Personal Computer

MZ-80B

Programming Utility

SHARP

NOTICE

The MZ-80 series of sophisticated personal computers is manufactured by the SHARP CORPORATION. Hardware and software specifications are subject to change without prior notice; therefore, you are requested to pay special attention to version numbers of the monitor and the system software (supplied in the form of cassette tape or mini-floppy disk files).

This manual is for reference only and the SHARP CORPORATION will not be responsible for difficulties arising out of inconsistencies caused by version changes, typographical errors of omissions in the descriptions.

This manual is based on the SB-1500 series monitor and the SB-7000 series Floppy DOS.

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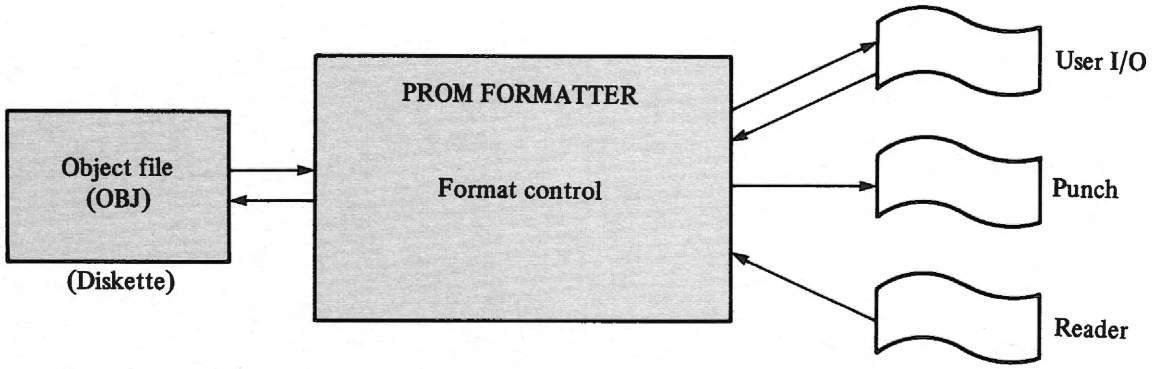
PROM FORMATTER

The rapid advances in LSI technology have allowed the functions of a computer's CPU to be concentrated onto a single semiconductor chip. These microprocessors are becoming ever more sophisticated, while at the same time they are becoming less expensive. As a result, the range of fields in which microprocessors are being utilized is growing rapidly. One subject of great importance to the development of new device applications is that of developing efficient application programs; it is not too much to say that the quality of the application program determines how well a newly developed device performs.

On the other hand, developments in LSI technology have also stimulated efforts to develop low cost, large capacity memory elements (RAM and ROM). The increased availability of PROMs which are erasable with ultraviolet rays has had a particularly strong influence on the development of devices which incorporate microprocessors.

The procedure which is most suitable for efficiently developing application programs is to create an object file from a source file created through assembly programming using an assembly language, then to reassemble it after debugging. The function of the PROM formatter is to load one or more object programs created with the assembler and linker, then to output it to a paper tape punch after converting it to PROM writer format.



Functions of the PROM formatter

It also allows programs which are written in different formats to be input from a reader for storage on disk and enables conversion of programs to the required format for output on paper tape or the like.

—Activation of the PROM Formatter—

Entering PROM [CR] while in the DOS command entry mode activates the PROM formatter. Commands may be entered as soon as activation is completed.

The following formats are provided for in the PROM formatter:

1. BNPF

- Britronics
- Intel
- Takeda Riken

2. B10F

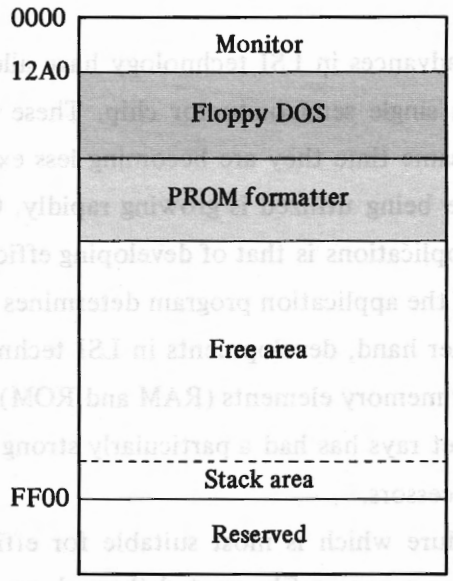
- Takeda Riken

3. HEXADECIMAL

- Britronics
- Takeda Riken
- Minato Electronics

4. BINARY

- Britronics



PROM formatter memory map

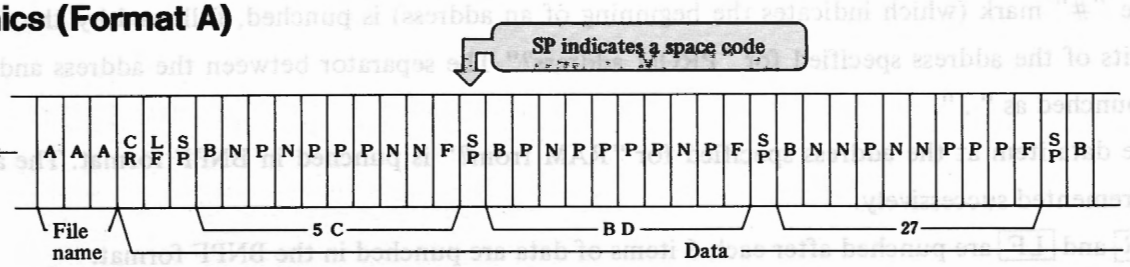
PROM WRITER FORMATS

PROM writers are provided in many formats by different companies. This section discusses forms which are converted by the PROM formatter; refer to the individual PROM writer manuals for details.

(The examples in the figures include the file name "AAA", the address "0000", and the data "5C", "BD" and "27". The leader section for the start of punched output and the trailer section for the end of punched output are created automatically.)

—BNPF—

Britronics (Format A)



— The file name is punched in ASCII code (if one is specified). (Using the character "B" as a file name will result in incorrect identification of the beginning of data.)

— [CR] and [LF] are punched in ASCII code.

— The space code (20H) and the byte of data at the address specified for "RAM from?" are punched in BNPF format. The address is incremented successively.

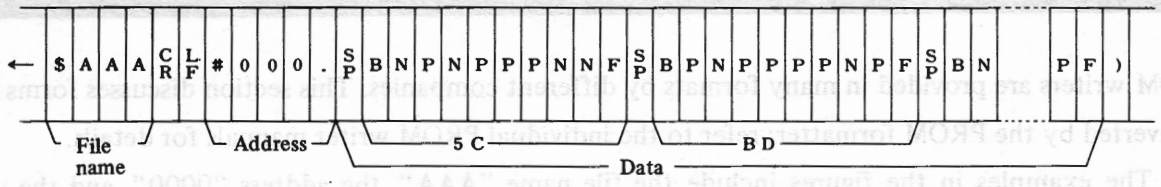
— [CR] and [LF] are punched after each 6 items of data are punched in the BNPF format.

— Punching is performed in BNPF format up to the address specified for "to?".

Intel (Format D)

— This is the same as the Britronics format. The BNPF format is one which has a relatively high degree of standardization; thus, the PROM formatter can also be used with devices other than those which are discussed in this manual.

Takeda Riken (Format E)



— The " $ " mark, which denotes the file name, is punched in ASCII code.

— The file name is punched in ASCII code (if one is specified).

— CR and LF are punched. The "$" mark is regarded as denoting the beginnning of a comment statement; the end of a comment statement is denoted with an LF code.

— The "#" mark (which indicates the beginning of an address) is punched, followed by the first three digits of the address specified for "PROM address?". The separator between the address and the data is punched as " . ".

— The data item at the address specified for "RAM from?" is punched in BNPF format. The address is incremented successively.

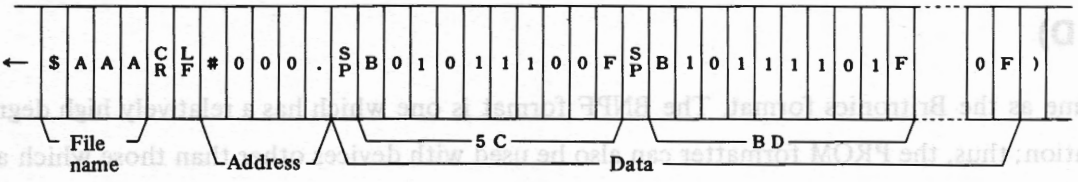
— CR and LF are punched after each 6 items of data are punched in the BNPF format.

— A tape leader stop mark ") " is punched after the data has been punched up to the address specified for "to?".

Note: Care must be taken to ensure that characters which act as control characters (B, :, $, #, etc.) are not used when a file name is specified. (Otherwise, incorrect operation will result.)

–B10F–

Takeda Riken (Format F)

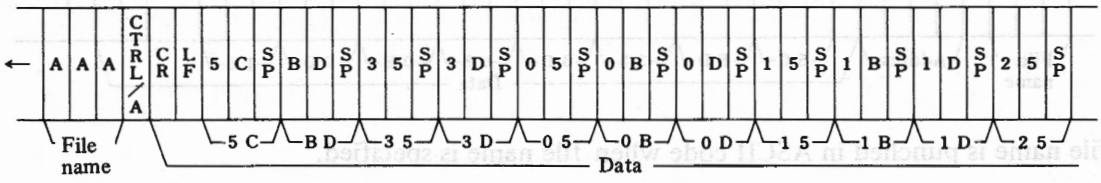


— Except for the NP section, this is the same as Takeda Riken's BNPF format.

— The B10F format corresponds to the BNPF format in that 1 = P and 0 = N.

—HEXADECIMAL—

Britronics (Format B)



— The file name is punched in ASCII code (if one is specified).

— The "CTRL/A" mark (01H) indicating the beginning of data is punched.

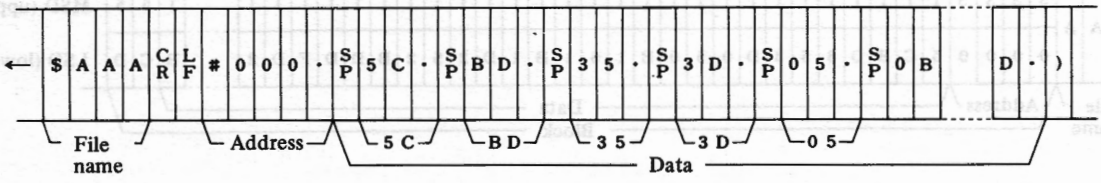
— CR and LF are punched.

— The data item at the address specified for "RAM from?" is punched as a 2-digit ASCII code, then a space code in punched.

— CR and LF are punched after 16 bytes of data have been punched.

— Data is punched up to the address specified for "to?".

Takeda Riken (Format G)



— The " $ " mark, which denotes the file name, is punched in ASCII code.

— The file name is punched in ASCII code (if one is specified).

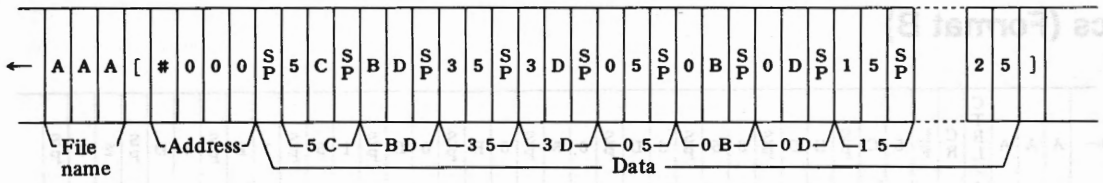
— After CR and LF are punched (followed by the address specification mark "#" and 3 digits of the address specified for "PROM address?"). The separator " . " is punched.

— The space code is punched, followed by the 2-digit ASCII code for the data at the address specified for "RAM from?". The separator " . " is punched after the data item.

— CR and LF are punched after 16 bytes of data have been punched.

— Data is punched up to the address specified for "to?", at which point the tape leader stop mark ") " is punched.

Minato Electronics (Format H)



— The file name is punched in ASCII code when file name is specified.

— The start-of-data mark " [" is punched.

— The address designation mark " # " is punched, followed by a 3-digit ASCII code for the address specified for "PROM address?".

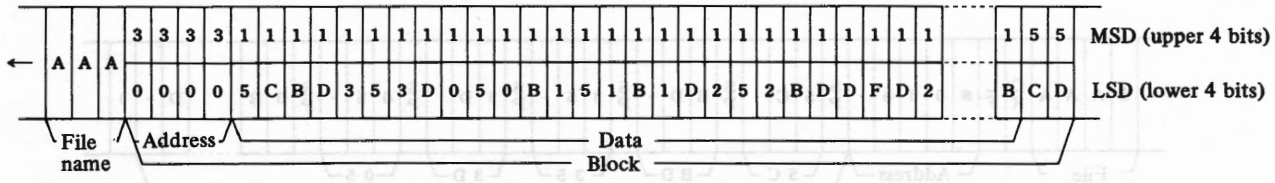
— A space code is punched, then the data at the address specified for "RAM from?" is converted to a 2-digit ASCII code and punched.

— 16 combinations of space codes and data items are punched, then [CR] and [LF] are punched.

— The end of data mark "] " is punched after data has been punched up to the address specified for "to?".

—BINARY—

Britronics (Format C)



— In the binary format, the 4-bit mark section and the 4-bit data section are expressed together as one character (8 bits). The mark section is punched as the upper 4 bits of the paper tape, while the data section is punched as the lower 4 bits.

— The file name is punched in ASCII code (if one is specified). Specifications which result in a "3" in the upper 4 bits of the ASCII code file name are not permitted. Such specifications will result in incorrect operation, since incorrect determination that the lower 4 bits of the file name are an address wll result.

— Three binary digits for the address specified for "PROM address?" are punched in the lower 4 bits. The address designation mark ("3") is punched in the upper 4 bits.

— A data mark ("1") is punched in the upper 4 bits and data at the address specified for "RAM from?" is punched in the lower 4 bits.

— Data is punched 4 bits at a time (with the upper and lower 4 bits punched in alternation) up to the address specified for "to?".

— Check sum marks ("5") are punched in the upper 4 bits, followed in alternation by check sum data in the lower 4 bits.

—Performance Boards of Various Companies— (Note: Consult the various manufacturers for details.)

a) Intel

2716
2732
8748/8741
3621, 3602, 3622, 3602A, 3622A, 3604, 3624, 3604A, 3624A, 3605, 3625, 3605A, 3625A, 3628, 3608, 3604AL-6, 3604AL
8702A/1702A
8708/8704/2708/2704
8755A

b) Britronics

Company	Element
Intel	3602A／22A, 3604A／24A, 3604AL／24L, 3605／25, 3608／28
Intersil	5600／10, 5603A／23, 5604／24, 5605／25
Fujitsu	7055, 7051, 7052, 7058, 7053, 7059, 7054, 7057
Monolithic Memory	5330／6330, 5331／6331, 5300／6300, 5335／6335, 5336／6336, 5308／6308, 5309／6309, 53134／63134, 53135／63135, 5305／6305, 5306／6306, 53137／63137, 53141／63141, 5340／6340, 5341／6341, 5348／6348, 5349／6349, 5350／6350, 5351／6351, 5352／6352, 5353／6353, 5380／6380, 5381／6381, 5384／6384, 5385／6385, 5386／6386, 5387／6387
Harris	7602／03, 7610A／11A, 7620A／21A, 7640A／41A, 7640AR／41AR, 7642／43, 7644, 7646R／47R, 7648／49, 7608, 7680／81, 7680R／81R, 7680P／81P, 7680RP／81RP, 7683, 7684／85, 7684P／85P, 7686／87, 7686R／87R, 7686P／87P, 7686RP／87RP
Fairchild	93417／27, 93436／36, 93438／48, 93452／52
National Semiconductor	54／74S387, 54／74S287, 54／74S470, 54／74S471, 54／74S570, 54／74S571, 77／87S295, 77／87S296, 54／74S473, 54／74S472, 54／74S572, 54／74S573
NEC	403D, 406D
Raytheon	29660／61, 29600／01, 29612／13
Signetics	82S114／115, 82S126／127, 82S130／131, 82S140／141, 82S136／137, 82S180／181, 82S2708, 82S184／185, 82S190／191
Texas Instruments	54／7488A, 54／74S／88, 54／74S288, 54／74S470, 54／74S71, 54／74S73, 54／74S72, 54／74S75

c) Minato Electronics

Adaptable to all PROMs.

d) Takeda Riken

MOS Type

Element	Bit configuration, capacity (words x bits = capacity)	Maker name											
		Oki Denki	Toshiba	NEC	Hitachi	Fujitsu	Mitsubishi	Intersil	Intel	Texas Instruments	Fairchild	AMD	SIGNE
MOS	256 x 8 = 2048			μPD454D⑩	HN351702A⑦	MB8503 MB8513	M5L1702⑦		1602A ⑦ 1702A			AM1702A⑦	1702A ⑦
	512 x 4 = 2048		TMM121C TMM121C-1										
	512 x 8 = 4096								2704 ⑧				
	1024 x 8 = 8192	MSM3758⑧	TMM322C⑧	μPD458D⑩	HN462708⑧	MB8518⑧	M5L2708⑧		2708 ⑧ 2758 ⑨	TMS2708⑧	F2708 ⑧	AM2708 ⑧	2708 ⑧
	2048 x 8 = 16384		TMM323C⑨	μPD2716D⑨	HN462716⑨	MB8516⑨	M5L2716⑨		2716 ⑨	TMS2716⑧ TMS2516⑨			
	4096 x 8 = 32768								2732	TMS2532			
CMOS	512 x 8 = 4096							1M6654④					
	1024 x 4 = 4096							1M6653④					
	1024 x 8 = 8192						M58460 S						
Compound MOS									8755				

Bipolar Type

Element	Bit configuration, capacity (words x bits = capacity)	Maker name											
		Nihon Denki	Hitachi	Fujitsu	Mitsubishi	Intersil	Intel	Texas Instruments	Harris	Fairchild	Raytheon	MMI	AMD	SIGNE
Bipolar	32 x 8 = 256			MB7051 MB7056	M54730	1M5600 1M5610		SN74188A SN74S188 SN74S288	HM7602 HM76LS03 HM7603			6330-1 6331-1	AM27S18 AM27S19	82S23 82S123
	256 x 4 = 1024	μPB403D②		MB7052② MB7057②	M54700	1M5603A 1M5623	3601 3621	SN74S287 SN74S387	HM7610A HM7610 HM7611A HM7611	93417 93427	29662 29663 29660 29661	6300-1 6301-1	AM27S20 AM27S21	82S126 82S129
	256 x 8 = 2048							SN74S470 ③ SN74S471 ③	HM7625R HM7629		29600 29601	6308-1 6309-1 6335-1 6336-1 63135-1		82S114
	512 x 4 = 2048			MB7053② MB7058②		1M5604 1M5624	3602 3622		HM7620 HM7620A HM7621 HM7621A	93436 93446	29612 29613	6305-1 6306-1	AM27S12 AM27S13	82S130 82S131
	512 x 8 = 4096	μPB405D μPB425D				1M5605 1M5625	3604A 3624A	SN74S472 SN74S473 SN74S474 ③ SN74S475	HM7640 H M7640A HM7641 HM7641A HM7640AR HM7641AR HM7647R HM7648 HM7649	93438 93448		6341-1 6340-1 6348-1 6349-1	AM27S15 AM27S26 AM27S27	82S115 82S140 82S141
	1024 x 4 = 4096	μPB406D μPB426D⑤		MB7054 MB7059⑤		1M5606 1M5626	3605A 3625A		HM7642 HM7642A HM7643 HM7643A HM7644 HM7644A HM7642P HM7643P	93452 93453		6350-1 6351-1 6352-1 6353-1	AM27S32 AM27S33	82S136 82S137
	1024 x 8 = 8192	μPB417D μPB427D⑥		MB7055 MB7060⑤			3608A 3628A		HM7680 HM7681 HM7680P HM7681P HM7680R HM7681R HM7680RP HM7681RP HM7608 HM7683	93450 93451		6380-1 6381-1 6384-1 6385-1 6386-1 6387-1 63133-1		82S180 82S181 82S2708
	2048 x 4 = 8192								HM7684 HM7685 HM7684P HM7685P HM7686 HM7687 HM7686P HM7687P HM7686R HM7687R HM7686RP HM7687RP					82S184 82S185
	2048 x 8 = 16384						3636		HM7616 HM76160 HM76161					82S190 82S191

Elements annotated with the same figures in circles can be used with the same performance boards.

PROM FORMATTER COMMANDS

—File Input/Output Commands—

Y (Yank file) Command

Reads the object (OBJ) file specified by the file name into the free area.

＊ YCHARAGEN CR	Reads in CHARAGEN.OBJ
RAM from? 8000 to 87FF	Specifies read-in from address 8000 (read up to address 87FF)

— File name can be specified by entering a Y (Yank file command) when "＊" appears to indicate that command entry is awaited.

— Specify the starting address of the file to be read in as a 4-digit hexadecimal number. (Reading will start at the address specified regardless of the actual data address of the object file.)

— The last address read is displayed when file read-in is completed.

Caution: The address specified for read-in must be in the free area.

S (Save file) Command

Writes the specified program (or data) in the free area onto a disk.

＊ STEST# 2 CR	Output program (data) to TEST# 2.OBJ
RAM from? 8400 to? 87E7	Output program (data) from adress 8400 to 87E7
exec? 1300 data? 1300	Execute address 1300, data address 1300

— Another file name can be specified by entering an S (Save file) command when "＊" appears to indicate that command entry is awaited.

— The addresses of the memory block in the free area which is to be output are specified with 4-digit hexadecimal numbers.

— The execute address and data address of the object (OBJ) file created are specified with 4-digit hexadecimal numbers. The data address is the address to which the program (data) is to be reloaded into memory by a later RUN or LOAD command. The execute address is the address from which a program reloaded into memory is to be executed. Specify 0000 when either of these addresses is not necessary.

CY (Yank disk) Command

This command loads data in units of 256 bytes from the specified sector(s) of the specified track on the floppy disk in the specified drive into RAM.

```
* CY [CR]
  drive? 1
  track, sect? 0301
  byte size? 0100 adrs? 7000
```

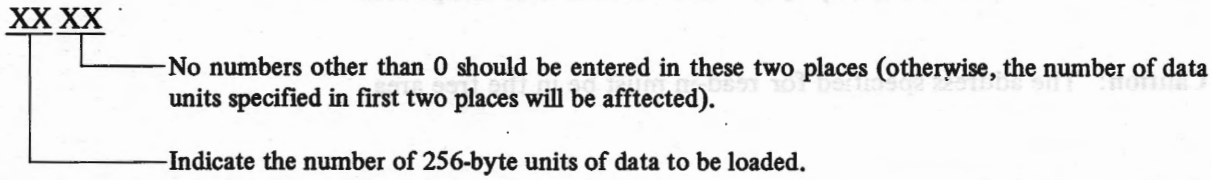
— Enter the CY command when "*" appears to indicate that command entry is awaited.

— Specify the number of disk drive containing the floppy disk storing the data to be loaded.

— Enter the track number and the first of the sector numbers in which the data to be loaded is stored as 4 continuous hexadecimal digits.

— Enter the 4 hexadecimal digits which indicate the number of 256 byte units of data, then enter the starting address (4 hexadecimal digits) of the RAM area into which the data is to be loaded.

— The 4-digit hexadecimal number which indicates the amount of data is constructed as shown below.



Ex.) 512 bytes of data are loaded when 0200 is entered (0101 is also interpreted as 0200).

CS (Save disk) Command

This command saves data in 256-byte units from RAM memory in the specified sector(s) of the specified track of the floppy disk in the specified disk drive.

```
* CS [CR]
  drive? 2
  track, sect? 3002
  byte size? 0100 adrs? 7000
```

— Enter the CS command when "*" appears to indicate that command entry is awaited.

— Specify the number of the disk drive containing the floppy disk on which the data is to be saved.

— Enter the track number and the first of the sector numbers in which the data is to be saved as a 4-digit hexadecimal number.

— Enter the 4-digit hexadecimal number which indicates the number of 256 byte units of data, then enter the starting address (4 hexadecimal digits) of the RAM area from which the data is to be saved.

— The 4-digit hexadecimal number which indicates the amount of data is constructed in the same manner as for the CY command.

For example, 0101 is interpreted as 0200.

— The track number must be 3 or greater. Great care must be taken not to destroy existing data on the floppy disk.

—Formatting Commands—

P (Punch) Command

Punches data in the free area in the specified format.

＊P [CR]	Punch command
filename? CHARAGEN [CR]	File name assigned to the paper tape to be punched.
format? C [CR]	Format C
RAM from? 8000 to? 87FF	Addresses 8000 to 87FF in the free area
PROM address? 0000	PROM write address 0000

— Enter the P (Punch) command when "＊" appears to indicate that command entry is awaited.

— Next, the file name is specified. This is not the file name which is included on the disk but the name which is to be punched at the beginning of the tape. Refer to the explanations of the various formats for details. When no file name is needed, enter only [CR].

— Next, specify the conversion format (A~H) and enter [CR].

— Specify the starting and ending addresses of the memory block in the free area which is to be output with 4-digit hexadecimal numbers.

— Finally, specify the PROM write address. (This step may not be required, depending on the format.)

The P command described above outputs formatted data to a PTP device. (More precisely, $PTP/LF is used as the output device.)

The PROM FORMATTER can also output converted format data to devices other than PTP (including user I/O and disk).

(Ex. 1)	＊P$USR1 [CR]	Outputs to user I/O
(Ex. 2)	＊PXYZ [CR]	Outputs file name XYZ.ASC to the diskette.
(Ex. 3)	＊P$PTP/PE/LF [CR]	Adds even parity to PTP, affixes [LF] after [CR] and outputs the file.

As an application, data may be sent directly to the PROM writer by creating hardware and user routines for its online interface.

R (Read) Command

This command reads in data formatted in the BNPF, HEXADECIMAL or other format from a paper tape reader.

＊R [CR]	Read command
format? C [CR]	Format C
RAM from? 8000 to 83FF	Addresses in the free area into which data is to be read.
filename PROM#2	

— Enter the R (Read) command when "＊" appears to indicate that command entry is awaited.
— Next, specify the format of the data to be read.
— Finally, specify the starting address of the free area into which the data is to be read with a 4-digit hexadecimal number.
— The last data address and the file name are displayed after the read is completed and entry of the next command is awaited.
— With this PROM writer format, it may not be possible to read tapes punched using other programs because of the need to maintain a certain minimum degree of redundancy.

The R command described above reads in formatted data from a PTR device, (More precisely, $PTR is used as the input device.)

The PROM FORMATTER can also read in converted format data from devices other than PTR (including user I/O and disk).

(Ex. 1)	＊R$USR2 [CR]	Inputs from user I/O
(Ex. 2)	＊RXYZ [CR]	Inputs from XYZ.ASC on a disk.
(Ex. 3)	＊R$PTR/PE [CR]	Inputs data with even parity affixed from PTR.

—Other Commands—

M (Memory dump/modify) Command

This command is used to display and modify the contents of the free area.

```
＊ M [CR]                                          M command
 RAM from? 7000 to? 7014                           Area to be displayed
7000 ED 73 C8 5F 01 C6 5F 09   m S H ▔ ↓ F ▔ .
7008 60 22 D8 CD 3E 28 CA 27   ` " X M > ( J '
7010 28 22 DE 26 CD            ( " ^ & M
```

— Enter the M (Memory dump/modify) command when "＊" appears to indicate that command entry is awaited.
— Next, specify the starting and ending addresses in the free area of the data to be displayed with 4-digit hexadecimal numbers.
— The PROM formatter, in the 40 (80) characters per line mode, divides data in the specified addresses into 8-byte segments and displays the address (4 hexadecimal digits), the 8 (16) bytes of data (as groups of 2 hexadecimal digits) and the 8 (16) corresponding ASCII characters in that order.
However, when the corresponding ASCII character cannot be displayed, a " . " is displayed in its place. Further, data is printed in 16 byte segments when the printer is used with the " # " command.
— Execution of the M command can be suspended or resumed by pressing [SPACE]. A switch can be made to the command entry mode by pressing [BREAK].
— If no change is required in data displayed using the M command, just press [CR]. When a change is required, move the cursor to the position where the change is to be made and press [CR] after entering the 2 new hexadecimal digits. (The change is made when [CR] is pressed.) After data modification is completed, move the cursor to an empty line and press [CR] to return to the command wait state.

— Data can also be changed using the cursor when display is halted with [SPACE]. In this case, display is resumed when the cursor is moved to an empty line and [CR] is pressed.

Caution: Data is only printed when the printer is used with the " # " command; modification of data is not possible in this case.

V (Verify) Command

Reads data formatted in BNPF, HEXADECIMAL and so forth from the paper tape reader and compares it with the contents of the RAM free area.

＊V [CR]	Verify command
format? C [CR]	Format C
RAM from? 8000 to 8615	The start and end addresses of the area containing
filename ABC	the data to be compared.
Verify OK.	

— Enter the V (Verify) command when "＊" appears to indicate that command entry is awaited.
— Specify the format of data to be read.
— Specify the start address (4-digit hexadecimal) of the area containing the data to be compared.
— The end address of the data read is displayed and "Verify OK." is displayed when the data read matches the data compared. If not, the end address is not displayed and "Verify error." is displayed.

\ (DOS) Command

This command invokes the specified built-in DOS command. Command entry is awaited after execution of the DOS command.

```
＊\ DIR [CR]
```

— Enter the \ command when "＊" appears to indicate that command entry is awaited.
— Next, specify the built-in DOS command and press the [CR] key.
— The PROM formatter executes the built-in DOS command, then awaits entry of the next PROM formatter command.
— The XFER and EXEC commands cannot be executed. The RUN command cannot be executed if the program executed by the RUN command is too long.

(Change printer mode) Command

This command starts and stops output to the printer. Printer output is OFF when the PROM formatter is activated, and is changed from ON to OFF to ON each time the " # " command is executed.

When printer output is ON, data is printed almost as it appears on the display screen.

& (Clear) Command

Buries the entire free area in hexadecimal code FFH.

? (Disp free area) Command

Displays the free area.

! (Return) Command

Terminates the PROM formatter and returns to Floppy DOS.

—Format Commands—

Format commands are commands entered when "format?" is displayed during execution of the P, R or V commands. Selecting one of these commands during execution of the P command determines whether data is to be punched in BNPF, HEXADECIMAL or other format. Failure to specify the correct format command during execution of the R command will result in failure to correctly read the program into the free area.

A Command

— Used to specify the Britronics BNPF format. The control character "B" may not be used when the file name is specified.

B Command

— Used to specify the Britronics HEXADECIMAL format.

C Command

— Used to specify the Britronics BINARY format. Numerals and the codes (:;<=>?) may not be used when the file name is specified.

— The message "PROM address?" is displayed during execution of the P command to request specification of the PROM loading address; specify it as a 4-digit number.

— Check sums are written following the data (with the P command).

— Data from the address specification to the check sums constitutes one block; if data is to be loaded into an address which has been skipped, the operation must be divided into two or more parts. This also applies when two or more blocks are read in with the R command.

D Command

— This command is used to specify the Intel BNPF format. The character "B" cannot be used in the file name.

E Command

— This command is used to specify the Takeda Riken BNPF format. The character "B" may be used in the file name.

— A file is a block which begins with " $ " and ends with ") ".

— The message "PROM address?" is displayed during execution of the P command to request specification of the PROM loading address; specify it as a 4-digit number.

— If two or more blocks are to be read out or written in, the operation must be divided into two or more parts.

F Command

— This command is used to specify the Takeda Riken B10F format. The character "B" may be used in the file name.

— A file is a block which begins with " $ " and ends with ") ".

— The message "PROM address?" is displayed during execution of the P command to request specification of the PROM loading address; specify it as a 4-digit number.

— If two or more blocks are to be read out or written in, the operation must be divided into two or more parts.

G Command

— This command is used to specify the Takeda Riken HEXADECIMAL format.

— A file is block which begins with " $ " and ends with ") ".

— The message "PROM address?" is displayed during execution of the P command to request specification of the PROM loading address; specify it as a 4-digit number.

— If two or more blocks are to be read out or written in, the operation must be divided into two or more parts.

H Command

— This command is used to specify the Minato Electronics HEXADECIMAL format.

— The start-of-data symbol " [" may not be used in the file name.

— The message "PROM address?" is displayed during execution of the R command to request specification of the PROM loading address; specify it as a 4-digit number.

— Denote the end of data with the symbol "] ".

PROM FORMATTER (SB-7501) COMMANDS & MESSAGES

COMMAND		OPERATION
File Input/ Output commands	Y (Yank)	Loads a program (data) from the disk into the free area.
	S (Save)	Saves the program (data) in the free area on disk.
	CY (Yank disk)	Loads data in 256-byte units from the specified sector(s) of the specified track on the disk into RAM.
	CS (Save disk)	Saves data in 256-byte units from RAM memory in the specified sector(s) of the specified track of the disk.
Format commands	P (Punch)	Punches the specified contents of the free area in the specified format.
	R (Read)	Reads in a paper tape punched in the format specified.
Other commands	M (Memory)	Displays and modifies data in the free area.
	V (Verify)	Reads data from the paper tape reader and compares it with the contents of the RAM free area.
	\ (DOS)	Executes the specified built-in DOS command.
	#	Switches the list mode for listing on a printer.
	& (Clear)	Buries all data in the free area in hexadecimal code FFH.
	?	Displays the starting and ending addresses of the free area.
	! (Return)	Returns control to Floppy DOS.

Error message	Error content	Related command
memory protection	An address outside of the free area was specified.	Y, S, P, R, M, V
il command	The command was not entered correctly.	
il data	The format specified does not match the format read.	R, V
check sum	Check sum error.	R, V
$ LPT : not ready	The printer is not ready.	#
$ PTP : not ready	The paper tape punch is not ready.	P
$ PTR : not ready	The paper tape reader is not ready.	R, V

See the "System Error Messages" in System Command for other error messages.

Caution:

Entry of characters other than S, Y, CS, CY, P, R, M, V, \, &, #, ? or ! will cause a return to the command wait state after the command table is displayed.

If a character other than A~H is input while "format?" is displayed and format entry awaited, the format table will be displayed, after which the format entry wait state will be reentered. A return can be made to the command wait state at this time by pressing [BREAK].

EXAMPLE OF PLOTTER CONTROL APPLICATION

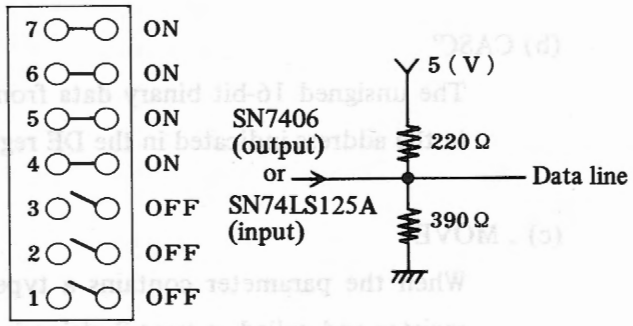
Use of the Floppy DOS editor, assembler and BASIC compiler allows the familiar BASIC language to be used to write main programs without loss in processing speed, as long as control programs are created for control of the various devices. Another benefit is that commands developed by the user can be used as BASIC commands.

—Interface Card—

Universal interface card MZ-80IO2 is used for the interface between the MZ-80B computer and the MIPLOT WX4671 plotter.

The connection conditions are as shown in Figure 1.

Output port (0FH)		Input port (0EH)	
I/O card	Plotter side	I/O card	Plotter side
O 27	STROBE	I 17	Grounded on the universal interface card
O 26	DB 6	I 16	
O 25	DB 5	I 15	
O 24	DB 4	I 14	
O 23	DB 3	I 13	
O 22	DB 2	I 12	
O 21	DB 1	I 11	ERROR
O 20	DB 0	I 10	BUSY



a) Connection conditions for all input/output terminals b) Address switch settings c) Data line termination conditions

Fig. 1 Connection conditions

SN7404 is included as the data driver for the universal interface card, but ICs 16 and 17 only are changed to SN7406. All data line and status input terminations are made as shown in Figure 1-c). A 1.5 m cable can be used for this purpose.

See the universal interface card instructions for details.

—Plotter Control Program—

This section may skip if you are not interested in assembly subroutines.

1. Conditions for linkage with a BASIC program

Conditions for linkage with a BASIC program

(a) Command names must be externally declared with the ENT statement .....SIZE : ENT

(b) The number of parameters must be specified ..... DEFB 1 (1 parameter)

(c) The parameter type must be specified. ..... DEFB 0 (real number)

(d) Buffers must be specified for parameters. ..... SE : DEFS 2 (2 bytes reserved)

(e) The RET instruction must be included at the end of all control routines.

The above are the linkage conditions; the processing program is written between items (d) and (e).

2. Linkage conditions when an error occurs

(a) A subroutine is used from Floppy DOS library RELO.LIB ..... CALL BEERR

(b) The error number is written. ..... DEFB 80

(c) The error message is written. ..... DEFM 'PLOTTER ERROR'

(d) The terminator is written. ..... DEFB 0DH

This causes ＊ ER 80:PLOTTER ERROR to be output on the display screen when a plotter error occurs.

3. Use of external subroutines

This control program uses 4 routines out of the subroutines included in Floppy DOS library RELO.LIB. One of these is BEERR, which was shown above; the remaining three are as follows;

(a) . . INT0

16 bit binary data is set in the HL register with a sign attached when an address with a parameter is loaded in the HL register and called. All registers except the AF register are protected in the event of an overflow if the carry flag is set.

(b) CASC'

The unsigned 16-bit binary data from the HL register is converted to ASCII code and stored in the address indicated in the DE register, then 0DH is set.

(c) . MOVE'

When the parameter contains a type 1 string and an address with data is loaded in the HL register and called, a type 2 string is set in the address indicated by the DE register and 0DH is set.

See the "LIBRARY/ PACKAGE" instructions for details on all subroutines.

4. Plotter control codes

All data for the MIPLOT WX4671 currently used is in 7-bit ASCII code. Input statuses include the BUSY signal and the ERROR signal. Data output is possible when the BUSY signal goes low, and the data is taken in on the plotter side when the STROBE signal is output.

" , " (that is, 2CH) is used as the data delimiter and 03H~0DH are valid as data terminators. However, only 0AH will be accepted when an error occurs; an error condition is not cleared by any data terminator other than 0AH.

At the port on the MZ-80 side, 0EH is used for the status (that is, as the input for the BUSY and ERROR signals) and 0FH is used for the data and STROBE signal output.

5. Program outline

Linkage conditions for a BASIC program have already been indicated; however, string type becomes applicable in the parameter type specification with the 80H. Moreover, parameter types and parameter buffers must be added depending on the number of parameters; the steps described in subparagraphs (c) and (d) of that section are not required if the number of parameters is zero. See routines CTYPE, SIZE, PLOT, HOME and so forth of the assembly listing for this.

This illustrated using the PLOT routine as a representative example. The flowchart is as shown in Figure 2 (pages 4 and 5).

(a) Data output

Although subroutines COUT, PLOT1 and DOUT are used, DOUT is the one which actually outputs the data. With DOUT, the data set in the accumulator is output to the plotter with the STROBE signal if the BUSY signal of the plotter is LOW. If BUSY is HIGH the routine repeats a loop.

With COUT and PLOT1, the data at the address indicated in the HL register is loaded in the accumulator and then DOUT is executed; this is repeated until 0DH is output. After 0DH is output, a check is made for plotter errors and a jump is made to the error routine if any are found. Note that continuation of program execution is possible if ON ERROR processing is provided on the BASIC side.

(b) Data conversion routine

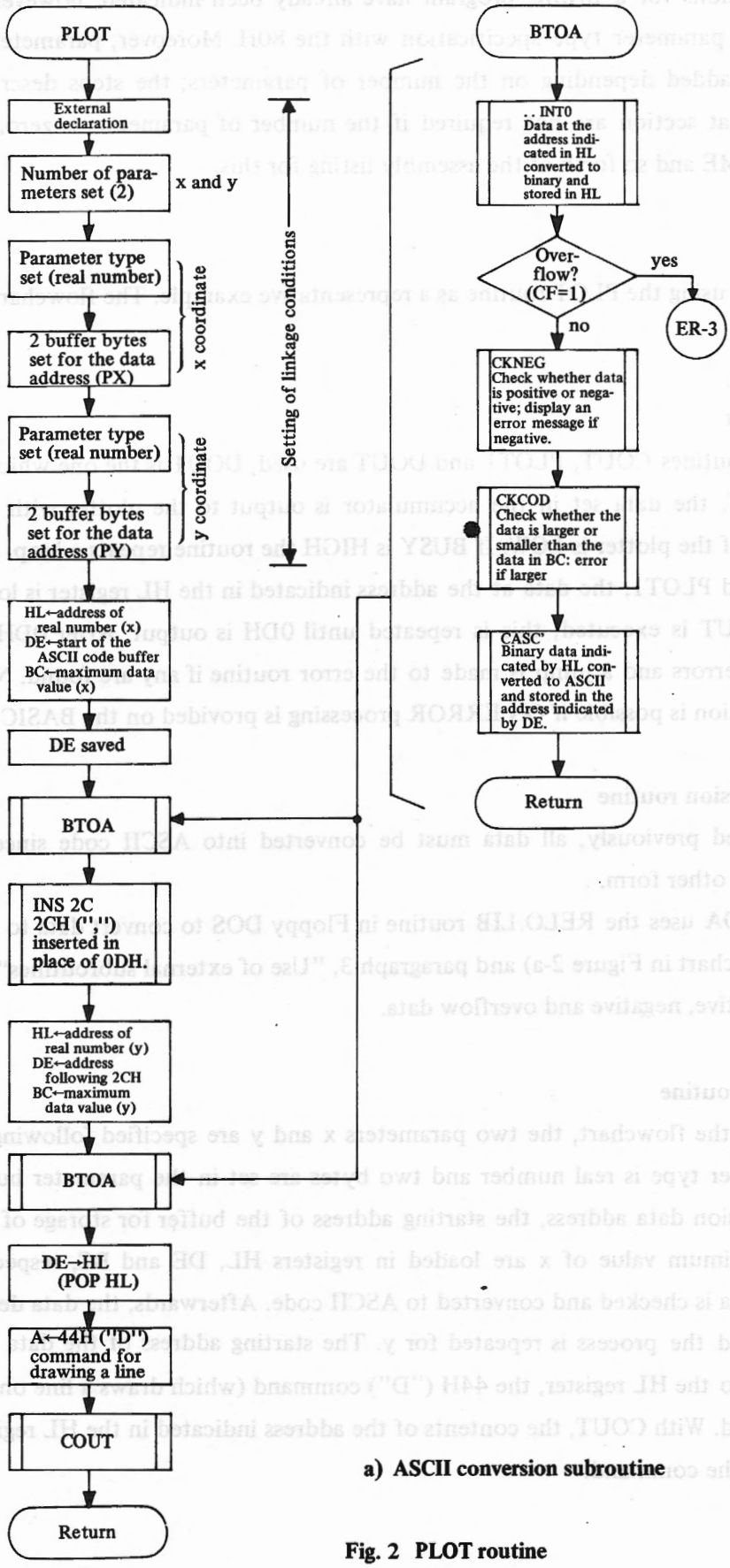
As was indicated previously, all data must be converted into ASCII code since the plotter will not accept data in any other form.

Subroutine BTOA uses the RELO.LIB routine in Floppy DOS to convert data to ASCII code. This is as shown in the flowchart in Figure 2-a) and paragraph 3, "Use of external subroutines"; however, checks are also made for positive, negative and overflow data.

(c) PLOT x, y routine

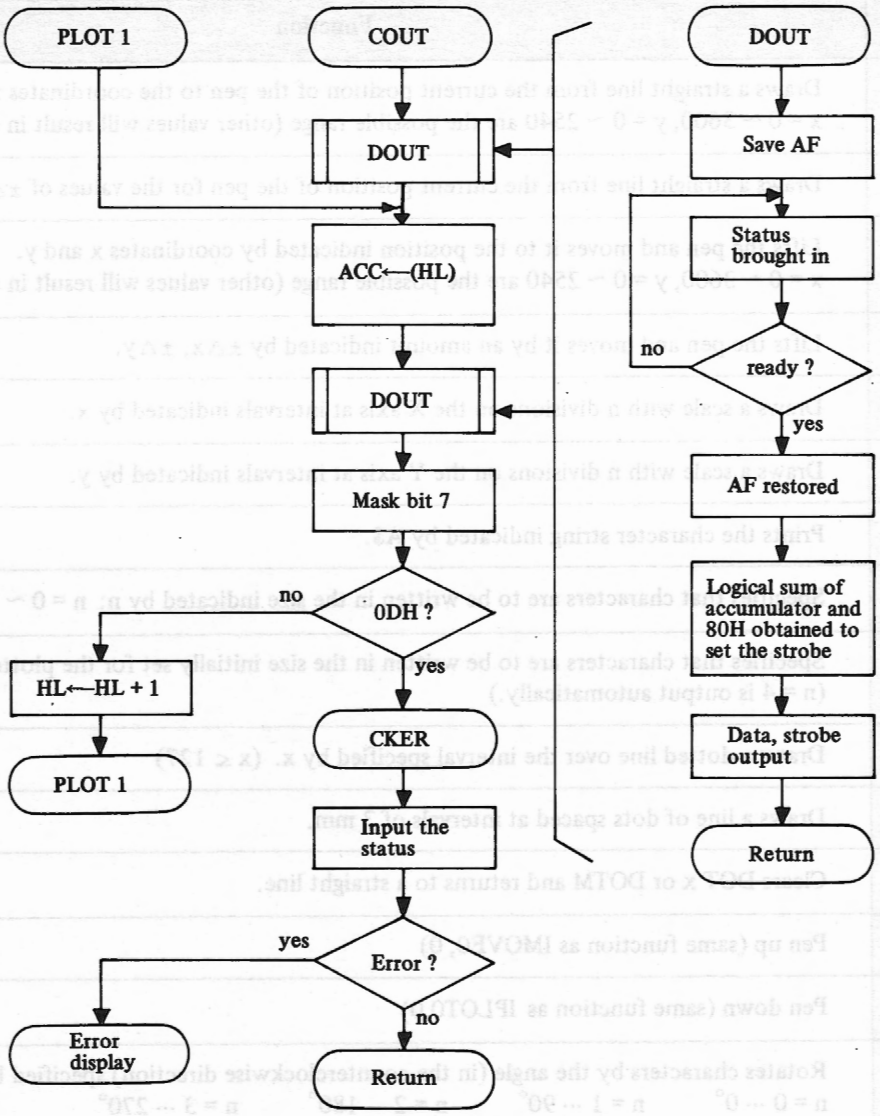
As is shown in the flowchart, the two parameters x and y are specified following the external declaration. The parameter type is real number and two bytes are set in the parameter buffer for both x and y.

The pre-conversion data address, the starting address of the buffer for storage of the data after conversion and the maximum value of x are loaded in registers HL, DE and BC, respectively, then BTOA is called and the data is checked and converted to ASCII code. Afterwards, the data delimiter for the plotter " , " is loaded and the process is repeated for y. The starting address of the data converted into ASCII code is loaded into the HL register, the 44H ("D") command (which draws a line on the plotter) is loaded and COUT is called. With COUT, the contents of the address indicated in the HL register are output to the plotter following the command.



a) ASCII conversion subroutine

Fig. 2 PLOT routine



b) Data output subroutine

Fig. 2 PLOT routine

—Command Table—

Table 1. Plotter control commands

Command name	Function
PLOT x, y	Draws a straight line from the current position of the pen to the coordinates x, y; x = 0 ~ 3600, y = 0 ~ 2540 are the possible range (other values will result in an error).
IPLOT △x, △y	Draws a straight line from the current position of the pen for the values of ±△x, ±△y only.
MOVE x, y	Lifts the pen and moves it to the position indicated by coordinates x and y. x = 0 ~ 3600, y = 0 ~ 2540 are the possible range (other values will result in an error).
IMOVE △x, △y	Lifts the pen and moves it by an amount indicated by ±△x, ±△y.
XAXIS x, n	Draws a scale with n divisions on the X axis at intervals indicated by x.
YAXIS x, n	Draws a scale with n divisions on the Y axis at intervals indicated by y.
CTYPE A$	Prints the character string indicated by A$.
SIZE n	Specifies that characters are to be written in the size indicated by n; n = 0 ~ 15
CSIZE	Specifies that characters are to be written in the size initially set for the plotter. (n = 4 is output automatically.)
DOT x	Draws a dotted line over the interval specified by x. (x ≤ 127)
DOTM	Draws a line of dots spaced at intervals of 3 mm.
DOT0	Clears DOT x or DOTM and returns to a straight line.
PUP	Pen up (same function as IMOVE0, 0)
PDOWN	Pen down (same function as IPLOT0,0)
ANGL n	Rotates characters by the angle (in the counterclockwise direction) specified by n. n = 0 ~ 3 n = 0 ··· 0° n = 1 ··· 90° n = 2 ··· 180° n = 3 ··· 270°
MARK n	Writes the mark specified by n. n = 1 ~ 6 n = 1 ··· · n = 2 ··· ◇ n = 3 ··· □ n = 4 ··· △ n = 5 ··· ⧖ n = 6 ··· ◎
HOME	Moves the pen to the x, y coordinates it was at when the power was turned on, clears the error lamp and clears plotter error.
ERCLR	Clears plotter errors when they occur; the error lamp is not cleared, however.
(Note)	Values indicated by x and y are specified as integral multiples of 0.1 mm; for example, PLOT 100, 2000 results in a line being drawn to x = 10 mm and y = 200 mm.

—Outline of the BASIC Program—

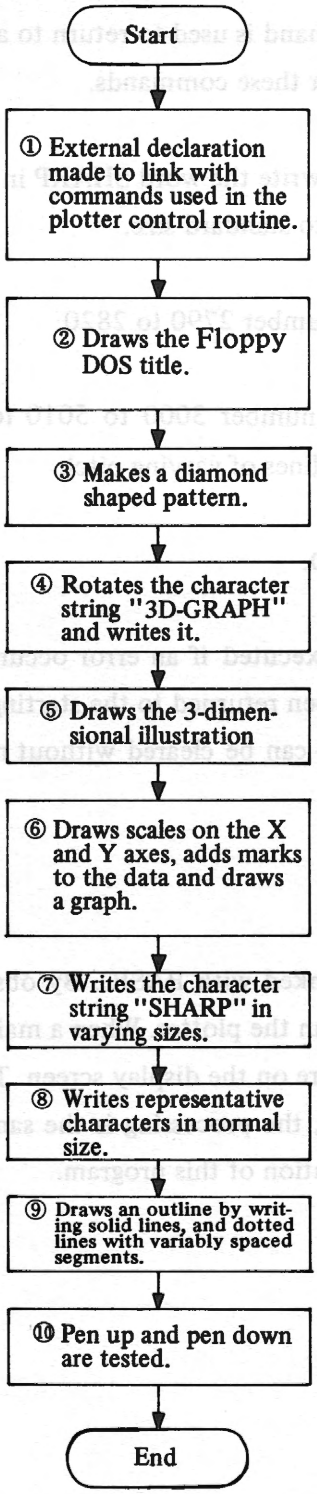


Fig. 3 Flowchart of the BASIC program

As is indicated in the flowchart at left, the program consists of 10 subroutines.

At ①, the EXTERNAL statement is used for linking the program with the plotter control program commands. Although it is not necessary to use line numbers with statements other than GOTO and GOSUB, they are used in other locations to make the program easier to understand.

At ②, the title of Floppy DOS is drawn from line number 110 to 910. This routine uses the MOVE, IMOVE, PLOT and IPLOT commands.

At ③, a diamond pattern is drawn from line number 920 to 1050. MOVE X, Y is used to return the pen to the starting point, while IPLOT A, B is used to draw the pattern.

At ④, "3D-GRAPH" specified by A$ is written at 90° angles with ANGL 1 and CTYPE A$ from line number 1090 to 1140.

At ⑤, repetitions of attenuated SIN(X) and a 3-dimensional graph are drawn from line number 1190 to 1910. The 3-dimensional graph is drawn in dots using the PUP and PDOWN commands.

Try changing the program from line number 1500 to 1510 as shown below to draw the graph with solid lines.

```
1500  IF (A – 2) > T THEN 1520
1502  T = A
1504  IF S = 0 THEN MOVE DX, DY : GOTO 1508
1506  PLOT DX, DY
1508  PDOWN : S = 1
1510  RETURN
1520  MOVE DX, DY : T = A : S = 0 : GOTO 1510
```

With this program, S indicates the pen status; S = 0 raises the pen while S = 1 lowers it.

At ⑥, scales are drawn on the X and Y axes with the XAXIS and YAXIS commands and marks are drawn on the graph with the MARK command; this processing is performed from line 1990 to line 2190. The dotted line is drawn with the DOTM command, and the DOT0 command is used to return to a solid line. The curve is a drawing of SIN(X)/X. Refer to the command table for these commands.

At ⑦, the SIZE command is used from line number 2390 to 2460 to write the word SHARP in characters of varying sizes. Afterwards, the CSIZE command is used to return to standard size.

At ⑧, representative characters of standard size are drawn from line number 2790 to 2820.

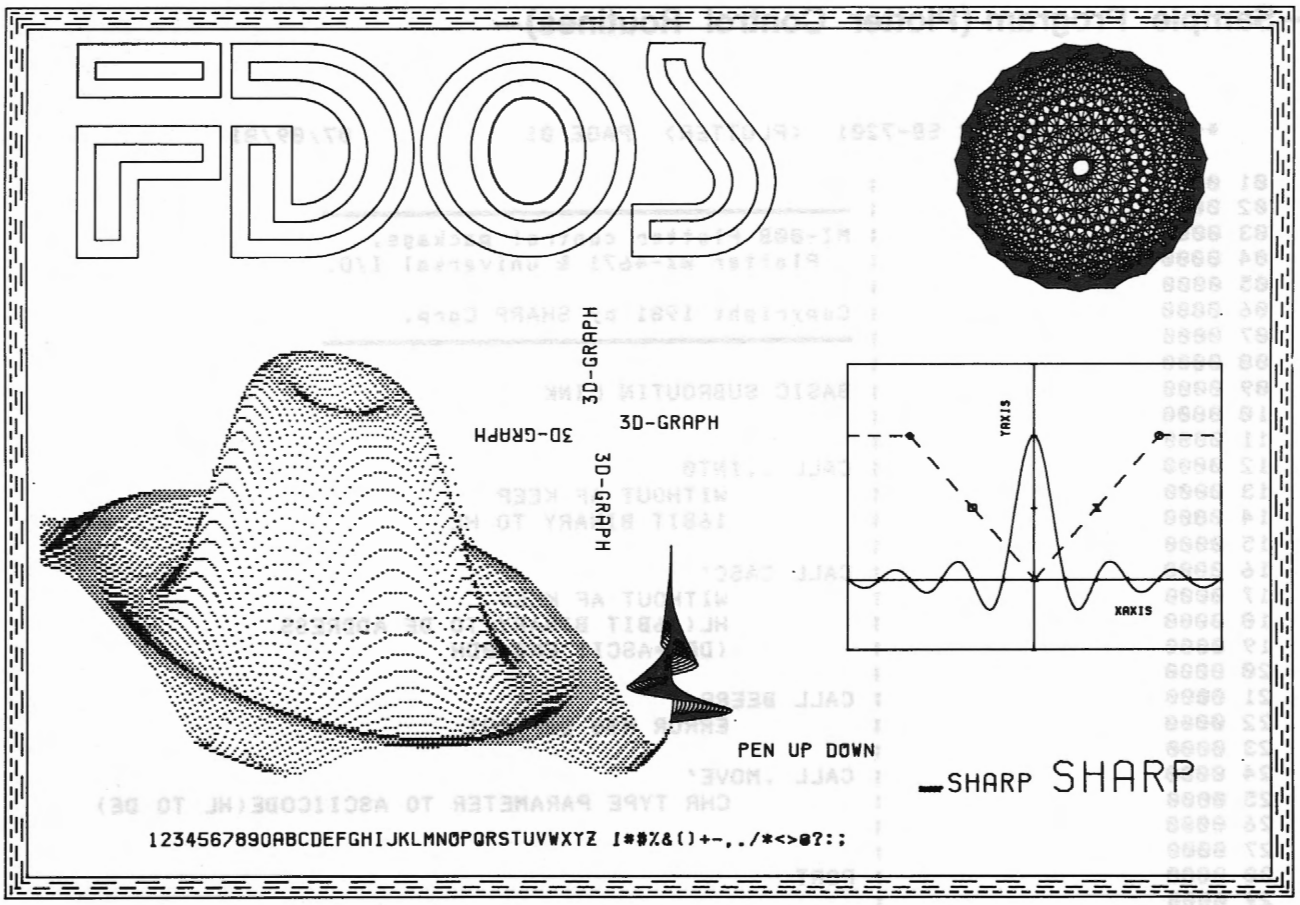
At ⑨, the HOME, DOT and DOT0 commands are used from line number 3000 to 5010 to draw the the surrounding outline by changing between solid lines and dotted lines of varying pitch.

At ⑩, pen up and pen down are tested from line number 5100 to END.

If the program is written so that the HOME command can be executed if an error occurs with the plotter, the error can be cleared, the error lamp extinguished and the pen returned to the starting position. If the ERCLR command is used (it is not in this program), the error can be cleared without moving the pen; however, in this case the error lamp is not extinguished.

—Conclusion—

As has been shown above, user-written programs can be easily linked with BASIC. By observing the conditions for linkage, it is possible to connect many devices other than the plotter. When a main program is created using the assembler, it may be necessary to output a picture on the display screen. The BASIC compiler and Floppy DOS are very useful for this purpose. Further, the processing is the same as with machine language. The photograph on page 9 shows the result of execution of this program.



—References—

1. Watanabe Manufacturing Co., MIPLOT WX4671 Instruction Manual
2. Sharp Corp., Universal Interface Card Instruction Manual

—Sample Program (Plotter Control Routines)—

```
   **  Z80 ASSEMBLER SB-7201  <PLOTTER>  PAGE 01          07/09/81

01 0000                    ;
02 0000                    ; ----------------------------------------
03 0000                    ; MZ-80B Plotter control package.
04 0000                    ;   Plotter WX-4671 & universal I/O.
05 0000                    ;
06 0000                    ; Copyright 1981 by SHARP Corp.
07 0000                    ; ----------------------------------------
08 0000                    ;
09 0000                    ; BASIC SUBROUTIN LINK
10 0000                    ;
11 0000                    ;
12 0000                    ; CALL ..INT0
13 0000                    ;         WITHOUT AF KEEP
14 0000                    ;         16BIT BINARY TO HL
15 0000                    ;
16 0000                    ; CALL CASC'
17 0000                    ;         WITHOUT AF KEEP
18 0000                    ;         HL(16BIT BINARY)TO DE ADDRESS
19 0000                    ;         (DE)=ASCII END=0DH
20 0000                    ;
21 0000                    ; CALL BEERR
22 0000                    ;         ERROR MSG DSP-OUT
23 0000                    ;
24 0000                    ; CALL .MOVE'
25 0000                    ;         CHR TYPE PARAMETER TO ASCIICODE(HL TO DE)
26 0000                    ;
27 0000                    ;
28 0000                    ; PORT
29 0000                    ;
30 0000  P                 PLTS:   EQU   0EH             ;PLOTTER STATUS READ
31 0000  P                 PLTD:   EQU   0FH             ;PLOTTER DATA OUT
32 0000                    ;
33 0000                    ; MOVE X,Y(PEN UP)
34 0000                    ;
35 0000                    MBUFF:  DEFS  +16
36 0010                    ;
37 0010                    MOVE:   ENT
38 0010 02                         DEFB  2              ;NO OF PARAMETER
39 0011 00                         DEFB  0              ;REAL NO.
40 0012                    MX:     DEFS  +2
41 0014 00                         DEFB  0              ;REAL NO.
42 0015                    MY:     DEFS  +2
43 0017                    ;
44 0017 2A1200                     LD    HL,(MX)
45 001A 110000                     LD    DE,MBUFF
46 001D D5                         PUSH  DE
47 001E 01110E                     LD    BC,0E11H       ;3600
48 0021 CD5202                     CALL  BTOA
49 0024 CD8302                     CALL  INS2C
50 0027 2A1500                     LD    HL,(MY)
51 002A 01ED09                     LD    BC,09EDH       ;2540
52 002D CD5202                     CALL  BTOA
53 0030 E1                         POP   HL
54 0031 3E4D                       LD    A,4DH          ;'M' MOVE CMD
55 0033 C34201                     JP    COUT
56 0036                    ;
57 0036                    ; INCREASE MOVE(PEN UP)DX,DY
58 0036                    ;
59 0036                    IMBUFF: DEFS  +16
60 0046                    ;
```

```
01 0046                 IMOVE:  ENT
02 0046 02                      DEFB    2               ;NO OF PARAMETER
03 0047 00                      DEFB    0               ;REAL
04 0048                 IMX:    DEFS    +2
05 004A 00                      DEFB    0               ;REAL
06 004B                 IMY:    DEFS    +2
07 004D                 ;
08 004D 2A4800                  LD      HL,(IMX)
09 0050 113600                  LD      DE,IMBUFF
10 0053 D5                      PUSH    DE
11 0054 01110E                  LD      BC,0E11H        ;3600
12 0057 CD6202                  CALL    NSBTOA
13 005A CD8302                  CALL    INS2C
14 005D 2A4B00                  LD      HL,(IMY)
15 0060 01ED09                  LD      BC,09EDH        ;2540
16 0063 CD6202                  CALL    NSBTOA
17 0066 E1                      POP     HL
18 0067 3E52                    LD      A,52H           ;'R' RELATIVE MOVE CMD
19 0069 C34201                  JP      COUT
20 006C                 ;
21 006C                 ; X-AXIS
22 006C                 ;
23 006C                 QRXBUF: DEFS    +16
24 007C                 ;
25 007C                 XAXIS:  ENT
26 007C 02                      DEFB    2               ;NO OF PARAMETER
27 007D 00                      DEFB    0               ;REAL
28 007E                 QX:     DEFS    +2
29 0080 00                      DEFB    0               ;REAL
30 0081                 RX:     DEFS    +2
31 0083                 ;
32 0083 2A7E00                  LD      HL,(QX)
33 0086 116C00                  LD      DE,QRXBUF
34 0089 D5                      PUSH    DE
35 008A 01110E                  LD      BC,0E11H        ;3600
36 008D CD5202                  CALL    BTOA
37 0090 CD8302                  CALL    INS2C
38 0093 2A8100                  LD      HL,(RX)
39 0096 01110E                  LD      BC,0E11H        ;3600
40 0099 CD5202                  CALL    BTOA
41 009C 3E31                    LD      A,31H           ;'1'
42 009E 1832                    JR      AXOUT
43 00A0                 ;
44 00A0                 ; Y-AXIS
45 00A0                 ;
46 00A0                 QRYBUF: DEFS    +16
47 00B0                 ;
48 00B0                 YAXIS:  ENT
49 00B0 02                      DEFB    2               ;NO OF PARAMETER
50 00B1 00                      DEFB    0               ;REAL
51 00B2                 QY:     DEFS    +2
52 00B4 00                      DEFB    0               ;REAL
53 00B5                 RY:     DEFS    +2
54 00B7                 ;
55 00B7 2AB200                  LD      HL,(QY)
56 00BA 11A000                  LD      DE,QRYBUF
57 00BD D5                      PUSH    DE
58 00BE 01ED09                  LD      BC,09EDH        ;2540
59 00C1 CD5202                  CALL    BTOA
60 00C4 CD8302                  CALL    INS2C
```

```
00C7 2AB500                     LD    HL,(RY)
00CA 01ED09                     LD    BC,09EDH          ;2540
00CD CD5202                     CALL  BTOA
00D0 3E30                       LD    A,30H             ;'0'
00D2 CD2302             AXOUT:  CALL  AXIS
00D5 E1                         POP   HL
00D6 186D                       JR    PLOT1
00D8                    ;
00D8                    ; INCREASE PLOT X+DX,Y+DY
00D8                    ;
00D8                    IPBUFF: DEFS  +16
00E8                    ;
00E8                    IPLOT:  ENT
00E8 02                         DEFB  2                 ;NO OF PARAMETER
00E9 00                         DEFB  0                 ;REAL
00EA                    IPX:    DEFS  +2
00EC 00                         DEFB  0                 ;REAL
00ED                    IPY:    DEFS  +2
00EF                    ;
00EF 2AEA00                     LD    HL,(IPX)
00F2 11D800                     LD    DE,IPBUFF
00F5 D5                         PUSH  DE
00F6 01110E                     LD    BC,0E11H          ;3600
00F9 CD6202                     CALL  NSBTOA
00FC CD8302                     CALL  INS2C
00FF 2AED00                     LD    HL,(IPY)
0102 01ED09                     LD    BC,09EDH          ;2540
0105 CD6202                     CALL  NSBTOA
0108 E1                         POP   HL
0109 3E49                       LD    A,49H             ;'I' INCREASE CMD
010B 1835                       JR    COUT
010D                    ;
010D                    ; PLOT X,Y
010D                    ;
010D                    PTBUFF: DEFS  +16
011D                    ;
011D                    ;
011D                    PLOT:   ENT
011D 02                         DEFB  2                 ;NO OF PARAMETER
011E 00                         DEFB  0                 ;REAL
011F                    PX:     DEFS  +2
0121 00                         DEFB  0                 ;REAL
0122                    PY:     DEFS  +2
0124                    ;
0124 2A1F01                     LD    HL,(PX)
0127 110D01                     LD    DE,PTBUFF
012A D5                         PUSH  DE
012B 01110E                     LD    BC,0E11H          ;3600
012E CD5202                     CALL  BTOA
0131 CD8302                     CALL  INS2C
0134 2A2201                     LD    HL,(PY)
0137 01ED09                     LD    BC,09EDH          ;2540
013A CD5202                     CALL  BTOA
013D E1                         POP   HL
013E 3E44                       LD    A,44H             ;'D' DRAW CMD
0140 1800                       JR    COUT
0142                    ;
0142                    ; ASCII CODE OUT SUB
0142                    ;
0142 CD2F02             COUT:   CALL  DOUT
```

```
01 0145 7E              PLOT1:  LD      A,(HL)
02 0146 CD2F02                  CALL    DOUT
03 0149 E67F                    AND     7FH
04 014B FE0D                    CP      0DH
05 014D 2803                    JR      Z,CKER
06 014F 23                      INC     HL
07 0150 18F3                    JR      PLOT1
08 0152                 ;
09 0152                 ; ERROR CHECK
10 0152                 ;
11 0152 CDCE02          CKER:   CALL    DLY
12 0155 DB0E                    IN      A,(PLTS)
13 0157 E602                    AND     02H             ;CKER(BIT 1=0?)
14 0159 C0                      RET     NZ
15 015A CD0000      E   CKER1:  CALL    BEERR
16 015D 50                      DEFB    50H             ;80
17 015E 504C4F54                DEFM    'PLOTTER ERROR'
18 0162 54455220
19 0166 4552524F
20 016A 52
21 016B 0D                      DEFB    0DH
22 016C                 ;
23 016C                 ; PRINT ASCII
24 016C                 ;
25 016C                 CTYPE:  ENT
26 016C 01                      DEFB    1               ;NO OF PARAMETER
27 016D 80                      DEFB    80H             ;CHR
28 016E                 TP:     DEFS    +2
29 0170                 ;
30 0170 2A6E01                  LD      HL,(TP)
31 0173 CD0000      E           CALL    .MOVE'
32 0176 EB                      EX      DE,HL
33 0177 3E50                    LD      A,50H           ;'P' PRINT CMD
34 0179 18C7                    JR      COUT
35 017B                 ;
36 017B                 ; SIZE ALPHA
37 017B                 ;
38 017B                 SBUF:   DEFS    +5
39 0180                 ;
40 0180                 SIZE:   ENT
41 0180 01                      DEFB    1               ;NO OF PARAMETER
42 0181 00                      DEFB    0               ;REAL
43 0182                 SE:     DEFS    +2
44 0184                 ;
45 0184 2A8201                  LD      HL,(SE)
46 0187 117B01                  LD      DE,SBUF
47 018A 011000                  LD      BC,0010H        ;15
48 018D CD5202                  CALL    BTOA
49 0190 EB                      EX      DE,HL
50 0191 3E53                    LD      A,53H           ;'S' SCALE CMD
51 0193 18AD                    JR      COUT
52 0195                 ;
53 0195                 ; DOT LINE
54 0195                 ;
55 0195                 DBUF:   DEFS    +5
56 019A                 ;
57 019A                 DOT:    ENT
58 019A 01                      DEFB    1               ;NO OF PARAMETER
59 019B 00                      DEFB    0               ;REAL
60 019C                 DT:     DEFS    +2
```

```
01 019E                 ;
02 019E 2A9C01                  LD      HL,(DT)
03 01A1 119501                  LD      DE,DBUF
04 01A4 018000                  LD      BC,0080H
05 01A7 CD5202                  CALL    BTOA
06 01AA EB                      EX      DE,HL
07 01AB 3E42            DOTWR:  LD      A,42H           ;'B' LINE GAGE CMD
08 01AD CD4201                  CALL    COUT
09 01B0 21A202                  LD      HL,DOTMSG
10 01B3 188D                    JR      COUT
11 01B5                 ;
12 01B5                 DOTM:   ENT
13 01B5 00                      DEFB    0               ;NO PARAMETER
14 01B6 219F02                  LD      HL,DOIMSG
15 01B9 18F0                    JR      DOTWR
16 01BB                 DOT0:   ENT
17 01BB 00                      DEFB    0               ;NO PARAMETER
18 01BC 219C02                  LD      HL,LTMSG
19 01BF 180A                    JR      CNCT
20 01C1                 CSIZE:  ENT
21 01C1 00                      DEFB    0               ;NO PARAMETER
22 01C2 21A502                  LD      HL,ISMSG
23 01C5 1804                    JR      CNCT
24 01C7                 ;
25 01C7                 ; PEN UP
26 01C7                 ;
27 01C7                 PUP:    ENT
28 01C7 00                      DEFB    0               ;NO PARAMETER
29 01C8 21A802                  LD      HL,PUMSG
30 01CB C34501          CNCT:   JP      PLOT1
31 01CE                 ;
32 01CE                 ; PEN DOWN
33 01CE                 ;
34 01CE                 PDOWN:  ENT
35 01CE 00                      DEFB    0               ;NO PARAMETER
36 01CF 21AD02                  LD      HL,PDMSG
37 01D2 18F7                    JR      CNCT
38 01D4                 ;
39 01D4                 ; ERROR CLEAR
40 01D4                 ;
41 01D4                 ERCLR:  ENT
42 01D4 00                      DEFB    0               ;NO PARAMETER
43 01D5 1806                    JR      LFOUT
44 01D7                 ;
45 01D7                 ; HOME
46 01D7                 ;
47 01D7                 HOME:   ENT
48 01D7 00                      DEFB    0               ;NO PARAMETER
49 01D8 3E48                    LD      A,48H           ;'H' HOME
50 01DA CD2F02                  CALL    DOUT
51 01DD 3E0A            LFOUT:  LD      A,0AH           ;ER CLEAR CMD
52 01DF 184E                    JR      DOUT
53 01E1                 ;
54 01E1                 ; ROTATE ALPHA
55 01E1                 ;
56 01E1                 PBUF:   DEFS    +5
57 01E6                 ;
58 01E6                 ANGL:   ENT
59 01E6 01                      DEFB    1               ;NO OF PARAMETER
60 01E7 00                      DEFB    0               ;REAL
```

```
01 01E8                    AL:     DEFS  2
02 01EA                    ;
03 01EA 2AE801                     LD    HL,(AL)
04 01ED 11E101                     LD    DE,PBUF
05 01F0 010400                     LD    BC,0004H
06 01F3 CD5202                     CALL  BTOA
07 01F6 EB                         EX    DE,HL
08 01F7 3E51                       LD    A,51H          ;'Q' ROTATE CMD
09 01F9 C34201                     JP    COUT
10 01FC                    ;
11 01FC                    ; MARK
12 01FC                    ;
13 01FC                    MBUF:   DEFS  +5
14 0201                    ;
15 0201                    MARK:   ENT
16 0201 01                         DEFB  1              ;NO OF PARAMETER
17 0202 00                         DEFB  0              ;REAL
18 0203                    MK:     DEFS  +2
19 0205                    ;
20 0205 2A0302                     LD    HL,(MK)
21 0208 CD0000      E              CALL  ..INT0
22 020B DA0000      E              JP    C,ER3
23 020E CDB202                     CALL  CKNEG
24 0211 010700                     LD    BC,0007H
25 0214 CD8D02                     CALL  CKCOD0
26 0217 11FC01                     LD    DE,MBUF
27 021A CD0000      E              CALL  CASC'
28 021D EB                         EX    DE,HL
29 021E 3E4E                       LD    A,4EH          ;'N' MARK CND
30 0220 C34201                     JP    COUT
31 0223                    ;
32 0223                    ; AXIS SUB
33 0223                    ;
34 0223 F5                 AXIS:   PUSH  AF
35 0224 3E58                       LD    A,58H          ;'X' AXIS CMD
36 0226 CD2F02                     CALL  DOUT
37 0229 F1                         POP   AF
38 022A CD2F02                     CALL  DOUT
39 022D 3E2C               AXIS1:  LD    A,2CH          ;',' DELIMITER
40 022F                    ;
41 022F                    ;
42 022F                    ;;;;;;;;;;
43 022F                    ;
44 022F                    ; PLOTTER DATA CONTROL
45 022F                    ;         A=DATA
46 022F                    ;
47 022F                    ;;;;;;;;;;;
48 022F                    ;
49 022F F5                 DOUT:   PUSH  AF
50 0230 DB0E               DOUTP:  IN    A,(PLTS)
51 0232 CB47                       BIT   0,A
52 0234 20FA                       JR    NZ,DOUTP
53 0236 F1                         POP   AF
54 0237 D30E                       OUT   (PLTD),A
55 0239 F680                       OR    80H
56 023B CDCE02                     CALL  DLY
57 023E D30E                       OUT   (PLTD),A
58 0240 F5                         PUSH  AF
59 0241 DB0E               DOUTQ:  IN    A,(PLTS)
60 0243 CB47                       BIT   0,A
```

```
01 0245 28FA                    JR    Z,DOUTQ
02 0247 3EFF                    LD    A,FFH
03 0249 3D                      DEC   A
04 024A 20FD                    JR    NZ,-1
05 024C F1                      POP   AF
06 024D E67F                    AND   7FH
07 024F D30E                    OUT   (PLTD),A
08 0251 C9                      RET
09 0252                 ;
10 0252                 ; BINARY TO ASCII
11 0252                 ;
12 0252 CD0000      E   BTOA:   CALL  ..INT0
13 0255 DA0000      E           JP    C,ER3
14 0258 CDB202                  CALL  CKNEG
15 025B CD9202                  CALL  CKCOD
16 025E CD0000      E           CALL  CASC'
17 0261 C9                      RET
18 0262                 ;
19 0262                 ;
20 0262 CD0000      E   NSBTOA: CALL  ..INT0
21 0265 DA0000      E           JP    C,ER3
22 0268 CD7202                  CALL  INS2D
23 026B CD9202                  CALL  CKCOD
24 026E CD0000      E           CALL  CASC'
25 0271 C9                      RET
26 0272                 ;
27 0272                 ; IF NEG... INSERT '-'
28 0272                 ;
29 0272 7C              INS2D:  LD    A,H
30 0273 CB7F                    BIT   7,A
31 0275 C8                      RET   Z
32 0276 3E2D                    LD    A,2DH           ;'-'
33 0278 12                      LD    (DE),A
34 0279 13                      INC   DE
35 027A 7D                      LD    A,L
36 027B 2F                      CPL
37 027C 6F                      LD    L,A
38 027D 7C                      LD    A,H
39 027E 2F                      CPL
40 027F 67                      LD    H,A
41 0280 23                      INC   HL
42 0281 C9                      RET
43 0282                 ;
44 0282                 ; SEEK 0D,INSERT 2C
45 0282                 ;
46 0282 13                      INC   DE
47 0283 1A              INS2C:  LD    A,(DE)
48 0284 FE0D                    CP    0DH
49 0286 20FA                    JR    NZ,INS2C-1
50 0288 3E2C                    LD    A,2CH
51 028A 12                      LD    (DE),A
52 028B 13                      INC   DE
53 028C C9                      RET
54 028D                 ;
55 028D                 ; CHECK DATA VALUE
56 028D                 ;
57 028D 7C              CKCOD0: LD    A,H
58 028E B5                      OR    L
59 028F CA0000      E           JP    Z,ER3
60 0292 E5              CKCOD:  PUSH  HL
```

```
01 0293 B7                      OR    A
02 0294 ED42              CKMAX:  SBC   HL,BC
03 0296 F20000      E           JP    P,ER3
04 0299 E1                      POP   HL
05 029A B7                      OR    A
06 029B C9                      RET
07 029C                   ;
08 029C                   ; LINE MSG
09 029C                   ;
10 029C 4C                LTMSG:  DEFB  4CH             ;'L' LINE CMD
11 029D 30                        DEFB  30H             ;'0'
12 029E 0D                        DEFB  0DH
13 029F                   ;
14 029F                   ; BETWEEN DOT
15 029F                   ;
16 029F 33                DOIMSG: DEFB  33H             ;'3'
17 02A0 30                        DEFB  30H             ;'0'
18 02A1 0D                        DEFB  0DH
19 02A2                   ;
20 02A2                   ; DOT MSG
21 02A2                   ;
22 02A2 4C                DOTMSG: DEFB  4CH             ;'L' LINE CMD
23 02A3 31                        DEFB  31H             ;'1'
24 02A4 0D                        DEFB  0DH
25 02A5                   ;
26 02A5                   ; INITIAL SIZE SET
27 02A5                   ;
28 02A5 53                ISMSG:  DEFB  53H             ;'S'
29 02A6 34                        DEFB  34H             ;'4'
30 02A7 0D                        DEFB  0DH
31 02A8                   ;
32 02A8                   ; PEN UP MSG
33 02A8                   ;
34 02A8 52                PUMSG:  DEFB  52H             ;'R' RELATIVE CMD
35 02A9 30                        DEFB  30H             ;'0'
36 02AA 2C                        DEFB  2CH             ;','
37 02AB 30                        DEFB  30H             ;'0'
38 02AC 0D                        DEFB  0DH
39 02AD                   ;
40 02AD                   ; PEN DOWN MSG
41 02AD                   ;
42 02AD 49                PDMSG:  DEFB  49H             ;'I' INCREASE CMD
43 02AE 30                        DEFB  30H             ;'0'
44 02AF 2C                        DEFB  2CH             ;','
45 02B0 30                        DEFB  30H             ;'0'
46 02B1 0D                        DEFB  0DH
47 02B2                   ;
48 02B2                   ; CHECK DATA SIGN
49 02B2                   ;
50 02B2 7C                CKNEG:  LD    A,H
51 02B3 CB7F                      BIT   7,A
52 02B5 C8                        RET   Z
53 02B6 CD0000      E     CKER2:  CALL  BEERR
54 02B9 51                        DEFB  51H             ;81
55 02BA 554E464F                  DEFM  'UNFORMAT DATA ERROR'
56 02BE 524D4154
57 02C2 20444154
58 02C6 41204552
59 02CA 524F52
60 02CD 0D                        DEFB  0DH
```

```
01 02CE                    ;
02 02CE C5                 DLY:    PUSH   BC
03 02CF F5                         PUSH   AF
04 02D0 060A                       LD     B,10
05 02D2 AF                 DLY2:   XOR    A
06 02D3 3D                         DEC    A
07 02D4 20FD                       JR     NZ,-1
08 02D6 10FA                       DJNZ   DLY2
09 02D8 F1                         POP    AF
10 02D9 C1                         POP    BC
11 02DA C9                         RET
12 02DB                            END
```



```
AL      01E8  ANGL    01E6  AXIS    0223  AXIS1   022D  AXOUT   00D2
BTOA    0252  CKCOD   0292  CKCOD0  028D  CKER    0152  CKER1   015A
CKER2   02B6  CKMAX   0294  CKNEG   02B2  CNCT    01CB  COUT    0142
CSIZE   01C1  CTYPE   016C  DBUF    0195  DLY     02CE  DLY2    02D2
DOIMSG  029F  DOM0    01BB  DOT     019A  DOTM    01B5  DOTMSG  02A2
DOTWR   01AB  DOUT    022F  DOUTP   0230  DOUTQ   0241  DT      019C
ERCLR   01D4  HOME    01D7  IMBUFF  0036  IMOVE   0046  IMX     0048
IMY     004B  INS2C   0283  INS2D   0272  IPBUFF  00D8  IPLOT   00E8
IPX     00EA  IPY     00ED  ISMSG   02A5  LFOUT   01DD  LTMSG   029C
MARK    0201  MBUF    01FC  MBUFF   0000  MK      0203  MOVE    0010
MX      0012  MY      0015  NSBTOA  0262  PBUF    01E1  PDMSG   02AD
PDOWN   01CE  PLOT    011D  PLOT1   0145  PLTD    000F  PLTS    000E
PTBUFF  010D  PUMSG   02A8  PUP     01C7  PX      011F  PY      0122
QRXBUF  006C  QRYBUF  00A0  QX      007E  QY      00B2  RX      0081
RY      00B5  SBUF    017B  SE      0182  SIZE    0180  TP      016E
XAXIS   007C  YAXIS   00B0
```

—BASIC Main Program—

```
     BASIC compiler SB-7701  <X-YDEMO>  page 1          07.09.81

000F       EXTERNAL IPLOT,PLOT,IMOVE,MOVE,PUP,PDOWN,XAXIS,YAXIS,CTYPE
000F       EXTERNAL CSIZE,SIZE,HOME,ANGL,MARK,ERCLR,DOTM,DOT0,DOT
000F       DIM D(1,255),E(50)
0042       DIM A(23),B(23)
005F       HOME : CSIZE : ANGL 0: DOT0
00A8       REM  *FDOS NO SAKUGA*
00A8       REM  * F *
00A8       MOVE 200,2400
00DD       IPLOT 400,0: IPLOT 0,-150: IPLOT -400,0: IPLOT 0,150
018C       IMOVE 50,-50: IPLOT 300,0: IPLOT 0,-50: IPLOT -300,0: IPLOT 0,50
0256       MOVE 200,2170: IPLOT 400,0: IPLOT 0,-150: IPLOT -230,0
0300       IPLOT 0,-220: IPLOT -170,0: IPLOT 0,370
038A       IMOVE 50,-50: IPLOT 300,0: IPLOT 0,-50
03FF       IPLOT -230,0: IPLOT 0,-220: IPLOT -70,0
047B       IPLOT 0,270
04A9       REM  * D *
04A9       MOVE 630,2400: IPLOT 210,0
0505       A=840: B=300: C=2100: GOSUB 1100
0540       IPLOT -210,0: IPLOT 0,370: IPLOT 170,0: IPLOT 0,-220
05DC       A=810: B=150: C=2100: GOSUB 1000
060B       IPLOT -180,0: IPLOT 0,150: IMOVE 50,-50: IPLOT 160,0
06B5       A=840: B=250: C=2100: GOSUB 1100
06E4       IPLOT -160,0: IPLOT 0,270: IPLOT 70,0: IPLOT 0,-220: IPLOT 60,0
07AE       A=810: B=200: C=2100: GOSUB 1000
07D6       IPLOT -130,0: IPLOT 0,50: GOTO 1200
0836  1000 FOR I=-«/2 TO «/2 STEP «/60
0890       X=INT(A+B*COS(I)): Y=INT(C+B*SIN(I))
090A       PLOT X,Y
091F       NEXT I
092A       RETURN
0930  1100 FOR I=«/2 TO -«/2 STEP -«/60
0978       X=INT(A+B*COS(I)): Y=INT(C+B*SIN(I))
09DE       PLOT X,Y
09F3       NEXT I
09F9       RETURN
09FF  1200 REM  * O *
0A05       X=0: Y=0: A=0: B=0: C=0: D=0: MOVE 1760,2100
0A69       A=1460: B=300: C=2100: D=300: GOSUB 1300
0AA1       IMOVE -50,0
0AC8       A=1460: B=250: C=2100: D=250: GOSUB 1300
0AF9       IMOVE -90,0
0B27       A=1460: B=160: C=2100: D=200: GOSUB 1300
0B58       IMOVE -50,0
0B7F       A=1460: B=110: C=2100: D=150: GOSUB 1300
0BB7       MOVE 1840,2350: GOTO 1400
0BF2  1300 FOR I=0*« TO 2*« STEP «/60
0C28       X=INT(A+B*COS(I)): Y=INT(C+D*SIN(I))
0C8E       PLOT X,Y
0CA3       NEXT I: A=0: B=0: C=0: D=0: X=0: Y=0: RETURN
0CE5  1400 REM  * S *
0CEB       FOR I=« TO «*7/6 STEP «/60
0D32       X=INT(1960+120*COS(I)): Y=INT(2350+120*SIN(I))
0DA6       PLOT X,Y: NEXT I: X=0: Y=0
0DD3       A=1920: B=110: C=2010: GOSUB 1500
0E09       IPLOT -120,0: IPLOT 0,-50: IPLOT 140,0
```

```
0E85        A=1940: B=160: C=2010: GOSUB 1600
0EB4        FOR I=π*7/6 TO π*186/180 STEP -π/60
0F0C      X=INT(2030+135*COS(I)): Y=INT(2370+135*SIN(I))
0F87        PLOT X,Y
0F9C        NEXT I: IPLOT -60,0: X=0: Y=0: IMOVE -38,45
1010        IPLOT 150,0
1037        FOR I=π*8/9 TO π*7/6 STEP π/60
108D        X=INT(2030+85*COS(I)): Y=INT(2370+85*SIN(I))
10FA        PLOT X,Y
110F        NEXT I: X=0: Y=0
1127        A=1940: B=210: C=2010: GOSUB 1500
114F        IPLOT -190,0: IPLOT 0,150: IPLOT 170,0
11CB        A=1920: B=60: C=2010: GOSUB 1600
11F3        FOR I=π*7/6 TO π*8/9 STEP -π/60
1244        X=INT(1960+170*COS(I)): Y=INT(2350+170*SIN(I))
12AA        PLOT X,Y
12BF        NEXT I: X=0: Y=0: GOTO 1700
12DD  1500  REM  * SUB A *
12E3        FOR I=π/6 TO -π/2 STEP -π/60
1325        X=INT(A+B*COS(I)): Y=INT(C+B*SIN(I))
138B        PLOT X,Y
13A0        NEXT I: X=0: Y=0: RETURN
13BE  1600  REM  * SUB B *
13C4        FOR I=-π/2 TO π/6 STEP π/60
13FD        X=INT(A+B*COS(I)): Y=INT(C+B*SIN(I))
1463        PLOT X,Y
1478        NEXT I: X=0: Y=0: RETURN
1496        REM  * DIAMOND *
1496        MOVE 3000,2050
14CB  1700  FOR Z=1 TO 23
14F1        A(Z)=INT(350*COS(2*π*(Z-1)/23+π/2)+3000)
158D        B(Z)=INT(-350*SIN(2*π*(Z-1)/23+π/2)+2050)
1621        NEXT Z
1627        FOR S=2 TO 11
1649        L=2-S
1655         X=A(23): Y=B(23)
1682        MOVE X,Y
1697        FOR I=1 TO 24
16B9        J=L+S
16C5        IF J<24 THEN 1800
16E7        J=J-23
16F3  1800  X1=A(J): L=J: Y1=B(J)
172A        A=X1-X: B=Y1-Y
1742        IPLOT A,B
1757        X=X1: Y=Y1
1769        NEXT I: NEXT S: X=0: Y=0: X1=0: Y1=0: A=0: B=0
17AB        MOVE 1650,1320
17E0        REM  *PRINT "  3D-GRAPH"*
17E0        A$="  3D-GRAPH"
1802        FOR I=3 TO 0 STEP -1
1830        MOVE 1650,1320
1857        ANGL I
1866        CTYPE A$
187D        NEXT I: A$=""
1891        REM  *  3D-GRAPHIC  *
```

```
1891        T=0: S=0
18A3        FOR L=0 TO 255
18BE        D(0,L)=-1: D(1,L)=-1: NEXT L
18F2        MOVE 100,250
1920        FOR Y=-180 TO 180 STEP 4
194E        FOR X=-180 TO 180 STEP 4
1975        IF (Y=-180)*(X=180) THEN 2600
19B3  1900  R=π/180*SQR(X*X+Y*Y)
19FE        Z=100*COS(R)-30*COS(3*R)
1A47        A=INT(110+X/2+(16-Y/2)/2)
1AA8        B=INT((116-Y/2-Z)/2): B=192-B
1B04        IF (A<0)+(A>255) THEN 2000
1B39        IF D(0,A)=-1 THEN 2100
1B68        IF B<=D(0,A) THEN 2300
1B93        IF B>=D(1,A) THEN 2400
1BBE  2000  NEXT X
1BCA        IMOVE 0,0: T=0: S=0
1C03        NEXT Y
1C09        GOTO 2700
1C0F  2100  IF A=0 THEN 2200
1C2D        IF D(0,A-1)=-1 THEN 2200
1C68        IF D(0,A+1)=-1 THEN 2200
1CA3        D(0,A)=INT((D(0,A-1)+D(0,A+1))/2)
1D0F        D(1,A)=INT((D(1,A-1)+D(1,A+1))/2)
1D7B        GOSUB 2500: GOTO 2000
1D8E  2200  D(0,A)=B: D(1,A)=B: GOSUB 2500: GOTO 2000
1DD5  2300  GOSUB 2500: D(0,A)=B: IF D(1,A)=-1 THEN D(1,A)=B
1E42        GOTO 2000
1E48  2400  GOSUB 2500: D(1,A)=B: IF D(0,A)=-1 THEN D(1,A)=B
1EB5        GOTO 2000
1EBB  2500  REM  *SUB DATA OUT *
1EC1        DX=100+7*A: DY=8*B
1EE5        MOVE DX,DY: PDOWN : PUP
1F0C        RETURN
1F12  2600  REM  *SUB GENSUI *
1F18        FOR K=1 TO 50: E(K)=0: NEXT K
1F4D        FOR I=1 TO 50
1F68        E(I)=SIN(I*π/12.5)
1FA4        NEXT I
1FAA        N=15
1FBA        FOR I=1 TO N
1FD5        D=5*I/N+5: G=(N-I+0.5)/N*4: O=DX: P=DY
2049        MOVE O,P
205E        FOR J=1 TO 50
2079        O=DX+E(J)*G*(50-J): P=P+D
20C0        PLOT O,P
20D5        NEXT J: NEXT I: MOVE DX,DY: GOTO 1900
20FC  2700  REM  * SIN(X)/X *
2102        MOVE 2350,900
2130        XAXIS 87,12
2165        MOVE 2870,700
219A        YAXIS 200,4: MOVE 2350,900
21E8        FOR I=-6 TO 6 STEP 0.08
2216        IF I=0 THEN Y=1: X=0: GOTO 2800
2243        X=I*π
```

```
224F        Y=SIN(X)/X
2264  2800  A=2870+INT(27.5*X+0.5)
229E        B=900+INT(400*Y)
22BF        PLOT A,B
22D4        NEXT I
22DA        MOVE 2350,1300: DOTM : MARK 1
2329        IPLOT 174,0: MARK 2: IPLOT 174,-200: MARK 3: IPLOT 174,-200: MARK 4
23ED        IPLOT 174,200: MARK 5: IPLOT 174,200: MARK 6: IPLOT 174,0
2492        DOT0
249B        MOVE 2350,700: IPLOT 0,800: IPLOT 1044,0: IPLOT 0,-800: IPLOT -1044,0
256C        MOVE 3100,800: SIZE 2: A$="XAXIS": CTYPE A$
25D7        A$="YAXIS": MOVE 2800,1300: ANGL 1: CTYPE A$: ANGL 0: A$=""
2668        REM  * SHARP SIZE *
2668        MOVE 2550,300
2696        B$="SHARP "
26AA        FOR I=1 TO 15 STEP 5
26D1        SIZE I
26E0        CTYPE B$
26F2        NEXT I: B$=""
2706        CSIZE
270F        REM  * CHARACTOR SET *
270F        MOVE 400,150
2736        C$="1234567890ABCDEFGHIJKLMNOPQRSTUVWXYZ !#$%&()+-,./*<>@?:;"
277C        CTYPE C$
278E        REM  * DOT0 TYPE *
278E        HOME : PLOT 0,2500: PLOT 3590,2500: PLOT 3590,0: PLOT 0,0: IMOVE 15,15
2868        H=3560: V=2470: R=15
2891        FOR I=20 TO 60 STEP 20
28BF        DOT I
28CE        IPLOT 0,V: IPLOT H,0: IPLOT 0,-V: IPLOT -H,0: IMOVE R,R
296D        V=V-2*R: H=H-2*R
299D        NEXT I
29A3        HOME : IMOVE 60,60
29D3        DOT0 : IPLOT 0,V: IPLOT H,0: IPLOT 0,-V: IPLOT -H,0
2A66        D$="PEN UP DOWN"
2A7F        MOVE 2050,400
2AA6        CTYPE D$
2AB8        IMOVE 50,0
2ADF        FOR I=1 TO 5: PUP : PDOWN : NEXT I
2B12        CSIZE : DOT0 : ANGL 0: HOME
2B45        END
** Compiler found no errors.
```