
ADVANTEST®

ADVANTEST CORPORATION

R3752/53/64/65/66/67H series
Network Analyzer
PROGRAMMING GUIDE

MANUAL NUMBER · GEA00 9701

This manual is for the following models.

R3752AH/BH/EH

R3753AH/BH/EH

R3764AH/BH/CH

R3765AH/BH/CH

R3766AH/BH/CH

R3767AH/BH/CH

Before reselling to other corporations or re-exporting to other countries, you are required to obtain permission from the Japanese Government under its Export Control Act.

Safety Summary

To ensure thorough understanding of all functions and to ensure efficient use of this instrument, please read the manual carefully before using. Note that Advantest bears absolutely no responsibility for the result of operations caused due to incorrect or inappropriate use of this instrument.

If the equipment is used in a manner not specified by Advantest, the protection provided by the equipment may be impaired.

■ Warning Labels

Warning labels are applied to Advantest products in locations where specific dangers exist. Pay careful attention to these labels during handling. Do not remove or tear these labels. If you have any questions regarding warning labels, please ask your nearest Advantest dealer. Our address and phone number are listed at the end of this manual.

Symbols of those warning labels are shown below together with their meaning.

DANGER: Indicates an imminently hazardous situation which will result in death or serious personal injury.

WARNING: Indicates a potentially hazardous situation which will result in death or serious personal injury.

CAUTION: Indicates a potentially hazardous situation which will result in personal injury or a damage to property including the product.

■ Basic Precautions

Please observe the following precautions to prevent fire, burn, electric shock, and personal injury.

● Use a power cable rated for the voltage in question. Be sure however to use a power cable conforming to safety standards of your nation when using a product overseas. Do not place anything heavy on top of the power cable.

● When inserting the plug into the electrical outlet, first turn the power switch OFF and then insert the plug as far as it will go.

- When removing the plug from the electrical outlet, first turn the power switch OFF and then pull it out by gripping the plug. Do not pull on the power cable itself. Make sure your hands are dry at this time.
- Before turning on the power, be sure to check that the supply voltage matches the voltage requirements of the instrument.
- Be sure to plug the power cable into an electrical outlet which has a safety ground terminal. Grounding will be defeated if you use an extension cord which does not include a safety ground terminal.
- Be sure to use fuses rated for the voltage in question.
- Do not use this instrument with the case open.
- Do not place objects on top of this product. Also, do not place flower pots or other containers containing liquid such as chemicals near this product.
- When the product has ventilation outlets, do not stick or drop metal or easily flammable objects into the ventilation outlets.
- When using the product on a cart, fix it with belts to avoid its drop.
- When connecting the product to peripheral equipment, turn the power off.

■ Caution Symbols Used Within this Manual

Symbols indicating items requiring caution which are used in this manual are shown below together with their meaning.

DANGER : Indicates an item where there is a danger of serious personal injury (death or serious injury).

WARNING : Indicates an item relating to personal safety or health.

CAUTION : Indicates an item relating to possible damage to the product or instrument or relating to a restriction on operation.

■ Safety Marks on the Product

The following safety marks can be found on Advantest products.



: ATTENTION - Refer to manual.



: Protective ground (earth) terminal.



: DANGER - High voltage.



: CAUTION - Risk of electric shock.

■ Precautions when Disposing of this Instrument

When disposing of harmful substances and batteries, be sure dispose of them properly with abiding by the state-provided law.

Harmful substances:(1) PCB (polycarbon biphenyl)

(2) Mercury

(3) Ni-Cd (nickel cadmium)

(4) Other

Items possessing cyan, organic phosphorous and hexadic chromium and items which may leak cadmium or arsenic (excluding lead in solder).

PREFACE

Using This Manual

This manual describes how to create and execute the BASIC program by the use of editor in R3752/53/64/65/66/67H Series analyzers.

Related Manuals:

The following four manuals describe the names of the part, functions and key operations of this network analyzer.

- R3752H Series Network Analyzer Operation Manual
- R3753H Series Network Analyzer Operation Manual
- R3764/66H Series Network Analyzer Operation Manual
- R3765/67H Series Network Analyzer Operation Manual

The following two manuals describe built-in BASIC and GPIB.

- R3752/53H Series Network Analyzer Programming Manual
- R3764/65/66/67H Series Network Analyzer Programming Manual

Convention of the keys in this manual:

- Panel keys of this analyzer: Be shown with a bracket.
(Example) [ENT], [BS], [0] to [9]
- Soft keys of this analyzer: Be shown with a curly bracket.
(Example) {EDIT}
- IBM-PC keyboard: Be shown with a style of bold Italic Helvetica.
(Example) ***Enter, Backspace. 0 to 9***

Convention of the commands in this manual:

- The commands input by the keyboard: Be shown with a style of Italic Helvetica.
(Example) *EDIT* command, *PRINT*
- The commands selecting from the menu of editor: Be shown with a style of bold Helvetica.
(Example) **EDIT** command, **Print**

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1 Introduction

In R3752/53, R3764/66 and R3765/67 Series (analyzers) , since the execution environment of BASIC-language programs is provided, the BASIC programs created on external personal computers etc. can be executed. In addition, the development of program with the editor described in this manual can be performed.

(Note) First install the editor, because it has not been installed before delivery.

1.1 Features of the BASIC Language Provided

The BASIC language can load and execute the BASIC programs which have no line numbers. When a BASIC program without line numbers is loaded, it is numbered automatically from the first line. Since the line number is not necessary, the editing of program can be performed easily.

To create a BASIC program with this instrument, the editor should be installed. When the editor is used, the program file can be loaded and executed in this editor. When the program is executed in this editor, the error occurred during the execution (runtime error) is traced.

When an error occurs, the cursor moves automatically to the line where the error generated. Almost every command prepared in this editor can be executed from the menu, and so the commands can be simply carried out without referring to the manual.

1.2 Editor Package

The editor package consists of the following items.

- Editor install disk (1)
(PR37670001-FK, HD 1.44M bytes)
- Sample program disk (1)
(PR37670003-FJ , DD 720k bytes)
- Programming Guide (This manual)

1.3 Equipment Hardware Environment

The following hardware environment is required for use of BASIC and the editor.

- Network analyzer R3764/66 series or R3765/67 series
Or network analyzers with the version of system software is B00 or higher, R3752/53 series.
- IBM-PC compatible keyboard 101 or 106
- External CRT display (for R3752, R3764/66)

1.4 Installation

Install the editor before using.

1.4.1 Installation Method

Installing the editor is done by simply inserting the install disk provided in the editor package into the disk drive of the analyzer and restarting the analyzer.

- Installing procedure

① Switch the power off.

1.5 Disk Format Conversion Program

- ② Insert the install-disk of the editor into the drive.
- ③ Switch on the power.
When the installation gets started, the message "INSTALLING EDITOR..." appears on the screen.
- ④ Wait until the message " COMPLETE" appears on the screen.
- ⑤ Eject the install-disk of the editor from the drive.
- ⑥ Switch off the power of this instrument and then restart.

The editor is completed to be installed in the memory disk (C: BIN) of the analyzer.

(Note) *The operation of the editor is not ensured if it has been copied or modified. If installation is attempted when many registers are in use, installation might not succeed. If this occurs, perform installation after first deleting registers.*

1.4.2 Setting the System

- Using 101 keyboard
It is necessary to set the system.
Enter 101 in the service menu of the analyzer.
If not, the key code may change.
- Using 106 keyboard
It is not necessary to set the system.

1.5 Disk Format Conversion Program

The program (floppy disk) created with the old type network analyzer made by ADVANTEST (R4611/R3751 series / R3762 series) can not be used without file exchanging. It is necessary to convert it to the disk format that can be processed with MS-DOS by using the disk conversion program (PR37670002-FK), that is optionally available.

The whole program operation is done on the front panel.

(Caution) *Set the disk formatted by the old type to the write protection mode, in order not to initialize it to MS-DOS format.*

- Converting disk format
 - ① Switch off the power (R3764/66, R3765/67 series).
 - ② Insert the format conversion program disk into the drive.
 - ③ Switch on the power.
 - ④ When the following message appears on the screen, eject the floppy-disk from the drive.

```

DISK CONVERT ( to MS-DOS )
-----
INSERT OLD-TYPE DISK

[ 1 ]: OK
[ 0 ]: CANCEL
[BS ]: EXIT

Ready ?
    
```

- ⑤ Insert the floppy disk into the drive to convert the format.
- ⑥ Press the ten key [1] of the front panel, then the screen changes to as follows.

```

DISK CONVERT ( to MS-DOS )
-----
reading .....
    
```

After the floppy disk has been read out successfully, the screen changes to as follows.

```

DISK CONVERT ( to MS-DOS )
-----
INSERT NEW DISK (2DD)

[ 1 ]: OK
[ 0 ]: CANCEL
[BS ]: EXIT

Ready ?
    
```

(Note) The use of a floppy disk that is not properly formatted causes error message. In such case, press any one in "Ten Key".
 The screen returns to the original one, then insert another floppy disk and repeat the operation of ⑥

- ⑦ Eject the floppy disk from the drive.
- ⑧ Insert a new 2DD floppy disk into the drive.
- ⑨ • In the case of inserting formatted floppy disk
 Press the ten key [1] of the front panel , then the contents of the old type network analyzer disk is copied into the new disk. When the copying of the disk ended, the screen returns to the original one.
- In the case of inserting unformatted floppy disk
 Press the ten key [1] of the front panel, then the screen changes to as follows.

1.5 Disk Format Conversion Program

```
DISK CONVERT ( to MS-DOS )
-----
FORMAT DISK
      [ 1 ]: OK
      [ 0 ]: CANCEL
      [BS ]: EXIT

Ready ?
```

Press the ten key [1] of the front panel, then the contents of the old type network analyzer disk are copied into the new disk after the floppy disk has been formatted. When the copying of the disk ended, the screen returns to the original one.

- ⑩ To convert other disks continually , repeat the same operations mentioned above. When the disk format conversion is completed, press the [BS] on the front panel.

2 Fundamentals of Programming

2.1 Program Mode

2.1.1 Starting the Program Mode

(1) Starting the program mode

To create the program of BASIC by using the key board connected with the network analyzer, the system must be turned to the program mode from the measurement mode.

- R3764/66 series

Since the program mode is started automatically when the power is switched on , no special operation is necessary.

- R3765/67 Series

When the power is switched on, the state of R3765/67 gets into the measurement mode, in which the frequency of filter etc. can be measured. It is necessary to perform the following operations.

- ① To convert the mode to the program mode, press [RUN] of the front panel key.

The program menu is displayed and the cursor appears on the screen. (Refer to Figure2-1.)

- ② To delete the program mode, press any key of the front panel except [CH1] and [CH2].

When the program mode is deleted, the cursor disappears from the screen.

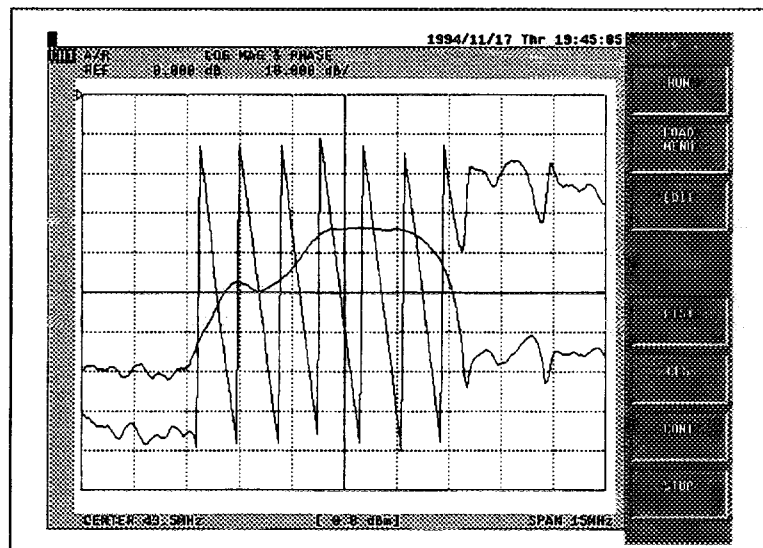


Figure 2-1 Screen of Program (Direct) Mode

2.1 Program Mode

(2) Program mode state

The BASIC commands and programs can be entered from the external keyboard in the program mode.

The program mode consists of "direct mode" and "edit mode". In the initial state, the direct mode is set.

In the direct mode, the entered character string is executed after it is sent to the BASIC directly. (Refer to 2.1.2.)

In the edit mode, the entered character string is not executed. (Refer to 2.6.)

The measurement can also be performed in the program mode. In the direct mode, the measured waveform is left as the waveform displayed. The character string produced through the use of entered text and PRINT syntax of the BASIC is shown overlapped with the measurement waveform.

The part in which the character string is displayed is called "text screen", and the part in which the measurement waveform is displayed is called "measurement screen". These two screens are displayed synthetically.

As a result, the characters of the text on the screen are not clear, depending on the displaying position and the measurement waveform. In this case, the following method enables text character being clear. (Refer to (3).)

(3) Method for enabling the text screen clear

There are two methods as follows:

- Disables the measurement screen with DISP statement and enables the text screen only (the waveform data can not be seen).
- Divides the full screen into two parts: the upper and the lower (the upper is the measurement screen and the lower is the text screen.).

① Press [DISP] key of the front panel.

② Set the display menu to DUAL CH OFF and SPLIT CH ON.

③ Set the scroll area to the lower part of the screen by using the CONSOLE statement in the program mode.

(Note) Only the active channel is available in this method. This method is not available for the dual channels being ON (DUAL CH ON), the method can not be used.

2.1.2 Direct Mode

In the state of direct mode, the cursor move key is not to enable the cursor moving freely. The characters entered from the keyboard are displayed at the position of the cursor. When a character is input, the cursor moves one position to the right.

When the entered character is to be corrected, press the **Backspace** to erase one character on the left.

When **Enter** is pressed, the entered character string is executed as a command.

There are the following two ways to input from the keyboard.

- Executing by inputting a command and outputs the result soon. (direct format).
- Creating a processing procedure by using multi-commands (program format).

When the direct mode is used, each statement of the BASIC is executed directly and the operation can be ensured. If the statement is executed in direct mode, the operation of the statement can be ensured even when the program is not executed totally,

- Executing the command in direct mode
 - ① Enter CLS and press **Enter**, then the full text screen can be deleted.
 - ② Input the following statement correctly.

```
PRINT 2+5
```

- ③ Press **Enter** and execute the input code.

When the PRINT statement is executed, 7 is displayed in the text screen.

2.2 BASIC Instructions by Command

When a command is input in the direct mode, it is executed at once and the result is output immediately. It is used only for calculations or commands not necessary to store, such as the list of programs having been input so far.

2.2.1 PRINT Command

PRINT command is used to evaluate the equations following to PRINT and displays the results on the screen. Moreover, it can display character strings instead of the equations on the screen.

- Calculating equations following the PRINT and displaying the results on the screen.

The four fundamental operations of arithmetic (addition, subtraction, multiplication and division) in BASIC are expressed with plus sign (+), minus sign (-), asterisk mark (*) and slash mark (/). The power of number is expressed with the caret (^).

Input the following statements in the direct mode, then press **Enter** and check the results of the operation.

2.2 BASIC Instructions by Command

Operation	Result
PRINT 2.0+3.0	5.0
PRINT 2.0-3.0	-1.0
PRINT 2.0*3.0	6.0
PRINT 2.0/3.0	0.666666666666
PRINT 2.0^3.0	8.0

- Displaying character string on the screen.

Character string is a sequence of characters enclosed in double quotation marks " " .

- ① Input the following statement correctly.

`PRINT "Hello, world"`

- ② Press **Enter**.

Execution result: Hello, world

The calculation result can be assigned to a variable and then output by using it.

2.2.2 Assignment Command

The assignment command is used to assign the <expression> on the right of the equal mark (=) to the <variable> on the left.

The content of the <expression> is available for numerics or character strings. However, the type of <expression> must be the same as that of <variable>. When the type is mismatched, it is assigned in accordance with the type of the left <variable>.

- Assigning calculation result

- ① Input the following statement correctly.

`A=(5+3)^2`
`B=2*5+6/2`

- ② Press **Enter**.

- ③ The following statement is input and the value of A is displayed.

`PRINT A`

Execution result: 64.0

- ④ The following statement is input and the value of B is displayed.

`PRINT B`

Execution result: 13.0

In these example, equations $(5+2)^2$ and $2 \times 5 + 6 \div 2$ are calculated and the answers are assigned into A and B, respectively. The contents of A and B are displayed by using the PRINT command.

2.3 Creating and Executing Programs

In the program mode, the program is stored in the memory, then a command is executed. Therefore, after the program execution is completed, the program still remains in the memory, even when the command, having been executed, disappears. The program can be executed for several times.

2.3.1 Program Input and Execution (LIST , RUN)

The input method of program is adding a line number in front of the command input statement that has been described above.

A line which the statement follows is called "program line" and a line without a specified line number is called "command line".

(Example) 10 PRINT 2+5: Program line with line number 10
 PRINT 2+5: Command line

Each program line of the BASIC is preceded by line number. The line number indicates the sequence with which the program lines are stored into the memory, and the program execution is performed from lower number to higher one.

- Program example

```
10 A=(5+3)^2
20 B=2*5+6/2
30 PRINT A
40 PRINT B
50 STOP
```

- (1) Displaying program list (LIST).

The LIST command is used to display the program list in the scroll area of the screen.

- ① Input the following command correctly.

```
LIST
```

- ② Press **Enter**.

- (2) Displaying a part of the program lines (LIST starting line, ending line).

LIST starting line, or ending line is a command to display the program list of the specified line range.

(Note) *If the starting line is omitted, the program from the first line through the ending line will be displayed. If the ending line is omitted, lists from the starting line through the last line of the program. If both of the two lines are omitted, lists from the first line through the last line.*

- ① Input the following statement correctly.

```
LIST 10,40
```

- ② Press **Enter**.

Execution result: Displaying the program lines from line number 10 to line number 40.

2.3 Creating and Executing Programs

- (3) Executing a program after the input is completed. (RUN)

The RUN command is used to execute the entered program.

- ① Input the following command

RUN

- ② Press **Enter**.

Execution result: If there is no input mistake, "64.0" and "13.0" will be displayed on the screen.

2.3.2 Scratching Programs (SCRATCH)

SCRATCH command is used to erase the programs and variables, that have been input. When inputting a new program, be sure to erase the programs entered so far.

- Scratching programs

- ① Input the following command.

SCRATCH

- ② Press **Enter**.

Execution result: The following message is displayed on the text screen.
BASIC Ready

2.3.3 Input data during program execution

In the programs mentioned above, the data of calculation has been integrated into the programs in advance. Here is a program to enable the calculation data to be entered during execution and then output the result.

- Program example for calculating the area of a triangle

- ① Input CLS command to clear the screen.

- ② Input the following program correctly.

```
10 INPUT "TEIHEN ?=" ,A
20 INPUT "TAKASA ?=" ,B
30 C=A*B/2
40 PRINT "KOTAE", C
50 STOP
```

- ③ Input Run command to execute the program.

- ④ Then, the state is ready for the key input.

Since "TEIHEN?=" is displayed to ask the value of base, inputs the value by the keyboard.

"TAKASA?=" is displayed to ask the value of height, inputs the value by the keyboard. The area of triangle is calculated and displayed as "KOTAE", thus the value of answer is output.

2.4 Saving Programs (INITIALIZE, SAVE)

Save the program to be stored in a floppy disk. The object of this procedure is as follows.

A program line proceeded by a line number is input and the **Enter** is pressed. Then the program is stored in the memory. However it will be deleted when the power is switched off. That is the same in SCRATCH command.

Prepare a floppy disk and initialize it with INITIALIZE command. The initialization is writing the necessary information on the disk in order to enable it to be used on the network analyzer. INITIALIZE can be abbreviated to INIT.

(Note) *2DD floppy disk can not be initialized with the writing format of 2HD.
Conversely, the 2HD can not be initialized with the writing format of 2DD.*

The software structure of floppy disk in R3764/66 and R3765/67 is the same as that of MS-DOS. Therefore, the floppy disks initialized at MS-DOS can be used just as they are.

When the floppy disk initialized at personal computer is used, it is not necessary to use the INITIALIZE command. However, the 2HD floppy disk initialized with 720k bytes and the 2DD floppy disk initialized with 1.2M bytes and 1.4M bytes cannot to be used.

- Initializing floppy disk (INITIALIZE)

For the 2DD floppy disk:

- ① Close all the opened files according to the CLOSE * command.
- ② Insert the floppy disk into the drive.
- ③ Input the following command.

```
INITIALIZE "MYDISK" 0
```

If it is executed, the floppy disk is initialized and its name is "MYDISK". For the volume name, up to 12 characters are available, and it can be specified freely (also can be abbreviated). The memory size of floppy disk after initialization becomes 720K bytes.

- For the 2HD floppy disk

Specifications as follows.

Writing format	Sector Size	Sector count of each drag	Total capacity
INITIALIZE "MYDISK" 1	1024 bytes	8 sector	1.2 M bytes
INITIALIZE "MYDISK" 2	512 bytes	18 sector	1.4 M bytes
INITIALIZE "MYDISK" 3	512 bytes	15 sector	1.2 M bytes

- Saving a program (SAVE)

To save a program in a floppy disk, use the SAVE command.

- ① Insert the initialized floppy disk into the drive.
- ② Input SAVE command.

```
SAVE "A:MYFILE.BAS"
```

2.5 Loading Programs (LOAD)

(Note) *The file name can be specified with up to 8 characters and an extension of 3 characters at the most. When a file is saved with the same name as that of the file which has been saved previously, the old program will be overwritten and lost.*

Although the program has been saved, it still remains in the memory so long as the power is on. When creating new program, input it after deleting the old with the SCRATCH command. When a sub-directory is created after the floppy disk is formatted with personal computer, the saving can be performed in this sub-directory. When saving is performed in a sub-directory, specify the directory name in front of the file name.

```
SAVE "A:MYSUB1/MYFILE.BAS"
```

In this example, the program is saved under the directory "MYSUB1". However, there is no function to create the sub-directory in the BASIC.

2.5 Loading Programs (LOAD)

To read out the stored program from the memory (LOAD), use the LOAD command.

① Insert the floppy disk into the drive.

② Input the LOAD command.

```
LOAD "A:MYFILE.BAS"
```

(Note) • *Input the file name specified when it is saved.*
• *When the program is loaded, the program entered previously is removed.*
(The LOAD command is executed with the SCRATCH together.)

2.5.1 Searching File Names (CAT)

When you forget loading a file name or want to know which files are saved in a floppy disk, use the CAT command.

① Insert the floppy disk into the drive.

② Input CAT command.

```
CAT
```

Execution result: The following is displayed in the scroll area of the text screen.

NO	:File Name	Bytes	At
1	:MYFILE.BAS	418	0

The contents shown on the screen represent register number, file name, character counts of file and file attribute from left to right in turn .

2.5.2 Outputting to Printer (GLIST, LLIST)

As one of the methods for storing programs, the program also can be printed out on the printer by using a printer device.

The printer output can be performed in the following two ways.

- Using GLIST command, output to a printer via GPIB.
- Using LLIST command, output to a printer which is connected with a serial port.

The writing methods of these two commands are the same. However, when GPIB is used, the mode of GPIB should be set to SYSTEM CONTROLLER in advance and the GPIB address of printer must be set.

- Printing on a GPIB printer of address 18.
 - ① Input "CONTROL 7;1" then GPIB mode turns to SYSTEM CONTROLLER.
 - ② Input "PRINTER 18" and set GPIB address of printer.
 - ③ Input GLIST command.

```
GLIST 10,100
```

Execution result: Printing out lines from line number 10 to 100.

2.6 Editing Mode

The edit mode is used to edit programs.

When program editing is performed in the direct mode, the cursor can not move freely. Therefore, to correct a program line that has been input previously, it is necessary to input the whole line. This is very inconvenient.

In the edit mode, all the operations necessary for the programming, from program editing to program execution, can be performed by operating the pull-down menu. This program environment is called "BASIC editor".

Here, editing simple program with this editor is performed. For the detail of editor, see "3. Function of BASIC Editor".

2.6.1 Starting Editor

Install the BASIC editor with the attached install-disk before starting the editor (refer to 1.4.1). If the editor is started without installation, the following message appears and the execution can not be performed.

Editor not installed

- Turning to edit mode

Press **F12** of the external keyboard to turn to the edit mode.

When the environment is turned to the edit mode, the screen becomes as shown in Figure 2-2.

The measurement waveform and the text are not shown on the editor screen.

2.6 Editing Mode

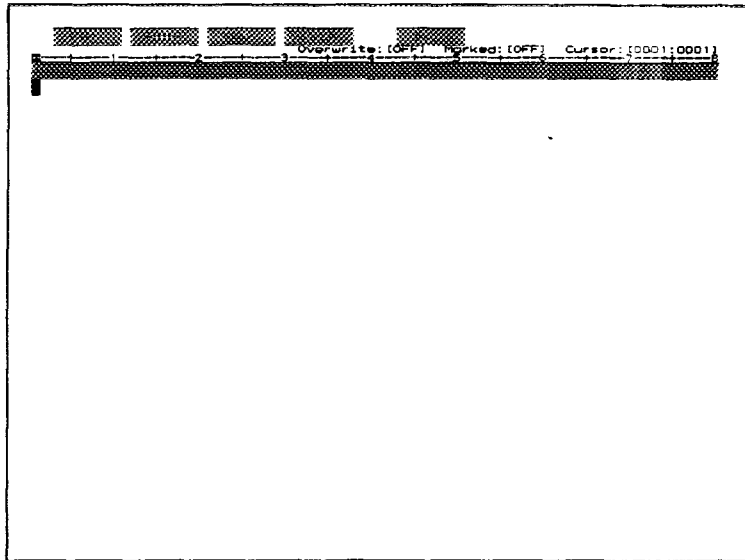


Figure 2-2 Screen of edit Mode

2.6.2 Programming Environment of Editor

There are many programming tools in the editor.

The program auditing, file management and printing etc. can be performed.

There are several menus in the menu bar at the uppermost place of the editor screen. The commands used to control the programming environment are in the menu. By using these commands, creating and revising program can be carried out in the view window.

2.6.3 Opening Menu

Almost every command of the editor is executed by choosing it from the menu. The menu bar is laid out in the order from left to right corresponding to the function keys (F1, F2 ...) of the keyboard.

To open a menu, press the corresponding function key.

If the menu has been opened, selecting menu can be performed with the direction keys (↑, ↓, ←, →)

- Procedure for opening menu

① Press **F1** to select F1: File menu.

Using ↑ and ↓, you can choose any command in the opened menu.

Using ← and →, you can open any menu in the opened menu.

② To close the menu without executing command, repress the **F1** or press the **Esc** key.

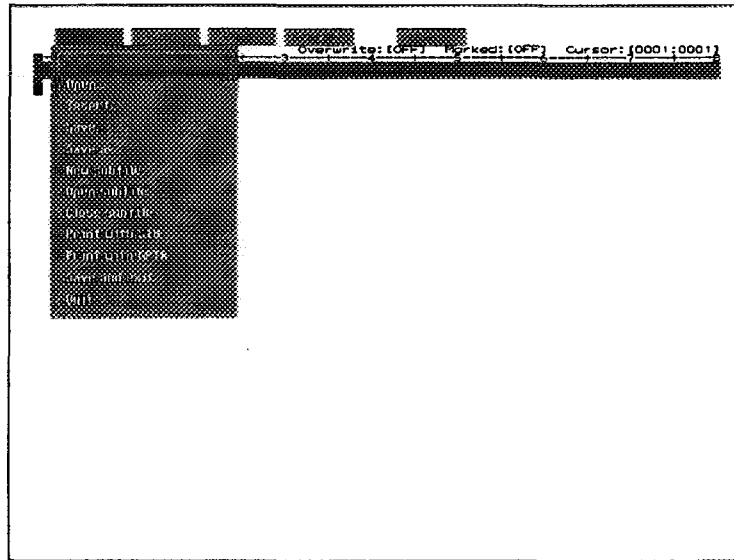


Figure 2-3 F1: File Menu

2.6.4 Choosing Edit Command

To choose and execute edit commands, choose the target command from menu by using \uparrow and \downarrow , then press **Enter**.

If a command name is followed by ellipsis dots (...), execute the command, then a dialog box appears as shown in Figure 2-4. If a command name is not followed by ellipsis, the command is executed immediately.

2.6 Editing Mode

2.6.5 Using a Dialog Box

When a command, whose name followed by ellipsis(...) is executed, a dialog box appears. The editor presents necessary information before executing a command by using the dialog box.

(1) Components of a dialog box

Dialog box is used to provide editor information.

Components	Explanation
Text field	Used to input text such as file name, etc.
List box	Used to select one item from several items.
Command button	Showing usable keys

(2) Operation of a dialog box

If you open a dialog box for the first time, the default setting is displayed. After that, if you open the dialog box, the previously selected setting is displayed. To choose any items in a dialog box, use **Tab**, ← or →.

- Opening dialog box of the **Open ...** command in F1: File menu

- ① Press **F1** to open the F1: File menu.
- ② Press ↓ until the **open ...** command is displayed in highlight.
- ③ Press **Enter** to open the dialog box.
- ④ Press **Tab** or → continually to move the cursor to the "Catalog:" list box.

When there exist a lot of items in a list box, changing selection item in the list box can be carried out by pressing ↓.

- ⑤ Press **Esc** to close the dialog box, without reading file.

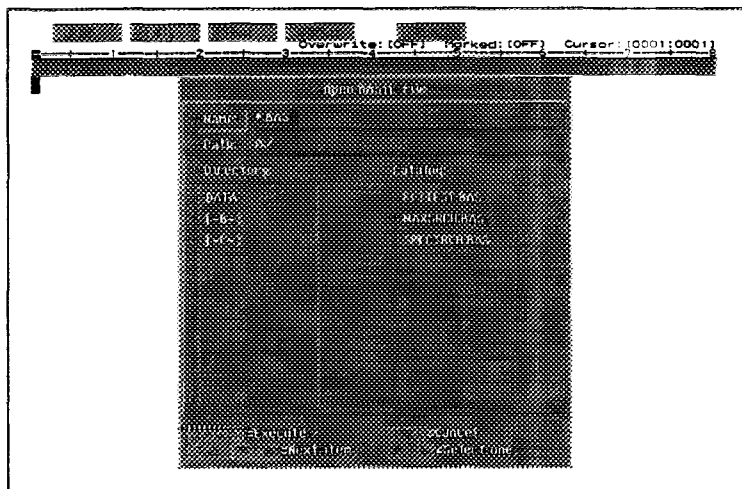


Figure 2-4 Dialog Box of **Open ...** Command

2.6.6 Executing Edit Command Directly

The edit command can be executed directly when used in combination with the shortcut keys. It is not necessary to open the menu and choose a menu command when the edit command is executed directly.

The shortcut keys can be used with the main edit commands.

(1) Shortcut keys used for choosing command

For the commands being to use shortcut keys, the indications of the short cut keys are listed to the right of the command name.

(Example) When cutting and pasting

The **cut** command of F2:Edit menu can be executed by pressing the **Delete**, holding **Shift** key down. The **Paste** command, by pressing the **Insert**, holding **Shift** key down.

(2) Other keys used in combination

Almost every key is used in combination of **Shift**, **Alt**, **Ctrl** and function keys: **Insert**, **Delete**, **↑**, **↓**, **←**, **→**, etc.

(Example) When pressing **←** or **→**, the cursor of the screen can be moved to the left or right. To move the cursor to the left or the right from the word where it currently located, press **←** or **→**, holding the **Ctrl** down.

2.6.7 Closing Editor

- Closing editor

① Execute **Quit** command of the F1: File menu.

② When there is a file being not saved, a message appears to make sure whether the closing may be executed or not.

When pressing **Y**, the environment becomes direct mode without saving the file.

When pressing **N**, the screen returns to the original edit and executes program once again after saving the file.

2.7 Editing Programs

This section explains how to edit a program by using the editor.

Editing a program means the operations that perform revising, adding and correcting for a written program. When a program line is input in the direct mode, it must be added by a line number. However, it is not necessary in the edit mode.

When a program file without a line number is specified, the BASIC adds the line number automatically.

(Caution) The program examples to be explained later are described without the line number.

2.7 Editing Programs

2.7.1 Inserting Characters

When you want to insert characters into the line which has been programmed, move the cursor to the character behind the location where you want to insert, then input the characters as they are.

When entered, the characters are inserted into the cursor position. All the characters, from the cursor position to the end of the line, move to the right by one position.

- Inserting characters

- ① Input the following program line.

```
PRNT "NUMBER"█
```

- ② Press the ← key to move the cursor to the N of PRNT.

```
PR█NT"NUMBER"
```

- ③ Input I. I is inserted into the location of N and the characters following N is moved to the right.

```
PR I█NT"NUMBER"
```

When pressing **Insert**, a space is inserted at the cursor location as it is.

All the characters following the cursor move to the right by one position and the space is displayed at the cursor location.

In a program, up to 511 characters are available for each line.

However, when the characters are more than 80, the screen displays only 80 characters at most.

If you press → key to move the cursor to the last character of the displayed line, the remained characters are displayed in the screen.

To display the first character of a line, press ← key and move the cursor to the first character of the displayed line.

2.7.2 Inserting Lines

When you want to insert a new line between two lines of a program, press **Insert** holding **Ctrl** down.

- Inserting lines

- ① Input the following program line.

```
INPUT A
C=A*B█
```

- ② Add a command line called "INPUT B" between "INPUT A" and "C=A*B" of this program as follows.

Press **Home** key holding **Ctrl** down. The cursor moves to the head of the line.

```
INPUT A
█=A*B
```

- ③ After the cursor has been moved to the head of line, press **Insert** holding **Ctrl** down.

```
INPUT  A
█
C=A*B
```

The blank line also can be inserted by pressing **Enter**. In this case, the cursor is moved to the head of the next line.

To split a line into two parts, press **Insert** key holding **Ctrl** down or execute **Enter** at the middle of the line, then the characters from the cursor position to the end of the line move to the second line.

2.7.3 Deleting Characters and Lines

To delete characters , press **Backspace** or **Delete**.

When **Backspace** is used, one character to the left of the cursor is deleted, and the cursor and all the characters from the current cursor position to the end of the line are moved one position to the left.

When **Delete** is used, the character of the current cursor position is deleted and the characters from the right of the cursor to the end of the line are moved one position to the left.

- (1) Deleting characters by the use of **Backspace**

- ① Input the following line.

```
PRINT "A"█
```

- ② Move the cursor to the position of the second | by using the cursor move keys.

```
PR█INT "A"
```

- ③ Press **Backspace**.

The first | is deleted, and the characters INT "A" are moved to the left.

```
PR█INT "A"
```

If the **Backspace** is performed at the head of the line , the lines can be connected. The cursor and the cursor resident line will move up to the end of the previous line.

- (2) Deleting characters by the use of **Delete**

- ① Input the following line.

```
PRINT "A"█
```

- ② Move the cursor to the position of the second | by using the cursor move keys.

```
PR█INT "A"
```

- ③ Press Delete.

The | at the cursor position is deleted and the characters NT "A" are moved to the left.

```
PR█INT "A"
```

If **Delete** is performed at the end of statement , the lines can be connected.

2.7 Editing Programs

The next line will move to the cursor position wholly.

- (3) Deleting from the cursor position to the end of line.

To delete a line from the cursor position to the end of the line, use **Delete line** command of the F2 : Edit menu.

- ① Input the following program line.

```
A=1+3
B=5*4
PRINT A
```

- ② Move the cursor to the head of the line B=5*4 by using the cursor move keys.

```
A=1+3
B=5*4
PRINT A
```

- ③ Press **F2** to open the F2 : Edit menu, then execute **Delete line** command. The line B=5*4 is deleted and the next line is moved up.

```
A=1+3
PRINT A
```

When the **Delete line** command is executed in the middle of the line, all the characters from the cursor position to the end of the line are deleted (The next line does not move).

If you press **Delete** holding **Shift** down, this command can be executed at one stroke of the key operation.

When **Delete line** command is executed for a wrong position, perform the **Paste** command at once, then the deleted content can be recovered.

If you press **Insert** holding **Shift** down, this command can be executed at one stroke of the key operation.

2.7.4 Block Editing

The block editing means the operation that specifies the edit lines in a integrated way.

Using editor, the editing can be performed for the characters and the lines. When the lines are specified in a integrated way, the deleting and moving can be performed in a wide range in integrated way. These integrated lines are called "block". To select a block, move the cursor to the head of the target block and set the mark, then execute the edit command.

- (1) Setting mark

The mark is set at the head of block editing line.

- ① Input the following program line.

```
INPUT A
INPUT B
C=A+B
PRINT A
```


- ② Move the cursor to the head of the line C=A+B, using the cursor move keys.

```
INPUT  A
INPUT  B
█=A+B
PRINT  A
```

- ③ Press **Space** holding **Ctrl** down.

When the mark is set, "Mark set" is displayed in the message line.

The mark is also used for memory of cursor position in addition to the block editing. If press **Space** holding **Alt** down, then the mark and cursor exchange. The cursor moves to the mark position, and the mark is set at the current cursor position.

- (2) Cut and copy

The cutting and copying can be performed when the block is selected with the set mark.

(Note) *When the mark is not set, the cutting and copying can not be performed. In this case "No mark in this window" is displayed in the message line.*

Cutting a block of lines selected for block editing means that the selected lines are delete in an integrated way.

To copy a block means that the copying is performed for the selected block.

The cut block and copied block are stored in a place of the memory. This place is known as "clip board".

The content of clip board can not be viewed directly. It is displayed when pasting is performed.

Whenever the cutting , copying and line deleting are performed, the content of clip board is renewed. The contents of cut , copied and deleted line are stored at last.

The content of clip board can be inserted to the cursor position by pasting operation to be described later.

- Executing **Cut** command

- ① Input the following program lines.

```
INPUT  A
INPUT  B
C=A+B
PRINT  A█
```

- ② Move the cursor to the end of line after the mark is set at the head of C=A+B.

- ③ Press **F2** to open the F2: Edit menu.

- ④ Execute **cut** command.

```
INPUT  A
INPUT  B
█
PRINT  A
```

The selected text is sent to the clip board.

Only one text block can be sent at a time.

If you press **Backspace** holding **Shift** down, the command can be executed at one

2.7 Editing Programs

stroke of the key operation.

If you press **Backspace** only, merely one character to the left of the cursor position is deleted.

(3) Pasting text block

The text sent to the clip board is remained till the new text is sent to the clip board or the editor is closed.

- Pasting program line

- ① Input the following program line

```
INPUT  A
INPUT  B
C=A+B
PRINT  A
█
```

- ② Press **Space** holding **Ctrl** down, then the mark is set at the cursor position.

- ③ Use the arrow key to move the cursor to the head of C=A+B.

- ④ Press **Space** holding **Alt** down, then the mark and cursor exchange.

- ⑤ Press **F2** to open the F2: Edit menu.

- ⑥ Execute **copy** command.

- ⑦ Press **F2** to open the F2: Edit menu.

- ⑧ Execute **Paste** command.

```
INPUT  A
INPUT  B
C=A+B
PRINT  A
C=A+B
PRINT  A
█
```

If you press **Insert** holding **Shift** down, this command can be executed at one stroke of the key operation.

If you Press **Insert** only, merely one space is inserted to the cursor position.

3 Functions of BASIC Editor

In this chapter, Various BASIC editor functions described in "2.6 Edit Mode" are explained in detail. As mentioned above, all the operations necessary for the programming such as editing, debugging till program executing can be performed using the pull-down menu *holded* by editor.

The following items are described.

- Method for starting BASIC Editor
- Method for executing menu command
- Method for selecting options of dialog box
- Scrolling list box
- Method for selecting dialog box and text in window
- Method for changing window size
- Method for using direct screen
- Method for using watching window

3.1 Starting BASIC Editor

Editor is started by external keyboard. (Refer to 3.1.1.)

The BASIC editor must be installed in this instrument before starting the editor by the use of attached install-disk. (Refer to 1.4.1.) When you start the editor without installing it, the following message appears and it can not be started.

Editor not installed

3.1.1 Starting Editor

- Turning to the edit mode
Press **F12** of the external keyboard.

3.1.2 BASIC Editor Screen

When the editor is started, the editor screen is displayed.

In this editor screen, the measurement wave form and BASIC text screen are not displayed.

The component parts of a editor screen are shown in Figure 3-1.

NETWORK ANALYZER PROGRAMMING GUIDE

3.1 Starting BASIC Editor

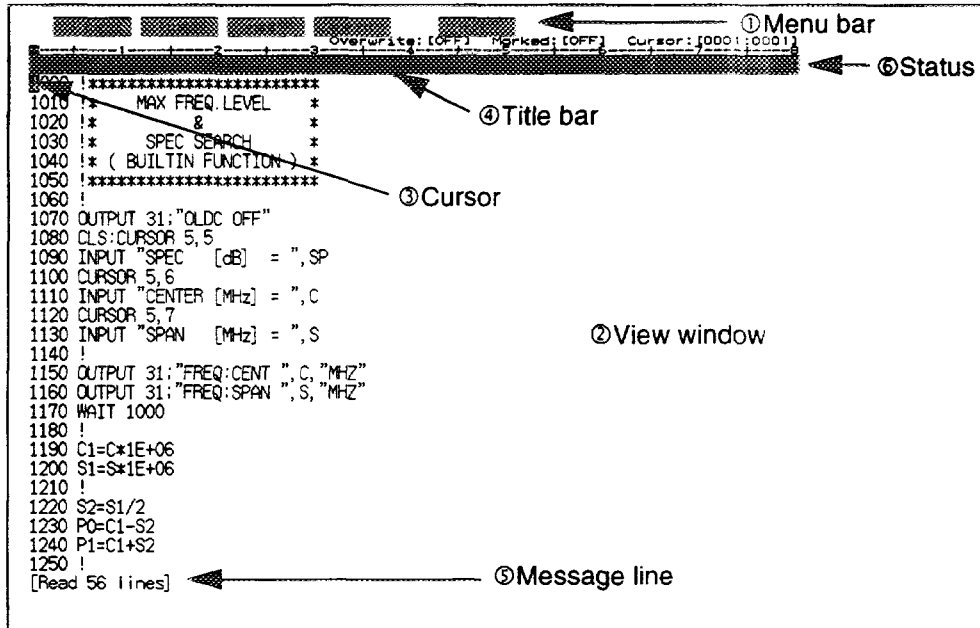


Figure 3-1 Component parts of a Editor Screen

- Component parts of editor Screen

Components	Explanation
①Menu bar	Shows the name of each menu.
②View window	Shows the text of program.
③Cursor	Indicates the position where the text to be input and edited. The cursor appears in the active window.
④Title bar	Shows the buffer name-file name of program and subfile. For BASIC program, the buffer name is represented by main. For other subfiles except that represented as the same as file.
⑤Message line	For the files added by editing, an asterisk (*) is displayed at the head of title bar. Shows the error occurred in the course of editing and the related information.
⑥Status	Shows the status (Overwrite / Marked / Cursor) of editor. <ul style="list-style-type: none"> • Overwrite: shows Insert / Overwrite mode. • Marker: shows the status of text block.(Specifies text range) • Cursor: shows the position of cursor on the screen with x/y.

3.2 Opening Menu and Executing Command

Each command of editor exists in the pull-down menu of menu bar. Figure 3-2 shows one of the pull-down menu, i.e. F1 : File menu.

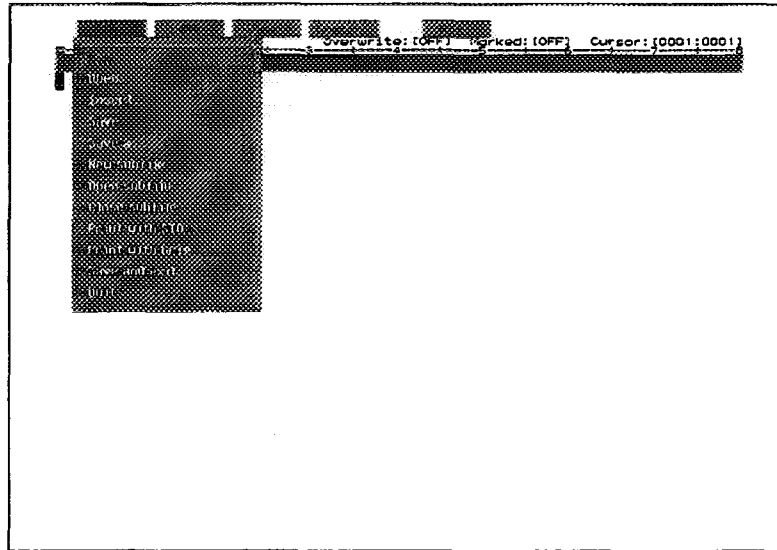


Figure 3-2 F1 : File Menu

The programming environment is designed to enable the operation to be performed as simple as possible.

After the menu is opened by pressing function keys, the command can be executed. (Refer to 3.2.1.)

However, some commands can be executed directly by using the shortcut keys without opening the menu. (Refer to 3.2.2.)

For the command followed by ellipsis (...) after the name, it is necessary to show some information that should be specified in more detail before it is executed.

When the command of this kind is executed, a dialog box appears in the view window so as to specify the items that is necessary for the command execution.

3.2.1 Executing Commands through key operation

This section describes a method about opening a menu by using external keyboard and executing the editor commands.

To open a menu, press the function key (*F1* to *F5*) that is corresponding to the menu name.

If you press ← or → when a menu has been opened, then the menu to the left or right of this menu can be opened.

When a menu is open, commands of this menu are displayed, and the executable commands are indicated with the command name in high-light.

Press ↑ and ↓, then the high-light indication of command name moves up and down.

Press **Enter**, then the command displayed in high-light can be executed.

To cancel the execution of a command, press **Esc**. Then, the opened menu closes and returns to the original status.

3.2 Opening Menu and Executing Command

When a command followed by ellipsis (...) after the name is executed, a dialog box appears on the screen. Input the items necessary for command execution.

To cancel the dialog box, press **Esc**. Then, the execution of this command is cancelled.

3.2.2 Executing Command by using Shortcut keys

This section describes the method of command execution by using the shortcut keys.

When using the shortcut keys, the menu command can be executed at one key stroke. The shortcut keys of menu commands are displayed to the right of the command name on the menu.

Table 3-1 shows the functions of BASIC editor shortcut keys and the catalog of the corresponding commands.

Table 3-1 Shortcut Key Operation

Key operation	Explanation
Shift + Backspace	Cuts the selected area.
Shift + Insert	Pastes the content of clip board.
Ctrl + F2	Cuts from the cursor position to the end of line.
Alt + F2	Pastes the content of clip board.
Ctrl + F3	Loads the next buffer.
Alt + F3	Shows the Buffer list ... dialog box.
Ctrl + F4	Searches the next searching target.
Alt + F4	Searches the next searching target backward.
Ctrl+ F5	Restarts the program from the interrupting position.
Alt + F5	Starts the program from the beginning.
F11	Activates the next window.
Shift + F11	Activates the previous window.
F12	Converts between editing screen and output screen.
Shift + F12	Converts the split window alternately.

*(Note) The said key operation **Shift + Backspace** means that press the **Backspace** key holding the **shift** key down. (The following are same.)*

3.3 Using a Dialog Box

(1) Function of dialog box

When it is necessary to specify options before a command is executed, the editor provides a dialog box. Figure 3-3 and Figure 3-4 show the component parts of a dialog box. The dialog box performs the following functions.

- Acquiring the input of file name
- Acquiring the setting of option

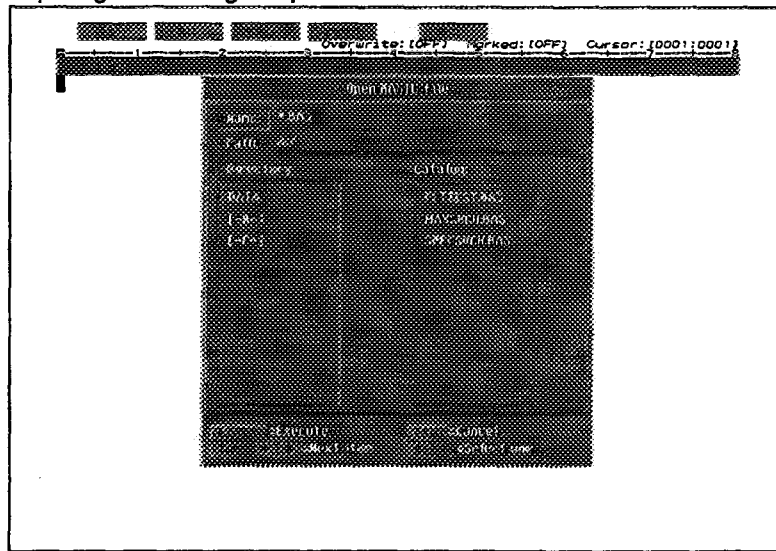


Figure 3-3 Dialog Box of Open ... Command

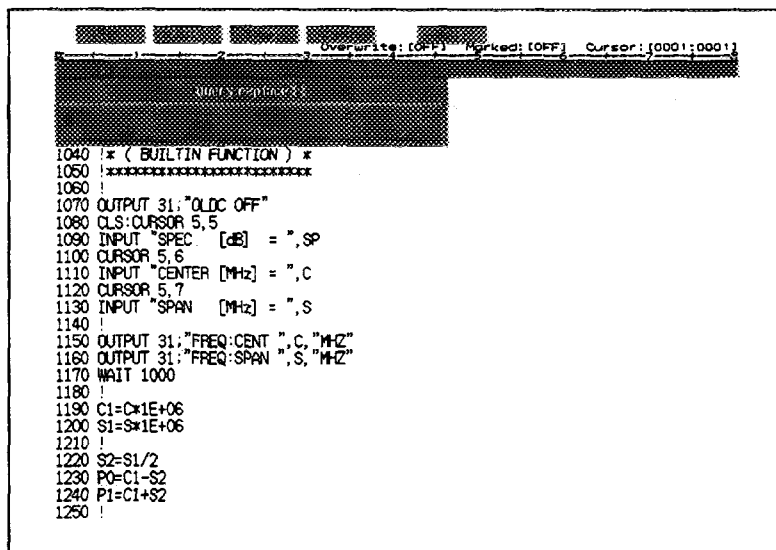


Figure 3-4 Dialog Box of Replace ... Command

3.4 Using Message Line

(2) Moving cursor

To move the cursor to an item of a dialog box, there are the following two ways :

- Press **Tab** to move the cursor to the next item.
- Press **Tab** holding **Shift** down to move the cursor to the previous items.

(3) Function of each item in a dialog box

Path name specifying field :

Shows the path of current directory.

Inputs a new path name with the Name field or selects a suitable directory with the Directory box or changes the display of path.

Text input field:

Shows the entered text.

List box:

Shows the catalog of directory and files etc.

Command button :

Shows the catalog of keys necessary for the command execution.

Performs by pressing the corresponding keys.

To execute command, press **Enter**.

3.4 Using Message Line

The message line is displayed at the lowest part of the screen.

It is used to make sure the command execution or cancelling, and notify errors.

The message line is erased when performing next operation.

3.5 Using Window

The part showing the loaded program is called "View window". The view window can perform the split screen editing.

For the editing file and program, a buffer name is added in addition to the file name.

Among the files that in the course of editing, those not displayed in the view window can be referred according to the buffer name.

For BASIC programs, the buffer name is called main.

Among the files being edited, the buffer name:main can be executed in fact.

3.5.1 Function of Each Window

View window can be splitted into two parts : the upper and the lower.

When the window is splitted into two parts, the two parts of program can be viewed and edited at the same time.

To split the view window, execute **Split window** command of F3 : View menu.

Execute this command once again, then the screen returns to the original.

3.5.2 Changing Active Window

The window holding the cursor is called "active window" .

To activate other windows, perform either of the following operations.

- Press **F11**, and activate the windows in the lower part of the screen in sequence.
- Press **F1** holding **Shift** down to activate the windows in the upper part of the screen in sequence.

3.5.3 Changing Window Size

The window size can be enlarged or reduced in line unit.

Also, a window can be displayed on the full screen.

To change the window size, active the window whose size to be changed, and perform the key operations shown below..

Key operation	Explanation
Alt + PageUp	Enlarges the active window by one line.
Alt + PageDown	Reduces the active window by one line.
Shift + F12	Enables the active window to fill the full screen.

3.5.4 Scrolling Active Window

Scroll the view window, when you want to see the upper and/or lower parts of a file that are not displayed in view window.

Press the direction keys to move the cursor to the end of the screen, then the scrolling starts. However, scrolling to left or right is performed only by the current cursor line.

Key operation	Explanation
Home	Moves to the beginning of a file.
End	Moves to the end of a file.
PageUp	Scrolls one page up.
PageDown	Scrolls on page down.
Ctrl + Home	Moves to the beginning of a line.
Ctrl + End	Moves to the end of a line.
Ctrl + ↑	Scrolls one line up.
Ctrl + ↓	Scrolls one line down.

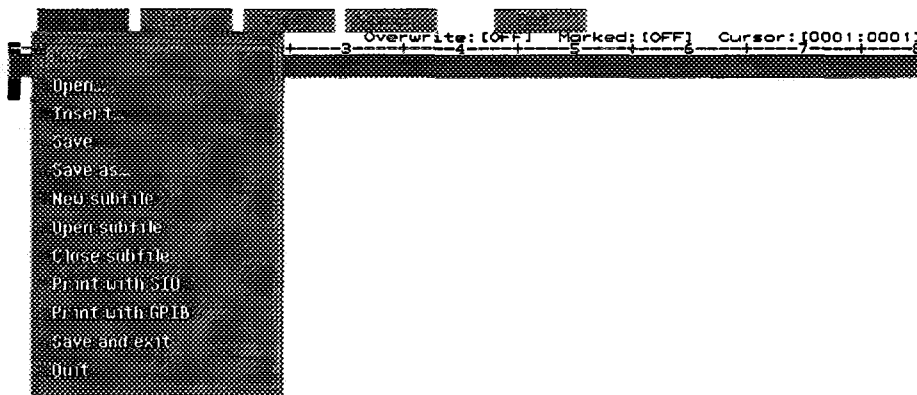
MEMO ①

4 F1: File Menu

F1: File menu is prepared for editing files used in BASIC.

Executing the commands of F1: File menu, you can create a new file, load files from a floppy disk or revise a file.

Using the commands of F1: File menu, you can also print files on a line printer or end the operations of the editor.



- **New command**
Removes the BASIC program which has been loaded before.
Use it when you start to write a new program.
- **Open ... command**
Loads a program which has been saved in a floppy disk.
Select the file from files of dialog box and catalog of directory.
- **Insert ... command**
Merges the contents of two files into one file.
- **Save command**
Writes the content of a file displayed in an active window into a floppy disk file.
- **Save as ... command**
Writes a file in the course of operation into a floppy disk file with a specified name.
- **New subfile command**
Creates a usual text file. The subfile can not be executed.
- **Open subfile command**
Loads the program stored in a floppy disk and the ordinary file as a subfile.
- **Close subfile command**
Releases the editing text file from the memory.
- **Print with SIO command**
Outputs the file contents displayed in an active window from the SIO board.

4.1 New command

- **Print with GPIB** command
Outputs the file contents displayed in an active window from the GPIB board.
- **Save and exit** command
Writes all the files being loaded into a floppy disk and closes the editor.
- **Quit** command
Closes the editor.

4.1 New command

The **New** command of F1: File menu deletes all the BASIC program that have been loaded up to now, so that a entirely new program can be entered.

When a program in the memory is not saved, the following message is displayed in the message line.

Discard changes [y / n] ?

When pressing **Y**, the program is released from the memory without it saved in a floppy disk, and other files being edited are displayed in the active window.

When pressing **N**, the program is moved to another buffer editing.

Execute the **New** command after saving in a floppy disk with **Save** command or **Save as ...** command.

4.2 Open ... command

The **Open ...** command is used to load a program which has been saved in a floppy disk.

When this command is executed, a dialog box appears and displays the catalog of files whose extension is .BAS. in the current directory.

The catalog of other directories and the files in other floppy disk also can be displayed with this dialog box.

When the **Open ...** command is executed, the dialog box as shown Figure 4 - 1 appears.

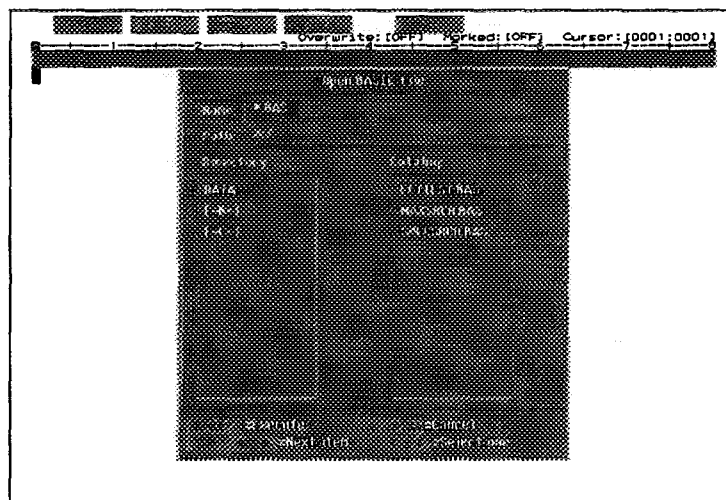


Figure 4-1 Dialog Box of Open ... Command

4.2.1 Specifying Files

The catalogs of directories and the accessible drives are displayed in Directory box.

The file catalog is displayed in the Catalog box of this dialog box.

When it can not be displayed in one screen, scroll it up and down with ↑ and ↓, separately.

There are the following two ways to specify the file to be loaded.

- Entering file name directly

Input the file name of program into the Name field, and press **Enter**.

To delete the content displayed in the Name field, press **Backspace**.

Then, the character to the left of the cursor position is deleted, and the cursor is moved one character position to the left.

- Selecting from Catalog box

Keep pressing the **Tab** to move the cursor to the Catalog box.

Use ↑ and ↓, to move the high-light indication over to the file to be loaded, then press **Enter**.

4.2.2 Catalog display of Directory Content

Keep pressing the **Tab** to move the cursor to the Directory box. Use ↑ and ↓ to move the high-light indication over to the accessing directory, then press **Enter**.

All sub-directories on the selected directory and the catalog of files with the extension. BAS in that directory are displayed.

When **Enter** is pressed, the file is loaded in the memory.

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4.3 Insert ... Command

The following describes how to display the catalog of directory content.

- Displays all the files in current directory.
Input * in the Name field and then press **Enter**.
- Displays root directory file of floppy disk.
Input A:/ in the Path field and then press **Enter**.
- Displays all the files in subdirectory that is called SUB.
In the Directory box, display the name called SUB in high-light and press **Enter**.
Then, input * in the Name field and press **Enter**.
- Displays files of the previous directory of current directory.
In Directory box, display .. in high-light and then press **Enter**.
- Displays files whose name is composed of six characters.
Input ?????? in the Name field, then press **Enter**.
- Displays files whose name begins with B.
Input B* in the Name field, then press **Enter**.
- Displays files with the extension DAT.
Input *.DAT in the Name field, then press **Enter**.
- Displays files with the extension composed of two characters.
Input *.?? in the Name field, then press **Enter**.
- Displays files with the last character of extension from B to FEEEE.
Input *.*[B-F] in the Name field, then press **Enter**.

4.3 Insert ... Command

This command is used to insert the content of other files into the cursor position of a working file. When the **Insert ...** command is executed, a dialog box as shown in Figure 4-2 appears. The method of using this dialog box is completely the same as that in the **Open ...** command box.

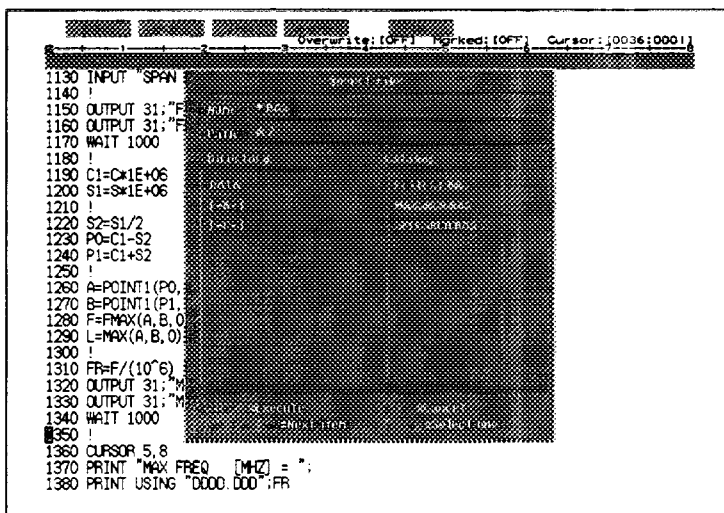


Figure 4-2 Dialog Box of Insert ... Command

4.4 Save Command

The **Save** command is used to save the content of the operating file to a floppy disk file.

When the file to be saved has been named, the **Save** command writes it into the file which has the same name in the floppy disk.

When the file is not named, the message "No file name" appears in the message line and the file can not be saved. Specify the file name and then save it with the **Save as ...** command.

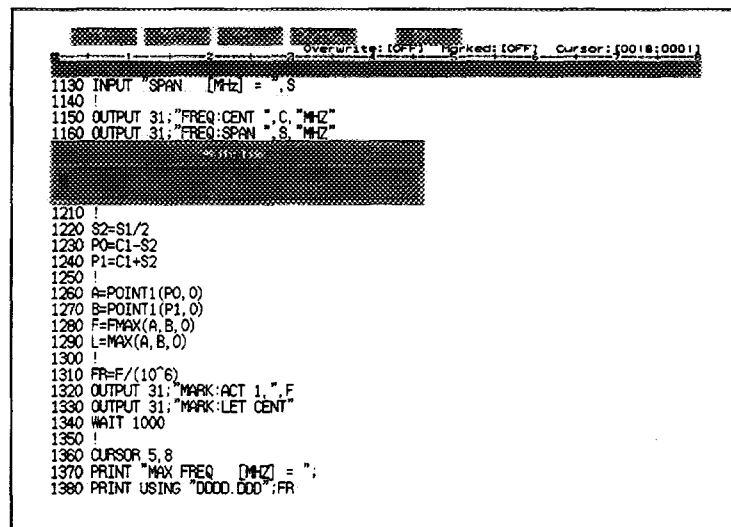
4.5 Save as ... Command

The **Save as ...** command is used to save a file being operated with the specified name.

This command is used when you specify a new name to a file or do not change a file that has not been revised. When a new name is specified to a file, the old file remains in the floppy disk with the original name.

When the **Save as ...** command is executed, a dialog box as shown in Figure 4-3 appears.

When a new name is entered and saved, the file name in the title bar of window is changed.



```

1130 INPUT "SPAN [MHz] = ";S
1140 !
1150 OUTPUT 31;"FREQ:CENT ".C."MHZ"
1160 OUTPUT 31;"FREQ:SPAN ".S."MHZ"
1170 !
1210 !
1220 S2=S1/2
1230 P0=C1-S2
1240 P1=C1+S2
1250 !
1260 A=POINT1(P0,0)
1270 B=POINT1(P1,0)
1280 F=FMAX(A,B,0)
1290 L=MAX(A,B,0)
1300 !
1310 FR=F/(10^6)
1320 OUTPUT 31;"MARK:ACT 1 ".F
1330 OUTPUT 31;"MARK:LET CENT"
1340 WAIT 1000
1350 !
1360 CURSOR 5,8
1370 PRINT "MAX FREQ [MHz] = ";
1380 PRINT USING "0000.000";FR

```

Figure 4-3 Dialog Box of Save as ... Command

4.6 New subfile Command

The **New subfile** command is used to create text file except for the BASIC program. The file that is created as a subfile can be executed by using F5 : Run menu.

When the **New subfile** command is executed, a dialog box as shown in Figure 4-4 appears.

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4.7 Open subfile Command

```
1130 INPUT "SPAN [MHz] = ",S
1140 !
1150 OUTPUT 31:"FREQ CENT ",C,"MHz"
1160 OUTPUT 31:"FREQ SPAN ",S,"MHz"
1210 !
1220 S2=S1/2
1230 PC=C1-S2
1240 P1=C1+S2
1250 !
1260 A=POINT1(PC,0)
1270 B=POINT1(P1,0)
1280 F=FMAX(A,B,0)
1290 L=MAX(A,B,0)
1300 !
1310 FR=F/(10^6)
1320 OUTPUT 31:"MARK:ACT 1,"F
1330 OUTPUT 31:"MARK:LET CENT"
1340 WAIT 1000
1350 !
1360 CURSOR 5,8
1370 PRINT "MAX FREQ [MHz] = ";
1380 PRINT USING "0000.000";FR
```

Figure 4-4 Dialog Box of New subfile Command

Input Buffer Name with this dialog box. The buffer name is used by the editor to control the editing of file internally. When you want to save a file edited with this, do that with **Save** command or specify the file name first and then save with the **Save as ...** command.

For the program files, only one file can be loaded. But for the subfile, more than one are enabled to be loaded. The subfile can display the file in the course of editing through the buffer name with the **Buffer list ...** of F3 :View window, or display the file information.

For the BASIC program, the executable buffer name is **main**. The **main** must be allocated to the file that is edited with **New** and **Open ...** command.

4.7 Open subfile Command

The **Open subfile** command is used to load the text file from a floppy disk. The file loaded with this command can not be executed by using F5 : Run menu.

When the **Open subfile** command is executed, the dialog box as shown in Figure 4-5 appears.

```
1130 INPUT "SPAN [MHz] = ",S
1140 !
1150 OUTPUT 31:"FREQ CENT ",C,"MHz"
1160 OUTPUT 31:"FREQ SPAN ",S,"MHz"
1170 WAIT 1000
1180 !
1190 C1=C*1E+06
1200 S1=S*1E+06
1210 !
1220 S2=S1/2
1230 PC=C1-S2
1240 P1=C1+S2
1250 !
1260 A=POINT1(PC,0)
1270 B=POINT1(P1,0)
1280 F=FMAX(A,B,0)
1290 L=MAX(A,B,0)
1300 !
1310 FR=F/(10^6)
1320 OUTPUT 31:"MARK:ACT 1,"F
1330 OUTPUT 31:"MARK:LET CENT"
1340 WAIT 1000
1350 !
1360 CURSOR 5,8
1370 PRINT "MAX FREQ [MHz] = ";
1380 PRINT USING "0000.000";FR
```

Figure 4-5 Dialog Box of Open subfile Command

The method of using this dialog box is completely the same as that in the **Open ...** command.

For the program files, only one file can be loaded. But for the subfile, more than one are enabled to be loaded. The subfile can display the file in the course of editing through the buffer name with the **Buffer list ...** of F3 :View window, or display the file information.

For the BASIC program, the executable buffer name is **main**. The **main** must be allocated to the file that is edited with **New** and **Open ...** command.

4.8 Close subfile Command

The **Close subfile** command is used to delete the subfile being edited in active window from the memory.

When a changed file is not saved in a floppy disk during operation, the following message is displayed in the message line.

Discard changes [y / n] ?

When you press **Y**, it is released from the memory without saved in a floppy disk, and other files in the course of editing are turned to be displayed in the active window.

When you press **N**, it is moved to the editing of other buffers.

Execute the **Close subfile** command after saving in a floppy disk with **Save** command or **Save as ...** command.

4.9 Print with SIO Command

The **Print with SIO** command is used to output the content of file displayed in an active window with the SIO board (RS-232C board).

When using the **Print with SIO** command, connect the printer with RS-232C board of this analyzer.

4.10 Print with GPIB Command

The **Print with GPIB** command is used to output the content of file displayed in an active window with the GPIB board.

When using the **Print with GPIB** command, connect the printer with GPIB board of this analyzer.

4.11 Save and exit Command

The **Save and exit** command is used to save all those edited during operation from among the files that currently loaded, and close the editor.

The names of files loaded currently are displayed in the dialog box of **Buffer list ...** in F3 : View menu.

When there exists a file whose name is not specified, "No file name" is displayed and the screen returns to the original. Specify a name to the file with **Save as ...** command.

4.12 Quit Command

4.12 Quit Command

The **Quit** command is used to release the editor from the memory and close the editor.

When closing the editor, if there are new files that have not been saved, or programs that have been edited, the following message will be displayed in the message line.

Modified buffers exist, Save all [y / n] ?

When you press **Y**, the editor closes without saving the modified file.

When you press **N**, the screen returns to the original.

To close the editor after all files have been saved, execute the **Save and exit** command.

5 Basic Operation of Editor

This chapter describes the fundamental methods for using editor and entering program text. The following items are explained.

- Entering text and moving cursor
- Deleting and inserting text
- Moving and copying block of text
- Searching and replacing characters, words and statements
- Method for copying text from other files

5.1 Entering Text

There are two ways to write characters in text : " Insert" and " Overwrite "

In the insert mode, the editor inserts the entered characters to the left of cursor.

In the overwrite mode, the character at cursor position is replaced by the entered character.

To convert the insert mode and the overwrite mode, press the **Alt** key and hold it down, then press **Insert** key.

The setting state of mode can be checked on the status line.

The following message will be shown :

For the insert mode, Overwrite : [OFF]

For the overwrite mode, Overwrite : [ON]

5.2 Selecting Text

When you operate a text program with the editing function, select the range of text first, then specify the part to be edited.

- ① Move the cursor to the beginning of target text, press the **Ctrl** and hold it down, then press **Space** key to set the mark.
When the mark is set, the Marked : [] in the status line becomes ON.
- ② Move to the end of text, then execute the edit command.

Once the Mark is set, the texts including from the text where the mark is set to the text where the cursor resident currently turn to the select state all the time.

5.3 Indenting Text

When a text is indented, the structure of program becomes easy to read.

To indent a text, enter **Space** or **Tab** at the beginning of a line. The indent is set at the column to which the space skipped from the beginning of the line. After this, when the **Enter** is pressed, the cursor moves to the same position of the next line.

5.4 Outline of Edit Command

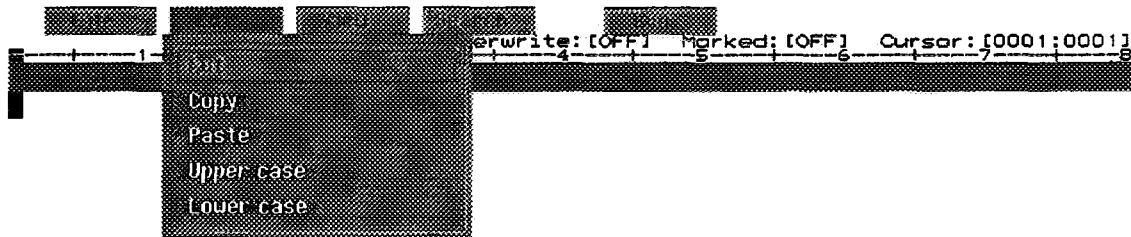
Moving the cursor or an active window can be performed by the simple combined operations of keys. The following is the catalog of edit command.

Table 5-1 Catalog of Edit Command

	Key operation	Explanation
(1) Moving Cursor	← → Ctrl + ← Ctrl + → ↑ ↓ Home End Ctrl + Home Ctrl + End Alt + Home Alt + End Ctrl + Space Alt + Space	Moves one character left. Moves one character right. Moves one word left. Moves one word right. Moves one line up. Moves one line down. Moves to the beginning of a file. Moves to the end of a file. Moves to the beginning of the cursor line. Moves to the end of the cursor line. Moves to another window. Moves to another window. Sets mark at the cursor position. Exchanges between the positions of mark and cursor.
(2) Insert	Enter Insert Ctrl + Insert Shift + Insert Alt + Insert	Inserts change line. Inserts one space. Inserts a blank line. Inserts the content of clip board. Converts Insert / Overwrite modes.
(3) Delete	Backspace Delete Ctrl + Backspace Ctrl + Delete Shift + Backspace Shift + Delete	Deletes the character to the left of cursor. Deletes the character at the cursor position. Deletes the word to the left of cursor position. Deletes the word to the right of cursor position. Deletes the selected text. Deletes till the end of a line.
(4) Scroll	Ctrl + ↑ Ctrl + ↓ PageUp PageDown Ctrl + Pageup Ctrl + Pagedown	Scrolls one line upward. Scrolls one line downward. Scrolls one page upward. Scrolls one page downward. Enlarges a window for one line. Reduces a window for one line.

6 F2 : Edit menu

The commands, used to write or interchange programs and texts, are prepared in F2 : Edit menu. Using the commands of F2 : Edit menu, you can perform cutting, copying and pasting for a text. It is necessary to select the text to be edited in advance. For the selecting procedure, refer to " 5.2 Selecting Text ".



- **Cut** command
Used to send a selected text to the clip board after it has been cut.
- **Copy** command
Used to send a copy of a selected text to the clip board.
- **Paste** command
Used to insert the content of clip board to the cursor position.
- **Upper case** command
Used to change a selected text to the upper case letters.
- **Lower case** command
Used to change a selected text to the lower case letters.

6.1 Clip Board

The clip board is a place used to store, cut or copy texts, temporary. After cutting or copying a text is performed with **Cut** or **Copy** of F2 : Edit menu, the text is stored in the clip board.

The content of clip board can be insert into the cursor position by using the **Paste** command. Only one block can be stored in the clip board at the same time. The text of clip board can be pasted regardless of how many times.

6.2 Cut Command

6.2 Cut Command

This command is used to cut a selected text from the screen and send it to the clip board. To execute the **Cut** command, be sure to perform it after the text has been selected.

When **Cut** and **Paste** commands are used, the movement of line and text block can be performed.

- Moving line and text block
 - ① Select a text to be moved. (Refer to 5.2.)
 - ② Execute the **Cut** command of F2 : Edit menu.
 - ③ Move the cursor to the position where the cut text to be inserted.
 - ④ Execute the **Paste** command of F2 : Edit menu.
- Shortcut key : **Shift + Backspace**

6.3 Copy Command

This command is used to copy a text just as it is, and send it to the clip board. To execute the **Copy** command, be sure to perform it after the text has been selected.

When **copy** and **Paste** commands are used, a part of program or the whole program can be copied.

- Copying a part of program or the whole program
 - ① Select the text to be copied. (Refer to 5. 2.)
 - ② Execute the **Copy** command of F2 : Edit menu.
 - ③ Move the cursor to the position where the copied text to be inserted.
 - ④ Execute the **Paste** command of F2 : Edit menu.
 - ⑤ Correct the copied text according to the requirement.

6.4 Paste Command

This command is used to insert the copy of the content of clip board into the cursor position.

The command can be used only when a text is stored in the clip board.

- shortcut key : **Shift + Insert**

6.5 Upper case Command

This command is used to change the whole alphabetic characters of the selected text to the upper case letters.

To execute the **Upper case** command, be sure to perform it after the text is selected.

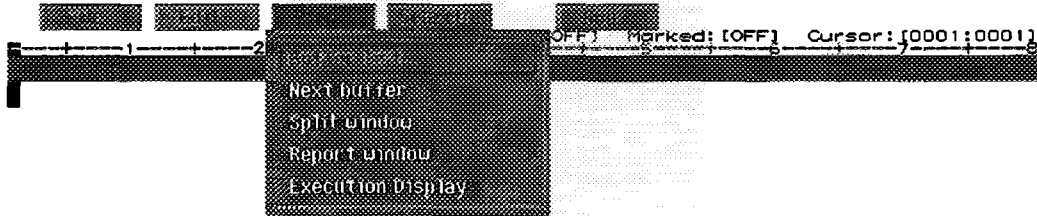
6.6 Lower case Command

This command is used to change the whole alphabetic characters of the selected text to the lower case letters.

To execute the **Lower case** command, be sure to perform it after the text is selected.

7 F3 : View menu

Using F3 : View menu, you can split the view window or edit the content of a loaded file by displaying it in the view window.



- **Buffer list ... command**
Used to watch programs and buffer catalog of subfiles that have been loaded from the floppy disk.
In addition, a file can be selected from the buffer catalog and displayed in the view window.
- **Next buffer command**
Used to display the next file of the buffer in an active window.
- **Split window command**
Used to split the view window into two parts: the upper and the lower.
- **Execution display command**
Used to convert editor screen and measurement screen.

7.1 Buffer list ... Command

When using the **Buffer list ...** command, you can see the catalog of files that have been loaded and select the target file. The selected file is displayed in the view window.

When the **Buffer list ...** is executed, a dialog box as shown in Figure 7-1 appears. Select a file to be edited.

7.2 Next Buffer Command

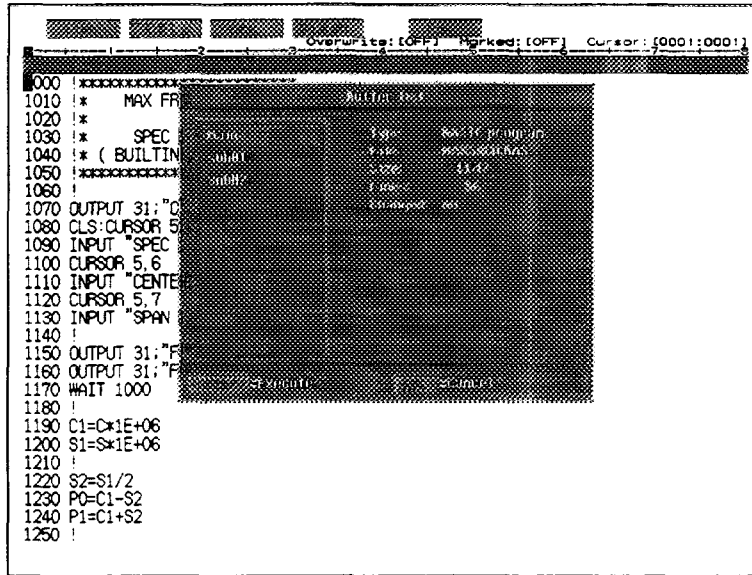


Figure 7-1 Dialog Box of Buffer list ... Command

- Displaying file
 - ① Execute the **Buffer list ...** command of F3 : View menu, a dialog box as shown in Figure 7-1 appears.
 - ② Execute one of the following operations after display the target buffer name in high - light with ←, →, ↑ or ↓ keys.
 - To display the item shown in high - light in an active window, press **Enter** key.
 - To cancel the processing, press **Esc** key.
 - Short cut key : **Alt + F3**

7.2 Next Buffer Command

When more than one file have been loaded in the edit memory, if you execute the **Next buffer** command, the next buffer is displayed in active window in alphabetic sequence. When there is no file is loaded, this command does not function.

- Shortcut key : **Ctrl + F3**

7.3 Split Window Command

This command is used to split the view window into two parts : the upper and the lower. When the view window is splitted, you can operate with the two parts of a file viewed at the same time.

- Operating with more than one files seen at the same time
 - ① Split the view window with **Split window** command.
 - ② A file is displayed in an active window when the **Open subfile** command in F1 :File menu or the **Buffer list ...** command in F3 : View menu is executed. (Active window means a window where the cursor resident.)
- Operating with the view window splitted by **Split window** command
 - ① Execute the **Split window** command of F3 : View menu.
 - ② When you press **Home** holding **Alt** down (or press **End** holding **Alt** down), the cursor moves to the other window. Thus, the cursor resident window becomes an active window.
 - ③ If you execute the **Split window** command of F3 : View menu once again, the active window will be enlarged to fill the entire view window and the other which is not activated is closed.

- Changing window size

To change a window size, activates the window whose size is to be changed, then perform the following operations.

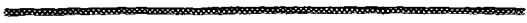
Key operation	Explanation
Ctrl + PageUp	Enlarges active window for one line.
Ctrl + PageDown	Reduces active window for one line.
Shift + F12	Active window is enlarged to fill the entire screen.

7.4 Execution display Command

This command is used to display the editor screen and measurement screen of the BASIC alternately. This command can be used at any time in the course of program editing. Especially, it is convenient to use this command to ensure the result after the program measurement condition has been converted.

- Shortcut key : **F12**

MEMO 



8 F4: Search Menu

Searching a certain character string and replacing the searched character string can be performed by using the command of F4 : Search menu. When a large program is edited, much time is apt to be required to scroll it. In this case, the cursor can jump to the target character string after being searched. In addition, when you want to change a variable name, that can be performed simply by using the replace function.



- **Find ... command**
Used to search the specified character string and move the cursor to the position behind the searched character string.
- **Find word command**
Used to search the character string that is the same as the word at the cursor position, then move the cursor to the position behind the searched character string.
- **Find again command**
Used to search the character string which has been searched just now from the current cursor position.
- **Replace ... command**
Used to search the specified character string and replace it with a new text.
- **Find label ... command**
Used to search the specified line label.

8.1 Find ... command

This command is used to search a specified character string, starting from the cursor position. When the target character string is found, the cursor is moved to the position behind it. The character strings that can be searched may be composed of any character (including space etc.), character string and word.

When **Find ...** command is executed, a dialog box as shown in Figure 8-1 appears. Input the character string being searched to the text box.

8.2 Find word Command

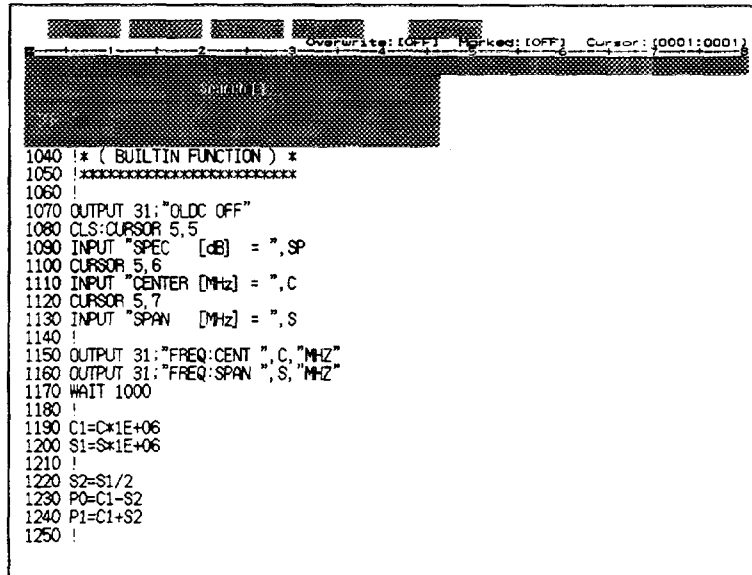


Figure 8-1 Dialog Box of Find ... command

The searching is performed from the cursor position to the whole file displayed in the active window.

- Searching text

- ① Execute the **Find ...** command of F4: Search menu.
- ② Input the text to be searched with a text input file Find text.

When the specified character string is found , the cursor is moved to the position behind the searched character string.

When the specified character string is not found, the message "Not found" is displayed on the lower part of the screen and the cursor is not moved. This message can be cancelled by the next operation.

8.2 Find word Command

This command is used to search a word (sequential alphabetic characters) at the cursor position of an active window.

- Using **Find word** command

- ① Move the cursor to the word being selected. The length of the selected word should be less than one line.
- ② Execute the **Find word** command of F4: Search menu.

8.3 Find again Command

This command is used to search the text once again which has been searched just now. That is, the searching character string specified by using **Find ...**, **Find word** and **Replace ...** commands becomes symmetrical.

When the searching character string is not entered, the **Find again** command does not work.

- Shortcut key: **Ctrl + F4** (Backward from the cursor position.)
Alt + F4 (Forward from the cursor position.)

8.4 Replace ... Command

This command is used to search a specified character string and replace it with other character string. The searching character string may be characters, words or the combination of characters and words.

When the **Replace...** command is executed, a dialog box appears as shown in Figure 8-2. Input the searching character string and the replacing character string in this dialog box.

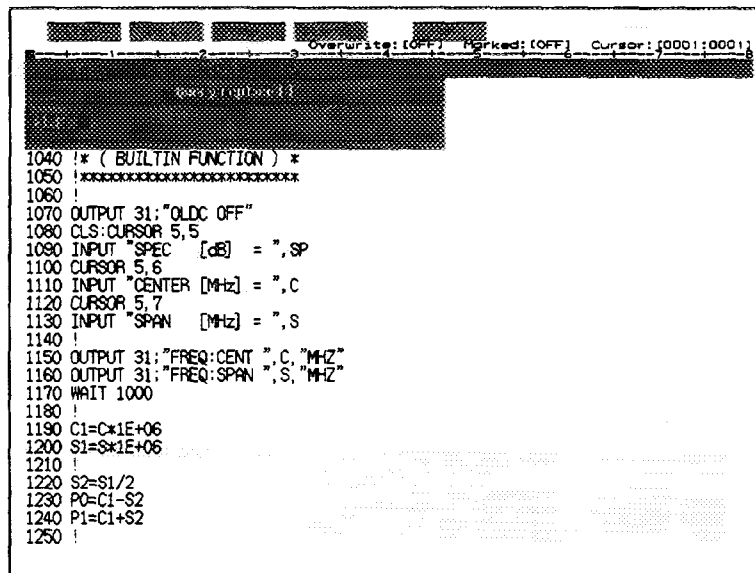


Figure 8-2 Dialog Box of Replace ... Command

- Replacing the specified text
 - ① Execute the **Replace ...** command of F4: Search menu.
 - ② Input the searching character string with the text input file Find-text.
 - ③ Input the replacing character string with the text input file Replace-text.
 - ④ Press **Enter**, then the replacement of text starts.
 - ⑤ On the character string is found, the following message is displayed in the message line.
Replace 'find-text' with 'replace-text'?

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8.5 Find label ... Command

When **Y** is pressed, the next searching is performed after the replacement of character string .

When **N** is pressed, the next searching is carried out without performing the replacement.

The following is the list of functions that can be selected in this state.

Key operation	Explanation
Esc	Stops searching with the cursor moved to the searched character string.
!	Replaces the remainder in a batch.
?	Displays the list of key operation.
.	Stops searching and returns the cursor to the position where the searching is started.
Y	Replaces the text and searches the next one.
N	Perform the next searching without the text replaced.

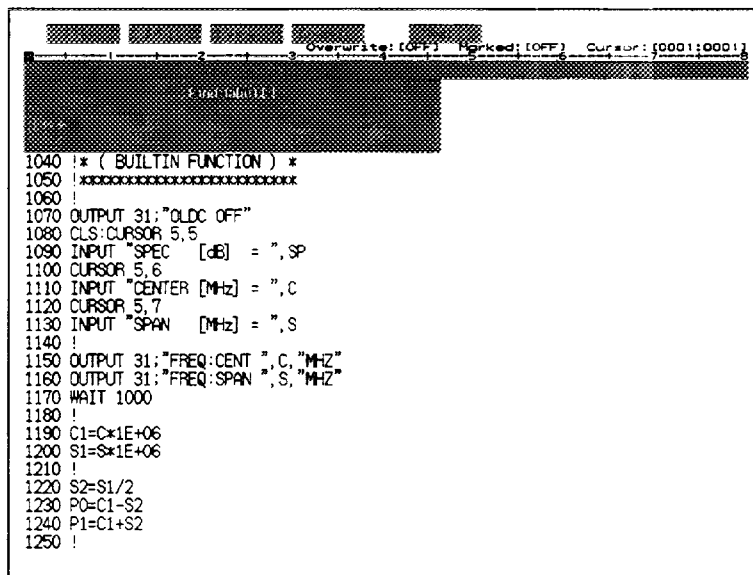
When the searching character string is not found, a message "Not found" is displayed in the message line. The message is cancelled by performing the next operation.

8.5 Find label ... Command

This command is used to search a line label of BASIC program.

The line label should be proceeded by an asterisk (*). Therefore, only those texts that entered by using the text input file Find text and an asterisk is added to, can be searched.

When the **Find label ...** command is executed, a dialog box appears as shown in Figure 8-3.



```
Overwrite: [OFF] Marked: [OFF] Cursor: {0001:0001}
Find label
1040 !* ( BUILTIN FUNCTION ) *
1050 !xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
1060 !
1070 OUTPUT 31:"OLDC OFF"
1080 CLS:CURSOR 5,5
1090 INPUT "SPEC [dB] = ",S
1100 CURSOR 5,6
1110 INPUT "CENTER [MHz] = ",C
1120 CURSOR 5,7
1130 INPUT "SPAN [MHz] = ",S
1140 !
1150 OUTPUT 31:"FREQ:CENT ",C,"MHz"
1160 OUTPUT 31:"FREQ:SPAN ",S,"MHz"
1170 WAIT 1000
1180 !
1190 C1=C*1E+06
1200 S1=S*1E+06
1210 !
1220 S2=S1/2
1230 P0=C1-S2
1240 P1=C1+S2
1250 !
```

Figure 8-3 Dialog Box of Find label ... Command

9 F5: Run Menu

Several available commands are listed in F5: Run menu to execute a program in the programming environment of BASIC, and perform the Upload from BASIC memory or the Download to BASIC memory and so on.

```

Overwrite: 0          Cursor: (0001:0001)
1000 !*****
1010 !*  MAX FREQ. LEVEL  *
1020 !*           &      *
1030 !*  SPEC SEARCH    *
1040 !* ( BUILTIN FUNCTION ) *
1050 !*****
1060 !
1070 OUTPUT 31:"OLDC OFF"
1080 CLS:CURSOR 5,5
1090 INPUT "SPEC [dB] = ",SP
1100 CURSOR 5,6
1110 INPUT "CENTER [MHz] = ",C
1120 CURSOR 5,7
1130 INPUT "SPAN [MHz] = ",S
1140 !
1150 OUTPUT 31:"FREQ:CENT ",C,"MHz"
1160 OUTPUT 31:"FREQ:SPAN ",S,"MHz"
1170 WAIT 1000
1180 !
1190 C1=C*1E+06
1200 S1=S*1E+06
1210 !
1220 S2=S1/2
1230 PO=C1-S2
1240 P1=C1+S2
1250 !

```

- **Start** command
Executes a program.
- **Initialize** command
Resets all the numeric variables to 0 so as to turn the BASIC to the initial state.
- **Continue** command
Restarts the program execution from the statement where the execution is interrupted. In this case, the values of variables are not reset.
- **Upload** command
Reads a program that has been loaded in BASIC memory into the editor.
- **Download** command
Loads a program in the cause of editing to BASIC memory.

9.1 Start Command

9.1 Start Command

The **Start** command of F5: Run menu is used to run a program.

Loads the program into the BASIC memory first, when a program on the way of editing has not been loaded in BASIC memory or a editing is added.

When there is no line number at the beginning line of a program, the line number is added automatically.

To pause the execution of a program, press **Pause**.

To restart the program, execute the **Continue** command of F5: Run menu.

To execute the program from the beginning, execute **Start** command.

The screen changes to the measurement screen when the program execution is started , and returns to the editor screen when the program is paused.

- Shortcut key : **Alt + F5**

9.2 Initialize Command

The **Initialize** command is used when a program is debugged.

This command resets all the values of variables in a program to 0.

This command is used for preparing program execution, not for running a program.

9.3 Continue Command

The **Continue** command is used for debugging.

When this command is used, a program can be executed from break point and watch point to the next ones.

When a program execution is paused, using this command enables the execution to be restarted from the last executed statement or the program to be executed from the beginning.

- Shortcut key : **Ctrl + F5**

9.4 Upload Command

The **upload** command is used to read a program loaded in BASIC memory into the editor.

9.5 Download Command

The **Download** command is used to load a program being edited to the BASIC memory without BASIC program being executed.

The programs being edited with no line number are loaded to BASIC memory with the line number added automatically (The line number can not be directly added to the program on the way of editing.)

10 Automatic Measurement on Network Analyzer

This chapter describes how to create a program to be measured actually with this network analyzer.

(Note) The program presented in this chapter is an example used for R3752/53.

When it is used for R3765/67 and R3764/66, the program is required to be changed according to the initial setting and frequency range, etc.

10.1 Program with OUTPUT and ENTER Commands

10.1.1 Executing Program

This program is used to specify a frequency and show a mark at the position, then read the data, displaying the frequency, level and phase. (This program can not be executed with R3752.)

Example 10-1 Program with OUTPUT and ENTER Command

```

100  ! *****
110  ! *          OUTPUT / ENTER          *
120  ! *****
130  !
140  OUTPUT 31; "OLDC OFF"
150  OUTPUT 31; "MARK:ACT 1, 380E+6"
160  OUTPUT 31; "FETC?"
170  ENTER 31; F, L, P
180  PRINT "FREQ [Hz] = ", F
190  PRINT "LEVEL [dB] = ", L
200  PRINT "PHASE [deg] = ", P
210  STOP
    
```

When the program of Example 10-1 is executed with RUN (BASIC command), a mark is shown. The frequency and level of that position are displayed.

```

FREQ [Hz] = 3.8e + 08
LEVEL [dB] = 0.7818921033
PHASE [deg] = 109.241912841
    
```

This program shows the example using ceramic band pass filter as DUT (Device Under Test), its center frequency 380MHz.

In R3752, there is no GPIB command to deal with the mark. Therefore, built-in function is used when a wave form analysis is performed with R3752.

The program of Example 10-1 is as follows (This program also can be used for R3752.).

For the details of the built-in functions, refer to 10.2.

10.1 Program with OUTPUT and ENTER Commands

Example 10-2 Program with OUTPUT and ENTER Command (using the built- in functions)

```

100 PRINT "FREQ [Hz] = ", 3.8e+8
110 PRINT "LEVEL [dB] = ", CVALUE(3.8e+8,0)
120 PRINT "PHASE [deg]= ", CVALUE(3.8e+8,8)
130 STOP
    
```

Explanation of Program:

The program flow of " Example 10-1 " is explained below.

Explanation of Example 10-1	
100 to 130	Comment line.
140	Sets GPIB command mode of this instrument.
150	Sets the first mark at 380MHz.
160	The first mark position displayed at line 150 is sent.
170	Receives the data sent from line 160 and assigns necessary data to variables. (Since the frequency and level is necessary here, assigns the frequency to F, the level to L and the phase to P.)
180	Displays the data-entered variable F on the screen with the PRINT statement.
190	Displays the data-entered variable L on the screen with the PRINT statement.
200	Displays the data-entered variable P on the screen with the PRINT statement.
210	Ends the program.

This program is carried out is provided in accordance with the settings after the power is switched on.

Explanation of program command:

The OUTPUT, ENTER and RUN (or !) commands used for the program of Example 10-1 are explained below.

(1) OUTPUT command

OUTPUT device address: Numeric representation
 character string representation

The OUTPUT command is used to send data and commands written in numeric or character string to the device specified with the device address number, so as to be executed in the specified device.

The "31" of OUTPUT 31 written in line 140 of this program is the address number . That

10.1 Program with OUTPUT and ENTER Commands

shows the sending content to the instrument. OLDC OFF (Setting of IEEE488.2-1987 command mode) is executed in this instrument. The control of this instrument can be performed by using the OUTPUT command and GPIB command. Furthermore, the other external instrument also can be controlled by changing the device address.

(2) Enter command

ENTER device address : Numeric representation
 Character string representation

The ENTER command is used to receive the data through GPIB from the device specified with device address and then assign it to BASIC variables that may be numeric or character string.

In Example 10-1 , the ENTER is used as a response. Here, it is used in the combination with OUTPUT.

```
150 OUTPUT 31; "MARK:ACT 1,380 E+6"
160 OUTPUT 31; "FETC?"
170 ENTER 31; F,L,P
```

- Using OUTPUT command of line 150, sets the first mark at the position of frequency 380 MHz in device address 31 (this instrument) so as to show it .
- Using OUTPUT command of line 160, specifies " FETC ?" to this instrument in the same way. The question mark follows GPIB command closely and it is used when you want to know the values of setting and measurement value (query of data). Here, the data of mark (frequency and level) is asked.
- Using ENTER command of line 170, receives the data of mark and assigns the necessary data to the variables F, L and P . The frequency is assigned to F; the level, to L and the phase, to P.

The contents of sent data are different according to the used GPIB command . For the details , refer to another book " Programming Manual ".

(3) REM command

The REM command is used when a comment line is added to program . All the characters following the REM are considered as a comment statement. REM command can be substituted with ! (exclamation mark) .

```
10 REM PROGRAM1 } Same meaning
10 ! PROGRAM1
```

When this program is executed with R3753, it is displayed as shown in Figure10-1.

10.1 Program with OUTPUT and ENTER Commands

Execution result:

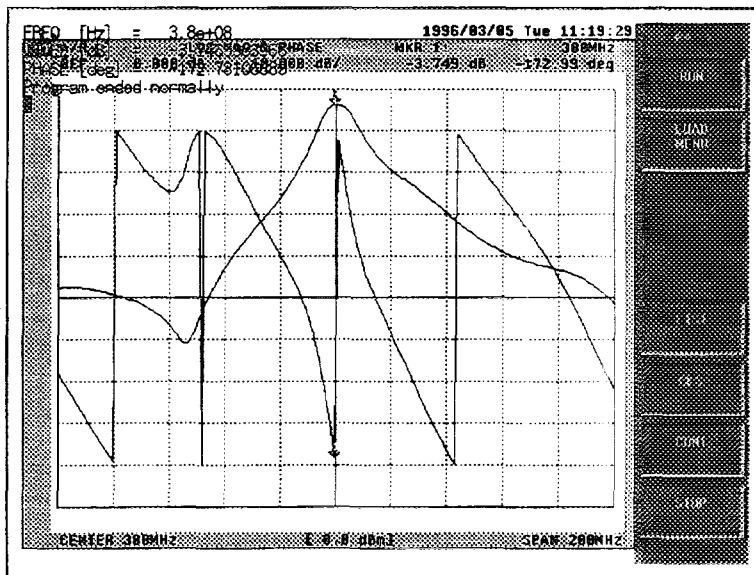


Figure 10-1 Screen Display of Execution Result

Two wave forms are displayed.

The reason is that the measurement FORMAT after the power is switched on adopts the LOG MAG & PHASE traces in R3757.

The ∇ mark is seen at a slightly higher position from the centre, showing the frequency 380MHz at this position.

The uppermost line of graph is taken as reference line.

REF 20.000dB is written on the upper left part of the screen, meaning that the reference value at present is 20dB. However, the interval between each division in graph is 10dB as shown on the right side of the reference value REF in this Figure.

The following is shown on the upper right part of the screen.

```
MKR 1;           380MHZ
    0.781 dB     109.24 deg
```

This means that the level of 380MHz position shown by the mark is 0.781dB.

Since the level value is changed in each scan, it is not limited to the same value for each time. The execution result of this program is also displayed in the figure as follows :

```
FREQ [Hz] = 3.8e +8
LEVEL [dB] = 0.7818921033
PHASE [deg] = 109.241912841
```

The value of FREQ (frequency) written as 3.8e+8 is 380,000,000 Hz (Hertz).
The LEVEL is 0.781 dB and the PHASE is 109.24 deg.

10.1.2 Program with USING

In the program of Example 10-1, FREQ is shown in MHz (megahertz) unit for an easy understand and the values of LEVEL and PHASE are shown with the number that is rounded to three decimal places so as to be seen clearly.

Example 10-3 Display Program with USING

```

100  ! *****
110  ! *          OUTPUT / ENTER          *
120  ! *          (GPRINT & USING)       *
130  ! *****
140  !
150  OUTPUT 31;"OLDC OFF"
160  OUTPUT 31;"MARK:ACT  1,380E+6"
170  OUTPUT 31;"FETC?"
180  ENTER 31;F,L,P
190  !
200  FR=F/(10^6)
210  !
220  GPRINT " FREQ  [MHz] = ";
230  GPRINT USING "DDDD.DDD";FR
240  GPRINT "LOGMAG  [dB] = ";
250  GPRINT USING "MDDD.DDD";L
260  GPRINT "PHASE  [deg] = ";
270  GPRINT USING "MDDD.DDD";P
280  STOP

```

When this program is executed, the result becomes as follows.

Execution result:

```

FREQ  [MHz]= 380.000
LEVEL  [dB]=  0.781
PHASE  [deg]= 109.241

```

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10.1 Program with OUTPUT and ENTER Commands

Explanation of Program (GPRINT USING):

The program flow of Example 10-3 is explained below.

Explanation of example 10-3	
100 to 140	Command lines
150	Prompts this instrument to take a new command mode.
160	Sets the first mark of this instrument at 380 MHz
170	Prompts to send the first mark data of this instrument.
180	Assigns the data sent by line 170 to the variables F, L, P.
190	Command line.
200	In order to represent F (frequency) in MHz unit, divides it by 10^6 and assigns the quotient to FR.
210	Command line.
220	Outputs <code>FREQ [MHz] =</code> to a printer. (Do not change the line.)
230	Outputs the value assigned to FR to the printer, positioning it immediately after the last value that is output from line 220 till to the third decimal place. (Changes the line.)
240	Outputs <code>LOGMAG [dB] =</code> to the printer. (Do not change the line.)
250	Outputs the value assigned to L to the printer, positioning it immediately after the last value that is output from line 240 till to the third decimal pace. (Changes the line.)
260	Outputs <code>PHASE [deg] =</code> to the printer. (Do not change the line.)
270	Outputs the value assigned to P to the printer, positioning it immediately after the last value that is output from line 260 till to the third decimal place. (Changes the line.)
280	Ends the program.

A new command is used in program of Example 10-3 that is not used in the program of Example 10-1 . That is the GPRINT USING command used in 220 to 270 lines.

This command can be used in a program not only as the GPRINT USING but also as a GPRINT singly.

GPRINT is almost the same as PRINT command, but the data is output to GPIB board without it displayed on the screen.

That is, the variable and character string enclosed by double quotation " " after the GPRINT can be output from GPIB board. When a printer is connected with this GPIB board, the data also can be output on the printer.

The semicolon ; added at the end of a line means the line does not change. The next output follows the last output without changing the line.

PRINT formatting command (PRINT USING / GPRINT USING)

PRINT USING command outputs characters and values according to the image specification determined by the setting of print format . See the line 230 of Example 10-3 program. The "DDDD.DDD" ; FR means that the value assigned to FR is to be printed up to the third decimal place and if the integer part to be printed is only three digits, the remaining position should be filled with a blank (space).

The " MDDD.DDD" in line 250 and line 270 is the same meaning as in line 230. When the value assigned to the variable L or P is negative, adds the minus sign in front of the value, and when the value is positive, print a blank (space) in stead.

In this example, the execution result is output to printer using the GPRINT USING command. When the USING is used, the line changement code is added automatically.

10.2 Built-in Functions

The built-in functions are used to compute and analyze the captured measurement data at a high speed with the CPU incorporated.

For these functions, it is not necessary to transfer the data using OUTPUT and ENTER of GPIB program code as it is done previously. Since the operation can be performed with the built-in CPU of this instrument at a high speed directly, so that the time used for the processing can be cut down greatly.

The mark analysis function is not prepared for R3752. Therefore, to analyze the wave form data with R3752, a program that used the built-in functions must be created.

The built-in functions can be used for all types of R3752/53, R3764/66 and R3765/67.

10.2.1 Using Built-in Functions

The built-in functions assign the necessary value to the variables just as other variables used so far have done.

For instance, the format of CVALUE function (specifies frequency value and then evaluates the measurement response value (level) of the frequency.) of built-in functions is shown as follows.

CVALUE (Specifying frequency , Specifying CH being measured)

As an example , a program used to evaluate the level of frequency 380MHz of DUT (device under text) connected with CH1 is shown as follows.

Example 10-4 Program with CVALUE Function

```
100 A=3.8e+8
110 L=CVALUE(A,0)
120 PRINT L
```

In this program, the frequency 380MHz is assigned into variable A first.

Then , the level is evaluated with line 110 in which the above mentioned A is entered as the specifying frequency, and the CH1 connected with DUT is specified to 0 as the CH being measured. Then, when the level value is evaluated, assigns this value into the variable L .

After that , the value is displayed on the screen by the PRINT Command of line 120.

Thus it can be seen, the built-in functions can be incorporated into an expression, so that it can be used as the same as the normal variable computation.

For the detail of built-in functions, refer to " 4.4 Built-in functions" of R3764/66, R3765/67 programming manual.

10.2 Built-in Functions

10.2.2 Program with Built-in Functions

Here, a program is created using more than one built-in functions. When the program of Example 10-3 is rewritten with the built-in functions, it becomes as shown below. Where the lines from line 150 to line 190 are changed and others are not. The execution result is also the same as the original.

Example 10-5 Program with Built-in Functions

```

100 ! *****
110 ! *          OUTPUT / ENTER          *
120 ! *          (BUILTIN)              *
130 ! *****
140 !
150 OUTPUT 31;"OLDC OFF"
160 AP=POINT1(3.8e+8,0)
170 F=FREQ(AP,0)
180 L=VALUE(AP,0)           ! 1st data (CH1)
190 P=VALUE(AP,8)          ! 2nd data (CH1)
200 FR=F/(10^6)
210 !
220 PRINT "FREQ [MHz] = ";
230 PRINT USING "DDDD.DDD";FR
240 PRINT "LOGMAG [dB] = ";
250 PRINT USING "MDDD.DDD";L
260 PRINT "PHASE [deg] = ";
270 PRINT USING "MDDD.DDD";P
280 STOP

```

This program employs the ceramic BPF of 380 MHz as the DUT, just as the program of Example 10-3 did.

The POINT1 function is used in line 160. This function specifies frequency, and calculates the address point where the measurement frequency that is nearest to the specified frequency exists. (Address point is used to specify the analysis range of the measurement data and the position where the data is being measured. It is specified with the value of 0 to 1200.) Here, the frequency is changed to address point with POINT1 function at the start.

The writing format of POINT function is as follows.

POINT1 (Specifying frequency, Analysis channel)

Almost all the built-in functions are used with the similar format of CVALUE and POINT1.

In line 170, using the obtained address, the frequency is evaluated with FREQ function point, and the value is assigned to variable F. Since it has been known that the frequency is 380MHz, it should not have been presented. However, it is used here in order to describe how to obtain the

frequency value from the address point. The writing format of FREQ function is as follows.

```
FREQ ( Address point, Analysis channel )
```

In line 180, using the assigned variable AP of address point, the amplitude is evaluated and then assigned to variable L with the VALUE function. The format of VALUE function is as follows.

```
VALUE ( Address point , Analysis channel )
```

In line 190, the phase is determined and the value is assigned to P.

The other lines display the frequency, amplitude and phase on the screen as the same as the program of Example 10-3. (PRINT is used in stead of GPRINT).

The difference in processing speed is not made in such a short program like this. However, when a long and complicated program is created by using the built-in functions, the processing can be performed at high speed.

For the detail of built-in functions and analysis channel, refer to "4.4 Built-in Functions" of R3764/66, R3765/67 programming manual.

10.2.3 Program to Judge Measurement Value

The programs described till now is used to evaluate the amplitude and phase by assigning the specified frequency value into the programs directly.

Here, a new program is introduced. In this program, the center frequency (CENTER) and span value (SPAN) are entered by using INPUT command, then the frequency and amplitude at the maximum amplitude point in the range of the center frequent are evaluated. Furthermore, a decision processing is included in this program to judge whether the amplitude value at the maximum amplitude point has reached the standard value.

Explanation of decision program:

As an initial setting, the following standard values are assigned to the variables with INPUT command. The standard values are used to judge which levels are necessary for CENTER, SPAN and amplitude value.

```
INPUT "SPEC      [dB] = ", SP
```

```
INPUT "CENTER [MHz] = ", C
```

```
INPUT "SPAN    [MHz] = ", S
```

When executing this , input the SPEC value just as it is . However, since the unit of CENTER and SPAN are MHz, input the data without MHz. For example, input 150 when its value is 150MHz. After the necessary values are entered, input the CENTER and SPAN values in measuring mode.

```
OUTPUT 31; "OLDC OFF"
```

```
OUTPUT 31; "FREQ:CENT "; C; "MAHZ"
```

```
OUTPUT 31; "FREQ:SPAN "; S; "MAHZ"
```

OLDC OFF is used to set the command mode of GPIB to a new mode. FREQ: CENT and FREQ: SPAN of GPIB program code are used for the frequency setting of CENTER and SPAN.

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10.2 Built-in Functions

In the state of OLDC ON , the command names used in R3751 and R3762/63 can be used. However, the new command mode enables the program to be read more easily.

The next is to change the value of CENTER and SPAN which are assigned to the variable C and S from MHz unit to Hz unit.

```
C1=C*1.0e+6
```

```
S1=S*1.0e+6
```

The CENTER value in Hz unit is assigned to variable C1 and the SPAN value, to variable S1. The START and STOP values in measuring mode are evaluated before using the built-in functions. After dividing the SPAN value by two, and adding this value to the CENTER value get the STOP value, while subtracting this value from the CENTER value get the START value.

```
S2= S1/2
```

```
P0=C1-S2
```

```
P1=C1+S2
```

After the START and STOP values have been obtained, the maximum frequency and its amplitude between START and STOP are evaluated with the built-in functions.

```
A=POINT1 (P0, 0)
```

```
B=POINT1 (P1, 0)
```

```
F=FMAX (A, B, 0)
```

```
L=MAX (A, B, 0)
```

First, P0 and P1 are converted to address point that can be used for built-in functions. The starting address point is assigned to A and the stop address point, to B.

Then, the frequency of the maximum amplitude point is evaluated using the FMAX function and the maximum amplitude value is searched using the MAX function.

```
FMAX (Start address point , Stop address point, Analysis channel)
```

```
MAX (Start address point , Stop address point, Analysis channel)
```

The obtained frequency of the maximum amplitude point is assigned to variable F and the amplitude value, to L .

The evaluated values are displayed on the screen using the PRINT command after the processing of built-in functions is ended.

```
FR=F/(10^6)
```

```
!
```

```
PRINT "MAX  FREQ [MHz] = ";
PRINT USING "DDDD.DDD";FR
PRINT "MAX  LEVEL [dB] = ";
PRINT USING "MDDD.DDD";L
PRINT "SPEC LEVEL      = " ;
PRINT USING "MDDD.DDD";SP
```

The unit of maximum frequency assigned to variable F is converted from Hz to MHz. Then, the values are displayed in the sequence of maximum frequency, level, SPEC (standard value). The values of variables are displayed up to the third decimal places, and the PRINT USING command is used to fill up the digits. Finally, the level of maximum frequency is compared with the input standard value (SPEC). When the maximum frequency is satisfied for SPEC, SPEC OK !! is displayed by the PRINT command, and when it is not satisfied, SPEC NG !! is displayed.

```
IF L<SP THEN GOTO *NG
!
PRINT "*** SPEC OK!! ***"
STOP
!
! 'NG' DISPLAY
!
*NG
PRINT "*** SPEC NG!! ***"
STOP
```

The full decision program is shown as follows.

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Example 10-6 Program for Deciding Measurement Value

```
100 ! *****
110 !*      MAX FREQ. AND LEVEL SEARCH      *
120 !*              &                      *
130 !*              JUDGE SPEC            *
140 !*              (BY BUILTIN)          *
150 !*****
160 !
170 OUTPUT 31;"OLDC OFF"
180 CLS
190 INPUT "SPEC      [dB] = ",SP
200 INPUT "CENTER [MHz] = ",C
210 INPUT "SPAN    [MHz] = ",S
220 !
230 OUTPUT 31;"FREQ:CENT";C;"MAHZ"
240 OUTPUT 31;"FREQ:SPAN";C;"MAHZ"
250 !
260 !
270 C1=C*1E+6
280 S1=S*1E+6
290 !
300 S2=S1/2.0
310 P0=C1-S2
320 P1=C1+S2
330 !
340 A=POINT1(P0,0)
350 B=POINT1(P1,0)
360 F=FMAX(A,B,0)
370 L=MAX(A,B,0)
380 !
390 FR=F/(10.0^6)
400 OUTPUT 31;"MARK:ACT 1,";FR
410 OUTPUT 31;"MARK:LET CENT"
420 !
430 !
```

```

440 PRINT "MAX FREQ [MHz] = ";
450 PRINT USING "DDDD.DDD";FR
460 PRINT "MAX LEVEL [dB] = ";
470 PRINT USING "MDDD.DDD";L
480 PRINT "SPEC LEVEL [dB] = ";
490 PRINT USING "MDDD.DDD";SP
500 !
510 IF L<SP THEN GOTO *NG
520 !
530 PRINT "*** SPEC OK !!***"
540 STOP
550 !
560 ! 'NG' DISPLAY
570 !
580 *NG
590 PRINT "*** SPEC NG !!*** "
600 STOP
    
```

When performing Example 10-6 , the SPEC value is inquired first. Since the ceramic filter of 380MHz is used as DUT here, the measurement is performed with SPEC level (SPEC) -10dB, CENTER 380MHz and SPAN 200MHz.

When Example 10-6 is executed, the result is as follows.

Execution result:

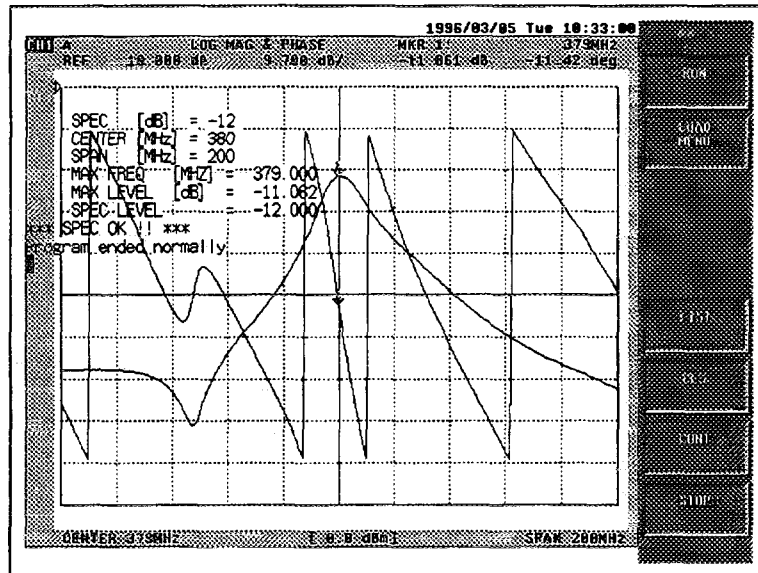


Figure 10-2 Execution Result of Decision Program

10.2 Built-in Functions

10.2.4 Output to Parallel I/O Port

In the program of Example 10-6 , the decided result is displayed as “ OK !! ” or “ NG !! ” by using PRINT command , but here it is output through the use of parallel I/O port. Using INPUT 1 (External input) of parallel I/O port, the program is created which starts the measurement with the trigger switch.

As a circuit example, the circuit diagram of the guide of this instrument“ Operating Program According to Trigger Switch of Parallel I/O “ is employed.

(Refer to the “Function Explanation and Communication with Peripheral Apparatus” in the manuals of various machines.

Creating Program:

- ① The setting of port mode is added between line 170 and line 180 of the program in Example 10-6.

```
171 OUTPUT 36;16
172 OUTPUT 35;80
173 OUTPUT 35;112
```

- In line 171, since the parallel I/O port is used, the setting of port mode is performed.
Here , all of A , B, C and D port are set to output port.
- In line 172 and line 173, resets OUTPUT1 and OUTPUT2 . That is , switch off the LED (OUTPUT1) being measured and LED (OUTPUT2) to be measured.

- ② A program is added between line 260 and line 270 to wait the starting of measurement until the switch is pressed.

```
261 OUTPUT 35;48
262 ENTER 34;A
263 WAIT 500
264 IF A< >1 THEN GOTO 262
265 OUTPUT 35;112
```

- In line 261, OUTPUT2 is turned to the state of set and the LED is lighted up. This means waiting measurement (READY), that is, showing the waiting of switch input with the LED.
- In line 262 and line 264 , the loop is continued till the switch input is done so as to stop the program sequence. When the switch is not pressed, nothing is assigned to the numeric variable A of line 262, and proceeded to line 273 just as 0 it is .
- The WAIT of line 263 is used to keep a short interval for performing the switch input properly (WAIT time : msec ; 0 to 65535)
- In line 264 , when the switch is not pressed, the variable A is 0. If the conditional expression holds, the operation is repeated till the switch is pressed.
When the switch is pressed, 1 is assigned to the numeric variable A according to the specification of ENTER 34; A (External input) in line 262. In this case, the conditional expression does not hold and the operation proceeds to line 265.
- In line 265, LED of OUTPUT2 is shut off. This means the switch is input and the system is not in the state of waiting measurement.
If the switch is pressed , the LEDs of OUTPUT1 and OUTPUT2 are lighted up.

The LED of OUTPUT2 is shut off in line 265, while OUTPUT1 is lighted up all the time by reason that no specification is made for it . This indicates the measurement is in progress.

- ③ The program used to shut off the LED, when the measurement is stopped, is added between line 430 and line 440.

```
431 OUTPUT 35;80
```

- In line 431 , LED of OUTPUT1 is turned to the reset state and the LED is shut off.

- ④ The I/O port output that is produced when the decision is performed with SPEC value is shown simply with OK or NG. The OK means output to port A and the NG, to port B. OK output is added between line 530 and line 540 , and NG output, between line 590 and line 600.

```
531 OUTPUT 33;1
```

```
591 OUTPUT 34;1
```

- When the judgement is OK, outputs 1 to port A. When NG, outputs 1 to port B. Add the LED, to No.5 (1 of port A) and No.13 (1 of port B) of the parallel I/O connector (refer to " Function Explanation-Communication with peripheral apparatus " of various machine manual). The result of output , i.e., OK or NG can be seen according to which LED has been lighted up.

The program list is shown in Example 10-7.

Example 10-7 Program for Deciding Measurement Value (Using parallel I/O port)

```
100 !*****
110 !*      MAX FREQ. AND LEVEL SEARCH      *
120 !*              &                      *
130 !*              JUDGE SPEC              *
140 !*              (BY BUILTIN)           *
150 !*****
160 !
170 OUTPUT 31;"OLDC OFF"
171 OUTPUT 36;16                ! A,B,C,D -> OUTPUT
172 OUTPUT 35;80                ! RESET OUTPUT1
173 OUTPUT 35;112               ! RESET OUTPUT2
180 CLS
190 INPUT "SPEC      [dB] = ",SP
200 INPUT "CENTER [MHz] = ",C
210 INPUT "SPAN    [MHz] = ",S
220 !
230 OUTPUT 31;"FREQ:CENT";C;"MAHZ"
```

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```
240 OUTPUT 31;"FREQ:SPAN";C;"MAHZ"
250 !
260 !
261 OUTPUT 35;48           ! SET OUTPUT1 AND OUTPUT2
262 ENTER 34;A           ! READ OUTPUT1 (INPUT1)
263 WAIT 500             ! WAIT 500MSEC
264 IF A< >1 THEN GOTO 262 ! CHECK TRIGGER SWITCH INPUT
265 OUTPUT 35;112        ! RESET OUTPUT2
270 C1=C*1E+6
280 S1=S*1E+6
290 !
300 S2=S1/2.0
310 P0=C1-S2
320 P1=C1+S2
330 !
340 A=POINT1(P0,0)
350 B=POINT1(P1,0)
360 F=FMAX(A,B,0)
370 L=MAX(A,B,0)
380 !
390 FR=F/(10.0^6)
400 OUTPUT 31;"MARK:ACT 1, ";FR
410 OUTPUT 31;"MARK:LET CENT"
420 !
430 !
431 OUTPUT 35;80           ! RESET OUTPUT1
440 PRINT "MAX PREQ  [MHz] = ";
450 PRINT USING "DDDD.DDD";FR
460 PRINT "MAX LEVEL  [dB] = ";
470 PRINT USING "MDDD.DDD";L
480 PRINT "SPEC LEVEL [dB] = ";
490 PRINT USING "MDDD.DDD";SP
500 !
510 IF L<SP THEN GOTO *NG
520 !
530 PRINT "*** SPEC OK !! ***"
```


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10.2 Built-in Functions

```
531 OUTPUT 33;1                ! WRITE 1 TO PORT-A
540 STOP
550 !
560 ! 'NG' DISPLAY
570 !
580 *NG
590 PRINT "*** SPEC NG !! ***"
591 OUTPUT 34;1                ! WRITE 1 TO PORT-B
600 STOP
```

MEMO 



11 Program Examples for Wave Form Analysis

This chapter describes program examples for wave form analysis and the using method of built-in functions by turns.

*(Note) The programs presented in this chapter are the examples used for R3752/53 .
To use them on R3765/67 and R3764/66 , it is required to be changed according to the difference of initial setting state and the frequency range.*

11.1 MAX and MIN Level Automatical Measurement Program

The example of program used to measure automatically the maximum and minimum level value by the use of built-in function MAX and MIN is shown in Example 11-1.

Example 11-1 Automatical Measurement Program of MAX and MIN level

```

1000 !*****
1010 !
1020 !           MAX-MIN  LEVEL  MEASUREMENT
1030 !
1040 !*****
1050 *MAIN
1060     GOSUB  *SETUP
1070     GOSUB  *CAL
1080     CLS
1090     *MEAS_LOOP
1100         GOSUB *MEAS
1110         GOSUB *RESULTS
1120         GOTO  *MEAS_LOOP
1130 !
1140 !-----
1150 *SETUP
1160     OUTPUT 31;"LDC OFF"
1170     OUTPUT 31;" DISP:ACT 1;:FUNC1:POW AR;:CALC:FORM MLOP"
1180     OUTPUT 31;"DISP:Y:PDIV 10"
1190     OUTPUT 31;"DISP:Y:RPOS 10"
1200     OUTPUT 31;"DISP:Y:RLEV 0"
1210     OUTPUT 31;"POW ODBM"
1220     !
1230     OUTPUT 31;"SWE:POIN 201"

```

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11.1 MAX and MIN Level Automatical Measurement Program

```
1240     OUTPUT 31;"FREQ:STAR 100MAHZ"  
1250     OUTPUT 31;"FREQ:STOP 200MAHZ"  
1260     RETURN  
1270     !  
1280     !-----  
1290     *CAL  
1300     CURSOR 6,9  
1310     PRINT "CONNECT [THROUGH]"  
1320     CURSOR 6,10  
1330     INPUT "IF OK THEN PRESS `ENT` or `X1`",D$  
1340     OUTPUT 31;"CORR:COLL NORM;*OPC?"  
1350     ENTER 31;A  
1360     RETURN  
1370     !  
1380     !-----  
1390     *MEAS  
1400     CURSOR 5,10  
1410     PRNT "CONNECT DUT"  
1420     CURSOR 5,11  
1430     INPUT "IF OK THEN PRESS `ENT` or `X1`",D$  
1440     !  
1450     MAX_DT=MAX(0,1200,0)  
1460     MIN_DT=MIN(0,1200,0)  
1470     RETURN  
1480     !  
1490     !-----  
1500     *RESULTS  
1510     CLS  
1520     CURSOR 5,15  
1530     PRINT "MAX VALUE [dB] = ";  
1540     PRINT USING "3D.3D";MAX_DT  
1550     CURSOR 5,16  
1560     PRINT "MIN VALUE [dB] = ";  
1570     PRINT USING "3D.3D";MIN_DT  
1580     RETURN
```

11.1 MAX and MIN Level Automatical Measurement Program

The MAX function used in this program searches the maximum response value, while the MIN function searches, the minimum response value. These functions are also used to evaluate the response value of resonance point and anti-resonance point. The program of Example 11-1 is explained below.

Program Explanation of Example 11-1	
1000 to 1040	Comment lines
1050	Level MAIN of main routine.
1060	Calls out initial setting routine SETUP.
1070	Calls out calibration routine CAL.
1080	Clears the screen.
1090	Level MEAS_LOOP of measurement repetition loop.
1100	Calls out measurement routine MEAS.
1110	Calls out display routine RESULT.
1120	Loop of measurement.
1130 to 1140	Comment lines.
1150	Level SETUP of initial setting routine.
1160	Releases IEEE 488.1-1987 command mode.
1170	Sets active channel to CH1, input port to A/R and format to LOGMAG & PHASE.
1180	Sets the scan resolution to 10dB.
1190	Sets the reference position to 10%.
1200	Sets the reference level to 0dB.
1210	Sets the output level to 0dBm.
1220	Comment line.
1230	Sets the point count to 201 points.
1240	Sets the scan start frequency to 100MHz.
1250	Sets the scan stop frequency to 200MHz.
1260	Gets rid of initial setting routine.
1270 to 1280	Comment lines.
1290	Level CAL of calibration routine.
1300	Moves the cursor.
1310	Displays the message "CONNECT [THROUGH]".

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11.2 Ceramic Filter Automatic Measurement Program

1320	Moves the cursor.
1330	Displays the message " IF OK THEN PRESS 'ENT' or 'X1' " and waits the input.
1340	Executes calibration.
1350	Waiting till the calibration is ended.
1360	Gets rid of the calibration routine.
1370 to 1380	Comment lines.
1390	Level MEAS of measurement routine.
1400	Moves the cursor.
1410	Displays the message " CONNECT DUT ".
1420	Moves the cursor.
1430	Displays the message " IF OK THEN PRESS ' ENT ' or ' X1 ' and waits the input.
1440	Comment line.
1450	Gets the maximum value.
1460	Gets the minimum value.
1470	Gets rid of the measurement routine.
1480 to 1490	Command lines.
1500	Level RESULTS of display routine.
1510	Clears the screen.
1520 to 1540	Comment line.
1550 to 1570	Moves the cursor and displays the minimum value.
1580	Gets rid of the display routine.

11.2 Ceramic Filter Automatic Measurement Program

The program examples used to evaluate the insertion loss and the frequency of 3dB bandwidth are shown in Example 11-2.

Example 11-2 Ceramic Filter Automatic Measurement Program

```

1000 !*****
1010 !
1020 !           CERAMIC FILTER MEASUREMENT
1030 !
1040 !*****
1050 *MAIN
1060     GOSUB  *SETUP
1070     GOSUB  *CAL
1080     CLS
1090     *MEAS_LOOP
1100         GOSUB *MEAS
1110         GOSUB *RESULTS
1120         GOTO  *MEAS_LOOP
1130 !
1140 *SETUP
1150     NA=31
1160     OUTPUT NA;"OLDC OFF"
1170     OUTPUT NA;"SYST:PRES;:INIT:CONT OFF;:STAT:OPER:ENAB 8;*ESB
                                     128;*OPC?"
1180     ENTER NA;A
1190     OUTPUT NA;"FREQ:SPAN 10KHZ"
1200     OUTPUT NA;"FREQ:CENT 10.7MAHZ"
1210     SPOLL(NA)
1220     RETURN
1230 !
1240 *CAL
1250     CURSOR 6,9
1260     PRINT "CONNECT [THROUGH]"
1270     CURSOR 6,10
1280     INPUT "IF OK THEN PRESS `ENT` or `X1`",D$
1290     OUTPUT NA;"CORR:COLL NORM;*OPC?"
1300     ENTER NA;A
1310     RETURN
1320 !

```

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11.2 Ceramic Filter Automatic Measurement Program

```
1330 *MEAS
1340     CURSOR 6,25
1350     PRINT "CONNECT DUT"
1360     CURSOR 6,26
1370     INPUT "IF OK THEN PRESS 'ENT' or 'X1'",D$
1380 !
1390     ON ISRQ GOTO *LPOUT
1400     ENABLE INTR
1410     OUTPUT NA;"INIT"
1420     *LP
1430         GOTO *LP
1440 !
1450 *LPOUT
1460     SPOLL(NA)
1470     DISABLE INTR
1480     I_LOSS=MAX(0,1200,0)
1490     MAX_F=FMAX(0,1200,0)
1500     BW3DB=CBND(MAX_F,3,0)
1510     RETURN
1520 !
1530 *RESULTS
1540     CURSOR 5,4
1550     PRINT "I LOSS [dB]           = ";
1560     PRINT USING "3D.3D";I_LOSS
1570     CURSOR 5,5
1580     PRINT "3 DB BAND WIDTH [MHz] = ";
1590     PRINT USING "3D.3D";BW3DB/1E+6
1600     RETURN
```

The CBND function employed in the program of Example 11-2 is used to evaluate the band width. It searches those points that attenuated only for the specified attenuation level at the specified frequency, and then evaluates the band width .

The searching is performed from the specified address point towards outside.

In this program, the frequency of maximum response is evaluated with the FMAX function, and the band width of 3dB down is evaluated from this frequency with the CBND function.

Program Explanation of Example 11-2	
1000 to 1040	Comment lines
1050	Level MAIN of main routine.
1060	Calls out the initial setting routine SETUP.
1070	Calls out calibration routine CAL.
1080	Clears the screen.
1090	Level MEAS_LOOP of measurement repetition loop.
1100	Calls out measurement routine MEAS.
1110	Calls out display routine RESULT.
1120	Loop of measurement.
1130 to 1140	Comment lines.
1150	Level SETUP of the initial setting routine.
1160	Releases IEEE 488.1-1987 command mode.
1170	After pre-sets this instrument, turns it to the single scan mode, and sets it to such a state that enables to produce SRQ requirement when the scan is ended.
1180	Waiting until the end of setting.
1190	Sets the frequency of scan center to 10KHz.
1200	Sets the frequency SPAN of scan to 10.7MHz.
1210	Performs serial poll and drops RSV bit.
1220	Gets rid of initial setting routine.
1230	Comment line.
1240	Level CAL of calibration routine.
1250	Moves the cursor
1260	Displays message "CONNECT [THROUGH]".
1270	Moves the cursor.
1280	Displays the message " IF OK THEN PRESS ' ENT ' or 'X1' " and waits the input.
1290	Executes calibration.
1300	Waiting until the end of calibration.
1310	Gets rid of calibration routine.

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11.3 Ripple Analysis Program

1320	Comment line.
1330	Level MEAS of measuring routine.
1340	Moves the cursor.
1350	Displays message "CONNECT DUT" .
1360	Moves the cursor.
1370	Displays the message " IF OK THEN PRESS 'ENT' or 'X1' " and waits the input.
1380	Comment line.
1390	Specifies the branch destination of service request interrupting .
1400	Enables interrupting.
1410	Executes the scan for one times.
1420 to 1430	Repeats interruption waiting loop.
1440	Comment lines.
1450	Branch destination level LPOUT of service request interrupt.
1460	Performs serial poll and drops RSV bit.
1470	Disables interrupting.
1480	Evaluates maximum value of level with MAX function and assigns it to variable I_LOSS.
1490	Evaluates the measurement frequency of the maximum level with FMAX function and assigns it to variable MAX_F.
1500	Evaluates the band width of 3dB with CBAND function and assigns it to variable BW3DB.
1510	Gets rid of the interrupt processing routine.
1520	Comment line.
1530	Level RESULTS of display routine.
1540 to 1560	Moves the cursor and displays the insertion loss value by moving.
1570 to 1590	Moves the cursor and displays the frequency of 3dB band width.
1600	Gets rid of the display routine.

11.3 Ripple Analysis Program

An example of program using the ripple function is shown in Example 11-3.

Example 11-3 Ripple Analysis Program

```
1000 !*****
1010 !
1020 !           RIPPLE MEASUREMENT
1030 !           (NO USED SRQ)
1040 !
1050 !*****
1060 DIM  PR1$(25),PR2$(25),PR3$(25)
1070 !
1080 *MAIN
1090     GOSUB *SETUP
1100     CLS
1110     *MEAS_LOOP
1120         GOSUB *MEAS
1130         GOSUB *RESULTS
1140         GOTO *MEAS_LOOP
1150 !
1160 *SETUP
1170     NA=31
1180     OUTPUT NA;"OLDC OFF"
1190     OUTPUT NA;"SYST:PRES;:INIT:CONT OFF";
1200     OUTPUT NA;"DISP:FORM ULOW"
1210     OUTPUT NA;"CALC:FORM MLOD"
1220     OUTPUT NA;"FREQ:CENT 17.9MAHZ;SPAN 30KHZ"
1230     OUTPUT NA;"BAND 1KHZ"
1240     OUTPUT NA;"SWE:TIME 1SEC"
1250     RETURN
1260 !
1270 *MEAS
1280     CURSOR 6,25
1290     PRINT "CONNECT DUT"
1300     CURSOR 6,26
1310     INPUT "IF OK THEN PRESS `ENT` or `X1`",D$
1320 !
1330     OUTPUT NA;"INIT;*OPC?"
```

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11.3 Ripple Analysis Program

```
1340     ENTER NA;DUMMY$
1350     OUTPUT NA;"DISP:Y8 AUTO"
1360     !
1370     A1=PMAX(0,1200,0)
1380     A2=BNDL(A1,3,0)
1390     A3=BNDH(A1,3,0)
1400     A4=POINT2(A2,0)
1410     A5=POINT2(A3,0)
1420     B1=RPL2(A4,A5,1,0.001,0)           ! LOGMAG RIPPLE
1430     B2=RPL4(A4,A5,1,0.001,0)
1440     IF B1<B2 THEN
1450         B3=B2
1460     ELSE
1470         B3=B1
1480     END IF
1490     C1=RPL2(A4,A5,1,1e-08.8)          ! DELAY RIPPLE
1500     C2=RPL4(A4,A5,1,1e-08.8)
1510     IF C1<C2 THEN
1520         C3=C2
1530     ELSE
1540         C3=C1
1550     END IF
1560     RETURN
1570     !
1580     *RESULTS
1590     PR1$="LOGMAG RIPPLE [dB] ="
1600     CURSOR 0,16:PRINT USING"k,M2D.5D";PR1$,B3
1610     PR2$="DELAY RIPPLE [us] ="
1620     CURSOR 0,17:PRINT USING "k,M2D.5D";PR2$,C3*10^6
1630     RETURN
```

First, the frequency range is evaluated with PMAX, BNDL and BNDH in this program. The PMAX function evaluates the measurement point of the maximum response and calculates the band width from the measurement point. The BNDL function evaluates the frequency on the side of low frequency band and the BNDH function evaluates the frequency on the side of high frequency band. then , the ripple analysis is specified with this frequency range.

Next , the ripple analysis is performed after the frequency has been converted to address point with POINT2 function. There are various ripple analysis functions. RPL2 and RPL4 are used in this pro-

gram. Both of the functions are used to evaluate the maximum values of the neighboring highest value and lowest value, but the ways with which they get a pair of highest value and lowest value are different. The highest value is on the side of low frequency in RPL2 function while it is on the side of high frequency in RPL4 function.

The program of Example 11-3 is explained below.

Program Explanation of Example 11-2	
1000 to 1050	Comment lines
1060	Defines character string array.
1070	Comment line.
1080	Level MAIN of main routine
1090	Calls out initial setting routine SETUP.
1100	Clears the screen.
1110	Level MEAS_LOOP of measurement repetition loop.
1120	Calls out measurement routine MEAS.
1130	Calls out display routine RESULT.
1140	Loop of measurement.
1150	Comment line.
1160	Level SETUP of initial setting routine.
1170	Assigns address 31 to variable NA .
1180	Releases IEEE488. 1-1987 command mode.
1190	Presets this instrument and turns it to single scan mode.
1200	Sets split screen mode.
1210	Sets calculation format to LOGMAG & DELAY
1220	Sets the frequency of scan centre to 17.9MHz, and SPAN to 30kHz.
1230	Sets the resolution band width to 1kHz.
1240	Sets the scan time to one second.
1250	Gets rid of initial setting routine.
1260	Comment line.
1270	Level MEAS of measurement routine.
1280	Moves the cursor.
1290	Displays the message "CONNECT DUT"
1300	Moves the cursor.

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11.3 Ripple Analysis Program

1310	Displays the message " IF OK THEN PRESS 'ENT' or 'X1' " and waits the input.
1320	Comment line.
1330	Executes the scan for one times and sends OPC quarry.
1340	Waiting until the end of scan.
1350	Performs the automatic setting of Y axis.
1360	Comment line.
1370	Evaluates the measurement point of maximum level and assigns it to variable A1.
1380	Evaluates the frequency on the low frequency side of 3dB band width , and assigns it to variable A2.
1390	Evaluates the frequency on the high frequency side of 3dB band width , and assigns it to variable A3.
1400	Converts frequency A2 to address point. and assigns it to A4.
1410	Converts frequency A3 to address point, and assigns it to A5.
1420	Evaluates the maximum value of the neighboring highest value and lowest value from the amplitude data with RPL2 function.
1430	Evaluates the maximum values of the neighboring highest value and lowest value from the amplitude data with RPL4 function.
1440 to 1480	Assigns the large value from among them to variable B3
1490	Evaluates the maximum values of the neighboring highest value and lowest value from the delay data with RPL2 function.
1500	Evaluates the maximum values of the neighboring highest value and lowest value from the delay data with RPL4 function.
1510 to 1550	Assigns the large value from among them to variable C3.
1560	Gets rid of the measurement routine.
1570	Comment line.
1580	Level RESULTS of display routine.
1590 to 1600	Displays the ripple analysis value of amplitude data.
1610 to 1620	Displays the ripple analysis value of delay data.
1630	Gets rid of display routine.

11.4 Example of Band-pass Filter Measurement

In this section , the measurement of band-pass filter of central frequency : 10.7MHz is taken as an example to explain the filter analysis program. The program example is shown in Example 11-4.

Example 11-4 Measurement of Band-pass Filter

```

1000 !*****
1010 !
1020 !           BAND PASS FILTER ANALYSIS
1030 !           f=10.7MHz
1040 !
1050 ! FILE : BPF.BAS
1060 !*****
1070 *MAIN
1080     GOSUB *SETUP
1090     GOSUB *CAL
1100     CLS
1110     *MEAS_LOOP
1120         GOSUB *MEAS
1130         GOSUB *RESULTS
1140         GOTO *MEAS_LOOP
1150 !
1160 *SETUP
1170     INTEGER EV
1180     DIM L(2),F(2,4)
1190     NA=31 :EV=1 :L(1)=3.0 :L(2)=60.0
1200     OUTPUT NA;"OLDC OFF"
1210     OUTPUT NA;"SYST:PRES;:INIT:CONT OFF;:STAT:OPER:ENAB 8;*SRE
                                     128;*OPC?"
1220     ENTER NA;A
1230     OUTPUT NA;"CALC:FORM MLOG"
1240     OUTPUT NA;"FREQ:SPAN 2MHZ;CENT 10.7MAHZ"
1250     RETURN
1260 !
1270 *CAL
1280     CURSOR 6,9 :PRINT "CONNECT [THROUGH]"
1290     CURSOR 6,10 :INPUT "IF OK THEN PRESS 'ENT' or 'X1'",D$

```

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11.4 Example of Band-pass Filter Measurement

```
1300     OUTPUT NA; "CORR:COLL NORM;*OPC?" :ENTER NA;A
1310     RETURN
1320     !
1330     *MEAS
1340     CURSOR 6,25 :PRINT "CONNECT DUT"
1350     CURSOR 6,26 :INPUT "IF OK THEN PRESS 'ENT' or 'X1'",D$
1360     OUTPUT NA;"INIT" :WAIT EVENT EV
1370     AP=PMAX(0,1200,0)
1380     NP=MBNDI(0,1200,AP,2,L(1),F(1,1),0)
1390     QF=F(1,3)/F(1,4)                ! QF = CF(3dB)   / BW (3dB)
1400     SF=F(2,4)/F(1,4)                ! SF = BW'(60dB) / BW (3dB)
1410     RETURN
1420     !
1430     *RESULTS
1440     CURSOR 5,4 :PRINT "C.F [MHz]="; :PRINT USING "3D.7D";F(1,3)
                                                /1.0E+6
1450     CURSOR 5,5 :PRINT "L.F [MHz]="; :PRINT USING "3D.7D";F(1,1)
                                                /1.0E+6
1460     CURSOR 5,6 :PRINT "R.F [MHz]="; :PRINT USING "3D.7D";F(1,2)
                                                /1.0E+6
1470     CURSOR 5,7 :PRINT " BW [ Hz]="; :PRINT USING "5D.1D";F(1,4)
1480     CURSOR 5,8 :PRINT "  Q      ="; :PRINT USING ".5D";QF
1490     CURSOR 5,9 :PRINT " SF      ="; :PRINT USING ".5D";SF
1500     RETURN
```

When this program is performed, the screen display of this instrument becomes as shown in Figure 11-1.

11.5 Example of Crystal Resonant Point Measurement

Execution result:

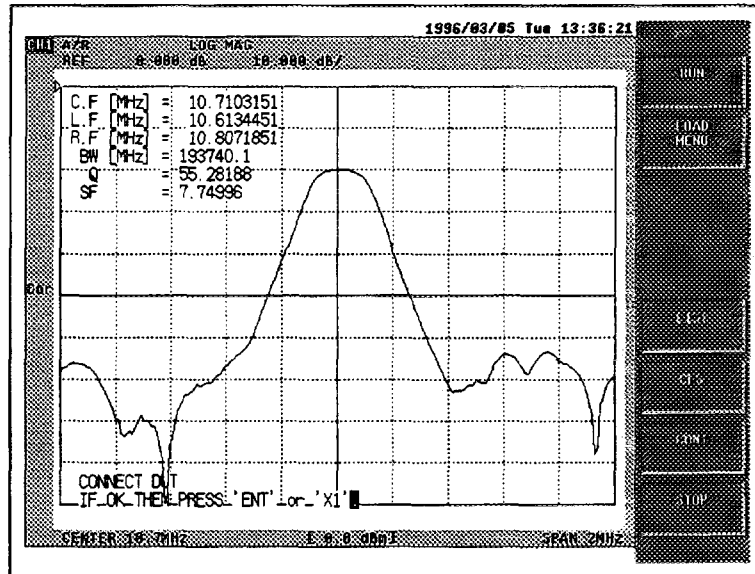


Figure 11-1 Screen Display of Execution Result (Measurement of Band-pass Filter)

After the measurement point of the maximum response value has been found with PMAX function, evaluate the band width and frequency of the two measurement points with the MBND function whose attenuation is 3dB and 60dB, respectively. Using MBND function, the analysis of more than one attenuations level can be performed at a time, so that the frequency of low frequency band, frequency of high frequency band, the center frequency and the band width can be obtained, respectively.

11.5 Example of Crystal Resonant Point Measurement

In this section, the program seeking from the measurement of transferring resonant point and anti-resonant point of ceramic oscillator (f = 45.1 Mhz) is explained . The example of program is shown in Example 11-5 .

Example 11-5 Measurement of Crystal Resonant Point

```

1000 !*****
1010 !
1020 !           SEARCH  RESONANCE  POINT
1030 !           f=45.1MHz
1040 !
1050 ! FILE: RESONA.BAS
1060 !*****
1070 *MAIN
1080     GOSUB *SETUP
1090     GOSUB *CAL
    
```

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11.5 Example of Crystal Resonant Point Measurement

```
1100     CLS
1110     *MEAS_LOOP
1120         GOSUB *MEAS
1130         GOSUB *RESULTS
1140         GOTO *MEAS_LOOP
1150     !
1160     *SETUP
1170         INTEGER EV
1180         NA=31 :EV=1
1190         OUTPUT NA;"OLDC OFF"
1200         OUTPUT NA;"SYST:PRES;:INIT:CONT OFF;:STAT:OPER:ENAB 8;*SRE
                                                128;*OPC?"
1210         ENTER NA;A
1220         OUTPUT NA;"FREQ:SPAN 1MAHZ;CENT 45.1MAHZ"
1230         OUTPUT NA;"BAND 1KHZ"
1240         OUTPUT NA;"CALC:TRAN:IMP:CIMP 12.5;TYPE ZTR"
1250         RETURN
1260     !
1270     *CAL
1280         CURSOR 6,9 :PRINT "CONNECT [THROUGH]"
1290         CURSOR 6,10 :INPUT "IF OK THEN PRESS 'ENT' or 'X1'",D$
1300         OUTPUT NA;"CORR:COLL NORM;*OPC?" :ENTER NA;A
1310         RETURN
1320     !
1330     *MEAS
1340         CURSOR 6,25 :PRINT "CONNECT DUT"
1350         CURSOR 6,26 :INPUT "IF OK THEN PRESS 'ENT' or 'X1'",D$
1360         OUTPUT NA;"INIT" :WAIT EVENT EV
1370         FR1=FMAX(0,1200,0) :AP1=POINT1(FR1,0)
1380         FR2=FMIN(0,1200,0) :AP2=POINT1(FR2,0)
1390         FS1=ZEROPHS(AP1-60,AP1+60,8) :LV1=VALUE(AP1,0) :PH1=VALUE
                                                (AP1,8)
1400         FS2=ZEROPHS(AP2-60,AP2+60,8) :LV2=VALUE(AP2,0) :PH2=VALUE
                                                (AP2,8)
1410         RETURN
1420     !
1430     *RESULTS
```

NETWORK ANALYZER PROGRAMMING GUIDE

11.5 Example of Crystal Resonant Point Measurement

```
1440 CURSOR 5,4 :PRINT "RESONANCE FR1 [MHz]="; :PRINT USING "3D.7D"  
;FR1/1.0E+6  
1450 CURSOR 5,5 :PRINT "          FS1 [MHz]="; :PRINT USING "3D.7D"  
;FS1/1.0E+6  
1460 CURSOR 5,6 :PRINT "          LEVEL [dB]="; :PRINT USING "3D.7D"  
;LV1  
1470 CURSOR 5,7 :PRINT "          PHASE [deg]="; :PRINT USING "3D.7D"  
;PH1  
1480 CURSOR 5,8 :PRINT "ANTI-RES  FR2 [MHz]="; :PRINT USING "3D.7D"  
;FR2/1.0E+6  
1490 CURSOR 5,9 :PRINT "          FS2 [MHz]="; :PRINT USING "3D.7D"  
;FS2/1.0E+6  
1500 CURSOR 5,10 :PRINT "          LEVEL [dB]="; :PRINT USING "3D.3D"  
;LV2  
1510 CURSOR 5,11 :PRINT "          PHASE [deg]="; :PRINT USING "3D.7D"  
;PH2  
1520 RETURN
```

When this program is executed, the screen display of this instrument is turned as shown in "figure 11-2". π Circuit jig (PIC-001) is used for setup here.

Execution result:

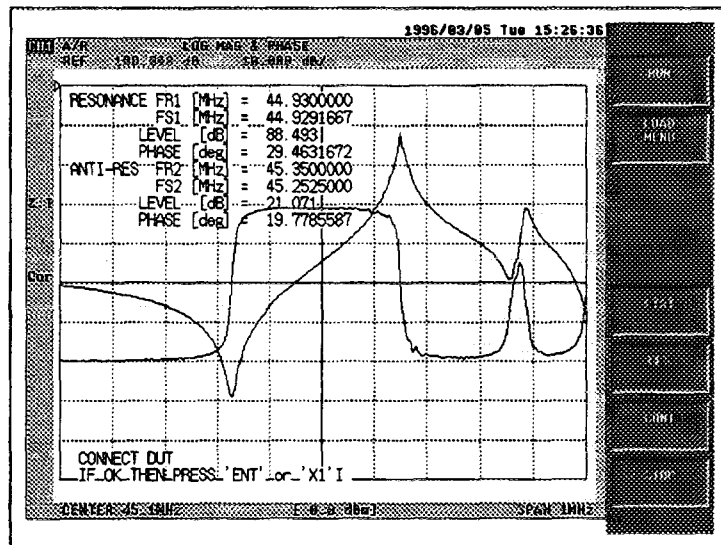


Figure 11-2 Screen Display of Execution Result (Measurement of crystal Resonant Point)

The resonant point and anti-resonant point. can be sought through the following two ways.

- Searching with maximum level value and minimum level value.
- Searching with zero phase.

11.6 Using Built-in Functions

Here, the measurement points of maximum level value and minimum level value are searched first with FMAX and FMIN functions.

Then, search the zero phase point being near to the measurement point is searched with the use of ZEROPHS function.

11.6 Using Built-in Functions

This instrument is provided with the built-in functions related to wave form analysis such as band width analysis and ripple analysis.

In R3753, R3764/66 and R3765/67, mark function is used to perform the wave form analysis. However, with the built-in functions, you can perform all the operations by calling up one function.

For the function explanation of built-in functions, refer to "4.4 Built-in Functions" of R3752/53, R3764/66, R3765/67 Program Manual.

In this section, the example using built-in functions is explained.

11.6.1 Basic Function

The built-in functions listed below are used to perform the basic conversions such as calculating necessary parameters etc. with the real analysis function.

POINT1	Gets the measurement point nearest the specified frequency.
POINT1L	Gets the maximum measurement point lower than the specified frequency.
POINT1H	Gets the minimum measurement point higher than the specified frequency.
POINT2	Gets the address point nearest the specified frequency.
POINT2L	Gets the address point lower than the specified frequency.
POINT2H	Gets the minimum address point higher than the specified frequency.
DPOINT	Gets the address point band width corresponding to the specified frequency band width.
SWPOINT	Gets the last measurement point.
FREQ	Gets the frequency corresponding to the specified address point.
DFREQ	Gets the frequency band width corresponding to the interval between the specified addresses.
SWFREQ	Gets the last scan frequency.
VALUE	Gets the response value of the specified address point.
DVALUE	Gets the difference of response values between the specified addresses.
CVALUE	Gets the response value of specified frequency.
DCVALUE	Gets the difference of response values between the specified frequencies.
SWVALUE	Gets the last measurement response value.

Almost all the built-in functions treat the address point as argument. To use other built-in functions, convert the frequency to the measurement point by using these functions. The absolute range of address point is 0 to 1200. The measurement point is the value actually existing in this range. The measurement point varies with the measurement point count set by the measurement condition.

The data of address point except for measurement point uses the value interpolated from the measurement point.

The following is a program example.

```

100 P = POINT1(250.0E6,0) ! Measurement point nearest to 250MHz.
110 V = VALUE(P,0)       ! Gets measurement value.
120 P0 = POINT1L(100.0E6,0) ! The maximum value by address point lower
                           than 100MHz.
130 P1 = POINT1H(200.0E6,0) ! The minimum value of address point upper
                           than 200MHz.
140 Va = MAX(P0,P1,0)     ! Gets the maximum value.
    
```

11.6.2 Using Example of Maximum and Minimum Value Analysis Functions

The built-in functions shown as follows are used to analyze the maximum and minimum values in the specified range.

MAX	Gets the maximum response value.
MIN	Gets the minimum response value.
FMAX	Gets the maximum response frequency.
FMIN	Gets the minimum response frequency.
PMAX	Gets the maximum response measurement point.
PMIN	Gets the minimum response measurement point.

These functions are used to search the measurement point of maximum response or minimum response between the address points of specified channel. Then , the analysis value of the measurement point is transferred as a function value.

The function MAX and MIN return the response values, FMAX and FMIN functions return the stimulus values (frequency value) and PMAX and PMIN return the measurement point values.

When these functions are used in combination, the resonant point and anti-resonant point can be analyzed.

11.6 Using Built-in Functions

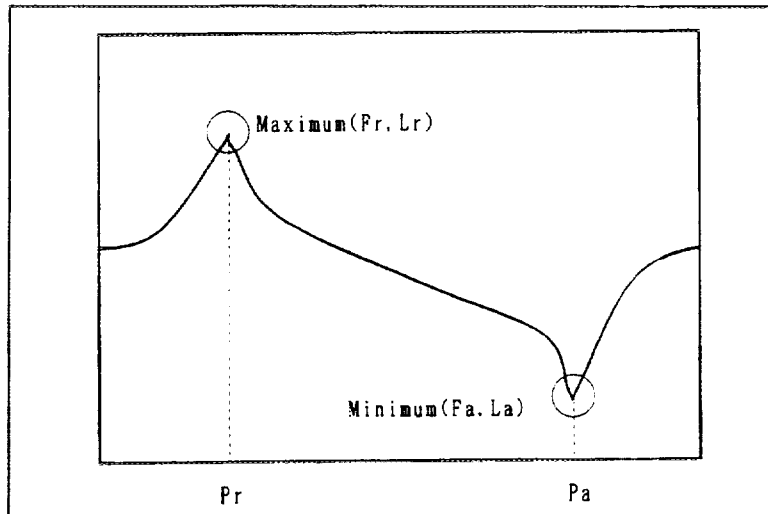


Figure 11-3 Maximum and Minimum Value Analysis Function

The following shows an example of program for analyzing the maximum and minimum values.

```

100 Vr = MAX(0,1200,0) ! Gets the maximum response value.
110 Fr = FMAX(0,1200,0) ! Gets the stimulus value of maximum response.
120 Pr = PMAX(0,1200) ! Gets the measurement point of maximum
    response.
130 Va = MIN(0,1200,0) ! Gets the minimum response value.
140 Fa = FMIN(0,1200,0) ! Gets the stimulus value of minimum response.
150 Pa = PMIN(0,1200,0) ! Gets the measurement point of minimum
    response.
    
```

To get all analysis values of maximum or minimum response, it is not necessary to call out all these functions.

First, the measurement point is got with PMAX or PMIN, then it is taken as a parameter to call out FREQ and VALUE functions.

In this way, the analysis value can be got at a high speed higher than that when MAX and FMAX or MIN and FMIN are used.

```

100 Pr = PMAX(0,1200,0) ! Gets the measurement point of maximum
    response.
110 Vr = VALUE(Pr,0) ! Gets the maximum response value.
120 Fr = FREQ(Pr,0) ! Gets the stimulus value of maximum
    response.
140 Pa = PMIN(0,1200,0) ! Gets the measurement point of minimum
    response.
150 Va = VALUE(Pa,0) ! Gets the minimum response value.
160 Fa = FREQ(Pa,0) ! Gets the stimulus value of minimum
    response.
    
```

11.6.3 Using Example of Attenuation Level Analysis Functions

The following built-in functions are used to analyze the typical parameters in filter etc.

- BND Gets the band width from the specified address point.
- BNDL Gets the low frequency of band width from the specified address point.
- BNDH Gets the high frequency of band width from the specified address point.
- CBND Gets the band width from the specified frequency.
- CBNDL Gets the low frequency of band width from the specified frequency.
- CBNDH Gets the high frequency of band width from the specified frequency.
- MBNDI Performs the multiple band width analysis outwards.
- MBNDO Performs the multiple band width analysis inwards.

(1) BND, BNDL, BNDH, CBND, CBNDL, CBNDH

These functions are used to analyze the attenuation point and band width from the specified attenuation level. For those functions whose name are led by C , the standard point of the function is specified with address pointer, and for those whose name are not led by C , specified with frequency.

When the special parameter of filter is to be calculated, it can be achieved by combination of these functions.

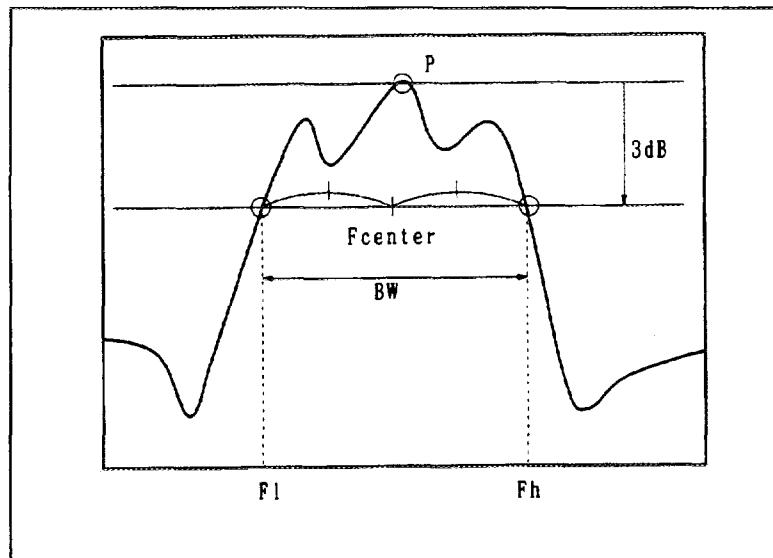


Figure 11-4 Analysis of Attenuation Level

The following is an example of attenuation level analysis program.

```
100 P = PMAX(0,1200,0) ! Gets the measurement point of maximum response.
```

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11.6 Using Built-in Functions

```

110 BW = BND(P,3,0)      ! Gets the band width of attenuation
                          ! level 3dB.
120 F1 = BNDL(P,3,0)    ! Gets the low frequency of attenuation
                          ! level 3dB of band width.
130 Fh = BNDH(P,3,0)    ! Gets the high frequency of attenuation
                          ! level 3dB of band width.
140 FC = (F1+Fh)*0.5    ! Calculates the center frequency.
150 Q = SQR(F1*Fh) / BW ! Calculates Q.
    
```

(2) MBNDI, MBNDO

MBNDI or MBNDO function is used when the analysis of multiple attenuation level is performed.

These functions enable the multiple attenuation points to be analyzed at a time and the low frequency, high frequency, center frequency and band width can be obtained for one attenuation level.

When the analysis of attenuation level is performed outward from the standard pointer, the MBNDI function is used.

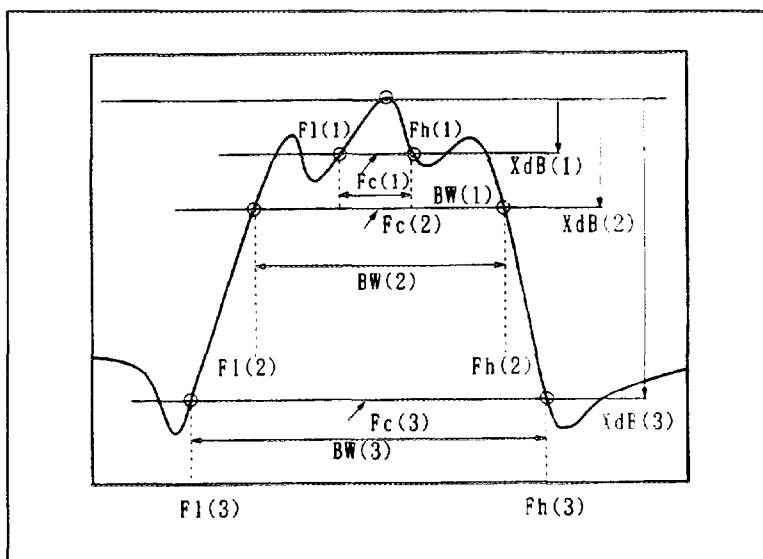


Figure 11-5 MBNDI

The example of program using MBNDI function is shown as follows.

```

100 DIM Levels(3)      ! Defines an array used for
                       ! attenuation level specification.
110 DIM DataBuffer(3,4) ! Defines an array used for getting
                       ! analysis value.
120 Levels(1) = 1.0    ! Specifies the first attenuation
                       ! level to be analyzed to 1.0dB.
130 Levels(2) = 3.0    ! Specifies the second attenuation
                       ! level to be analyzed to 3.0dB.
    
```



```

140 Levels(3) = 10.0      ! Specifies the third attenuation
                        ! level to be analyzed to 10.0dB.
150 P=PMAX(0,1200,0)    ! Gets the measurement point of
                        ! maximum response.
160 N=MBNDI(0,1200,p,3,Levels(1),DataBuffer(1,1),0)
                        ! Analyzes multiple levels.
170 PRINT DataBuffer(1,1) ! Low frequency of band width of Fl(1)
                        ! -attenuation level 1.0dB.
180 PRINT DataBuffer(1,2) ! High frequency of band width of Fh(1)
                        ! -attenuation level 1.0dB.
190 PRINT DataBuffer(1,3) ! Center frequency of band width of
                        ! Fc(1)-attenuation level 1.0dB.
200 PRINT DataBuffer(1,4) ! Band width of BW(1)- attenuation
                        ! level 1.0dB.
210 PRINT DataBuffer(2,1) ! Low frequency of band width of Fl(2)
                        ! -attenuation level 1.0dB.
220 PRINT DataBuffer(2,2) ! High frequency of band width of Fh(2)
                        ! -attenuation level 1.0dB.
230 PRINT DataBuffer(2,3) ! Center frequency of band width of
                        ! Fc(2)-attenuation level 1.0dB.
240 PRINT DataBurrer(2,4) ! Band width of BW(2)-attenuation
                        ! level 1.0dB.
250 PRINT DataBuffer(3,1) ! Low frequency of band width of Fl(3)
                        ! -attenuation level 1.0dB.
260 PRINT DataBuffer(3,2) ! High frequency of band width of Fh(3)
                        ! -attenuation level 1.0dB.
270 PRINT DataBuffer(3,3) ! Center frequency of band width of
                        ! Fc(3)-attenuation level 1.0dB.
280 PRINT DataBurrer(3,4) ! Band width of BW(3)- attenuation
                        ! level 1.0dB.

```

When the analysis of attenuation level is performed inward from outside to the standard pointer, the MBNDO function is used.

11.6 Using Built-in Functions

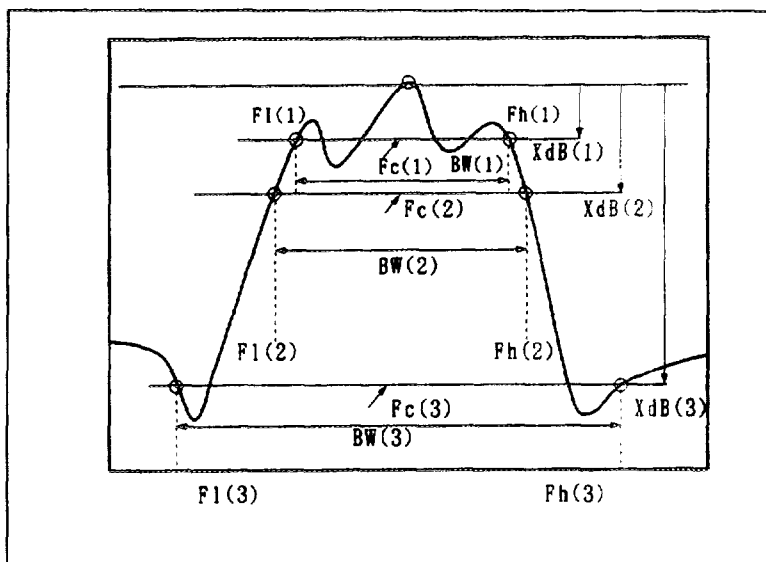


Figure 11-6 MBNDO

The example of program using MBNDO function is shown as follows.

```

100 DIM Levels(3)           ! Defines an array used for
                             attenuation level specification.
110 DIM DataBuffer(3,4)     ! Defines an array used for getting
                             analysis value.
120 Levels(1) = 1.0        ! Specifies the first attenuation
                             level to be analyzed to 1.0dB.
130 Levels(2) = 3.0        ! Specifies the second attenuation
                             level to be analyzed to 3.0dB.
140 Levels(3) = 10.0       ! Specifies the third attenuation
                             level to be analyzed to 10.0dB.
150 P = PMAX(0,1200,0)     ! Gets the measurement point of
                             maximum response.
160 N = MBNDO(0,1200,p,3,Levels(1),DataBuffer(1,1),0)
                             ! Analyzes multiple levels.
170 PRINT DataBuffer(1,1)  ! Low frequency of band width of F1(1)
                             -attenuation level 1.0dB.
180 PRINT DataBuffer(1,2)  ! High frequency of band width of Fh(1)
                             -attenuation level 1.0dB.
190 PRINT DataBuffer(1,3)  ! Center frequency of band width of
                             Fc(1)-attenuation level 1.0dB.
200 PRINT DataBuffer(1,4)  ! Band width of BW(1)- attenuation
                             level 1.0dB.
210 PRINT DataBuffer(2,1)  ! Low frequency of band width of F1(2)
                             -attenuation level 1.0dB.

```

```

220 PRINT DataBuffer(2,2)    ! High frequency of band width of Fh(2)
                             -attenuation level 1.0dB.
230 PRINT DataBuffer(2,3)    ! Center frequency of band width of
                             Fc(2)-attenuation level 1.0dB.
240 PRINT DataBurrer(2,4)    ! Band width of BW(2)-attenuation
                             level 1.0dB.
250 PRINT DataBuffer(3,1)    ! Low frequency of band width of F1(3)
                             -attenuation level 1.0dB.
260 PRINT DataBuffer(3,2)    ! High frequency of band width of Fh(3)
                             -attenuation level 1.0dB.
270 PRINT DataBuffer(3,3)    ! Center frequency of band width of
                             Fc(3)-attenuation level 1.0dB.
280 PRINT DataBurrer(3,4)    ! Band width of BW(3)- attenuation
                             level 1.0dB.
    
```

11.6.4 Ripple Analysis Functions Using Example (1)

The following built-in functions are used to analyze the ripples and get the result.

RPL1	Gets the maximum value of difference between the highest value and lowest value.
RPL2	Gets the maximum value of difference between the neighboring highest value and lowest value.
RPL3	The total maximum value of the difference between the neighboring highest value and lowest value and the difference between the neighboring lowest value and highest value.
RPL4	Gets the maximum value of difference between the neighboring lowest value and highest value.
RPL5	Gets the maximum value of the highest value.
RPL6	Gets the minimum value of the highest value.
RPLF	Gets the frequency difference between the first highest point and lowest point.
RPLR	Gets the response difference between the first highest point and lowest point.
RPLH	Gets the response value of the first highest point.
FRPLH	Gets the frequency value of the first highest point.
PRPLH	Gets the measurement point of the first highest point.
RPLL	Gets the measurement point of the first lowest point.
FRPLL	Gets the frequency value of the first lowest point.
PRPLL	Gets the measurement point of the first lowest point.

11.6 Using Built-in Functions

As the searching target , ripple is specified with the coefficients of abscissa axis cant rate and ordinate axis cant rate. The cant rate coefficient of abscissa axis is specified with address point,while the cant rate coefficient of ordinate axis is specified with response value. For instance , when the ripple occurs 0.5dB up and down per one point in RPL1 function, it is shown as follows.

```
100 MaxDiff = RPL1(0,1200,1,0.5.0)
```

(1) RPL1

RPL1 function is used to get the maximum value of difference between the highest value and the lowest value in the specified range.

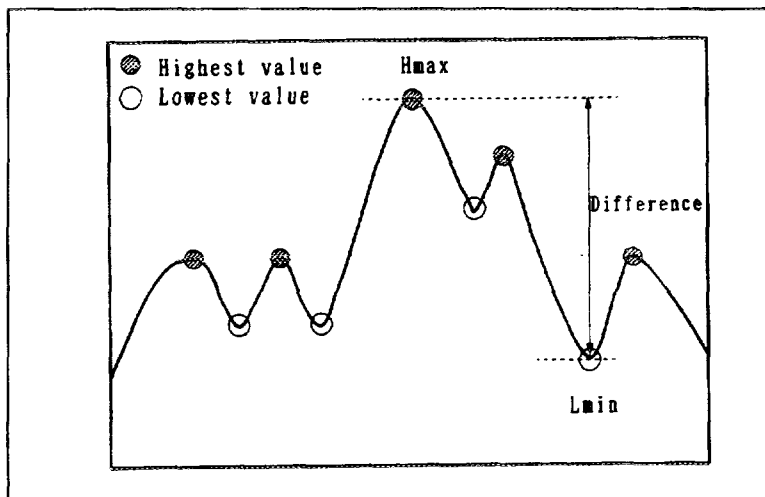


Figure 11-7 RPL1

The example of program showing the maximum value of difference between the highest and the lowest is shown as follows.

```
100 MaxDiff = MAX(0,1200,0) ! Gets the maximum value of differ-
110 PRINT MaxDiff           ence between the highest value and
                             the lowest value.
```

(2) RPL2 , RPL4

These functions are used to get the maximum value of difference between the neighboring highest value and lowest value.

However, RPL2 is used to detect the difference between the highest value and the lowest value to the right of the highest value , while RPL4 is used to detect the difference between the highest value and the lowest value to the left of the highest value.

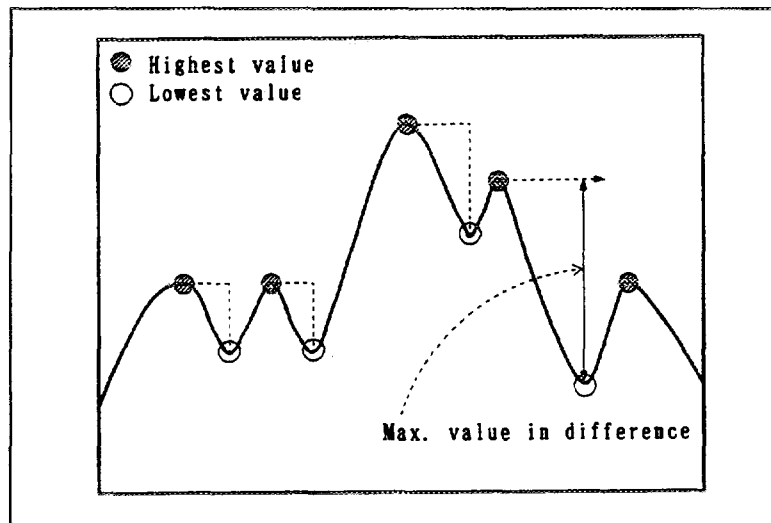


Figure 11-8 RPL2

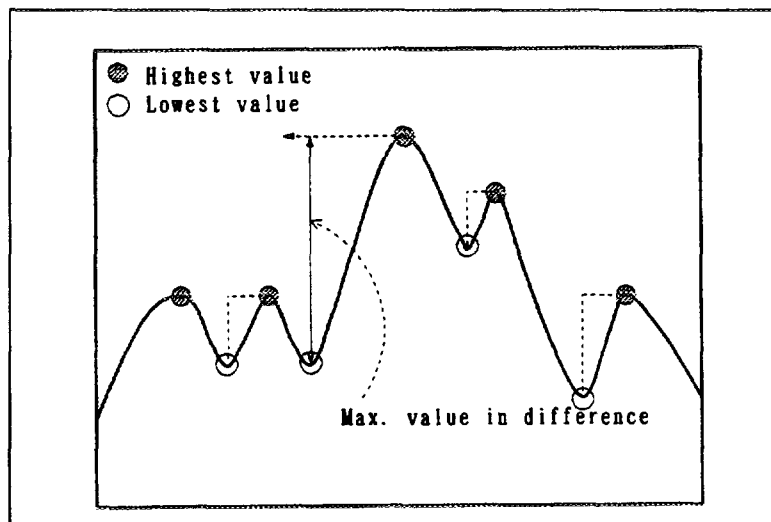


Figure 11-9 RPL4

The example of program is shown as follows.

```

100 P    = PMAX(0,1200,0)      ! Gets the measurement point.
110 RMax = RPL2(0,P,1,0.5,0)  ! Searches the right side.
120 LMax = RPL4(0,P,1,0.5,0) ! Searches the left side.
    
```

11.6 Using Built-in Functions

(3) RPL3

RPL3 function is used to get the total maximum value that is obtained by adding the difference between the neighboring highest value and lowest and the difference between the lowest value and the highest value.

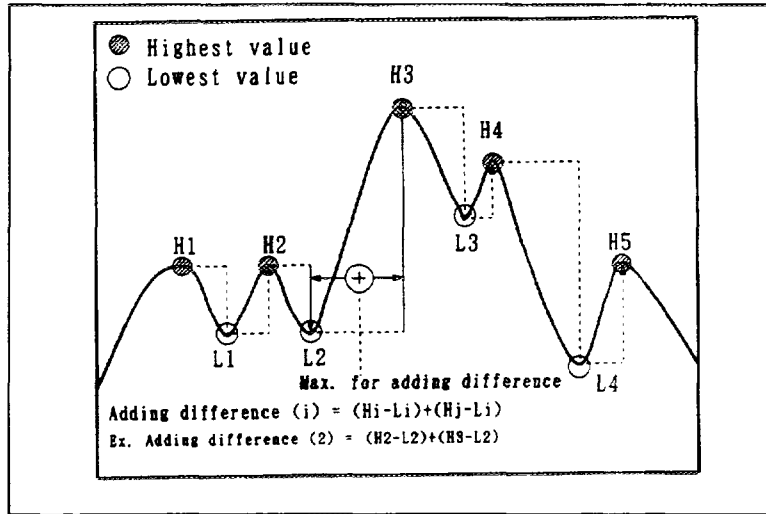


Figure 11-10 RPL3

The example of program used to get the maximum value of added differences is shown as follows.

```
100 MaxAdding = RPL3(0,1200,1,0.5,0)
```

(4) RPL5 , RPL6

These functions are used to get the maximum value and minimum value of the highest value. It is used when ripple spurious is analyzed.

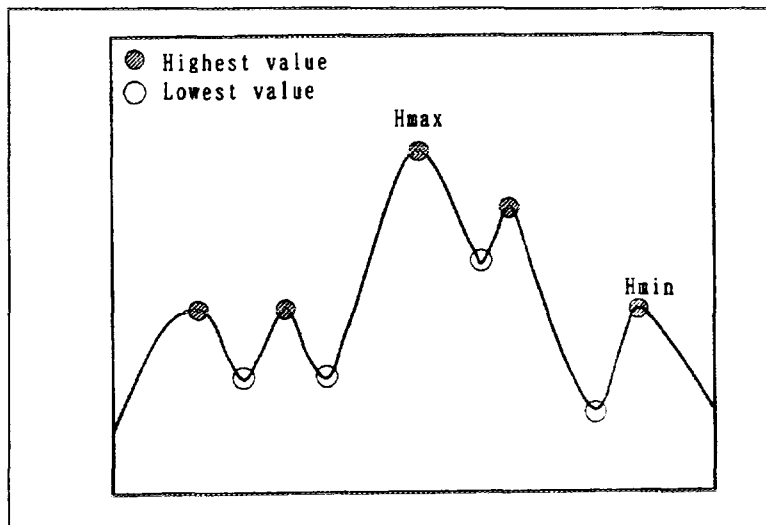


Figure 11-11 Maximum Value and Minimum Value of the highest value.

The example of program is shown as follows.

```

100 P0 = POINT1(10.0E6,0)      ! Start range of analysis is 10MHz.
110 P1 = POINT1(20.0E6,0)     ! End range of analysis is 20MHz.
120 Hmax = RPL5(P0,P1,1,0.5,0) ! Gets the maximum value of the
                               ! highest value.
130 Hmin = RPL6(P0,P1,1,0.5,0) ! Gets the minimum value of the
                               ! highest value.
    
```

(5) RPLF, RPLR, RPLH, RPLL, FRPLH, FRPLL, PRPLH, PRPLL

These functions are used to analyze the ripples of the highest point and the lowest point which is detected first. RPLF and RPLR are used to calculate the response difference (or frequency difference) between the highest point and the lowest point; RPLH and RPLL, get the response value of the highest point or the lowest point; FRPLH and FRPLL, get the frequency value of the highest point or the lowest point and PRPLH and PRPLL, get the measurement point of the highest point or the lowest point.

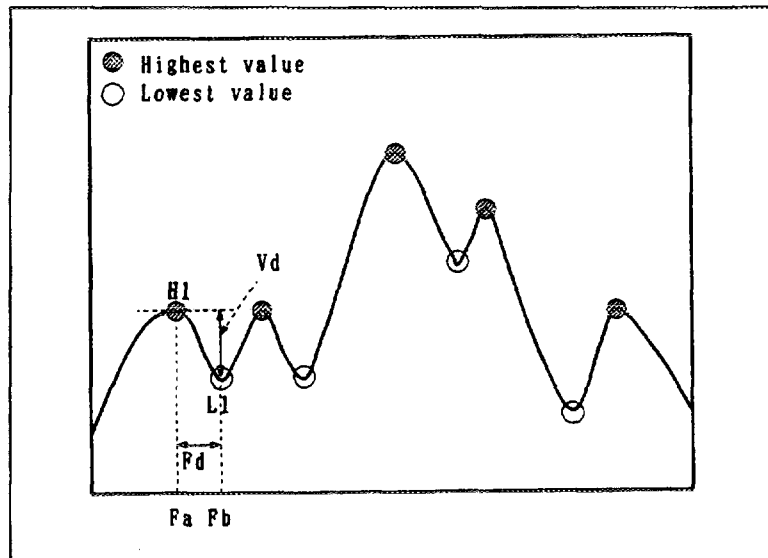


Figure 11-12 Response and Frequency of Ripple

The example of program is shown as follows.

```

100 Fd = RPLF(0,1200,1,0.5,0) ! Gets the frequency difference
                               ! between highest point and lowest
                               ! point.
110 Vd = RPLR(0,1200,1,0.5,0) ! Gets the response difference
                               ! between highest point and lowest
                               ! point.
120 H1 = RPLH(0,1200,1,0.5,0) ! Gets the response of highest
                               ! point.
130 L1 = RPLL(0,1200,1,0.5,0) ! Gets the response of lowest
                               ! point.
    
```

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11.6 Using Built-in Functions

```
140 Fa = FRPLH(0,1200,1,0.5,0) ! Gets the frequency of highest
                                point.
150 Fb = FRPLL(0,1200,1,0.5,0) ! Gets the frequency of lowest
                                point.
160 Pa = PRPLH(0,1200,1,0.5,0) ! Gets the measurement point of
                                highest point.
170 Pb = PRPLL(0,1200,1,0.5,0) ! Gets the measurement point of
                                lowest point.
```

However, this program is not in practice, because every time you call up the built-in functions, the overwrite for the searching should be considered.

If you know the measurement points of the highest point and the lowest point, the frequency and response value can be calculated with **FREQ** and **VALUE** functions. The program is transferred in practice after it is changed to as follows.

```
100 Pa = RPLH(0,1200,1,0.5,0) ! Gets the measurement point of
                                highest point.
110 Pb = RPLL(0,1200,1,0.5,0) ! Gets the measurement point of
                                lowest point.
120 Fa = FREQ(Pa,0)           ! Calculates the frequency of
                                highest point.
130 Fb = FREQ(Pb,0)           ! Calculates the frequency of
                                lowest point.
140 H1 = VALUE(Pa,0)          ! Calculates the response of
                                highest point.
150 L1 = VALUE(Pb,0)          ! Calculates the response of
                                lowest point.
160 Fd = Fb - Fa              ! Calculates the frequency differ-
                                ence between highest point and
                                lowest point.
170 Vd = H1 - L1              ! Calculates the response differ-
                                ence between highest point and
                                lowest point.
```

11.6.5 Ripple Analysis Function Using Example (2)

The following built-in functions are used first to get all ripples to be analyzed, then analyze them after the ripple number is specified. When multiple ripples are analyzed, the analysis functions described below are used.

NRPLH	Gets the count of highest points.
NRPLL	Gets the count of lowest points.
PRPLHN	Gets the measurement point of the n-th highest point.
PRPLLN	Gets the measurement point of the n-th lowest point.
FRPLHN	Gets the frequency value of the n-th highest point.
FRPLLN	Gets the frequency value of the n-th lowest point.

- VRPLHN Gets the response value of the n-th highest point.
- VRPLLN Gets the response value of the n-th lowest point.
- PRPLHM Gets the measurement points of multiple highest point.
- PRPLLM Gets the measurement points of multiple lowest point.
- FRPLHM Gets the frequency value of multiple highest point.
- FRPLLM Gets the frequency value of multiple lowest point.
- VRPLHM Gets the response value of multiple highest point.
- VRPLLM Gets the response value of multiple lowest point.

(1) NRPLH , NRPLL

These two functions are used to analyze the count of highest point or lowest point. When the built-in functions are used to analyze the ripples after the ripple number is specified, the ripple count is obtained in advance according to NRPLH and NRPLL.

(2) PRPLHN, PRPLLN, FRPLHN, FRPLLN, VRPLHN, VRPLLN

These functions are used to perform the analysis for those ripples obtained with NRPLH and NRPLL, then specified by numbers.

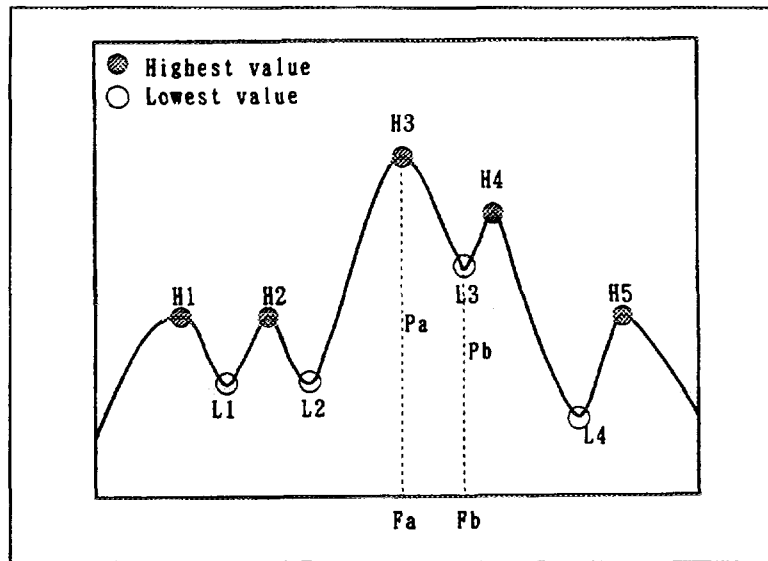


Figure 11-13 Analysis of Specified Ripple

The example of program is shown as follows.

```

100 Nh = NRPLH(0,1200,1,0,5,0)    ! Searches the highest point and
                                   enables to perform the number-
                                   specified analysis.
110 Nl = NRPLL(0,1200,1,0,5,0)    ! Searches the lowest point and
                                   enables to perform the number-
                                   specified analysis.
120 Pa = PRPLHN(3,0)              ! Gets the measurement point of
                                   the third highest point.
    
```

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11.6 Using Built-in Functions

```

130 Fa = PRPLHN(3,0)      ! Gets the frequency point of
                          ! the third highest point.
140 H3 = VRPLHN(3,0)     ! Gets the response value of
                          ! the third highest point.
150 Pb = PRPLL(3,0)      ! Gets the measurement point of
                          ! the third lowest point.
160 Fb = FRPLL(3,0)      ! Gets the frequency of the third
                          ! lowest point.
170 L3 = VRPLL(3,0)     ! Gets the response value of the
                          ! third lowest point.

```

(3) PRPLHM, PRPLLM, FRPLHM, FRPLLM, VRPLHM, VRPLLM

These functions are used to get the analysis values of all ripples with NRPLH and NRPLL.

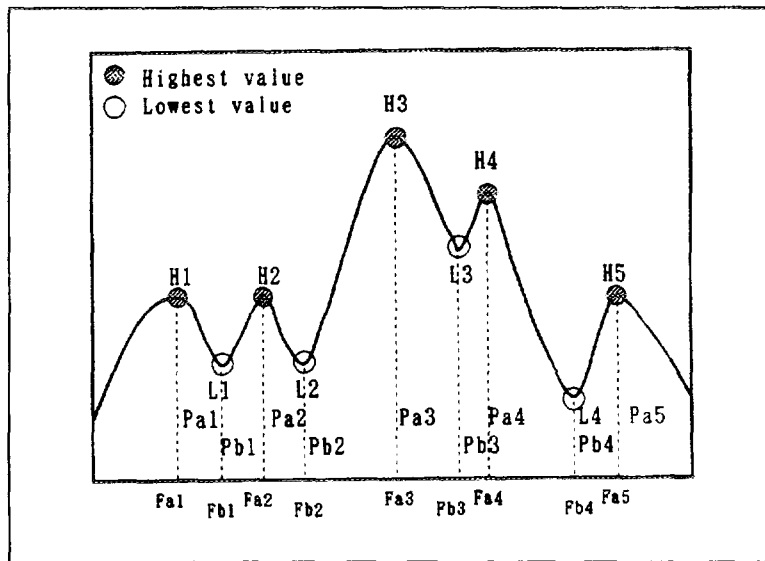


Figure 11-14 Analysis of All Ripple

The example of program is shown as follows.

```

100 INTEGER Pa(300), Pb(300)
110 DIM Fa(300), Fb(300)
120 DIM Va(300), Vb(300)
130 Nh = NRPLH(0,1200,1,0.5,0) ! Searches highest point and en-
                              ! ables number specified analysis.
140 Nl = NRPLL(0,1200,1,0.5,0) ! Searches lowest point and en-
                              ! ables number specified analysis.
150 Na = PRPLHM(Pa(1),0)      ! Gets measurement points of all
                              ! the highest point.
160 Nb = PRPLLM(Pb(1),0)     ! Gets measurement points of all
                              ! the lowest point.

```

```

170 Na = FRPLHM(Fa(1),0)      ! Gets frequencies of all the
                               highest point.
180 Nb = FRPLLM(Fb(1),0)      ! Gets frequencies of all the
                               lowest point.
190 Na = VRPLHM(Va(1),0)      ! Gets response values of all the
                               highest point.
200 Nb = VRPLLM(Vb(1),0)      ! Gets response values of all the
                               lowest point.

```

11.6.6 Using Example of Direct Search Functions

The following built-in functions are used to search the response value given in the specified range.

DIRECT Gets the address point of specified response.

DIRECTL Gets the left measurement point corresponding to the specified response.

DIRECTH Gets the right measurement point corresponding to the specified response.

CDIRECT Gets the frequency of specified response.

CDIRECTL Gets the left real frequency corresponding to specified response.

CDIRECTH Gets the right real frequency corresponding to specified response.

DDIRECT Gets the address point width of specified response.

CDDIRECT Gets the band width of specified response.

ZEROPHS Searches the frequency of the first zero phase.

(1) **DIRECT, DIRECTL, DIRECTH, CDIRECT, CDIRECTL, CDIRECTH**

These functions are used to specifies response value and then search the place that is coincident with the response value.

For the **DIRECT** function whose name is leaded by **C** , the search range is specified with frequency , while for others, the search range is specified with address point .

The function whose name is ended by **L** searches from low frequency to high frequency, and that whose name is ended by **H** searches from high frequency to low frequency, so as to find the analysis value corresponding to the real measurement value. However, when no measurement point is coincident, then take the one that comes immediately after the specified response value.

11.6 Using Built-in Functions

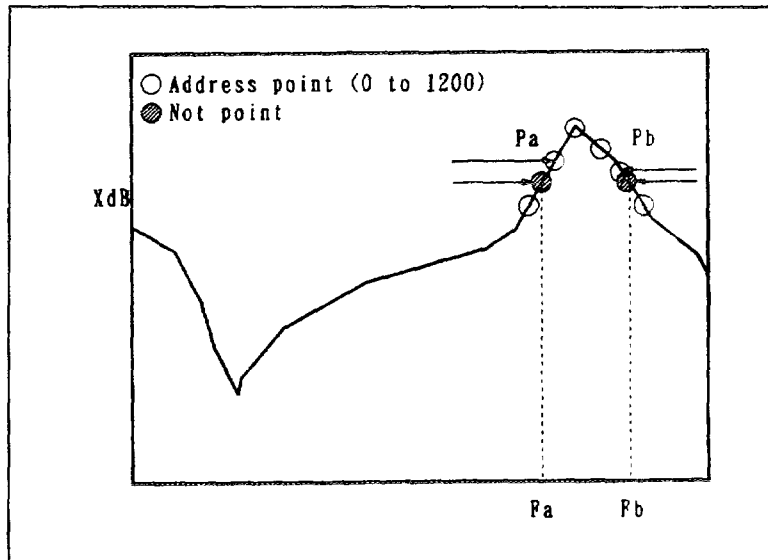


Figure 11-15 Direct Search

The example of program is shown as follows.

```

100 P = DIRECT(0,1200,-10,0)      ! Address point of response
                                   value -10dB.
110 Pa = DIRECTL(0,1200,-10,0)    !
120 Pb = DIRECTH(0,1200,-10,0)    !
130 F = CDIRECT(5,500.0E6,-10,0)  ! Frequency of response value
                                   -10dB
140 Fa = CDIRECTL(5,500.0E6,-10,0) !
150 Fb = CDIRECTH(5,500.0E6,-10,0) !
    
```

(2) DDIRECT, CDDIRECT

These functions are used to search two measurement points corresponding to the specified response value and get the point width.

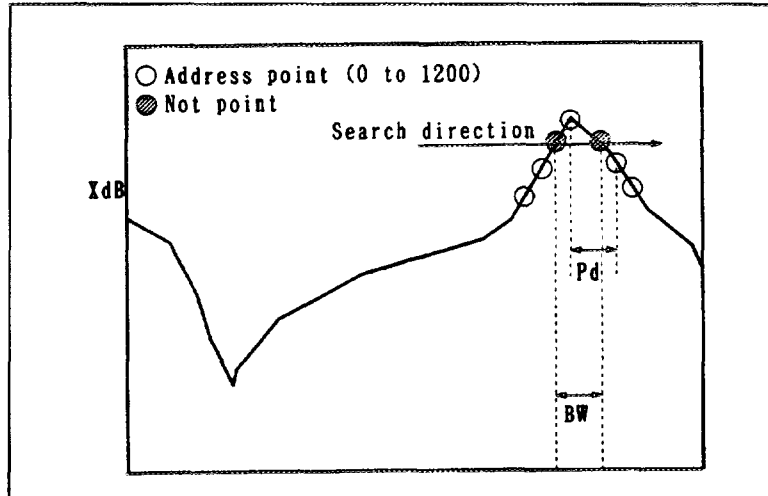


Figure 11-16 Band Width Corresponding to Response

The example of program is shown as follows.

```
100 Pd = DDIRECT(0,1200,-10,0) ! Address point width.
110 BW = CDDIRECT(5,500,0E6,-10,0)! Band width(interpolating with
frequency.)
```

(3) ZEROPHS

ZEROPHS function is used to search the frequency at which the phase value first becomes zero degree between the specified address points.

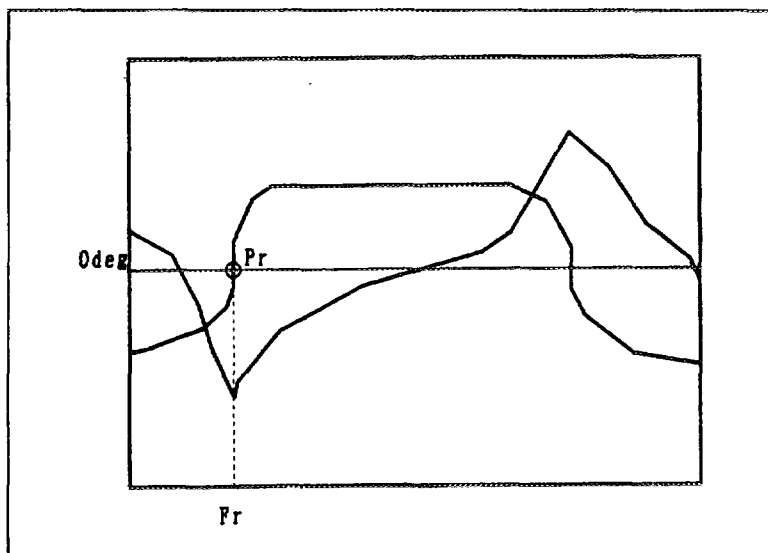


Figure 11-17 Search of Zero Phase

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11.7 Setting Limit Line

The example of program is shown as follows.

```
100 Pr = PMAX(0,1200,0)    ! Gets the measurement point of maximum
                           response.
110 Pa = PMIN(0,1200,0)    ! Gets the measurement point of minimum
                           response.
120 Fr = ZEROPHS(Pr,Pa,0) ! Gets the frequency of zero phase.
```

11.6.7 Data Transferring

The following built-in functions are used to transfer data between built-in and incorporated BASIC.

TRANSR Loads data from the memory of analysis channel.

TRANSW Writes data to the memory of analysis channel.

The example of program is shown as follows.

```
100 DIM buf(2,1200)          ! Defines data array.
110 N = TRANSR(0,1200,Buf(1,1),0) ! Reads in the first wave form
                                data of CH1.
120 N = TRANSR(0,1200,Buf(2,1),8) ! Reads in the second wave form
                                data of CH2.
```

11.7 Setting Limit Line

In this section, a program example of setting the limit line is explained.

A band-pass filter of 880MHz is used for the test specimen (DUT). After setup, normalized, then the limit line is set as shown below.

Segment	0	1	2	3	4
frequency	780MHz	820MHz	866MHz	898MHz	960MHz
upper value	-40dB	-40dB	-10dB	-10dB	-40dB
lower value	-65dB	-65dB	-30dB	-30dB	-65dB

(Note) Can not be used by R3752/53.

The program example is shown in Example 11-6.

Example 11-6 Setting Limit Line

```

100 ! *****
110 !
120 !           SET LIMIT LINE TABLE
130 !
140 ! *****
150 !
160 INTEGER I
170 OUTPUT 31;"OLDC OFF"
180 OUTPUT 31;"SYST:PRES"
190 OUTPUT 31;"DISP:ACT 2"
200 OUTPUT 31;"FREQ:CENT 880MHZ;SPAN 200MHZ"
210 !
220 CLS:CURSOR 0,16
230 INPUT "Connect THRU, then press [X1].",D$
240 OUTPUT 31;"CORR:COLL NORM;*OPC?"
250 ENTER 31;DUMMY$
260 !
270 FOR I=0 TO 4
280 READ ST,UP,LO
290 OUTPUT 31;"DISP:LIM:SEGM",I," :STIM",ST,"MHZ;UPP",UP,";LOW",LO
300 OUTPUT 31;"DISP:LIM:SEGM",I," :COL 3;WCOL 6"
310 NEXT
320 OUTPUT 31;"DISP:LIM:STAT ON;LINE ON"
330 CLS
340 STOP
350 !
360 DATA 780,-40,-65
370 DATA 820,-40,-65
380 DATA 866,-10,-30
390 DATA 898,-10,-30
400 DATA 960,-40,-65

```

There are two ways to set the limit line. one is setting all the segments at a time by using DISF [: WINDow [<chno>]] : LIMit [<parano>] : DATA <block>. Another is setting each segment in graded way by using DISPLay [: WINDow [<chno>]]:LIMit [<parano>]: SEGMENT <n> <Lock> parameter of each cement is set here, respectively

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11.7 Setting Limit Line

The program of Example 11-6 is explained below.

Program Explanation of Example 11-6	
100 to 150	Comment lines.
160	Turns variable I to integer type. (Because the segment is specified with interger.)
170	Releases the R3762/63 conversion command mode.
180	Initializes the setting of network analyzer.
190	Activates channel 2.
200	Turns scan frequency to center 880MHz, and span to 100MHz.
210	Comment line.
220	Clears the characters on the screen and moves the cursor.
230	Displays the message and waits for input.
240	Gets normalize-data and requests stop notification.
250	Waiting till the getting is ended.
260	Comment line.
270	Changes the segment number I from 0 to 4 in sequence.
280	Reads in the data of frequency, upper limit value and lower limit value.
290	Sets frequency , upper limit value and lower limit value to segment I.
300	Sets the color of limit line and wave form.
310	Moves to the next segment.
320	Turns the limit test decision and limit line display ON.
330	Clears the screen.
340	Ends.
350	Comment line.
360 to 400	Frequency , upper limit value and lower limit value of each segment.

11.8 Four Screens Display of All S Parameters

This section describes an example of program that is used to perform four-screen display of all S parameters.

A band-pass filter of 880MHz is used as the device under test (DUT).

After setup, two-port full-calibration is performed and the following four screens are displayed.

[CH1] S11 Smith chart SMITH (R+jx)	[CH2] S12 Amplitude/phase LOG MAG & PHASE
[CH3] S22 Smith chart SMITH (R+jx)	[CH4] S21 Amplitude/Group delay time LOG MAG & DELAY

*(Note) Can not be used by R3752/53.
S parameter measurement in R3764/65/66/67 is enabled only when C type or A type +S parameter test set is used.*

The program example is shown in Example 11-7.

Example 11-7 Four-Screen Display of all S Parameter

```

100 ! *****
110 !
120 !           2-PORT FULL CALIBRATION
130 !           AND 4 CHANNELS DISPLAY
140 !
150 ! *****
160 !
170 *MAIN
180   GOSUB *SETUP
190   GOSUB *CAL
200   GOSUB *DISP4CH
210   STOP
220   !
230 *SETUP
240   OUTPUT 31;"OLDC OFF"
250   OUTPUT 31;"SYST: PRES"
260   OUTPUT 31;"FREQ:CENT  880MHZ;SPAN  100MHZ"
270   OUTPUT 31;"BAND 100HZ"
280   OUTPUT 31;"DISP:FORM ULOW"
290   CLS:CURSOR 0,16
    
```

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11.8 Four Screens Display of All S Parameters

```
300     RETURN
310     !
320     *CAL
330     INPUT "Connect OPEN to port 1, then press [X1].",D$
340     OUTPUT 31;"CORR:COLL S110"
350     GOSUB *SWPEND
360     INPUT "Connect SHORT to port 1, then press [X1].",D$
370     OUTPUT 31;"CORR:COLL S11S"
380     GOSUB *SWPEND
390     INPUT "Connect LOAD to port 1, then press [X1].",D$
400     OUTPUT 31;"CORR:COLL S11L"
410     GOSUB *SWPEND
420     INPUT "Connect OPEN to port 2, then press [X1].",D$
430     OUTPUT 31;"CORR:COLL S220"
440     GOSUB *SWPEND
450     INPUT "Connect SHORT to port 2, then press [X1].",D$
460     OUTPUT 31;"CORR:COLL S22S"
470     GOSUB *SWPEND
480     INPUT "Connect LOAD to port 2, then press [X1].",D$
490     OUTPUT 31;"CORR:COLL S22L"
500     GOSUB *SWPEND
510     !
520     INPUT "Connect THRU between port 1 and 2, then press [X1].",D$
530     OUTPUT 31;"CORR:COLL GTHRU"
540     GOSU *SWPEND
550     !
560     OUTPUT 31;"CORR:COLL OIS"
570     GOSUB *SWPEND
580     !
590     OUTPUT 31;"CORR:COLL:SAVE"
600     OUTPUT 31;"BAND:AUTO ON"
610     CLS
620     RETURN
630     !
640     *DISP4CH
650     OUTPUT 31;"DISP:DUAL ON;FORM ULOW"
```

```

660     OUTPUT 31; "FUNC1:POW S11"
670     OUTPUT 31; "FUNC2:POW S12"
680     OUTPUT 31; "FUNC3:POW S22"
690     OUTPUT 31; "FUNC4:POW S21"
700     OUTPUT 31; "CALC1:FORM SCH"
710     OUTPUT 31; "CALC2:FORM MLOP"
720     OUTPUT 31; "CALC3:FORM SCH"
730     OUTPUT 31; "CALC4:FORM MLOD"
740     RETURN
750     !
760     *SWPEND
770     OUTPUT 31; "*OPC?"
780     ENTER 31; D$
790     RETURN
    
```

In order to display the submajor (channel 3,4), 3 or 4 must be specified in the channel specification <chno> of the measurement mode specification command [SENSE:] FUNCTION <chno> [: ON] " <input>" or [SENSE:] FUNCTION <chno>: POWER <input>. Specifying measurement format of channel 3 and 4 etc. is performed in advance with the measurement mode specification after the channel has been displayed.

The example of program is shown as follows.

Program Explanation of Example 11-7	
100 to 160	Comment lines.
170	Level MAIN of main routine.
180	Calls out initial setting routine SETUP.
190	Calls out correction routine CAL.
200	Calls out four screen display routine DISP4 CH.
210	Ends.
220	Comment line.
230	Level SETUP of initial setting routine.
240	Releases R3762/63 convention command mode.
250	Initializes the setting of network analyzer.
260	Turns scan frequency to center 880MHz and span to 100MHz.
270	Turns resolution band width to 100Hz.
280	Performs screen split display of upper and lower two parts.

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11.8 Four Screens Display of All S Parameters

290	Clears the characters on the screen and moves the cursor.
300	Gets rid of initial setting routine.
310	Comment line.
320	Level CAL of correction routine.
330	Displays message and waits for input. (be the same below.)
340	Gets correction data (S11 OPEN)
350	Waits for the end of getting (be the same below.)
360 to 380	Gets correction data (S11 SHORT).
390 to 410	Gets correction data (S11 LOAD).
420 to 440	Gets correction data (S22 OPEN).
450 to 470	Gets correction data (S22 SHORT).
480 to 500	Gets correction data (S22 LOAD).
510	Comment line.
520 to 540	Gets correction data (GROUP THRU).
550 to 560	Gets correction data (Omits ISOLATION correction).
580	Comment line.
590	Calculates error coefficient from correction data.
600	Enables the resolution band width to be set automatically.
610	Clears the characters on the screen.
620	Gets rid of correction data.
630	Comment line.
640	Level DISP4CH of four screen display routine.
650	Enables two channel display, upper and lower two parts split display.
660	Turns the measurement mode of channel 1 to S11.
670	Turns the measurement mode of channel 2 to S12.
680	Turns the measurement mode of channel 3 to S22.
690	Turns the measurement mode of channel 4 to S21.
700	Turns the measurement format of channel 1 to smith chart (R+jx).
710	Turns the measurement format of channel 2 to amplitude/phase.
720	Turns the measurement format of channel 3 to smith chart (R+jx).

730	Turns the measurement format of channel 4 to amplitude/phase.
740	Gets rid of four screen display routine.
750	Comment line.
760	Level SWPEND of wait sweep end routine.
770	Requests the operation end notification.
780	Gets the notification.
790	Gets rid of wait sweep end routine.

MEMO 

12 Using Example of External Controller

To connect a computer with this instrument by using GPIB and exchange the data between them, it is necessary to know the computer language and program creation.

This chapter is explained with BASIC (N88-BASIC, QuickBasic, HP-BASIC) and C language. It is not required to know all of them.

However, it is difficult to use GPIB skilfully without knowing the program of BASIC.

Therefore, the users are advised to learn something about the computer language before programming that is related to GPIB to be described from now, so as to use it in practice.

The following documents are recommended to be prepared for the programming.

- R3764/66, R3765/67 Operation Manual
- R3764/66, R3765/67 Programming Manual
- GPIB Address Allocation Table
- Manual of Personal Computer
- Manual of GPIB Interface Board

12.1 Before Programming

The GPIB is an interface that connects the network analyzer (this instrument) with other controller or peripheral apparatus with the cable for GPIB.

In this section, a program used to control this instrument with an external controller (Personal computer) that is connected to the instrument by GPIB cable is created.

There exist some computers that can use the GPIB command as soon as the power is switched on, however, it is necessary to load the dedicated programs from the floppy disk according to the controller. Besides, there are programs that can be used to specify the using area of memory before and after loading or output necessary commands to open the input / output port.

Set up the controller to be used after reading the manual attentively.

This chapter describes a method of program creation, centering around an example that takes PC-9801 computer in which the NEC pure GPIB interface board is prepared as an external controller. Employed language is N88 Japanese BASIC.

Set this instrument to the specified condition after the setup of external controller has done. To control this instrument from the external controller, the instrument should be set to GPIB mode and connected by GPIB cable, and the GPIB address of this instrument must be set. (Refer to 12.1.3.)

12.1.1 GPIB Mode

There are the following two types of GPIB mode in this instrument.

- SYSTEM CONTROLLER mode

Enables to measure the function and control the machines connected with this instrument according to the built-in BASIC programs.

- TAKER/ LISTENER mode

Enables to control this instrument with external controller.

Since the built-in BASIC interpreter is shared, the load of external controller can be reduced.

12.1 Before Programming

12.1.2 Connecting with This Instrument

The GPIB connector at the rear panel of this instrument is connected with the GPIB connector of external controller with GPIB cable that is optionally available.

When connecting, read the manuals about the interface board and computer to be used carefully, before connecting them.

(Note) *The GPIB connector of external controller is on the GPIB interface board. Therefore, it is necessary to purchase the GPIB interface board when using NEC-9800 series and IBM - PC compatible computer.*

The type name of GPIB cable varies with the length. The following table shows the name of type and the length.

Table 12-1 GPIB Cable (optionally available)

Type name	Length
408JE - 1P5	0.5m
408JE - 101	1m
408JE - 102	2m
408JE - 104	4m

12.1.3 Setting GPIB Address

When this instrument is controlled by external controller by using GPIB, it is necessary to set the GPIB address of this instrument.

When the address is set, it is stored in non-erasable memory of this instrument. Except for changing the address, it is not necessary to set it again.

The methods of setting GPIB address are different in R3764/66 and R3765/67, and described separately as follows.

(Note) *The setting of GPIB address is performed with the front panel keys.*

- Setting address in R3764/66 (Refer to " 4.1.5 " of R3764/66 operation manual.)
 - ① Press [*] (CONFIG) in the program mode, and turn to CONFIG mode.
The list of system variables is displayed on the fluorescent display tube.
 - ② Press [*] (CONFIG) and hold it down till the level of ADDRESS is displayed in highlight.
 - ③ Input the address with numeric keys, then press [ENT].
 - ④ To store the setting value to the non-erasable memory of this instrument, press [ENT] again. Since the message for ensuring is displayed on the fluorescence color display-tube, press [ENT] when you want to store it.

- Setting address in R3765/67 (Refer to “ 7.10.2 ” of R3765/67 operation manual.)
 - ① Press [LCL] to get GPIB menu mode.
 - ② Select {SET ADDRESSES} from the menu, and convert to SET ADDRESSES menu mode.
 - ③ When {ADDRESS R3765} is selected from the next menu, the currently set address is displayed on the active area.
 - ④ Here, input the address using numeric keys and press [X1].
Then, the address of this instrument is set and stored in non-erasable memory.

(Note) *When setting GPIB address, take care that the address allocated to external controller and the addresses of other connected machines can not be overlapped. The address specified here is that used when this instrument is controlled by using an external controller. When this instrument is controlled with built-in BASIC, the address is 31.*

12.2 Writing Method of Program

Till now, the program examples using BASIC language of this instrument have been explained. The programs written with BASIC language of this instrument can be executed in all series of R3764/66 and R3765/67.

However, the programs performed on external controller are different according to the computer, operation condition of combined interface board and the language with which the program is written. That is, the writing method of program (Style) varies with the environment of employed controller.

In this chapter, the following are shown as the main external controllers.

Table 12-2 Specialty of Main External Controller

Using language	Computer	GPIB Board
N88-Japanese BASIC	PC-9801	Pure board
HP-BASIC	HP-9000	(Built-in)
QuickBASIC	PC / AT	NI - 488.2
MicrosoftC	PC / AT	NI - 488.2

In this section , a simple program writing method for the programs performed with above-mentioned external controllers is explained. The outlines of creating programs is presented below.

Outline of program:

- (1) Initializes controller.
- (2) Sets the measurement condition of this instrument.
- (3) Searches measurement data with the built-in BASIC of this instrument (preparation).
- (4) Loads measurement data from the built-in BASIC of this instrument.

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12.2 Writing Method of Program

- (5) Displays the measurement data on the display of computer.
- (6) Ends the program.

12.2.1 Writing Method of Program in N88-BASIC

Turn PC-9801 into BASIC mode and input the following program.

Example 12-1 GPIB Control Program (N88-BASIC) on PC-9801

```
1000 ' *****
1010 ' *
1020 ' *          GPIB CONTROL PROGRAM          *
1030 ' *
1040 ' * TARGET:   PC-9801 (PURE)                *
1050 ' * LANGUAGE: N88-BASIC                      *
1060 ' * FILE:     N88STYLE.BAS                  *
1070 ' *****
1080 '
1090 ' (1) INITIALIZE
1100 '
1110 ISET IFC
1120 ISET REN
1130 NA = 11
1140 '
1150 ' (2) SETUP
1160 '
1170 PRINT @NA; "OLDC OFF "
1180 PRINT @NA; "FREQ:CENT 150MAHZ"
1190 PRINT @NA; "FREQ:SPAN 300MAHZ"
1200 '
1210 ' (3) SEARCH DATA BY BUILTIN
1220 '
1230 PRINT @NA; "@AP=POINT1 (1.5e+8,0)"
1240 PRINT @NA; "@FR=FREQ (AP,0)"
1250 PRINT @NA; "@LV=VALUE (AP,0)"
1260 PRINT @NA; "@PH=VALUE (AP,8)"
1270 '
1280 ' (4) GETTING DATA
```

```

1290 '
1300 PRINT @NA;"@OUTPUT 11;FR"
1310 INPUT @NA;F
1320 PRINT @NA;"@OUTPUT 11;LV"
1330 INPUT @NA;L
1340 PRINT @NA;"@OUTPUT 11;PH"
1350 INPUT @NA;P
1360 '
1370 ' (5) DISPLAY DATA
1380 '
1390 FR=F/10^6
1400 PRINT USING "FREQ = ####.### [MHz]";FR
1410 PRINT USING "LEVEL = ####.### [dB]";L
1420 PRINT USING "PHASE = ####.### [deg]";p
1430 '
1440 ' (7) ENDING
1450 '
1460 END

```

Then, input RUN, and press the return key to execute the program.

The result is as follows.

Execution result:

```

FREQ = 150.000 [MHz]
LEVEL = -3.855 [dB]
PHASE = 148.070 [deg]

```

When using GPIB, it is necessary to output GPIB interface-clear and remote-enable signal first. In N88-BASIC, ISET IFC command and ISET REN command are used.

- ISET IFC

Send IFC (interface-clear). It is used to initialize GPIB interface.

When this instrument is controlled from external controller with GPIB, it is must be specified.

- ISET REN

After REN (remote-enable) is sent, turn this instrument into the remote state.

When this instrument is in remote state, the [• REMOTE] LED on the front panel of the instrument is switched on.

When this instrument is not in remote state (in local start), the execution is not performed even although the GPIB command is sent. Therefore, make sure to turn the instrument to the remote state.

When using N88-BASIC, the PRINT @ command is used to send GPIB command to this instrument and the INPUT @ command is used to receive. These commands are corresponding to the OUTPUT and INPUT commands of built - in BASIC in this instrument. The GPIB address

12.2 Writing Method of Program

of the instrument is specified after @ (at - mark).
 In example 12 - 1" , the address is 11.

When command is sent to the built-in BASIC, @ is added at the beginning of BASIC command. The command proceeded by @ is processed with GPIB command which is used to set measurement condition and with other paths. In Example 12 - 1, the measurement data is obtained by using the built-in BASIC. (For detail, refer to " 12.2.3 Transferring Built-in BASIC Command added '@'.")

12.2.2 Writing Method of Program in HP-BASIC

When this instrument is controlled with HP-9000, the program becomes as follows.

Example 12-2 GPIB Control Program (HP-BASIC) on HP-9000

```

1000 ! *****
1010 ! *
1020 ! *          GPIB CONTROL PROGRAM          *
1030 ! *
1040 ! * TARGET:   HP-9000 (PURE)
1050 ! * LANGUAGE: HP-BASIC
1060 ! * FILE:     HPSTYLE. BAS
1070 ! *****
1080 !
1090 ! (1) INITIALIZE
1100 !
1110 ASSIGN @Na TO 711
1120 !
1130 ! (2) SETUP
1140 !
1150 OUTPUT @Na; "OLDC OFF"
1160 OUTPUT @Na; "FREQ:CENT 150MAHZ"
1170 OUTPUT @Na; "FREQ:SPAN 300MAHZ"
1180 !
1190 ! (3) SEARCH DATA BY BUILTIN
1200 !
1210 OUTPUT @Na; "@AP=POINT1(1.5e+8,0)"
1220 OUTPUT @Na; "@FR=FREQ(AP,0)"
1230 OUTPUT @Na; "@LV=VALUE(AP,0)"
1240 OUTPUT @Na; "@PH=VALUE(AP,8)"
    
```

```
1250  !
1260  ! (4) GETTING DATA
1270  !
1280  OUTPUT @Na;"@OUTPUT 11;FR"
1290  ENTER  @Na;F
1300  OUTPUT @Na;"@OUTPUT 11;LV"
1310  ENTER  @Na;L
1320  OUTPUT @Na;"@OUTPUT 11;PH"
1330  ENTER  @Na;P
1340  !
1350  ! (5) DISPLAY DATA
1360  !
1370  Fr=F/10^6
1380  PRINT "FREQ [MHz] = ";
1390  PRINT USING "DDDD.DDD";Fr
1400  PRINT "LEVEL [dB] = ";
1410  PRINT USING "DDDD.DDD";L
1420  PRINT "PHASE [deg] = ";
1430  PRINT USING "DDDD.DDD";P
1440  !
1450  ! (7) ENDING
1460  !
1470  END
```

To specify the address with HP-BASIC, it is necessary to define I/O path with ASSING command at the start. In this program, @Na of I/O path name is created with line 1110 ASSING @Na TO 711 and it is allocated to this instrument of address11.

The created I/O path name is used when the command is sent to this instrument or when data is received. The command sending is performed with OUTPUT command, while the data receiving is performed with ENTER command. However, the I/O path name must be written after the command.

12.2 Writing Method of Program

12.2.3 Writing Method of Program in QuickBASIC

The example of program that used QuickBASIC is shown as follows.

(Note) In this program, NI - 488.2 for PC/AT is used as GPIB interface board.

* NI - 488.2 : Register mark of National Instrument

Example 12-3 GPIB control Program (QuickBASIC) on PC/AT

```

' *****
' *
' *          GPIB CONTROL PROGRAM          *
' *
' * TARGET:   PC/AT(NI-488.2)             *
' * LANGUAGE: QuickBASIC                  *
' * FILE:     QBSTYLE.BAS                 *
' *****

REM $INCLUDE: 'qbdecl.bas'

DECLARE SUB naout (na%, msg$)
DECLARE SUB nainp (na%, dat$)
DECLARE SUB naerr (msg$)
DECLARE SUB gpiberr (msg$)

' (1) INITIALIZE
'
BDNAME$ = "GPIBO"
dvname$ = "DEV11"

CALL IBFIND(BDNAME$, brd0%)
IF (brd0% < 0) THEN CALL gpiberr("ibfind1 error")

CALL IBSIC(brd0%)
IF (IBSTA% AND EERR) THEN CALL gpiberr("ibsic error")
CALL IBSRE(brd0%, 1)
IF (IBSTA% AND EERR) THEN CALL gpiberr("ibsre error")

CALL IBFIND(dvname$, na%)

```

```
IF (na% < 0) THEN CALL gpiberr("ibfind2 error")
```

```
' (2) SETUP
```

```
,
```

```
CALL naout(na%, "OLDC OFF")
```

```
CALL naout(na%, "FREQ:CENT 150MAHZ")
```

```
CALL naout(na%, "FREQ:SPAN 300MAHZ")
```

```
' (3) SEARCH DATA BY BUILTIN
```

```
,
```

```
CALL naout(na%, "@AP=POINT1(1,5e+8,0)")
```

```
CALL naout(na%, "@LV=VALUE(AP,0)")
```

```
CALL naout(na%, "@FR=FREQ(AP,0)")
```

```
CALL naout(na%, "@LV=VALUE(AP,0)")
```

```
CALL naout(na%, "@PH=VALUE(AP,8)")
```

```
' (4) GETTING DATA
```

```
,
```

```
CALL naout(na%, "@OUTPUT 11;FR")
```

```
CALL nainp(na%, fdat$)
```

```
CALL naout(na%, "@OUTPUT 11;LV")
```

```
CALL nainp(na%, ldat$)
```

```
CALL naout(na%, "@OUTPUT 11;PH")
```

```
CALL nainp(na%, pdat$)
```

```
' (5) DISPLAY DATA
```

```
,
```

```
F = VAL(fdat$)
```

```
l = VAL(ldat$)
```

```
p = VAL(pdat$)
```

```
fr = F / 10^6
```

```
PRINT USING "FREQ = ####.### [MHz]"; fr
```

```
PRINT USING "LEVEL = ####.### [dB]"; l
```

```
PRINT USING "PHASE = ####.### [deg]"; p
```

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12.2 Writing Method of Program

```
' (7) ENDING
'

CALL IBONL(na%, 0)
CALL IBONL(brd0%, 0)
END

' This routine prints the result of status variables.
'

SUB gpiberr (msg$) STATIC
    PRINT msg$
    PRINT "ibsta=&H"; HEX$(IBSTA%); " <";
    IF IBSTA% AND EERR THEN PRINT " ERR";
    IF IBSTA% AND TIMO THEN PRINT " TIMO";
    IF IBSTA% AND EEND THEN PRINT " EEND";
    IF IBSTA% AND SRQI THEN PRINT " SRQI";
    IF IBSTA% AND RQS THEN PRINT " RQS";
    IF IBSTA% AND CMPL THEN PRINT " CMPL";
    IF IBSTA% AND LOK THEN PRINT " LOK";
    IF IBSTA% AND RREM THEN PRINT " RREM";
    IF IBSTA% AND CIC THEN PRINT " CIC";
    IF IBSTA% AND AATN THEN PRINT " AATN";
    IF IBSTA% AND TACS THEN PRINT " TACS";
    IF IBSTA% AND LACS THEN PRINT " LACS";
    IF IBSTA% AND DTAS THEN PRINT " DTAS";
    IF IBSTA% AND DCAS THEN PRINT " DCAS";
    PRINT ">"
    PRINT "iberr="; IBERR%;
    IF IBERR% = EDVR THEN PRINT " EDVR <DOS Error>"
    IF IBERR% = ECIC THEN PRINT " ECIC <Not CIC>"
    IF IBERR% = ENOL THEN PRINT " ENOL <No listner>"
    IF IBERR% = EADR THEN PRINT " EADR <Address error>"
    IF IBERR% = EARG THEN PRINT " EARG <Invalid argment>"
    IF IBERR% = ESAC THEN PRINT " ESAC <Not Sys Ctrlr>"
    IF IBERR% = EABO THEN PRINT " EABO <Op. aborted>"
    IF IBERR% = ENEB THEN PRINT " ENEB <No GPIB board>"
```



```

IF IBERR% = EOIP THEN PRINT " EOIP <Async I/O in prg>"
IF IBERR% = ECAP THEN PRINT " ECAP <No capability>"
IF IBERR% = EFSO THEN PRINT " EFSO <Fils sys. error>"
IF IBERR% = EBUS THEN PRINT " EBUS <Command error>"
IF IBERR% = ESTB THEN PRINT " ESTB <Status byte lost>"
IF IBERR% = ESRQ THEN PRINT " ESRQ <SRQ stuck on>"
IF IBERR% = ETAB THEN PRINT " ETAB <Table Overflow>"
PRINT "ibcnt="; IBCNT%
CALL IBONL(na%, 0)
CALL IBONL(brd0%, 0)
STOP
END SUB

' This routine would notify you that the na returned an invalid
  serial poll

' response byte.
'
SUB naerr (msg$) STATIC
  PRINT msg$
  PRINT "Status Byte = "; SPR%
  CALL IBONL(na%, 0)
  CALL IBONL(brd0%, 0)
  STOP
END SUB

' This routine nainps the data from device
'
SUB nainp (na%, dat$) STATIC
  RD$ = SPACE$(27)

  CALL IBRD(na%, RD$)
  IF (IBSTA% AND EERR) THEN CALL gpiberr("ibrd error")
  dat$ = LEFT$(RD$, IBCNT%)
END SUB

```

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12.2 Writing Method of Program

```
' This routine naouts the command to device
'  
SUB naout (dsc%, msg$) STATIC  
CALL ibwrt(dsc%, msg$)  
emsg$ = "ibwrt error:" + msg$  
IF (IBSTA% AND EERR) THEN CALL gpiberr(emsg$)  
END SUB
```

In N-488.2, various tools necessary for program development except for the interface board are included. When NI-488.2 system is purchased, install it to the computer after reading the manual carefully.

The functions and variables leaded by character *ib* are the library functions and variables provided by NI-488.2 system. In this program, library functions of IEEE488.1 level are used.

The NI-488.2 library and files used here are described below.

library and files of NI-488.2:

- **qbdecl.bas**
A function declaration file of QUICKBASIC program.
When NI-488.2 is installed, QBASIC directory is created, and then copied with the sample program that is following the directory together.
Copy this file to one's own operation disk.
- **ibfind**
Search the GPIB interface board and GPIB device that is connected with the board, and assign the intrinsic values to them. The value obtained with *ibfind* is used as argument in NI-488.2 library.
In Example 12-3, assigns to board (*o*) *brdo%* and this instrument to *na%* (address 11).
There are two systems of library functions: functions operated with board level and functions operated with device specification.
- **ibsic**
Show IFC (Interface-clear) message. This operation is performed corresponding to GPIB board.
When *ibsic* is executed, performs the initial setting for GPIB interface board is performed, and the board is turned to the CIC (controller-in-charge) state.
- **ibstre**
Control REN (remote - enable) signal. This operation is performed corresponding to GPIB board.
When *ibstre* (*brd\$0, 1*) is executed, this instrument is specified to listen address, and turned to the remote state at the same time.
- **ibwrt**
Send GPIB message to the specified device.
In Example 12 - 3, it is called out to send the GPIB command to this instrument in output sub-procedure.

- **ibrd**
Receive GPIB message from specified device.
In Example 12 - 3 , it is called out to receive the data from this instrument in input sub - procedure.
- **ibonl**
Release assigned device with ibfind.
Be sure to call it when the program is ended.
- **ibsta%, iberr%, ibcnt%**
These are status variables set with library functions.
These variables and the value set to the variables are defined with qbdecl. bas file.
Immediately after the library function is called, the status must be called out to check whether the operation is normal.

Since the GPIB operation command is incorporated into the BASIC language in N88-BASIC and HP-BASIC, the GPIB command is described as the same as usual statement.

Besides, when an error occurs, it can be caught with the BASIC language system, Therefore, it is not necessary to program a special error processing.

However, it is a different case in QuickBASIC. Since the GPIB command is not incorporated into the language, the library functions except for the linked are called up by the use of CALL statement.

Therefore, the occurred error can not be caught with GPIB operation in QuicdBASIC.

That is, whenever the library function is called, the status variable must be checked. If this checking is performed soon after all the functions have been called, the program line will become longer, so that it can not be read easily. There is little problem for those library functions that are not called frequently, but it is not desirable for those called frequently.

In Example 12 - 3 , the dedicated sub-procedures used for calling ibewrt and ibrd are described. They are known as output and input. When the command is sent to this instrument, output is called, and when data is received, input is called only. These sub-procedures are used to call out the library, and then perform the necessary error processing in practice.

However, the error processing is performed practically with sub-procedures gpiberr and baerr. When the error processing is described with sub-procedures, the total program becomes easy to read.

To execute the program of Example 12 - 3 on MS-DOS, the execution file is created in the following sequence.

Sequence of creating execution file:

- ① Inputs the following command.

```
LIB QBIB.LIB + QBIB.OBJ;
```

Create library QBIB. LIB from object file QBIB. OBJ used for QuickBASIC provided in NI-488. 2 system.

LIB command of MS-DOS is used for creating library.

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12.2 Writing Method of Program

- ② Input the following command.

```
BC qbstyle.bas;
```

Compile program file qbstyle. bas with BC command of QuickBASIC.
The result can be an object file QBSTYLE. OBJ.

- ③ Input the following command.

```
LINK QBSTYLE.OBJ,,,QBIB.LIB;
```

Link QBSTYLE. OBJ and QBIB. LIB with LINK command of MS-DOS.
The execution file QBSTYLE. EXE is created with the above operation.

- ④ Input QBSTYLE and press **Enter**, then it can be executed.

12.2.4 Writing Method of Program in C

The example of program using ANSI-C is shown as follows.

(Note) In this program, NI - 488. 2 for PC/AT is used as GPIB interface board.

Example 12-4 GPIB control Program (ANSI-C) on PC/AT

```
/*
 *          GPIB CONTROL PROGRAM
 *
 * TARGET:   PC/AT(NI-488.2)
 * LANGUAGE: C (ANSI-C STYLE)
 * FILE:     CSTYLE. C
 */

#include <stdio.h>
#include <stdlib.h>
#include <setjmp.h>
#include <errno.h>
#include "decl.h"

#define DATSIZ 27

jmp_buf jmpbuf;

void gpiberr(char *msg)
{
```

```
printf("%s\n", msg);
printf("ibsta=&H%x < ", ibsta );
if (ibsta & ERR) printf("ERR");
if (ibsta & TIMO) printf("TIMO");
if (ibsta & SRQI) printf("SRQI");
if (ibsta & RQS) printf("RQS");
if (ibsta & CMPL) printf("CMPL");
if (ibsta & LOK) printf("LOK");
if (ibsta & CIC) printf("CIC");
if (ibsta & TACS) printf("TACS");
if (ibsta & LACS) printf("LACS");
if (ibsta & DTAS) printf("DTAS");
if (ibsta & DCAS) printf("DCAS");
printf(" >\n");

printf("iberr= %d ", iberr);
switch (iberr)
{
case EDVR: printf("EDVR <DOS Error>"); break;
case ECIC: printf("ECIC <Not CIC>"); break;
case ENOL: printf("ENOL <No listner>"); break;
case EADR: printf("EADR <Address error>"); break;
case EARG: printf("EARG <Invalid argment>"); break;
case ESAC: printf("ESAC <Not Sys Ctrlr>"); break;
case EABO: printf("EABO <Op. aborted>"); break;
case ENEB: printf("ENEB <No GPIB board>"); break;
case EOIP: printf("EOIP <Async I/O in prg>"); break;
case ECAP: printf("ECAP <No capability>"); break;
case EFSO: printf("EFSO <Fils sys. error>"); break;
case EBUS: printf("EBUS <Command error>"); break;
case ESTB: printf("ESTB <Status byte lost>"); break;
case ESRQ: printf("ESRQ <SRQ stuck on>"); break;
case ETAB: printf("ETAB <Table Overflow>"); break;
}
printf("ibcntl= %d\n\n", ibcntl);
longjmp(jmpbuf, EIO);
```

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12.2 Writing Method of Program

```
    }

void outstr(int dsc, char *cmd)
{
    ibwrt(dsc, cmd, strlen(cmd));
    if (ibsta & ERR) gpiberr("ibwrt error");
}

void inpstr(int dsc, char *cmd, char *buf, unsigned bufsiz)
{
    if (cmd && *cmd)
    {
        ibwrt(dsc, cmd, strlen(cmd));
        if (ibsta & ERR) gpiberr("ibwrt error");
    }
    ibrd(dsc, buf, bufsiz);
    if (ibsta & ERR) gpiberr("ibrd error");
    buf[ibcnt] = '\0';
}

main(int argc, char **argv)
{
    char  sf[DATSIZ+1];
    char  sl[DATSIZ+1];
    char  sp[DATSIZ+1];
    int   bd = - 1;
    int   na = - 1;
    int   err;

    if (err = setjmp(jmpbuf))
    {
        if (na >= 0) ibonl(na,0);
        if (bd >= 0) ibonl(bd,0);
    }
}
```

```
        exit (1);
    }

    /*      (1) INITIALIZE
    */
    if ((bd = ibfind("GPIBO")) < 0) bpiberr("ibfind error");
    if ((na = ibfind("DEV11")) < 0) gpiberr("ibfind error");
    if (ibsic(bd) & ERR) gpiberr("ibsic error");
    if (ib sre(bd, 1) & ERR) gpiberr("ib sre error");

    /*      (2) SETUP
    */
    outstr(na, "OLDC OFF");
    outstr(na, "FREQ:CENT 150MAHZ");
    outstr(na, "FREQ:SPAN 300MAHZ");

    /*      (3) SEARCH DATA BY BUILTIN
    */
    outstr(na, "@AP=POINT1(1.5e+8,0)");
    outstr(na, "@LV=VALUE(AP, 0)");
    outstr(na, "@FREQ(AP, )");
    outstr(na, "@LV=VALUE(AP,0)");
    outstr(na, "@PH=VALUE(AP,8)");

    /*      (4) GETTING DATA
    */
    inpstr(na, "@OUTPUT 11;FR", sf, DATSIZ);
    inpstr(na, "@OUTPUT 11;LV", sl, DATSIZ);
    inpstr(na, "@OUTPUT 11;PH", sp, DATSIZ);

    /*      (5) DISPLAY DATA
    */
    printf(" FREQ = %4.4f MHz\n", atof(sf)/1.0e6);
    printf(" LEVEL = %4.4f Db\n", atof(sl));
    printf(" PHASE = %4.4f deg\n", atof(sp));
```

12.3 Remote Control with External Controller

```
/*      (6) ENDING
*/
ibon1 (na, 0);
ibon1 (bd, 0);
}
```

A library used for C programming is prepared in NI-488. 2 package and used in this program. The library functions in this program is the same as that of Example 12 - 3 written above.

When this program is compiled with Microsoft, it is performed in the following sequence.

Compile sequence:

- ① Copy DECL. H and MCIB. OBJ from C package of NI-488. 2 to one's own operation disk.
- ② Compile the program of Example 12 - 4 .
Input the following command.

```
CL MCSTYLE.C MCIB.OBJ
```

The execution file MCSTYLE. EXE is created with the above operations.

- ③ Input MCSTYLE and press **Enter**, then the execution can be performed.

12.3 Remote Control with External Controller

In order to control this instrument remotely from external controller, GPIB commands used to exchange the functions to commands are employed.

The built-in functions performing wave form data analysis, etc. can not be executed by usual GPIB commands. In this case, it is carried out through sending the commands that is obtained by adding the at - mark (@) to the built-in BASIC. When @ is added and sent at the start of transferring command, it is sent to the built-in BASIC and processed.

12.3.1 Transferring Usual GPIB Command

The following programs turn the measurement format of this instrument to the LOGMAG.

Example 12-5 Transferring GPIB Command in N88-BASIC

```
1000 ISET IFC
1010 ISET REN
1020 NA=11
1030 PRINT @NA; "OLDC OFF"
1040 PRINT @NA; "CALC:FORM MLOG"
1050 END
```


Example 12-6 Transferring GPIB Command in HP-BASIC

```
1000 ASSIGN @Na TO 711
1010 OUTPUT @Na;"OLDC OFF"
1020 OUTPUT @Na;"CALC:FORM MLOG"
1030 END
```

Example 12-7 Transferring GPIB Command in QuickBASIC

```
REM $INCLUDE: 'qbdecl.bas'

CALL ibfind("GPIB0",bd%)
CALL ibfind("DEV11",na%)
CALL ibsic(bd%)
CALL ibsre(bd%, 1)
CALL ibwrt(na%, "OLDC OFF")
CALL ibwrt(na%, "CALC:FORM MLOG")
CALL ibonl(na%, 0)
CALL ibonl(bd%, 0)
END
```

Example 12-8 Transferring GPIB Command in C

```
#include <stdio.h>
#include <stdlib.h>
#include "decl.h"

main(int argc, char **argv)
{
    int    bd, na;
    bd = ibfind("GPIB0");
    na = ibfind("DEV11");
    ibsic(bd)
    ibsre(bd, 1);
    ibwrt(na, "OLDC OFF", 8);
    ibwrt(na, "CALC:FORM MLOG", 13);
    ibonl(na, 0);
    ibonl(bd, 0);
}
```

12.3 Remote Control with External Controller

12.3.2 Transferring Built-in BASIC Commands Added by “@”

The commands to which the at mark (@) is added are used when the wave form analysis function, etc. are performed. A part of processing is executed with built-in BASIC, so that the load of external controller can be reduced.

The programs shown below are used to evaluate the maximum value of measurement data using the commands added by @, then receive the analysis data.

Example 12-9 Transferring BASIC Command in N88-BASIC

```

1000 ISET IFC
1010 ISET REN
1020 NA=11
1030 PRINT @NA; "OLDC OFF"
1040 PRINT @NA; "@V=MAX(0,1200,0)"
1050 PRINT @NA; "@OUTPUT 11;V"
1060 INPUT @NA;V
1070 PRINT V
1080 END
    
```

Example 12-10 Transferring BASIC Command in HP-BASIC

```

1000 ASSIGN @Na TO 711
1010 OUTPUT @Na; "OLDC OFF"
1020 OUTPUT @Na; "@V=MAX(0,1200,0)"
1030 OUTPUT @Na; "@OUTPUT 11;V"
1040 ENTER @Na;V
1050 PRINT V
1060 END
    
```

Example 12-11 Transferring BASIC Command in QuickBASIC

```

REM $INCLUDE: 'qbdecl.bas'

CALL ibfind("GPIBO",bd%)
CALL ibfind("DEV11",na%)
CALL ibsic(bd%)
CALL ibsre(bd%,1)
CALL ibwrt(na%, "OLDC OFF")
CALL ibwrt(na%, "@V=MAX(0,1200,0)")
CALL ibwrt(na%, "@OUTPUT 11;V")
dat$=SPACE$(27)
    
```

```
CALL ibrd(na%,dat$)
dat$=LEFT$(dat$,ibcnt%)
PRINT dat$
CALL ibonl(na%,0)
CALL ibonl(bd%,0)
END
```

Example 12-12 Transferring BASIC Command in C

```
#include <stdio.h>
#include <stdlib.h>
#include "decl.h"

main(int argc, char ** argv)
{
    char  dat[28];
    int   bd, na ;

    bd = ibfind("GPIBO");
    na = ibfind("DEV11");
    ibsic(bd);
    ibsre(bd, 1);
    ibwrt(na, "OLDC OFF", 8);
    ibwrt(na, "@V=MAX(0,1200,0)", 16);
    ibwrt(na, "@OUTPUT 11;V", 12);
    ibrd(na, dat, 27);
    dat[ibcnt] = '\0';
    printf(dat);
    ibonl(na, 0);
    ibonl(bd, 0);
}
```

12.4 Detecting Scan End

12.4 Detecting Scan End

In this section, a method of detecting scan end with the external controller is explained.

First, the trigger mode of this instrument is switched to INIT : CONT OFF.

When INIT command is sent in this state, only one scan is executed.

Next, the scan end is detected from the bit state of status register (A register used to report the current state of the machine.)

When the scan is ended, one of the status register known as Sweeping of Standard Operation Event Status Register is set to 1.

Since the bit of Standard Operation Event Enable Register corresponding to this status bit is set to 1, a service request can be generated when the scan is ended. (Refer to "4 Status byte" of R3764/66, R3765/67 Programming Manual.)

12.4.1 Detecting Scan End with N88-BASIC

The following program is used to detect the scan end during the measurement by interrupting processing with the N88-BASIC of PC-9801.

When the bit fills up the status register, a service request can be generated. In the following program, since the Standard Operation Event Enable Register and SRE are enabled, SRQ is generated when the scan is ended.

If the interrupt processing is declared in the program, when SRQ occurs, the processing performed till that time will be interrupted, and perform the processing specified with interrupting. In this program, when SRQ occurs, the infinite loop interrupts and the performance jumps to level * MEAS.END.

Example 12-13 Detecting Scan End with N88-BASIC

```

1000 ISET IFC
1010 ISET REN
1020 NA=11
1030 POLL NA, P
1040 ON SRQ GOSUB *MEAS.END
1050 '
1060 *MEAS.SETUP
1070     PRINT @NA; "OLDC OFF"
1080     PRINT @NA; "INIT:CONT OFF"
1090     PRINT @NA; "*CLS; *SRE 128; :STAT:OPER:ENAB 8"
1100     PRINT @NA; "INIT"
1110     SRQ ON
1120 '
1130 *MEAS.WAIT
1140     GOTO *MEAS.WAIT
1150 '
1160 *MEAS.END
    
```

```

1170     POLL NA,P
1180     P = P AND 128
1190     IF P<>128 THEN RETURN
1200     PRINT "SWEEP END"
1210     END

```

12.4.2 Detecting Scan End with HP-BASIC

The following program is used to detect the scan end during the measurement by interrupting the processing with the HP-BASIC of HP-9000 series.

It defines the branch destination (Measend) of interrupting with ON INTR command, and enables the interrupting to be performed with ENABLE INTR.

Example 12-14 Detecting Scan End with HP-BASIC

```

1000 ASSIGN @Na TO 711
1010 !
1020 OUTPUT @Na;"OLDC OFF"
1030 OUTPUT @Na;":INIT:CONT OFF"
1040 Stat=SPOLL(@Na)
1050 OUTPUT @Na;"*CLS;*SRE 128;:STAT:OPER:ENAB 8"
1060 OUTPUT @Na;"INIT"
1070 ON INTR 7 GOTO Measend
1080 ENABLE INTR 7;255
1090 Measwait:!
1100     GOTO Measwait
1110 !
1120 Measend:!
1130     PRINT "SWEEP END"
1140 END

```

12.4.3 Detecting Scan End with QuickBASIC

The following program is used to detect the scan end during measurement using NI-488.2 library functions with QuickBASIC on PC/AT.

The spoll is a sub-procedure used to detect service request.

That waits until the series requests are generated with the library function ibwait of NI-488.2 and reads in the status byte with the library function ibrsp of NI-488.2.

When error occurred some where, sub-procedure gpiberr is called out.

The gpiberr is called when error occurred to execute STOP command after displaying the error message.

For the using method of library functions, refer to manual of NI-488.2.

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12.4 Detecting Scan End

Example 12-15 Detecting Scan End with QuickBASIC

```
REM $INCLUDE: 'qbdecl.bas'

DECLARE SUB spoll (dsc%, spr%)
DECLARE SUB gpiberr (msg$)

CALL ibfind("GPIBO", bd%)
CALL ibfrind("DEV11", na%)
CALL ibsic(bd%)
CALL ibsre(bd%, 1)
CALL ibwrt(na%, "OLDC OFF")
CALL ibwrt(na%, ":INIT:CONT OFF")
CALL ibrsp(na%, spr%)
CALL ibwrt(na%, "*CLS;*SRE 128;:STAT:OPER:ENAB 8")
CALL ibwrt(na%, "SWE:TIME 0")
CALL ibwrt(na%, "INIT")
CALL spoll(na%, spr%)
PRINT "SWEEP END"
CALL ibonl(na%, 0)
CALL ibonl(bd%, 0)
END

' Error Handler
'
SUB gpiberr (msg$) STATIC
    PRINT msg$
    PRINT "ibsta=&H"; HEX$(ibsta%)
    CALL ibonl(na%, 0)
    CALL ibonl(bd%, 0)
    STOP
END SUB

' SRQ Handler
'
SUB spoll (na%, spr%) STATIC
    spr% = 0
```

```

mask% = &H800
CALL ibwait(na%, mask%)
IF (ibsta% AND EERR) THEN CALL gpiberr("ibwait error")
CALL ibrsp(na%, spr%)
IF (ibsta% AND EERR) THEN CALL gpiberr ("ibsta error")
IF (spr%<>&HCO) THEN CALL gpiberr("R3764/66,R3765/67 SRQ
                                error")

END SUB

```

12.4.4 Detecting Scan End with C

The following program is used to detect the scan end during measurement using NI-488.2 library functions with Microsoft C on PC/AT.

The same as described in previous section, it detects the service request with spoll and returns 0 when succeeded.

For the using method of library functions, refer to manual of NI-488.2.

Example 12-16 Detecting Scan End with Microsoft C

```

#include <stdio.h>
#include <stdlib.h>
#include "decl.h"

static int spoll(int dsc, char *spr)
{
    if (ibwait(dsc, TIMO|RQS) & (ERR|TIMO))
    {
        fprintf(stderr, "ibwait error: &H%x\n", ibsta);
        return -1;
    }
    if (ibrsp(dsc, spr) & ERR)
    {
        fprintf(stderr, "ibrps error: &H%x\n", ibsta);
        return -1;
    }
    if (*spr & 0xff) != 0x0C0)
    {
        fprintf(stderr, "R3764/66, R3765/67 error: &H%x\n", *spr);
        return -1;
    }
}

```

12.4 Detecting Scan End

```

    return 0;
}

main(int argc, char **argv)
{
    int    bd, na;
    int    err;
    char   spr;

    bd = ibfind("GPIBO");
    na = ibfind("DEV11");
    ibsic(bd);
    ibsre(bd, 1) ;
    ibwrt(na, "OLDC OFF", 8);
    ibwrt(na, ":INIT:CONF OFF", 14);
    ibrsp(na, &spr);
    ibwrt(na, "*CLS;*SRE 128;:STAT:OPER:ENAB 8", 31);
    ibwrt(na, "SWE:TIME 0", 10);
    ibwrt(na, "INIT", 4);
    if ((err = spoll(na, &spr)) == -1)
    {
        ibonl(na, 0);
        ibonl(bd, 0);
        exit(1);
    }
    printf("SWEEP END\n");
    ibonl(na, 0);
    ibonl(bd, 0);
}

```


12.5 Transferring Trace Data

The data transferring between an external controller and built-in BASIC can be performed in either way, with ASCII format or binary format.

In binary format, a format corresponding to the external controller can be selected from six types of format. (Refer to "7.7 Format Subsystem" of R3764/66, R3765/67 Programming Manual.)

In ASCII format, the data transferring can be performed with a simple operation.

The speed of transferring data in binary format is higher than in ASCII format. When the data transferring speed is not required specially, the ASCII format is applicable for its simple program. However, when a high speed of data transferring is required, the binary format is used.

This section describes the programs transferring data in two different format: ASCII and binary.

12.5.1 Transferring Trace Data from This Instrument to PC-9801

The following programs are used to assign the trace data of this instrument to the array TR of N88-BASIC.

The data transferring with ASCII format is shown in Example 12 - 17 and the that with binary format is shown in Example 12-18.

In N88-BASIC, there is no GPIB command used for transferring block data. Therefore, in this program, the data receiving part is described with machine language, and the BIOS routine is called up directly.

In addition, Microsoft single-precision floating binary is used in this library format.

Example 12-17 Data Input of PC-9801 (ASCII format)

```

1000 ' *****
1010 ' *
1020 ' *          INPUT TRACE DATA FROM NA          *
1030 ' *          (ASCII FORMAT)                    *
1040 ' *
1050 ' * TARGET:   PC-9801 (PURE)                    *
1060 ' * LANGUAGE: N88-BASIC                          *
1070 ' * FILE:     N88TINPA.BAS                       *
1080 ' *****
1090 '
1100 DIM TR$( 1201, 2 )
1110 '
1120 ISET IFC
1130 ISET REN
1140 'NA=11
1150 '
1160 *TINP.EXEC
1170     PC98=IEEE(1) AND &H1F
1180     CMD DELIM=3
    
```

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12.5 Transferring Trace Data

```
1190     PRINT @NA; "OLDC OFF" @
1200     PRINT @NA; "FORM:DATA ASC" @
1210     FOR N=1 TO 2
1220         PRINT @NA; "TRAC? FDAT"+CHR$(48+N) @
1230         WBYTE &H3F,&H5F,&H40+NA,&H20+PC98;
1240         GOSUB *TINP.RECEIVE
1250         WBYTE &H3F,&H5F,&H40+PC98,&H20,NA;
1260     NEXT
1270     GOSUB *TINP.PRINT
1280     WBYTE &H3F,&H5F;
1290     END
1300 '
1310 *TINP.PRINT
1320     PRINT @NA; "SWE:POIN?" @
1330     INPUT @NA;PTS
1340     FOR I=0 TO PTS-1
1350         PRINT 1,TR$(I,1),TR$(I,2)
1360     NEXT
1370     RETURN
1380 '
1390 *TINP.RECEIVE
1400     I%=0
1410     A$=" "
1420     *RECEIVE.NEXT
1430         RBYTE ; D%
1440         S%=IEEE(2) AND &H8
1450         IF D%=44 THEN *RECEIVE.SEPARATE
1460         A$=A$+CHR$(D%)
1470         IF S%<>0 THEN *RECEIVE.SEPARATE
1480         GOTO *RECEIVE.NEXT
1490     *RECEIVE.SEPARTE
1500         TR$(I%,N)=LEFT$(A$,22)
1510         I%=I%+1
1520         A$=" "
1530         LOCATE 0,24:PRINT I%;
1540         IF S%=0 THEN *RECEIVE.NEXT
```

```
1550         PRINT
1560     RETURN
```

Example 12-18 Data Input of PC - 9802 (Binary format)

```
1000 ' *****
1010 ' * *
1020 ' * INPUT TRACE DATA FROM NA *
1030 ' * (BINARY FORMAT) *
1040 ' * *
1050 ' * TARGET: PC-9801(PURE) *
1060 ' * LANGUAGE: N88-BASIC *
1070 ' * FILE: N88TINPB.BAS *
1080 ' *****
1090 '
1100 CLEAR &H100:DEF SEG=SEGPTR(2)
1110 DIM TR1!(1202),TR2!(1202)
1120 GOSUB *SETGPIB.RECEIVE
1130 '
1140 ISET IFC
1150 ISET REN
1160 NA=11
1170 '
1180 *TINP.EXEC
1190 PC98=IEEE 1) AND &H1F
1200 CMD DELIM=3
1210 PRINT @NA;"OLDC OFF" @
1220 PRINT @NA;"FORM:DATA MBIN,32" @
1230 FOR N=1 TO 2
1240 PRINT @NA;"TRAC:DATA? FDAT"+CHR$(48+N) @
1250 WBYTE &H3F,&H5F,&H40+NA,&H20+PC98;
1260 NUM%=4816
1270 IF N=1 THEN CALL RECEIVE.DATA(TR1!(0),NUM%)
1280 IF N=2 THEN CALL RECEIVE.DATA(TR2!(0),NUM%)
1290 WBYTE &H3F,&H5F,&H40+PC98,&H20+NA;
1300 NEXT
1310 GOSUB *TINP.PRINT
```

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12.5 Transferring Trace Data

```
1320     WBYTE *H3F,&H5F;
1330     END
1340 '
1350 *TINP.PRINT
1360     PRINT @NA;"SWE:POIN?" @
1370     INPUT @NA;PTS
1380     FOR I=1 TO PTS
1390         PRINT I,TR1!(I+1),TR2!(I+1)
1400     NEXT
1410     RETURN
1420 '
1430 ' Call GPIB BIOS of RECEIVE DATA
1440 ' SYNTAX: CALL RECEIVE.DATA(VAR,SIZE%)
1450 '
1460 *SETGPIB.RECEIVE
1470     RECEIVE.DATA = &HO
1480     RESTORE *GPIB.BIOS.RECEIVE
1490     FOR ADR = 0 TO &H38
1500         READ BYTE: POKE ADR,BYTE
1510     NEXT
1520     RETURN
1530 '
1540 *GPIB.BIOS.RECEIVE
1550     DATA &H50           : 'PUSH  AX
1560     DATA &H51           : 'PUSH  CX
1570     DATA &H52           : 'PUSH  DX
1580     DATA &H06           : 'PUSH  ES
1590     DATA &H56           : 'PUSH  SI
1600     DATA &H57           : 'PUSH  DI
1610     DATA &H55           : 'PUSH  BP
1620     DATA &H53           : 'PUSH  BX
1630     DATA &H8B,&H4F,&H02 : 'MOV   CX,2[BX]
1640     DATA &H8E,&HC1       : 'MOV   ES,CX
1650     DATA &H8B,&H37       : 'MOV   SI,[BX]
1660     DATA &H26,&H8B,&H0C : 'MOV   CX,ES:[SI] ; DATA LENGTH
1670     DATA &H8B,&H7F,&H04 : 'MOV   DI,4[BX]; ; DATA OFFSET
```

```

1680    DATA &H8E,&H47,&H06    : 'MOV    ES,6[BX]    ; SEGMENT BASE
1690    DATA &HBB,&H00,&H00    : 'MOV    BX,00H      ; COMMAND LENGTH
1700    DATA &HBE,&H00,&H00    : 'MOV    SI,00H      ; COMMAND OFFSET
1710    DATA &HB0,&H80          : 'MOV    AL,80H      ; EOI ONLY
1720    DATA &HB4,&H05          : 'MOV    AH,05H      ; RECEIVE DATA
1730    DATA &HCD,&HD1          : 'INT    0DIH        ; CALL GPIB BIOS
1740    DATA &H5B              : 'POP    BX
1750    DATA &H53              : 'PUSH   BX
1760    DATA &H8B,&H4F,&H02    : 'MOV    CX,2[BX]
1770    DATA &H8E,&HC1          : 'MOV    ES,CX
1780    DATA &H8B,&H37          : 'MOV    SI,[BX]
1790    DATA &H26,&H89,&H14    : 'MOV    ES:[SI],DX
1800    DATA &H5B              : 'POP    BX
1810    DATA &H5D              : 'POP    BP
1820    DATA &H5F              : 'POP    DI
1830    DATA &H5E              : 'POP    SI
1840    DATA &H07              : 'POP    ES
1850    DATA &H5A              : 'POP    DX
1860    DATA &H59              : 'POP    CX
1870    DATA &H58              : 'POP    AX
1880    DATA &HCF              : 'IRET
1890    ' TOTAL 39H byte

```

When binary format is used, the first 8 bytes becomes the header. Here, the data including header are loaded in array TR.

TR is a single-precision floating array, the data count per point is two, and the byte count per point is 8 bytes. Thus, in this program, the original trace data is stored from the place where the subscript of array TR is 2.

12.5.2 Transferring trace Data from PC - 9801 to This Instrument

The following programs are used to transfer the array data from the program of N88 - BASIC program to this instrument.

(Caution) *This program can not be used originally.*

When using the program in practice, first get the data with the trace data input program presented above and store it in a file, etc. then run the program from reading the data into the array TR.

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12.5 Transferring Trace Data

Example 12-19 Data Output of PC-9801 (ASCII format)

```
1000 ' *****
1010 ' *
1020 ' *          OUTPUT TRACE DATA TO NA          *
1030 ' *          (ASCII FORMAT)                    *
1040 ' *
1050 ' * TARGET:   PC-9801(PURE)                    *
1060 ' * LANGUAGE: N88-BASIC                          *
1070 ' * FILE:     N88TOUTA.BAS                      *
1080 ' *****
1090 '
1100 DIM TR$(1201,2)

1120 '
5000 '
5010 ISET IFC
5020 ISET REN
5030 NA=11
5040 '
5050 *TOUT.EXEC
5060     PC98=IEEE(1) AND &H1F
5070     CMD DELIM=3
5080     PRINT @NA;"OLDC OFF" @
5090     PRINT @NA;"FORM:DATA ASC" @
5100     FOR N=1 TO 2
5110         PRINT @NA;"TRAC:DATA FDAT"+CHR$(48)+", " @
5120         WBYTE &H3F,&H5F,&H40+PC98,&H20+NA;
5130         GOSUB *TOUT.SEND
5140     NEXT
5150     WBYTE &H3F,&H5F;
5160     END
5170 '
5180 *TOUT.SEND
5190     I%=0
5200     *SEND. NEXT
5210         IF TR$(I%+1,N)=" " GOTO *SEND.LAST
```

```

5220      PRINT @;TR$(I%,N)+CHR$(44)
5230      LOCATE 0,23:PRINT I%,TR$(I%,N);
5240      I%=I%+1
5250      GOTO *SEND.NEXT
5260      *SEND.LAST
5270      PRINT @;TR$(I%,N) @
5280      LOCATE 0,23:PRINT I%,TR$(I%,N)
5290      RETURN
    
```

Example 12-20 Data Output of PC-9801 (Binary format)

```

1010 ' *****
1020 ' *          OUTPUT TRACE DATA TO NA          *
1030 ' *          (BINARY FORMAT)                  *
1040 ' *                                                                 *
1050 ' * TARGET:   PC-9801(PURE)                   *
1060 ' * LANGUAGE: N88-BASIC                        *
1070 ' * FILE:    N88TOUTB. BAS                     *
1080 ' *****
1090 '
1100 CLEAR &H100:DEF SEG=SEGPTR(2)
1110 DIM TR1!(1202),TR2!(1202)
1120 GOSUB *SETGPIB.SEND
1130 '
1140 ISET IFC
1150 ISET REN
1160 NA=11
1170 '
1180 *TOUT.EXEC
1190      PC98=IEEE(1) AND &H1F
1200      CMD DELIM=3
1210      PRINT @NA;"OLDC OFF" @
1220      PRINT @NA;"FORM:DATA MBIN,32" @
1230      NUM%=4816
1240      FOR N=1 TO 2
1250          PRINT @NA;"TRAC:DATA FDAT"+CHR$(48)+" , "
1260          WBYTE &H3F,&H5F,&H40+PC98,&H20+NA;
    
```

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12.5 Transferring Trace Data

```
1270         IF N=1 THEN CALL SEND.DATA(TR1(0),NUM%)
1280         IF N=2 THEN CALL SEND.DATA(TR2(0),NUM%)
1290     NEXT
1300     WBYTE &H3F,&H5F;
1310     END
1320 '
1330 ' Call GPIB BIOS of SEND DATA
1340 ' SYNTAX: CALL SEND.DATA(VAR.SIZE%)
1350 '
1360 *SETGPIB.SEND
1370     SEND.DATA = &H39
1380     RESTORE *GPIB.BIOS.SEND
1390     FOR ADR = &H39 TO &H65
1400         READ BYTE: POKE ADR,BYTE
1410     NEXT
1420     RETURN
1430 '
1440 *GPIB.BIOS.SEND
1450     DATA &H50           : 'PUSH    AX
1460     DATA &H51           : 'PUSH    CX
1470     DATA &H52           : 'PUSH    DX
1480     DATA &H06           : 'PUSH    ES
1490     DATA &H56           : 'PUSH    SI
1500     DATA &H57           : 'PUSH    DI
1510     DATA &H55           : 'PUSH    BP
1520     DATA &H53           : 'PUSH    BX
1530     DATA &H8B,&H4F,&H02 : 'MOV    CX,2[BX]
1540     DATA &H8E,&HC1       : 'MOV    ES, CX
1550     DATA &H8B,&H37       : 'OV    SI,[BX]
1560     DATA &H26,&H8B,&H0C : 'MOV    CX,ES:[SI] ; DATA LENGTH
1570     DATA &H8B,&H7F,&H04 : 'MOV    DI,4[BX] ; DATA OFFSET
1580     DATA &H8E,&H47,&H06 : 'MOV    ES,6[BX] ; SEGMENT BASE
1590     DATA &HBB,&H00,&H00 : 'MOV    BX,00H ; COMMAND LENGTH
1600     DATA &HBE,&H00,&H00 : 'MOV    SI,00H ; COMMAND OFFSET
1610     DATA &HB0,&H80       : 'MOV    AL,80H ; EOI ONLY
1620     DATA &HB4,&H04       : 'MOV    AH,04H ; RECEIVE DATA
```



```

1630 DATA &HCD,&HD1      : 'INT    0D1H      ; CALL GPIB BIOS
1640 DATA &H5B          : 'POP    BX
1650 DATA &H5D          : 'POP    BP
1660 DATA &H5F          : 'POP    DI
1670 DATA &H5E          : 'POP    SI
1680 DATA &H07          : 'POP    ES
1690 DATA &H5A          : 'POP    DX
1700 DATA &H59          : 'POP    CX
1710 DATA &H58          : 'POP    AX
1720 DATA &HCF          : 'IRET
1730 ' TOTAL 2DH byte
    
```

12.5.3 Transferring Trace Data from This Instrument to HP - BASIC

The following programs are used to assign trace data of this instrument to array Tr of HP-BASIC. In binary format, IEEE Double-precision floating is selected.

Example 12-21 Data Input of HP-BASIC (ASCII format)

```

1000 ! *****
1010 ! * *
1020 ! *          INPUT TRACE DATA FROM NA          *
1030 ! *          (ASCII  FORMAT)                    *
1040 ! * *
1050 ! *  TARGET:   HP-9000 (PURE)                    *
1060 ! *  LANGUAGE: HP-BASIC                          *
1070 ! *  FILE:     HPTINPA.BAS                       *
1080 ! *****
1090 !
1100 ASSIGN @Na TO 711
1110 DIM Tr1(1:201),Tr2(1:201)
1120 !
1130 OUTPUT @Na;"OLDC OFF"
1140 OUTPUT @Na;"SWE:POIN 201"
1150 OUTPUT @Na;"FORM:DATA ASC"
1160 !
1170 OUTPUT @Na;"TRAC? FDAT1"
1180 ENTER @Na;Tr1(*)
1190 !
    
```

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12.5 Transferring Trace Data

```
1200 OUTPUT @Na;"TRAC? FDAT2"
1210 ENTER @Na;Tr2(*)
1220 !
1230 FOR I=1 TO 201
1240     PRINT "No.";I;": ";Tr1(I),Tr2(I)
1250 NEXT I
1260 !
1270 END
```

Example 12-22 Data Input of HP-BASIC (BINARY format)

```
1000 ! *****
1010 ! *
1020 ! *          INPUT TRACE DATA FROM NA          *
1030 ! *          (BINARY FORMAT)                   *
1040 ! *
1050 ! * TARGET:   HP-9000 (PURE)                    *
1060 ! * LANGUAGE: HP-BASIC                          *
1070 ! * FILE:     HPTINPB.BAS                       *
1080 ! *****
1090 !
1100 ASSIGN @Na TO 711
1110 ASSIGN @Dt TO 711;FORMAT OFF          ! BINARY DATA PASS
1120 DIM Tr(1:201,1:2)
1130 !
1140 OUTPUT @Na;"OLDC OFF"
1150 OUTPUT @Na;"SWE:POIN 201"
1160 OUTPUT @Na;"FORM:BORD NORM"
1170 OUTPUT @Na;"FORM:DATA REAL,64"
1180 !
1190 OUTPUT @Na;"TRAC? FDAT1"
1200 ENTER @Na USING "%,8A";Header$      ! READ HEADER STRING
1210 ENTER @Dt;Tr1(*)                   ! READ ALL TRACE DATA
1220 ENTER @Na USING "%,1A";Terminate$  ! READ TERMINATOR
1230 !
1240 OUTPUT @Na;" TRAC? FDAT2"
1250 ENTER @Na USING "%,8A";Header$      ! READ HEADER STRING
```

```

1260 ENTER @Dt;Tr2(*)           ! READ ALL TRACE DATA
1270 ENTER @Na USING "%,1A";Terminate$ ! READ TERMINATOR
1280 !
1290 I=1
1300 WHILE I <202
1310     PRINT "No.";I;":";Tr1(I),Tr2(I)
1320     I=I+1
1330 END WHILE
1340 !
1350 END

```

12.5.4 Transferring Trace Data from This Instrument to QuickBASIC

The following programs are used to assign the trace data of this instrument into array tr of QuickBASIC being executed with PC/AT.

(Note) NI - 488.2 interface board and library functions are used.

Example 12-23 Data Input of QuickBASIC (ASCII format)

```

' *****
' *
' *           INPUT TRACE DATA FROM NA
' *           (ASCII FORMAT)
' *
' * TARGET:   PC/AT(NI-488.2
' * LANGUAGE: QuickBASIC
' * FILE:     QBTINPA.BAS
' *****

```

```
REM $INCLUDE: 'qbdecl.bas'
```

```

DECLARE SUB gpinit (bdname$, bd%)
DECLARE SUB nainit (bd%, naname$, dv%)
DECLARE SUB tisetup (dv%, name$)
DECLARE SUB tireceive (bd%, dat!())
DECLARE SUB tiprint (dv%, dat1!(), dat2!())
DECLARE SUB prterr (msg$)

```

```
DIM tr1!(1 TO 201), tr2!(1 TO 201)
```

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12.5 Transferring Trace Data

```
CALL gpinit("GPIBO", bd%)
CALL nainit(bd%, "DEV11", na%)
CALL tisetup(na%,  FDAT1")      ' trace 1
CALL tireceive(bd%, tr1!())
CALL tisetup(na%,  "FDAT2")      ' trace 2
CALL tireceive bd%, tr2!())
CALL tiprint(na%, tr1!(), tr2!())
CALL ibonl(na%, 0)
CALL ibonl(dv%, 0)
END
```

```
' This routine open the gpib board and initialize
'
```

```
SUB gpinit (bdname$, bd%) STATIC

    CALL ibfind(bdname$, bd%)      ' OPEN BOARD
    IF (bd% < 0) THEN
        CALL prtterr("ibfind error")
        STOP
    END IF
    CALL ibsic(bd%)                ' INTERFACE CLEAR
    IF (ibsta% AND EERR) THEN
        CALL prtterr("ibsic error")
        CALL ibonl(bd%, 0)
        STOP
    END IF
    CALL ibsre(bd%, 1)            ' REMOTE ENABLE
    IF (ibsta% AND EERR) THEN
        CALL prtterr("ibsre error")
        CALL ibonl(bd%, 0)
        STOP
    END IF
END SUB
```

```
' This routine open N.A and initialize
'
```

```
SUB nainit (bd%, dvname$, dv%) STATIC

    CALL ibfind(dvname$, dv%)
    IF (dv% < 0) THEN
        CALL prtterr("ibfind error")
        CALL ibonl(bd%, 0)
        STOP
    END IF

    cmb$ = "OLDC OFF"
    CALL ibwrt(dv%, cmb$)
    IF (ibsta% AND EERR) THEN
        CALL prtterr("ibwrt error")
        CALL ibonl(dv%, 0)
        CALL ibonl(bd%, 0)
        STOP
    END IF

END SUB
```

' This routine prints the result of status variables.
,

```
SUB prtterr (msg$) STATIC

    PRINT msg$
    PRINT "ibsta=&H" ; HEX$(ibsta%); " <";
    IF ibsta% AND EERR THEN PRINT " ERR";
    IF ibsta% AND TIMO THEN PRINT " TIMO";
    IF ibsta% AND EEND THEN PRINT " EEND";
    IF ibsta% AND SRQI THEN PRINT " SRQI";
    IF ibsta% AND RQS THEN PRINT " RQS";
    IF ibsta% AND CMPL THEN PRINT " CMPL";
    IF ibsta% AND LOK THEN PRINT " LOK";
    IF ibsta% AND RREM THEN PRINT " RREM";
    IF ibsta% AND CIC THEN PRINT " CIC";
    IF ibsta% AND AATN THEN PRINT " AATN";
```

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```
IF ibsta% AND TACS THEN PRINT " TACS ";
IF ibsta% AND LACS THEN PRINT " LACS ";
IF ibsta% AND DTAS THEN PRINT " DTAS ";
IF ibsta% AND DCAS THEN PRINT " DCAS ";
PRINT " > "

PRINT "iberr="; iberr%;
IF iberr% = EDVR THEN PRINT " EDVR <DOS Error>"
IF iberr% = ECIC THEN PRINT " ECIC <NOT CIC>"
IF iberr% = ENOL THEN PRINT " ENOL <NO listner>"
IF iberr% = EADR THEN PRINT " EADR <Address error>"
IF iberr% = EARG THEN PRINT " EARG <Invalid argument>"
IF iberr% = ESAC THEN PRINT " ESAC <Not Sys Ctrlr>"
IF iberr% = EABO THEN PRINT " EABO <Op. aborted>"
IF iberr% = ENEB THEN PRINT " ENEB <No GPIB board>"
IF iberr% = EOIP THEN PRINT " EOIP <Async I/O in prg>"
IF iberr% = ECAP THEN PRINT " ECAP <No capability>"
IF iberr% = EFSO THEN PRINT " EFSO <Fils sys. error>"
IF iberr% = EBUS THEN PRINT " EBUS <Command error>"
IF iberr% = ESTB THEN PRINT " ESTB <Status byte lost>"
IF iberr% = ESRQ THEN PRINT " ESRQ <SRQ stuck on>"
IF iberr% = ETAB THEN PRINT " ETAB <Table Overflow>"
PRINT "ibcnt="; ibcnt%
```

END SUB

```
' This routine print received data
'
```

SUB tiprint (dv%, dat1!(), dat2!()) STATIC

```
cmd$ = "SWE:POIN?"
CALL ibwrt(dv%, cmd$)
cmd$ = SPACE$(23)
CALL ibrd(dv%, cmd$)
pts% = VAL(cmd$)
FOR num% = 1 TO pts%
    PRINT num%, dat1!(num%), dat2!(num%)
```

```

NEXT

END SUB

' This routine receives trace data
'

SUB tireceive (bd%, buf!()) STATIC

    v% = &H427
    CALL ibeos(bd%, v%)

    cmd$ = "?_K"          ' UNL UNT MLA 0 TAD 11
    CALL ibcmd(bd%, cmd$)
    IF (ibsta AND EERR) THEN
        CALL prtterr("ibcmd error")
        STOP
    END IF
    eoi% = 0
    num% = 1
    WHILE eoi% = 0
        cmd$ = SPACE$(23)    ' [S#.#####]
        CALL ibrd(bd%, cmd$)    ' READ ONE DATA
        dat$ = LEFT$(cmd$, 22)
        buf!(num%) = VAL(dat$)
        eoi% = ibsta% AND EEND
        num% = num% + 1
    WEND

    v% = &H40A
    CALL ibeos(bd%, v%)

END SUB

' This routine setups
'

SUB tisetup (dv%, name$) STATIC

```

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```
cmd$ = "SWE:POIN 201"          ' BASE COMMAND
CALL ibwrt(dv%, cmd$)
cmd$ = "FORM:DATA ASC;:TRAC?" + name$ ' TRACE INPUT COMMAND
CALL ibwrt(dv%, cmd$)
```

```
END SUB
```

12.5.5 Transferring Trace Data from This Instrument to C

The following program is used to assign the trace data of this instrument into array tr of C being executed with PC/AT.

(Note) *NI-488.2 interface board and library functions are used.*

Example 12-24 Data Input of C (ASCII format)

```
/*
 *      INPUT TRACE DATA FROM NA
 *      (ASCII FORMAT)
 *
 * TARGET:   PC/AT(NI-488.2)
 * LANGUAGE: C (ANSI-C STYLE)
 * FILE:     MCTINPA.C
 */

#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include "decl.h"

double  databuf1[210], databuf2[201];          /* data buffer */

/* prtterr - print gpib error message and status code
 */
static void prtterr(char *msg)
{
    printf("%s\n", msg);
    printf("ibsta=&H%x < ", ibsta);
    if (ibsta & ERR) printf("ERR");
    if (ibsta & TIMO) printf("TIMO");
    if (ibsta & SRQI) printf("SRQI");
}
```



```
    if (ibsta & RQS) printf("RQS");
    if (ibsta & CMPL) printf("CMPL");
    if (ibsta & LOK) printf("LOK");
    if (ibsta & CIC) printf("CIC");
    if (ibsta & TACS) printf("TACS");
    if (ibsta & LACS) printf("LACS");
    if (ibsta & DTAS) printf("DTAS");
    if (ibsta & DCAS) printf("DCAS");
    printf(">\n");

    printf("iberr= %d", iberr);
    switch(iberr)
    {
        case EDVR: printf("EDVR <DOS Error>"); break;
        case ECIC: printf("ECIC <Not CIC>"); break;
        case ENOL: printf("ENOL <No listner>"); break;
        case EADR: printf("EADR <Address error>"); break;
        case EARG: printf("EARG <Invalid argment>"); break;
        case ESAC: printf("ESAC <Not Sys Ctrlr>"); break;
        case EABO: printf("EABO <Op. aborted>"); break;
        case ENEB: printf("ENEB <No GPIB board>"); break;
        case EOIP: printf("EOIP <Async I/O in prg>"); break;
        case ECAP: printf("ECAP <No capability>"); break;
        case EFSO: printf("EFSO <Fils sys. error>"); break;
        case EBUS: printf("EBUS <Command error>"); break;
        case ESTB: printf("ESTB <Status byte lost>"); break;
        case ESRQ: printf("ESRQ <SRQ stuck on>"); break;
        case ETAB: printf("ETAB <Table Overflow>"); break;
    }
    printf("ibcntl= %d\n\n", ibcntl);
}

/* gpinit - open gpib board and initialize
*/
static int gpinit(char *bdname)
{
```

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```
int    bd;

if ((bd = ibfind(bdname)) < 0)          /* open board */
{
    prterr ("ibfind error");
    return -1;
}

if (ibsic(bd) & ERR)                   /* interface clear */
{
    prterr("ibsic error");
    ibonl(bd, 0);
    return -1;
}

if (ibsre(bd, 1) & ERR)                /* remote enable */
{
    prterr("ibsre error");
    ibonl(bd, 0);
    return -1;
}

return bd ;                            /* return descriptor */
}

/* nainit - open N.A port and initialize
*/
static int nainit(char *dvname)
{
    int    dv;

    if ((dv = ibfind("DEVII")) < 0)    /* open N.A */
    {
        prterr("ibfind error");
        return -1;
    }

    ibwrt (dv, "OLDC OFF", 9);         /* default command */
}
```

```
    if (ibsta & ERR)
    {
        prterr("ibwrt error");
        ibonl(dv, 0);
        return -1;
    }
    return dv;
}                                     /* return descriptor */

/* tisetup - setups
*/
static int tisetup (int dv)
{
    ibwrt(dv, "SWE:POIN 201", 13);
    ibwrt(dv, "FORM:DATA ASC", 14);
    return 0;
}

/* tireceive - receives trace data
*/
static int tireceive(int bd, double *buf, unsigned bufsiz, char *name)
{
    unsigned int len, cnt = 0;
    char s[32], n[20];

    *n = 0;
    strcat(strcpy(n, "TRAC?"), name);
    ibwrt(bd, n, strlen(n));           /* query */
    ibeos(bd, 0x427);
    ibcmd(bd, "?_ K", 4);              /* UNL UNT MLA 0 TAD 11 */

    while (cnt < bufsiz)
    {
        ibrd(bd, s, 23);               /* [S#.#####] */
        s[ibcntl] = 0;
        *buf++ = atof(s);
    }
}
```

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```
        cnt ++ ;
        if (ibsta & END) break ;          /* with EOI */
    }

    ibeos(bd, 0x40A);
    ibcmd(bd, "?_+@", 4);                 /* UNL UNT MLA 11 TAD 0 */
    return cnt;
}

/* tiprint - print trace data
*/
static int tiprint(double *data1, double *data2, unsigned num)
{
    unsigned i;

    for (i = 0; i < num; ++i)
    {
        printf(" %4d: %1.7e\t%1.7e\n", i, *data1, *data2);
        data1 ++ ;
        data2 ++ ;
    }
}

/* main entry
*/
main(int argc, char **argv)
{
    int    bd, na;
    int    num;

    if ((bd = gpinit("GPIBO")) == -1)
        exit(1);
    if ((na = nainit("DEV11")) == -1)
    {
        ibonl(bd, 0);
        exit(1);
    }
}
```

```

    }

    tisetup(na);
    num = tireceive(bd, databuf1, 201, "FDAT1");
    num = tireceive(bd, databuf2, 201, "FDAT2");
    tiprint(&databuf1[0], &databuf2[0], num);

    ibonl(na, 0);
    ibonl(bd, 0);
}

```

Example 12-25 Data Input of C (Binary format)

```

/*
 *      INPUT TRACE DATA FROM NA
 *      (BINARY FORMAT)
 *
 * TARGET:   PC/AT(NI-488.2)
 * LANGUAGE: C (ANSI-C STYLE)
 * FILE:     MCTINPB.C
 */
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include "decl.h"

static int gpinit(char *bdname);
static int nainit(char *dvname);
static int tisetup(int dv);
static int tireceive(int bd, double *buf, unsigned bufsiz);
static int tiprint(double *data, unsigned points);
static void prterr(char *msg);

double databuf[402];                /* data buffer */

/* main entry

```

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```
*/
main(int argc, char **argv)
{
    int    bd, na;
    int    num;

    if ((bd = gpinit("GPIBO")) == -1)
        exit(1);
    if ((na = nainit("DEV11")) == -1)
    {
        ibonl(bd, 0);
        exit(1);
    }

    tisetup(na);
    num = tireceive(bd, &databuf[0], 402);
    tiprint(&databuf[0], num);

    ibonl(na, 0);
    ibonl(bd, 0);
}

/* gpinit - open gpib board and initialize
*/
static int gpinit(char *bdname
{
    int    bd;

    if ((bd = ibfind(bdname)) < 0)                /* open board */
    {
        prterr("ibfind error");
        return -1;
    }

    if (ibsic(bd) & ERR)                          /* interface clear */
    {
```

```
        prterr("ibsic error");
        ibonl(bd, 0);
        return -1;
    }
    if (ibsre(bd, 1) & ERR)                /* remote enable */
    {
        prterr("ibsre error");
        ibonl(bd, 0);
        return -1;
    }
    return bd;                            /* return descriptor */
}

/* nainit - open N.A port and initialize
*/
static int nainit(char *dvname)
{
    in dv;

    if ((dv = ibfind("DEV11")) < 0)      /* open N.A */
    {
        prterr("ibfind error");
        return -1;
    }
    ibwrt(dv, "OLDC OFF", 9);            /* default command */
    if (ibsta & ERR)
    {
        prterr("ibwrt error");
        ibonl(dv, 0);
        return -1;
    }
    return dv ;
}                                        /* return descriptor */

/* tisetup - setups
*/
```

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12.5 Transferring Trace Data

```
static int tisetup(int dv)
{
    ibwrt(dv, "SWE:POIN 201", 13);
    ibwrt(dv, "FORM:BORD SWAP;DATA REAL,64", 28);
    return 0;
}

/* tireceive - receives trace data
*/
static int tireceive(int bd, double *buf, unsigned bufsiz)
{
    unsigned cnt;
    char s[32];

    ibwrt(bd, "TRAC:DATA? DATA", 16);          /* query */

    ibconfig(bd, 12, 0);                        /* disable EOS detection */
    ibwrt(bd, "?_ K", 5);                       /* UNL UNT MLA 0 TAD 11 */

    ibrd(bd, s, 8);                             /* read header */
    ibrd(bd, (char *)buf, sizeof(double)*bufsiz);
    cnt = ibcnt;
    if (!(ibsta&END)) ibrd(bd, s, 1);           /* read terminator */

    ibconfig(bd, 12, '\n');                     /* enable EOS detection */
    return cnt/sizeof(double);
}

/* tiprint - print trace data
*/
static int tiprint(double *data, unsigned num)
{
    unsigned points = num>>1;
    unsigned i;

    for (i=0; i<points; ++i)
```



```
    {
        printf ( %4d: %1.7e\t%1.7e\n", i, *data, *(data+1));
        data += 2;
    }
}

/* prterr - print gpib error message and status code
*/
static void prterr(char *msg)
{
    printf("%s\n", msg);
    printf("ibsta=&H%x < ", ibsta);

    if (ibsta & ERR)    printf("ERR");
    if (ibsta & TIMO)   printf("TIMO");
    /*if (ibsta & EEND) printf("EEND");*/
    if (ibsta & SRQI)   printf("SRQI");
    if (ibsta & RQS)    printf("RQS");
    if (ibsta & CMPL)   printf("CMPL");
    if (ibsta & LOK)    printf("LOK");
    /*if (ibsta & RREM) printf("RREM");*/
    if (ibsta & CIC)    printf("CIC");
    /*if (ibsta & AATN) printf("AATN");*/
    if (ibsta & TACS)   printf("TACS");
    if (ibsta & LACS)   printf("LACS");
    if (ibsta & DTAS)   printf("DTAS");
    if (ibsta & DCAS)   printf("DCAS");
    printf(" >\n");

    printf("iberr= %d", iberr);
    switch (iberr)
    {
        case EDVR: printf("EDVR <DOS Error>"); break;
        case ECIC: printf("ECIC <Not CIC>"); break ;
        case ENOL: printf("ENOL <No listner>"); break;
        case EADR: printf("EADR <Address error>"); break;
    }
}
```

12.5 Transferring Trace Data

```
    case EARG: printf("EARG <Invalid argment>"); break;
    case ESAC: printf("ESAC <Not Sys Ctrlr>"); bread;
    case EABO: printf("EABO <Op. aborted>"); break;
    case ENEB: printf("ENEB <No GPIB board>"); break;
    case EOIP: printf("EOIP <Async I/O in prg>"); break;
    case ECAP: printf("ECAP <No capability>"); break;
    case EFSO: printf("EFSO <Fils sys. error>"); break;
    case EBUS: printf("EBUS <Command error>"); break;
    case ESTB: printf("ESTB <Status byte lost>"); break;
    case ESRQ: printf("ESRQ <SRQ stuck on>"); break;
    case ETAB: printf("ETAB <Table Overflow>"); break;
  }
printf("ibcnt=  %d\n\n", ibcnt1);
}
```

12.6 Using Built-in BASIC and External Controller Simultaneously

This section describes a method in which the measurement is performed by executing the BASIC program of this instrument from an external controller, then the measurement data is received and displayed with the external controller.

Besides , a measurement program is created with built-in BASIC of this instrument side and a program example which performs a filter analysis with the built-in functions is presented.

Then, a program which receives the measurement data by the use of SRQ (service request) is created with the program of external controller side. The program of external controller is different according to the employed computer and language. In the first place, N88-BASIC programs of NEC PC-9801 is described.

The following shows the outline of programs described in this section.

External controller side		Built-in BASIC side
(1) Initialize interface.		
(2) Execute the program of this instrument after loading.	→	(1) Set the measurement condition of this instrument. (2) Pausing
(3) CONT the program of this instrument.	→	(3) Start the scan and waits till the scan is ended with WAIT EVENT.
(4) Loop waiting till the SRQ comes.		(4) Analyze the measurement data.
(5) Perform serial poll when SRQ comes.	←	(5) Output SRQ with REQUEST command.
(6) Receive data and displays it on the screen.	←	(6) Send data.
(7) Repeat from (3).		(7) Repeat from (2).

When the data sending-receiving is performed between external controller and built-in BASIC of this instrument, the exchanging written above becomes necessary.

12.6.1 Sending Program of Built-in BASIC

A program that performs the filter analysis and sends the analysis data using the built-in BASIC of this instrument is shown as follows.

Example 12-26 Sending Program of Built-in BASIC

```

1000 !*****
1010 !*                                     *
1020 !*          DATA TRANSFER PROGRAM    *
1030 !*                                     *
1040 !* TARGET: NETWORK ANALYZER (to PC-9801) *
1050 !* FILE:   NSEND.BAS                  *
1060 !*****
1070 INTEGER EV
1080 DIM L(2),F(2,4)
1090 !
1100 *MAIN
1110     GOSUB *SETUP
1120     CLS
1130     *MEAS_LOOP
1140         CURSOR 0,0
1150         PAUSE
1160         GOSUB *MEAS
1170         GOSUB *SEND
1180         GOTO *MEAS_LOOP
1190 !
1200 *SETUP
1210     NA=31 :PC=11 :EV=1 :L(1)=3.0 :L(2)=60.0
1220     OUTPUT NA;"OLDC OFF"
1230     OUTPUT NA;"SYST:PRES;:INIT:CONT OFF;:STAT:OPER:ENAB 8;*SRE
                                     128;*OPC?"
1240     ENTER NA;A
1250     OUTPUT NA;"FREQ:SPAN 20MAHZ;CENT 12MAHZ"
1260     RETURN
1270 !
1280 *MEAS
1290     SPOLL(NA)

```

12.6 Using Built-in BASIC and External Controller Simultaneously

```

1300     OUTPUT NA;"INIT":WAIT EVENT EV
1310     AP=PMAX(0,1200,0)
1320     NP=MBNDI(0,1200,AP,2,L(1),F(1,1),0)
1330     QF=F(1,3)/F(1,4)           ! QF = CF(3dB)    / BW(3dB)
1340     SF=F(2,4)/F(1,4)           ! SF = BW'(60dB) / BW(3dB)
1350     RETURN
1360 !
1370 *SEND
1380     REQUEST 65
1390     OUTPUT PC;F(1,1) :OUTPUT PC;F(1,2) :OUTPUT PC;F(1,3) :
                                     OUTPUT PC;F(1,4)
1400     OUTPUT PC;QF      :OUTPUT PC;SF
1410     RETURN

```

Input this program and store it in a floppy disk.

The file is named as " NSEND.PGM " when it is stored.

The file name is referred to when it is loaded from external controller.

In this program, the pause is performed automatically after the initialization and the measurement condition of this instrument is set.

After @ CONT is sent from the external controller, the measurement is performed , then the measurement data is analyzed and sent to the external controller.

After this series of processing is performed, the pause is performed again.

12.6.2 Receiving Program of N88-BASIC

The receiving program of PC-9801 is shown as follows.

Example 12-27 Receiving Program of N88-BASIC

```

1000 ' *****
1010 ' *
1020 ' *          CONTROL AND RECEIVE DATA          *
1030 ' *
1040 ' * TARGET: PC-9801
1050 ' * FILE:  NRECEIVE.BAS
1060 ' *****

1070 ISET IFC
1080 ISET REN
1090 NA=11
1100 POLL NA,P
1110 ON SRQ GOSUB *SRINT
1120
1130 A$="A:/NSEND.BAS"
1140 M$=CHR$(34)+A$+CHR$(34)
1150 L$="@LOAD"+M$
1160 PRINT @NA;"@SCRATCH"
1170 PRINT @NA;L$
1180 PRINT @NA;"@RUN"
1190 '
1200 CLS
1210 *MEAS.LOOP
1220     GOSUB *MEAS.CONT
1230     GOSUB *RECEIVE
1240     GOTO *MEAS.LOOP
1250 '
1260 *MEAS.CONT
1270     LOCATE 6,9 :PRINT "CONNECT DUT"
1280     LOCATE 6,10 :INPUT "IF OK THEN PRESS ANY KEY",D$
1290     PRINT @NA ;"@CONT"
1300     URQ=0

```

12.6 Using Built-in BASIC and External Controller Simultaneously

```

1310     SRQ ON
1320     RETURN
1330 '
1340 *RECEIVE
1350     IF URQ=0 THEN GOTO *RECEIVE
1360     INPUT @NA;LF:INPUT @NA;RF:INPUT @NA;CF:INPUT @NA;BW
1370     INPUT @NA;QF:INPUT @NA;SF
1380     LOCATE 5,1:PRINT USING "C.F = #####.##### [MHz]";CF/10^6
1390     LOCATE 5,2:PRINT USING "L.F = #####.##### [MHz]";LF/10^6
1400     LOCATE 5,3:PRINT USING "R.F = #####.##### [MHz]";RF/10^6
1410     LOCATE 5,4:PRINT USING "BW = #####.##### [MHz]";BW/10^6
1420     LOCATE 5,5:PRINT USING "QF = #####.##### ";QF
1430     LOCATE 5,6:PRINT USING "SF = #####.##### ";SF
1440     RETURN
1450 '
1460 *SRINT
1470     POLL NA,P
1480     P = P AND 1
1490     IF P<>0 THEN URQ=1
1500     RETURN

```

This program is input with BASIC mode of PC-9801.

The program is performed in the following sequence.

Execution sequence:

- ① Insert the floppy disk in which the " Example 12-26 " is stored into the drive.
- ② Execute the program of PC-9801 side.
Input RUN and press Return key.

When the program is executed on PC-9801 side, the program of this instrument side is loaded from the floppy disk and executed automatically.

When it is executed, according to the program , this instrument is set and the measurement is started.

When the measurement is ended and the result is produced, it is sent to PC-9801 side.

The result is as follows.

Execution result:

```

C.F = 146.716000 [MHz]
L.F = 137.156000 [MHz]
R.F = 157.699000 [MHz]
BW = 21.964200 [MHz]

```

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```
QF = 6.679790
SF = 0.000000
```

When PC-9801 matches the execution result as shown here, it is recognized that the data is sent and received certainly.

In R3752 series, the mark function can be substituted by creating programs like this.

12.6.3 Receiving Program of HP-BASIC

The example of receiving program that used HP-BASIC is shown as follows.

Example 12-28 Receiving Program of HP-BASIC

```
1000 ! *****
1010 ! *
1020 ! *          CONTROL AND RECEIVE DATA          *
1030 ! *
1040 ! * TARGET: HP-BASIC
1050 ! * FILE:  HPREC.BAS
1060 ! *****
1070 !
1080 DIM L$(24)
1090 !
1100 ASSIGN @Na TO 711
1110 ON INTR 7 GOSUB Srint
1120 !
1130 A$="A:/NSEND.BAS"
1140 M$=CHR$(34)+A$+CHR$(34)
1150 L$="@LOAD"+M$
1160 !
1170 OUTPUT @Na;"@SCRATCH"
1180 OUTPUT @Na;L$
1190 OUTPUT @Na;"@RUN"
1200 !
1210 Meas_loop: !
1220     GOSUB Meas_cont
1230     GOSUB Receive
1240     GOTO Meas_loop
1250 !
1260 Meas_cont: !
```


12.6 Using Built-in BASIC and External Controller Simultaneously

```

1270     PRINT "CONNECT DUT"
1280     INPUT "IF OK THEN PRESS ANY KEY",D$
1290     OUTPUT @Na;"@CONT"
1300     Urq=0
1310     ENABLE INTR 7;255
1320     RETURN
1330 !
1340 Receive:!
1350     IF Urq=0 THEN GOTO *Receive
1360     DISABLE INTR 7
1370     ENTER @Na;Lf
1380     ENTER @Na;Rf
1390     ENTER @Na;Cf
1400     ENTER @Na;Bw
1410     ENTER @Na;Qf
1420     ENTER @Na;Sf
1430     PRINT "C.F [MHz] = ";
1440     PRINT USING "DDDD.DDDDDD";Cf/10^6
1450     PRINT "L.F [MHz] = ";
1460     PRINT USING "DDDD.DDDDDD";Lf/10^6
1470     PRINT "R.F [MHz] = ";
1480     PRINT USING "DDDD.DDDDDD";Rf/10^6
1490     PRINT "BW [MHz] = ";
1500     PRINT USING "DDDD.DDDDDD";Bw/10^6
1510     PRINT "Q          = ";
1520     PRINT USING "DDDD.DDDDDD";Qf
1530     PRINT "SF          = ";
1540     PRINT USING "DDDD.DDDDDD";Sf
1550     RETURN
1560 !
1570 Srint:!
1580     Stat = SPOLL(@Na) AND 1
1590     IF Stat<>0 THEN Urq = 1
1600     RETURN
1610 END

```

12.6.4 Receiving Program of QuickBASIC

The example of receiving program that used QuickBASIC is shown as follows.

Example 12-29 Receiving Program of QuickBASIC

```

' *****
' *
' *          CONTROL AND RECEIVE DATA          *
' *
' * TARGET:   PC/AT(NI-488.2)                   *
' * LANGUAGE: QuickBASIC                        *
' * FILE:     QBREC.BAS                         *
' *****

REM $INCLUDE: `qbdecl.bas`

DECLARE SUB gpinit (bdname$, bd%)
DECLARE SUB nainit (bd%, naname$, dv%)
DECLARE SUB nasetup (dv%)
DECLARE SUB nacont (dv%)
DECLARE SUB nareceive (bd%)
DECLARE SUB prtterr (msg $)

CALL gpinit("GPIB0", bd%)
CALL nainit(bd%, "DEV11", na%)
CALL nasetup(na%)

Measloop:
    CALL nacont(na%)
    CALL nareceive(na%)
    GOTO Measloop

CALL ibonl(na%, 0)
CALL ibonl(dv%, 0)
END

```

12.6 Using Built-in BASIC and External Controller Simultaneously

```
'      This routine open the gpib board and initialize
'
SUB gpinit (bdname$, bd%) STATIC

    CALL ibfind(bdname$, bd%)          ' OPEN BOARD
    IF (bd% < 0) THEN
        CALL prtterr("ibfind error")
        STOP
    END IF

    CALL ibsic(bd%)                    ' INTERFACE CLEAR
    IF (ibsta% AND EERR) THEN
        CALL prtterr ("ibsic error")
        CALL ibonl (bd%, 0)
        STOP
    END IF

    CALL ibsre(bd%, 1)                 ' REMOTE ENABLE
    IF (ibsta% AND EERR) THEN
        CALL prtterr ("ibsic error")
        CALL ibonl (bd%, 0)
        STOP
    END IF

END SUB

'      This routine continue the N.A BASIC PROGRAM
'
SUB nacont (dv%) STATIC

    PRINT "CONNECT DUT"
    INPUT "IF OK THEN PRESS ANY KEY", key$
    cmd$ = "@CONT"
    CALL ibwrt(dv%, cmd $)

END SUB
```

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12.6 Using Built-in BASIC and External Controller Simultaneously

```
' This routine open N.A and initialize
'
SUB nainit (bd%, dvname$, dv%) STATIC

    CALL ibfind(dvname$, dv%)
    IF (dv% < 0) THEN
        CALL prtterr("ibfind error")
        CALL ibonl(bd%, 0)
        STOP
    END IF

    cmd$ = "OLDC OFF"
    CALL ibwrt(dv%, cmd$)
    IF (ibsta% AND EERR) THEN
        CALL prtterr ("ibwrt error")
        CALL ibonl(dv%, 0)
        CALL ibonl(bd%, 0)
        STOP
    END IF

END SUB

' This routine receives data and print
'
SUB nareceive (dv%) STATIC

    mask% = &H4800

Nawait:

    CALL ibwait(dv%, mask%)
    CALL ibrsp(dv%, spr%)
    spr% = spr% AND 1
    IF (spr% = 0) GOTO Nawait

    str1$ = SPACE$(23)
    str2$ = SPACE$(23)
```

12.6 Using Built-in BASIC and External Controller Simultaneously

```
str3$ = SPACE$(23)
str4$ = SPACE$(23)
str5$ = SPACE$(23)
str6$ = SPACE$(23)

CALL ibrd(dv%, str1$)
CALL ibrd(dv%, str2$)
CALL ibrd(dv%, str3$)
CALL ibrd(dv%, str4$)
CALL ibrd(dv%, str5$)
CALL ibrd(dv%, str6$)

PRINT USING "C.F = ####.##### [MHz]"; VAL(str3$) / 10^6
PRINT USING "L.F = ####.##### [MHz]"; VAL(str1$) / 10^6
PRINT USING "R.F = ####.##### [MHz]"; VAL(str2$) / 10^6
PRINT USING "BW = ####.##### [MHz]"; VAL(str4$) / 10^6
PRINT USING "QF = ####.#####"; VAL(str5$)
PRINT USING "SF = ####.#####"; VAL(str6$)

END SUB

' This routine setups
'
SUB nasetup (dv%) STATIC

cmd% = "@STOP"
CALL ibwrt(dv%, cmd$)
CALL ibwrt(dv%, cmd$)
cmd$ = "@SCRATCH"
CALL ibwrt(dv%, cmd$)
cmd$ = "@LOAD" + CHR$(34) + "A:/NSEND.BAS" + CHR$(34)
CALL ibwrt(dv%, cmd$)
cmd% = "@RUN"
CALL ibwrt(dv%, cmd$)

END SUB
```

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12.6 Using Built-in BASIC and External Controller Simultaneously

' This routine prints the result of status variables.

```
'
SUB prterr (msg$) STATIC

    PRINT msg$
    PRINT "ibsta=&H"; HEX$(ibsta%); " <";
    IF ibsta% AND EERR THEN PRINT " ERR";
    IF ibsta% AND TIMO THEN PRINT " TIMO";
    IF ibsta% AND EEND THEN PRINT " EEND";
    IF ibsta% AND SRQI THEN PRINT " SRQI";
    IF ibsta% AND RQS THEN PRINT " RQS";
    IF ibsta% AND CMPL THEN PRINT " CMPL";
    IF ibsta% AND LOK THEN PRINT " LOK";
    IF ibsta% AND RREM THEN PRINT " RREM";
    IF ibsta% AND CIC THEN PRINT " CIC";
    IF ibsta% AND AATN THEN PRINT " AATN";
    IF ibsta% AND TACS THEN PRINT " TACS";
    IF ibsta% AND LACS THEN PRINT " LACS";
    IF ibsta% AND DTAS THEN PRINT " DTAS";
    IF ibsta% AND DCAS THEN PRINT " DCAS";
    PRINT " >"

    PRINT "iberr="; iberr%;
    IF iberr% = EDVR THEN PRINT " EDVR <DOS Error>"
    IF iberr% = ECIC THEN PRINT " ECIC <Not CIC>"
    IF iberr% = ENOL THEN PRINT " ENOL <No listner>"
    IF iberr% = EADR THEN PRINT " EADR <Address error>"
    IF iberr% = EARG THEN PRINT " EARG <Invalid argument>"
    IF iberr% = ESAC THEN PRINT " ESAC <Not Sys Ctrlr>"
    IF iberr% = EABO THEN PRINT " EABO <Op. aborted>"
    IF iberr% = ENEB THEN PRINT " ENEB <No GPIB board>"
    IF iberr% = EOIP THEN PRINT " EOIP <Async I/O in prg>"
    IF iberr% = ECAP THEN PRINT " ECAP <No capability>"
    IF iberr% = EFSO THEN PRINT " EFSO <File sys. error>"
    IF iberr% = EBUS THEN PRINT " EBUS <Command error>"
    IF iberr% = ESTB THEN PRINT " ESTB <Status byte lost>"
```

```

IF iberr% = ESRQ THEN PRINT " ESRQ <SRQ stuck on>"
IF iberr% = ETAB THEN PRINT " ETAB <Table Overflow>"
PRINT " ibcnt = " ;   ibcnt%

```

```
END SUB
```

12.6.5 Receiving Program of ANSI-C

The example of receiving program that used C is shown as follows.

Example 12-30 Receiving Program of C

```

/*
 *      CONTROL AND RECEIVE DATA
 *
 * TARGET:   PC/AT(NI-488.2)
 * LANGUAGE: C (ANSI-C STYLE)
 * FILE:     MCREC.C
 */
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include "decl.h"

/* prtterr - print gpib error message and status code
 */
static void prtterr(char *msg)
{
    printf("%s\n", msg);
    printf("ibsta=&H%x <", ibsta);
    if (ibsta & ERR) printf("ERR");
    if (ibsta & TIMO) printf("TIMO");
    if (ibsta & SRQI) printf("SRQI");
    if (ibsta & RQS) printf("RQS");
    if (ibsta & CMPL) printf("CMPL");
    if (ibsta & LOK) printf("LOK");
    if (ibsta & CIC) printf("CIC");
    if (ibsta & TACS) printf("TACS");

```

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12.6 Using Built-in BASIC and External Controller Simultaneously

```
    if (ibsta & LACS) printf("LACS");
    if (ibsta & DTAS) printf("DTAS");
    if (ibsta & DCAS) printf("DCAS");
    printf(" >\n");

    printf("iberr= %d", iberr);
    switch(iberr)
    {
        case EDVR: printf("EDVR <DOS Error>"); break;
        case ECIC: printf("ECIC <Not CIC>"); break;
        case ENOL: printf("ENOL <No listner>"); break;
        case EADR: printf("EADR <Address error>"); break;
        case EARG: printf("EARG <Invalid argument>"); break;
        case ESAC: printf("ESAC <Not Sys Ctrlr>"); break;
        case EABO: printf("EABO <Op.aborted>"); break;
        case ENEB: printf("ENEB <No GPIB board>"); break;
        case EOIP: printf("EOIP <Async I/O in prg>"); break;
        case ECAP: printf("ECAP <No capability>"); break;
        case EFSO: printf("EFSO <Fils sys. error>"); break;
        case EBUS: printf("EBUS <Command error>"); break;
        case ESTB: printf("ESTB <Status byte lost>"); break;
        case ESRQ: printf("ESRQ <SRQ stuck on>"); break;
        case ETAB: printf("ETAB <Table Overflow>"); break;
    }
    printf ( "ibcnt1= %d\n\n", ibcnt1 );
}

/* gpinit - open gpib board and initialize
*/
static int gpinit(char *bdname)
{
    int  bd;

    if ((bd = ibfind(bdname)) < 0)
        prterr("ibfind error");
}
```



```
        return -1;
    }

    if (ibsic(bd) & ERR)                /* interface clear */
    {
        prterr("ibsic error");
        ibonl(bd, 0);
        return -1;
    }

    if (ibsre(bd, 1) & ERR)             /* remote enable */
    {
        prterr("ibsre error");
        ibonl(bd, 0);
        return -1;
    }
    return bd;                          /* return descriptor */
}

/* nainit - open N.A Port and initialize */
*/
static int nainit(char *dvname)
{
    int  dv;
    if ((dv = ibfind("DEV11")) < 0)    /* open R3752/R3753 */
    {
        prterr("ibfind error");
        return -1;
    }

    ibwrt (dv, "OLDC OFF", 8);         /* default command */
    if (ibsta & ERR)
    {
        prterr("ibwrt error");
        ibonl(dv, 0);
        return -1;
    }
}
```

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12.6 Using Built-in BASIC and External Controller Simultaneously

```
    }
    return dv;
}                                     /* return descriptor */

/* nasetup - setups
*/
static int nasetup(int dv)
{
    ibwrt(dv, "@STOP", 5);
    ibwrt(dv, "@STOP", 5);
    ibwrt(dv, "@SCRATCH", 8);
    ibwrt(dv, "@LOAD \"A:/NSEND.BAS\" ", 20);
    ibwrt(dv, "@RUN", 4);
    return 0 ;
}

/* nacont - continue INTERNAL BASIC
*/
static int nacont(int dv)
{
    int    f;
    char   c;

    printf("CONNECT DUT\n");
    printf("IF OK THEN PRESS KEY [y/n]");
    fflush(stdout);

    while (1)
    {
        c = getchar();
        if (c == EOF)
        {
            f = -1;
            break;
        }
        if (c == 'y' || c == 'Y')
```

```
        {
            f = 0;
            break;
        }
    if (c == '\n' || c == '\N')
        {
            f = -1;
            break;
        }
    }
    fflush(stdin);
    ibwrt(dv, "@CONT", 5);
    return f;
}

/* nareceive - receives trace data
*/
static int nareceive(int na, int bd)
{
    char buf[6][24];
    int i;
    char s;

    while (1)
        {
            ibwait(na, (int)0x4800);
            ibrsp(na, &s);
            if (s & 1) break;          /* check user request bit */
        }

    ibcmd(bd, "?_K", 4);              /* UNL UNT MLA 0 TAD 11 */
    for (i = 0; i < 6; i++)
        {
            ibrd(bd, &buf[i][0], 23);
            buf[i][ibcnt1] = '\0';
        }
}
```

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12.6 Using Built-in BASIC and External Controller Simultaneously

```
    ibcmd(bd, "?_+@", 4);                                /* UNL UNT MLA 11 TAD 0 */

    printf("C.F = %4.6f [MHz]\n", atof(&buf[2][0])/1.0e6);
    printf("L.F = %4.6f [MHz]\n", atof(&buf[0][0])/1.0e6);
    printf("R.F = %4.6f [MHz]\n", atof(&buf[1][0])/1.0e6);
    printf("BW  = %4.6f [MHz]\n", atof(&buf[3][0])/1.0e6);
    printf("QF  = %4.6f\n",  atof(&buf[4][0]));
    printf("SF  = %4.6f\n",  atof(&buf[5][0]));

    return 6;
}

/* main entry
*/
main(int argc, char **argv)
{
    int    bd, na;
    int    num;

    if ((bd = gpinit("GPIB0")) == -1)
        exit(1);
    if ((na = nainit("DEV11")) == -1)
    {
        ibonl(bd, 0);
        exit(1);
    }

    nasetup(na);
    while (1)
    {
        if (nacont(na) == -1) break;
        nareceive (na, bd);
    }
    ibonl(na, 0);
    ibonl(bd, 0);
}
```

12.7 Download of BASIC Program

This section describes a method with which the program used for this instrument is down loaded from external controller to this instrument side and then executed.

On the contrary, next section " 12.8 " will describe a method with which the programs is up loaded from this instrument.

First of all, the down-load and up-load are simply described.

- Download

An external controller is used to create the program file and save it to the floppy disk in advance. The download is that transferring the program to the memory of this instrument side via GPIB.

- Upload

Contrary to the download, the upload is that transferring the program existing in the memory of this instrument side to the memory of external controller via GPIB.

In the case of download, when the program file used for built-in BASIC is managed with an external controller, the program can be loaded without using floppy disk.

That is, the built-in BASIC can be controlled as the same as other GPIB commands.

The program creates down loads the program to be executed with built-in BASIC, then executes it after exchanging it with the program to be executed on the external controller.

The two programs in Example 12-26 and Example 12-27 can be used.

Outline of program:

- (1) Initialize external controller.
- (2) Open the program file to be down-loaded and transfer the content to this instrument.
- (3) After download, load the program to be executed with the external controller and execute it.

12.7 Download of BASIC Program

12.7.1 Download Program of N88-BASIC

The download program to be executed with PC-9801 is shown as follows.

Example 12-31 Download Program of N88-BASIC

```

1000 ' *****
1010 ' *
1020 ' *          DOWN LOAD PROGRAM          *
1030 ' *
1040 ' * TARGET: PC-9801
1050 ' * FILE:   NDOWNLD.BAS
1060 ' *****
1070 NA=11
1080 ISET IFC
1090 ISET REN
1100 CMD DELIM=2
1110 CMD TIMEOUT=3
1120 '
1130 ON ERROR GOTO *ERRORMES
1140 RINT "PROGRAM TRANSFER (PC to NA)"
1150 '
1160 *DNLD. ENTER
1170     FLAG=0
1180     INPUT "ENTER DOWNLOAD PROGRAM";F$
1190     OPEN F$ FOR INPUT AS #1
1200     IF FLAG=1 THEN *DNLD. ENTER
1210     PRINT @NA;"@SCRATCH" @
1220 '
1230 *DNLD. LOOP
1240     LINE INPUT #1,DB$
1250     DB$="@"+DB$
1260     PRINT DB$
1270     PRINT @NA;DB$ @
1280     IF EOF(1) THEN *DNLD. EXIT ELSE *DNLD. LOOP
1290 '
1300 *DNLD. EXIT

```

```
1310     CLOSE
1320     PRINT "COMPLETE DOWNLOAD"
1330 '
1340 *EXEC. ENTER
1350     FLAG=0
1360     INPUT "ENTER STARTING PROGRAM";F$
1370     IF F$=" " THEN END
1380     OPEN F$ FOR INPUT AS #1
1390     IF FLAG=1 THEN *EXEC. ENTER
1400     CLOSE
1410     ON ERROR GOTO 0
1420     RUN F$
1430     END
1440 '
1450 *ERRORMES
1460     FLAG=1
1470     PRINT "ERROR: LINE=";ERL;" NO.=";ERR
1480     INPUT "RETRY? (Y/N)";A$
1490     IF A$="Y" OR A$="y" THEN RESUME NEXT
1500     ON ERROR GOTO 0
1510     END
```

Input this program under the BASIC mode of PC-9801.
Save it to a floppy disk after input.

The program execution is performed in the following sequence.

Execution sequence:

- ① Create a download program , then save it to a floppy disk.
Here, Example 12-26 is used.
- ② Create a program to be controlled with external controller, then save it to a floppy disk.
Here, a part of Example 12-27 is used after correcting it .
Turn line 1190 to 1190 ! PRINT NA ; L \$ command line.
- ③ Execute download program.
After ENTER DOWNLOAD PROGRAM is displayed. it turns to waiting input state.

12.7 Download of BASIC Program

- ④ Here, Input the file name of program to be down-loaded. (For instance, NSEND. BAS etc.)
 After input the file name, press Return key, then the file is loaded and the download starts.
 The download is performed by each line of the program , and the line being transferred is displayed on the screen so as to be checked.
 When the download is ended, COMPLETE DOWNLOAD is displayed on the screen.
- ⑤ Next, as ENTER STARTING PROGRAM is displayed , input the file name of control program to be executed with external controller.
 The entered program is exchanged with the present download program and executed.
 When only download is performed, press Return key only .
 The execution result is the same as the result of Example 12-27.

12.7.2 Download Program of HP-BASIC

The download program to be executed with HP-BASIC is shown as follows.

Example 12-32 Download Program of HP-BASIC

```

1000 ! *****
1010 ! *
1020 ! * DOWN LOAD PROGRAM *
1030 ! *
1040 ! * TARGET: HP-BASIC *
1050 ! * FILE: HPDNL.D.BAS *
1060 ! *****
1070 !
1080 ASSIGN @Na TO 711
1090 DIM Line$[512]
1100 !
1110 PRINT "PROGRAM TRANSFER (HP-9000 TO NA)"
1120 INPUT "ENTER DOWNLOAD PROGRAM";Name$
1130 OUTPUT @Na;"*RST"
1140 OUTPUT @Na;"@SCRATCH"
1150 !
1160 ON ERROR GOTO Done
1170 ASSIGN @File TO Name$
1180 !
1190 LOOP
1200 Line$=" "
1210 ENTER @File;Line$ ! READ ONE LINE
    
```



```

1220     OUTPUT @Na;"@"+Line$           ! TRANSFER ONE LINE
1230 END LOOP
1240 !
1250 Done: !                             ! END OF FILE
1260     OFF ERROR
1270     ASSIGN @File TO *               ! CLOSE FILE
1280 END
1290
1300

```

12.7.3 Download Program in QuickBASIC

The download program to be executed with QuickBASIC is shown as follows.

Example 12-33 Download Program Used for QuickBASIC

```

' *****
' *
' *           DOWN LOAD PROGRAM           *
' *
' * TARGET:   PC/AT(NI-488.2)             *
' * LANGUAGE: QuickBASIC                  *
' * FILE:     QBDNLD. BAS                  *
' *****

REM $INCLUDE: `qbdecl.bas`

DECLARE SUB gpinit (bdname$, bd%)
DECLARE SUB nainit (bd%, naname$, dv%)
DECLARE SUB prterr (msg$)

DIM LineBuffer$(512)
DIM cmd$(512)

PRINT "PROGRAM TRANSFER (PC/AT TO NA)"
INPUT "ENTER DOWNLOAD PROGRAM"; Name$
CALL gpinit("GPIB0", bd%)
CALL nainit(bd%, "DEV11", na%)

```

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12.7 Download of BASIC Program

```
OPEN Name$ FOR INPUT AS #1

DO UNTIL EOF(1)
    LINE INPUT #1, LineBuffer$      ' READ ONE LINE
    PRINT LineBuffer$              ' PRINT TO DISPLAY
    cmd$ = "@" + LineBuffer$
    CALL ibwrt(na%, cmd$)          ' TRANSFER PROGRAM TO NA
LOOP

CLOSE #1
CALL ibonl(na%, 0)
CALL ibonl(dv%, 0)
END

' This routine open the gpib board and initialize
'
SUB gpinit (bdname$, bd%) STATIC

    CALL ibfind(bdname$, bd%)      ' OPEN BOARD
    IF (bd% < 0) THEN
        CALL prtterr("ibfind error")
        STOP
    END IF

    CALL ibsic(bd%)                ' INTERFACE CLEAR
    IF (ibsta% AND EERR) THEN
        CALL prtterr("ibsic error")
        CALL ibonl(bd%, 0)
        STOP
    END IF

    CALL ibsre(bd%, 1)             ' REMOTE ENABLE
    IF (ibsta% AND EERR) THEN
        CALL prtterr("ibsre error")
        CALL ibonl(bd%, 0)
        STOP
    END IF
END SUB
```

```
        END IF

    END SUB

'   This routine open N.A and initialize
'
SUB nainit (bd%, dvname$, dv%) STATIC

    CALL ibfind(dvname$, dv%)
    IF (dv% < 0) THEN
        CALL prtterr("ibfind error")
        CALL ibonl(bd%, 0)
        STOP
    END IF

    cmd$ = "OLDC OFF;*RST"
    CALL ibwrt(dv%, cmd$)
    IF (ibsta% AND EERR) THEN
        CALL prtterr("ibwrt error")
        CALL ibonl(dv%, 0)
        CALL ibonl(bd%, 0)
        STOP
    END IF

    cmd$ = "@SCRATCH"
    CALL ibwrt(na%, cmd$)

END SUB

'   This routine prints the result of status variables.
'
SUB prtterr (msg$) STATIC

    PRINT msg$
    PRINT "ibsta=&H"; HEX$(ibsta%); " <";
    IF ibsta% AND EERR THEN PRINT " ERR";
```

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12.7 Download of BASIC Program

```
IF ibsta% AND TIMO THEN PRINT " TIMO";
IF ibsta% AND EEND THEN PRINT " EEND";
IF ibsta% AND SRQI THEN PRINT " SRQI";
IF ibsta% AND RQS THEN PRINT " RQS";
IF ibsta% AND CMPL THEN PRINT " CMPL";
IF ibsta% AND LOK THEN PRINT " LOK";
IF ibsta% AND RREM THEN PRINT " RREM";
IF ibsta% AND CIC THEN PRINT " CIC";
IF ibsta% AND AATN THEN PRINT " AATN";
IF ibsta% AND TACS THEN PRINT " TACS";
IF ibsta% AND LACS THEN PRINT " LACS";
IF ibsta% AND DTAS THEN PRINT " DTAS";
IF ibsta% AND DCAS THEN PRINT " DCAS";
PRINT ">"

PRINT " iberr = " ; iberr% ;
IF iberr% = EDVR THEN PRINT " EDVR <DOS Error>"
IF iberr% = ECIC THEN PRINT " ECIC <Not CIC>"
IF iberr% = ENOL THEN PRINT " ENOL <NO listener>"
IF iberr% = EADR THEN PRINT " EADR <Address error>"
IF iberr% = EARG THEN PRINT " EARG <Invalid argument>"
IF iberr% = ESAC THEN PRINT " ESAC <Not Sys Ctrlr>"
IF iberr% = EABO THEN PRINT " EABO <Op. aborted>"
IF iberr% = ENEB THEN PRINT " ENEB <No GPIB board>"
IF iberr% = EOIP THEN PRINT " EOIP <Async I/O in prg>"
IF iberr% = ECAP THEN PRINT " ECAP <No capability>"
IF iberr% = EFSO THEN PRINT " EFSO <Files sys. error>"
IF iberr% = EBUS THEN PRINT " EBUS <Command error>"
IF iberr% = ESTB THEN PRINT " ESTB <Status byte lost>"
IF iberr% = ESRQ THEN PRINT " ESRQ <SRQ stuck on>"
IF iberr% = ETAB THEN PRINT " ETAB <Table Overflow>"
PRINT "ibcnt"; ibcnt%
```

END SUB

12.7.4 Download Program in C

The download program to be executed with C is shown as follows.

Example 12-34 Download Program used for C

```
/*
 *      DOWN LOAD PROGRAM
 *
 * TARGET:   PC/AT(NI-488.2)
 * LANGUAGE: C (ANSI-C STYLE)
 * FILE:     MCDNLD.C
 */
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <errno.h>
#include "decl.h"

static char line[512];

/* prtterr - print gpib error message and status code
 */
static void prtterr(char *msg)
{
    printf("%s\n", msg);
    printf("ibsta=&H%x < ", ibsta);
    if (ibsta & ERR) printf("ERR");
    if (ibsta & TIMO) printf("TIMO");
    if (ibsta & SRQI) printf("SRQI");
    if (ibsta & RQS) printf("RQS");
    if (ibsta & CMPL) printf("CMPL");
    if (ibsta & LOK) printf("LOK");
    if (ibsta & CIC) printf("CIC");
    if (ibsta & TACS) printf("TACS");
    if (ibsta & LACS) printf("LACS");
    if (ibsta & DTAS) printf("DTAS");
}
```

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12.7 Download of BASIC Program

```
if (ibsta & DCAS) printf("DCAS");
printf(" >\n");

printf("iberr= %d", iberr);
switch(iberr)
{
  case EDVR: printf("EDVR <DOS Error>"); break;
  case ECIC: printf("ECIC <Not CIC>"); break;
  case ENOL: printf("ENOL <No listner>"); break;
  case EADR: printf("EADR <Address error>"); break;
  case EARG: printf("EARG <Invalid argument>"); break;
  case ESAC: printf("ESAC <Not Sys Ctrlr>"); break;
  case EABO: printf("EABO <Op.aborted>"); break;
  case ENEB: printf("ENEB <No GPIB board>"); break;
  case EOIP: printf("EOIP <Async I/O in prg>"); break;
  case ECAP: printf("ECAP <No capability>"); break;
  case EFSO: printf("EFSO <Fils sys. error>"); break;
  case EBUS: printf("EBUS <Command error>"); break;
  case ESTB: printf("ESTB <Status byte lost>"); break;
  case ESRQ: printf("ESRQ <SRQ stuck on>"); break;
  case ETAB: printf("ETAB <Table Overflow>"); break;
}
printf("ibcnt1= %d\n\n", ibcnt1);
}

/* gpinit - open gpib board and initialize
*/
static int gpinit(char *bdname)
{
  int    bd;

  if ((bd = ibfind(bdname)) < 0)          /* open board */
  {
    prterr ("ibfind error");
    return -1;
  }
}
```

```
    }

    if (ibsic(bd) & ERR)                /* interface clear */
    {
        prtterr("ibsic error");
        ibonl(bd, 0);
        return -1;
    }

    if (ibsre(bd, 1) & ERR)             /* remote enable */
    {
        prtterr("ibsre error");
        ibonl(bd, 0);
        return -1;
    }
    return bd;                          /* return descriptor */
}

/* nainit - open N.A Port and initialize
*/
static int nainit(char *dvname)
{
    int na;
    if ((na = ibfind(dvname)) < 0      /* open R3752/R3753 */
    {
        prtterr("ibfind error");
        return -1;
    }
}

ibwrt(na, "OLDC OFF;*RST", 14);      /* default command */
if (ibsta & ERR)
{
    prtterr("ibwrt error");
    ibonl(na, 0);
    return -1;
}
```

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12.7 Download of BASIC Program

```
        ibwrt(na, "@SCRATCH", 9);
        return na;
    }                                     /* return descriptor */

/* main entry
*/
main(int argc, char **argv)
{
    char  name[64], *s;
    FILE  *fp;
    int   bd, na;
    int   n;

    printf("PROGRAM TRANSFER (PC/AT to NA)\n");
    printf("Enter DOWNLOAD PROGRAM ?");
    fflush(stdout);
    fflush(stdin);
    if (scanf("%s", name) <=0)
    {
        fprintf(stderr, "File name error\n");
        exit(1);
    }

    if ((bd = gpinit("GPIB0")) == -1)
        exit(1) ;
    if ((na = nainit("DEV11")) == -1)
    {
        ibonl(bd, 0);
        exit(1);
    }

    if ((fp = fopen(name, "r")) == NULL)
    {
        fprintf(stderr, "%s: not found\n", name);
        ibonl(na, 0);
        ibonl(bd, 0);
    }
}
```



```

        exit ( 1 ) ;
    }
    line[0] = '@';
    while ((s = fgets(&line[1], 510, fp)) && *s != NULL)
    {
        printf("%s", line):
        ibwrt(na, line, strlen(line));
    }

    fclose(fp);
    ibonl(na, 0);
    ibonl(bd, 0);
}

```

12.8 Upload of BASIC Program

This section describes a method with which the program existing in the memory of this instrument side is uploaded to the external controller.

Since the up loaded program is controlled by external controller side, the using method is almost the same as that of the download program, pay attention to the following note.

(Note) *When the program of this instrument is uploaded with the upload program described in this example, let the last line of the program of this instrument be 65535 END. This is used to decide the lost line of the upload program.*

The example of upload program to be executed with N88-BASIC is shown as follows.

Example 12-35 Upload Program Used for N88-BASIC

```

1000 ' *****
1010 ' * *
1020 ' *          UPLOAD PROGRAM          *
1030 ' * *
1040 ' * TARGET: PC-9801 *
1050 ' * FILE :  NDOWNLD.N88 *
1060 ' *****
1070 NA=11
1080 ISET IFC
1090 ISET REN
1100 CMD DELIM=0
1110 CMD TIMEOUT=3
1120 '

```

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12.8 Upload of BASIC Program

```
1130 ON ERROR GOTO *ERRORMES
1140 PRINT "PROGRAM UPLOAD (NA to PC)"
1150 '
1160 *UPLD. ENTER
1170     FLAG=0
1180     INPUT "ENTER NEW FILE NAME";F$
1190     OPEN F$ FOR OUTPUT AS #1
1200     IF FLAG=1 THEN *UPLD. ENTER
1210 '
1220     PRINT "UpLoading... (Saving";F$;" )"
1230     PRINT @NA;"@GLIST"
1240 '
1250 *UPLD. LOOP
1260     LINE INPUT @NA;DA$
1270     PRINT DA$
1280     PRINT #1,DA$
1290     IF DA$ <>"65535 END" THEN *UPLD.LOOP
1300     CLOSE
1310     PRINT "COMPLETE UPLOAD"
1320     ON ERROR GOTO 0
1330     END
1340 '
1350 *ERRORMES
1360     FLAG=1
1370     PRINT "ERROR: LINE=";ERL;"NO.=";ERR
1380     INPUT "RETRY? (Y/N)";A$
1390     IF A$="Y" OR A$="y" THEN RESUME NEXT
1400     ON ERROR GOTO 0
1410     END
```

12.9 Transferring Correction Data

This section presents an example of program that performs input and output all correction data of two port calibrations between external controllers.

Transferring correction data is carried out with the same method as used for tracing (wave form) data.

There are two formats of transferring data : ASCII and binary, just as for the tracing data, the transferring can be performed in higher speed with binary format. Here, a transferring program in binary format is taken as an example and presented with N88-BASIC and C.

12.9.1 Transferring Correction Data Between This Instrument and PC-9801 (N88-BASIC)

This program is used to transfer the correction data between this instrument and PC-9801.

(Note) NEC pure GPIB interface board is used.

In the case of data receiving, the correction data from this instrument is transferred to PC-9801 and stored in the disk drive on PC-9801. Perform the two port calibrations in advance.

On the other hand, in the case of data sending , the data is transferred to this instrument after the data in the disk drive is loaded. It is necessary to keep the setting conditions such as point count, etc. as they are stored.

When this program is executed, 1 : Receive (SAVE) , 2 : Send (LOAD) ? is displayed. Input 1 to receive (save) the data , and input 2 to send (regenerate) the data. Since File name = ? is displayed next , input the file name.

Example 12-36 Transferring Correction Data Between This Instrument and PC-9801 (Binary format)

```

1000 ' *****
1010 '
1020 '          TRANSFER 2PORT CAL. DATA
1030 '
1040 ' *****
1050 '
1060 CLEAR &H100
1070 DEF SEG=SEGPTR(2)
1080 DIM TR1!(1201*2+4)
1090 '
1100 GOSUB *SETUP.GPIBCALL
1110 ISET IFC: ISET REN
1120 CMD DELIM=3
1130 PC98=IEEE(1) AND &H1F           ' my GPIB address
1140 NA=11                          ' target GPIB address
1150 BITLEN%=32                      ' bit length (32 or 64)

```

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12.9 Transferring Correction Data

```
1160 PRINT @NA;"OLDC OFF" @
1170 PRINT @NA;"SWE:POIN?" @
1180 INPUT @NA;POINTS%
1190 PRINT @NA;"FORM MBIN,"+STR$(BITLEN%) @
1200 DT=12 ' number of traces
1210 NUMSET%=2*POINTS%*(BITLEN%/8)+9
1220 '
1230 *FORM.DATA
1240 DATA EDF,ESF,ERF,ELF,ETF,EXF
1250 DATA EDR,ESR,ERR,ELR,ETR,EXR
1260 '
1270 CLS
1280 INPUT "1:Receive(SAVE), 2:Send(LOAD)";MODE
1290 IF MODE<1 OR 2<MODE THEN END
1300 INPUT "File name = ";FILENAME$
1310 ON MODE GOSUB *SAVE.CALDATA,*LOAD.CALDATA
1320 END
1330 '
1340 ' save full calibration data
1350 *SAVE.CALDATA
1360 RESTORE *FORM.DATA
1370 OPEN FILENAME$ FOR OUTPUT AS #1
1380 FOR J=1 TO DT
1390 READ FORM$
1400 GOSUB *RECEIVE.TRACE
1410 GOSUB *WRITE.TRACE
1420 NEXT
1430 CLOSE #1
1440 RETURN
1450
1460 ' load full calibration data
1470 *LOAD.CALDATA
1480 RESTORE *FORM.DATA
1490 OPEN FILENAME$ FOR INPUT AS #1
1500 FORM$="DATA":GOSUB *RECEIVE.TRACE
1510 FOR J=1 TO DT
```

```
1520 READ FORM$
1530 GOSUB *READ.TRACE
1540 GOSUB *SEND.TRACE
1550 NEXT
1560 CLOSE #1
1570 PRINT @NA;"CORR:CSET:STAT ON" @
1580 RETURN
1590 '
1600 ' receive data on one trace
1610 *RECEIVE.TRACE
1620 PRINT @NA;"TRAC:DATA?" +FORM$ @           ' trace data read
1630 WBYTE &H3F,&H5F,&H40+NA,&H20+PC98;        ' set TALKER/LISTENER
1640 NUM%=NUMSET%                               ' read buffer size
1650 CALL RECEIVE.DATA(TR1!(0),NUM%)           ' read data
1660 RETURN
1670 '
1680 ' send data on one trace
1690 *SEND.TRACE
1700 NUM%=NUMSET%
1710 PRINT @NA;"TRAC:DATA"+FORM$+"", "
1720 CALL SEND.DATA(TR1!(0),NUM%)
1730 RETURN
1740 '
1750 ' write trace data into the file
1760 *WRITE.TRACE
1770 FOR I=0 TO 2*POINTS%-1
1780 PRINT #1,TR1!(1+2)
1790 NEXT I
1800 RETURN
1810 '
1820 ' read trace data from the file
1830 *READ.TRACE
1840 FOR I=0 TO 2*POINTS%-1
1850 INPUT #1,TR1!(I+2)
1860 NEXT I
1870 RETURN
```

NETWORK ANALYZER PROGRAMMING GUIDE

12.9 Transferring Correction Data

```
1880 '
1890 ' setup system calls
1900 *SETUP.GPIBCALL
1910 RECEIVE.DATA=&H0: SEND.DATA=&H39
1920 RESTORE *GPIB.BIOS
1930 FOR ADR=0 TO &H65
1940 READ BYTE$: POKE ADR,VAL("&H"+BYTE$)
1950 NEXT
1960 RETURN
1970 '
1980 *GPIB.BIOS
1990 DATA 50,51,52,06,56,57,55,53, 8B,4F,02,8E,C1,8B,37,26
2000 DATA 8B,0C,8B,7F,04,8E,47,06, BB,00,00,BE,00,00,B0,80
2010 DATA B4,05,CD,D1,5B,53,8B,4F, 02,8E,C1,8B,37,26,89,14
2020 DATA 5B,5D,5F,5E,07,5A,59,58, CF,50,51,52,06,56,57,55
2030 DATA 53,8B,4F,02,8E,C1,8B,37, 26,8B,0C,8B,7F,04,8E,47
2040 DATA 06,BB,00,00,BE,00,00,B0, 80,B4,04,CD,D1,5B,5D,5F
2050 DATA 5E,07,5A,59,58,CF
```

12.9.2 Transferring Correction Data Between This Instrument and PC/AT (C language)

This program is used to transfer the correction data between this instrument and PC/AT. In the case of data receiving, the correction data from this instrument is transferred to PC/AT, and stored in the disk drive on PC/AT. Perform the two port calibrations in advance. On the other hand, in the case of data sending, the data is transferred to this instrument after the data in the disk drive is loaded. It is necessary to keep the setting conditions such as point count, etc. as they are stopped.

When this program is executed, 1 : Receive (SAVE) , 2: Send (LOAD) ? is displayed. Input 1 to receive (save) the data and input 2 to send (regenerate) the data. Since File name = ? is displayed next, input the file name.

(Note) NI-488.2 interface board and library functions are used.

Example 12-37 Transferring Correction Data Between This Instrument and PC/AT(Binary format)

```

/* Transfer two port full calibration data via GPIB
 * between R376X and DOS/V PC with NI-488 GPIB board
 * FORMat [:DATA] REAL,32
 * How to compile: bcc trans.c mcib.lib
 */

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "decl.h"          /* NI-488.2 headers <DOS> */

#define ADDRESS 11        /* target GPIB address */
#define KIND     12       /* kinds of cal. data */
#define COMP     2        /* 1(FDATn) or 2(others) */
#define BYTE     4        /* 4(REAL,32) or 8(REAL,64) */
#define HEAD     8        /* block header length */
#define FOOT     1        /* block footer(LF) length */
#define TRAC     9        /* command " RAC E**," length */
#define BUFLLEN (HEAD+1201 * BYTE * COMP+FOOT)
#define EOT__CONFIG 1     /* ibeot configuration value */
#define EOS__CONFIG 0     /* ibeos configuration value */

char *form[] = {
    "EDF", "ESF", "ERF", "ELF", "ETF", "EXF",
    "EDR", "ESR", "ERR", "ELR", "ETR", "EXR"
};

void gpib__err(int id, char *msg)
{
    if (id == -1)
        fprintf(stderr, "%s\n", msg);
    else
    {
        fprintf(stderr, "%s: ibsta=0x%x, iberr=%d, ibcnt=%d\n",
            msg, ibsta, iberr, ibcnt);
    }
}

```

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12.9 Transferring Correction Data

```
        ibonl(id,0);
    }
    exit(-1);
}

int gpib__init(int address)
{
    int id;

    if ((id = ibdev(0, address, 0, T1s, EOT__CONFIG, EOS__CONFIG)) <0)
        gpib__err(id, "ibdev error");

    if (ibdma(0, 1) & ERR)                /* enable DMA transfer */
        gpib__err(id, "ibdma error");

    return id;                            /* return device identifier */
}

void gpib__end(int id)
{
    if (ibonl(id, 0) & ERR)                /* interface offline */
        gpib__err(id, "ibonl error");
}

int send__buf(int id, char *buf)
{
    int len;

    len = strlen(buf);
    if (ibwrt(id, buf, (long)len) & ERR)    /* IBWRT */
        gpib__err(id, "ibwrt error");
    return ibcnt1;                          /* return actual sent bytes */
}

int receive__buf(int id, char *buf)
```



```
{
    int eval, count = 0;

    while (1)
    {
        if ((eval = ibrd(id, buf, (long)BUFLen)) & ERR) /* IBRD */
            gpib__err(id, "ibrd error");
        count += ibcnt1; /* sum total length */
        if (eval & END) /* END or EOS detected */
            break;
    }
    return count; /* return actual received bytes */
}

float btof(char *buf) /* 32bit raw binary to float */
{
    char tmp[4];

    tmp[3] = buf[0];
    tmp[2] = buf[1];
    tmp[1] = buf[2];
    tmp[0] = buf[3];
    return *((float *)tmp)
}

void ftob(float *f, char *buf) /* float to 32bit raw binary */
{
    buf[3] = *((char *)f + 0);
    buf[2] = *((char *)f + 1);
    buf[1] = *((char *)f + 2);
    buf[0] = *((char *)f + 3);
}

void save__caldata(int id, char *buf, char *filename)
{
    FILE *fp;
```

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12.9 Transferring Correction Data

```
int i, j, len;

if ((fp = fopen(filename, "w") == NULL)
    gpib__err(-1, "File open error");
for (j = 0; j < KIND; j++)
    {
    sprintf(buf, "TRAC? %3s", form[j]);
    send__buf(id, buf);
    len = receive__buf(id, buf);

    for (i = 0; i < (len - HEAD - FOOT) / BYTE; i++)
        fprintf(fp, "%f\n", btof (buf + HEAD + i * BYTE));
    }
fclose(fp);
}

void load__caldata(int id, char *buf, char *filename)
{
FILE *fp;
float f;
int i, j, pts;

send__buf(id, "SWE:POIN?");
receive__buf(id, buf);
sscanf(buf, "%d", &pts);

if ((fp = fopen(filename, "r")) == NULL)
    gpib__err(-1, "File open error");

for (j = 0; j < KIND; J++)
    {
    sprintf(buf, "TRAC %3s,#6%06d", form[j], pts * BYTE * COMP);

    for (i = 0; i < pts * COMP; i++)
        {
        fscanf(fp, "%f", &f);
```

```
        ftob(&f, buf + TRAC + HEAD + i * BYTE);
    }
    *(buf + TRAC + HEAD + pts * BYTE * COMP) = '\n';

    if (ibwrt(id, buf, (long)(TRAC + HEAD + pts * COMP * BYTE +
                                FOOT)) & ERR)
        gpib__err(id, "ibwrt error")
    }
    send__buf (id, " CORR:CSET:STAT ON");
}

void main(void)
{
    int id;
    char *buf, filename[20];
    if ((buf = malloc(BUFLen)) == NULL)
        gpib__err(-1, "Memory allocation error");

    id = gpib__init (ADDRESS);
    send__buf(id, "OLDC OFF");
    send__buf(id, "FORM REAL,32");

    while (1)
    {
        printf("1:Receive(SAVE), 2:Send(LOAD) ?");
        if (strchr ("12", *gets(buf)) != NULL)
            break;
    }

    printf("File name =?");
    gets (filename);

    switch(* buf)
    {
        case '1':
            save__caldata(id, buf, filename);
            break;
    }
}
```

12.9 Transferring Correction Data

```
        case '2':  
            load_caldata(id, buf, filename);  
            break;  
        }  
  
    gpib__end(id);  
}
```

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WARRANTY

ADVANTEST product is warranted against defects in material and workmanship for a period of one year from the date of delivery to original buyer.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by buyer, unauthorized modification or misuse, accident or abnormal conditions of operations.

No other warranty is expressed or implied. ADVANTEST specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

ADVANTEST shall not be liable for any special incidental or consequential damages, whether in contract, tort or otherwise.

Any and all warranties are revoked if the product is removed from the country in which it was originally purchased.

SERVICE

During the warranty period, ADVANTEST will, at its option, either repair or replace products which prove to be defective.

When trouble occurs, buyer should contact his local supplier or ADVANTEST giving full details of the problem and the model name and serial number.

For the products returned to ADVANTEST for warranty service, buyer shall prepay shipping and transportation charges to ADVANTEST and ADVANTEST shall pay shipping and transportation charges to return the product to buyer. However, buyer shall pay all charges, duties, and taxes incurred in his country for products returned from ADVANTEST.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL BUYER

The product should be thoroughly inspected immediately upon original delivery to buyer. All material in the container should be checked against the enclosed packing list or the instruction manual alternatively. ADVANTEST will not be responsible for shortage unless notified immediately.

If the product is damaged in any way, a claim should be filed by the buyer with carrier immediately. (To obtain a quotation to repair shipment damage, contact ADVANTEST or the local supplier.) Final claim and negotiations with the carrier must be completed by buyer.

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