capacity changes by this hardware handshake.



- ① The remaining buffer capacity is decreasing if the computer continues to transmit data to CAMM-1 when the remaining buffer capacity is maximal (buffer empty) and also the DTR pin is High, because data transmission speed is faster than the cutting (plotting) speed of CAMM-1.
- ② CAMM-1 leads the DTR pin to Low if the remaining buffer capacity is less than a block size that may be determined by the 1st parameter of either **[ESC].H** or **[ESC].I** (default value: 80 bytes). The remaining buffer capacity is then increasing because the computer is at rest to transmit data.
- ③ CAMM-1 leads the DTR pin to High if the remaining buffer capacity is over a block size determined by the 1st parameters of **[ESC].H** and **[ESC].I** plus 128 bytes. The computer then starts data transmission again.

Fig. 4-6

The default conditions after power-on means that the hardware handshake is acceptable.

No matter what handshakes are set, the DTR pin is switched to High/Low in accordance with the remaining buffer capacity. If this causes inconvenience, the 1st parameter of **[ESC].@** can be used to fix the DTR pin to High.

### 4.3.2 Software Checking Handshake

CAMM-1 has a function to outputs the remaining buffer capacity to the computer. Making use of this function, CAMM-1 allows the computer to send data while checking the remaining buffer capacity with software.

#### [Example of software checking handshake]

```
100 ' CAMM-1 RS-232C DEVICE CONTROL COMMAND
110 ' SAMPLE PROGRAM FOR SOFTWARE HANDSHAKE
120 OPEN "COM1:9600,N,8,1" AS #1
130 PRINT #1,CHR$(27);".M100;;;;13:";
140 ' MAIN PROGRAM .....
```

GOSUB 1000

Main program compulsory to cut (plot)

GOSUB 1000

END .....

```
1000 ' SUBROUTINE FOR BUFFER CHECK
1010 PRINT #1,CHR$(27);".B";
1020 INPUT #1,B
1030 PRINT "Buffer space :";B
1040 IF B>=150 THEN RETURN
1050 GOTO 1010
```

**[Explanation]**

- Line 120 Opens RS-232C port. The grammar varies depending on the computers.
- Line 130 Sets the terminator for data output from CAMM-1 as **[CR]** (CHR\$(13)), taking the delay time CAMM-1 spends to respond to the computer as 100msec, if the computer requests CAMM-1 for data output.
- Line 1010 Instructs CAMM-1 to outputs the remaining buffer capacity.
- Line 1020 Checks the remaining buffer capacity and waits if the remaining buffer capacity is below 150 bytes.
- Line 1050

In this sample program, lines 1000 through 1050 check the remaining buffer capacity and control the data transmission. Because of this, GOSUB 1000 must be executed in order to check the remaining buffer capacity in every quarter of the main program. In other words, data transmission must be controlled so that data will not overshoot the maximum buffer capacity between the execution of the first GOSUB 1000 and the next GOSUB 1000.

### 4.3.3 Xon/Xoff Handshake

In this handshake mode, CAMM-1 sends out to the computer a character determined as Xoff if the remaining buffer capacity is below a certain value and also a character determined as Xon if the remaining buffer capacity is over a certain value. The computer stops data transmission if the Xoff character is sent and starts that transmission if the Xon character is sent.

The Xon character is determined by the **[ESC].I** command and the Xoff character is determined by the **[ESC].N** command. The remaining buffer capacity that outputs the Xoff character is determined by the **[ESC].I** command. The remaining buffer capacity that outputs the Xon character is the sum of the remaining buffer capacity that outputs the Xoff character and 128 bytes.

Fig. 4-7 shows an example of the Xon/Xoff handshake below.

**[Example of Xon/Xoff handshake]**

```
100 ' CAMM-1 RS-232C DEVICE CONTROL COMMAND
110 ' SAMPLE PROGRAM FOR Xon/Xoff HANDSHAKE
120 OPEN "COM1:9600,N,8,1" AS #1
130 ON COM(1) GOSUB 1000
140 PRINT #1,CHR$(27);".M0;0;0;13;0;0:";
150 PRINT #1,CHR$(27);".I150;0;17:";
160 PRINT #1,CHR$(27);".N;19:";
170 PRINT #1,CHR$(27);".@;0:";
180 COM(1) ON
190 ' MAIN PROGRAM-----
```

Program compulsory to engrave

END-----

```
1000 ' INTERRUPT Xon/Xoff
1010 IF LOC(1)=0 THEN RETURN
1020 A$=INPUT$(1,#1)
1030 IF A$=CHR$(19) THEN PRINT "Xoff   "
1040 PRINT "wait !!"
1050 A$=INPUT$(1,#1)
1060 IF A$=CHR$(17) THEN PRINT "Xon   ":RETURN
1070 PRINT "ILLEGAL Xon !!"
```

1080 END

**[Explanation]**

- Line 120 Opens RS-232C port. The grammar varies depending on the computers.
- Line 140 Sets the terminator for data output from CAMM-1 as **CR**(CHR\$(13)).
- Line 150 Limiting the remaining buffer capacity to 150 bytes, sets the Xon character to **DC1**(CHR\$(17)).
- Line 160 Sets the Xoff character to **DC3**(CHR\$(19)).
- Line 170 Always sets the DTR pin to high and performs the handshake.
- Line 1000 Handles an interrupt signal from CAMM-1. Stops data transmission if **DC3** is sent from CAMM-1 and starts that transmission again if **DC1** is sent.
- Line 1060

By setting lines 140 through 170, CAMM-1 operates as follows.

- (1) Outputs **DC3** as the Xoff character if the remaining buffer capacity reaches 150 bytes. (The computer stops data transmission.)
- (2) Outputs **DC1** as the Xon character if the remaining buffer capacity is over 278 (150 + 128) bytes. (The computer starts data transmission again.)

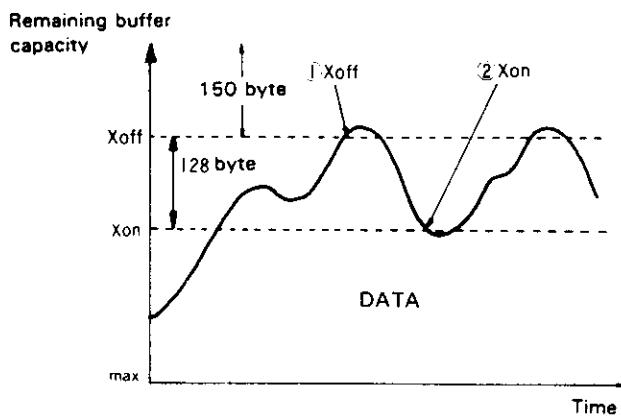


Fig. 4-7

Since this sample program performs a handshake using an interrupt signal during execution, the handshake will not be implemented successfully if the computer does not have an interrupt. If an interruption is entered here, the program jumps to lines 1000 through 1080 and waits until the Xon signal is input if that interrupt signal is the Xoff character.

#### 4.3.4 ENQ/ACK Handshake

In this handshake mode, the computer sends a character established as the ENQ character to CAMM-1 and ask CAMM-1 whether to transmit a certain amount of data. To this, CAMM-1 determines whether to accept data by a character established as the ACK character and tells the computer that data acceptance is ready if the remaining buffer capacity is over the amount of that data.

The ENQ/ACK handshake is subdivided into MODE1, MODE2 and dummy. The MODE1 is entered by the **[ESC].H** command, the MODE2 entered by the **[ESC].I** command, and the dummy entered by the **[ESC].H** command from which all parameters are omitted.

In dummy ENQ/ACK mode, especially if ENQ and ACK characters are not established, CAMM-1 unconditionally returns the ACK character when receiving the ENQ character. The difference between MODE1 and MODE2 is as described in Fig. 4-8. Output trigger character, echo terminator character and output terminator are sent in the sequence as described in Fig. 4-8 if they have been established in MODE1. Even if they are established in MODE2, they are ignored. For more detail, refer to 4.3.5 About specifications of handshake output.

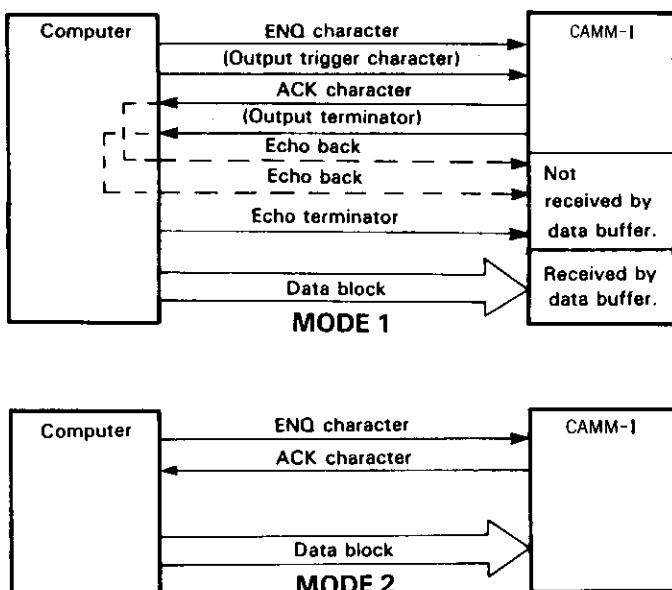


Fig. 4-8

An example of ENQ/ACK handshake mode1 is described in the following paragraphs.

You cutting (plotting) data, which will be sent to CAMM-1, into a data file called DATA1 before outputting it to CAMM-1. Then, it opens the DATA1 cutting (plotting) data file and executes [Example 2].

“Task other than DATA1” of [Example 2] refers to a task other than the computer cuts (plots) making use of an empty space produced when CAMM-1 is buffering.

[Example 1]

```
10 OPEN "1:DATA1" FOR OUTPUT AS #1  
20 PRINT #1, "....."
```

Data for CAMM-1

```
1000 END
```

[Example 2]

```
100 ' CAMM-1 RS-232C DEVICE CONTROL COMMAND  
110 ' SAMPLE PROGRAM FOR ENQ/ACK HANDSHAKE  
120 '  
130 OPEN "COM1:9600,N,8,1" FOR OUTPUT AS #1 : OPEN  
      "DATA1" FOR INPUT AS #2  
140 ON COM(1) GOSUB 1000  
150 COM(1) ON  
160 '<<< SET HANDSHAKE MODE ENQ/ASK    >>>  
170 PRINT#1,CHR$(27);".K";  
180 PRINT#1,CHR$(27);".R";  
190 PRINT#1,CHR$(27);".@;0:";  
200 PRINT#1,CHR$(27);".M100;00;00;13;00;00:";  
210 '   ENQ character = CHR$(5)  
220 '   ACK character = CHR$(6)  
230 PRINT#1,CHR$(27);".H256;5;6:";  
240 '<<< MAIN PROGRAM    >>>
```

```

250 PRINT "***ENQ !!":PRINT #1,CHR$(5);
.
.
.
.
END

1000 ' <<< BLOCK TRANSFER >>>
1010 IF LOC(1)=0 THEN RETURN
1020 PRINT "ACK!!":INPUT #1,ACK$
1030 IF ACK$<> CHR$(6) THEN GOTO 2000
1040 FOR I=1 TO 256
1050     IF EOF(2) THEN GOTO 1110
1060     A$=INPUT$(1,#2)
1070     PRINT #1,A$;
1080     PRINT A$;
1090 NEXT I
1100 PRINT "***ENQ !!":PRINT #1,CHR$(5);:RETURN
1110 PRINT "DATA END !!":END
2000 PRINT "ILLEGAL CHARACTER":ASC(ACK$):END

```

Task other  
than DATA1

#### [Explanation]

- Line 130 Opens two files. For file open, change them in accordance with the computers.
- Line 140 Sets interruption handling.
- Line 170 Clears data from the CAMM-1 buffer.
- Line 180 Initializes all settings pertaining to the handshake.
- Line 190 Sets the hardware handshake to OFF.
- Line 200 Sets the output terminator to CR(CHR\$(13)), taking the delay time CAMM-1 spends to start outputting as about 100msec.
- Line 230 Sets the data block to 256 bytes, taking an ENQ code as ENQ(CHR\$(5)) and an ACK code as ACK(CHR\$(6)).
- Line 1000 Slips out from the main program when an ACK-signal interruption is entered from CAMM-1, sets the data of DATA1 to a 256-byte data block and outputs it to CAMM-1.
- Line 1120

On line 230, the computer sends [ENQ](CHR\$(5)) as the ENQ character to CAMM-1, and CAMM-1 sends [ACK](CHR\$(6)) as the ACK character back to the computer if there is a remianing buffer capacity over 256 bytes.

In this sample program, the computer checks the status of CAMM-1 en route to the main program and outputs 1 block (256-byte data for CAMM-1) using an interrupt operation if the CAMM-1 buffer has an extra space. The computer handles "Task other than DATA1" if there is no extra space or no output data in the CAMM-1 buffer.

#### 4.3.5 About Specifications of Handshake Output

The output specifications of the Xon/Xoff and ENQ/ACK handshakes vary depending on the estableishement of device control commands as described in Table 4-2.

○ sign denotes that these handshakes are in effect when device control commands have been establised. × sign denotes that these handshakes are ignored even when device control commands have been established. There is a possibility that the output by the CAMM-GL III command has an influence on the handshakes.

Handshake	ENQ/ACK		Xon / Xoff	Output by CAMM-GL III	Set command (parameter)
	mode1	mode2			
Delay time	○	○	×	○	[ESC] .M(P1)
Output trigger character	○	×	×	○	[ESC] .M(P2)
Echo terminator	○	×	×	○	[ESC] .M(P3)
Output terminator	○	×	×	○	[ESC] .M(P4,P5)
Output initiator	×	×	×	○	[ESC] .M(P6)
Intercharacter delay	○	○	○	○	[ESC] .N(P1)
Immediate response character	○	○	×	×	[ESC] .N(P2~P11)

Table 4-2

Delay time	: The time CAMM-1 delays for a while (msec) until it starts outputting when the computer requests for CAMM-1 to output data. This prevents data transmission from CAMM-1 before the computer gets ready to receive data.
Output trigger character	: The last character that is sent at the end of an output request which the computer sends to CAMM-1. If this character is established, CAMM-1 waits to output until that character is sent. For this, <b>[DC1](CHR\$(17))</b> is often used. The initial value is 0 (which sets nothing).
Echo terminator	: Used when the computer echoes back the data sent from CAMM-1 again to CAMM-1. If the echo terminator is established so that CAMM-1 will not produce an error after data receipt, CAMM-1 continues to ignore input until this character comes in. For this, <b>[LF](CHR\$(10))</b> is often used. The initial value is 0 (which sets nothing).
Output terminator	: The last character that is sent at the end of all data CAMM-1 sends to the computer. Depending on the computers, some computers are required to send this character as a signal to tell the beginning of data transmission before CAMM-1 sends data. For this, <b>[STX](CHR\$(2))</b> is often used. The initial value is 0 (which sets nothing).
Intercharacter delay	: The delay time (msec) between the characters of a character string CAMM-1 outputs to the computer. Depending on the computers, some computers cannot transmit data successfully if there is not a delay time between the characters CAMM-1 outputs. In such a case, this delay time is established. The initial value is 0 msec.
Immediate response character	: The character that is set before the ACK character when the ENQ/ACK handshake has been established. Depending on the computers, some computers send a data request to CAMM-1 immediately after sending the ENQ character. In such a case, if this character is set, the computer can send this character back immediately after receiving the ENQ character. For this, <b>[DC3](CHR\$(19))</b> is often used. The initial value is 0 (which sets nothing).

The device control commands are to determine the communication sequence between CAMM-1 and the computer with an RS-232C interface and to tell the computer the status of CAMM-1. In addition, some of them are to establish the output specifications of the CAMM-GL III command.

A device control command is organized with three characters: **[ESC]** (CHR\$(27)) and “.” and an uppercase letter. There are also two types of device control commands: one with parameter and the other without parameter.

Parameters are optional. Semicolons “;” are used as separators between parameters. Any semicolons “;” without parameters mean that parameters have been omitted. For a device control command with parameters, the terminator is required to be placed to show the end of instructions. A colon “:” is used as the terminator and this must not be omitted.

No terminator is necessary for device control commands without parameters.

### 4.4.1 Handshake Mode Commands

These are the same as device control commands for use in handshakes.

#### **ESC. B Command**

**Outputs the remaining buffer capacity**

##### • FORMAT

**[ESC] .B**

##### • EXPLANATION

Outputs the currently unused space of the buffer capacity (remaining buffer capacity) to the computer. With this command, the computer can know the remaining buffer capacity. Therefore, it can also output data below that capacity to CAMM-1. In other words, use of this command prevents data from overshooting or the possible overflow of the buffer. For more detail, refer to the examples under 4.3.2 Software checking handshake.

**ESC. M Command****Sets the specifications of handshake output (1)****● FORMAT****[ESC] .M P1;P2;P3;P4;P5;P6:****● EXPLANATION**

Sets the specifications of handshake output.

<P1> : Determines the delay time CAMM-1 spends to start outputting when the computer sends a data request to CAMM-1. The range of parameters is from 0 through 32767, and the unit is msec.  
 (Default value: 0)

[EXAMPLE] PRINT #1,CHR\$(27);".M100:";

This program sets the delay time to about 100 msec.

<P2> : Sets the output trigger character. For this character, refer to 4.3.5 About specifications of handshake output. The output trigger character is also applicable to the output by the output commands of the CAMM-GL III command.  
 (Default value: 0 (which sets nothing))

[EXAMPLE] PRINT #1,CHR\$(27);".M;13:";

<P1> will be defaulted to 0. The output trigger character will be the carriage return [CR] (CHR\$(13)). For example, if sending [ESC] .B and then the carriage return [CR] to CAMM-1, CAMM-1 will output the remaining buffer capacity to the computer.

<P3> : Sets the echo terminator. For the echo terminator, refer to 4.3.5 About specifications of handshake output. The echo terminator is also applicable to the output by the output commands of the CAMM-GL III command.  
 (Default value: 0 (which sets nothing))

[EXAMPLE] PRINT #1,CHR\$(27);".M;;10:";

<P1> and <P2> will be defaulted, the echo terminator will be the line feed [LF] (CHR\$(10)), and the computer should output the line feed [LF] at the end of the echo back to CAMM-1.

<P4, P5> : Set the output terminator. The output terminator is the last character that is sent at the end of data CAMM-1 outputs and is organized with one uppercase or two uppercases. This is also applicable to the output by the output commands of the CAMM-GL III command.  
 (Default value: <P4> :13(**CR**)  
 <P5> :0 (which sets nothing)

[EXAMPLE]

```
(1) PRINT #1,CHR$(27);".M;;;;13:";  

(2) PRINT #1,CHR$(27);".M;;;;13;10;10:";
```

In (1), the carriage return **CR**(CHR\$(13)) will be output as the terminator; in (2), both carriage return **CR** and line feed **LF**(CHR\$(10)) will be output. However, in the case of two characters like (2), <P6> should always be set to 0.

<P6> : Sets the output initiator. For the output initiator, refer to 4.3.5 About specifications of handshake output. Always set <P5> to 0 if setting the output initiator. This is also applicable to the output by the output commands of the CAMM-GL III command.

(Default value: 0 (which sets nothing))

[EXAMPLE] PRINT #1,CHR\$(27);".M;;;;13;0;33:";

An exclamation “!” (CHR\$(33)) placed before data the CAMM-1 send will be output to the computer.

## ESC. N Command

Sets the specifications of handshake output (2)

● **FORMAT**

**[ESC].N P1;P2;P3; ... ;P11:**

● **EXPLANATION**

Sets the intercharacter delay and also sets the Xoff character for the Xon/Xoff handshake.

<P1> : Sets the intercharacter delay. The range of parameters is from 0 through 32767, and the unit is msec. For the intercharacter delay, refer to 4.3.5 About specifications of handshake output. This setting is applicable to all handshake modes and also to the output by the output commands of the CAMM-GL III command.  
 (Default value: 0)

[EXAMPLE] **[ESC].N10:**

CAMM-1 will output 1 0 2 4 CHR\$(13) in order when sending the **[ESC].L** command to CAMM-1. At this time, each character and terminator will be sent at 10 msec intervals to the computer.

<P2~P11> : Sets the Xoff character when the Xon/Xoff handshake has been established (refer to the paragraphs under ESC.I Command).  
 Sets the immediate response character when the ENQ/ACK handshake has been established. For the immediate response character, refer to 4.3.5 About specifications of handshake output.  
 The maximum number of characters that can be set as a character string is 10.  
 (Default value: 0 for all (which sets nothing))

<b>ESC. H Command</b>	<b>Sets in ENQ/ACK handshake MODE1</b>
-----------------------	--

● **FORMAT**

**[ESC].H P1;P2;P3; ... ;P12:**

● **EXPLANATION**

Establishes settings in the ENQ/ACK handshake MODE1. CAMM-1 outputs the ACK character established by <P3> only when there is a remaining buffer capacity over the value set by <P2> if the computer sends the ENQ character established by <P2> to CAMM-1. The computer can sum up the number of the bytes set by <P1> and send it to CAMM-1 after the ACK character is returned.

This handshake cannot be performed if parameters are all omitted, that is, sending **[ESC].H**. However, CAMM-1 always outputs the ACK character regardless of the remaining buffer capacity if the computer sends the ENQ character to CAMM-1. This is called a dummy handshake.

**<P1>** : Sets the number of the data block bytes sent from the computer to CAMM-1. CAMM-1 will output the ACK character if the reamining buffer capacity is over the value set by **<P1>** after receiving the ENQ character. The range of **<P1>** is from 0 through 15358.  
(Default value: 80)

**<P2>** : Sets the ENQ character. **[ENQ](CHR\$(5))** is usually used. If 0 is specified, the ENQ/ACK handshake will not be established.  
(Default value: 0)

**<P3~P12>** : Sets the ACK character only when **<P2>** has been set. The maximum number of characters that can be set as a character string is 10. **[ACK](CHR\$(6))** is usually used. If 0 is specified, the ACK character will not be output, but only the output terminator set by **[ESC].M** will be output.  
(Default value: 0)

[EXAMPLE] **PRINT #1,CHR\$(27);".H 128;5;6:";**

The maximum number of data block byte is 128. The ENQ character will be **[ENQ](CHR\$(5))**, and the ACK character will be **[ACK](CHR\$(6))**.

<b>ESC. I Command</b>	Sets Xon/Xoff handshake, ENQ/ACK handshake MODE2
-----------------------	---

- **FORMAT**

**[ESC].I P1;P2;P3; ..... ;P12;**

- **EXPLANATION**

Used when using the Xon/Xoff handshake, the ENQ/ACK handshake MODE2. These handshakes cannot be performed if all parameters are omitted, that is, sending **[ESC].I**. CAMM-1 always outputs the ACK character when the computer sends the ENQ character to CAMM-1. This is also called a dummy handshake.

<P1> : Sets the limit of the remaining buffer capacity in Xon/Xoff handshake mode. CAMM-1 will output the Xoff character if the remaining buffer capacity is less than the value set by <P1>.

Sets the size of a data block in ENQ/ACK handshake mode (MODE 2). The range of parameters is from 10 through 15358.  
(Default value: 80)

[EXAMPLE] PRINT #1,CHR\$(27);".I100;;17:" ; CHR\$(27);".N;19:";

If the remaining buffer capacity reaches 100 bytes, the Xoff character (**DC1**) will be output.

<P2> : Sets the ENQ character in ENQ/ACK handshake mode (MODE 2). Sends nothing if 0 is set. Whenever the ENQ/ACK handshake is used, 0 should always be set.  
(Default value: 0 (which sets nothing))

[EXAMPLE] PRINT #1,CHR\$(27);".I;0;17:"  
PRINT #1,CHR\$(27);".N;19:";

<P3~P12> : Sets the Xon character in Xon/Xoff handshake mode.  
Sets the ACK character in ENQ/ACK handshake mode (MODE 2.)  
The maximum number of characters that can be set as a character string is 10. Use semicolons ";" to separate the respective character codes. The terminator set by the ESC. M command will not be output.  
If 0 is specified, nothing will be sent.  
(Default value: 0 for all (which sets nothing))

[EXAMPLE] PRINT #1,CHR\$(27);".I;5;6:";

Performs the ENQ/ACK handshake. The ENQ character will be set to **ENQ**(CHR\$(5)), the ACK character to **ACK**(CHR\$(6)) and the data block size to 80 bytes.

[EXAMPLE] PRINT #1,CHR\$(27);".@;0:";

Performs the Xon/Xoff handshake. The Xon character will be set to **DC1**(CHR\$(17)), the Xoff character to **DC3**(CHR\$(19)) and the remaining buffer capacity to 80 bytes.

**ESC. @ Command****Controls DTR****• FORMAT****[ESC] .@ P1;P2:****• EXPLANATION**

&lt;P1&gt; : Ignored.

&lt;P2&gt; : Controls the DTR signal (No.20 pin of RS-232C). For more detail about the DTR signal, refer to 4.3.1 Hardware handshake.

An even parameter (e.g. 0) always sets the DTR signal to High without performing the hardware handshake. An odd parameter (e.g. 1) performs the hardware handshake and controls the DTR signal according to the remaining buffer capacity. The parameter range is from 0 through 255.  
(Default value: 1)

**[EXAMPLE]** PRINT #1,CHR\$(27);".@;0:";

Always sets the DTR signal to ON without performing the hardware handshake.

**4.4.2 Status Commands****ESC. O Command****Outputs the status of buffer, pause****• FORMAT****[ESC] .O**

- **EXPLANATION**

Outputs the status codes of CAMM-1 shown in Table 4-3 to the computer.

Code	Meaning
0	Data being remained in buffer.
8	Buffer being empty.
16	Data being remained in buffer. CAMM-1 being paused (Pause On being displayed).
24	Buffer being empty. CAMM-1 being paused (Pause On being displayed).

Table 4-3

## ESC. E Command

Outputs the error codes of RS-232C

- **FORMAT**

[ESC].E

- **EXPLANATION**

CAMM-1 outputs the error codes pertaining to RS-232C to the computer when receiving this command. The codes are as described in Table 4-4. At the same time, CAMM-1 releases the error display.

Error message	Cause	Action from CAMM-1
* ESC.E Error 10 * Please See Manual	After execution of an output command, other output commands are sent before the output was not completed.  Example : PRINT #1,CHR\$(27);".L" ;CHR\$(27);".B"	Let the computer to read the plotter output by the output command and then send another output command.

Error message	Cause	Action from CAMM-1
* ESC.E Error 11 * Please See Manual	An error occurs in a device control command.  Example : PRINT #1,CHR\$(27);".C"	Correct your program referring to 4.4 Device Control Commands in CHAPTER 4, Part 2.
* ESC.E Error 13 * Please See Manual	Parameters are overflowed.  Example : PRINT #1,CHR\$(27); ".M35000;"	Correct your program referring to 4.4 Device Control Commands in CHAPTER 4, Part 2. The parameter range varies depending on the commands.
* ESC.E Error 14 * Please See Manual	The number of parameters is too large, and colon ":" is not used as the terminator.  Example : PRINT #1,CHR\$(27); ".@,0,1,0;"  Example : PRINT #1,CHR\$(27); ".I1024PD;"	Correct your program referring to 4.4 Device Control Commands in CHAPTER 4, Part 2.
* ESC.E Error 15 * Please See Manual	Framing, parity and overrun errors occur at the time of data receipt.	Match the communication protocols of both computer and plotter (baud rate, data bit length, stop bit length).
* ESC.E Error 16 * Please See Manual	I/O buffer is overflowed.	This error does not occur when hardware handshake is performed, but may occur when software handshake is performed. If this error occurs, check the remaining buffer capacity of the plotter and send data less than the remaining buffer capacity.

Table 4-4

**ESC. L Command****Outputs the size of I/O buffer****• FORMAT****[ESC].L****• EXPLANATION**

CAMM-1 outputs the size of the I/O buffer to the computer when receiving this command. It usually outputs 1024 (bytes).

**4.4.3 Abort Commands****ESC. J Command****Aborts device control command****• FORMAT****[ESC].J****• EXPLANATION**

Aborts the device control command being executed.

**ESC. K Command****Aborts the CAMM-GL III command****• FORMAT****[ESC].K****• EXPLANATION**

Continues to execute the CAMM-GL III command being in operation, aborts other incoming CAMM-GL III commands and clears the data buffer.

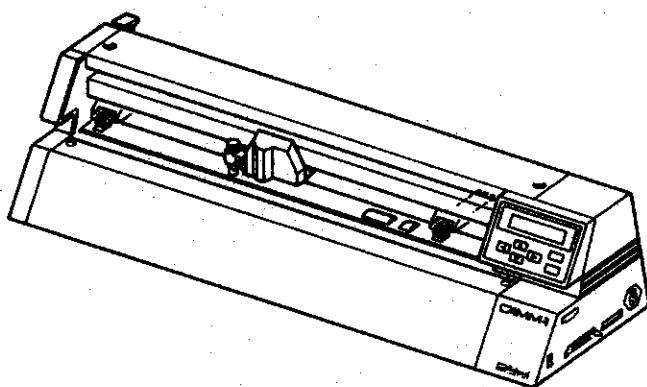
**ESC. R Command****Initializes device control commands****• FORMAT**

Initializes all of the settings established by the device control commands. Execution of [ESC].R brings the same states as the following device control commands are executed.

[ESC].J

[ESC].K

# APPENDIX

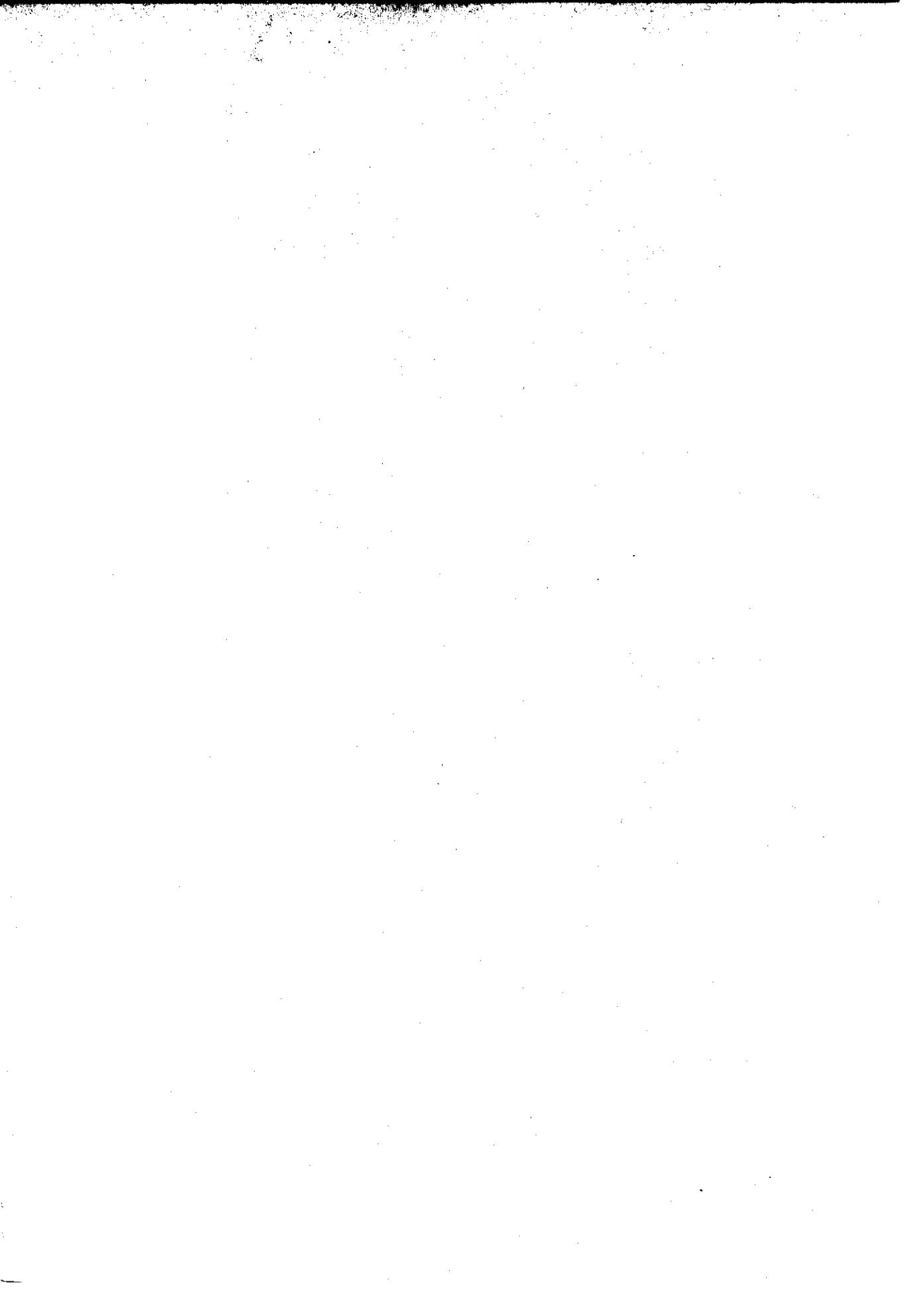


**DESKTOP SIGN MAKER**  
**CAMM-1**

MODEL PNC-1000

---

**OPERATION MANUAL**



## **APPENDIX**

APPENDIX



## LIST OF OPTIONS

### Connecting Cables

#### Parallel connection (Centronics)

Option	Model No.	Compatible models
Connecting cables: For parallel interface (Centronics)	XY-IPC	IBM PC (5150), PC/XT (5160), PC/AT (5170)
Parallel interface card:	XY-APL	APPLE II, IIe (cable included)

- APPLE II, IIe are trademarks of Apple computer inc.
- IBM PC, PC/XT, PC/AT are trademarks of International Business Machine Corporation

#### Serial connection (RS-232C)

Option	Model No.	Compatible models
Connecting cables: For serial interface (RS-232C)	XY-RS-11 (1.5 m) XY-RS-31 (3 m) XY-RS-51 (5 m)	APPLE II, IIe
	XY-RS-13 (1.5 m) XY-RS-33 (3 m)	IBM PC (5150), PC/XT (5160)
	XY-RS-14 (1.5 m) XY-RS-34 (3 m)	IBM PC/AT (5170)

- APPLE II, IIe are trademarks of Apple computer inc.
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## LIST OF DISPLAY CHARACTERS

	High-order digit Low-order digit	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F				
0				0	1	2	3	4	5	6	7	8	9	A	B	C	D				
1			1	2	3	4	5	6	7	8	9	A	B	C	D	E					
2				2	3	4	5	6	7	8	9	A	B	C	D	F					
3					3	0	S	C	S			A	T	E							
4						4	D	T	d	t			A	T							
5							5	E	U	e	u			A	T						
6								6	F	U	f	u			A	T					
7									7	G	b	g	w			A	T				
8										8	H	X	b	x			A	T			
9											9	I	V	i	v			A	T		
A												*	J	Z	j	z			A	T	
B												+	K	O	k	o			A	T	
C												×	L	N	l	n			A	T	
D												-	M	I	m	i			A	T	
E												,	N	O	n	o			A	T	
F												/	2	0	0	0			A	T	

00~1F, 7F, 80~9F and E0~FF are ignored even if they are sent.

## LIST OF CONTROL CHARACTERS

For more information about the range of character codes from 33 to 126 (decimal), see E.II "LIST OF CHARACTERS SETS"

Decimal Value	Hex	ASCII Character	All Sets
0	00	NULL	Unused
1	01	SOH	Unused
2	02	STX	Unused
3	03	ETX	Label terminator
4	04	ETO	Unused
5	05	ENQ	RS-232C
6	06	ACK	RS-232C
7	07	BEL	Unused
8	08	BS	Backspace
9	09	HT	Half Back Left
10	0A	LF	Line Feed
11	0B	VT	Inverse Line Feed
12	0C	FF	Unused
13	0D	CR	Carriage Return
14	0E	SO	Select Alternate Character Set
15	0F	SI	Select Standard Character Set
16	10	DLE	Unused
17	11	DC1	Unused
18	12	DC2	Unused
19	13	DC3	Unused
20	14	DC4	Unused
21	15	NAK	Unused
22	16	SYN	Unused
23	17	ETB	Unused
24	18	CAN	Unused
25	19	EM	Unused
26	1A	SUB	Unused
27	1B	ESC	Unused
28	1C	FS	Unused
29	1D	GS	Unused
30	1E	RS	Unused
31	1F	US	Unused
32	20	SP	Space
127	7F	DEL	Unused
142	8E	SS2	Unused
143	8F	SS3	Unused

## LIST OF CHARACTER SETS

## I Line Character Sets

Hexa-decimal	Decimal	Character Set No.																			
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
21	33	!	!	!	!	!	!	!	!	À	.	!	!	!	!	!	!	!	!	À	.
22	34	"	"	"	"	"	"	"	"	Â	„	"	"	"	"	"	"	"	Â	„	"
23	35	#	#	£	£	£	#	#	È	,	#	#	#	£	£	£	#	#	È	,	#
24	36	\$	\$	\$	\$	\$	\$	\$	Ê	,	\$	\$	\$	\$	\$	\$	\$	\$	Ê	,	¤
25	37	%	%	%	%	%	%	%	Ë	°	%	%	%	%	%	%	%	%	Ë	°	%
26	38	&	&	&	&	&	&	&	Î	؂	&	&	&	&	&	&	&	&	î	؂	&
27	39	'	'	[ ]	'	[ ]	'	'	Ï	؂	'	'	[ ]	'	[ ]	'	'	Ï	؂	'	'
28	40	(	(	(	(	(	(	(	‘	ي	(	(	(	(	(	(	(	(	‘	ي	(
29	41	)	)	)	)	)	)	)	‘	و	)	)	)	)	)	)	)	)	‘	و	)
2A	42	*	*	*	*	*	*	*	^	ء	*	*	*	*	*	*	*	*	^	ء	*
2B	43	+	+	+	+	+	+	+	”	؂	+	+	+	+	+	+	+	”	؂	+	+
2C	44	.	.	.	.	.	.	.	~	؂	,	,	,	,	,	,	,	,	~	؂	,
2D	45	-	-	-	-	-	-	-	Ù	؂	-	-	-	-	-	-	-	-	Ù	؂	-
2E	46	.	.	.	.	.	.	.	Û	؂	.	.	.	.	.	.	.	.	Û	؂	.
2F	47	/	/	/	/	/	/	/	£	؂	/	/	/	/	/	/	/	/	£	؂	/
30	48	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	-	0	-
31	49	1	1	1	1	1	1	1	؂	1	1	1	1	1	1	1	1	1	؂	1	1
32	50	2	2	2	2	2	2	2	؂	2	2	2	2	2	2	2	2	2	؂	2	2
33	51	3	3	3	3	3	3	3	‘	و	3	3	3	3	3	3	3	3	‘	و	3
34	52	4	4	4	4	4	4	4	₵	؂	4	4	4	4	4	4	4	4	₵	؂	4
35	53	5	5	5	5	5	5	5	₵	؂	5	5	5	5	5	5	5	5	₵	؂	5
36	54	6	6	6	6	6	6	6	Ñ	؂	6	6	6	6	6	6	6	6	Ñ	؂	6
37	55	7	7	7	7	7	7	7	ñ	؂	7	7	7	7	7	7	7	7	ñ	؂	7
38	56	8	8	8	8	8	8	8	‘	و	8	8	8	8	8	8	8	8	‘	و	8
39	57	9	9	9	9	9	9	9	‘	ك	9	9	9	9	9	9	9	9	‘	ك	9
3A	58	:	:	:	:	:	:	:	؂	؂	:	:	:	:	:	:	:	؂	؂	:	
3B	59	:	:	:	:	:	:	:	£	؂	:	:	:	:	:	:	:	£	؂	:	
3C	60	<	<	<	<	<	<	<	¥	؂	<	<	<	<	<	<	<	¥	؂	<	
3D	61	=	=	=	=	=	=	=	§	؂	=	=	=	=	=	=	=	§	؂	=	
3E	62	>	>	>	>	>	>	>	f	؂	>	>	>	>	>	>	>	f	؂	>	
3F	63	?	?	?	?	?	?	?	₵	؂	?	?	?	?	?	?	?	₵	؂	?	
40	64	@	@	@	@	@	@	@	â	؂	@	@	@	@	@	@	@	â	؂	@	

[ ] Automatic backspace

Hexa-decimal	Decimal	Character Set No.																		
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
41	65	A	A	A	A	A	¤	A	ê	ƒ	A	A	A	A	A	¤	A	ê	ƒ	A
42	66	B	B	B	B	B	ø	B	ô	ƒ	B	B	B	B	B	ø	B	ô	ƒ	B
43	67	C	C	C	C	C	¤	C	û	ƒ	C	C	C	C	C	¤	C	û	ƒ	C
44	68	D	D	D	D	D	+	D	á	ト	D	D	D	D	D	+	D	á	ト	D
45	69	E	E	E	E	E	x	E	é	ナ	E	E	E	E	E	x	E	é	†	E
46	70	F	F	F	F	F	◊	F	ó	ニ	F	F	F	F	F	◊	F	ó	ニ	F
47	71	G	G	G	G	G	+	G	ú	叉	G	G	G	G	G	+	G	ú	叉	G
48	72	H	H	H	H	H	×	H	à	ネ	H	H	H	H	H	×	H	à	ネ	H
49	73	I	I	I	I	I	z	I	è	ノ	I	I	I	I	I	z	I	è	/	I
4A	74	J	J	J	J	J	Y	J	ò	八	J	J	J	J	J	Y	J	ò	八	J
4B	75	K	K	K	K	K	×	K	ù	ヒ	K	K	K	K	K	×	K	ù	ヒ	K
4C	76	L	L	L	L	L	*	L	ä	フ	L	L	L	L	L	*	L	ä	フ	L
4D	77	M	M	M	M	M	×	M	ë	ヘ	M	M	M	M	M	×	M	ë	ヘ	M
4E	78	N	N	N	N	N	,	N	ö	木	N	N	N	N	N	,	N	ö	木	N
4F	79	O	O	O	O	O	*	O	ü	ರ	O	O	O	O	O	*	O	ü	ր	O
50	80	P	P	P	P	P	-	P	å	ミ	P	P	P	P	P	-	P	å	ミ	P
51	81	Q	Q	Q	Q	Q	,	Q	î	ム	Q	Q	Q	Q	Q	,	Q	î	ム	Q
52	82	R	R	R	R	R	R	R	ø	メ	R	R	R	R	R	R	R	ø	メ	R
53	83	S	S	S	S	S	S	æ	€	ſ	S	S	S	S	S	æ	€	ſ	S	
54	84	T	T	T	T	T	å	ঢ	T	T	T	T	T	T	ত	ঢ	T	ত	ঢ	
55	85	U	U	U	U	U	U	í	ঢ	ু	U	U	U	U	U	U	í	ু	U	
56	86	V	V	V	V	V	V	ø	ঢ	ৃ	V	V	V	V	V	ঢ	ৃ	০	V	
57	87	W	W	W	W	W	W	w	æ	ର	W	W	W	W	W	w	æ	ର	W	
58	88	X	X	X	X	X	X	Ä	ର	ି	X	X	X	X	X	ି	ର	ି	X	
59	89	Y	Y	Y	Y	Y	Y	Y	ି	ଲ	Y	Y	Y	Y	Y	Y	ି	ଲ	Y	
5A	90	Z	Z	Z	Z	Z	Z	Ö	ର	ି	Z	Z	Z	Z	Z	ି	ର	ି	Z	
5B	91	[	[	[	Ø	[	[	Ü	ର	[	[	[	[	[	Ø	[	[	Ü	ର	[
5C	92	\	√	ç	ି	i	\	É	ର	\	√	ç	ି	i	\	É	ର	\	\	
5D	93	]	]	]	Ø	]	]	ି	ନ	]	]	]	]	]	Ø	]	]	ି	ନ	]
5E	94	^	↑	æ	ି	^	ß	·	^	↑	æ	ି	^	ß	·	^	æ	ି	^	ß
5F	95	-	-	-	-	-	-	Ô	·	-	-	-	-	-	Ô	·	-	-	Ô	·
60	96	,	,	,	,	,	,	Á	,	,	,	,	,	,	Á	,	,	,	,	

Hexa-decimal	Decimal	Character Set No.																		
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
61	97	a	a	a	a	a	ñ	a	Ã	a	a	a	a	a	a	ñ	a	Ã	a	a
62	98	b	b	b	b	b	ð	b	ã	b	b	b	b	b	b	ð	b	ã	b	b
63	99	c	c	c	c	c	c	c	ð	c	c	c	c	c	c	c	c	ð	c	c
64	100	d	d	d	d	d	ú	d	d	d	d	d	d	d	d	ú	d	d	d	d
65	101	e	e	e	e	e	—	e	í	e	e	e	e	e	e	—	e	í	e	í
66	102	f	f	f	f	f	=	f	í	f	f	f	f	f	f	=	f	í	f	f
67	103	g	g	g	g	g	≈	g	ó	g	g	g	g	g	g	≈	g	ó	g	g
68	104	h	h	h	h	h	≈	h	ò	h	h	h	h	h	h	≈	h	ò	h	h
69	105	i	i	i	i	i	~	i	õ	i	i	i	i	i	i	~	i	õ	i	i
6A	106	j	j	j	j	j	≤	j	õ	j	j	j	j	j	j	≤	j	õ	j	j
6B	107	k	k	k	k	k	≥	k	š	k	k	k	k	k	k	≥	k	š	k	k
6C	108	l	l	l	l	l	≠	l	š	l	l	l	l	l	l	≠	l	š	l	l
6D	109	m	m	m	m	m	Δ	m	ú	m	m	m	m	m	m	Δ	m	ú	m	m
6E	110	n	n	n	n	n	π	n	ÿ	n	n	n	n	n	n	π	n	ÿ	n	n
6F	111	o	o	o	o	o	Σ	o	ÿ	o	o	o	o	o	o	Σ	o	ÿ	o	o
70	112	p	p	p	p	p	±	p	þ	p	p	p	p	p	p	±	p	þ	p	p
71	113	q	q	q	q	q	†	q	þ	q	q	q	q	q	q	†	q	þ	q	q
72	114	r	r	r	r	r	→	r	r	r	r	r	r	r	r	→	r	r	r	r
73	115	s	s	s	s	s	↑	s	s	s	s	s	s	s	s	↑	s	s	s	s
74	116	t	t	t	t	t	—	t	t	t	t	t	t	t	t	—	t	t	t	t
75	117	u	u	u	u	u	↓	u	u	u	u	u	u	u	u	↓	u	u	u	u
76	118	v	v	v	v	v	ʃ	v	—	v	v	v	v	v	v	ʃ	v	—	v	v
77	119	w	w	w	w	w	÷	w	¼	w	w	w	w	w	w	÷	w	¼	w	w
78	120	x	x	x	x	x	*	x	½	x	x	x	x	x	x	*	x	½	x	x
79	121	y	y	y	y	y	▽	y	á	y	y	y	y	y	y	▽	y	á	y	y
7A	122	z	z	z	z	z	·	z	ø	z	z	z	z	z	z	·	z	ø	z	z
7B	123	[	†	“	”	~	]	{	«	{	{	π	”	~	]	{	«	{	]	[
7C	124		†	“	”	~			□			†	“	”			□			
7D	125	]	†	“	”	~	]	]	»	]	]	→	“	”	]	]	»	]	]	
7E	126	~	~	~	~	~	~	~	±	~	~	~	~	~	~	~	~	±	~	

Hexa-decimal	Decimal	Character Set No.																		
		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
21	33	!	!	!	!	!	!	!	!	À	.	!	!	!	!	!	!	!	!	!
22	34	"	"	"	"	"	"	"	Â	‘	”	”	”	”	”	”	”	”	”	”
23	35	#	#	£	£	£	£	£	È	,	£	£	£	£	£	£	£	£	£	£
24	36	\$	\$	\$	\$	\$	\$	\$	Ê	,	¤	¤	¤	\$	\$	\$	\$	\$	\$	\$
25	37	%	%	%	%	%	%	%	Œ	•	%	%	%	%	%	%	%	%	%	%
26	38	&	&	&	&	&	&	&	†	?	&	&	&	&	&	&	&	&	&	&
27	39	‘	’	[ ]	[ ]	‘	’	‘	’	’	‘	’	’	‘	’	’	’	’	’	’
28	40	(	(	(	(	(	(	(	)	‘	(	(	(	(	(	(	(	(	(	(
29	41	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)
2A	42	*	*	*	*	*	*	*	^	I	*	*	*	*	*	*	*	*	*	*
2B	43	+	+	+	+	+	+	+	~	†	+	+	+	+	+	+	+	+	+	+
2C	44	,	,	,	,	,	,	,	‡	,	,	,	,	,	,	,	,	,	,	
2D	45	-	-	-	-	-	-	-	Ù	ú	-	-	-	-	-	-	-	-	-	-
2E	46	.	.	.	.	.	.	.	Û	ú	.	.	.	.	.	.	.	.	.	
2F	47	/	/	/	/	/	/	/	£	¥	/	/	/	/	/	/	/	/	/	/
30	48	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0
31	49	1	1	1	1	1	1	1	?	1	1	1	1	1	1	1	1	1	1	1
32	50	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2
33	51	3	3	3	3	3	3	3	‘	ú	3	3	3	3	3	3	3	3	3	3
34	52	4	4	4	4	4	4	4	ç	I	4	4	4	4	4	4	4	4	4	4
35	53	5	5	5	5	5	5	5	ç	ô	5	5	5	5	5	5	5	5	5	5
36	54	6	6	6	6	6	6	6	Ñ	カ	6	6	6	6	6	6	6	6	6	6
37	55	7	7	7	7	7	7	7	ñ	キ	7	7	7	7	7	7	7	7	7	7
38	56	8	8	8	8	8	8	8	;	ク	8	8	8	8	8	8	8	8	8	8
39	57	9	9	9	9	9	9	9	í	ヶ	9	9	9	9	9	9	9	9	9	9
3A	58	:	:	:	:	:	:	:	¤	¤	:	:	:	:	:	:	:	:	:	
3B	59	;	;	;	;	;	;	;	£	₪	;	;	;	;	;	;	;	;	;	
3C	60	<	<	<	<	<	<	<	¥	₩	<	<	<	<	<	<	<	<	<	
3D	61	=	=	=	=	=	=	=	§	λ	=	=	=	=	=	=	=	=	=	
3E	62	>	>	>	>	>	>	>	f	ተ	>	>	>	>	>	>	>	>	>	
3F	63	?	?	?	?	?	?	?	¢	¥	?	?	?	?	?	?	?	?	?	
40	64	ø	ø	ø	ø	ø	ø	ø	â	ä	ø	ø	É	ø	§	à	ø	§	§	

Hexa-decimal	Decimal	Character Set No.																			
		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
41	65	A	A	A	A	A	¤	A	ê	ƒ	A	A	A	A	A	A	A	A	A	A	
42	66	B	B	B	B	B	ø	B	ô	ÿ	B	B	B	B	B	B	B	B	B	B	
43	67	C	C	C	C	C	△	C	û	Ŗ	C	C	C	C	C	C	C	C	C	C	
44	68	D	D	D	D	D	+	D	á	ł	D	D	D	D	D	D	D	D	D	D	
45	69	E	E	E	E	E	x	E	é	†	E	E	E	E	E	E	E	E	E	E	
46	70	F	F	F	F	F	◊	F	ó	=	F	F	F	F	F	F	F	F	F	F	
47	71	G	G	G	G	G	↑	G	ú	✗	G	G	G	G	G	G	G	G	G	G	
48	72	H	H	H	H	H	x	H	à	‡	H	H	H	H	H	H	H	H	H	H	
49	73	I	I	I	I	I	z	I	è	/	I	I	I	I	I	I	I	I	I	I	
4A	74	J	J	J	J	J	y	J	ò	ñ	J	J	J	J	J	J	J	J	J	J	
4B	75	K	K	K	K	K	x	K	ù	č	K	K	K	K	K	K	K	K	K	K	
4C	76	L	L	L	L	L	*	L	ä	ž	L	L	L	L	L	L	L	L	L	L	
4D	77	M	M	M	M	M	z	M	ë	^	M	M	M	M	M	M	M	M	M	M	
4E	78	N	N	N	N	N	,	N	ö	ł	N	N	N	N	N	N	N	N	N	N	
4F	79	Ø	Ø	Ø	Ø	Ø	*	Ø	ü	ў	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	
50	80	P	P	P	P	P	-	P	Å	Ξ	P	P	P	P	P	P	P	P	P	P	
51	81	Q	Q	Q	Q	Q	,	Q	í	₄	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
52	82	R	R	R	R	R	R	R	ø	✗	R	R	R	R	R	R	R	R	R	R	
53	83	S	S	S	S	S	S	Æ	€	S	S	S	S	S	S	S	S	S	S	S	
54	84	T	T	T	T	T	T	à	†	T	T	T	T	T	T	T	T	T	T	T	
55	85	U	U	U	U	U	U	U	í	‡	U	U	U	U	U	U	U	U	U	U	
56	86	V	V	V	V	V	V	ø	ے	V	V	V	V	V	V	V	V	V	V	V	
57	87	W	W	W	W	W	W	W	æ	ž	W	W	W	W	W	W	W	W	W	W	
58	88	X	X	X	X	X	X	X	Ä	ў	X	X	X	X	X	X	X	X	X	X	
59	89	Y	Y	Y	Y	Y	Y	Y	í	₄	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
5A	90	Z	Z	Z	Z	Z	Z	Z	Ö	ў	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
5B	91	[	[	[	[	[	[	[	Ü	ø	[	Ä	Ä	Æ	Ä	·	[	·	i	Ã	[
5C	92	\	†	ç	£	i	\	¥	É	₩	\	Ö	Ö	Ø	Ö	ç	\	ç	Ñ	ç	\
5D	93	]	]	]	]	]	]	]	í	ょ	]	À	À	À	Ù	§	]	é	¿	õ	]
5E	94	^	↑	¤	æ	^	^	ø	‘	^	Ø	^	^	^	^	^	^	^	^	^	
5F	95	—	—	—	—	—	—	—	ö	·	—	—	—	—	—	—	—	—	—	—	
60	96	‘	‘	‘	‘	‘	‘	‘	Á	‘	‘	é	‘	‘	‘	‘	‘	‘	‘	‘	

Hexa-decimal	Decimal	Character Set No.																		
		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
61	97	á	á	á	á	á	á	ñ	á	Ã	á	á	á	á	á	á	á	á	á	á
62	98	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ	þ
63	99	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç
64	100	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð
65	101	é	é	é	é	é	é	é	é	í	é	é	é	é	é	é	é	é	é	é
66	102	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ
67	103	g	g	g	g	g	g	g	g	g	ó	g	g	g	g	g	g	g	g	g
68	104	h	h	h	h	h	h	h	h	h	ò	h	h	h	h	h	h	h	h	h
69	105	í	í	í	í	í	í	í	í	í	õ	í	í	í	í	í	í	í	í	í
6A	106	j	j	j	j	j	j	≤	j	ö	j	j	j	j	j	j	j	j	j	j
6B	107	k	k	k	k	k	k	≥	k	š	k	k	k	k	k	k	k	k	k	k
6C	108	l	l	l	l	l	l	#	l	š	l	l	l	l	l	l	l	l	l	l
6D	109	m	m	m	m	m	m	Δ	m	ú	m	m	m	m	m	m	m	m	m	m
6E	110	n	n	n	n	n	n	∏	n	ÿ	n	n	n	n	n	n	n	n	n	n
6F	111	o	o	o	o	o	o	Σ	o	ÿ	o	o	o	o	o	o	o	o	o	o
70	112	p	p	p	p	p	p	±	p	þ	p	p	p	p	p	p	p	p	p	p
71	113	q	q	q	q	q	q	ƒ	q	þ	q	q	q	q	q	q	q	q	q	q
72	114	r	r	r	r	r	r	→	r	r	r	r	r	r	r	r	r	r	r	r
73	115	s	s	s	s	s	s	↑	s	s	s	s	s	s	s	s	s	s	s	s
74	116	t	t	t	t	t	t	←	t	t	t	t	t	t	t	t	t	t	t	t
75	117	u	u	u	u	u	u	↓	u	u	u	u	u	u	u	u	u	u	u	u
76	118	v	v	v	v	v	v	ʃ	v	—	v	v	v	v	v	v	v	v	v	v
77	119	w	w	w	w	w	w	÷	w	¼	w	w	w	w	w	w	w	w	w	w
78	120	x	x	x	x	x	x	*	x	½	x	x	x	x	x	x	x	x	x	x
79	121	y	y	y	y	y	y	◊	y	ä	y	y	y	y	y	y	y	y	y	y
7A	122	z	z	z	z	z	z	·	z	ø	z	z	z	z	z	z	z	z	z	z
7B	123	{	†	‡	§	¤	¤	¤	¤	¤	{	{	«	[	ä	ä	æ	ä	é	{
7C	124		†	‡	§	¤	¤	¤	¤	¤		ö	ö	ø	ö	ù		ò	ñ	ç
7D	125	)	→	‡	§	¤	¤	¤	¤	¤	)	)	»	)	å	å	å	ü	è	ç
7E	126	~	‡	§	¤	¤	¤	¤	¤	¤	~	~	±	—	—	ö	—	ø	”	~

Hexa-decimal	Decimal	Character Set No.																			
		40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
21	33	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!
22	34	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
23	35	#	#	#	#	£	£	£	£	#	\$	#	#	#	£	£	£	£	#	\$	¢
24	36	¤	¤	\$	\$	\$	\$	\$	\$	¤	¤	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
25	37	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
26	38	&	&	&	&	&	&	&	&	&	&	&	&	&	&	&	&	&	&	&	&
27	39	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,
28	40	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(
29	41	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)
2A	42	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2B	43	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2C	44	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,
2D	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2E	46	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2F	47	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
30	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	49	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
32	50	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
33	51	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
34	52	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
35	53	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
36	54	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
37	55	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
38	56	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
39	57	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
3A	58	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
3B	59	;	;	;	;	;	;	;	;	;	;	;	;	;	;	;	;	;	;	;	
3C	60	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	
3D	61	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	
3E	62	>	>	>	>	>	>	>	>	>	>	>	>	>	>	>	>	>	>	>	
3F	63	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	
40	64	€	É	€	§	à	€	§	§	€	€	É	€	€	§	à	€	§	§	€	

Hexa-decimal	Decimal	Character Set No.																				
		40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	99
41	65	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
42	66	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
43	67	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
44	68	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
45	69	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
46	70	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	
47	71	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	
48	72	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
49	73	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	
4A	74	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	
4B	75	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	
4C	76	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	
4D	77	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
4E	78	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
4F	79	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
50	80	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	
51	81	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
52	82	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
53	83	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
54	84	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	
55	85	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	
56	86	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	
57	87	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	
58	88	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
59	89	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
5A	90	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	
5B	91	Ä	Ä	Æ	Ä	·	[	·	i	Ä	Æ	Ä	Æ	Ä	·	[	·	i	Ä	Æ	[	
5C	92	Ö	Ö	Ø	Ö	ç	\	ç	Ñ	ç	Ø	Ö	Ø	Ö	ç	\	ç	Ñ	ç	Ø	Ø	
5D	93	Å	Å	Å	Ü	§	]	é	ł	ö	Å	Å	Å	Å	Ü	§	]	é	ł	ö	Å	]
5E	94	^	ö	^	^	^	^	^	^	ü	^	^	^	^	ü	^	^	^	^	^	l	
5F	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
60	96	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	‘	

Hexa-decimal	Decimal	Character Set No.																			
		40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
61	97	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a
62	98	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b
63	99	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
64	100	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
65	101	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e
66	102	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f
67	103	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g
68	104	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h
69	105	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i
6A	106	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j
6B	107	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k
6C	108	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l
6D	109	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
6E	110	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
6F	111	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
70	112	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
71	113	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q
72	114	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
73	115	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s
74	116	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t
75	117	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u
76	118	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v
77	119	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
78	120	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
79	121	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
7A	122	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
7B	123	ä	ä	æ	ä	é	{	à	·	ä	æ	ä	æ	ä	é	{	à	·	ä	æ	µ
7C	124	ö	ö	ø	ö	ù		ò	ñ	ç	ø	ö	ø	ö	ù		ò	ñ	ç	ø	ø
7D	125	å	å	å	ü	è	)	è	ç	ð	å	å	å	å	ü	è	)	è	ç	ð	ø
7E	126	-	ü	-	ß	"	-	í	-	~	-	ü	-	ß	"	-	í	-	~	~	~

## II Outlined Character Sets

Hexa-decimal	Decimal	Outlined character set numbers									
		0	1	2	3	4	5	6	7	8	9
21	33	!	!	!	!	!	!	!	À	!	!
22	34	¤	¤	¤	¤	¤	¤	¤	Â	¤	¤
23	35	#	#	£	£	¢	#	#	È	#	#
24	36	\$	\$	\$	\$	\$	\$	\$	Ê	Ø	
25	37	%	%	%	%	%	%	%	‰	%	
26	38	&	&	&	&	&	&	&	Í	&	
27	39	,	,	,	,	,	,	,	Ó	,	,
28	40	(	(	(	(	(	(	(	)	(	
29	41	)	)	)	)	)	)	)	)	)	
2A	42	*	*	*	*	*	*	*	^	*	*
2B	43	+	+	+	+	+	+	+	‰	+	+
2C	44	,	,	,	,	,	,	,	,	,	,
2D	45	-	-	-	-	-	-	-	Ú	-	-
2E	46	□	□	□	□	□	□	□	Û	□	□
2F	47	/	/	/	/	/	/	/	£	/	/
30	48	Ø	Ø	Ø	Ø	Ø	Ø	Ø	—	Ø	Ø

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	Outlined character set numbers									
		0	1	2	3	4	5	6	7	8	9
31	49	1	1	1	1	1	1	1		1	
32	50	2	2	2	2	2		2		2	
33	51	3	3	3	3	3	3	3	°	3	
34	52	4	4	4	4	4	4	4	¢	4	
35	53	5	5	5	5	5	5	5	¤	5	
36	54	6	6	6	6	6	6	6	Ñ	6	
37	55	7	7	7	7	7	7	7	ñ	7	
38	56	8	8	8	8	8	8	8	í	8	
39	57	9	9	9	9	9	9	9	ö	9	
3A	58	□	□	□	□	□	□	□	ø	□	
3B	59	÷	÷	÷	÷	÷	÷	÷	£	÷	
3C	60	ʌ	ʌ	ʌ	ʌ	ʌ	ʌ	ʌ	¥	ʌ	
3D	61	॥	॥	॥	॥	॥	॥	॥	॥	॥	
3E	62	߱	߱	߱	߱	߱	߱	߱	߱	߱	
3F	63	߳	߳	߳	߳	߳	߳	߳	߳	߳	
40	64	@	@	@	@	@	@	@	ߺ	@	

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	Outlined character set numbers									
		0	1	2	3	4	5	6	7	8	9
41	65	A	A	A	A	A	A	â		A	
42	66	B	B	B	B	B	B	ô		B	
43	67	C	C	C	C	C	C	ú		C	
44	68	D	D	D	D	D	D	á		D	
45	69	E	E	E	E	E	E	é		E	
46	70	F	F	F	F	F	F	ó		F	
47	71	G	G	G	G	G	G	ú		G	
48	72	H	H	H	H	H	H	à		H	
49	73	I	I	I	I	I	I	é		I	
4A	74	J	J	J	J	J	J	ó		J	
4B	75	K	K	K	K	K	K	ú		K	
4C	76	L	L	L	L	L	L	â		L	
4D	77	M	M	M	M	M	M	ê		M	
4E	78	N	N	N	N	N	N	ö		N	
4F	79	Ø	Ø	Ø	Ø	Ø	Ø	ú		Ø	
50	80	P	P	P	P	P	P	Å		P	

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	0	1	2	3	4	5	6	7	8	9
51	81	Q	Q	Q	Q	Q		Q	Î	Q	
52	82	R	R	R	R	R		R	Ø	R	
53	83	S	S	S	S	S		S	A	S	
54	84	T	T	T	T	T		T	å	T	
55	85	U	U	U	U	U		U	í	U	
56	86	V	V	V	V	V		V	ø	V	
57	87	W	W	W	W	W		W	æ	W	
58	88	X	X	X	X	X		X	Ä	X	
59	89	Y	Y	Y	Y	Y		Y	ì	Y	
5A	90	Z	Z	Z	Z	Z		Z	Ö	Z	
5B	91	(	(	(	Ø	(		(	Ü	(	
5C	92	\	√	ç	Æ	i		Y	É	\	
5D	93	)	)	)	ø	)		)	ï	)	
5E	94	^	↑		œ			^	ß	^	
5F	95								ô		
60	96	-						-	á	-	

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	Outlined character set numbers									
		0	1	2	3	4	5	6	7	8	9
61	97	ä	ö	ä	ä	ä		ä	Ä		ä
62	98	b	b	b	b	b		b	ő		b
63	99	c	c	c	c	c		c	đ		c
64	100	d	d	d	d	d		d	ć		d
65	101	e	e	e	e	e		e	í		e
66	102	f	f	f	f	f		f	ì		f
67	103	g	g	g	g	g		g	ó		g
68	104	h	h	h	h	h		h	ò		h
69	105	i	i	i	i	i		i	ô		i
6A	106	j	j	j	j	j		j	õ		j
6B	107	k	k	k	k	k		k	š		k
6C	108	l	l	l	l	l		l	š		l
6D	109	m	m	m	m	m		m	ú		m
6E	110	n	n	n	n	n		n	ÿ		n
6F	111	o	ö	ö	ö	ö		o	ÿ		o
70	112	p	p	p	p	p		p	þ		p

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	Outlined character set numbers									
		0	1	2	3	4	5	6	7	8	9
71	113	q	q	q	q	q	q	b	q		
72	114	r	r	r	r	r	r			r	
73	115	s	s	s	s	s	s			s	
74	116	t	t	t	t	t	t			t	
75	117	u	u	u	u	u	u			u	
76	118	v	v	v	v	v	v	-		v	
77	119	w	w	w	w	w	w	½		w	
78	120	x	x	x	x	x	x	½		x	
79	121	y	y	y	y	y	y	®		y	
7A	122	z	z	z	z	z	z	®		z	
7B	123	(	π				(	«		(	
7C	124		†					□			
7D	125	)	→				)	»		)	
7E	126	—		°			—	±		—	

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	Outlined character set numbers									
		30	31	32	33	34	35	36	37	38	39
21	33	!	!	!	!	!	!	!	!	!	!
22	34	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
23	35	#	#	#	#	£	£	£	£	#	§
24	36	Ø	Ø	\$	\$	\$	\$	\$	\$	\$	\$
25	37	%	%	%	%	%	%	%	%	%	%
26	38	&	&	&	&	&	&	&	&	&	&
27	39	,	,	,	,	,	,	,	,	,	,
28	40	(	(	(	(	(	(	(	(	(	(
29	41	)	)	)	)	)	)	)	)	)	)
2A	42	*	*	*	*	*	*	*	*	*	*
2B	43	+	+	+	+	+	+	+	+	+	+
2C	44	,	,	,	,	,	,	,	,	,	,
2D	45	-	-	-	-	-	-	-	-	-	-
2E	46	□	□	□	□	□	□	□	□	□	□
2F	47	/	/	/	/	/	/	/	/	/	/
30	48	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	Outlined character set numbers									
		30	31	32	33	34	35	36	37	38	39
31	49	1	1	1	1	1	1	1	1	1	1
32	50	2	2	2	2	2	2	2	2	2	2
33	51	3	3	3	3	3	3	3	3	3	3
34	52	4	4	4	4	4	4	4	4	4	4
35	53	5	5	5	5	5	5	5	5	5	5
36	54	6	6	6	6	6	6	6	6	6	6
37	55	7	7	7	7	7	7	7	7	7	7
38	56	8	8	8	8	8	8	8	8	8	8
39	57	9	9	9	9	9	9	9	9	9	9
3A	58	:	:	:	:	:	:	:	:	:	:
3B	59	;	;	;	;	;	;	;	;	;	;
3C	60	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
3D	61	□	□	□	□	□	□	□	□	□	□
3E	62	♪	♪	♪	♪	♪	♪	♪	♪	♪	♪
3F	63	?	?	?	?	?	?	?	?	?	?
40	64	@	Ѐ	@	Ӯ	ӻ	@	Ӯ	ӻ	ӻ	@

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	Outlined character set numbers									
		30	31	32	33	34	35	36	37	38	39
41	65	A	A	A	A	A	A	A	A	A	A
42	66	B	B	B	B	B	B	B	B	B	B
43	67	C	C	C	C	C	C	C	C	C	C
44	68	D	D	D	D	D	D	D	D	D	D
45	69	E	E	E	E	E	E	E	E	E	E
46	70	F	F	F	F	F	F	F	F	F	F
47	71	G	G	G	G	G	G	G	G	G	G
48	72	H	H	H	H	H	H	H	H	H	H
49	73	I	I	I	I	I	I	I	I	I	I
4A	74	J	J	J	J	J	J	J	J	J	J
4B	75	K	K	K	K	K	K	K	K	K	K
4C	76	L	L	L	L	L	L	L	L	L	L
4D	77	M	M	M	M	M	M	M	M	M	M
4E	78	N	N	N	N	N	N	N	N	N	N
4F	79	O	O	O	O	O	O	O	O	O	O
50	80	P	P	P	P	P	P	P	P	P	P

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	30	31	32	33	34	35	36	37	38	39
51	81	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
52	82	R	R	R	R	R	R	R	R	R	R
53	83	S	S	S	S	S	S	S	S	S	S
54	84	T	T	T	T	T	T	T	T	T	T
55	85	U	U	U	U	U	U	U	U	U	U
56	86	V	V	V	V	V	V	V	V	V	V
57	87	W	W	W	W	W	W	W	W	W	W
58	88	X	X	X	X	X	X	X	X	X	X
59	89	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5A	90	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5B	91	Ä	Ä	Æ	Ä	ö	ı	ö	i	Ã	Æ
5C	92	Ö	Ö	Ø	Ö	ç	\	ç	ñ	ç	Ø
5D	93	À	À	À	Ü	§	)	é	đ	ő	À
5E	94	^	Ü	^	^	^	^	^	^	^	^
5F	95	—	—	—	—	—	—	—	—	—	—
60	96	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

Hexa-decimal	Decimal	Outlined character set numbers									
		30	31	32	33	34	35	36	37	38	39
61	97	ä	ä	ä	ä	ä	ä	ä	ä	ä	ä
62	98	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö
63	99	ç	ç	ç	ç	ç	ç	ç	ç	ç	ç
64	100	đ	đ	đ	đ	đ	đ	đ	đ	đ	đ
65	101	€	€	€	€	€	€	€	€	€	€
66	102	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ
67	103	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø
68	104	њ	њ	њ	њ	њ	њ	њ	њ	њ	њ
69	105	ќ	ќ	ќ	ќ	ќ	ќ	ќ	ќ	ќ	ќ
6A	106	ј	ј	ј	ј	ј	ј	ј	ј	ј	ј
6B	107	ќ	ќ	ќ	ќ	ќ	ќ	ќ	ќ	ќ	ќ
6C	108	۱	۱	۱	۱	۱	۱	۱	۱	۱	۱
6D	109	۳	۳	۳	۳	۳	۳	۳	۳	۳	۳
6E	110	۴	۴	۴	۴	۴	۴	۴	۴	۴	۴
6F	111	۰	۰	۰	۰	۰	۰	۰	۰	۰	۰
70	112	۵	۵	۵	۵	۵	۵	۵	۵	۵	۵

Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

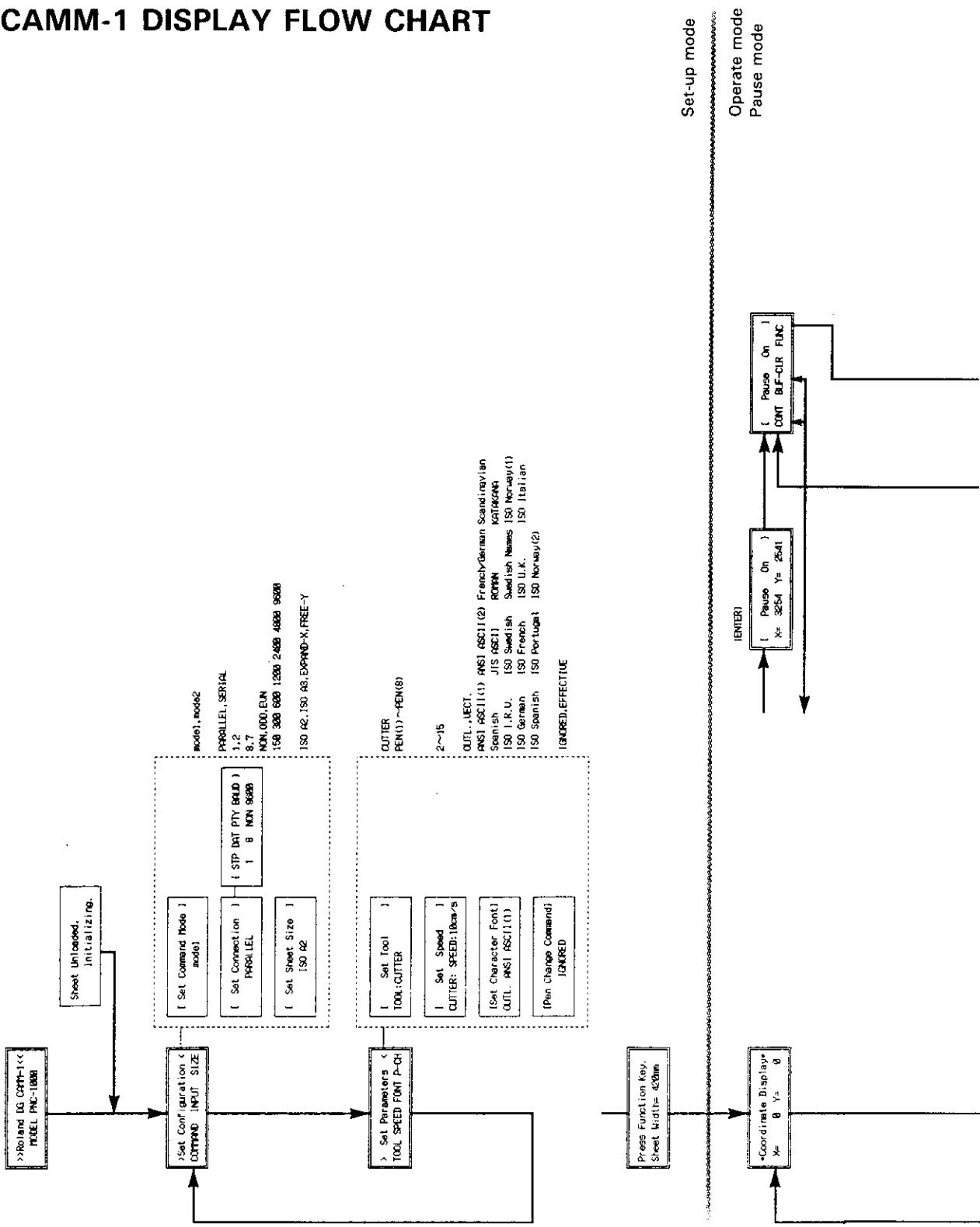
Hexa-decimal	Decimal	Outlined character set numbers									
		30	31	32	33	34	35	36	37	38	39
71	113	q	q	q	q	q	q	q	q	q	q
72	114	r	r	r	r	r	r	r	r	r	r
73	115	s	s	s	s	s	s	s	s	s	s
74	116	t	t	t	t	t	t	t	t	t	t
75	117	u	u	u	u	u	u	u	u	u	u
76	118	v	v	v	v	v	v	v	v	v	v
77	119	w	w	w	w	w	w	w	w	w	w
78	120	x	x	x	x	x	x	x	x	x	x
79	121	y	y	y	y	y	y	y	y	y	y
7A	122	z	z	z	z	z	z	z	z	z	z
7B	123	়	়	়	়	়	়	়	়	়	়
7C	124	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ
7D	125	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ	ঁ
7E	126	—	—	—	—	—	—	—	—	—	—

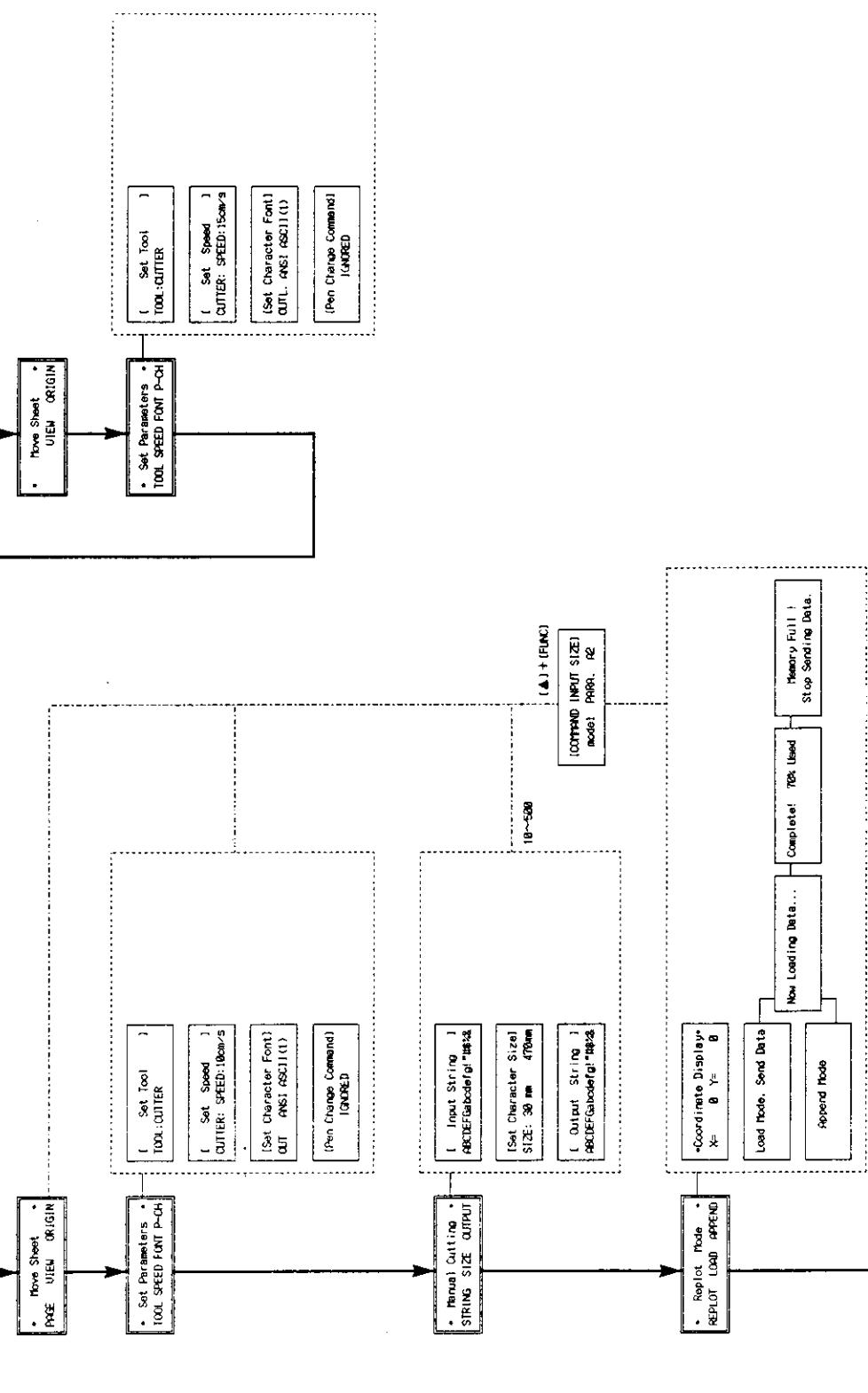
Character set numbers 5 and 8 result in error No. 5 if they are selected with a command. Other blanks are ignored.

# **APPENDIX E**

## **CAMM-1 DISPLAY FLOW CHART**

## CAMM-1 DISPLAY FLOW CHART







# **APPENDIX F**

## **LIST OF CAMM-GL III COMMANDS**

## LIST OF CAMM-GLIII

## ● mode1

Command		Format	Parameter range (defaults)
H	Move to User Origin	H	
D	Cut (Plot) Absolute Line	Dx1, y1, ..., xn, yn	xn: absolute X-axis coordinate yn: absolute Y-axis coordinate
M	Tool-up Move to Absolute Coordinate Point	Mx1, y1, ..., xn, yn	xn: absolute X-axis coordinate yn: absolute Y-axis coordinate
I	Cut (Plot) Relative Line	I Δx1, Δy1, ..., Δxn, Δyn	Δxn: relative X-axis coordinate Δyn: relative Y-axis coordinate
R	Tool-up Move to Relative Coordinate Point	RΔx1, Δy1, ..., Δxn, Δyn	Δxn: relative X-axis coordinate Δyn: relative Y-axis coordinate
L	Specify Line Type	Lp	p : line pattern
B	Specify Broken Line Pitch	Bl	l : pitch length
X	Cut (Plot) Coordinate System	Xp, q, r	p : specification of coordinate axis 0, 1 q : spacing of ticks r : number of times
P	Cut (Plot) Character	Pc1, c2, ..., cn	cn: character
S	Set Character Size	Sn	n: character size
Q	Specify Character Rotate Angle	Qn	n: selection of rotation angle
N	Cut (Plot) Special Symbol	Nn	n: selection of special character
C	Cut (Plot) Arc	Cx, y, r, θ1, θ2, l, θd	x, y: center coordinates r : radius θ1 : start angle θ2 : end angle θd : angle resolution
E	Cut (Plot) Arc from Tool Position	Er, θ1, θ2, l, θd	
A	Specify G & K Center Coordinates	Ax, y	
G	Cut (Plot) Arc Around A-Command Center	Gr, θ1, θ2, l, θd	
K	Cut (Plot) Division Line	Kn, l1, l2	n: angle of division lines l1: distance of division line from endpoint l2: distance of division line from startpoint
T	Cut (Plot) and Hatch Rectangle	Tn, x, y, d, t	n : hatching pattern x, y: size of rectangle d : spacing of hatching t : angle of hatching
^	Call mode2	^ mode2 command Parameter .... (,Parameter) terminator	conforming to each mode2 command

Function	Page
Moves tool to work origin	2-2-3
Cuts (Plots) a straight line in absolute coordinates	2-2-3
Moves tool with tool up in absolute coordinates	2-2-5
Cuts (Plots) a straight line in relative coordinates	2-2-6
Moves tool with tool up in relative coordinates	2-2-7
Specifies the type of line	2-2-8
Specifies the pitch of broken line	2-2-10
Cuts (Plots) coordinate axis	2-2-11
Cuts (Plots) a character	2-2-13
Sets the size of character	2-2-14
Specifies the rotation angle of character	2-2-16
Cuts (Plots) a special symbol	2-2-18
Cuts (Plots) a circle or arc	2-2-19
Cuts (Plots) a circle or arc taking the tool position as the startpoint.	2-2-21
Sets center coordinates of a circle by G and K commands	2-2-23
Cuts (Plots) a circle or arc centered at coordinates by A command	2-2-23
Cuts (Plots) a division line for circle	2-2-25
Hatches and cuts a rectangle	2-2-27
Invokes a mode2 command	2-2-29

**• Commands in common with mode1 & mode2**

Command		Format	Parameters
INR	Not Ready	INR	None
IOK	Output Key	IOK	None
IPG	Page Feed	IPG n IPG	n: page
ISF	Select Font	ISF n, m ISF	n: character type m: character spacing
IST	Select Tool	IST n	n: tool

Function	Page
Not Ready	2-2-30 2-3-77
Outputs a function key	2-2-31 2-3-78
Feeds a page	2-2-32 2-3-80
Specifies character type	2-2-34 2-3-81
Select tool	2-2-35 2-3-82

## ● mode2

Command		Format	Parameter range (defaults)
AA	Arc Absolute	AA x, y, $\theta$ c( $\theta$ d);	x : X coordinate of center y : Y coordinate of center $\theta$ c: Center angle $\theta$ d: Resolution
AR	Arc Relative	AR $\Delta$ x, $\Delta$ y, $\theta$ c( $\theta$ d);	$\Delta$ x: Difference of X center coordinates $\Delta$ y: Difference of Y center coordinates $\theta$ c: Center angle $\theta$ d: Resolution
CA	Alternate Character Set	CAn; CA;	n: Character set number
CI	Circle	Clr( $\theta$ d);	r : Radius $\theta$ d: Resolution
CP	Character Plot	CPnx, ny; CP;	nx: Number of characters in X direction ny: Number of characters in Y direction
CS	Standard Character Set	CSn; CS;	n: Character set number
DF	Default	DF;	
DI	Absolute Direction	DI run, rise; DI;	run=0 : Vertical printing rise=0: Horizontal printing
DR	Relative Direction	DR run, rise; DR;	run=0: Vertical printing rise=0: Horizontal printing
DT	Define Label Terminator	DTt;	t: Label terminator
EA	Edge Rectangle Absolute	EA X, Y;	X: X Absolute coordinate of corner Y: Y Absolute coordinate of corner
ER	Edge Rectangle Relative	ER $\Delta$ x, $\Delta$ y;	$\Delta$ x: Relative coordinate of corner $\Delta$ y: Relative coordinate of corner
EW	Edge Wedge	EWr, $\theta$ 1, $\theta$ c( $\theta$ d);	r : Radius $\theta$ 1: Start angle $\theta$ c: Center angle $\theta$ d: Resolution
FT	Fill Type	FTn(d, $\theta$ ); FT;	n = Pattern d = Distance $\theta$ = Angle

Function	Page
Cuts (Plots) an arc centered at X, Y	2-3-3
Cuts (Plots) an arc centered at the relative coordinates $\Delta X$ , $\Delta Y$	2-3-5
Designates the alternate character set	2-3-6
Cuts (Plots) a circle centered on the current pen position	2-3-8
The tool is moved by the number of characters	2-3-9
Designates the standard character set	2-3-11
Default	2-3-12
Designates absolute printing direction	2-3-14
Designates relative printing direction	2-3-16
Defines the label terminator	2-3-18
Cuts (Plots) a rectangle	2-3-20
Cuts (Plots) a rectangle with relative coordinates	2-3-22
Cuts (Plots) a wedge	2-3-24
Specifies hatching	2-3-26

Command		Format	Parameter range (defaults)
IM	Input Mask	IMe; IM;	e: Error mask value
IN	Initialize	IN;	
IP	Input P1 & P2	IP P1x, P1y(,P2x,P2y);	X and Y coordinates of P1 and P2
IW	Input Window	IW LLx, LLy, URx, URy; IW;	LLx: X-axis coordinates at lower-left corner of window LLy: Y-axis coordinates at lower-left corner of window URx: X-axis coordinates at upper-right corner of window URy: Y-axis coordinates at upper-right corner of window
LB	Label	LBc1c2 ....cn;	c: Character
LT	Line Type	LTn(,l); LT;	n: Pattern number l : 1 pitch's length
OA	Output Actual Point	OA;	
OC	Output Commanded Position	OC;	
OE	Output Error	.OE;	
OF	Output Factor	OF;	
OH	Output Hard-Clip Limits	OH;	
OI	Output Identification	OI;	
OO	Output Option Parameter	OO;	
OP	Output P1 and P2	OP;	
OS	Output Status	OS;	
OW	Output Window	OW;	
PA	Plot Absolute	PAx1, y1 (,x2 ,y2, ....); PA;	Xn: Absolute X-axis coordinates Yn: Absolute Y-axis coordinates
PD	Tool Down	PDx1, y1 (,x2 ,y2, ....); PD;	Xn: X-axis coordinates Yn: Y-axis coordinates
PR	Plot Relative	PRΔx1, Δy1 (, Δx2, Δy2, ....); PR;	ΔXn: Relative X-axis coordinates ΔYn: Relative Y-axis coordinates
PT	Tool Thickness	PTd; PT;	d : Filling spacing
PU	Tool Up	PUx1, y1 (,x2 ,y2, ....); PU;	Xn: X-axis coordinates Yn: Y-axis coordinates
RA	Shade Rectangle Absolute	RAx, y;	X: X coordinates of corner Y: Y coordinates of corner
RR	Shade Rectangle Relative	RR Δx, Δy;	Δx: X Relative coordinates of corner Δy: Y Relative coordinates of corner

Function	Page
Input mask	2-3-28
Initialization	2-3-30
Sets P1 and P2	2-3-30
Sets cutting (plotting) area	2-3-32
Character cutting (plotting)	2-3-33
Pitch of dotted or dot-dash-line	2-3-35
Outputs X and Y coordinates of tool position and tool condition (for CAMM-1 coordinates only)	2-3-37
Outputs X and Y coordinates of tool position and tool condition (for user coordinates only)	2-3-38
Output-error code	2-3-39
Outputs the number of CAMM-1 unit per millimeter in the X- and Y-Axis	2-3-40
Outputs the lower-left (LL) and upper-right (UR) coordinates of the current hard-clip limits	2-3-41
Outputs the CAMM-1 model name (PNC-1000)	2-3-42
Outputs eight option parameters	2-3-43
Outputs P1 and P2	2-3-44
Outputs status byte	2-3-45
Outputs coordinates of lower left corner and upper right corner of window	2-3-47
Moves in absolute coordinates	2-3-48
Moves in a tool down condition	2-3-49
Moves in relative coordinates	2-3-50
Specifies the filling spacing	2-3-52
Moves in a tool up condition	2-3-53
Fills a rectangle	2-3-55
Fills a rectangle using relative coordinates	2-3-56

Command		Format	Parameter range (defaults)
SA	Select Alternate Set	SA;	
SC	Scaling	SC xmin, xmax, ymin, ymax; SC;	xmin, ymin : User coordinates of P1 xmax, ymax : User coordinates of P2
SI	Absolute Character Size	SIw (,h); SI;	w: Character width h : Character height
SL	Character Slant	SL tan $\theta$ ; SL;	tan $\theta$ : Character slant
SM	Symbol Mode	SMs; SM;	s : Character or symbol
SR	Relative Character Size	SRw (,h); SR;	w: Character width (%) h : Character height (%)
SS	Select Standard Set	SS;	
TL	Tick Length	TL lp,lm; ; TL;	lp : Tick length in positive direction lm: Tick length in negative direction
UC	User Defined Character	UC(c, $\Delta x_1$ , $\Delta y_1$ , (c,)...( $\Delta x_n$ , $\Delta y_n$ ); UC;	c : Tool control value $\Delta x_1$ : Number of moving units in X-axis direction $\Delta y_1$ : Number of moving units in Y-axis direction
VS	Velocity Select	VSV; VS;	v: Tool velocity 0 ~ 30 mm/sec
WD	Write to Display	WDc1c2,...cn; WD;	cn: Characters chr\$(32) ~ chr\$(127) chr\$(160) ~ chr\$(223)
WG	Shade Wedge	WGr, $\theta_1$ , $\theta_c$ , $\theta_d$ ;	r : Radius $\theta_1$ : Start angle $\theta_c$ : Center angle $\theta_d$ : Resolution
XT	X-tick	XT;	
YT	Y-tick	YT;	

### ● Commands in common with mode1 & mode2

Command		Format	Parameters
!NR	Not Ready	!NR	None
!OK	Output Key	!OK	None
!PG	Page Feed	!PG n !PG	n: page
ISF	Select Font	ISF n, m ISF	n: character type m: character spacing
IST	Select Tool	IST n	n: tool

Function	Page
Selects alternate character set	2-3-57
Sets user coordinates	2-3-58
Designates absolute character size	2-3-60
Designates character slant	2-3-62
Draws characters or symbols around the current pen position	2-3-63
Designates relative character size	2-3-65
Select Standard character set	2-3-66
Sets XT and YT tick	2-3-67
Defines user characters	2-3-69
Set tool speed	2-3-71
Write to Display	2-3-72
Fills a wedge	2-3-74
Cut (Plot) tick on X axis	2-3-76
Cut (Plot) tick on Y axis	2-3-77

Function	Page
Not Ready	2-2-30 2-3-77
Outputs a function key	2-2-31 2-3-78
Feeds a page	2-2-32 2-3-80
Specifies character type	2-2-34 2-3-81
Select tool	2-2-35 2-3-82



## SPECIFICATIONS

### • Hardware Specifications

Cutting method	Paper moving
Cutting range	[ISO A2] [ISO A3] [ANSI C] [ANSI B] [FREE-Y] [EXPAND-X]
Loadable sheet width	450mm ~ 500mm
Sheet type	SUMITOMO 3M Design Sheet
Paper size (sheet media)	ISO A2, ISO A3, ANSI C, ANSI B
Paper type (sheet media)	High quality paper, tracing paper
Tool (option)	Cutter : cemented carbide, sapphire Pen : water based fiber tipped pen, POP art pen
Cutting speed	20mm ~ 150mm/sec in 10mm increments in all directions
Pen force	50g ~ 150g
Number of Tool up/down	6/sec (one in up/down)
Mechanical resolution	0.05mm (0.00156/microstep)
Software resolution	0.025mm/step
Distance accuracy	±0.1% of moving distance or ±0.1mm which ever larger
Repeating accuracy	Below ±0.1mm
Interface	Parallel (complies with Centronics spec.) Serial (complies with RS-232C spec.)
Buffer size	1K byte (8K-byte replot buffer)
Font	Outlined character, line character
Command system	CAMM-GL <sup>III</sup> (mode1, mode2)
Display	Liquid crystal display, 20 characters × 2 lines (with back light)
Switch	Power switch, Pen force control
Key	▲ ▼ ◀ ◁ FUNC ENTER
Sheet feeding	By sheet roller base
Sheet separation	By sheet separator
Other functions	Manual cutting, data replotting, cutter compensating, offsetting, setting memory, pen change command handling
Power consumption	55W
External dimensions	735mm(W) × 275mm(D) × 205mm(H)
Weight	13kg
Operating temperature	5 ~ 40°C
Operating humidity	35% ~ 80% (No dewing allowed)

**● Interface Specifications**

<b>[PARALLEL]</b>	
Standard	Based on Centronics specifications
Input signal	<u>STROBE</u> (1BIT), DATA (8BITS)
Output signal	BUSY (1BIT), ACK (1BIT)
I/O level	TTL level
Transmission	Asynchronous data transmission
<b>[SERIAL]</b>	
Standard	Based on RS-232C specifications
Transmission	Asynchronous, full duplex data transmission
Transmission speed	150,300,600,1200,2400,4800,9600 (changeable by panel key)
Parity check	Odd, Even, None (changeable by panel key)
Data bits	7 or 8 bits (changeable by panel key)
Stop bits	1 or 2 bits (changeable by panel key)
Usable connector	DB-25S