ADVANTEST®
ADVANTEST CORPORATION

INSTRUCTION
# MANUAL
# R4136
## SPECTRUM ANALYZER

MANUAL NUMBER OEH00 9204



First printing September 19, 1987
Printed in Japan

No. ESB002

# 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.

Careful attention to personal safety should be paid when operating and servicing this instrument. Please be sure to always use this instrument correctly and safely.

## ■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.

## ■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

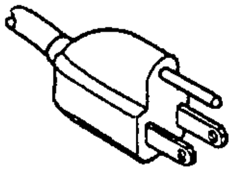
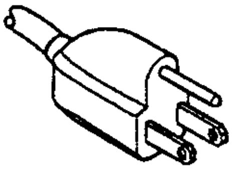
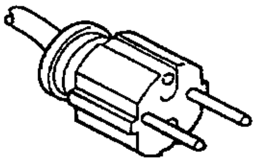
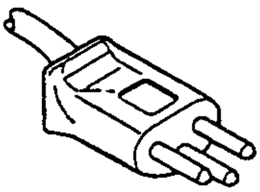
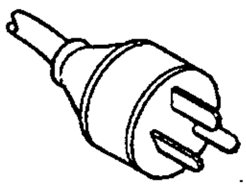
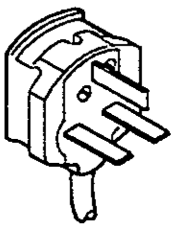
(3) Ni-Cd (nickel cadmium)

(4) Other

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

# Table of Power Cable options

There are six power cable options (refer to following table).
Order power cable options by Accessory Codes.

| | Plug Configuration | Standards | Rationg, Color and Length | Accessory Codes (Option Number) |
|---|---|---|---|---|
| 1 |  | JIS: Japan<br>Law on Electrical Appliances | 125V at 7A<br>Black<br>2m (6ft) | Straight: A01402<br>(Standard)<br>Angled: A01412 |
| 2 |  | UL: United States of America<br>CSA: Canada | 125V at 7A<br>Black<br>2m (6ft) | Straight: A01403<br>(Option 95)<br>Angled: A01413 |
| 3 |  | CEE: Europe<br>VDE: Germany<br>OVE: Austria<br>SEMKO: Sweden<br>DEMKO: Denmark<br>KEMA: Holland<br>FIMKO: Finland<br>NEMKO: Norway<br>CEBEC: Belgium | 250V at 6A<br>Gray<br>2m (6ft) | Straight: A01404<br>(Option 96)<br>Angled: A01414 |
| 4 |  | SEV: Switzerland | 250V at 6A<br>Gray<br>2m (6ft) | Straight: A01405<br>(Option 97)<br>Angled: A01415 |
| 5 |  | SAA: Australia, New Zealand | 250V at 6A<br>Gray<br>2m (6ft) | Straight: A01406<br>(Option 98)<br>Angled: ―――― |
| 6 |  | BS: United Kingdom | 250V at 6A<br>Black<br>2m (6ft) | Straight: A01407<br>(Option 99)<br>Angled: A01417 |

# PREFACE

1. Related Manual

| | |
|---|---|
| TR4515 | Synthe Sized Sweeper |
| TR13211 | Sweep Adaptor |
| TR4154 | Tracking Generator |
| TR4153A/B | Tracking Generator |

2. In this manual, softkey menus displayed on the CRT is enclosed in dotted lines, e. g. EXT INPUT . To select a desired softkey menu, press the soft key (on the right of the softkey menu) corresponding to that item.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

# LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont'd)

LIST OF ILLUSTRATIONS (Cont'd)

LIST OF ILLUSTRATIONS (Cont'd)

## LIST OF TABLES

LIST OF TABLES (Cont'd)

# LIST OF EXAMPLES

# 1. GENERAL

With this manual, we will explain how to operate the R4136 spectrum analyzer for basic operations.

This chapter describes how to use this instruction manual and outlines the functions provided for this analyzer. It also sets out the procedures for setting up this analyzer up until connecting the power source, and details some precautions. Be sure to read these before starting measurement.

## 1.1 USING THIS INSTRUCTION MANUAL

Those users who have no knowledge or experience of this type of analyzer are to read all the chapters of this manual starting with Chapter 1.

Those users who have some such knowledge or experience may read only Chapter 1 and Chapter 5 and then will gain general understanding of the R4136 spectrum analyzer.

This manual is set out as in the blocks shown below.

| | |
|---|---|
| 1. INTRODUCTION OF R4136 | Provides introductory remarks and general cautions on the R4136 spectrum analyzer. |
| 2. FOR THE FIRST USERS OF R4136 | Provides general description on the individual parts of the R4136 spectrum analyzer and their basic operating procedure. |
| 3. OPERATING PROCEDURES (1) | Functional description: Describes the basic functions of the R4136 spectrum analyzer as it works as a spectrum analyzer. |
| 4. OPERATING PROCEDURES (2) | Functional description: Describes the individual functions of the R4136 spectrum analyzer as it works as an intelligent analyzer. |
| 5. EXAMPLES OF MEASUREMENT | Provides the examples of basic measurement. |
| 6. GPIB: REMOTE PROGRAMMING | Provides general description on GPIB and shows its programming. |
| 7. OPTION 06 | Describes how to use the MEMORY-CARDs. |

(To be continued to the next page.)

(Continued from the previous page.)

| | |
|---|---|
| 8. INSPECTION AND SIMPLE MAINTENANCE | Describes the procedures of inspection and maintenance of the R4136 spectrum analyzer. |
| 9. SPECIFICATIONS AND ACCESSORIES PROVIDED | Describes the specifications and accessories of the R4136 spectrum analyzer. |
| 10. PRINCIPLES OF OPERATION | Provides the principle of operation of the R4136 spectrum analyzer. |
| APPENDIX | Provides the glossary, level conversion table, and list of softkey menus. |
| INDEX | |
| SKETCH DRAWINGS | Provides the views of the appearance, dimensions, and front and rear panels of the R4136 spectrum analyzer. |

## 1.2 OUTLINE OF PRODUCT

This instrument is a spectrum analyzer that uses synthesized local oscillators and high-frequency instrumentation technology, which together make the instrument capable of analyzing spectrum with high stability. The instrument has various types of basic performance capabilities. These include: a wide frequency range from 0.5 kHz to 23 GHz (the range can be extended with an external mixer); a wide input range from -131 dBm to +30 dBm; high resolution up to a maximum of 30 Hz; a residual FM level below30 Hzp-p (frequency ≦ 7.5 GHz, span ≦ 2 MHz); a proximity noise response of -95.5 dBz/Hz (at a frequency of 20 GHz, 20kHz off the carrier); a dynamic range from 3.5 GHz to 23 GHz at 100 dB; and so on. The instrument also enables high-accuracy frequency counting, occupied-bandwith measurement (option), and adjacent-channel leakage power measurement (option). A memory card option, in addition to the standard GPIB full-remote control function, enables programming of panel operations, storage of programs using IC cards, and automatic measurement in solation from a host system.

< Features of the instrument >

① Measurements can be made over a wide range from 0.5 KHz to 23 GHz, and log sweeping at up to 1 GHz is also possible.

② In a range from 3.5 GHz to 23 GHz, use of the preselector function contained in the instrument allows measurement of wide dynamic ranges exceeding 100 dB. This function is useful for spurious signal measurement, intermodulation distortion measurement, etc.

③ Adjacent high-frequency signals and spurious signals can be analyzed at a high frequency-resolution level up to a maximum of 30 Hz.

④ The built-in reference crystal oscillator with a aging rate of 2 x $10^{-7}$/week enables frequency measurement using the marker in the counter mode to be made at a resolution level of 1 Hz. Very week signals up to 23 GHz that are not measurable with an ordinary counter can be measured using the high-sensitivity counter function.

⑤ The synthesized local osciallator enables high-accuracy frequency setting.

⑥ The grated-sweep function enables burst signals to be analyzed without the restrictions that have conventionally been imposed on such analysis.

⑦ An occupied-bandwidth measurement function and an adjacent-channel leakage power measurement function are available as options. (Both option 04)

⑧ Panel operations can be programmed with the memory card (option 06). This programming in turn enables automatic measurement by GO/NO-GO identification, storage of programs using IC cards, and; storage of screen information (including that about the waveform display on the CRT).

⑨ The excellent neiboring response of -95.5 dBc/Hz (at a frequency of 20 GHz, 20 kHz off the carrier) is ensured by the uniquely combined synthesizer technology and high-purity YIG technology. Neiboring spurious signals can therefore be measured at high accuracy during microwave communications.

⑩ Use of the TR13211 sweep adapter in combination with the TR4515 sweeper (10 MHz to 18 GHz) enables the dynamic-range response of frequencies up to 18 GHz to be measured at high speed. Higher accuracy of frequency measurement can be achieved by using the TR4154 tracking generator (100 kHz to 3.5 GHz) in conjunction with the TR4153A/TR4153B (100 kHz to 2 GHz).

# 1.3 PREPARATIONS

## 1.3.1 Checking of Appearance and Accessories

When this equipment is delivered to you, check that no damages occurred during transportation. Then check the quantity and standards of the standard attachments according to [Table 1-1].

If the equipment is damaged or any of the standard attachments are missing, contact our CE head office (in the CE center in Yokohama), nearest sales office, or agency.

The addresses and telephone Nos. are listed at the end of this document.

Table 1-1 Standard Accessories (1/2)

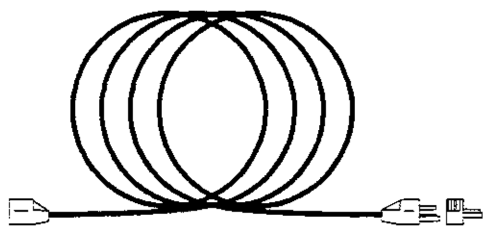
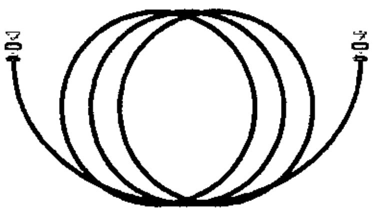
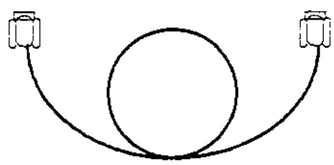
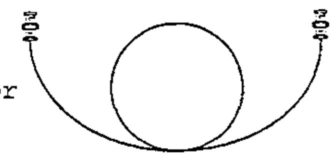
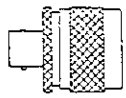
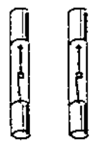
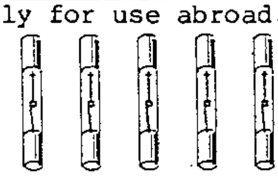
| Product names | Standards | Parts codes | Q'ty | Remarks |
|---|---|---|---|---|
| Power supply cable | A01402 | DCB-DD2428X01 | 1 |  |
| Input cable | MI-02 | DCB-FF0386 | 1 | Connector UG-88/U BNC-BNC  |
| | A01002 | —— | 1 | Connector SMA-SMA  |

Table 1-1 Standard Accessories (2/2)

| Product names | Standards | Parts codes | Q'ty | Remarks |
|---|---|---|---|---|
| Input cable | MC-06 | DCB-FF0298 | 1 | Connector UG-88/U BNC-BNC  |
| N-BNC conversion adapter | JUG-201A/U | JCF-AF001EX03 | 1 |  |
| Power supply fuse | MDA-2.5A | DFT-AF2R5A-1 | 2 | For 100/200 VAC specification  |
| | MDX-1.25A | DFT-AG1R25A | | For 220/240 VAC specification |
| Internal fuse | TMF51NR1 | DFN-AA1A | 5 | *: Only for use abroad.  |
| Operation manual | —— | JR4136 | 1 | Japanese sentence |
| | —— | ER4136 | | English sentence |

### 1.3.2 The Line Fuses and Setup of Line Voltage

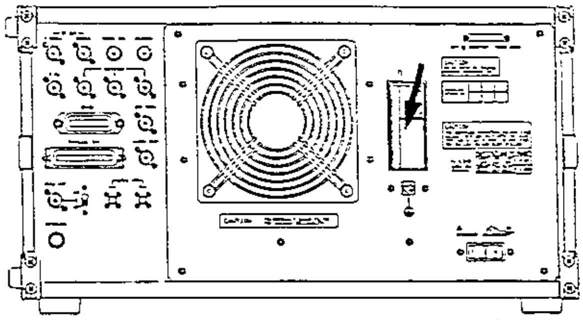


Figure 1-1 Line Fuse and Line Voltage Selector Location

Table 1-2 Rating for Line Fuses

| Supply voltage | Standards | Parts codes |
|---|---|---|
| 100/120 V | MDA-2.5 A | DFT-AF2R5A |
| 220/240 V | MDX-1.25 A | DFT-AG1R25A |

(1) Replacing the fuse

Before replacing the fuse, disconnect the power cable from the AC LINE connector. After disconnecting this cable, slide up the fuse-box plastic cover located underneath the AC LINE connector and then pull the FUSE PULL lever toward you. The fuse can now be removed. (See Figure 1-2.)

the fuse must be replaced with a supplied one or with a nonsupplied one rated at the specifications (see Table 1-2).

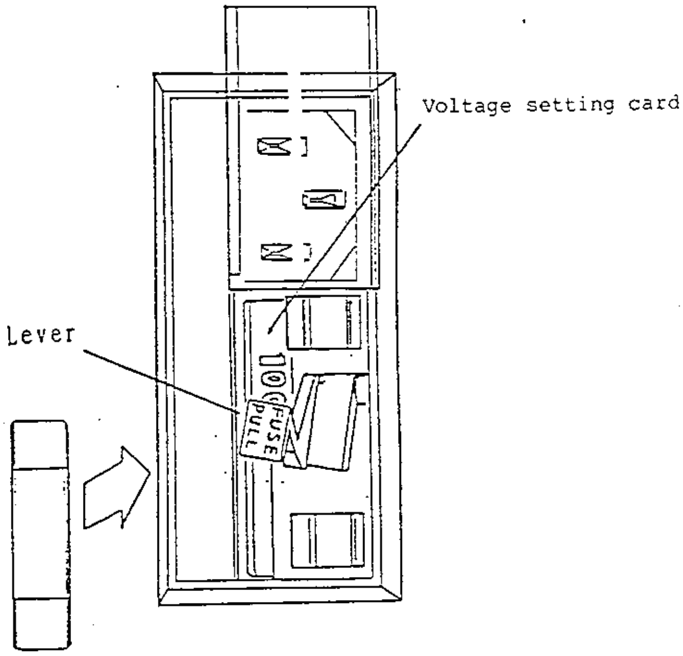



Figure 1-2 Fuse Replacement and Voltage Setting Card

(2) Resetting the voltage-setting card

If the instrument is to be operated on power other than 100 VAC, the card located to the left of the fuse must be reset. On removing the fuse. You will see the 100 V-labeled card on the left side of the FUSE PULL lever. Voltage settings of 120 V, 220 V, and 240 V, in addition to 100 V, are inscribed on the card. Change the direction of the card or hold it upside down, and insert it in the direction that allows you to read the value of the operating voltage after inserting the card. (See Figure 1-2).

### 1.3.3 Power Cable

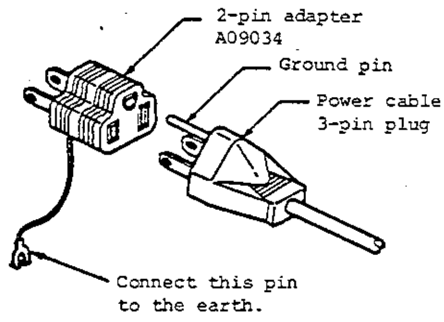
A power cable plug consists of three pins. Its rounded center pin works as a ground.

When connecting the power cable to the outlet by using the two-pin adapter, connect either the ground lead or the ground terminal mounted on the rear panel of the mainframe to the external earth for grounding.

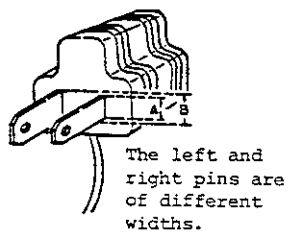
The supplied adapter A09034 (KPR-18) conforms to the Electrical Appliance and Material Control Law of Japan. This A09034, illustrated in Figure 1-3 (b), has two different-width electrodes. Accordingly, you should confirm the polarization of both the plug and outlet, and insert the adapter into the inlet properly. When A09034 does not fit the inlet to be used, purchase another adapter KPR-13.

**CAUTION**

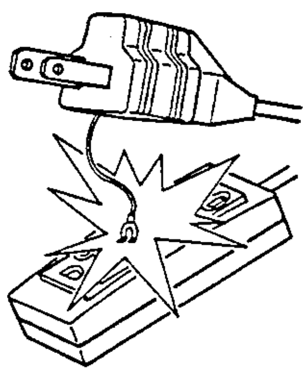
The power cable connection to the power source can supply power to this R4136 analyzer even if the POWER switch is set OFF. Therefore, be sure to remove the power cable to completely turn OFF the analyzer power source.




(a) Power plug




(b) Adapter A09034



Be careful not to short circuit the adaptor ground lead line.

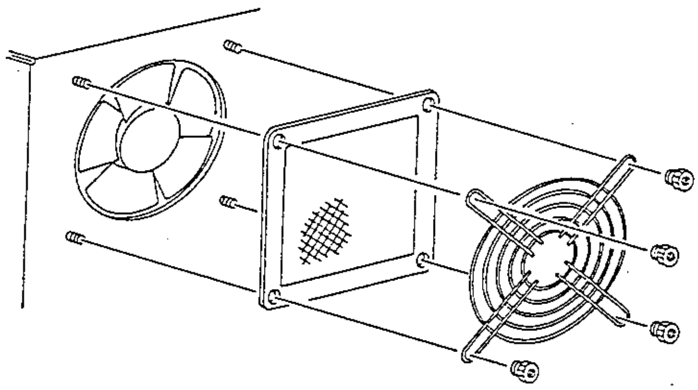
Figure 1-3 Power Cable Plug & Adapter

### 1.3.4 Operating Environment

(1) Avoid places where the equipment may be exposed to direct sunlight, dust and corrosive gas. Ambient temperature should be between 0 to +50oC. Humidity should be 85% or less.

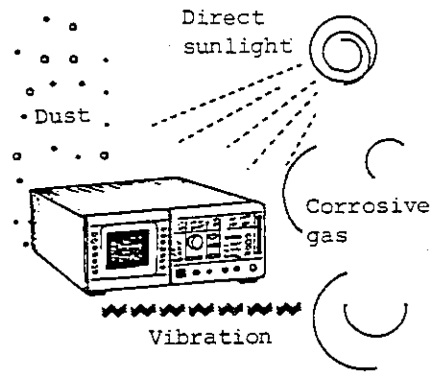
(2) This R4136 analyzer has a cooling fan on its rear panel to prevent temperature rising inside the frame. This fan is an exhaust type, and therefore, you should allow a space of more than 10-cm between the panel and any object such as a back wall. Remember never to place anything very close to the rear panel of the analyzer.
When the air filter of fan becomes clogged, the internal temperature of this device will rise, to causing problems. Therefore, clean the air filter periodically.

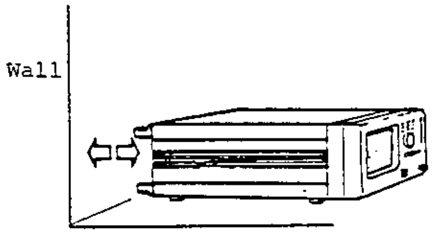
< Removal of air filter >



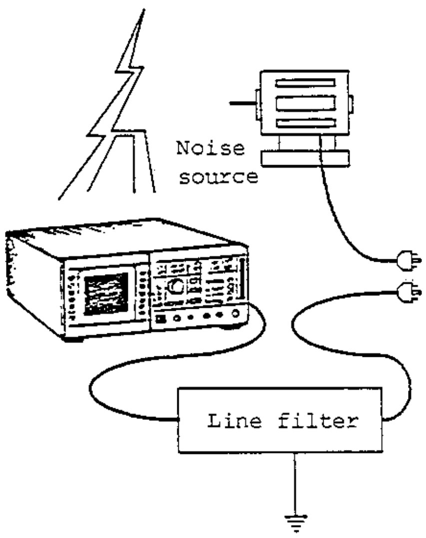
(3) R4136 has been well designed against noise generation at the AC power line. However, you should use it in a place of the least possible noise. If you cannot avoid noise generation, use the noise filter.

(1) Avoid such places given below.




(2) Put the unit away from the wall by more than 10 cm.




(3) To avoid a large amount of noise superposed in the power line, use the noise filter.

Figure 1-4 Working Environmental Conditions

### 1.3.5 Storage, Cleaning, and Transportation

(1) Storage

The R4136 spectrum analyzer should be kept in temperatures ranging from −20 to +60°C. When left unused for a long time, it should be covered with vinyl sheet and other appropriate cover or contained in a corrugated fiberboard box for storage in a dry place free from direct sunlight.

(2) Cleaning

The filter protecting the CRT display should be cleaned regularly with soft cloth and other appropriate material.

WARNING

For maintenance or cleaning of the R4136 spectrum analyzer, do not use any solvent that will deteriorate plastics (e. g. benzene, toluene, acetone, and other organic solvent).

Ordinary maintenance requires cleaning of only the surface of the filter. When the inside of the filter and the CRT display itself are dirty, clean them with soft cloth and other appropriate material after removing the vessel in accordance with the procedure below.

Procedure of Removing CRT Display Filter

① Remove the belt cover with a phillips screwdriver.

② Remove the two screws on the top of the vessel.

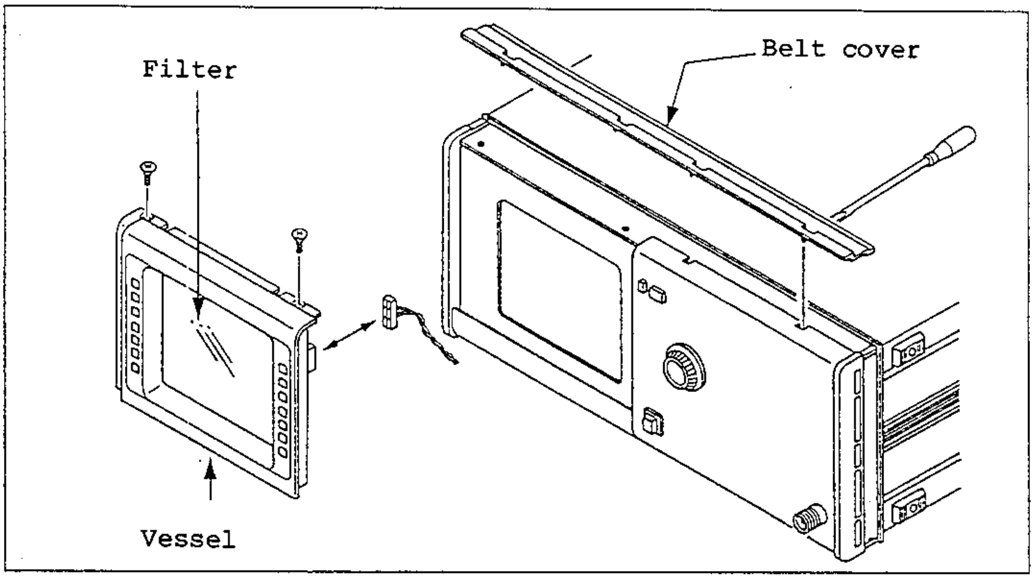



Figure 1-5 Removing CRT Display Filter

(3) Transportation

To transport the R4136 spectrum analyzer, use the packing material delivered together with it or its equivalent of the same or higher quality. If the designated packing material is lost or if its equivalent is not available, cover the spectrum analyzer with appropriate cushioning material and place it in a corrugated fiberboard box with the thickness of 5mm or more. Then place the accessories on the spectrum analyzer thus protected, place another cushioning material on them, close the box, and fasten the outside of the box with an appropriate packing cord.

MEMO

# 2. FOR THE FIRST USERS OF R4136

This chapter describes each block of the panel, display screen, and default state of the R4136 analyzer. For users who are about to use this analyzer for the first time, this chapter will demonstrate how to operate the most basic keys.

# 2.1 DESCRIPTIONS OF THE PANELS

## 2.1.1 Front Panel

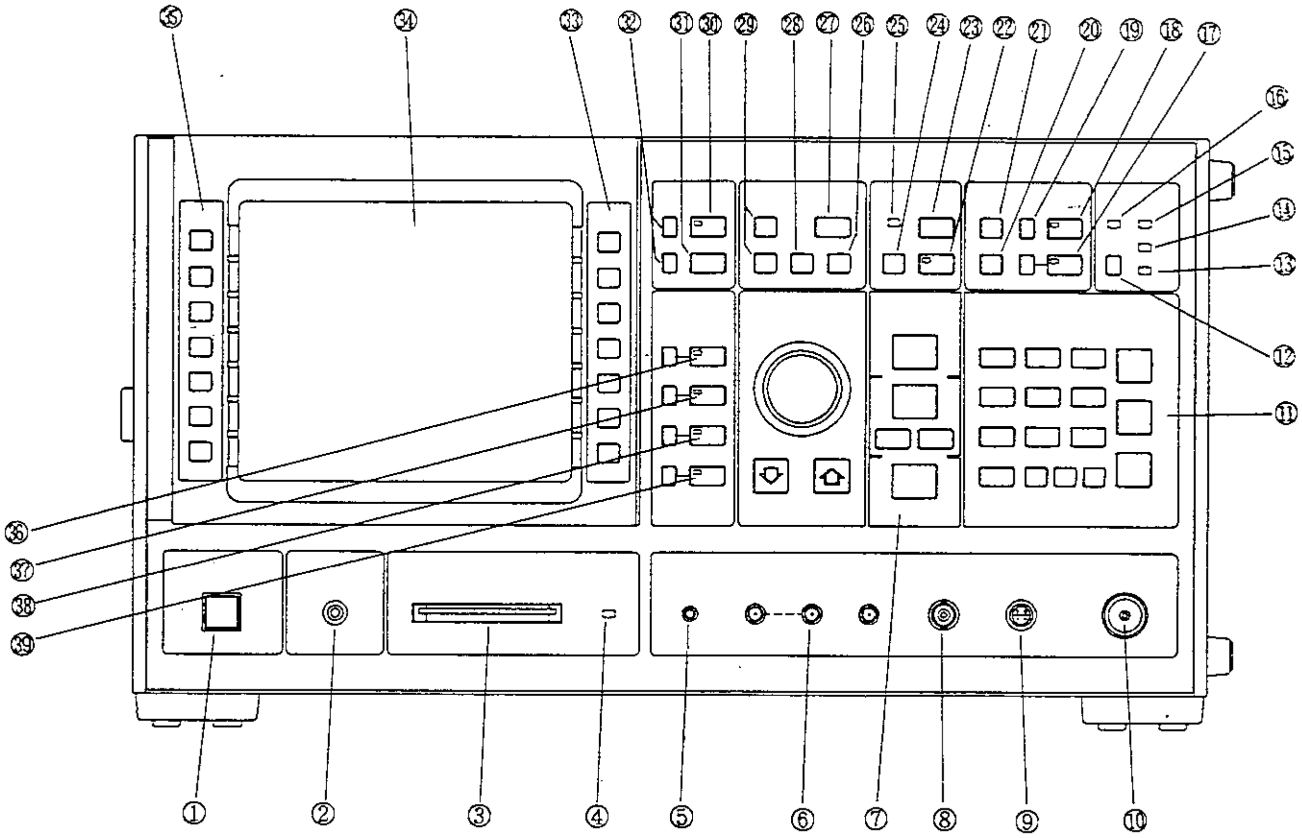



Figure 2-1 Description of Front Panel

Description

1. Power switch
2. 8Ω earphone terminal
3. Comes on at the start of the IC card driver
4. IC card driver [Optional]
5. Level display calibration knob
6. External mixer connection terminal
7. FUNCTION section
   CENTER FREQuency: Center frequency
   FREQuency SPAN : Frequency span
   REFerence LEVEL : Reference level
   START and STOP : Sweep start frequency and stop frequency
   → Sets the input mode for the above data
8. Calibration signal output terminal (200MHz, -10dBm)
9. Power for such accessories as active probes


1:NC
2:GND
3:-15 V
4:+15 V

10. Input terminal: N type connector
11. Ten-key pad and unit key
    : Sets numerical data
    The [.] key sets a decimal point while the [±] key sets polarity
    The [BK SP] key backspaces
    The data knob finely adjusts input data
    The step key changes data sequentially
12. LOCAL mode selection
    : Suspends external control and enables keying
13. Comes on at the start of the LISTENer
14. Comes on at the start of the TALKer
15. Comes on during transmission of Service ReQuest
16. ReMote : Comes on during control of the external controller
17. Sets the screen character entry mode
    This mode is cleared by pressing the [CLR] key
18. Sets the automatic measurement programming mode [OPTION 06]
19. Displays other function menus [Optional]
20. Stores the panel settings in memory
21. Initializes all settings
22. Sets the manual sweep mode
23. Selects a trigger condition setting mode and displays softkey menu
24. Starts sweep during the SINGLE trigger mode and resets the SINGLE trigger mode during sweep
25. Comes on during sweep
26. Sets marker frequency to center frequency
27. Displays the softkey menu during marker mode
28. Moves the marker to the maximum waveform peak for display on the CRT
29. The [ON] key displays the marker while the [OFF] key clears it
30. Selects WRITE during trace mode
31. Displays the softkey menu during trace mode
32. Selects trace memories A and B
33. Softkeys
34. CRT display
35. Edit keys
36. Sets sweep time
37. Sets resolution bandwidth
38. Sets video bandwidth
39. Sets the operation mode for each input attenuator
    The [AUTO] key automatically sets the optimum operating conditions for each input attenuator

### 2.1.2 Rear Panel

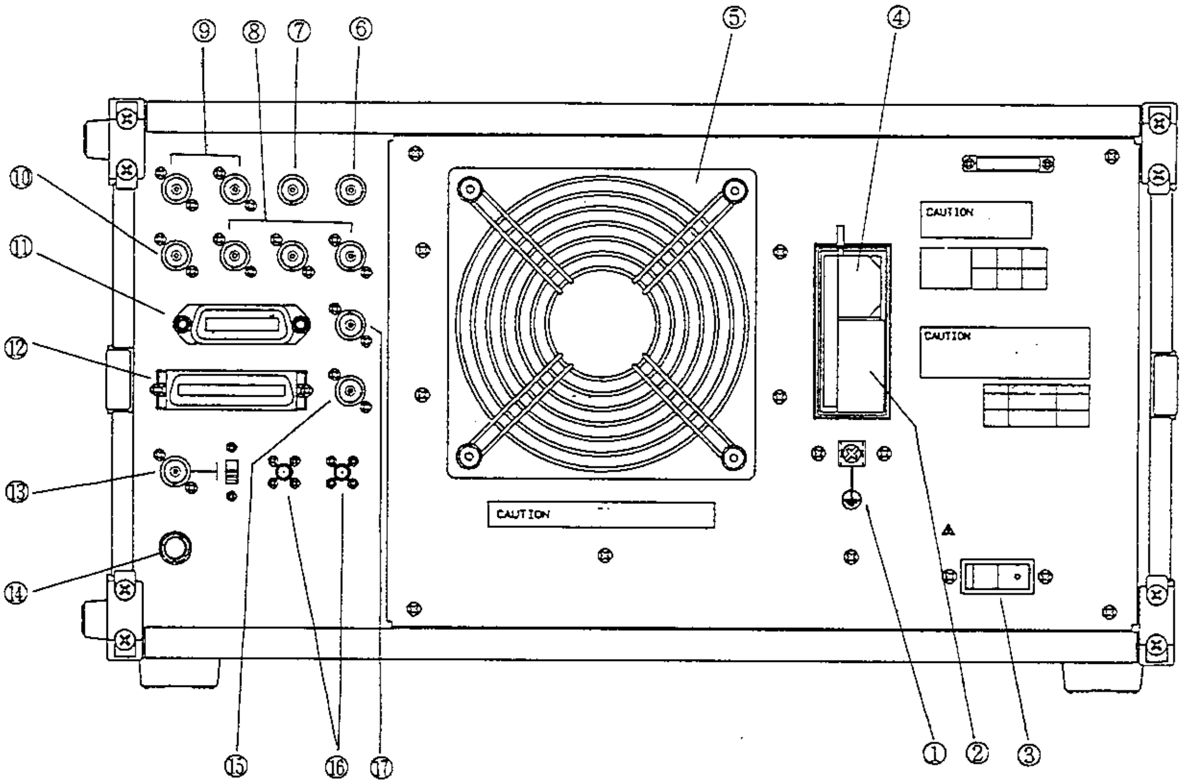



Figure 2-2 Description of Rear Panel

**Description**

① Grounding terminal

② Source voltage setting card

③ BREAKER
Disables the primary AC power when the temperature of the internal power circuit heat dissipator reaches 90°C and enables it when the temperature falls below 70°C

④ AC power cable connector

⑤ Cooling fan

⑥ 2V/N* GHz external output terminal
Outputs a voltage of 2V for the tuning frequency change of 1GHz
* The "N" indicates higher harmonics

⑦ Terminal for output to the external CRT display and the video plotter
Output impedance
: Approx. 75Ω
Approx. 1Vp-p
Composite signal

⑧ Terminal for output to the XY recorder
X output : Approx. -5 to +5V
Output impedance : Approx. 10kΩ
Y output : Approx. 0 to +4V
Output impedance : Approx. 220Ω
Z output TTL level
: (Low level during blanking)

⑨ Terminal for output to the IF signal monitor
Final IF frequency : 3.58MHz
Second IF output : 226MHz

⑩ Y input terminal
Terminal for input of
TRACE [MENU] EXT INPUT
Input range : 0 to 4V
Input impedance : 1MΩ

⑪ GPIB connector
Terminal for connection with the external controller and the video plotter

⑫ PRL I/O [Optional]

⑬ Input/output signal for reference frequency (10MHz) signal
Output level : Approx. 0dBm
Input level : 0dB (Minimum) to TTL

⑭ Keyboard [Optional]

⑮ Input terminal for external sweep control signal
The external sweep control signal stops sweep at its low level and restarts sweep at its high level

⑯ TG LOCAL OUT connector

⑰ Input terminal for external trigger
(The external trigger works at its trailing edge)

## 2.2 POWER ON AND INPUT

(1) Power-on precheck

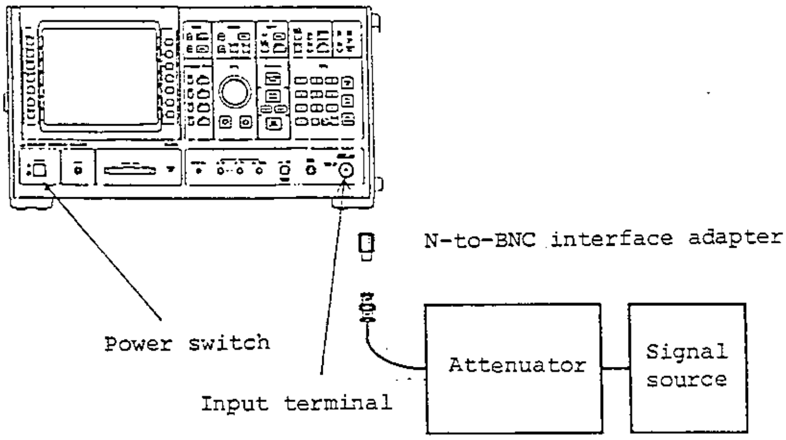
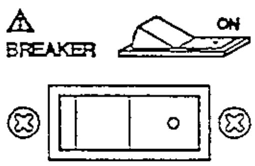



Figure 2-3 Power-on and Input

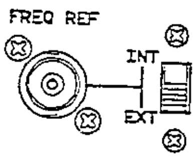
① BREAKER




Before turning the power on, make sure that the BREAKER on the rear panel of the instrument is set to the ON position.

In order to protect the internal circuit of the instrument, the BREAKER cuts off the power from the primary AC power circuit if the temperature of the internal power circuit heat dissipator increases above 90$^{o}$C. If its temperature decrease to 70$^{o}$C or less and the BREAKER has actuated again, reset it to the ON position by hand.

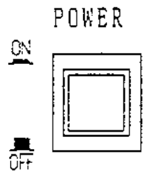
② FREQ REF




Check the rear panel to ensure that the INT/EXT selector switch for the reference frequency signal is set to the INT (internal) position.

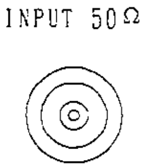
If this switch is to be set to the EXT (external) position, a references frequency signal source that generates the signal at a frequency of 10 MHz and an amplitude of 0 dBm or more must be connected to the INPUT terminal of the instrument.

(2) Power-on and warming-up




Turn the power on and allow a warming-up time of about 30 minutes for the instrument to operate within its performance specifications.

(3) Input




The N-type input connector is located in the lower right section of the front panel. Use the N-BNC conversion adapter (supplied) if input is to be made from the BNC connector. Take care not to break the connector pins during connection. The maximum input level is +30 dBm (at an input attenuator level of 20 dBm or more), with a DC voltage of ±0 V.

The input impedance is approximately 50 Ω. If impedance matching is required, input data via a suitable matching circuits.

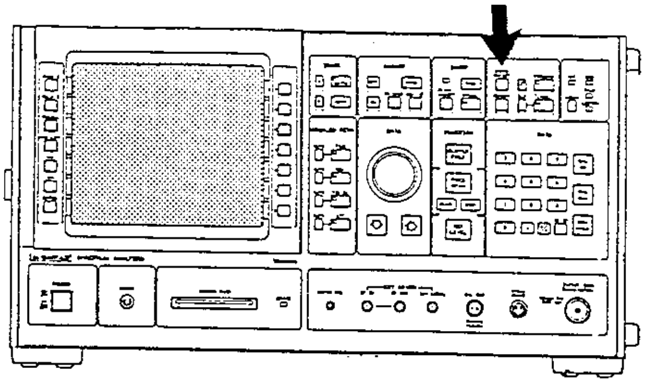
**WARNING**

The maximum level of voltage signal that can be input via the INPUT connector of the instrument is shown below. If a voltage exceeding this level is input, then this may cause destruction of the input mixer or other sections, thus requiring major repairs. If, therefore, the maximum input signal level of the instrument is likely to be exceeded, be sure to sufficiently decrease the signal level using an external attenuator before making inputs.
Incidentally, the instrument uses DC coupling for signal input. If, therefore, DC is likely to be superimposed on an input signal, a DC cutting block must be connected to the instrument.

Maximum input level: +30 dBm (INPUT ATT 20 dB or more)
DC coupling : ±0 Vdc maximum

## 2.3 INITIALIZATION AND CRT DISPLAY

### (1) Initializing R4136




INSTR PRESET — The INSTR PRESET key sets each measurement parameter in the states given in Table 2-1. This setting is made if you turn ON the power source.

Table 2-1 Initialization

| Measurement parameter | Initialization |
|---|---|
| Center frequency | 1.80 GHz |
| Frequency span | 3.60 GHz |
| Reference level | 0 dBm |
| Sweep time | AUTO (50 ms) |
| Resolution bandwidth | AUTO (1 MHz) |
| Video bandwidth | AUTO (1 MHz) |
| Step size | AUTO |
| Input attenuator | AUTO (10 dB) |
| Trigger mode | FREE RUN |
| Trace mode | WRITE |
| Detection mode | Normal mode |
| Marker | OFF |
| Display line | OFF |
| Labeling function | OFF |
| Vertical axis | 10 dB/div. |

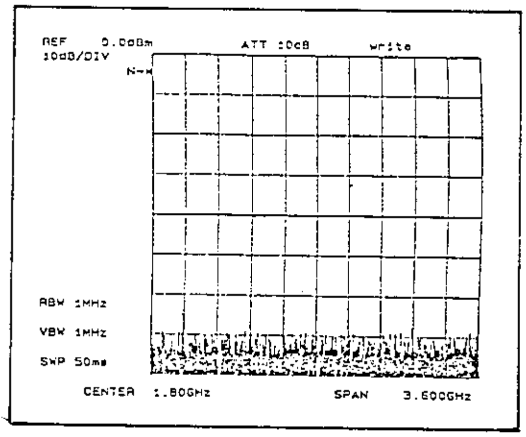



Figure 2-4 CRT Display on Initialized State

(2) CRT Display: How to Read the CRT Annotation

The CRT display provides the trace (waveform), vertical axis and horizontal axis scales, data on various measurement conditions, name of a function for which a setting change mode is selected (active function), setting value to be changed, softkey menu, optional user input (label), and messages to the user.

To adjust screen intensity, use the softkey menu "INTENS" which is displayed by pressing TRACE [TRACE MENU].

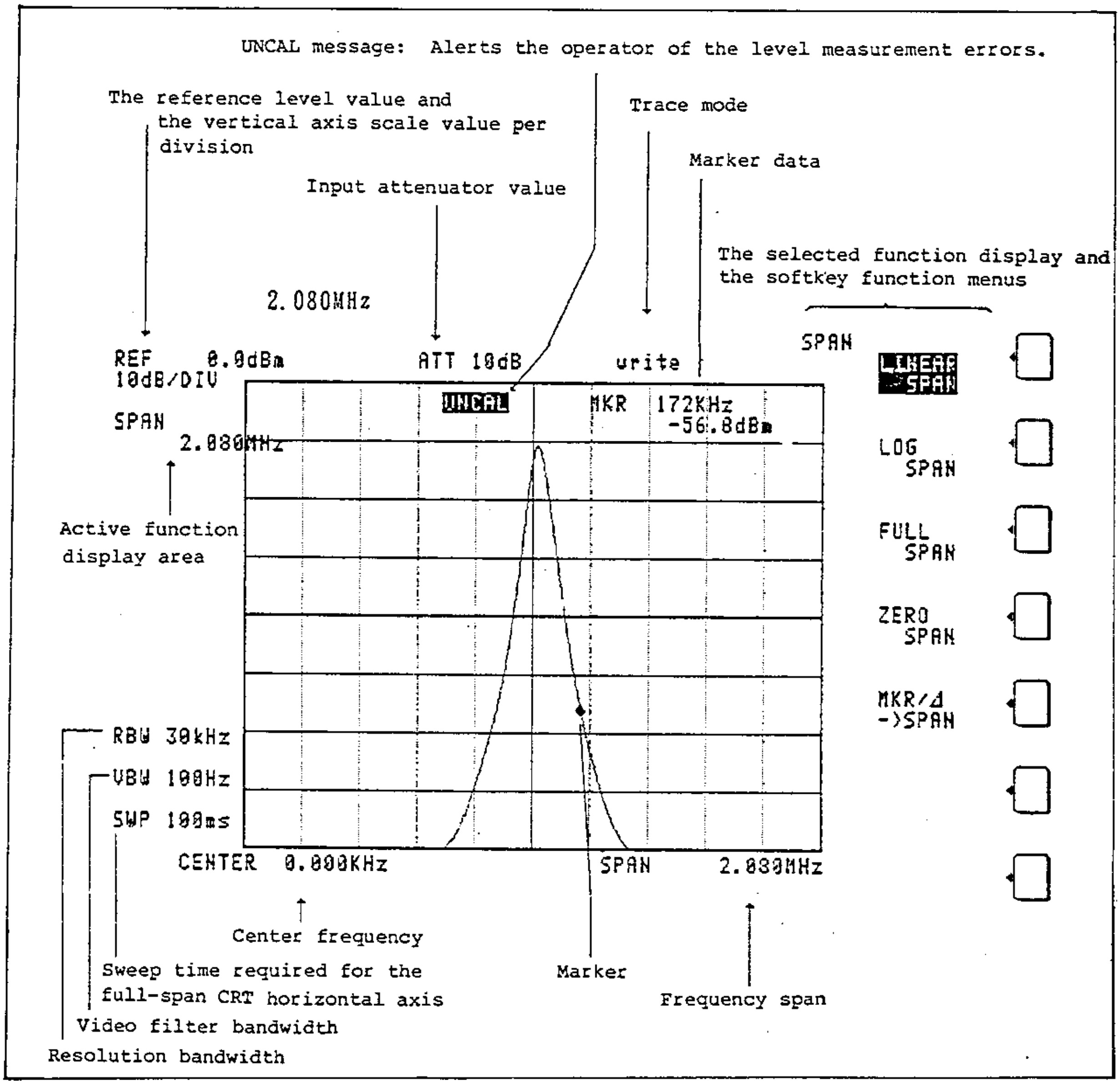



Figure 2-5 Reading of the CRT Display

## 2.4 KEYS NECESSARY FOR BASIC OPERATIONS

This section is intended for first-time users of this type of analyzer. By using the calibration signals provided with this analyzer, we will discuss the most basic keys below. Users who are accustomed to using this kind of measuring instrument need not read this section; see the next section to get more detailed information on this analyzer.

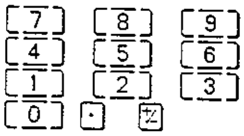
① Fundamental Setting


Used to select the input mode of the center frequency.


Used to select the input mode of the frequency span.


Used to select the input mode of the reference level.

② Data Entry Key, Step Key, and Data Knob



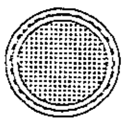

Ten-key pad: Decimal point key and polarity selection key

BK SP

Back space key: Used when ten-key input is corrected.


Used to select the data unit and to execute the setting.

Step key: Inputs the data sequentially.



Data knob: Finely adjusts the data input.

③ Marker

Used to display and delete the marker to directly read the data on each part of the trace.

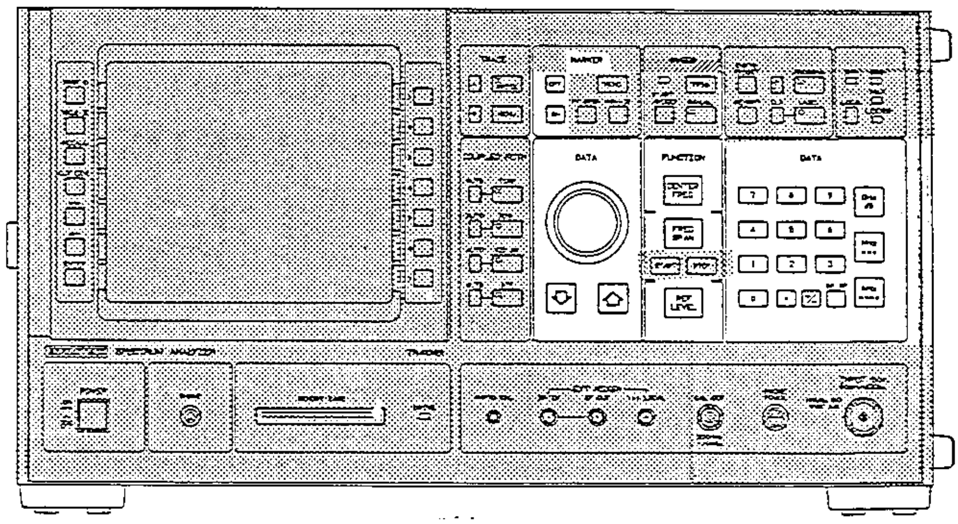


Figure 2-6 Keys Necessary for Basic Operations

(1) Inputting the Signal to be Measured

First, supply the power, and apply the signal. To feed the calibration signal into the INPUT terminal as shown in Figure 2-7, use the N-BNC adapter and interconnection cable MC-06. The calibration signal of R4136 has a frequency of 200 MHz, and an output level of -10 dBm.

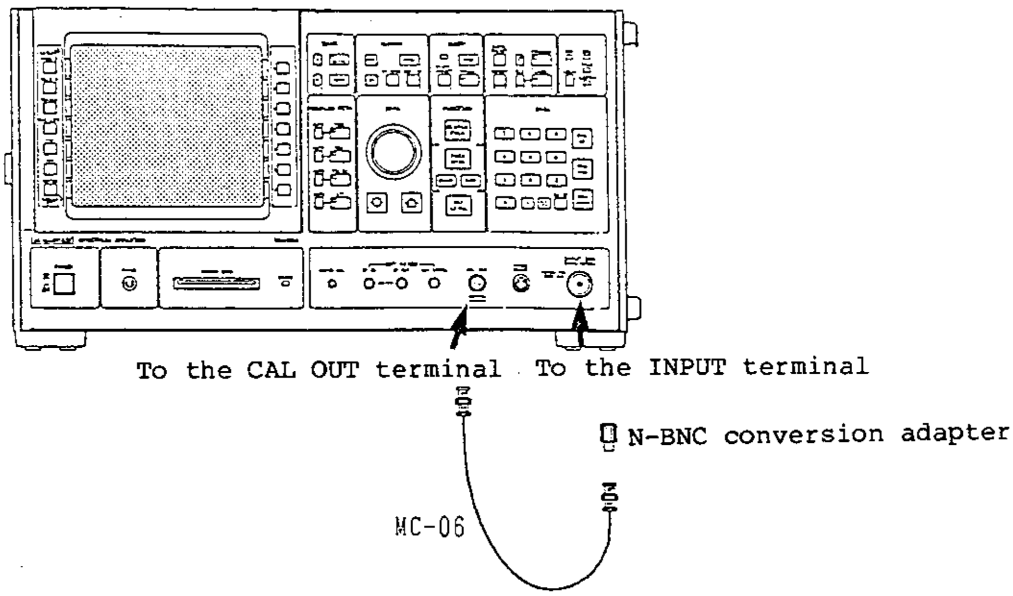



Figure 2-7 Inputting the Calibration Signal

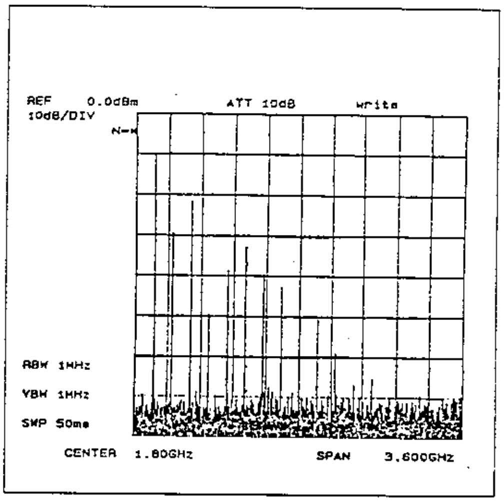



Figure 2-8 Calibration Signal at the Initial Screen

(2) Reading the frequency and level of the signal to be measured

① Set the center frequency to 200 MHz.

First, press [CENTER FREQ] to select the setup mode for the center frequency. After this key is pressed, "CENTER" appears on the active function display area in the upper left corner of the CRT.

Pressing [2] [0] [0] [MHz sec] subsequently will cause the center frequency to be set to 200 MHz and the calibration signal to move to the middle of the screen. In addition, the span will be automatically changed to 2.4 GHz since the starting frequency is limited to -1 GHz.

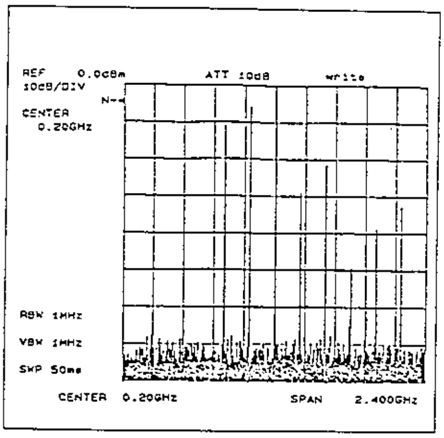
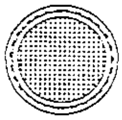
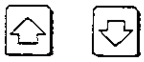



Figure 2-9 Setting of the Center Frequency to 200 MHz

Instead of the ten-key pad, the data knob or step keys can also be used to set the center frequency.



Turn the knob clockwise to move the waveform to the left; this means the center frequency becomes higher.



A single key-operation would increase or decrease the center frequency by one scale of the horizontal axis. (The discussion of this step size setting follows in the next chapter.)

② The frequency span has been set to 2.4 GHz. Because this span value covers too wide a range, set it to 100 MHz.

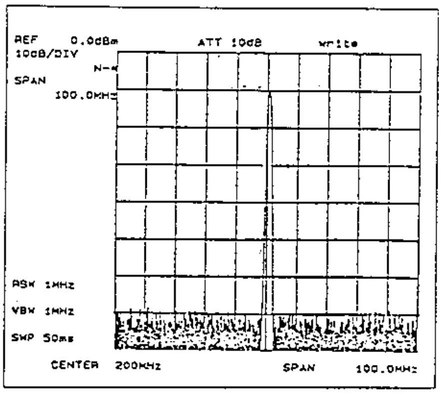



Figure 2-10 Setting the Frequency Span to 100 MHz

First, press [FREQ SPAN] to select the setting mode of the frequency span. After this key is pressed, "SPAN ... Hz" appears on the upper left corner of the screen.

Pressing [1] [0] [0] [MHz sec] sets the CRT horizontal scale to 100 MHz, and each SPAN per division becomes one-tenth of the scale, i.e. 10 MHz. The frequency span value is displayed in the lower right corner of the CRT.

Changing the frequency span may deviate the calibration signal on the center of the CRT. This is because the resolution varies with the frequency span.

Press [CENTER FREQ] and turn the data knob to finely adjust the center frequency and to set the spectrum at the center of the CRT.

If the frequency value is already known, enter that frequency using the ten-key pad to prevent the spectrum from deviating from the center of the CRT.

③ Next, adjust the calibration signal to REFerence LEVEL (Reference level: on the uppermost line of the graticule) to measure the level.

The reference level at the power on state is 0 dBm. Change this level value to -10 dBm to adjust the calibration signal to the reference level.

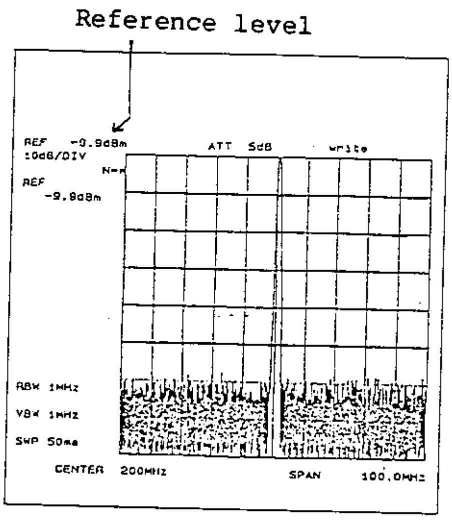



Figure 2-11 Setting of the Reference Level to -10 dBm

Press [REF LEVEL] to select the setting mode for the reference level. After this key is pressed, "REF LEVEL **dBm" appears on the screen.

Press [-] [1] [0] [GHz dB] to set the reference level to -10 dB. The [-] key is also valid when entered after the numeric data. The reference level may also be set with the step keys. Therefore, try each setting method while monitoring the display. Note that the level display should be calibrated if the calibration signal does not match the reference level. Turn the AMPTD CAL control on the front panel to adjust the calibration signal level to the reference level.

By setting the signal at the center of the screen and adjusting the waveform peak to the reference level as above, the frequency and level of an unknown signal (a calibration signal in this example) can be read by the center frequency and reference level data displayed on the screen.

Use the marker (spot) to directly read these values as a marker frequency and a marker level data without adjusting the signal to the center frequency and to the reference level.

④ First, press MARKER [ON] to display the marker.

Use the data knob or the [⇧] and [⇩] keys to adjust the marker to the signal peak.

Then, the marker frequency and its level are displayed on the upper left corner of the screen. With the data, the signal frequency and level can be monitored directly. To delete the marker, press [OFF].

Display of the marker frequency and level

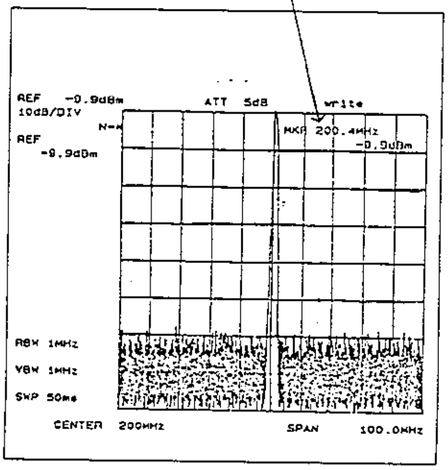



Figure 2-12 Frequency and Level Measurement with the Marker

The above keys are most frequently used to operate R4136. Accordingly, you are requested to get familiar with those keys.

## 2.5 LIST OF PANEL KEYS AND SOFTKEY MENU ITEMS

There are different types of softkeys : some cause action immediately after pressed, some allow data entry when pressed, and others display a softkey menu that is one ahead of the current one.
Softkey menu are listed by section in A1.3 of the appendix to this manual and described by function in 3.4 of the text of this manual.

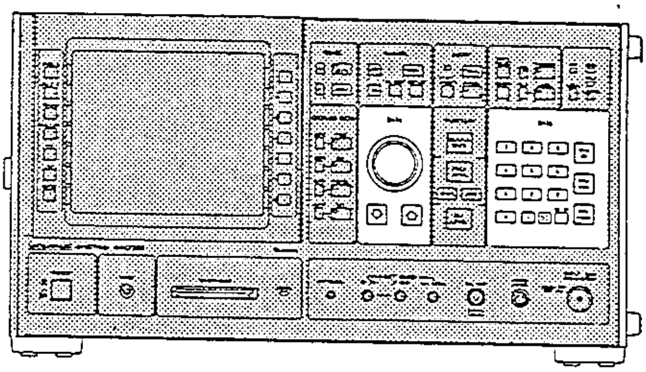
# 3. OPERATING PROCEDURES (1)

The front panel keys are classified in the following sections by function group:

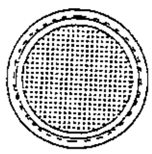
| | |
|---|---|
| ① DATA section | : Inputs the setting data for each function. (See [Clause 3.1]) |
| ② FUNCTION section | : Sets the basic measurement conditions. (See [Clause 3.2]) |
| ③ COUPLED FunCTioN section | : Sets the coupled functions such as resolution bandwidth and video bandwidth, sweep time input attenuator setting modes. (See [Clause 3.3]) |
| ④ SWEEP section | : Sets the sweep mode and the trigger mode. (See [Clause 3.4]) |
| ⑤ MARKER section | : Sets the marker mode. (See [Clause 3.5]) |
| ⑥ TRACE section | : Sets the trace mode. (See [Clause 3.6]) |
| ⑦ The other sections | : The section for storage and recall of the measurement conditions and others. Softkey section, and a section for status display in the remote control mode. |

Each key can be classified into four types: Keys which operate the function upon being pressed, keys which allow data entries, keys which display the softkey menus upon being pressed, and keys which operate with a combination of the above mentioned functions. Modes in which these keys are set can be confirmed by the LEDs on these keys and the active function display on the screen.

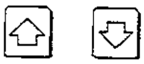
## 3.1 DATA SECTION



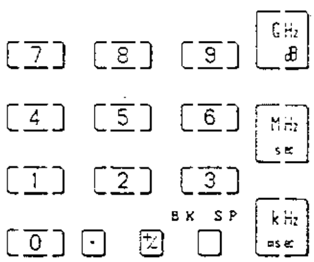
The DATA section consists of the data knob, step keys, ten-key pad, and unit keys; these are used to enter the data set in the setting modes for each function.



Data knob:
Increases the data value when turned clockwise, and decreases when turned counterclockwise. Generally, this knob is used for fine adjustment of the input data. The setting resolution differs depending on each function.



Step keys:
Change the data in steps according to the step size setting.



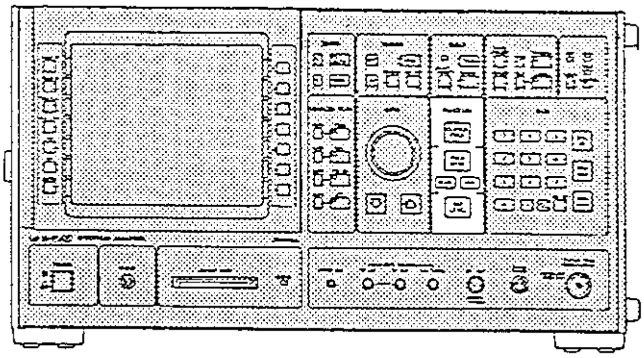

Ten-key pad:
Enters the data directly with numeric values.

Press the set numeric and unit keys to enter the data in the function block.
The unit is changed as frequency, level or time according to the function being in activate.

When you press an incorrect numeric value, press BK SP and enter the correct value.

The polarity key is valid even after the numeric value is entered.

## 3.2 FUNCTION SECTION



[CENTER FREQ] CENTER FREQuency key

[REF LEVEL] REFerence LEVEL key

[FREQ SPAN] FREQuency SPAN key

[START] [STOP] Sweep START and STOP keys

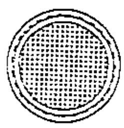
### 3.2.1 Setting the Center Frequency

The center frequency may be set within the range of 0 to 23 GHz 1800 MHz has been set at the time of initialization.

[CENTER FREQ] Selects the center frequency setting mode. This selection enables the data entry and displays the softkey menu.

(1) Data Entries

To enter center frequency data, use the following keys:



Increases the center frequency when turned clockwise, and decreases it when turned counterclockwise. The setting resolution is approx. 1/100 of the frequency span.

Increases and decreases the center frequency in steps according to the step size setting. When the step size is set to AUTO, the center frequency will be set 1/10 of the frequency span, that is, one division of the horizontal axis is a step size.

[Ten key] Sets the center frequency with a numeric value. The setting resolution is approx. 1/500 of the frequency span.

Accuracy of the Center Frequency

The accuracy of the center frequency depends upon the frequency span and the reference oscillator accuracy.

When the span is less than 2 MHz,

± (2% of the span + center frequency x reference oscillator accuracy + n x 50 kHz)

When the span is greater than or equal to 2 MHz,

± (3% of the span + center frequency x reference oscillator accuracy + n x 100 Hz)

The reference oscillator accuracy: $2 \times 10^{-7}$/week, $1 \times 10^{-6}$/year

If the external time base (10 MHz) is used, the accuracy is that of the time base.

"n" denotes the number of orders of harmonic mixing.

n = 1; 0.5 kHz to 7.5 GHz
n = 2; 7.2 GHz to 15.2 GHz
n = 3; 14.9 GHz to 23 GHz

Display Resolution of the Center Frequencies

The display resolution of the center frequencies, which can be set up to 10 Hz, depends on the frequency span.

| | |
|---|---|
| 25 GHz ≧ SPAN ≧ 10 GHz: | 100 MHz |
| 10 GHz > SPAN ≧ 1000 MHz: | 10 MHz |
| 1000 MHz > SPAN ≧ 100 MHz: | 1 MHz |
| 100 MHz > SPAN ≧ 10 MHz: | 100 kHz |
| 10 MHz > SPAN ≧ 1 MHz: | 10 kHz |
| 1 MHz > SPAN ≧ 100 kHz: | 1 kHz |
| 100 kHz > SPAN ≧ 10 kHz: | 100 Hz |
| 10 kHz > SPAN ≧ 2 kHz: | 10 Hz |

(2) Configuration of Softkey Menus

The softkey menus for the CENTER FREQ key are configured as shown in A1.3.6 (1).

(3) Description of Softkey Menu

①

CF STEP SIZE

Selects the change mode of the step size for the center frequency set with the step keys. Allows the step size entry with the ten-key pad, and subdivides the softkey menu ② as follows:

FREQ. OFFSET

Selects the setting mode for the center frequency offset. The center frequency and the marker frequency are displayed by adding the offset values entered with the ten-key pad. The offset values are displayed on the CRT.

To turn OFF the function, specify [0] [GHz/dB] or [MHz/sec] or [kHz/msec] to set the offset value to 0.

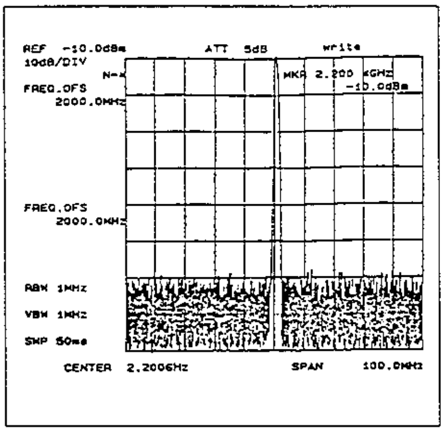



Figure 3-1 Frequency Offset Value Display

CF STEP AUTO

Pressing this key causes the AUTO mode to be selected for setting the center frequency step size and the step size to be set equal to 1/10 of the frequency span. This AUTO is the initial setting.

AUTO TUNE

By pressing this key and setting SPAN, the marker (◇) appears, and the max. level signal of the input signal is displayed in the center of the display by means of the set SPAN in the range of approx. 50 MHz to 3.6 GHz.
For this operation, the "SIG. TRACK" mode can be set automatically. To cancel this operation, either turn "OFF" the marker or turn "OFF" the SIG. TRACK of the marker [MENU].

INT. MIXER

Sets the available center frequency range to the band (0 GHz to 23 GHz) that is appropriate for the internal mixer. If this frequency range has been set to EXT MIXER before this key is pressed, then the center frequency and frequency span existing before the range was set to EXT.MIXER becomes valid once again.

EXT. MIXER

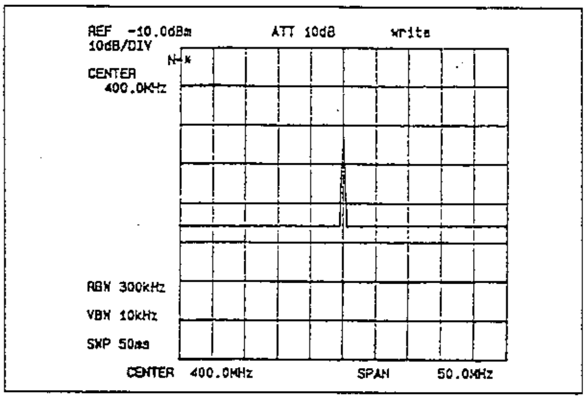
Sets the available center frequency range to the band appropriate for the external mixer used (between 13 GHz and 325 GHz). If the INT MIXER has been selected before this key is pressed, then the center frequency will be initially set to 16.5 GHz, the frequency span to 7 GHz, the reference level to 0 dBm, and the IF 4 GHz NORMAL, respectively. In addition, the N(-) AUTO mode will be set.

②

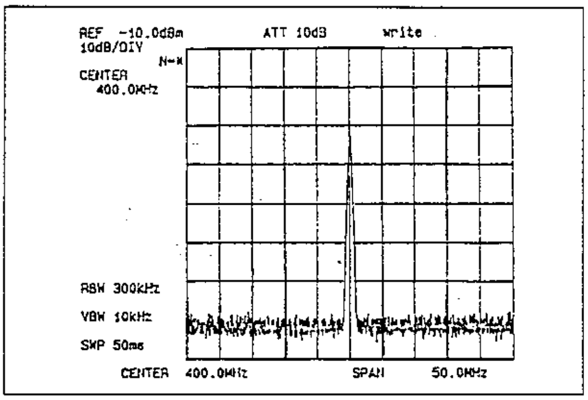
| | |
|---|---|
| MKR FREQ STEP SIZE | Sets marker (see 3.5) frequency values in step sizes. |
| MKR/Δ →STEP SIZE | Sets delta marker (see 3.5) frequency differences in step sizes. |
| RETURN | Returns you to the initial softkey menu ①. |

③

| | |
|---|---|
| NORMAL IF | Sets the first IF of the heterodyne section of the instrument to the normal value of 3996.4211 MHz. |
| SHIFT IF | Shifts the first IF of the heterodyne section of the instrument to 4001.4211 MHz which is 5 MHz higher than the normal value. If a 3996.4211 MHz signal is applied while the instrument IF stays set to 4 GHz NORMAL, resulting IF feedthrough will raise the baseline and reduce the measurement dynamic range. In such a case, setting the SHIFT IF mode will prevent raising of the baseline since the IF will shift by 5 MHz. |
| RETURN | Returns you to the initial softkey menu ①. |




CENTER FREQ → INT. MIXER → SHIFT IF



④

| | |
|---|---|
| MIXER MODE | Allows selection of the mode that is to be used with an external mixer. |
| MIXER PARAM | Enables you to set the various parameters to be used if an external mixer is connected. |
| RETURN | Returns you to the initial softkey menu ①. |

⑤

| | |
|---|---|
| 4GHz IF | Allows the first IF of the internal heterodyne section to be set to either 3996.4211 MHz or 4001.4211 MHz. |
| 226MHz IF | Allows the first IF of the internal heterodyne section to be set to 226.4211 MHz. |
| RETURN | Returns you to the initial softkey menu ④. |

⑥

| | |
|---|---|
| NORMAL IF | Allows the first IF of the internal heterodyne section to be set to 3996.4211 MHz. |
| SHIFT IF | Allows the first IF of the internal heterodyne section to be set to 4001.4211 MHz. If a 4 GHz signal is applied while the instrument IF stays set to 4 GHz NORMAL, resulting IF feedthrough will raise the baseline and reduce the measurement dynamic range. In such a case, setting the SHIFT IF mode will prevent raising of the baseline since the IF will shift by 5 MHz. However, it is not available for the IF feedthrough when IF is set at 226 MHz. |
| RETURN | Returns you to the initial softkey menu ⑤. |

⑦

| | |
|---|---|
| N(-) AUTO | Auto-sets the internal computation harmonics order "N" according to the selected center frequency. Also sets the mixing mode to (-). |
| N(-) FIXED | Sets the internal compulation harmonics order "N" and keeps it fixed. Data must be input using the numeric key(s). Also sets the mixing mode to (-). If a value outside the "N" range in which the existing center frequency has been input is specified, an error message will be displayed. In that case, specify an appropriate "N". |

The available range of center frequencies
for "N" = N x 4 GHz - IF to N x 8 GHz - IF

| |
|---|
| (Example) [1] [2] [GHz dB] : Set "N" = 12 |

N(+) AUTO : Auto-sets the internal computation harmonics order "N" according to the selected center frequency. Also sets the mixing mode to (+).

N(+) FIXED : Sets the internal compulation harmonics order "N" and keeps it fixed.
Data must be input using the numeric key(s). Also sets the mixing mode to (+). if a value outside the "N" range in which the existing center frequency has been input is specified, an error message will be displayed. In that case, specify an appropriate "N".
The available range of center frequencies for "N" = N x 4 GHz + IF to N x 8 GHz + IF

RETURN : Returns you to the initial softkey menu ⑥.

⑧

N(-) AUTO : Auto-sets the internal computation harmonics order "N" according to the selected center frequency. Also sets the mixing mode to (-).

N(-) FIXED : Sets the internal compulation harmonics order "N" and keeps it fixed.
Data must be input using the numeric key(s). Also sets the mixing mode to (-). if a value outside the "N" range in which the existing center frequency has been input is specified, an error message will be displayed. In that case, specify an appropriate "N".
The available range of center frequencies for "N" = N x 4 GHz - IF to N x 8 GHz - IF

| (Example) [1] [2] [GHz/dB] : Set "N" = 12 |
|---|

N(+) AUTO : Auto-sets the internal computation harmonics order "N" according to the selected center frequency. Also sets the mixing mode to (+).

N(+) FIXED : Sets the internal compulation harmonics order "N" and keeps it fixed.
Data must be input using the numeric key(s). Also sets the mixing mode to (+). if a value outside the "N" range in which the existing center frequency has been input is specified, an error message will be displayed. In that case, specify an appropriate "N".
The available range of center frequencies for "N" = N x 4 GHz + IF to N x 8 GHz + IF

RETURN : Returns you to the initial softkey menu ⑤.

⑨

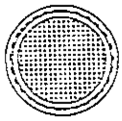
**REF. OFFSET** — Enables you to compensate for any conversion loss due to harmonics mixing or for any data loss due to cabling. The reference level displayed includes the offset value. Use the numeric keys to input data.

| | |
|---|---|
| (Example) [1] [4] [GHz/dB] : | Set the offset value at 14 dB. |

To clear this function, input zero as the offset value.

**MIXER BIAS** — Enables adjustment of the DC bias of an external mixer diode. Set the value that gives the maximum signal level. Available data is form 255 (approximately +11 mA) to -255 (approximately -11 mA). The voltage is limited with an allowable error of ±3.8 V.

Data entry



The mixer bias can be increased (or decreased) one step by turning the knob clockwise (or counterclockwise).

[⇩] [⇧] Enables data to be changed in 10 steps

[Ten-key] The resolution level set is 1.

**PORT** — Used to select the method of connecting an external mixer to the external mixer port of the instrument.

**RETURN** — Returns you to the initial softkey menu ④.

⑩

**2 PORT** — Inverses the display.

**3 PORT** — Inverses the display.

**RETURN** — Returns you to the initial softkey menu ⑨.

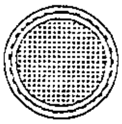
### 3.2.2 Setting the Frequency Span

The initial value is 3600 MHz, and LINEAR SPAN is displayed on the screen. This span can be set within the range of 3600 MHz to 2 kHz. This range varies depending on the center frequency, sweep frequency bandwidth, trigger mode, and other conditions currently set. For details, see 3.2.3 (2) Precautions on multiband sweeping.

[FREQ SPAN] Selects the setting mode of the frequency span. This selection enables the data entries and displays the softkey menu on the screen.

(1) Data Entries

To enter frequency span data, use the following keys:


Widens the frequency span when turned clockwise, and narrows it down when turned counterclockwise. The setting resolution is approx. 1% of the current span.

[⇩] [⇧] Sets the frequency span in 1-2-5 steps in the following sequence:

25.00 GHz ↔ 20.00 GHz ↔ 10.00 GHz ↔ 5000 MHz ↔ .. 5 kHz ↔ 2 kHz

[Ten-key] Sets the frequency span in accordance with the following steps:

| | | |
|---|---|---|
| 25.00 GHz to 4.01 GHz | : | 10 MHz step |
| 4000 MHz to 401 MHz | : | 1 MHz step |
| 400 MHz to 40.1 MHz | : | 100 kHz step |
| 40.00 MHz to 2.01 MHz | : | 10 kHz step |
| 2.000 MHz to 0.401 MHz | : | 1 kHz step |
| 400.0 kHz to 40.1 kHz | : | 100 Hz step |
| 40.00 kHz to 2.00 kHz | : | 10 Hz step |

Span Accuracy

The frequency span setting accuracy is as follows:

LINEAR mode: Within ±3% (Except during multiband sweeping)
LOG mode : Within ±10%

(2) Configuration of Softkey Menus

The softkey menus for the FREQ SPAN key are configured as shown in A1.3.6 (2).

(3) Description of Softkey Menus

①

| | |
|---|---|
| LINEAR SPAN | Sets the frequency span scale in the LINEAR display mode (initial state). |
| LOG SPAN | Sets the frequency span scale in the LOG display mode. The following softkey menus ②, in which the sweep start frequency is selected, appear on the screen. The softkey menus ③ to ⑦ for selecting the following sweep stop frequency appears on the screen. "START F" or "STOP F" is displayed on the CRT to prompt for data entries. |
| FULL SPAN 1 | Presents a display of CENTER 1.8 GHz, SPAN 3.600 GHz. (Starting frequency set to 0 MHz, and the stopping frequency set to 3.6 GHz.) The center frequency cannot be changed at this time. |
| FULL SPAN 2 | Presents a display of CENTER 13.2 GHz, SPAN 19.5 GHz. (Starting frequency set to 3.5 GHz, and the stopping frequency set to 23.0 GHz.) The center frequency cannot be changed at this time. |
| ZERO SPAN | Fixes the frequency to the center frequency and operates the analyzer as a tuned receiver. The horizontal axis at this time is handled as handled as a time axis. |
| MKR Δ →SPAN | Use START and STOP frequencies for the two marker frequencies in the Δ marker mode (see Section 3.5.2). |

②

| | |
|---|---|
| 10 kHZ<br>100 kHZ<br>1 MHZ<br>10 MHZ<br>100 MHZ | Selects the frequency at which sweep is to be started. |
| RETURN | Returns you to the initial softkey menu ①. |

③

| | |
|---|---|
| 100 kHZ / 1 MHZ / 10 MHZ | Selects the frequency at which sweep is to be stopped. |
| RETURN | Returns you to the softkey menu ②. |

④

| | |
|---|---|
| 1 MHZ / 10 MHZ / 100 MHZ | Selects the frequency at which sweep is to be stopped. |
| RETURN | Returns you to the softkey menu ②. |

⑤

| | |
|---|---|
| 10 MHZ / 100 MHZ / 1000 MHZ | Selects the frequency at which sweep is to be stopped. |
| RETURN | Returns you to the softkey menu ②. |

⑥

| | |
|---|---|
| 100 MHZ / 1000 MHZ | Selects the frequency at which sweep is to be stopped. |
| RETURN | Returns you to the softkey menu ②. |

⑦

| | |
|---|---|
| 1000 MHZ | Selects the frequency at which sweep is to be stopped. |
| RETURN | Returns you to the softkey menu ②. |

### 3.2.3 Setting the START/STOP Frequencies

[START] [STOP] When these keys are pressed, the modes used to select a starting frequency and a stopping frequency will be set and "START xxHz" and "STOP xxHz" will be displayed at the left and right corners of the screen, respectively, as the sweep starting and stopping frequencies that are now in effect. The value of (stopping frequency - starting frequency) becomes the frequency span.

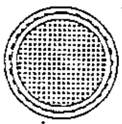
The range of frequencies that can be selected here is as shown below. If unavailable values are entered, then the upper and lower-limit values of the available starting and stopping frequencies are set automatically.

The two types of frequencies must be as follows when the internal mixer (0 to 23 GHz) is to be used:

$$-1.0 \text{ GHz} \leq \text{START} \leq 23 \text{ GHz}$$
$$0 \text{ GHz} \leq \text{STOP} \leq 24 \text{ GHz}$$

(1) Data Entries

To enter start/stop frequency data, use the following keys:


Changes the START or STOP frequency in steps of approx. 1% of the currently-set frequency span.

[⇩] [⇧] Sets the step width to 1/10 (one division of the horizontal axis) of the currently-set frequency span.

[Ten-key] The setting resolution of START and STOP frequency is set by setting resolution of the frequency span.

(2) Precautions on multiband sweeping

The particular settings of the starting/stopping frequencies or center/span frequencies may cause sweeping over several bands to occur at one time. This is referred to as multiband sweeping.

Multiband sweeping breaks at the band changeover point and then band changeover takes place. In addition, multiband sweeping that includes a 0 GHz to 3.6 GHz band cannot be selected in trigger modes except for the SINGLE TRIGGER mode. In that case, set the SINGLE TRIGGER mode before selecting frequencies (that is, selecting a center frequency of 11.5 GHz, a frequency span of 25.0 GHz (starting frequency of -1.0 GHz, stopping frequency of 24.0 GHz), and so on.

Spectrum display may either become superimposed or disappear if a signal close in level to the band changeover point is input to the instrument. If this is the case, set frequencies that do not cause multiband sweeping and then check for signals close to the changeover point. The frequency bands available with the instrument are shown below. Check the display of "N=---" appearing the left corner of the screen to determine which band is appropriate for the particular requirements.

1.0 GHz to 3.6 GHz ——— N=*
(0 GHz)
3.5 GHz to 7.5 GHz ——— N=-1
7.2 GHz to 15.2 GHz——— N=-2
14.9 GHz to 24.0 GHz——— N=-3
(23.0 GHz)

### 3.2.4 Setting the Vertical Axis Scale

Reference level, dB/div. Unit

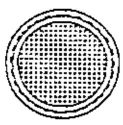
The uppermost level of the graticule is used as a reference level. It can be set within the range of +40 to -69.9 dBm. The initial value of the reference level is 0 dBm, and one division of the vertical axis is 10 dB.

For display line, i.e. horizontal cursor line, see 3.6 TRACE Section.

[REF LEVEL] Selects the setting mode of the reference level.

(1) Data Entries

To enter reference level data, use the following keys:



Increases the reference value when turned clockwise, and decreases when turned counterclockwise.

Sets the reference value in steps of 5 dB.

[Ten-key] Sets the reference value in 0.1 dB resolution.

Value of reference level and that of vertical axis one division

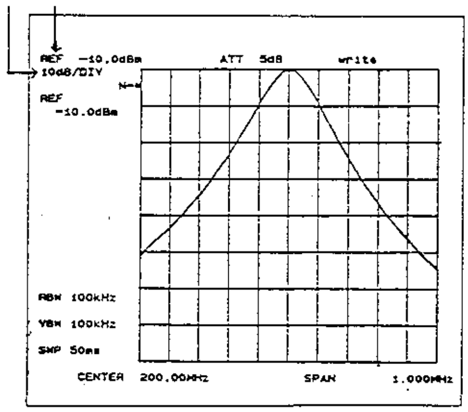



Figure 3-2 Reference Level

**CAUTION**

If the input attenuator is in MANUAL mode, the reference level may be narrower than the range of -69.9 dBm to +40 dBm depending on the set value in the MANUAL mode.

---

Reference Level Accuracy

The reference level must be ±1 dB or less after calibration with the reference level range of 0 to −69.9 dBm, the frequency at 200 MHz and with the input attenuator of 10 dBm.

---

Reference Level Calibration

① Warm up R4136 for more than 30 minutes.
② Input the calibration signal in R4136.
③ Set the reference level to −10 dBm, adjust the AMPTD CAL control on the front panel, and set the calibration signal peak at the reference level.

(2) Configuration of Softkey Menus

The softkey menus for the REF LEVEL key are configured as shown in A1.3.6 (3).

(3) Description of Softkey Menu

①

**dB/DIV** — Sets the vertical axis scale in the LOG display mode, and displays the following softkey menu ②:

**LINEAR** — Sets the vertical axis scale in the LINEAR display mode, and displays the following softkey menu ④. In the LINEAR mode, the CRT vertical axis scale is set to the one proportioned to the input voltage. The uppermost level is set as the reference level (see Figure 3-3).

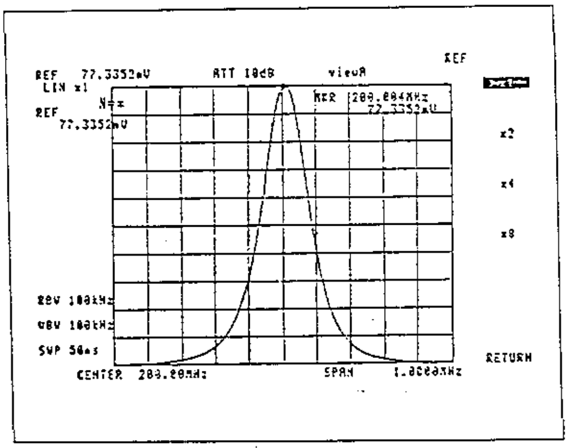



Figure 3-3 LINEAR Display for the Vertical Axis Scale

| | |
|---|---|
| REF. OFFSET (dB) | Sets and displays the offset value for the reference level. Enters the data with the ten-key pad. |

> Example:
>
> [1] [6] [-] [GHz dB] Sets the offset value to -16 dB. The offset data is displayed on the CRT.

Note: Cannot be used when the R4136 is in the linear mode.

| | |
|---|---|
| QP | Sets in the measurement mode of the QP value, and displays the QP value measurement condition menu ⑤. For the QP value measurement, see Section 5.2. |
| UNITS | Sets the unit selection mode for the measurement data, and displays the following softkey menu ⑥. |
| PEAK SEARCH | Displays the marker on the maximum peak of the spectrum. |
| MKR →REF | Sets the marker level to the reference level. |

②

| | |
|---|---|
| 10 dB/ | Sets the size of the vertical axis scale per division 10dB (initial value). |
| 5 dB/ | Sets the size of one division of the vertical axis scale to 5 dB. |
| 2 dB/ | Sets the size of one division of the vertical axis scale to 2 dB. |
| 1 dB/ | Sets the vertical axis scale to 1 dB. |
| RETURN | Returns you to the initial softkey menu ①. |

③

| | |
|---|---|
| 8 DIV. | Sets the vertical axis scale to 8 DIV (initial value). |
| 10 DIV. | Sets the vertical axis scale to 10 DIV. |
| RETURN | Returns you to the initial softkey menu ②. |

④

| | |
|---|---|
| ×1 | Sets the top graticule line as the reference level, and the bottom to 0 V. |
| ×2 | Sets the top graticule line as the reference level, and the bottom reference level/2 V. |
| ×4 | Sets the top graticule line as the reference level, and the bottom reference level/4 V. |
| ×8 | Sets the top graticule line as the reference level, and the bottom reference level/8 V. |
| RETURN | Returns you to the initial softkey menu ①. |

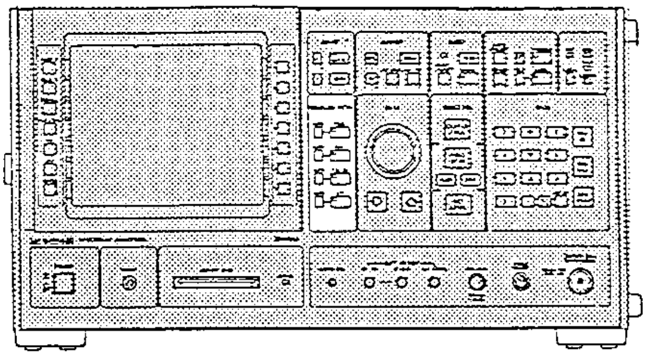
⑤

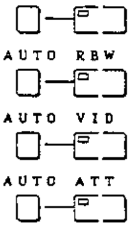
| | |
|---|---|
| 10 kHz~ 150 kHz | Sets the conditions for measuring QP values. |
| 150kHz ~30 MHz | |
| 30 MHz ~1000 MHz | |
| QP-OFF | Clears the QP measurement mode, and returns to the original reference level (initial state). |
| RETURN | Returns you to the initial softkey menu ①. |

⑥

| | |
|---|---|
| dBm | Sets dBm as a unit (initial state). |
| dBμ | Sets dBμ as a unit (the value in dBm + 107) dBμ. |
| dBμ (EMF) | Sets dBμ (EMF) as a unit (the value in dBm + 113) dBμ. |
| dBpw | Sets dBpw as the unit (the value in dBm + 90) dBpw. |
| RETURN | Returns you to the initial softkey menu ①. |

## 3.3 COUPLED FUNCTION SECTION





AUTO TIME — Setup keys for sweep time

AUTO RBW — Setup keys for resolution bandwidth

AUTO VID BW — Setup keys for video bandwidth

AUTO ATT — Setup keys for input attenuator

### 3.3.1 Setting the Resolution Bandwidth

For higher resolution measurement

Narrower resolution bandwidth setting narrows the spectrum resolution (see Figures 3-4 and 4-5). With this feature, you can isolate the near-by noise of the spectrum to be measured or the spectrum. Note, however, that the narrower the resolution becomes, the longer the sweeping time required. The drop of the signal level displays the UNCAL message.

The initial resolution bandwidth is set in the AUTO mode, allowing the optimum resolution bandwidth for the frequency span.

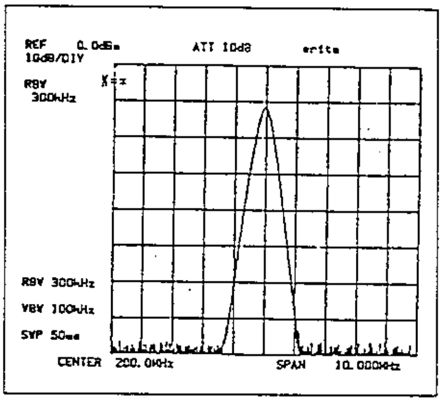



Figure 3-4 Resolution Bandwidth of 300 kHz

RBW

Selects the resolution bandwidth setting mode, and displays the softkey menu shown in (2). The resolution bandwidth can be set from the following 10 steps.

| RBM |
|---|
| 1 MHz |
| 300 kHz |
| 100 kHz |
| 30 kHz |
| 10 kHz |
| 3 kHz |
| 1 kHz |
| 300 Hz |
| 100 Hz |
| 30 Hz |

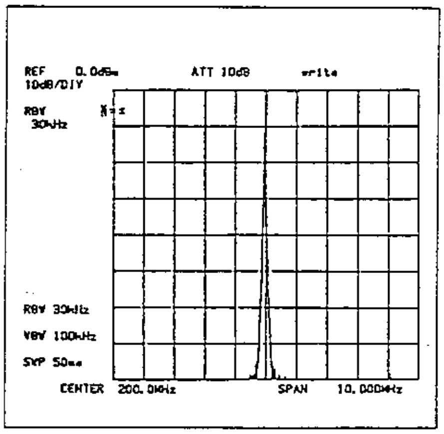



Figure 3-5 Resolution Bandwidth of 30 kHz

(1) Data Entries

To enter resolution bandwidth data, use the following keys:

Widens the resolution bandwidth in the above step when turned clockwise, and narrows when turned counterclockwise.

Changes the resolution bandwidth in the above step.

Ten-key: Sets the resolution bandwidth only in the above step, with the switching point at 1.5. For example,

When 150 kHz $\leqq$ the setting value, 300 kHz is set.
When 150 kHz $>$ the setting value, 100 kHz is set.

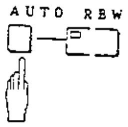
(2) Configuration of Softkey Menu

RBW

↓

| | |
|---|---|
| 120 kHz (6 dB) | The softkey menu bandwidth is 6 dB, which is usually used when measuring the QP value which conforms to the CISPR standard. |
| 9 kHz (6 dB) | |
| 200 Hz (6 dB) | |
| OFF | Returns to the original resolution bandwidth. |

(3) AUTO Mode




Sets the AUTO setting mode for the resolution bandwidth. Selects the resolution bandwidth in the following way, depending on the frequency span, and also sets the optimum value of the sweep time.

Table 3-1 Relationship of the Frequency Span with the AUTO Setting Value of the Resolution Bandwidth

| Setting of the frequency span | Resolution bandwidth |
|---|---|
| 60 MHz ≦ SPAN | 1 MHz |
| 20 MHz ≦ SPAN < 60 MHz | 300 kHz |
| 6 MHz ≦ SPAN < 20 MHz | 100 kHz |
| 2 MHz ≦ SPAN < 6 MHz | 30 kHz |
| 300 kHz ≦ SPAN < 2 MHz | 10 kHz |
| 100 kHz ≦ SPAN < 300 kHz | 3 kHz |
| 30 kHz ≦ SPAN < 100 kHz | 1 kHz |
| 10 kHz ≦ SPAN < 30 kHz | 300 Hz |
| 3 kHz ≦ SPAN < 10 kHz | 100 Hz |
| SPAN < 3 kHz | 30 Hz |

### 3.3.2 VIDeo Bandwidth

Internal noise reduction

This VID BW key is used to average out the noise contained in the signal waveform and to average the bottom noise to search the signal buried in noise. The low pass filter is set in the detected signal to average the noise. With this method, the S/N ratio will be improved by approx. 10 dB. To perform the average operation successively, this low pass filter bandwidth should be set according to the resolution bandwidth shown in Table 3-2. When narrowing the video bandwidth, the measurement level will be lowered due to the time constant of the low pass filter, and may display the UNCAL message. In such a case, allow longer time for sweeping. Video Bandwidth has been set to AUTO at the initialization.

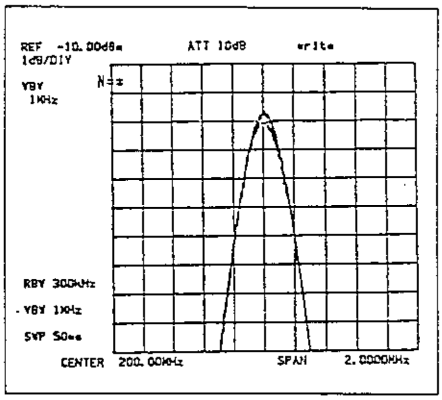



Figure 3-6 VIDEO FILTER 1 MHz

VID BW

Selects the setting mode for the video bandwidth. This bandwidth can be set in the 7 steps given in the table below.

| VID BW |
|---|
| 1 MHz |
| 100 kHz |
| 10 kHz |
| 1 kHz |
| 100 Hz |
| 10 Hz |
| 1 Hz |

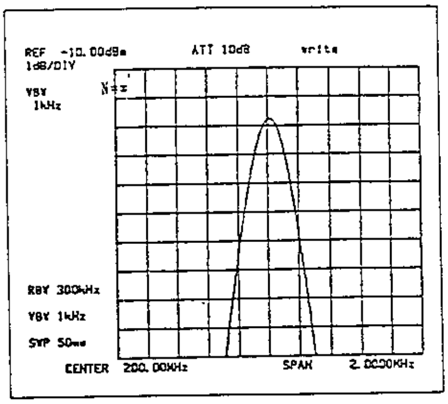
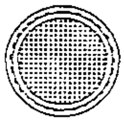



Figure 3-7 VIDEO FILTER 1 kHz

(1) Data Entries

To enter video bandwidth data, use the following keys:



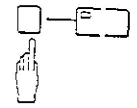
Increases the bandwidth in the above step when turned clockwise, and decreases when turned counterclockwise.

Changes the bandwidth in the above step.

Ten-key The value is set in the above step after being rounded to the nearest whole number (a number of 5 or less is truncated, and 6 or more rounded up wards). For example, if 55 kHz, then the bandwidth will be 10 kHz. If 60 kHz, then the bandwidth will be 100 kHz.

(2) AUTO Mode

AUTO VID BW



Selects the AUTO setting mode of the video bandwidth (LED comes on). The video bandwidth is set according to the resolution bandwidth as shown in Table 3-2.

Table 3-2 Relationship Between the Resolution Bandwidth and AUTO Setting Values of the Video Filter Bandwidth

| Resolution bandwidth | AUTO setting value of VIDeo BandWidth | Resolution bandwidth | AUTO setting value of VIDeo BandWidth |
|---|---|---|---|
| 1 MHz | 1 MHz | 3 kHz | 1 kHz |
| 300 kHz | 100 kHz | 1 kHz | 1 kHz |
| 100 kHz | 100 kHz | 300 Hz | 100 Hz |
| 30 kHz | 10 kHz | 100 Hz | 100 Hz |
| 10 kHz | 10 kHz | 30 Hz | 10 Hz |

### 3.3.3 Setting the Sweep Time

An error is generated in the level display if the signal display cannot be monitored due to too fast sweep operation. With this condition, the message "UNCAL" appears at the center of the screen. In such a case, change the measurement condition by taking more time for sweeping (see Figures 3-8 and 3-9). AUTO has been set as the initial state, thus the sweep time is determined automatically not to cause any level error corresponding to the frequency span, resolution bandwidth, and VIDEO Bandwidth.

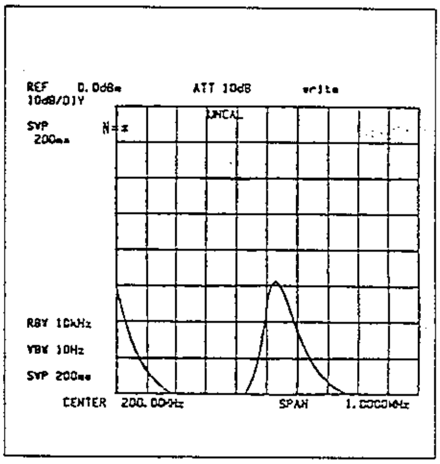



Figure 3-8 Waveform for 20 s Sweep Time

TIME

Selects the setting mode for the sweep time (LED comes on). The setting value can be selected from the 1-2-5 sequence shown in the right table.

| Sweep time |
|---|
| 50 ms |
| 0.1 s |
| 0.2 s |
| 0.5 s |
| 1 s |
| 2 s |
| 5 s |
| 10 s |
| 20 s |
| 50 s |
| 100 s |
| 200 s |
| 500 s |
| 1000 s |

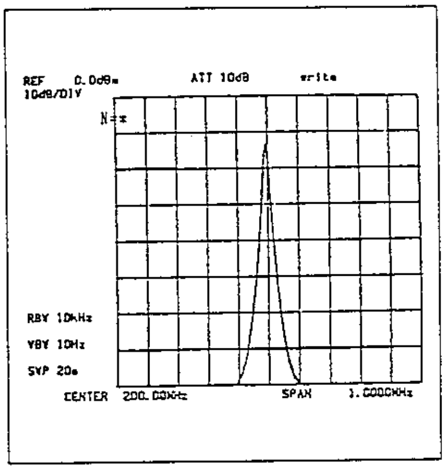
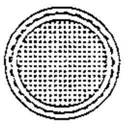



Figure 3-9 UNCAL Message
(Sweep Time: 200 ms)

(1) Data Entries

To enter sweep time data, use the following keys:



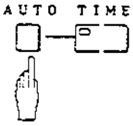
Prolongs the sweep time when turned clockwise in the above step, and shortens it when turned counterclockwise.

Changes the sweep time in the above step.

[Ten-key] Sets the round-up operation in the above step. For example, when 5.0 ≧ the setting value(s) > 2.0, 5 s will be set.

(2) AUTO Mode

AUTO TIME



Sets the shortest sweep time with which no "UNCAL" is displayed, according to the setting of the resolution bandwidth and video filter bandwidth.

### 3.3.4 Setting the Input Attenuator

For distortion-free measurement

This input attenuator is used to prevent the input block from being destroyed. It is also used to attenuate the input signal amplitude so as to avoid any distortion generation during measurement (see Figures 3-10 and 3-11). The input attenuator is generally used by being set in the AUTO mode.

Selects the manual setting mode for the input attenuator. Sets the RF attenuator value between the INPUT connector and the 1st mixer within the range of 0 to 55 dB in 5 dB steps.

| input ATTenuator | |
|---|---|
| 0 dB: | Can be set only with the ten-key pad. |
| 5 dB | |
| 10 dB: | Initial value |
| 15 dB | |
| 20 dB | |
| 25 dB | |
| 30 dB | |
| 35 dB | |
| 40 dB | |
| 45 dB | |
| 50 dB | |
| 55 dB | |

Display if input attenuator data

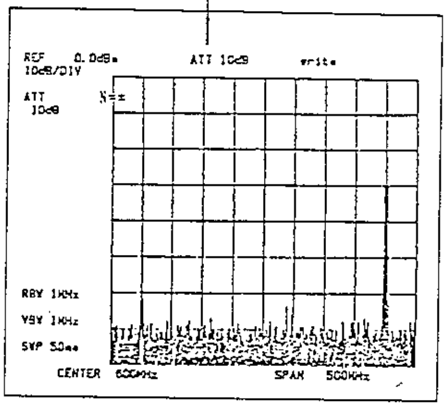



Figure 3-10 INPUT ATTENUATOR 10 dB

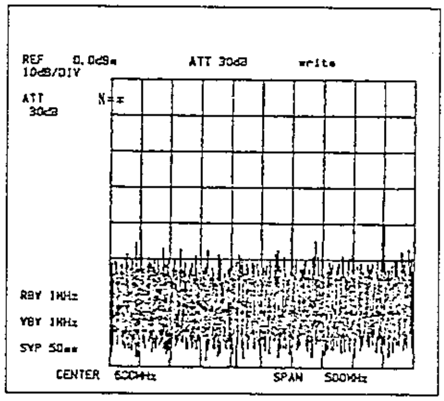
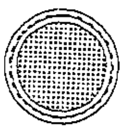



Figure 3-11 Decreased Harmonic Due to Internal Distortion (70 dB or more down with input of -30 dBm)

(1) Data Entries

To enter input attenuator data, use the following keys:


Steps up the input attenuator value when turned clockwise, and steps down when turned counterclockwise. Note that 0 dB cannot be set.


Changes the input attenuator value in the above step. Note that 0 dB cannot be set.

[Ten-key] Rounds up the input attenuator value of less than 5 dB for setting. 0 dB can be set with the ten-key pad only.

NOTE

1. Precautions on Setting the Attenuator to 0 dB

   The attenuator value can be set to 0 dB with the ten-key pad only. Be sure to check that the R4136 is not to be over- loaded with input signal for this setting.

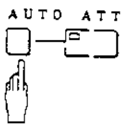
2. Precautions for Unknown Input Signal Level

   If there is any possibility of exceeding the R4136 maximum input level (the 30 dBm, ±0 VDC when the input attenuator level is 20 dB or more), attenuate the level via the pre- attenuator before application of the incoming signal. To enter a higher level signal, set the input attenuator level to 55 dB, and decrease the level in steps of 5 dB while monitoring the level on the CRT.

3. If the Input signal is Likely to Include DC-superimposed Components

   This instrument can accept only DC-coupled inputs to ensure the optimum frequency response. If DC is likely to be superimposed on the input signal, be sure to connect a DC-cutoff block to the preinput stage before making the input.

(2) AUTO mode




With the input attenuator AUTO mode, the input attenuator is automatically set according to the reference level. The more the reference level is increased, the larger the magnitude of attenuation becomes. Decreasing the reference level results in a smaller attenuator value.

The gain of the IF amplifier is controlled so that reference levels remain unchanged even if the minimum value setting of the input attenuator is changed. The initial value of the input attenuator is set to 10 dB to protect the mixer.

CAUTION

1. Input Signal Level and Appropriate Input Attenuator Value

   A signal of +20 dBm entered, for example, would result in a mixer input edge level (input signal level - input attenuator value) of -10 dB or more and the gain compressing of 1 dBm or less. Accordingly, set the attenuator value to 30 dB or more. To measure the level distortion of 70 dB or more, set the input attenuator level to 50 dB because the R4136 mixer input edge level is -30 dBm and the internal mixer distortion is 70 dB or less (the frequency is 10 MHz or more).

2. Other Precautions

   If the available frequency range for the instrument is set according to the band of the external mixer used, then the input signal does not pass through the input attenuator of instrument. In the case, the ATT switch on the instrument is preset to 55 dB.

(3) AUTO Mode Softkey Menu Configuration

AUTO (ATT)

| | |
|---|---|
| MIN. ATT ON | This key sets the minimum input ATT. The value of the input ATT decreases automatically by lowering the reference level, however, it will not be below the minimum setting of the input ATT. |
| MIN. ATT OFF | This key returns the input ATT to the regular AUTO mode. |

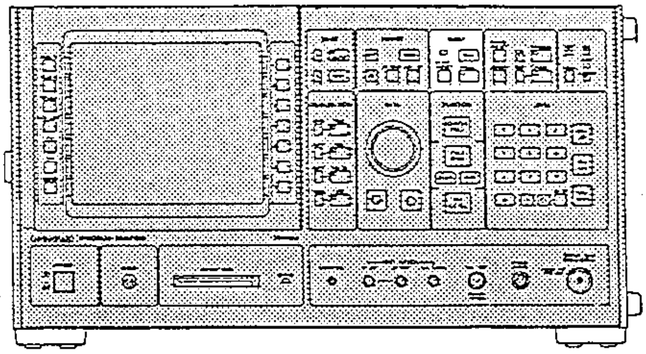
(Data input)
A setting below 5 dB is raised to the next higher integer. It cannot be set to 0 dB. Input ATT is invalid in manual setting mode.

## 3.4 SWEEP SECTION

START/RESET START and RESET keys for single sweep

TRIG TRIGger key

MANUAL Setup key for the MANUAL sweep mode



### 3.4.1 Setting of Trigger Conditions

TRIG Selects the setting mode for the trigger conditions, and displays the softkey menu of the trigger mode.

(1) Configuration of Softkey Menu

TRIG
↓

| | |
|---|---|
| FREE RUN | Repeats sweeping automatically inside the R4136. |
| LINE | Repeats sweeping in synchronism with the AC line frequency. |
| VIDEO | Triggers signals with the waveform displayed on the CRT. |
| TV-V | Triggers signals with the TV vertical signal. |
| EXT. | Controls sweeping operation with the external trigger. Triggering takes place when the TTL level signal applied at the EXT TRIG terminal on the rear panel falls from High to Low. |
| | |
| SINGLE | Single sweep mode. Press START/RESET to control sweeping. |

### 3.4.2 Interrupt Execution of Sweep

START/RESET

Pressing this key in the single trigger mode executes the sweep operation once. When the key is pressed during sweep operation, the sweep operation in all trigger modes will be stopped and reset from the start. This key is used to reset the long-time sweep operation when renewing the screen.

### 3.4.3 Manual Sweep

MANUAL

Selects the manual sweep mode (LED comes on), and displays the current sweep point frequency and level. The manual sweep start point is at the active marker position if the marker is displayed. The setting resolution COARSE/FINE with the data knob can be selected at the softkey menu.

PRECAUTION

The manual sweep mode does not work during multiband sweeping.

(1) Data Entries

To enter manual sweep data, use the following keys:

Moves the sweep point to the right when turned clockwise; to the left when turned counterclockwise.

Moves the sweep starting point to the right.

Moves the sweep starting point to the left.

[Ten-key] Setup resolution is $\frac{1}{140000}$.

(2) Configuration of Softkey Menu

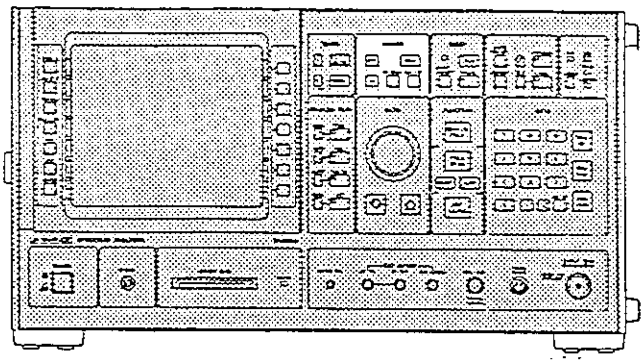
MANUAL

COARSE Sets the data knob resolution to 1/700.

FINE Sets the data knob resolution to 1/1400.

## 3.5 MARKER SECTION

Direct reading function for various data



[ON] Marker display key
[OFF] Maker deletion key
[MENU] Marker menu display key

PK SRCH
[ ] Peak search key

MK→CP
[ ] Marker→ Center Frequency key

### 3.5.1 Basic Operations

Peak SeaRCH, MarKeR → Center Frequency

[ON] The marker appears in the center frequency axis. The frequency and level data at the marker position are displayed on the CRT (see Figure 3-12).

[OFF] Clears the marker and its data on the CRT.

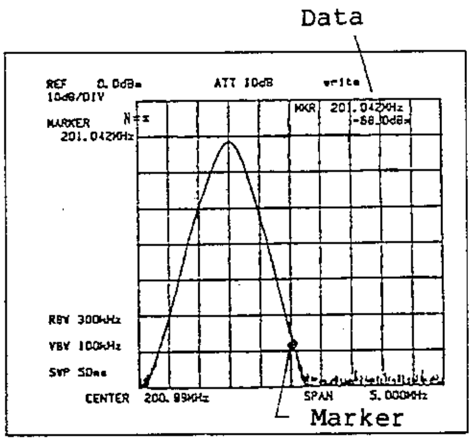
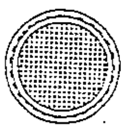



Figure 3-12 Display for the Marker and its Data

(1) Data Entries

To enter marker data, use the following keys:


Displays the marker. Moves the marker to the right when turned clockwise, to the left when turned counterclockwise.

[⇧] Moves the marker to the right by 1 division.

[⇩] Move the marker to the left by 1 division.

[Ten-key] Sets the marker to 50 MHz ( [5] [0] [MHz/sec] ).

**Marker Display Accuracy**

When measuring the signal frequency with the marker, the frequency accuracy can be obtained by "center frequency accuracy + span accuracy" in the normal marker mode. That is, the further away the marker is from the center of the screen, the lower the marker accuracy will be. The counter mode described in the next section allows signal frequency measurement under the frequency span of 2 MHz or less with the accuracy of the reference oscillator +30 Hz.

(2) Peak Search

PK SRCH ▢ Moves or displays the marker to the maximum peak of the spectrum (see Figures 3-12 and 3-13).

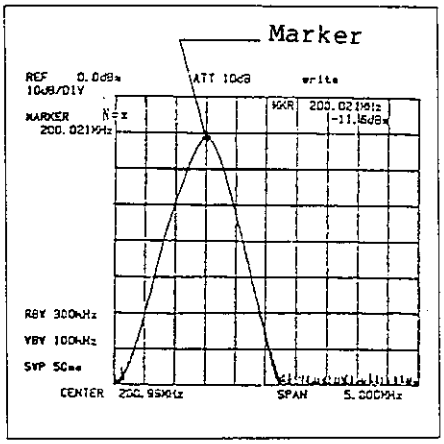



Figure 3-13 Peak Search

(3) MarKer → Center Frequency

MKR→CF ▢ Marker frequency becomes the center frequency, that is, the marker point signal moves to the center of the CRT (see Figures 3-13 and 3-14).

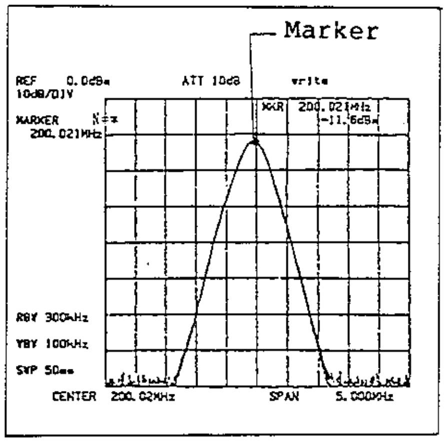



Figure 3-14 Marker → Center Frequency

### 3.5.2 Menu (MARKER)

(1) Configuration of Softkey Menus

The softkey menus for the MENU key of the marker mode are configured as shown in A1.3.2 (1).

(2) Description of Softkey Menus

①

| | |
|---|---|
| MKR STEP SIZE | Sets the marker step size setting mode, and displays the following softkey menu (Set the step size with the ten-key pad.): |
| SEARCH | Displays the following softkey menu ②. |
| SIGNAL TRACK | Marker follows the signal, and the signal is set to the center of the screen. If the signal drifts, since the maker follows it, the center frequency changes as the signal drift so the signal is always displayed in the middle of the screen. If the signal disappears from the CRT, it cannot be set on the CRT, where the softkey menu ③ will be displayed. |
| ΔMKR | Fixes the marker (*) and a new marker (◇) appears on the screen. The following softkey menu ④ is displayed as well. The marker data display indicates the frequency and level difference between the two markers (see Figures 3-14 and 3-15). The "◇" marker is operated by using the data knob, step key, or ten-key pad. To delete this "◇" marker and to activate the normal marker, press . To delete both of them, press . |

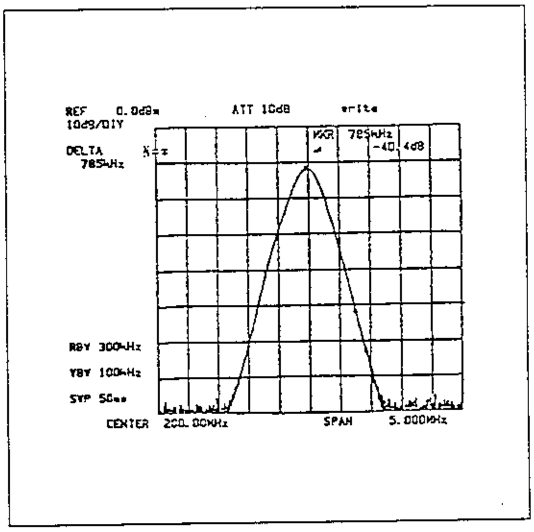



Figure 3-15 ΔMARKER

FREQ. COUNTR

Selects the frequency counter function. Note that this function is to be activated when the frequency span is set 2 MHz or less. This function measures the marker-contained signal frequency with higher accuracy when the marker point level is above the noise level by 15 dB or more. In this function, the marker need not be adjusted at the spectrum peak because the marker-existent signal frequency, not the marker frequency, is to be measured. Note, however, that amplitude indication is that of the marker point.

The marker frequency indication in the normal marker mode is made by computing the marker position from the center frequency on the frequency axis; in the counter mode, the marker frequency is measured directly with the reference oscillator accuracy. The message "COUNTER xx Hz" is displayed on the screen as well as the subdivided softkey menu ⑤, thus ensuring a maximum resolution of 1 Hz. Increasing the counter resolution prolongs the gate time, and results in slower sweeping. Note that this counter mode cannot be used together with SIG TRACK.

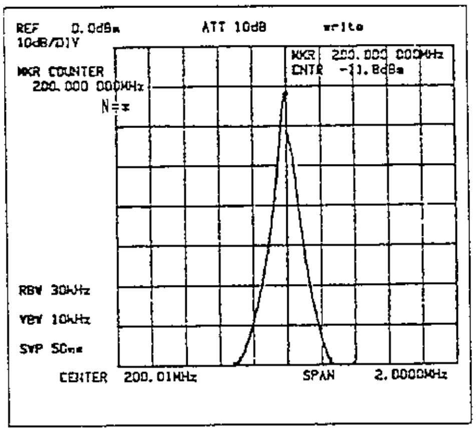



Figure 3-16 Counter Mode

PRESEL

This key enables the input sweep frequency and the sweep frequency of the preselector contained in the input section to be accurately tracked in an input range from 3.5 GHz to 23 GHz. Pressing this key causes the following softkey menu ⑥ and the marker to appear, enabling the marker to be moved.

MORE 1/2

Displays the softkey menu ⑦.

②

| | |
|---|---|
| PEAK SEARCH | Marker moves to the maximum peak on the CRT. |
| PEAK LIST | From the left edge of the display, perform automatically "NEXT. FREQ. PK" to display the lists of frequencies and levels.<br>Up to 20 items can be displayed.<br>To delete this display, press "PK LIST".<br>When the display line is displayed, this menu operates only for the signal above the display line. |
| NEG PEAK | Marker moves to the minimum value on the CRT. When the display line is displayed, this menu operates only for the signal above the display line. |
| DISP LINE ON | Displays the display line. |
| DISP LINE OFF | Erases the display line. |
| RETURN | Returns you to the initial softkey menu ①. |

③

| | |
|---|---|
| OFF | Turn off the signal track function and return to the conventional marker mode. |
| RETURN | Returns you to the initial softkey menu ①. |

④

| | |
|---|---|
| PEAK SEARCH | Moves both of the * and ◇ markers to the maximum peak spectrum on the CRT. |
| dBc/Hz | Used for C/N measurement of signal. (See 5.8.2.) |
| dBc/Hz OFF | |
| MKR/Δ →SPAN | Sets the two marker frequencies to the leftmost and rightmost frequencies respectively. |
| XdB DN MKR | To specify a point lower than the delta marker by XdB moves delta marker (*) and active marker (◇) to the point. Useful to measure bandwidth of a band pass filter. |
| RETURN | Returns you to the initial softkey menu ①. |

⑤

| | |
|---|---|
| OFF | Clears the counter mode. |
| 1 kHz | Sets the counter resolution of 1 kHz. |
| 100 kHz | Sets the counter resolution of 100 Hz. |
| 10 kHz | Sets the counter resolution of 10 Hz. |
| 1 Hz | Sets the counter resolution of 1 Hz. |
| RETURN | Returns you to the initial softkey menu ①. |

⑥

| | |
|---|---|
| PEAK SEARCH | Sets the marker to the waveform peak on the display. |
| AUTO PKING | Auto-adjusts the tracking accuracy of the preselector so that the input signal level that has been selected using the marker becomes the maximum. Before press- ing this key, set the marker to an approximate value of the input signal level desired. |
| MANUAL PKING | Enables manual adjustment of the tracking accuracy of the preselector. Adjustments can be made using the data knob, step keys or numeric keys. |
| RETURN | Returns you to the initial softkey menu ①. |

⑦

| | |
|---|---|
| FIELD STR | Enables the field strength data that was used to correct the antenna coefficient to be directly read with the marker during use of the antenna. Displays the softkey menu ⑧. |
| SIGNAL IDENT | This key is used to identify three factors: the under-measurement signal existing during use of an external mixer, the image response, and the multiple response. |
| NOISE MEASR | Used when measuring the noise in the noise power bandwidth of 1 Mz. (See [5.8.1]) Displays the softkey menu shown in ⑩. |
| FIXED ΔMKR | The delta marker (*) appears on the position of the active marker (◇) displayed by MARKER ON, and the difference between the active marker (◇) and the delta marker (*) is displayed as marker data based on the frequency and the level at that time. Therefore, the difference between the active marker (◇) and the delta marker (*) is displayed as marker data based on the frequency and the level when this function is operated even if the central frequency or REF LEVEL is changed. To cancel this function, set the marker "OFF". |
| MORE 2/2 | Returns you to the initial softkey menu ①. |

⑧

| | |
|---|---|
| DIPOLE (A) | Measures the field strength with an Advantest half-wave length dipole antenna TR1722. |
| LOG PERD (B) | Measures the field strength with an Advantest logarithmic-periodical antenna TR1711. |
| TR 17203 (C) | Measures the field strength with an Advantest active antenna TR17203. |
| RETURN | Returns you to the initial softkey menu ⑦. |

Note: Release of the electric intensity measurement:

Select UNITS of dBm in the softkey menu of REF LEVEL.

⑨

| | |
|---|---|
| N(+/-) | The mixing mode alternates between plus (IF = RF-N x L0) and minus (IF = N x L0-RF) each time the key is pressed. |
| NORMAL /SHIFT | Only while the IF remains set to 4 GHz, does the IF of the instrument change over between 3996.4211 MHz and 4001.4211 MHz each time the key is pressed. |
| RETURN | Returns you to the initial softkey menu ⑦. |

⑩

| | |
|---|---|
| dBm/Hz | Used when the unit of reference level is dBm. |
| dBμ/ √Hz | Used when the unit of reference level is dBμ. |
| OFF | Cancels the noise measuring mode. |
| RETURN | Returns you to the initial softkey menu ⑦. |

### 3.5.3 Peak Search

(1) Configuration and Description of Softkey Menus

Pressing the PK SRCH key moves the marker to the position of the maximum data values displayed on the CRT and displays the softkey menus below:

PK SRCH

| | |
|---|---|
| ΔMKR | Fixes on the CRT the "*" marker displayed by pressing the ON key and displays another " ◇ " marker as well as the softkey menu ④ on the CRT. The frequency and level deferences between these two markers are displayed as marker data. The " ◇ " marker can be moved with the data knob, step keys, and ten-key pad. To erase the " ◇ " marker and make the "*" marker active, press the ON key. To erase both markers, press the OFF key. |
| NEXT LEVEL PK | The active marker displayed moves to the signal of the next level. When the display line appears, the active marker (◇) operates only for the signals above the display line. During internal processing time, the display of the softkey menu reverses. |
| NEXT FREQ PK | The active marker (◇) displayed moves to the signal of next frequency.<br>When the display line appears, the active marker (◇) operates only for the signals above the display line.<br>During internal processing time, the display of the softkey menu reverses. |
| NEG PEAK | Moves the marker to the position of the minimum data value on the CRT. Works on signals above a display line if it is displayed. |
| MKR→REF | Sets the level of marker to the reference level. |
| AUTO PEAK | The active marker (◇) automatically tracks the signal of Max. level on the display.<br>The same operation is automatically performed when "PK SRCH" is operated for every sweep.<br>To cancel this function, either set the marker to "OFF" or press "AUTO PEAK" again. |

## 3.6 TRACE SECTION

The CRT display consists of 701 points in the horizontal axis, and 401 points in the vertical axis. Trace (spectrum signal) is displayed by displaying the level data for each point on the horizontal axis (see Figure 3-17).

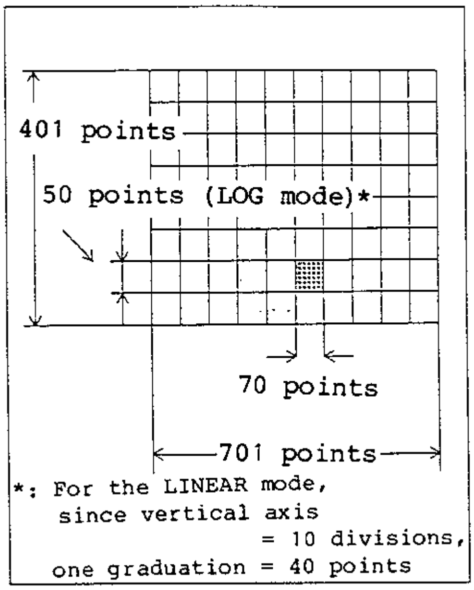



Figure 3-17 Dot Configuration of CRT Display

Figure 3-18 shows an overview of R4136 trace mode operations. The input signal is transferred via the RF/IF section, detected by the LOG/LIN amplifier, and then A/D-converted. A/D converted data is routed to the trace memory and controlled by the CPU before being displayed on the CRT.

A trace detection, in sampling the input signal to be A/D-converted, determines which data is to be displayed among input data for each point in the horizontal axis. Note that the data is detected within a given period of time which is regulated in accordance with the sweep time. In the NORMAL mode, the POSI or NEGA PEAK is selected as display data, by being compared with the previous display data. The POSI-PEAK mode gives the maximum value as display data, and the SAMPLE mode provides the last instantaneous value as display data. Select them according to the purpose of the measurement.

The trace memory provides for the WRITE memory in which data can be rewritten along with a sweep operation, and two memories, A and B, where a screen of any data in the WRITE memory can be stored. Two types of any waveform can be called from among the WRITE memory waveform and A or B memory waveform. Into the memory can be stored the maximum level spectrum (MAX HOLD) of the input signal, or the averaged spectrum (AVeragInG), thus enabling a variety of spectrum comparisons.

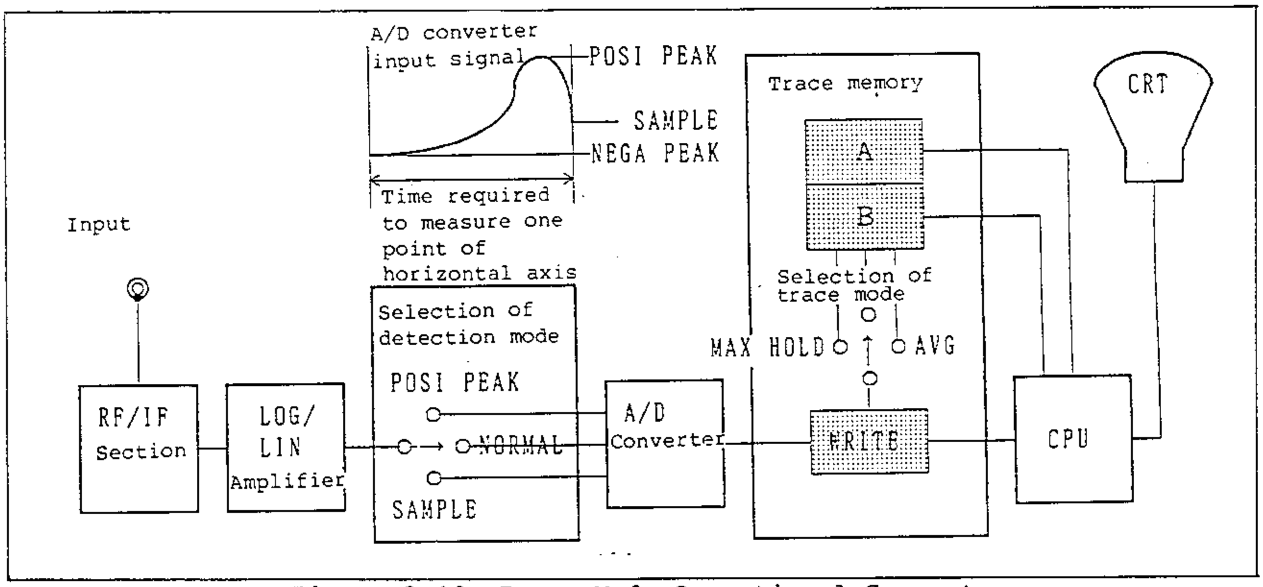
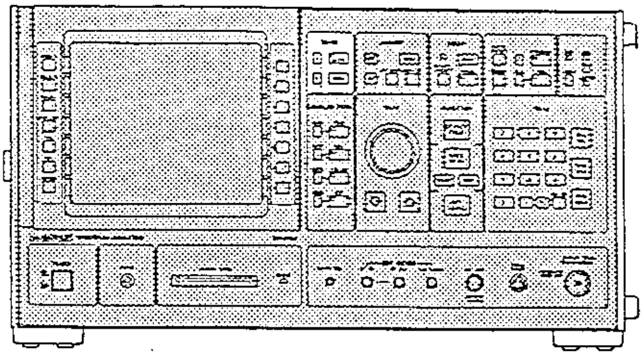



Figure 3-18 Trace Mode Operational Concept

## 3.6.1 Trace Memory Selection and the MAX HOLD and AVeraGing Modes



WRITE Trace memory WRITE selection key

MENU Displays trace mode softkey menu

A、B Trace memory A/B selection key

(1) WRITE Mode

WRITE Selects the WRITE memory for trace data to be displayed on the CRT display (initialization). The contents in the WRITE memory are renewed for each sweep operation; they are renewed even while another trace memory display mode is selected.

(2) STORE, VIEW, MAX HOLD, and AVeraGing Modes

. Configuration of Softkey Menus

Pressing the A or B key displays the softkey menu (shown in A1.3.1 (2)) and selects memory A or B as an object to be set.

. Description of Softkey Menu

①

| | |
|---|---|
| STORE | Stores the WRITE trace data into memory A (or B), and holds the screen (set in the VIEW mode). The stored trace data is preserved until new trace data is stored again. |
| VIEW | Displays the stored data. |
| MAX HOLD | Compares the data for each point on the CRT frequency axis with new data at every sweep operation time, and takes the larger value of data for display. Therefore, the waveform assumes the maximum value of trace in time series analysis. This mode is automatically set to POSI PEAK detection mode.<br>Displays the softkey menu ③. |
| AVG | Selects AVeraginG, and displays the modes shown in ④ for the setup of number of averages. The averaging operation can improve the S/N ratio in a shorter sweep time than the video bandwidth reduces noise, thereby enabling random component quantification and observation of the signal embedded in noise. This mode automatically assumes the SAMPLE mode in the trace detection mode. |
| A↔B | Replaces the contents of the A memory with the contents of the B memory. |
| A & B VIEW | Displays the contents of the A memory and the B memory simultaneously. |
| NORMALIZE | The value on subtracting the data stored in the A or B memory from the data of input signal is displayed. The difference between the data in the A or B memory, as a reference, and the data of input signal is displayed.<br>When the display line does not appear, the reference line (the line where the difference is zero) becomes the center of the display; when the display line appears, the reference line becomes the display line.<br>The marker display becomes the difference between the data in the A or B memory and the input data. Displays the softkey menu ②. On pressing this softkey again, the display becomes the "WRITE" mode. |

②

| | |
|---|---|
| AVG | |
| MAX HOLD | |
| OFF | |
| RETURN | Returns you to the initial softkey menu ①. |

③

| | |
|---|---|
| OFF | Cancellation of MAX HOLD |
| STOP/ RESTR | When first pressed, MAX HOLD is stopped; on repressing, MAX HOLD is restarted. |

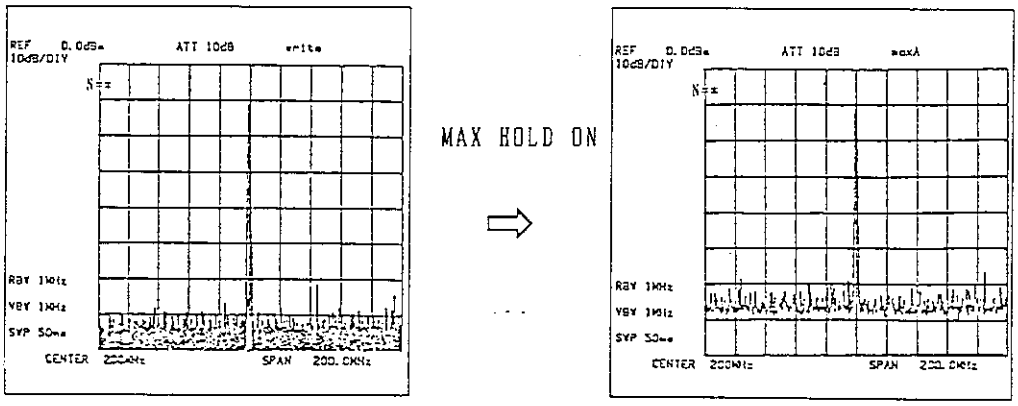



Figure 3-19 MAX HOLD

④

| | |
|---|---|
| OFF | Cancellation of averaging |
| STOP/ RESTR | When first pressed, the averaging is stopped; on repressing, the averaging is restarted. |
| 8 | Sets the number of average times to 8. |
| 16 | Sets the number of average times to 16. |
| 32 | Sets the number of average times to 32. |
| 64 | Sets the number of average times to 64. |
| 128 | Sets the number of average times to 128. |

The preset number of averaging times is displayed on the upper left of the screen like "043/128." 043 represents the current averaged times, and 128 represents the preset number of averaging (Figure 3-20).

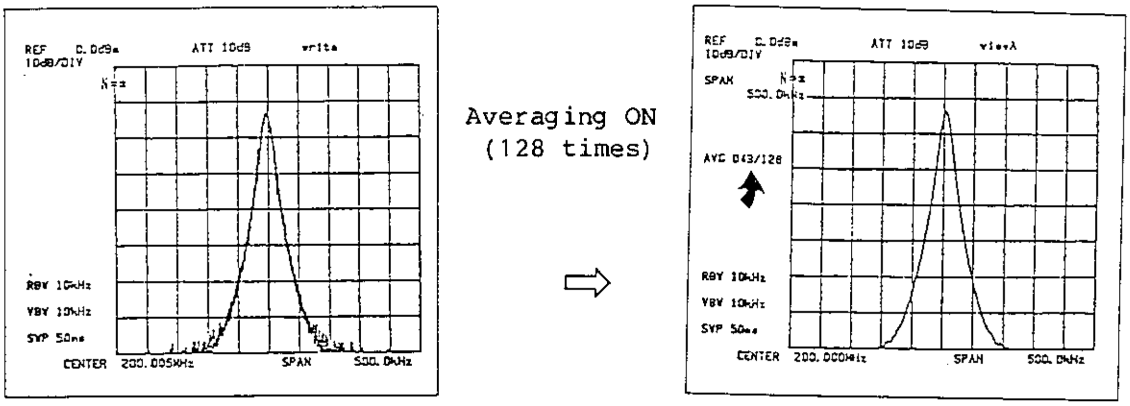



Figure 3-20 AveraGing

Averaging Operation

According to the number of set times, the averaged data and new data is added with certain time weighting for averaging.

$$\overline{Y}_n = \frac{n-1}{n} \cdot \overline{Y}_{n-1} + \frac{1}{n} Y_n \qquad \text{(when } n = 4, 8, 16, 32, 64, \text{ or } 128)$$

$$\overline{Y}_n = \frac{2^N-1}{n} \cdot \overline{Y}_{n-1} + \frac{1}{2^N} Y_n \qquad \text{(when } n < S \text{ and } n=4, 8, 16, 32, 64, 128. \text{ N is integer where } n > 2^N > \frac{2}{N})$$

$$\overline{Y}_n = \frac{S-1}{S} \cdot \overline{Y}_{n-1} + \frac{1}{S} Y_n \qquad \text{(when } n > S) \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(a)}$$

S : setup number of averaging; 4, 8, 16, 32, 64 or 128

Yn: nth input data

$\overline{Y}$n: nth averaged data

If the number of averages times exceeds S, setup number of averaging, the averaging is continued according to the formula (a) and the averaging time indication is fixed to S/S.

### 3.6.2 Dual-screen Display

[WRITE] is pressed to renew the waveform (Trace data) in WRITE memory at every sweep. The key operation, [A] (or [B]) STORE stores a trace data of a single sweep to the internal memory [A] (or [B]) and the CRT displays this stationary waveform. Note that the WRITE memory is always refreshed based on the sweep time setting. Pressing [WRITE] again recalls the trace data in WRITE memory along with [A] (or [B]) memory (Dual-screen display). To reset the display to a single screen, press [A] (or [B]) or [WRITE] to erase the corresponding screen. VIEW and [WRITE] operates for ON/OFF switch of the corresponding trace data in the dual-screen display mode.

The following is an example of Dual-screen display of the same waveform with difference in Resolution Bandwidth setting.

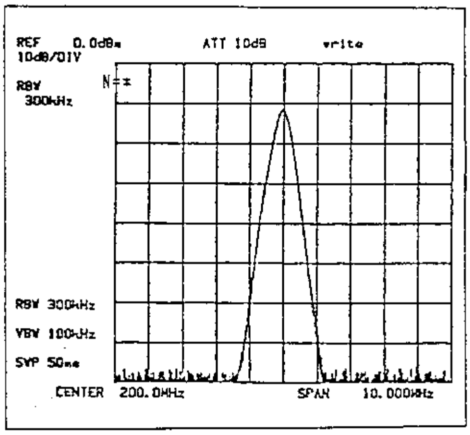



Figure 3-21 Signal to be Measured
RBW: 300 kHz

Operating Procedure

① First, adjust the spectrum of the signal to be measured at the center of the CRT. Then, select the measurement conditions (frequency span, sweep time, and others) for easier signal observation.
Set RBW at 300 kHz (See Figure 3-21).

② [A] STORE Stops the waveform. This waveform data is stored in memory A.

③ Pressing the [WRITE] key simultaneously displays the waveform stored during WRITE mode and the waveform stored in memory A or B. These two waveforms can be distinguished from each other by changing the resolution bandwidth to 30 KHz. Then, the CRT will change as shown in Figure 3-22.

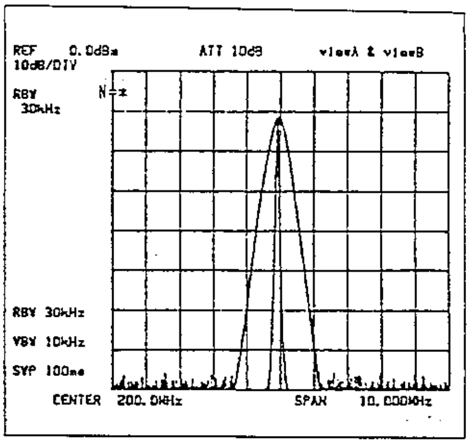



Figure 3-22 Dual-screen Display of a Refreshed WRITE Waveform and the Stored Waveform

④ To delete the waveform in memory A from the screen, keeping it in the memory, press VIEW . It will yield a single WRITE trace screen. On the other hand, press WRITE to display only the waveform in the memory. In other words, press the key of whichever waveform is to be deleted from the screen.

### 3.6.3 Menu (TRACE)

(1) Configuration of Softkey Menus

The softkey menus for the MENU key during TRACE mode are configured as shown in A1.3.1 (1).

(2) Description of Softkey Menu

①

| | |
|---|---|
| DISP LINE ON | Displays the display line. The display line is a horizontal cursor line for waveform level comparison. This line is moved by the data knob or step key. The message "DL=xx dBm" is displayed on the CRT. |
| DISP LINE OFF | Deletes the display line. |
| INPUT SEL. | Selects the signal to be input to the A/D converter. Displays the softkey menu ②. |
| TRACE DET | Displays the trace detection menu ④. |
| DISP FUNC. | Displays the following softkey menus ⑤: |
| INTENS | Enables change of the CRT display intensity. Use ⇩ ⇧ for adjustment. When the CRT become OFF state by pressing ⇩, press any key other than ⇩ ⇧ to return to the initial intensity. |

②

| | |
|---|---|
| RF INPUT | Displays the SPA RF input waveform. |
| EXT INPUT | Displays the external input signal on the rear panel. Each SCALE per division can be independently entered at the RF input waveform display with the following softkey menus 3 : |
| | |
| RETURN | Returns you to the initial softkey menu ①. |

③

| | |
|---|---|
| 0.5 V/ (10 dB/) | |
| 0.25 V/ (5 dB/) | |
| 0.1 V/ (2 dB/) | |
| 50 mV/ (1 dB/) | |
| SWEEP TIME | Sets the SWEEP TIME at the external input |
| VIDEO B.W. | Sets the RBW at the external input |
| RETURN | Returns you to the initial softkey menu ②. |

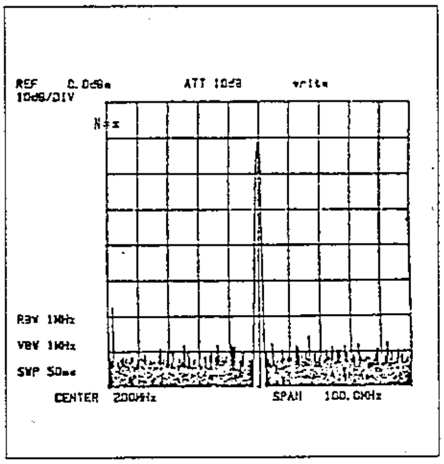


Figure 3-23 NORMAL DETECTION

④

| | |
|---|---|
| NORMAL | Sets the NORMAL detection (POSI-NEGA PEAK mode) (see Figure 3-23). The initial value is NORMAL DETECTION. |
| POSI. P | Sets POSI Peak (see Figure 3-24). Because this mode accurately ascertains the spectrum peak, it is useful to measure fine spectrum levels, and the Pulsed RF signal. |

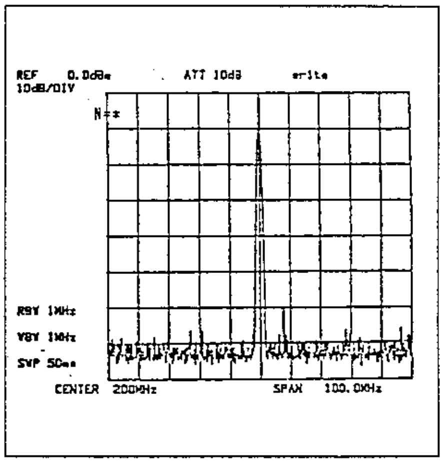


Figure 3-24 POSI PEAK DETECTION

NEGA. P — Sets NEGA Peak (see Figure 3-25).

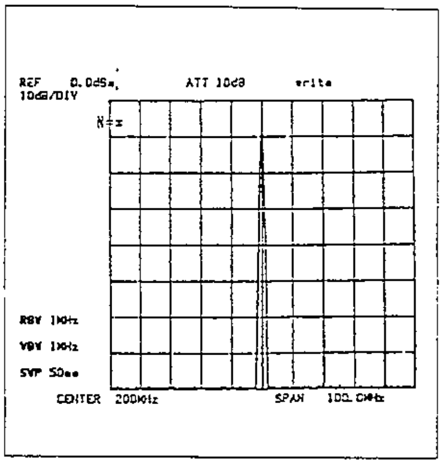



Figure 3-25 NEGA PEAK DETECTION

SAMPLE — Sets SAMPLE detection (see Figure 3-26).

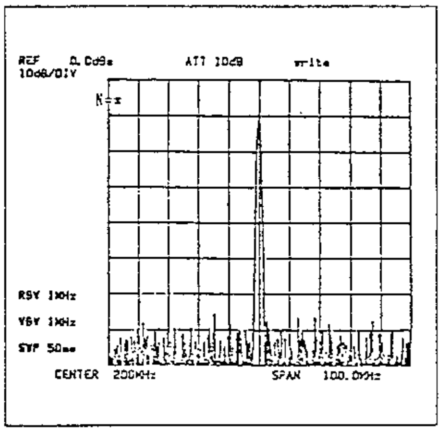



Figure 3-26 SAMPLE DETECTION

RETURN — Returns you to the initial softkey menu ①.

⑤

| | |
|---|---|
| B-A | Displays the values in which the B memory values are subtracted from the A memory values for each point. |
| INPUT -A | Displays the values in which new sweep data values are subtracted from the A memory values for each point. Displays the softkey menu ⑥. |
| A↔B | Transposes the A and B memory contents with each other. |
| INPUT -B | The value is obtained by subtracting the value in the B memory from the new sweep data is displayed for every point. Displays the softkey menu ⑥. |
| CORR. WRITE | (Option 06) Refer to [(2) in 7.6.3] Displays the softkey menu ⑥. |
| CORR. A VIEW | (Option 06) Refer to [(2) in 7.6.3] |
| RETURN | Returns you to the initial softkey menu ①. |

⑥

| | |
|---|---|
| AVG | Displays the softkey menu ⑦. |
| MAX HOLD | Displays the softkey menu ⑧. |
| OFF | |
| RETURN | Returns you to the initial softkey menu ⑤. |

⑦

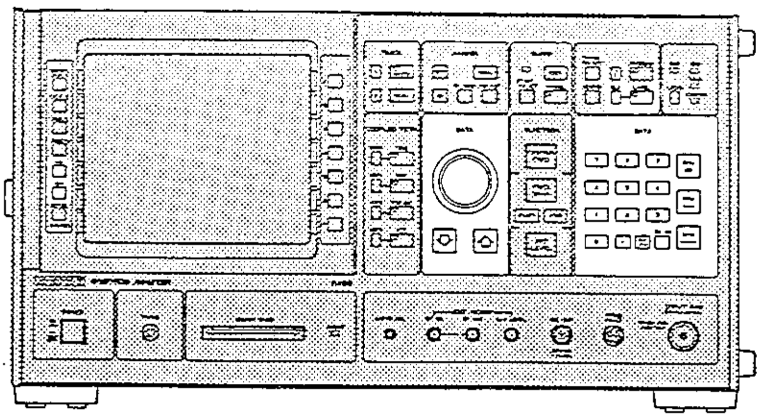
| |
|---|
| OFF |
| STOP/ RESTR |
| 8 |
| 16 |
| 32 |
| 64 |
| 128 |

⑧

| |
|---|
| OFF |
| STOP/ RESTR |

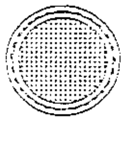
# 4. OPERATING PROCEDURES (2)

## 4.1 LABEL FUNCTION: LABEL CHARACTERS



| | |
|---|---|
| LABEL | Select Label mode |
| CLR | CLear the Label |
| | Select Label Characters |
| ⇨ ⇦ | Cursor control |

| | |
|---|---|
| LABEL | R4136 is set in the LABEL mode. The cursor appears on the upper-left corner of the CRT. In this mode the characters, numerics, and symbols shown in Table 4-1 can be used as labels. Label can be entered in 26 lines and up to 64 characters in a single line. As shown in Figure 4-1, however, the label can not entered in REF LEVEL display area and the active function display area, and can be replaced by function data display, softkey menu and so on in these area. |
| [0] to [9] | Used to input numerals. |
| [.] | Used to input ".". |
| [-] | Used to input "_". |
| Back sp | Deletes a character before the cursor. |
| GHz dB | Selects uppercase label characters. |
| MHz sec | Selects lowercase label characters. |
| kHz msec | Selects special label characters. |



When the data knob is turned, the characters and symbols that have been selected using the unit keys will appear one after another. (See Table 4-1).

Pressing ⇨ moves the cursor to the right to fix the displayed LABEL mode.

⇨ Moves the cursor to the right.

⇦ Moves the cursor to the left.

⇩ Moves the cursor up one line.

⇧ Moves the cursor down one line.

CLR Deletes the labels in the specified range. First, move the cursor to the first label to be deleted and press this key. This label character then starts blinking. Next, move the cursor to the end label, and press this again. The characters starting with the blinking and up to the last one where the cursor is positioned are deleted.

Table 4-1 Label Characters

| Selected key | The characters, numerics, symbols |
|---|---|
| When the data knob is turned clockwise. ⇨ | ⇦ When the data knob is turned counterclockwise. |
| GHz / dB | A B C D E F G H I J K L M N O P Q R S T U V W X Y Z |
| MHz / sec | a b c d e f g h i j k l m n o p q r s t u v w x y z |
| kHz / msec | + - * / = > < ( ) [ ] \ ^ . , : ; " ' ! @ # $ % ? ~ Δ & |

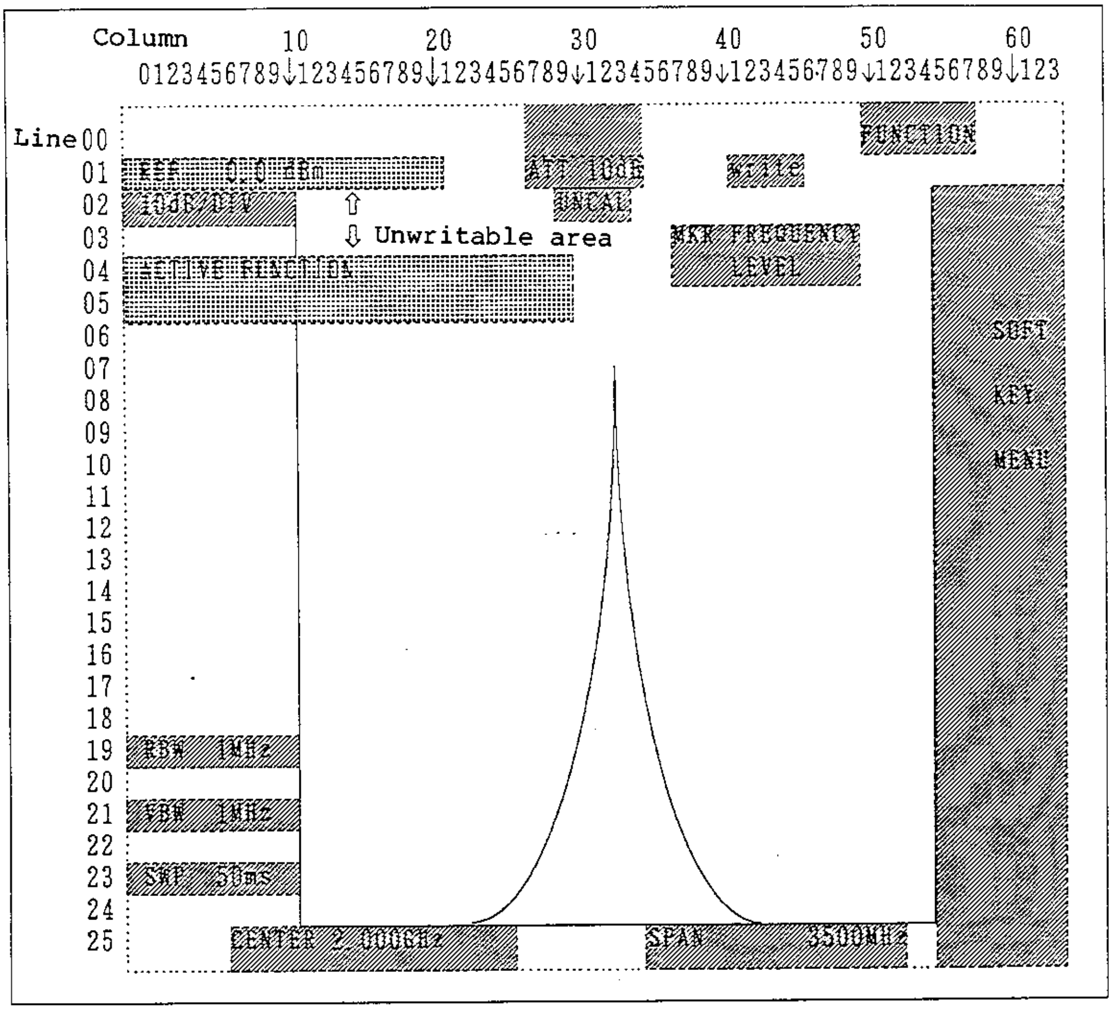
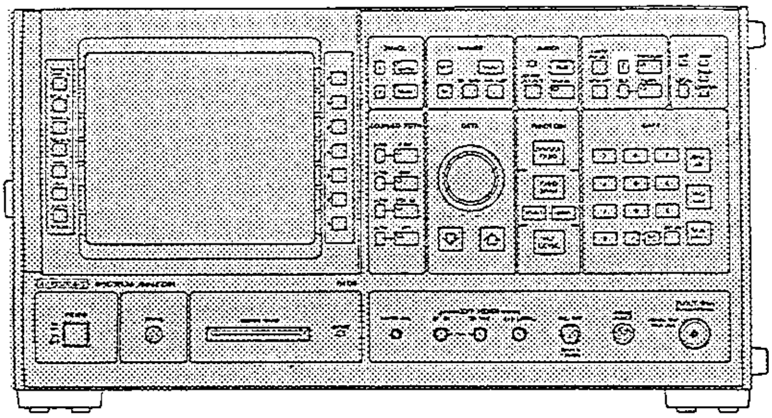



Figure 4-1 Area Unwrite in LABEL Mode ( ▒ ) and the Area Containing the LABELS that will be Deleted when the Measuring Conditions are Changed ( ▨ )

## 4.2 PLOTTER OUTPUT

The GPIB capability is implemented on R4136 as standard. When connected directly to the plotter, this GPIB can output the data displayed on the CRT without using the remote controller. Advantest's TR9831, TR9832, TR9834R, TR9835/R, and HP's 7440/70/75, and 7550 are connectable to the R4136 spectrum analyzer.

For the ADVANTEST TR9833, the TR9832 more must be used.



### 4.2.1 Plotter Output Procedure

The plotter output procedure is given below.

① Connect the GP-IB connector on the R4136 rear panel with the plotter's GPIB connector via the GPIB cable. Set the address switch of the plotter to "05".

NOTE

For paper setting, refer to the reference manual of the plotter to be used.

② Press [f] to call the softkey menu, and select the plotter mode. The output condition is set using the softkeys as mentioned below. Pressing the RETURN key at each softkey menu returns to the menu immediately prior to the current one.

### 4.2.2 Configuration and Description of Softkey Menus

(1) Configuration of Softkey Menus

The softkey menus for the f key are configured as shown in A1.3.4 (1).

(2) Description of Softkey Menus

This section describes the softkey menus for (a) Standard and (b) Option 04.
The softkey menus for (c) Option 06 and (d) Options 04 and 06 are described in 7.1.2.

(a) Standard

①

| | |
|---|---|
| GP-IB ADDRESS | |
| PLOTTER | Selects the plotter mode. Displays the softkey menu ②. |
| CMT DISP | |

②

| | |
|---|---|
| TR-PLOTTER | Selects the Advantest's plotters. Displays the softkey menu ③. |
| HP-PLOTTER | Selects the HP's plotters. Displays the softkey menu ⑨. |
| | |
| PEN | As Table 4-2 shows, up to six plot colors are available depending on the types of data. Displays the softkey menu ⑮. |
| | |
| RUN | Starts the plotter output operation. |
| CANCEL | Stops the plotter output operation. |
| RETURN | Returns you to the initial softkey menu ①. |

③

| | |
|---|---|
| TR 9834R 35R | Selects TR9834R/35R. — Displays the softkey menu ④. |
| TR9835 | Selects TR9835. |
| TR9832 | Selects TR9832. |
| TR9831 | Selects TR9831. |
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ②. |

④

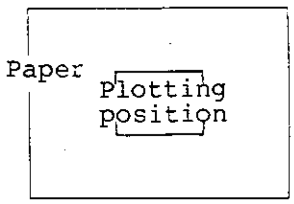
| | |
|---|---|
| ALL | Outputs all the data on the CRT. — Displays the softkey menu ⑤. |
| DATA | Outputs the trace data only. — Displays the softkey menu ⑤. |
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ③. |

⑤

| | |
|---|---|
| LARGE | Selects the paper size of A3. — Displays the softkey menu ⑥. |
| SMALL | Selects the paper size of A4. — Displays the softkey menu ⑥. |
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ④. |

⑥

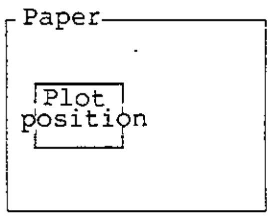
| | |
|---|---|
| 1 PIC TURE | Yields one plot. |



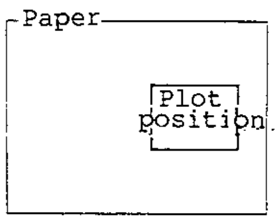

| | |
|---|---|
| 2 PIC TURES | Plots data in two splits. Displays the softkey menu ⑦. |
| 4 PIC TURES | Plots data in four splits. Displays the softkey menu ⑧. |
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ⑤. |

⑦

LEFT — Plots data on the left of the paper.



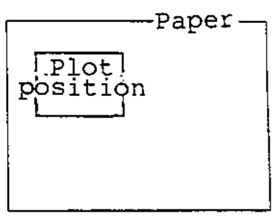

RIGHT — Plots data on the right of the paper.



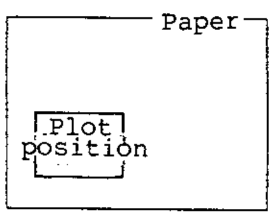

| | |
|---|---|
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ⑥. |

⑧

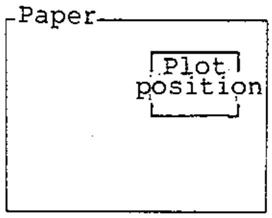
UPPER LEFT — Plots data on the upper left of the paper.



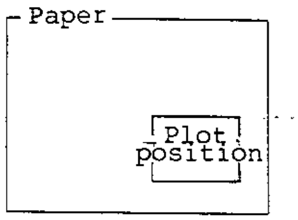

LOWER LEFT — Plots data on the lower left of the paper.



| | |
|---|---|
| UPPER RIGHT | Plots data on the upper right of the paper. |




| | |
|---|---|
| LOWER RIGHT | Plots data on the lower right of the paper. |




| | |
|---|---|
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ⑥. |

⑨

| | |
|---|---|
| HP7475 7550 | Selects HP7475 or 7550. — Displays the softkey menu ⑩. |
| HP7470 7440 | Selects H7470 or 7440. — Displays the softkey menu ⑩. |
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ②. |

⑩

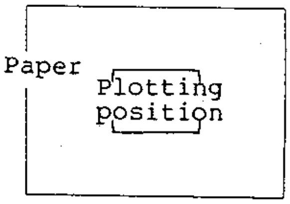
| | |
|---|---|
| ALL | Outputs all the data on the CRT. — Displays the softkey menu ⑪ . |
| DATA | Outputs the trace data only. |
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ⑨ . |

⑪

| | |
|---|---|
| LARGE | Selects the paper size of A3. — Displays the softkey menu ⑫ . |
| SMALL | Selects the paper size of A4. |
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ⑩ . |

⑫

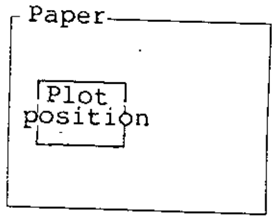
| | |
|---|---|
| 1 PIC TURE | Yields one plot. |



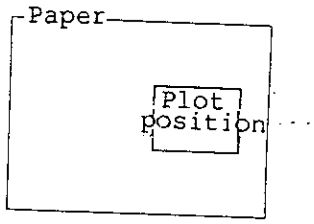

| | |
|---|---|
| 2 PIC TURES | Plots data in two splits. Displays the softkey menu ⑬ . |
| 4 PIC TURES | Plots data in four splits. Displays the softkey menu ⑭ . |
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ⑪ . |

⑬

LEFT — Plots data on the left of the paper.




RIGHT — Plots data on the right of the paper.



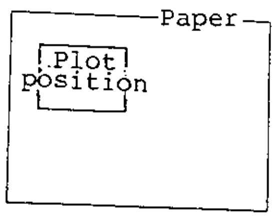

RUN — Starts plotter output.

CANCEL — Cancels plotter output.

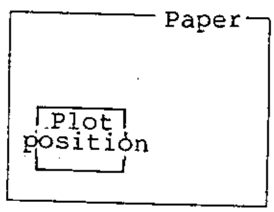
RETURN — Returns you to the initial softkey menu ⑫ .

⑭

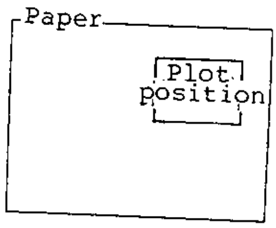
UPPER LEFT — Plots data on the upper left of the paper.



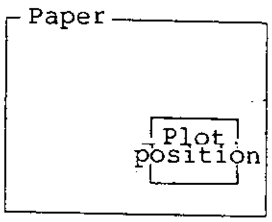

LOWER LEFT — Plots data on the lower left of the paper.



| | |
|---|---|
| UPPER RIGHT | Plots data on the upper right of the paper. |




| | |
|---|---|
| LOWER RIGHT | Plots data on the lower right of the paper. |




| | |
|---|---|
| RUN | Starts plotter output. |
| CANCEL | Cancels plotter output. |
| RETURN | Returns you to the initial softkey menu ⑫. |

⑮

| | |
|---|---|
| 1 PEN | Plots data in a single color. |
| 2 PEN | Plots data in two colors. |
| 4 PEN | Plots data in four colors. |
| 6 PEN | Plots data in six colors. |
| RUN | |
| CANCEL | |
| RETURN | Returns you to the initial softkey menu ②. |

Table 4-2 Plotting Data Coloring Specification

<table>
<tr><th>Plotting data</th><th>Mode 1 PEN</th><th>Mode 2 PEN</th><th>Mode 4 PEN</th><th>Mode 8 PEN</th></tr>
<tr><td>Scale</td><td rowspan="6">PEN 1</td><td rowspan="2">PEN 1</td><td>PEN 1</td><td>PEN 1</td></tr>
<tr><td>Character</td><td>PEN 2</td><td>PEN 2</td></tr>
<tr><td>Trace</td><td rowspan="4">PEN 2</td><td>PEN 3</td><td>PEN 3</td></tr>
<tr><td>Display line</td><td rowspan="3">PEN 4</td><td>PEN 4</td></tr>
<tr><td>Marker</td><td>PEN 5</td></tr>
<tr><td>Active marker</td><td>PEN 6</td></tr>
</table>

NOTE

1. When the plotter output menu has been selected, use the RETURN to check if the menu setting contains no errors. Selected menu is shown in inverted display.

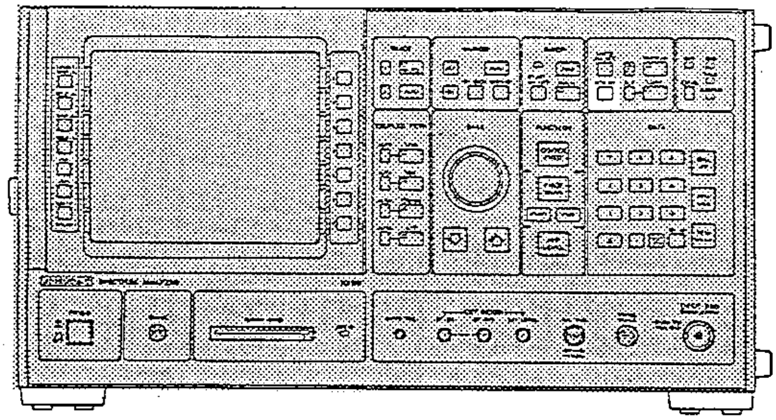
2. If the plotter output operation is executed while the plotter power is off, or when the address setting is not proper, R4136 still continues the plotter output operation for about 18 seconds. Therefore, no setting change can be made in this period.

## 4.3 SAVE AND RECALL FUNCTIONS

SAVE function saves up to 9 conditions of panel key settings to R4136 memory. RECALL function recalls and restores the setting conditions saved by the SAVE function.

Even if the POWER switch of this unit is turned off or a power cable is disconnected, the saved data is retained by an internal battery.

Data can also be saved into the memory card of option 06 (optional).



### 4.3.1 Configuration and Description of Softkey Menus

(1) Configuration of Softkey Menus

The softkey menus for the MEMORY key are configured as shown in A1.3.4 (2).

(2) Description of Softkey Menus

①

SAVE — Saves the settings of the panel keys.
(The CLEAR need not be executed.)

RECALL — Recalls the settings of the panel keys.

LIST — Displays information stored in internal memory.
The (optional) label characters entered from the top line on the CRT at the execution of the SAVE will be displayed as a title name.
Pressing the RETURN key returns you to the initial softkey menu.

CLEAR — Clears data stored in memory.
Unnecessary data should preferably be cleared. At the execution of the LIST, "(free)" will be displayed.

RUN — Saves, recalls, or clears data in memory of a number specified with the ten-key pads [1] to [9].

②

RETURN — Returns you to the initial softkey menu ①.

### 4.3.2 Basic Operation

(1) Operating Procedure

① Press the MEMORY key.

② Specify a desired memory number with the ten-key pads before executing the SAVE, RECALL, or CLEAR.

③ Press the RUN key to execute the selected function.

④ After completion of the execution of the selected function, confirm that a message to that effect is displayed on the left of the CRT.

(2) POWER ON 0 RECALL

When the R4136 POWER switch is turned on, the pänel key setting conditions of the last power off operation are automatically restored. At this time, the SAVE and RECALL functions of the condition are automatically executed using the memory No.0.

10 memories have been provided for SAVE and RECALL function. Usual memories (NO. 1 to 9) retain the memory content only when the power is on. This is different from the memory No. 0.

If the memory data cannot be retained because of an exhaustion of battery, the memory is restored to the state of INSTRUMENT PRESET. Once the POWER is turned ON, SAVE/RECALL functions can operate normally again because the battery is charged.

(3) Restrictions

The contents of the following setting conditions are partially changed, or not restored when SAVE and RECALL are made.

| Conditions at the SAVE | Restoration results of the RECALL function |
|---|---|
| Manual SWEEP ON | Turns to OFF, i.e. SWEEP changes to free run. |
| Signal track ON | Turns to OFF. |
| Trace data (stored in A and B) | Not restored. |
| Trace modes<br>(view, max, avg, B-A, input-A) | All turn to the write mode. |
| • GPIB address<br>• Brightness of the screen<br>• PLOT setting | Not restored. |
| Label characters entered on the CRT. | Only first line data (up to 30 characters) is restored. |
| Various settings of Option 06 | Not restored. |

*MEMO*

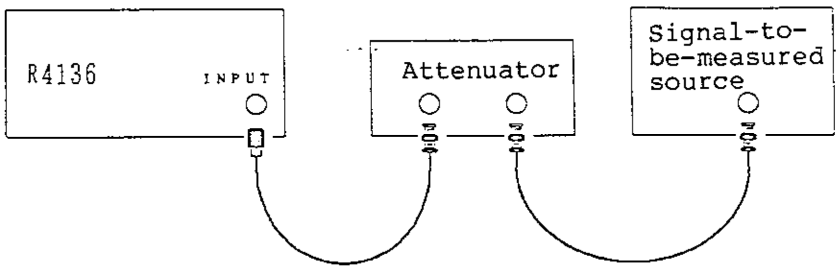
# 5. EXAMPLES OF MEASUREMENT

This chapter gives some basic measurement examples to demonstrate how to operate the R4136 in a practical manner. [Tracking Scope Application Note]

NOTE

1. For each measurement example it is assumed that the R4136 is set in its initial state.

2. Connect the R4136 to the signal source to be measured via an attenuator to keep the signal to be measured lower than the R4136's maximum input.




3. For the plotting of a measurement results, refer to the section [4.2 Plotter Output].

## 5.1 FIELD STRENGTH MEASUREMENT

The R4136 Spectrum Analyzer allows monitoring of a wide frequency band within a single frame of screen, and so may be used as a field strength measuring instrument. When combined with the ADVANTEST's antenna, the R4136, which indicates the level data compensating for the antenna factor, allows direct readings of electric field strength. Because the compensation value has been set assuming the accessory 5D2W cable of 10 m long is to be used, using other cables may cause an error.

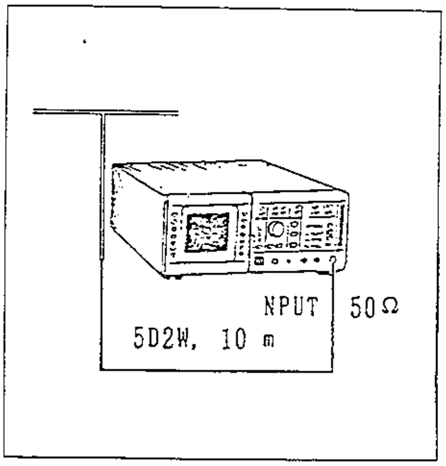


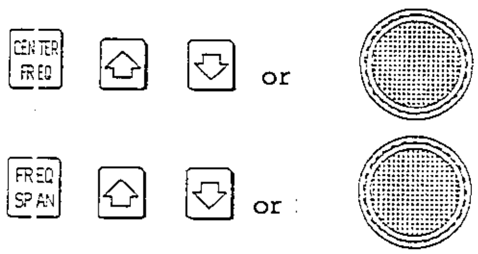

Figure 5-1 Setting Up

Operating Procedure

① Setting-up

Connect the antenna to the R4136 input terminal (50 Ω). If the antenna impedance level is not set to 50 Ω, use the matching circuit to match the impedance.

② Display the signal to be measured on the CRT.



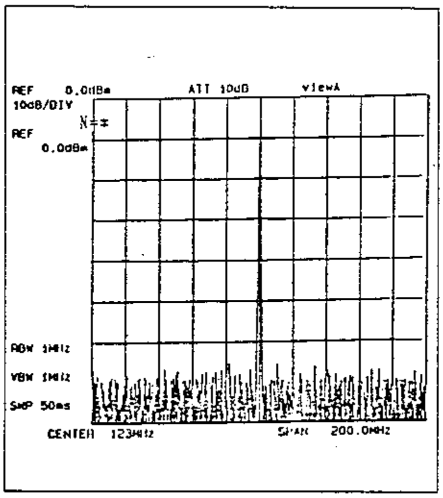




Figure 5-2 Signal to be Measured

③ Select the level unit according to the antenna to be used.

MARKER [MENU] ⇒ MORE ⇒ FIELD STR ⇒

| | | | |
|---|---|---|---|
| FIELD STR | ⇒ | DIPOLE | TR1722 half-wave dipole antenna |
| SIGNAL IDENT | | LOG PERD | TR1711 logarithmic periodic antenna |
| RETURN | | TR17203 | TR17203 active antenna (TR17203's compensation factor is 0, so the level is indicated in dBμ.) |
| | | RETURN | Returns you to the original softkey menu. |

④ Adjust the marker indicator to the spectrum peak. The marker data display indicates the field strength.

PK SRCH

⑤ Turn off FIELD STR is done by the UNITS menu of REF LEVEL.

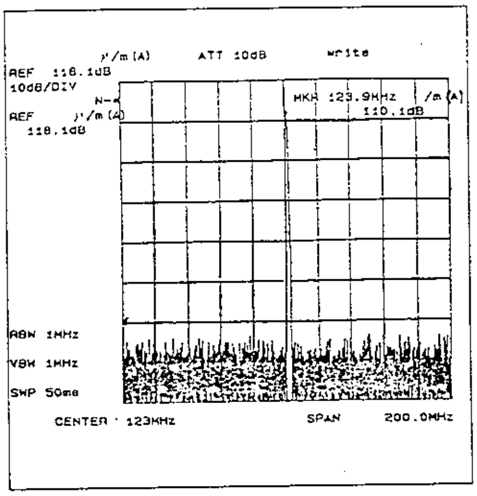



Figure 5-3 Direct Reading of Field Strength

Antenna compensation factor

Ex = ex + K = (ex + 6) + La − He + Ba

| | |
|---|---|
| Ex: Field strength (dBμ/m) | He (dB): Effective antenna length |
| ex: Input pin voltage (dBμV) | La (dB): Cable loss |
| K : Antenna factor (dB) | Ba (dB): Balance loss |

The compensation factor K for the half-wave dipole antenna can be obtained from the following expression:

$$K = 20 \log (\pi/300) + F + 6 + La + Ba$$
$$= -33.6 + 20 \log F + La + Ba$$

where, F is the reception frequency [MHz]

For the wide-band logarithmic periodic antenna, subtract the antenna gain (half-wave dipole antenna ratio) from the calculated value. The relationship between the frequency and compensation factor in a field strength measurement is shown in Figure 5-4.

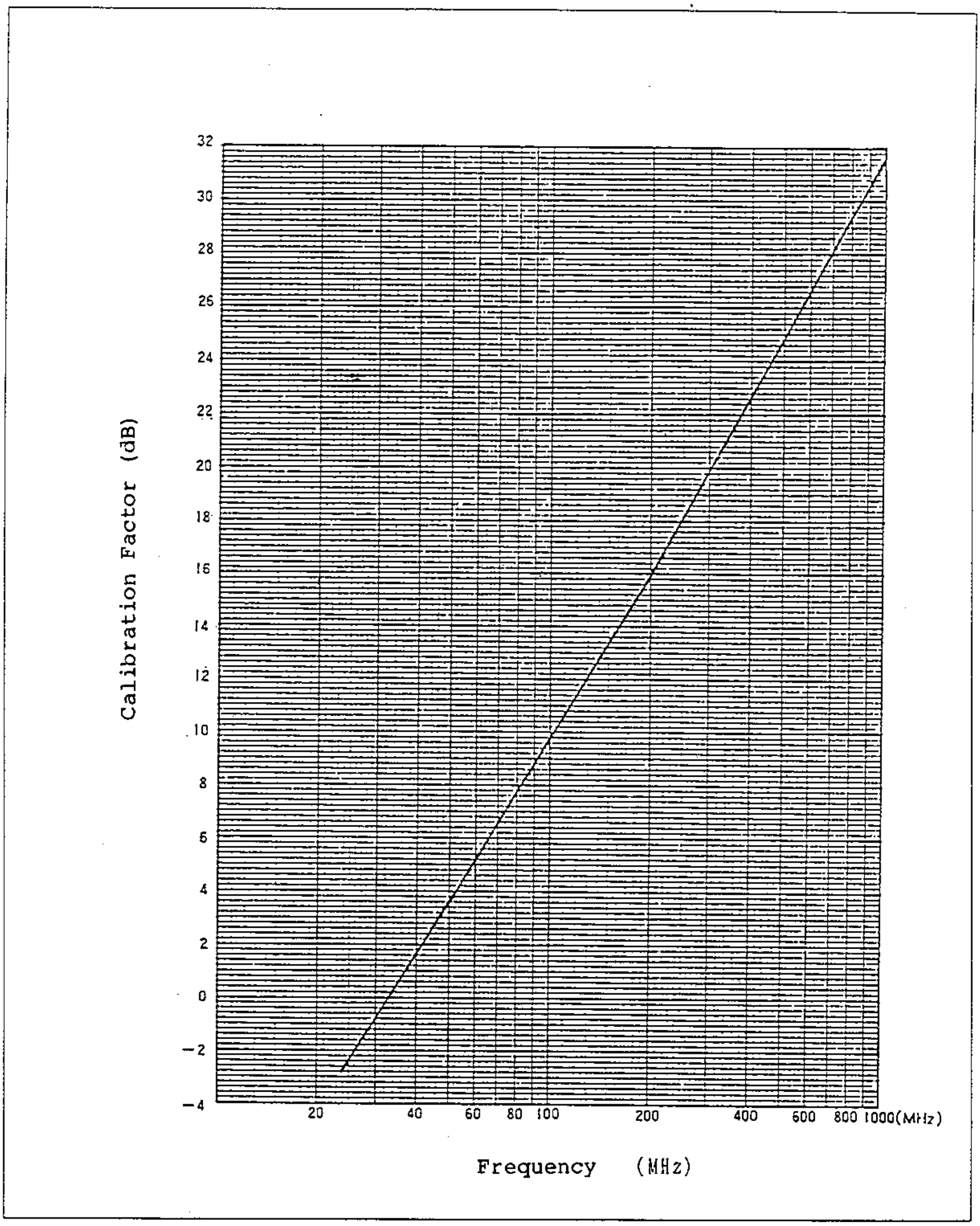



Figure 5-4 Relationship Between Frequency and Calibration Factor During Field Strength Measurement (Standard dipole antenna)

## 5.2 QP VALUE MEASUREMENT: EMI MEASUREMENTS CONFORMING TO CISPR STANDARDS

The R4136 spectrum analyzer is provided with an EMI measurement function (quasi-peak [QP] value measurement) as standard. The QP value measurement is intended to measure any pulsed noise, and each constant in the measurement is determined according to the CISPR standard as shown in Table 5-1.

Table 5-1 CISPR Standard Concerning Basic Characteristics of QP Value Measurements

| Measuring band | | 6-dB bandwidth | Detection time constant | | |
|---|---|---|---|---|---|
| | | | Charging time constant | Discharging time constant | Mechanical operation time constant |
| A | 10 kHz - 150 kHz | 200 Hz | 45 ms | 500 ms | 160 ms |
| B | 150 kHz - 30 MHz | 9 kHz | 1 ms | 160 ms | 160 ms |
| C | 30 MHz - 300 MHz | 120 kHz | 1 ms | 550 ms | 100 ms |
| D | 300 MHz - 1 GHz | 120 kHz | 1 ms | 550 ms | 100 ms |

The following is an example of the terminal noise voltage measurement on an artificial power network.

Operating Procedure

① Setting-up

Connect the Device under test, the artificial power network and R4136 input terminal (50 Ω) as shown in the Figure 5-5.

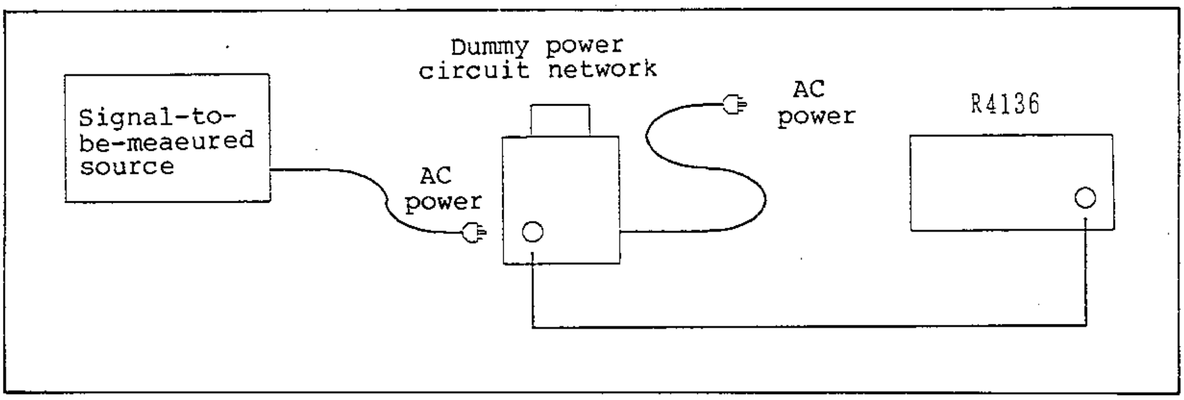



Figure 5-5 Terminal Noise Voltage Measurement

② Set up the QP mode.

REF LEVEL  QP  150 kHz ~30 MHz  Automatically selects a resolution bandwidth of 9 kHz, and a charging/discharging time constant.

③ Set the START and STOP frequencies to be measured.

START 1 5 0 kHz/nsec

STOP 3 0 MHz/sec

④ Increment or decrement the attenuator value in 10 dB steps to confirm that the wave level remains unchanged. Because a changed level indicates saturation of the R4136 input stage, increase the attenuator value or apply a bandpass filter to the input block.

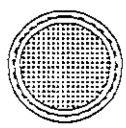
ATT ⇧ ⇩ (Confirmation of no level change)

⑤ Allow sufficient sweep time for measurement because some large time constants are entered when a QP value is measured as shown in Table 5-1. Table 5-2 indicates an standard of the sweep time setting for QP mode.  TIME ⇧ ⇩

Table 5-2 Sweep Time Standard for QP Mode

| Measuring band | | Sweep Time (s/Span) |
|---|---|---|
| A | 10 kHz - 150 kHz | 1s /200 Hz |
| B | 150 kHz - 30 MHz | 1s /10 kHz |
| C | 30 MHz - 300 MHz | 1s /100 kHz |
| D | 300 MHz - 1 GHz | |

⑥ Display the marker to read its level data. Compensate the measured value corresponding to the compensation factor of the artificial power network.

ON 

⑦ QP OFF pressing this key exits the QP value measurement mode, and sets the REF mode which was set before the QP value measurement setting.

## 5.3 MEASUREMENT OF DISTORTION

Operating Procedure

① Attenuate the transmitter outputs with the RF couples and connect it to the R4136. Because the R4136 maximum input level is +30 dBm with an input attenuation of 20 dB or more, specify the coupler value so that the RF coupler output is +30 dBm or less.

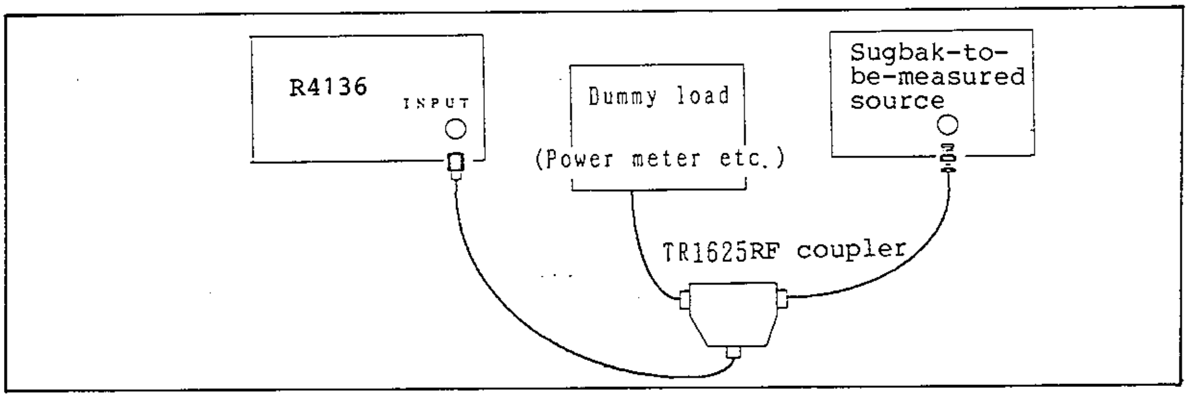



Figure 5-6 Transmitter Distortion Measurement

② Display the fundamental so it can be monitored easily, and adjust the peak to the reference level.

[CENTER FREQ] [2] [0] [0] [MHz sec]
[FREQ SPAN] [5] [0] [kHz msec]

PK SRCH [ ] [REF LEVEL] MKR → REF

③ Store the fundamental data in memory A, and display two screens on the CRT: new WRITE and the original A.

[A] STORE [WRITE]

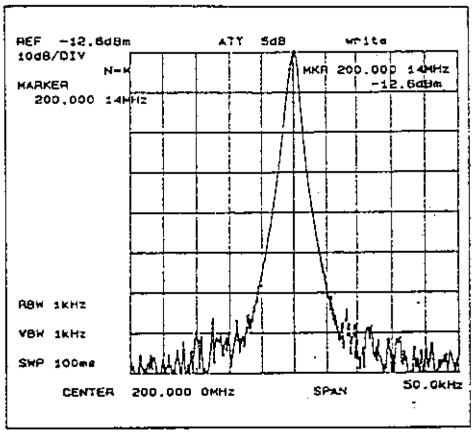



Figure 5-7 Level Measurement of the Fundamental Frequency

④ Set the step size of the step keys to the fundamental frequency.

PK SRCH [ ]   [CENTER FREQ]   [CF STP SIZE]   [MKR FREQ STP SIZE]

⑤ Monitor the second harmonic.

[CENTER FREQ] [⇧]   [B] [STORE]   [A & B VIEW]

⑥ Indicates the marker on the peak of the second harmonic. The marker indicates an absolute level of the second harmonic.

PK SRCH [ ]

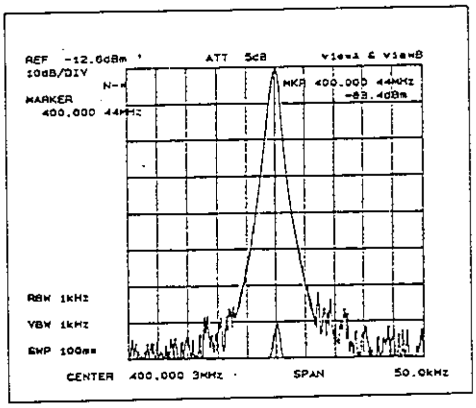



Figure 5-8 Level Measurement of Second Harmonic

⑦ Monitor the third harmonic in the same way as in Step 6 .

[CENTER FREQ] [⇧]   PK SRCH [ ]

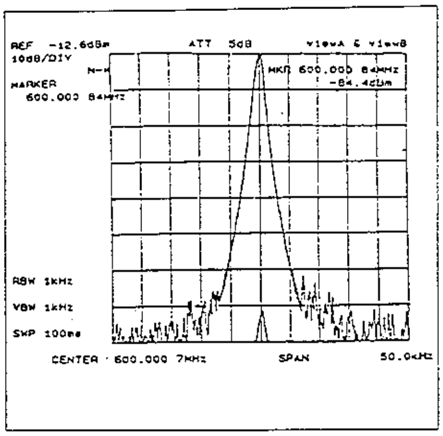



Figure 5-9 Level Measurement of Third Harmonic

MEASUREMENT OF HARMONIC DISTORTION RATIO

For low frequency bands, distortion meters are available dedicated for harmonic distortion measurements. Harmonics and microwaves must be measured in the same way as distortion; they are sometimes considered to be spurious outputs, and are measured as harmonic distortion in a high-frequency band amplifier in the same manner as in a low-frequency band. The deformation ratio of a pure sine wave is generally termed the distortion ratio, and is defined by the following formula:

$$\text{Distortion ratio K (\%)} = \frac{\text{Effective harmonic value}}{\text{Effective value of fundamental}} \times 100$$

$$= \frac{\sqrt{A_2{}^2 + A_3{}^2 + \ldots + A_n{}^2}}{A_1} \times 100$$

$A_1$: Effective fundamental-wave component value
$A_n$: Effective n-th harmonic component value

The harmonic distortion ratio is expressed by the ratio between the signal's harmonic component and its fundamental component (A1). With this spectrum analyzer, the fundamental (A1), second harmonic (A2), and nth harmonic (An) can all be directly monitored separately. Consequently, the distortion ratio (A2/A1) for the second harmonic as well as for the nth harmonic (An/A1) can be measured individually. And so the analyzer can measure how much distortion is generated in the odd harmonics compared to the even harmonics based on the principles of distortion ratio measurement.

To display a wide dynamic range, the spectrum analyzer uses the log (dB) display mode. Since the distortion ratio $a_n$ of the nth harmonic is 20 log (An/A1), (A2/A1) x 100 (%) will be 1% when $a_2$ equals 40 dB. In general, the analyzer directly monitors $a_2$ (20 dB), and displays it in decibel.

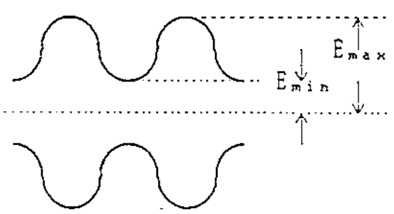
## 5.4 MEASUREMENT OF AM SIGNAL MODULATING FREQUENCY AND INDEX

Compared to the oscilloscope operating in the time domain, the spectrum analyzer has more sophisticated features in measuring low modulation such as for residual AM or FM.

The modulation index m of the AM wave in the time domain can be obtained from m = (Emax - Emin)/(Emax + Emin), as shown in Figure 5-10 (a). When this index is obtained with the spectrum analyzer, the amount of the difference (dB) between the sideband and the carrier can be measured (see Figure 5-10 (b)).

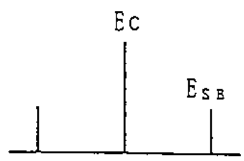
At the same time the degree of modulation for harmonics can also be determined separately. Especially with low modulation, approx. 2% of the modulation degree is read at best in the time domain. However, the spectrum analyzer can read up to 0.02% of modulation degree.

For higher measurement accuracy, the vertical axis scale should be observed in the LINEAR mode if the modulation index is 10% or more, and should be observed in the LOG mode if the modulation index is below 10%.




$$m\ (\%) = \frac{Emax - Emin}{Emax + Emin} \times 100$$

(a) AM signal monitored in the time domain




$$m\ (\%) = \frac{2E_{SB}}{EC} \times 100$$

(b) AM signal monitored in the frequency domain

Figure 5-10 AM Signal Wave

### 5.4.1 Measurement of AM Wave with Low Modulating Frequency, and Large Modulation Index

Operating Procedure

① Display the measured signal, and adjust the signal level to the reference level. In this example, the carrier is assumed to be 903 MHz.

[CENTER FREQ] [9] [0] [3] [MHz sec]

[FREQ SPAN] [2] [0] [MHz sec]

PK SRCH [ ] [REF LEVEL] [MKR →REF]

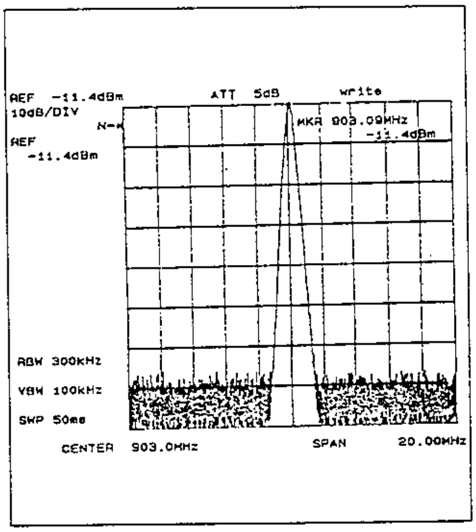



Figure 5-11 Displaying the Measured Signal

② Set the resolution bandwidth to more than three times the modulation frequency (see Figure 5-11).

RBW [ ] [⇧]

③ Set the vertical scale in the LINEAR mode.

[REF LEVEL] [LINEAR]

④ Set up the ZERO SPAN mode (Figure 5-12).

[FREQ SPAN] [ZERO SPN]

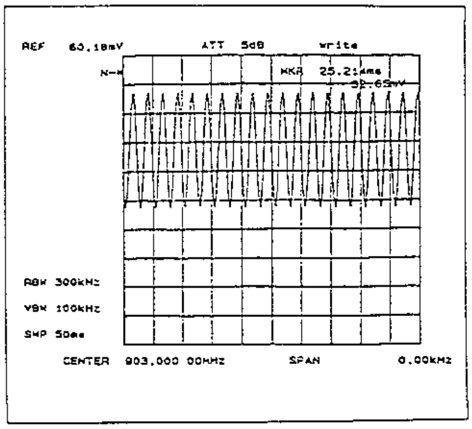



Figure 5-12 Vertical Scale: LINEAR, ZERO SPAN Mode

⑤ Set the detection mode to SAMPLE.

TRACE [MENU] [TRACE DET] [SAMPLE]

⑥ Adjust the signal level to the maximum.

[CENTER FREQ] (knob)

⑦ Set the TRIGGER mode to VIDEO.

[TRIG] [VIDEO]

⑧ Set the sweep time to an easy-to-measure value.

TIME [ ] [⇩]

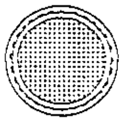
⑨ Use the marker to measure the distance between two modulation signal peaks, that is, the modulated wave cycle T(s).

Adjust the marker indicator to the harmonic peak.

PK SRCH
□

Adjust the Δ marker to the next peak (see Figure 5-13)

MARKER
[MENU]   ΔMKR



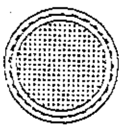
The modulation signal can be obtained from $fm = \frac{1}{T(s)}$.

In this example, $fm = \frac{1}{2.5(ms)} = 400(Hz)$

⑩ Next, read Emax and Emin to find m. Set the marker to the maximum value of the waveform, read its Emax level, and write it down (see Figure 5-14).

[ON] (Δ Marker OFF)

⑪ Set the marker to the minimum value of the waveform, and read its Emin level (Figure 5-15).



$$\text{Modulation index } m(\%) = \frac{\text{Emax} - \text{Emin}}{\text{Emax} + \text{Emin}} \times 100(\%)$$

In this example, m(%)

$$= \frac{53.11 - 29.04}{53.11 + 29.04} \times 100$$
$$= 29.3(\%)$$

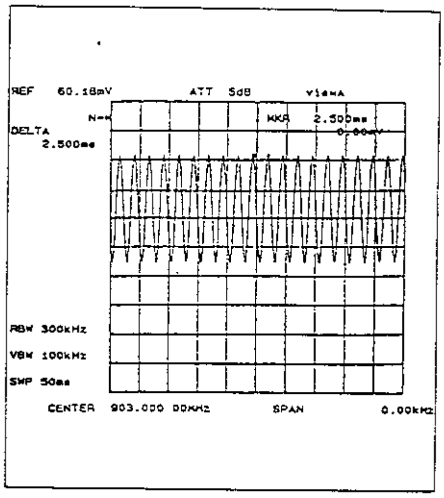



Figure 5-13 Reading Modulated Wave Cycle T(s) with Δ Marker

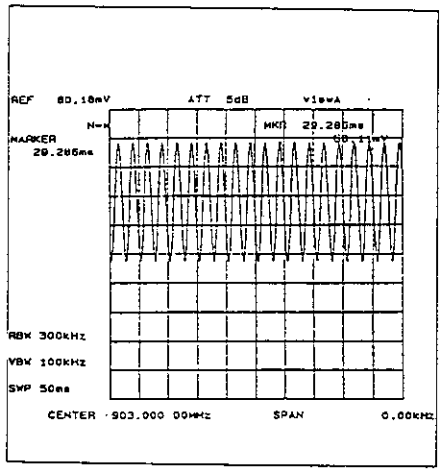



Figure 5-14 Reading Emax

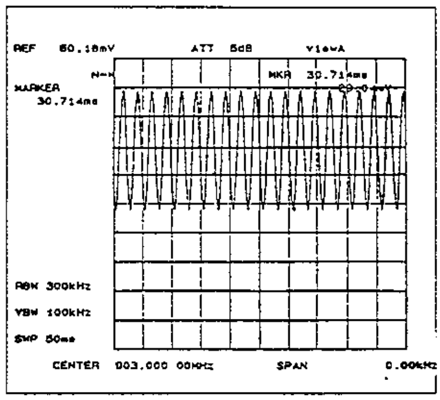
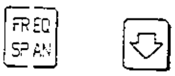



Figure 5-15 Reading Emin

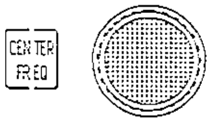
### 5.4.2 Measurement of AM Wave with High Modulating Frequency, and Small Modulation Index

Operating Procedure

① Set the frequency span to less than ten times the modulating frequency.



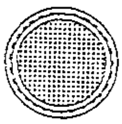

② Set the center frequency to the carrier frequency.




③ Set the marker to the carrier peak.

PK SRCH

④ Set the Δ marker to the modulation signal spectrum peak (see Figure 5-16).



The Δ marker frequency and level display at this time gives the modulating frequency and modulation index from the following formula.

fm = Δ marker frequency

$$m = \log^{-1} \frac{(E_{SB} - E_C + 6)}{20} \times 100$$

In this example, fm = 1.021 (kHz)

$$m = \log^{-1} \frac{-33.4 + 6}{20}$$

$$= 0.0427$$

$$= 4.27\ (\%)$$

Figure 5-17 shows the relationship between the resultant value of (Sideband level - Carrier level) ($E_{SB}$ - $E_C$) and modulation index m (%).

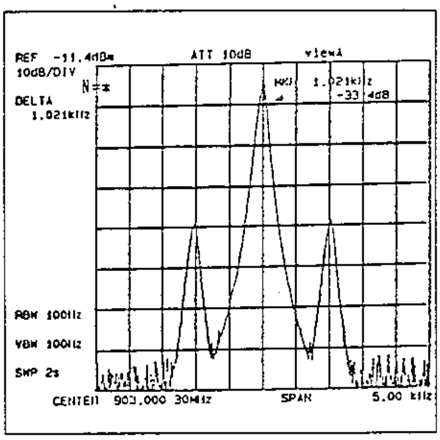



Figure 5-16 Measurement of AM Wave with High Modulating Frequency and Small Modulation Index

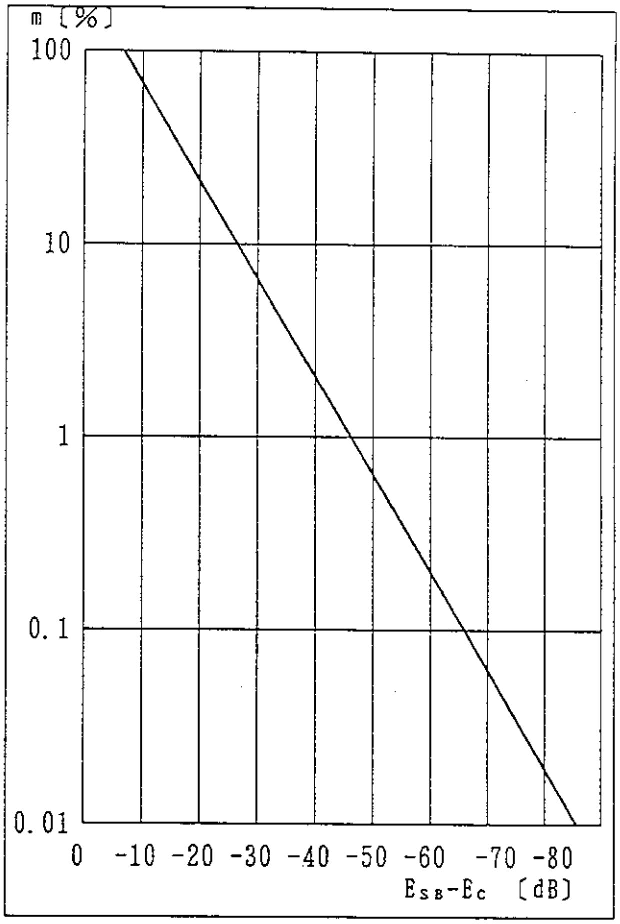



Figure 5-17 Relationship Between the Value of ($E_{SB}$ - $E_C$) and Modulation Index m (%)

## 5.5 MEASUREMENT OF FM SIGNAL

Generally FM wave observation includes the measurements of carrier frequency fc, modulation frequency fm, frequency deviation $\Delta$fpeak, modulation index m, and the occupied frequency bandwidth.

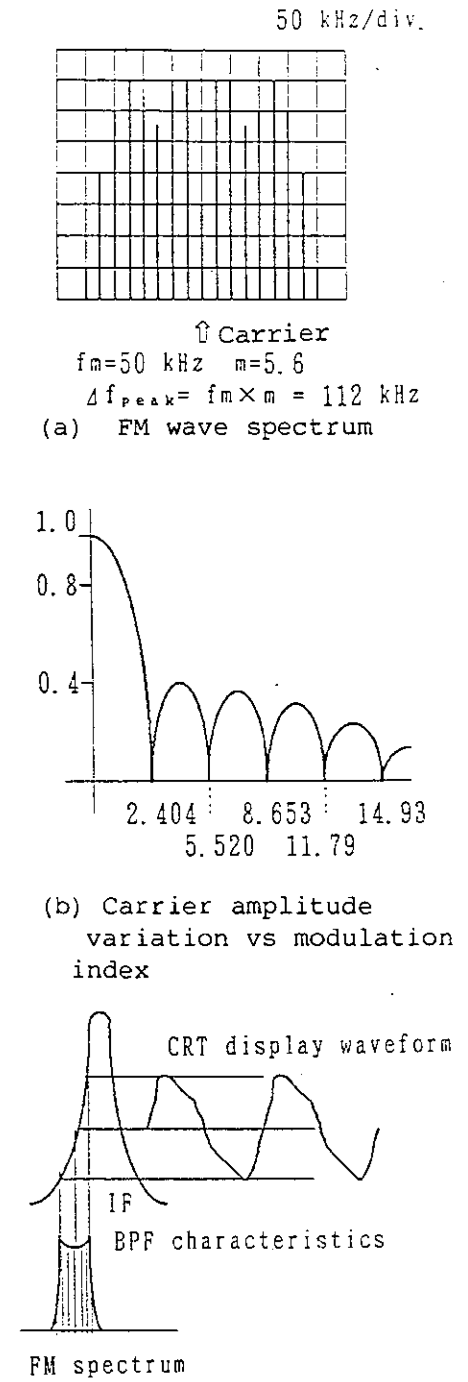
The FM wave modulation index m is expressed by $\Delta$fpeak/fm. With this expression the function of the smallest carrier wave for a modulation index of 2.4, 5.5, 8.6, or subsequent index, and modulation index m or frequency deviation $\Delta$fpeak can be obtained (see Figures 5-18 (a) and 5-18 (b)).

Since it is hard to recognize the contents of modulation clearly with the FM wave spectrum only, you must sometimes convert the external signal FM component into the corresponding amplitude level to make the display easier to observe. In this case you should prepare a discriminator separately. The spectrum analyzer can inspect waves through the slope of the IF (intermediate frequency) or BPF (bandpass filter). This detected modulated wave is displayed on the CRT (see Figure 5-18 (c)).

For a modulation frequency, set the horizontal axis of the R4136 to ZERO SPAN to run the R4136 as a fixed tuned receiver, and measure the signal on the time axis.

For a high modulation frequency, measure the frequency on the frequency axis, and find the modulating frequency from the sideband frequency.

When modulation index m is small (less than approx. 0.8), m can be obtained from the relationship of the carrier level to the first sideband wave level.




(a) FM wave spectrum

(b) Carrier amplitude variation vs modulation index

(c) Direct reading of FM modulated wave (fm)

Figure 5-18 FM Signal

### 5.5.1 Measurement of FM Wave with Low Modulating Frequency

Operating Procedure

① Set the signal carrier as the center frequency.

CENTER FREQ ⇩ ⇧

② Set the signal peak as the reference level.

PK SRCH REF LEVEL MKR →REF

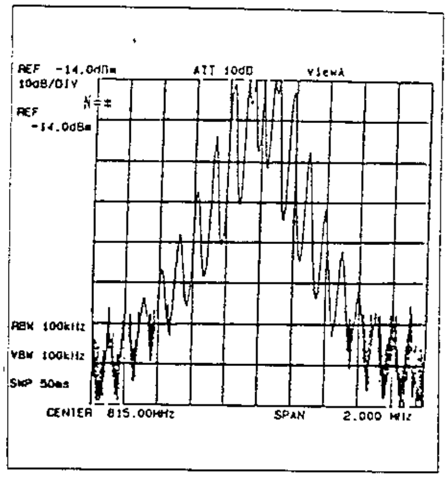



Figure 5-19 Measurement of FM Wave with Low Modulation Frequency

③ Decrease the reference level and set the ZERO SPAN mode.

REF LEVEL ⇩ FREQ SPAN ZERO SPN

④ Change the center frequency to set the demodulated wave in the center of the screen.

CENTER FREQ ⇩ ⇧

⑤ Set the resolution bandwidth to three times the modulation frequency for easier monitoring.

RBW ⇩ ⇧

⑥ Set the trigger mode to VIDEO.

TRIG VIDEO

⑦ Select the sweep time for easy monitoring of the demodulated wave.

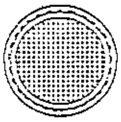
TIME ⇩ ⇧

⑧ Set the marker on the demodulated wave peak.

PK SRCH

⑨ Set the Δ marker on the adjacent peak (see Figure 5-20).

MARKER [MENU] Δ MKR



Assuming the time interval T(s) is between the Δ marker indication and the demodulated wave peak, fm can be obtained from:

$$fm = \frac{1}{T(s)}$$

In this example,

$$fm = \frac{1}{2.643\ (ms)} = 378.4\ (Hz)$$

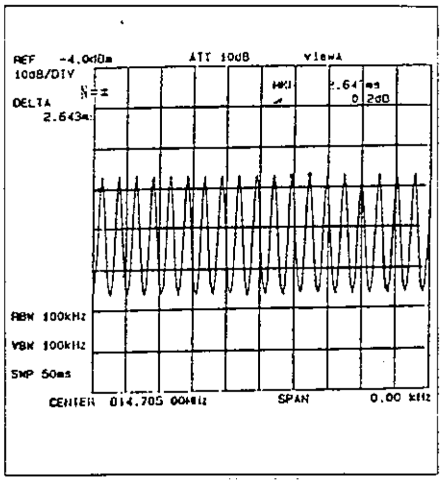



Figure 5-20 Finding the Time Interval T(s) of the Demodulated Wave Peak

5.5.2 Measurement of FM Wave with High Modulation Frequency, and Small Modulation Index m

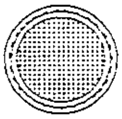
Oparating Procedure

① Set the frequency span to less than ten times the modulation frequency.

[FREQ SPAN] [⇩]

② Set the carrier frequency as the center frequency.

[CENTER FREQ]

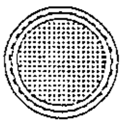


③ Place the marker on the carrier peak

PK SRCH [ ]

④ Place the Δ marker on the adjacent sideband signal peak. (Figure 5-21).

MARKER [MENU] Δ MKR



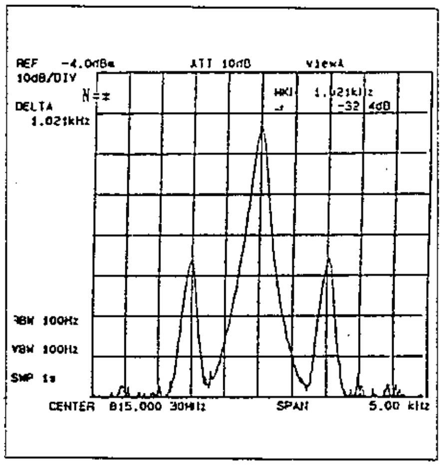



Figure 5-21 Reading the Modulation Frequency from the Δ Marker

The Δ marker frequency indication is set to modulation frequency fm.

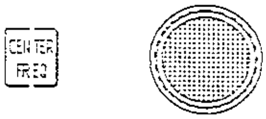
Here, fm = 1.021 (kHz)

### 5.5.3 Measurement of FM Wave Peak Deviation ($\Delta f_{peak}$)

Operating Procedure

① Set the resolution bandwidth to more than five times the modulation frequency, including the main sideband.


② Set the carrier frequency as the center frequency.




③ Set the frequency span to facilitate measurement according to the peak deviation.


④ Figure 5-22 gives an example with a small $\Delta f_{peak}$, Figure 5-23 an example with a large $\Delta f_{peak}$. The $\Delta f_{peak}$ peak can be measured with the waveform.

The $\Delta f_{peak}$ and modulation index m can be obtained from the following formula:

$$\Delta f_{peak} = \frac{1}{2}\,\Delta f_{peak}\text{ peak}$$

$$m = \frac{\Delta f_{peak}}{fm}$$

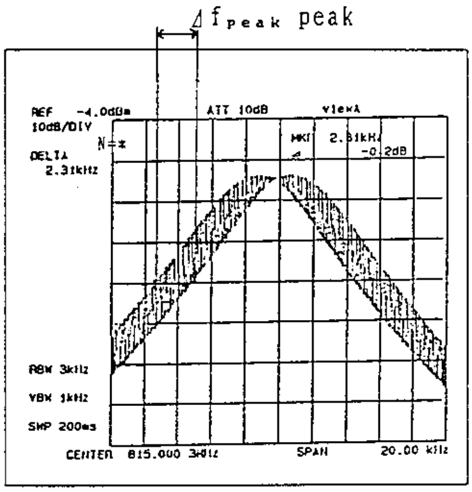



Figure 5-22 Measurement with Small $\Delta f_{peak}$

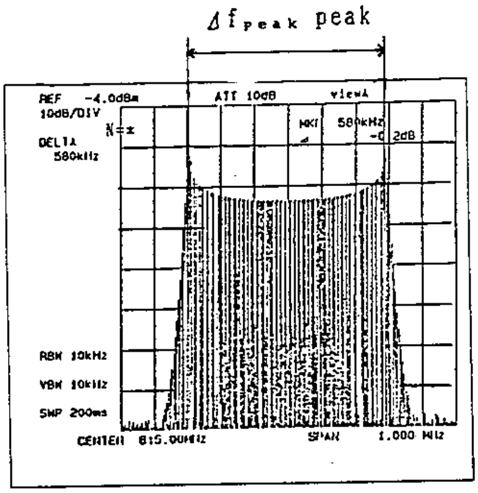



Figure 5-23 Measurement with Large $\Delta f_{peak}$

- Measurement with small $\Delta f_{peak}$ (Figure 5-22)

$\Delta f_{peak}$ peak = ( $\Delta$ marker frequency)

= 2.31 kHz

- Measurement with large $\Delta f_{peak}$ (Figure 5-23)

$\Delta f_{peak}$ peak = ( $\Delta$ marker frequency)

= 580 kHz

### 5.5.4 Finding the Small FM Modulation Index m

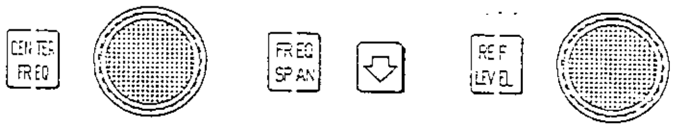
When the FM wave modulation index m is approx. 0.8 or less, the following formula holds:

$$m = \frac{2E_{SB}}{E_C}$$

$E_{SB}$: Level of the first sideband
$E_C$ : Level of the carrier

Operating Procedure

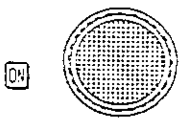
① Set the center frequency and the frequency span for easy viewing and adjust the carrier frequency to the reference level.

② 


③ Read the carrier frequency fc from the center frequency readout and carrier level $E_C$ from the reference level readout. (Figure 5-24)

where, fc = 904.992 MHz, $E_C$ = −10 dBm.
Carrier level : $E_C$ = −10 dBm
Carrier frequency: fc = 904.992 MHz

④ Set the marker on the first sideband, and read the frequency $f_{SB}$ and level $E_{SB}$ from the $\Delta$marker indication. (Figure 5-24)




Here, $f_{SB}$ = 904.992 MHz and
$E_{SB}$ = −42.4 dBm.

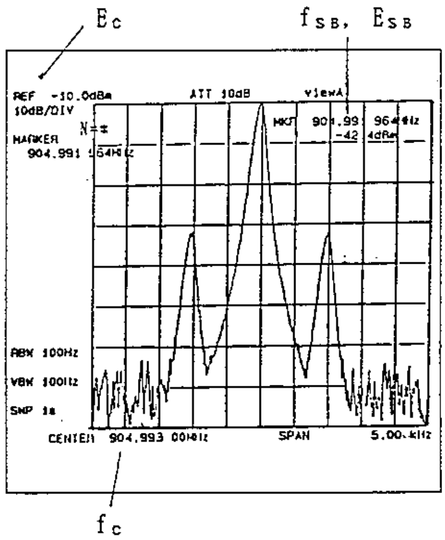



Figure 5-24 Finding the Small FM Modulation Index m

⑤ Determine the FM modulation index m using the following formula:

$$m = 2 \times \frac{E_{SB}}{E_C} = \log^{-1} \frac{E_{SB} - E_C + 6}{20}$$

$$m = \log^{-1} \frac{-42.4 - (-10) + 6}{20} = \log^{-1} (-1.32) = 0.04$$

⑥ Modulation frequency fm can be obtained from $| f_{SB} - fc |$. In this example, fm = 2 kHz is obtained.

⑦ The peak deviation $\Delta f_{peak}$ can be obtained from $\Delta f_{peak} = m \times fm$. In this example, $\Delta f_{peak} = 0.04 \times 2$ (kHz) = 80 Hz is obtained.

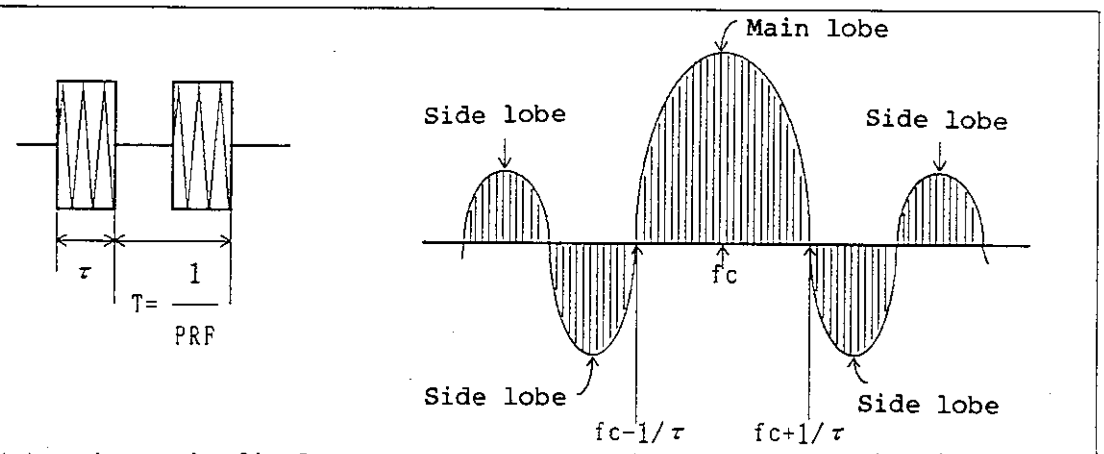
## 5.6 MEASUREMENT OF PULSE MODULATION WAVE

### 5.6.1 Measurement of Pulse Modulating Wave Having Higher Pulse Repeating Frequency

The spectrum analyzer equivalently resolves a waveform, and displays the fundamental and the harmonics in the waveform. As Figure 5-25 (a) illustrates, when converting the time-axis waveform of a pulse-modulated wave into a frequency-axis data, the spectrum distribution shows the envelope centering on carrier fc.

The spectrum analyzer can easily measure the following items when it measures modulated waves such as radar.

Pulse repetition frequency (PRF: Pulse Repetition Frequency)
Pulse width ($\tau$)*
Carrier frequency (fc)
Peak power (Ppeak)*
Average power (Pave)




(a) Time axis display (b) Frequency axis display

Figure 5-25 Pulse Modulated Wave

**CAUTION**

The maximum input level of the R4136 is set to +20 dBm and +25 V DC with a MIN INPUT ATTENUATOR of 20 dB or more. Because a pulse-modulated wave such as radar has high peak power, use the coupler to fully attenuate it before inputting it through the R4136 INPUT connector.

Since the R4136 mixer input level is -10 dB, set the MIN INPUT ATTENUATOR so Ppeak $\leqq$ -10 dBm. To avoid any mixer saturation, decrease the MIN INPUT ATTENUATOR setting from 50 dB in steps of 10 dB, and set the minimum attenuator value which does not cause a decrease in the level.

(1) Pulse Width ($\tau$)

Pulse width $\tau$ can be obtained from the inverse of the half-width of the main lobe, or the inverse of the side-lobe width. At this time, you should set the resolution bandwidth within the following range to secure an envelope with sufficient resolution.

Pulse repetition frequency (PRF) x 1.7 $\leq$ Resolution bandwidth $\leq$ 0.1/$\tau$

(2) Carrier Frequency (fc)

The fc measurement accuracy is determined according to pulse width $\tau$. With a small $\tau$, the main lobe broadens, and so it is difficult to determine the center of the pulse. To indicate the center more accurately, set SPAN/DIV. wider than 1/$\tau$. The measurement frequency accuracy in this case is equal to the center frequency accuracy of SPAN/DIV.

(3) Measurement of Peak Power ($P_{peak}$)

If the resolution bandwidth of the spectrum analyzer satisfies the following condition, the amplitude indication is proportional to the resolution bandwidth.

Pulse repetition frequency (PRF) x 1.7 $\leq$ Resolution bandwidth 0.2/$\tau$

At this time, the amplitude indication is proportional to the resolution bandwidth, and relationship between the actual peak power ($P_{peak}$(dBm)) and the amplitude indication ($P'_{peak}$(dBm)) is obtained from the following formula:

$$Ppeak = P'peak + \alpha(dB)$$
$$\alpha(dB) = 20 \log (\tau \times 1.5 \times RBW)$$

where, $\alpha$ : Pulse attenuation ratio.
$\tau$ : Pulse width (s)

(4) Average Power Pave (dBm)

Measurement of Average Power (Pave)

The average power P ave (dBm) can be obtained as follows:
$$Pave = Ppeak \times PRF \times \tau$$

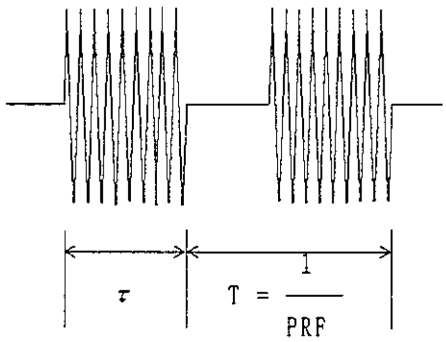
where, PRF : Pulse repetition frequency (Hz).
$\tau$ : Pulse width (s)

### 5.6.2 Measurement of Carrier Spectrum of Burst Wave Signal

When the spectrum of pulse modulating wave having lower pulse repeating frequency as shown in Figure 5-26 is measured using the spectrum analyzer, a part of spectrum chips as shown in Figure 5-27, and accurate spectrum analysis cannot be performed.

In this case, by sweeping the spectrum analyzer for only the time when the carrier of burst wave signal is being output, the continuous spectrum without the chipped portion can be displayed as shown in Figure 5-28.

By doing this operation, measurement of C/N ratio of the carrier of burst wave signal or the analysis of unnecessary spurious components can easily be performed. This function is called the gated sweep




Pulse repeating frequency (PRF): Approx. 25Hs
Pulse width (τ) : Approx. 20 ms
Carrier frequency (fc): Approx. 6 MHz

Figure 5-26 Example of Burst Wave Signal Having Lower Repeating Frequency

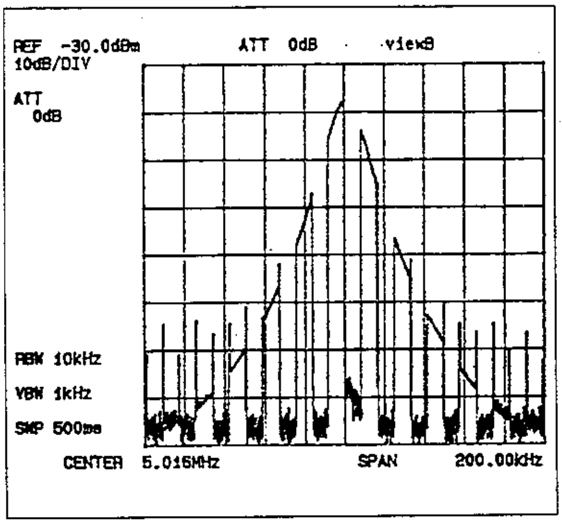



Figure 5-27 When Burst Wave Signal is Observed Directly

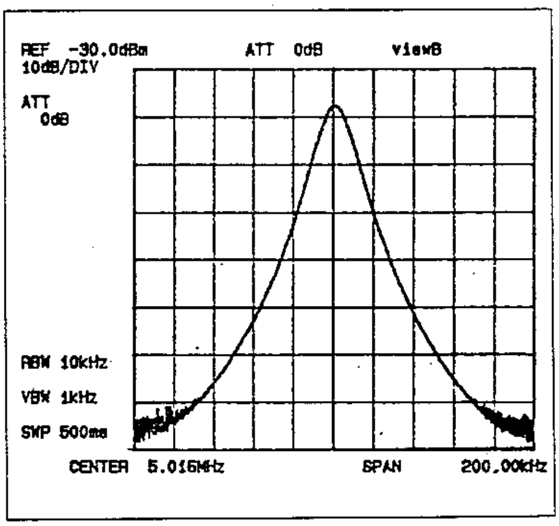



Figure 5-28 When Observed by Gated Sweep Function

This function is usable by inputting the gate signal to SWEEP STOP (signal input connector) on the rear panel of this equipment.

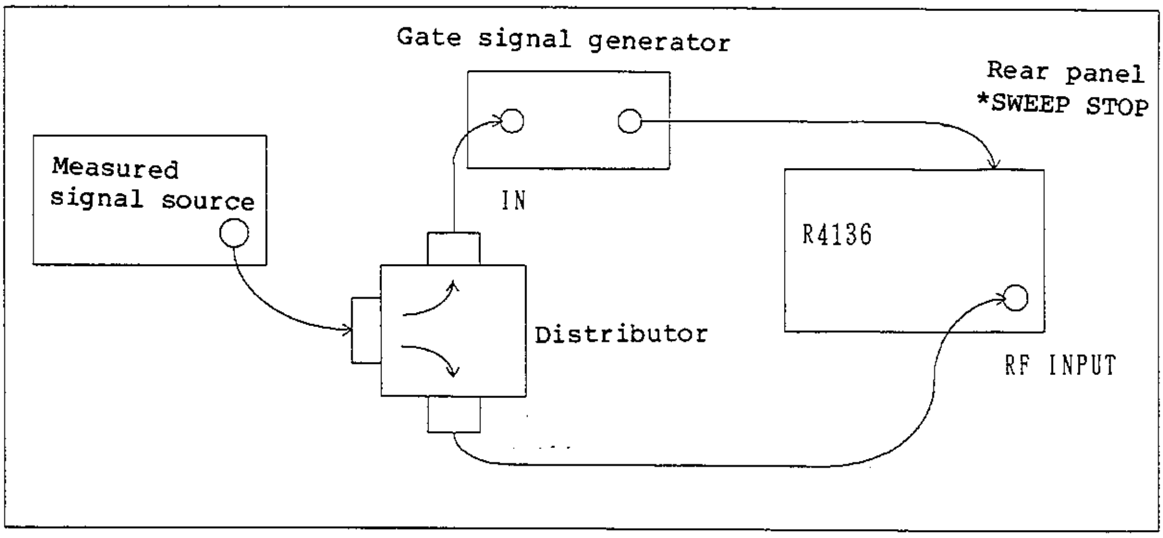



Figure 5-29 Set Up of Gated Sweep Function

*: The SWEEP STOP signal is a TTL level (0 V or +5 V)
+5 V or OPEN: Sweeps
0 V or GND : Stops

For the relation between the gate signal created by the gate signal generator and the burst wave signal of the measured signal, set the timing as shown in Figure 5-30.

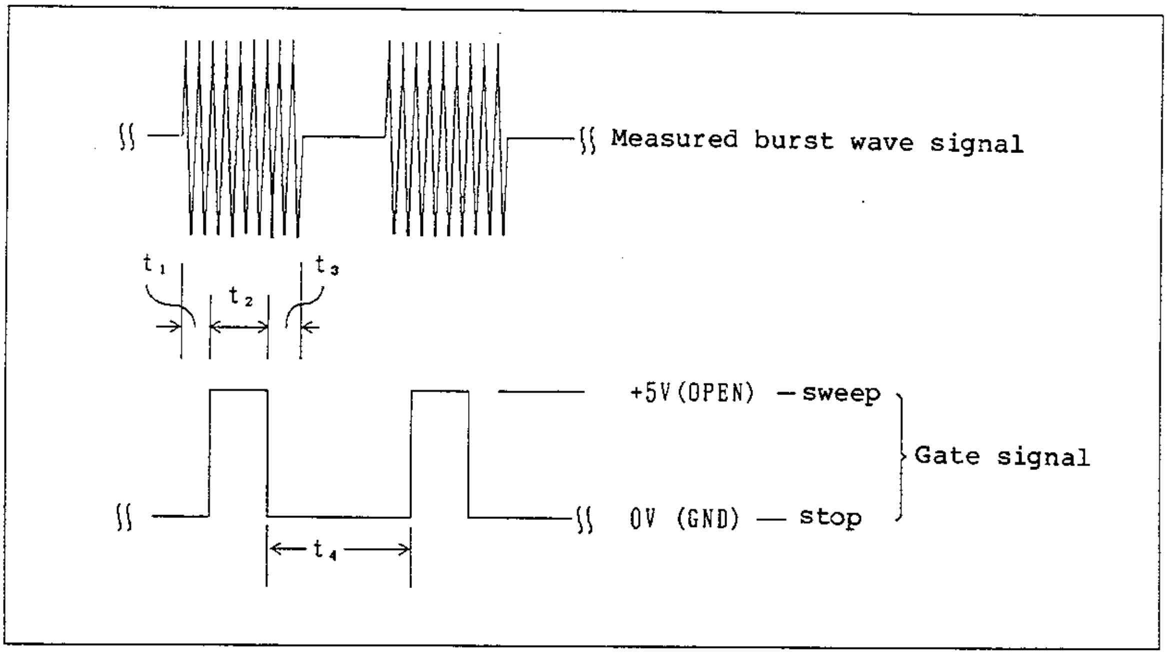



Figure 5-30 Relation Between the Measured Burst Wave Signal and the Gate Signal

$t_1$, $t_3$: When the resolution band width RBW of the spectrum analyzer and the VIDEO band width VBW are narrow, extend them. These band widths mean the wait time until the signal passing through the filter rises. For example, when the resolution band width RWB is 1 KHz, $t_1$ and $t_3$ are more than 2 ms.

$t_2$ : This means the time during which the spectrum analyzer sweeps and redraws the screen. This time is limited by the data processing time in the spectrum analyzer, and is 2 ms minimum.

$t_4$ : Repeating time of burst signal

NOTE: For the gated sweep, since the sweep operation is performed by being stopped once by the gate signal, the redrawing time for one screen becomes longer. See the following equation.

$$t_{write} \fallingdotseq \frac{ST}{t_2} \times t_4 \text{ [S]}$$

ST : Set sweep time of spectrum analyzer [S]

$t_{write}$: Redrawing time of one screen [S]

$t_2$ : Gate width [S]

$t_4$ : Gate repeating time [S]

# 5.7 EXTENSION OF THE MAXIMUM MEASURABLE FREQUENCY USING AN EXTERNAL MIXER

## 5.7.1 Connecting an External Mixer

An external mixer can be connected to the R4136 spectrum analyzer to extend the maximum measurable frequency to 325 GHz.

(1) 1st LOCAL terminal

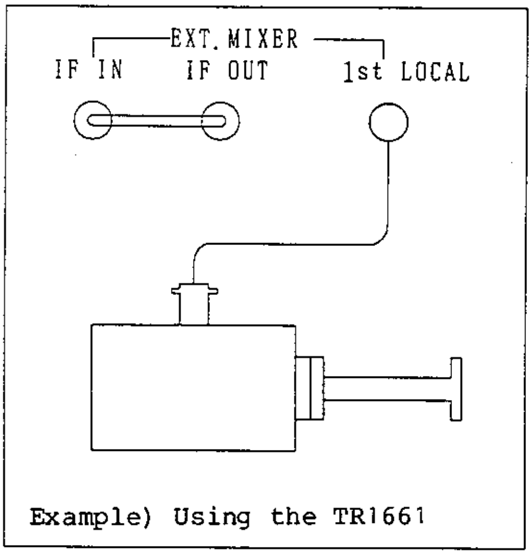
This is a local oscillator signal output terminal. its output level is from 4 GHz to 8 GHz, approximately +7 dBm. Connect this terminal to the LOCAL terminal of the external mixer used. Termination should be made at 50Ω.

(2) IF IN terminal

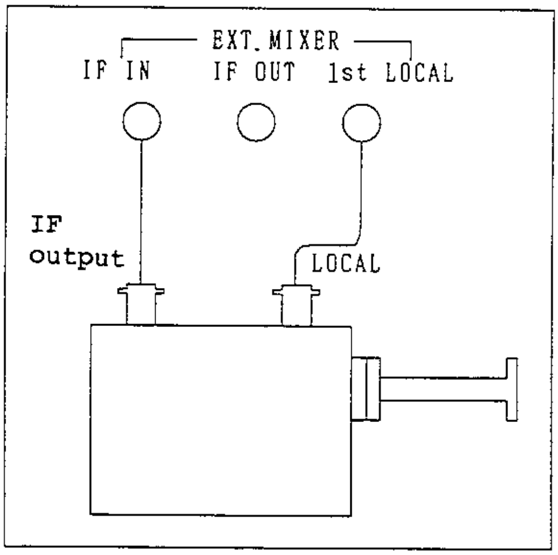
This terminal is usually connected to the IF OUT terminal via a coaxial cable. To use an external mixer, disconnect this coaxial cable and then connect the IF IN terminal to the IF output terminal of the external mixer used.

(3) IF OUT terminal

This terminal is usually connected to the IF IN terminal via a coaxial cable. To use an external mixer, disconnect this coaxial cable and then connect the IF OUT terminal to the 50Ω terminator at the 1st LOCAL terminal.




(a) 2-port connection




(b) 3-port connection

### 5.7.2 Measuring Frequencies Using an External Mixer

(1) Harmonics Mixing

The harmonics mixer obtains IF signals by mixing the fundamental wave (or harmonics) of the local oscillator and the signal being measured. The relational expression for this condition is as follows:

$$f_S = N \times f_{LO} \pm f_{IF} \ \ldots\ldots\ (1)$$

Where, $f_S$ : signal frequency
$f_{LO}$: frequency of the local oscillator
$f_{IF}$: intermediate oscillator frequency
$N$ : harmonics order of the local oscillator

(2) Actual Frequency Measurement

The example here assumes that a 26 GHz signal is input to an external mixer.

First, select a measurement range appropriate for the particular external mixer. Set the IF to 4 GHz NORMAL, and the N, to (-) AUTO. Subsequent setting of the center frequency to 25 GHz and the frequency span to 17.5 GHz will cause automatic setting of the value of the N to 5.

[CENTER FREQ] [EXT. MIXER] [MIXER MODE] [4GHz IF] [NOMAL IF] [N(-) AUTO]
[CENTER FREQ] [2] [5] [GHz dB]
[FREQ SPAN] [1] [7] [.] [5] [GHz dB]

Since the input signal level is 26 GHz, $F_S$ = 26 GHz, $f_{LO}$ = 4 to 8 GHz, and IF = 4 GHz. Assigning these values to expression (1) above gives the following seven conditions:

$F_S$ = 3 x 7.33 GHz + 4 GHz
$F_S$ = 4 x 7.5 GHz - 4 GHz
$F_S$ = 4 x 5.5 GHz + 4 GHz
$F_S$ = 5 x 6 GHz - 4 GHz
$F_S$ = 5 x 4.4 GHz + 4 GHz
$F_S$ = 6 x 5 GHz - 4 GHz
$F_S$ = 7 x 4.29 GHz - 4 GHz

Thus, the signal spectrum is displayed on the screen when $f_{LO}$ is 7.33 GHz, 7.5 GHz, 5.5 GHz, 6 GHz, 4.4 GHz, 5 GHz, and 4.29 GHz.

For the above frequency setting, the spectra of 17.5 GHz, 21 GHz, 18 GHz, 26 GHz, 23.5 GHz, 33.5 GHz, and 32.67 GHz are displayed. (See Figure 5-31.)

To identify the under-measurement signal from these signals, use the SIGNAL IDENT function.

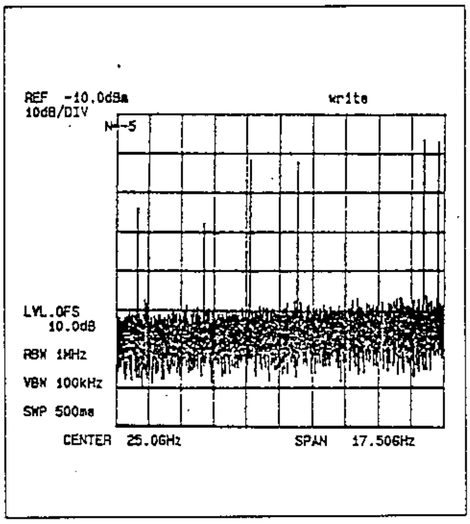



Figure 5-31 Multiple Response when External Mixer is Used

(3) SIGNAL IDENT by Changeover of Mixing Modes

Marker [MENU] [MORE] [SIGNAL IDENT] [N(+/-)]

The signal under measurement is that which does not change is display position after the above operations have been carried out. (See Figure 5-32.) SIGNAL IDENT will turn off when any switch on the front panel of the instrument is pressed.

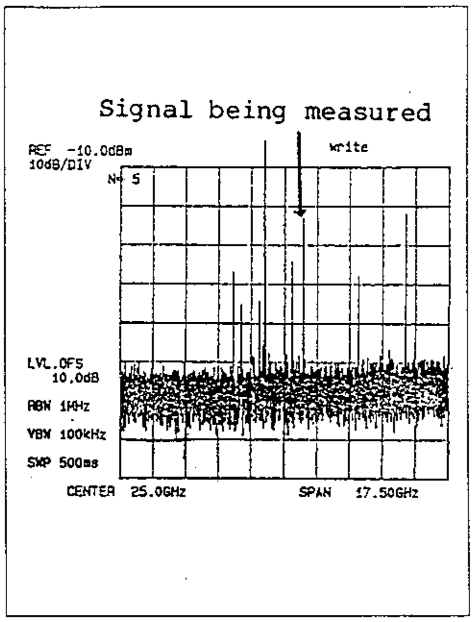



Figure 5-32 SIGNAL IDENT On

(4) SIGNAL IDENT by Changeover of Frequencies

Marker MENU → MORE → SIGNAL IDENT → NORMAL /SHIFT

The signal under measurement is that which does not change in display position after the above operations have been carried out. This SIGNAL IDENT, however, is valid only for frequency spans less than about 1 GHz and an IF of 4 GHz. SIGNAL IDENT will turn off when any switch on the front panel of the instrument is pressed.

### 5.7.3 Measuring Amplitude Using an External Mixer (Optional)

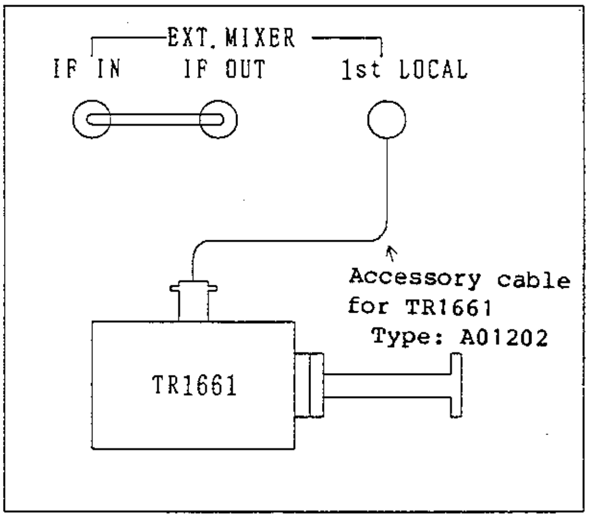
The optional external mixer with CORR. FACTOR values can be connected to the R4136 spectrum analyzer to extend the maximum frequency whose amplitude is measurable to 60 GHz.

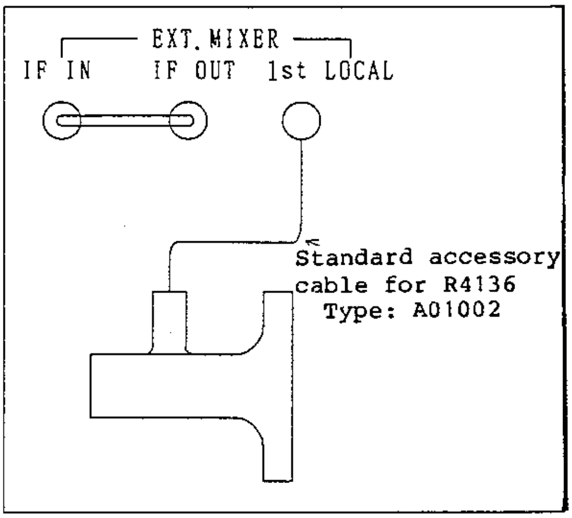
(1) Calibration of Amplitude

To calibrate amplitude, input a calibration signal (200 MHz and -10 dBm) to the R4136 spectrum analyzer about 30 minutes after turning on its power and then turn the AMPTD CAL knob on the front panel.

(2) Connection of Wave Guide Mixer

Connect the wave guide mixer as shown in the figures below:




Example) When TR1661, TR1662, and TR1663 are in use

Option 11 (18 GHz to 26.5 GHz)
Option 12 (26.5 GHz to 40 GHz)
Option 13 (Options 11 and 12)
Option 15 (18 GHz to 26.5 GHz)
Opiton 16 (26.5 GHz to 40 GHz)
Option 17 (40 GHz to 60 GHz)

**WARNING**

The maximum damaging level of input to TR1662 is 0 dBm. The compression level for 1 dBm is -15 dBm. Before inputting a calibration signal to TR1662, be sure to conform its level. To connect the external mixer to the TR1662, use a cable of the same type (i. e. A01202 or A01002) as the R4136. Otherwise, any difference in the output level of the 1st local terminal may change the mixer bias or CORR. FACTOR value.

(3) Setting of Mixing Modes for Mixer

Different harmonics mixing degrees, IF frequencies, and mixer modes (+ and -) can be optionally set by using the function keys, softkey menus, data entry keys.

① For Option 11 (18 GHz to 26.5 GHz)

CENTER FREQ  EXT. MIXER  [Keying center frequency data]
................. Sets center frequency.

MIXER MODE  226MHz IF  ............... Sets the 1st IF to 226.4211 MHz.

N(-) FIXED  4  GHz dB ................. Sets the harmonics mixing degree (n) to -4.

② For Option 12 (26.5 GHz to 40 GHz)

CENTER FREQ  EXT. MIXER  [Keying center frequency data]
................. Sets center frequency.

MIXER MODE  226MHz IF  ................ Sets the 1st IF to 226.4211 MHz.

N(-) FIXED  6  GHz dB ................. Sets the harmonics mixing degree (n) to -6.

③ For Option 13 (18 GHz to 60 GHz)

Combination of the settings ① and ② above.

④ For Option 15 (18 GHz to 26.5 GHz)

CENTER FREQ  EXT. MIXER  [Keying center frequency data]
................. Sets center frequency.

MIXER MODE  4GHz IF  NORMAL IF ..... Sets the 1st IF to 3996.4211 MHz.

N(-) FIXED  4  GHz dB ................. Sets the harmonics mixing degree (n) to -4.

⑤ For Option 16 (26.5 GHz to 40 GHz)

[CENTER FREQ] [EXT. MIXER] [Keying center frequency data]
................ Sets center frequency.

[MIXER MODE] [4GHz IF] [NORMAL IF] ..... Sets the 1st IF to 3996.4211 MHz.

[N(-) FIXED] [6] [GHz dB] ................ Sets the harmonics mixing degree (n) to -6.

⑥ For Option 17 (40 GHz to 60 GHz)

[CENTER FREQ] [EXT. MIXER] [Keying center frequency data]
................ Sets center frequency.

[MIXER MODE] [4GHz IF] [NORMAL IF] ..... Sets the 1st IF to 3996.4211 MHz.

[N(-) FIXED] [8] [GHz dB] ................ Sets the harmonics mixing degree (n) to +8.

(4) Confirmation of Signal Frequency

When an input signal is measured with a wave guide mixer, multiple spectrums will be displayed for that signal. When, therefore, measuring an input signal whose frequency is unknown, confirm it by changing over the mixing modes and using the SIGNAL IDENT function. For how to use the SIGNAL IDENT function, see "3.5.2 Configuration of Softkey Menu in the Marker Mode" or "5.7.2 Measuring Frequencies Using an External Mixer".

(5) Measurement of Amplitude

After completing the confirmation of the frequency of an input signal, adjust the MIX BIAS function to maximize its amplitude. By adding the CORR. FACTOR to the maximum amplitude, measure the amplitude of the input signal.
In reading the measured amplitude, it is convenient to set the CORR. FACTOR to [REF. OFFSET].
The MIX BIAS value is measured and displayed together with the CORR. FACTOR value and should be entered through the data entry keys.
For how to use the MIX BIAS function, see "(3) Description of Softkey Menus" of "3.2.1 Setting the Center Frequency".

(6) Saving of Settings

Any modes or values set by using the [MIX BIAS], [REF. OFFSET], or [MIXER MODE] function can be saved or recalled simultaneously with those set by using the [CENTER], [SPAN], [REF LEVEL] and other functions.
For more details, see "4.3 SAVE AND RECALL FUNCTIONS".

WARNING

The external mixer may have its diode damaged by any voltage present in its connection cable. To prevent such damage, connect the cable first to the R4136 spectrum analyzer and then to the external mixer.
When disconnecting the external mixer from the spectrum analyzer, remove the cable first from the external mixer and then from the spectrum analyzer.

# 5.8 MEASUREMENT OF NOISE LEVEL

## 5.8.1 Measurement of Noise Level Absolute Value (dBm/Hz, dBm/$\sqrt{Hz}$)

When measuring a noise normalized by 1 Hz noise power bandwidth, take an average of the noise with VIDEO bandwidth or AVG. function to measure the noise level. Absolute value of the noise level is calculated by the following formula.

$$N\ \text{dBm/Hz} = P - 20\log\left(\frac{1}{RBW \times 1.2}\right) + K_n$$

N : Noise level converted as 1 Hz bandwidth.
P : Measurement noise level
RBW: Setting resolution bandwidth of this unit (Hz)
$K_n$ : Compensation value in the log mode (dB)=2.5 dB

This unit can perform this calculation.

Operating Procedure

① Set the marker to the noise signal to be measured.

MARKER [ON] [1] [4] [5] [MHz/sec] [Marker is set to 145 MHz.]

② Set the VIDEO bandwidth "VID BW" to less than 1/30 of setting resolution bandwidth.

VID BW [ ] [1] [0] [MHz/sec]

③ MARKER

When [MENU] is set, softkey menu is displayed on the CRT.

If [NOISE MEASR] is set, [dBm/Hz] [dBμ/$\sqrt{Hz}$] [.OFF] are displayed on the CRT. Press dBμ/$\sqrt{Hz}$ when the level display unit is dBμ, or dBm/ Hz when dBm.

If dBm/Hz is set, marker level is displayed on the upper right part of screen. A noise level converted as 1-Hz bandwidth is displayed in such format as xxdBm/Hz.

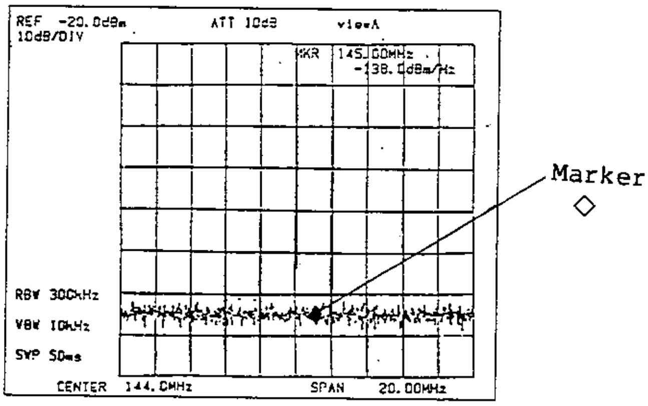



Figure 5-33 Measurement of Noise Level

④ The noise measurement mode is released by pressing [OFF]. Add the following value to a displayed value in order to convert a noise power bandwidth for another noise bandwidth.

$$K_B = 10 \log_{10} \left( \frac{\text{A bandwidth to be converted}}{1\ \text{Hz}} \right)$$

5.8.2 C/N Measurement

When measuring a side-band noise, a signal and the side-band noise normalized by 1 Hz noise power bandwidth can be displayed using the delta marker mode (△).

Operating Procedure

① Set the center frequency (CENTER FREQ) to place the signal in the center of the screen. Then set ①-1 frequency (FREQ SPAN), ①-2 resolution bandwidth (RBW) and ①-3 video bandwidth (VID BW) to the values to be measured.

①-1 [CENTER FREQ] [1] [GHz dB]

① -2 MARKER [MENU] [PK SRCH] [MKR →CF]

[FREQ SPAN] [2] [0] [0] [kHz msec]

① -3 RBW [ ] [1] [kHz msec]

VID BW [ ] [0] [·] [1] [kHz msec]

② Set MARKER [MENU]. And set [⊿MKR] from the softkey menu.

③ Press [PK SRCH] to adjust the marker to the peak of the signal.

④ Enter noise frequency to be measured with the difference from the signal frequency.

[2] [5] [kHz msec]

Press [dBc /Hz] of the softkey menu.

The difference between the noise of the frequency, which is 25 kHz far from the signal, and the signal is displayed in such a format as xxxdBc/Hz.

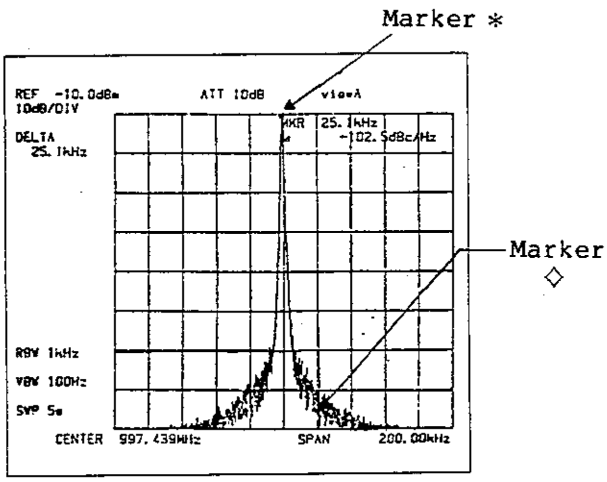



Figure 5-34 Example of C/N Measurement

## 5.9 MEASUREMENT OF OCCUPIED BANDWIDTH AND ADJACENT CHANNEL LEAKAGE POWER (WITH OPTION 04)

### 5.9.1 Measurement of Occupied Bandwidth

Option 04 makes an operation to obtain the occupied bandwidth from the data on the screen measured by R4136.
The operation is executed as follows.
There are 701 data points along the frequency axis on the R4136 screen. If a voltage is defined as $V_n$, the total power on the screen is calculated by following formula.

$$P = \sum_{n=1}^{701} \frac{V_n^2}{R} \quad \text{(R: Input impedance of R4136)}$$

Assuming that the point where the summation of electrical power from the left end of the screen is 0.5% of the total electrical power P is X from the left end of the frequency axis, the following equation is established.

$$0.005P = \sum_{n=1}^{X} \frac{V_n^2}{R}$$

Assuming that the point where the summation of electrical power form the left end of the screen is 99.5% of the total electrical power P is Y from the left end of the frequency axis, the following equation is established.

$$0.995P = \sum_{n=1}^{Y} \frac{V_n^2}{R}$$

X and Y are calculated by the above formula. Occupied bandwidth is obtained by the following formula using the frequency span.

$$OBW = \frac{f\ SPAN(Y-X)}{701}$$

The operating procedure of occupied bandwidth measurement is shown below.

CAUTION

1. When the signal oscillation is less than 40 dB on the screen, the operation error increases. So, set the "REF LEVEL" to indicate the signal oscillation more than 40 dB.
2. To set the resolution bandwidth of this unit to 1/200 or less of the setting span can reduce an error for measuring.
3. If the signal has much noise and if the modulating wave is such a pseudoaudio signal, error can be reduced by setting the TRACE DET. MODE to "SAMPL".
4. The vertical scale must be set to 10 dB/div on the screen. Set the manual SWEEP and signal track to OFF.

Operating Procedure

① Set the centerfrequency (CENTER FREQ) so that the signal wave is displayed in the center of the screen. Then set the frequency span (FREQ SPAN) and resolution bandwidth (RBW) to the values to be measured.

[CENTER FREQ] [1] [4] [4] [MHz sec]

[FREQ SPAN] [5] [0] [kHz msec]

RBW [ ] [0] [.] [3] [kHz msec]

② Set the TRACE DET. to SAMPL MODE.

TRACE [MENU] [TRACE DET] [SAMPL]

③ To measure the occupied bandwidth.

[f] [OBW]

Occupied bandwidth is displayed like "OBW XXHz" in the active display area of the upper left part of the screen.

Display of occupied bandwidth

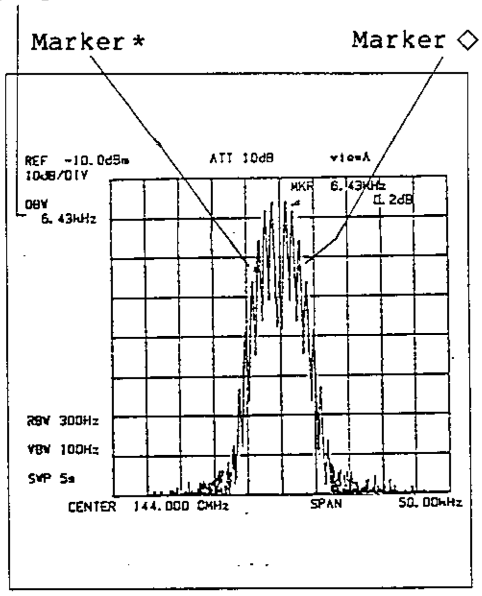



Figure 5-35 Measurement of Occupied Bandwidth

### 5.9.2 Measurement of Adjacent Channel Leakage Power

The data on the memory A measured by R4136 is divided into 701 points along the frequency axis. An electrical power width specified by Δ marker from the total power is integrated and the ratio is displayed in the form of graph or numeral.
Provided $P_n$ is a power of the wave on each point on the screen, the total electrical power P can be calculated by the following equation.

$$P = \sum_{n=1}^{701} P_n$$

Assuming that the ΔX is a delta marker width, the adjacent channel leakage power on the n point from the left end of the screen can be calculated by following equation.

$$P_{ADJ} = 10\log_{10} \frac{\sum_{n-\Delta x/2}^{n+\Delta x/2} P_n}{P}$$

CAUTION

1. A dynamic range of a measurement result is determined by a display amplitude of signal. Set the REF LEVEL so that the signal amplitude is indicated on the most significant scale.
2. To set the resolution bandwidth of this unit to 1/200 or less of setting span can reduce an error for measurement.
3. If the signal has much noise and if the modulating wave is a pseudoaudio signal, an error can be reduced by setting the TRACE DET. MODE to "SAMPLE".
4. The vertical scale must be set to 10 dB/div on the screen. And, set the manual SWEEP and signal track to OFF.

(1) Graph of Adjacent Channel Leakage Power

Operating Procedure

① Set the center frequency so that the signal wave is displayed in the center of the screen. And set the frequency span (FREQ SPAN) and resolution bandwidth (RBW) to the value to be measured.

[CENTER FREQ] [1] [4] [4] [MHz sec]

[FREQ SPAN] [5] [0] [kHz msec]

RBW [ ] [0] [.] [3] [kHz msec]

② Set the TRACE DET to "SAMPL".

TRACE [MENU] [TRACE DET] [SAMPL]

③ Set the marker to Δ point.

MARKER [ON] MARKER [MENU] [Δ MKR]

Specify the integral width.

[8] [.] [5] [kHz msec]

Execute the ADJ-GRAPH.

[f] [ADJ GRAPH]

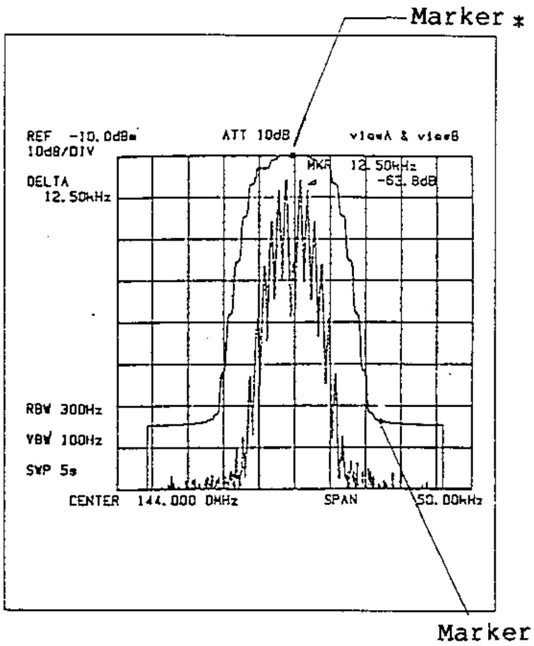



Figure 5-36 Graph of Adjacent Channel Leakage Power

Operation of memory A trace data is executed and "WORKING" is displayed on the upper left part of the screen.

When the operation is completed, the results are written in memory B. The screen becomes dual screen mode of VIEW A&B. Then both measured wave and processed wave are displayed.

④ To directly read the adjacent channel leakage power using the marker, follow the instructions below.

④-1 Set the marker to the carrier frequency.

MARKER
[ON] [1] [4] [4] [MHz/sec]

④-2 Specify the Δ marker and set the frequency to be measured (difference from the carrier frequency).

MARKER
[MENU] Δ MKR [1] [2] [.] [5] [kHz/msec]

The marker level is displayed as an adjacent channel leakage power.

(2) Adjacent channel leakage power (ADJ)

Use the following procedure to measure the specified one point leakage power.

Operating Procedure

① Execute the same procedure as above (1). (See (1) ①.)

② Execute the same procedure as above (1). (See (1) ②.)

③ Set the marker to the carrier frequency.

MARKER
[ON] [1] [4] [4] [MHz/sec]

④ Specify the Δ marker and set the frequency to be measured (difference from the carrier frequency).

MARKER
[MENU] Δ MKR [1] [2] [.] [5] [kHz/msec]

⑤ Specify the integral width.

[8] [.] [5] [kHz/msec]

⑥ Execute the ADJ.

[f] ADJ

Leakage power of the adjacent channel, 12.5 kHz far from the carrier wave, is displayed in the active area like ADJ xxdB.

The display is an ADJ value of one point indicated by Δ marker (*).

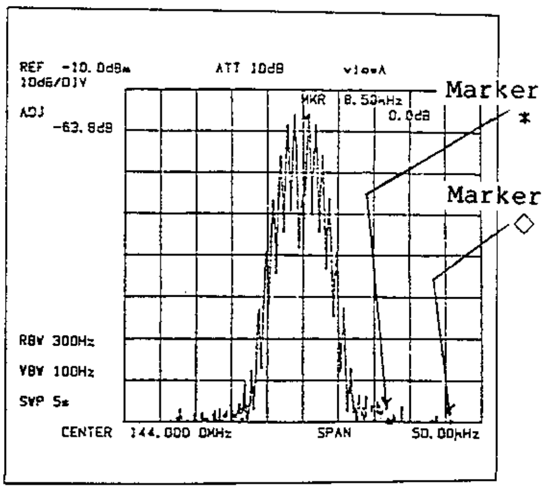



Figure 5-37 Measurement of Adjacent Channel Leakage Power

ADJ operation is made in the range of $+\Delta X/2$ and $-\Delta X/2$ (around the center point Δ marker).

(Δ X indicates the number of points between the active marker (◇) and Δ marker (*).) If the marker is on the point 0 or more than 700, or is superposed on the active marker (◇), an error occurs.

If OP command output data is specified to the marker level through external controller, the operation result can be read out.

[Measuring mode of Option 04]

- "View A" mode

  When starting an operation in the trace View A mode, the memory A data is used.

- "write" mode

  When starting an operation in the trace WRITE mode, trace A storage is automatically carried out. Trace data of "write" waveform is used for an operation.

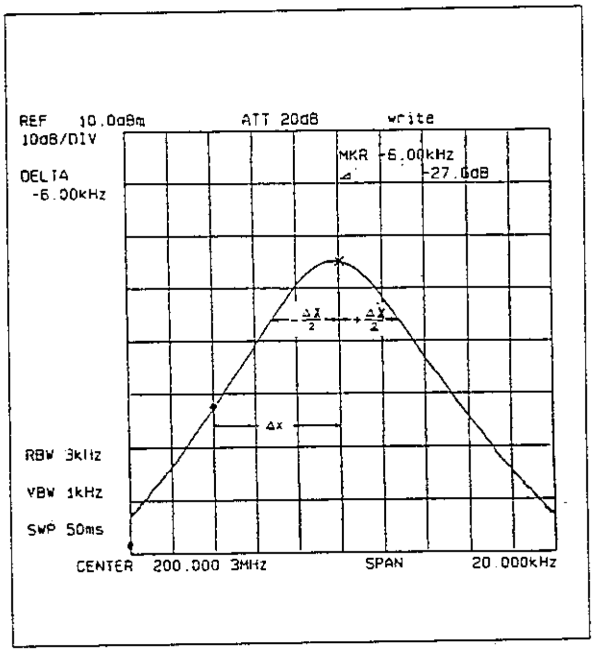



Figure 5-38 Measurement Example of Option 04

*MEMO*

# 6. GPIB : REMOTE PROGRAMMING

This chapter the external control and programming for the R4136 spectrum analyzer and the GPIB specifications.

## 6.1 INTRODUCTION

The R4136 spectrum analyzer has a GPIB (General Purpose Interface Bus), the IEEE488-1978 standard measuring instrumentation bus, as standard, enabling full remote-control using the external controller.

(1) GPIB Expandability and Interchangeability

The GPIB interfacing system interfaces the measuring instrument with the controller, or peripheral units using simple cable(s) (bus line(s)). Compared to conventional interfacing systems, this GPIB system has superior expandability, and is interchangeable with products made by other manufacturers electrically, mechanically, and functionally. And therefore various system configurations can be made easily, from a simple system with a single bus cable to an advanced automatic measuring system.

(2) Talker, Listener, and Controller Functions

In the GPIB system you should set addresses for each component connected to the bus line. Each unit can undertake one or more functions of controller, talker, and listener.

During system operation, only one talker can send data to the bus line, and several listeners can receive this data. The controller specifies the talker and listener addresses to transfer data from the talker to the listener. The controller itself (the talker in this case) also sets the listener measurement conditions.

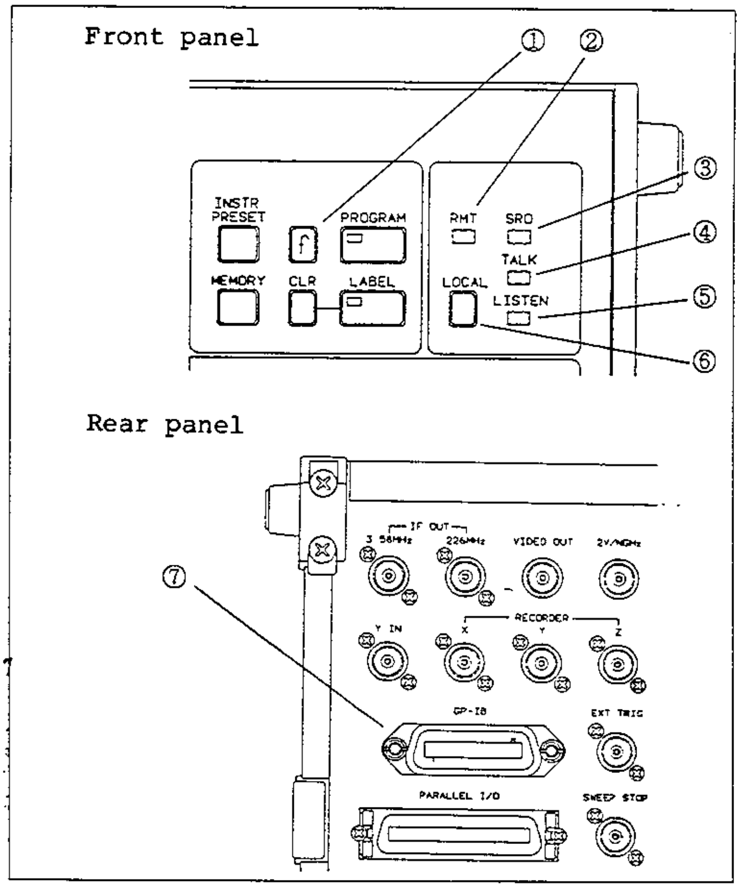



Figure 6-1 Description of Panel (GPIB)

① f GPIB address (software key function) setting key

② RMT ReMoTe LED: Lights when the instrument is placed in the remote (external) control mode.

③ SRQ Service ReQuest LED: Lights when a service request is issued.

④ TALK TALKer LED: Lights during data sending.

⑤ LISTEN LISTENer LED: Lights during data receiving.

⑥ LOCAL remote/LOCAL selector key: Aborts the remote control mode, enabling input from the panel.

⑦ GPIB connector

The functions which can be remote-controlled are listed below.

① Setting the measurement conditions: Various measurement conditions entries similar to key operations on the panel

② Outputting the setting conditions : Various R4136 measurement conditions and data calling

③ Outputting the measurement data : CRT tracing data calling

④ Inputting waveform data from the external section

⑤ Service request to the controller : Interrupt request for controlling the controller and outputting status bytes

⑥ Outputting the operating status : Outputting mode strings

### 6.1.1 System Configurations

The automatic measuring system configuration with the R4136 assumed as the measuring device requires the following controller, recorder, or their equivalent units to be connected:

Table 6-1 Configuration of Automatic Measuring System

| Peripheral unit | Recommended unit | | Remarks |
|---|---|---|---|
| Controller | HP's HP200 series, | | Manufactured by HP company |
| Data recorder | TR9831<br>TR9834R<br>TR9835/9835R | | Manufactured by ADVANTEST |
| Bus cable | ADVANTEST standard bus cable | | Each bus cable should be 4 m or less, and the total length of the bus cables should not exceed 20 m. |
| | Length | Product number | |
| | 0.5 m<br>1 m<br>2 m<br>4 m | 408JE-1P5<br>408JE-101<br>408JE-102<br>408JE-104 | |

The GPIB system consists of several unit and therefore you should check the condition of each unit and whether they operate normally before connecting the bus cable to the peripheral units.

### 6.1.2 Address Setting

Address setting is made by key operations on the panel.

Specifying [F] GP-ADR [0] [1] [GHz/dB] or [MHz/sec] or [kHz/msec] sets the GPIB address to 01. Up to 31 types of setting (from 00 to 30) are available. These types of setting will be completed by pressing any one of the unit keys. The set GPIB address is indicated on the CRT.

Note: When a GPIB address is set, the settings of GPIB functions including delimiter, header, service request and so on are initialized.

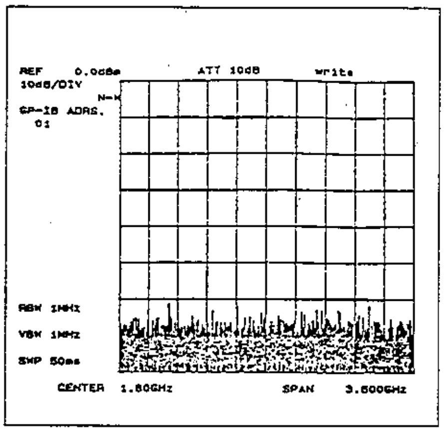



Figure 6-2 Indication of GPIB Address

## 6.2 PROGRAMMING

I/O instructions in the GPIB system such as GPIB command codes to the connected units, data transmission, data reading from the device, execution of bus commands, and serial polling are programmable. Other operational processing depends on how the program is coded with the controller.

The formats of the GPIB command and data I/O statement sent to a specified connected unit are as follows:

| I/O statement | | Unit address | ;" | I/O command code, data | " |
|---|---|---|---|---|---|

### 6.2.1 Entering the Measurement Parameters: Various Measurement Condition Entries Corresponding to Key Operations on the Panel

| Example 6-1: | Set the center frequency to 500 MHz and the frequency span to 2 MHz. |
|---|---|

For the HP200 series

```
100 OUTOUT 7 01; "SP 2MZ CF 500MZ "
```

500 MHz
Makes the center frequency active.
2 MHz
Makes the frequency span active.
Addresses the R4136 (GPIB address 01) as the listener.
Interface selector (GPIB)
Addresses the controller as the talker.

CF, SP, and MZ in the program above are the GPIB commands for controlling the R4136. These command codes correspond to each key, as described in Tables 6-1 and 6-2, and therefore programs can be created by pressing the keys on the panel. The command code delimiter is always valid irrespective of the presence or absence of spaces. The command codes can also be delimited by commas. Use uppercase characters for command entries. All lowercase characters and any uppercase characters other than the defined command codes are ignored.

When entering data with numeric values, 500 MZ and 500,000 KZ have the same meanings. For negative polarity identification, enter a minus symbol before the numeric value like -500 MZ. When the units are omitted, the basic units (Hz, dB, sec) are set as defaults according to the set functions.

In example 6-1 the measurement parameter is directly set with a numerical; however, the data can also be set one step at a time using the step-key operation command. Use these functions depending on the situation.

| | |
|---|---|
| Example 6-2: | Set the step size to AUTO to increase the central frequency by two steps. |

For the HP200 series

```
100 OUTPUT 701; "CS1 CF CU CU"
```

Increase the frequency by two steps.
Make the center frequency active.
Set the step size to AUTO.

Table 6-2 Command Codes of the Key Functions

| | Panel key | Code | | Panel key | Code | | Panel key | Code |
|---|---|---|---|---|---|---|---|---|
| FUNCTION | | | TRACE | | | DATA | 0 | 0 |
| | CENTER FREQ | CF | | WRITE | WR | | 1 | 1 |
| | FREQ SPAN | SP | | A | TA | | 2 | 2 |
| | START | FT | | B | TB | | 3 | 3 |
| | STOP | FP | | MENU | TM | | 4 | 4 |
| | REF LEVEL | RL | | | | | 5 | 5 |
| | | | | | | | 6 | 6 |
| | | | | | | | 7 | 7 |
| CUPLED FNC. | | | MARKER | | | | 8 | 8 |
| | AUTO TIME | AS | | PK SRCH | PS | | 9 | 9 |
| | TIME | SW | | MKR →CF | MC | | . | . |
| | AUTO RBW | BA | | ON | MN | | +/- | - |
| | RBW | BW | | OFF | MF | | BK SP | BS |
| | AUTO VID BW | VA | | MENU | KN | | GHz/dB | GZorDB |
| | VID BW | VB | | | | | MHz/sec | MZorSC |
| | AUTO ATT | AA | | | | | kHz/msec | KZorMS |
| | ATT | AT | | | | | Step key ⇧ | CU |
| | | | | | | | ⇩ | CD |
| | | | | | | | Data knob DOWN | FD |
| | | | | | | | UP | FU |
| SWEEP | TRIG | TR | SOFT KEY | SOFT KEY 1 | SF1 | OTHER | | |
| | MANAUAL | SM | | SOFT KEY 2 | SF2 | | PROGRAM | PG |
| | START/RESET | SR | | SOFT KEY 3 | SF3 | | LABEL | LAorLB1 |
| | | | | SOFT KEY 4 | SF4 | | CLR | CEorLB2 |
| | | | | SOFT KEY 5 | SF5 | | f | FN |
| | | | | SOFT KEY 6 | SF6 | | MEMORY | MM |
| | | | | SOFT KEY 7 | SF7 | | INSTR PRESET | IP |
| | | | | | | | LOCAL | LC |

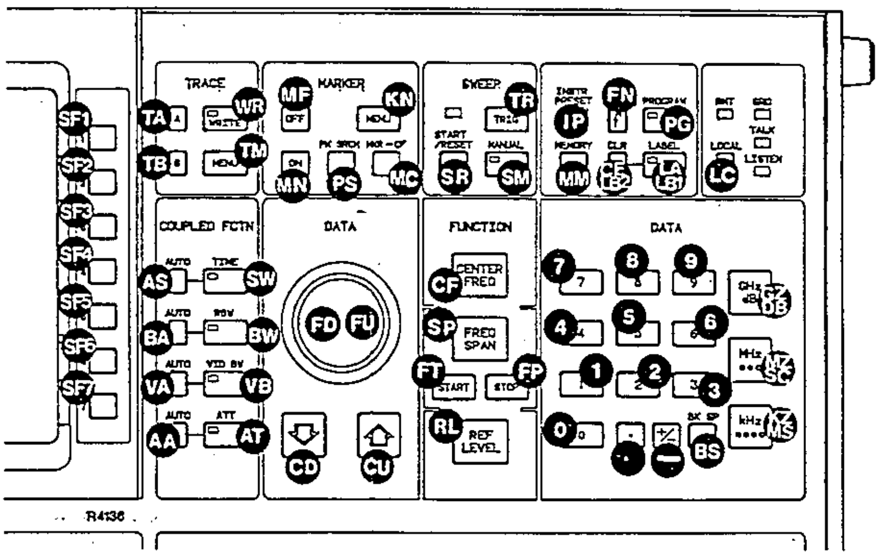


Table 6-3 Command Codes of the Softkey Functions (1/2)

| | Softkey menu | Code |
|---|---|---|
| CENTER FREQ | CF STEP SIZE; | |
| | AUTO | CS1 |
| | MKR FRQ STP SIZE | CS2 |
| | MKR/ Δ→STP SIZE | CS3 |
| | RETURN | RT |
| | FREQ OFS | CO |
| | INT MIX; | |
| | NOMAL IF | IF1 |
| | SHIFT IF | IF2 |
| | PRE SEL; | |
| | PK SRCH | PR1 |
| | ATUO PEAKING | PR2 |
| | MANUAL PEAKING | PR3 |
| | RETURN | RT |
| | EXT MIX; | EMX |
| | 4GHz IF | EX1 |
| | NORMAL IF | EXN |
| | N(-)AUTO | EA1 |
| | N(-)FIXED | EA2 |
| | N(+)AUTO | EA3 |
| | N(+)FIXED | EA4 |
| | RETURN | RT |
| | SHIFT IF | EXS |
| | N(-)AUTO | EB1 |
| | N(-)FIXED | EB2 |
| | N(+)AUTO | EB3 |
| | N(+)FIXED | EB4 |
| | RETURN | RT |
| | 226MHz IF | EX2 |
| | N(-)AUTO | EC1 |
| | N(-)FIXED | EC2 |
| | N(+)AUTO | EC3 |
| | N(+)FIXED | EC4 |
| | RETURN | RT |
| | REF. OFFSET | EX3 |
| | MIXER BIAS | EX4 |
| | PORT | EX5 |
| | 2PORT | EP1 |
| | 3PORT | EP2 |
| | RETURN | RT |

| | Softkey menu | Code |
|---|---|---|
| FREQ SPAN | LOG SPAN; | |
| | START STOP | |
| | 10 kHz 100 Hz | SG1 |
| | 1 | SG2 |
| | 10 | SG3 |
| | RETURN | RT |
| | 100 KHz 1 MHz | SH1 |
| | 10 MHz | SH2 |
| | 100 MHz | SH3 |
| | RETURN | RT |
| | 1 MHz 10 MHz | SI1 |
| | 100 MHz | SI2 |
| | 1 GHz | SI3 |
| | RETURN | RT |
| | 10 MHz 100 MHz | SJ1 |
| | 1 GHz | SJ2 |
| | ... RETURN | RT |
| | 100 MHz 1 GHz | SK1 |
| | RETURN | RT |
| | LINE SPAN | SL |
| | FULL SPAN1 | SU1 |
| | FULL SPAN2 | SU2 |
| | ZERO SPAN | SZ |
| | MKR/ Δ→SPAN | SO |
| REF LEVEL | dB/DIV; 10 dB/ | LD1 |
| | 5 dB/ | LD2 |
| | 2 dB/ | LD3 |
| | 1 dB/ | LD4 |
| | RETURN | RT |
| | LIN; ×1 | LL1 |
| | ×2 | LL2 |
| | ×4 | LL3 |
| | ×8 | LL4 |
| | RETURN | RT |
| | REF;OFS | LO |
| | QP; 10 kHz~150kHz | LQ1 |
| | QP; 150 kHz ~30 MHz | LQ2 |
| | 30 MHz~1 GHz | LQ3 |
| | OFF | LQ4 |
| | RETURN | RT |
| | UNIT; dBm | LU1 |
| | dBμ | LU2 |
| | dBμ(EMF) | LU3 |
| | dBpw | LU4 |
| | RETURN | RT |
| | PK SRCH | LP |
| | MKR →REF | LM |

| | Softkey menu | Code |
|---|---|---|
| MARKER | MKR STEP SIZE; | |
| | AUTO | MA |
| | RETURN | RT |
| | SRCH; PK SRCH | MR1 |
| | DISP LINE | MR5 |
| | RETURN | RT |
| | SIG TRACK | |
| | OFF | MT |
| | RETURN | RT |
| | ΔMKR; | MD0 |
| | PK SRCH | MD1 |
| | RETURN | RT |
| | FREQ. COUNT; | |
| | OFF | MU1 |
| | 1 kHz | MU2 |
| | 100 Hz | MU3 |
| | 10 Hz | MU4 |
| | 1 Hz | MU5 |
| | RETURN | RT |
| | FIELD STR; | |
| | DIPOLE | MI1 |
| | LOG PERD | MI2 |
| | TR17203 | MI3 |
| | RETURN | RT |
| | SIG. IDENT; | |
| | N(+/-) | ID1 |
| | NORM/SHIFT | ID2 |
| SWEEP | TRIG FREE RUN | ST1 |
| | LINE | ST2 |
| | VIDEO | ST3 |
| | TV-V | ST4 |
| | EXT | ST5 |
| | SINGLE | ST6 |
| | MANUAL COARSE | SN1 |
| | FINE | SN2 |

Table 6-3 Command Codes of the Softkey Functions (2/2)

| | Softkey menu | Code | | Softkey menu | Code | |
|---|---|---|---|---|---|---|
| TRACE MENU | DISP LINE ON | TN | TRACE A/B | | A | B |
| | DISP LINE OFF | TF | | | | |
| | INPUT SEL; | | | STORE | AR | BR |
| | RF INPUT | TIR | | VIEW | AV | |
| | EXT INPUT; | | | MAX HOLD | AM | BM |
| | 0.5V/(10dB/) | TE1 | | AVG OFF | AG1 | BG1 |
| | 0.25V/(5dB/) | TE2 | | 4 | AG2 | BG2 |
| | 0.1V/(2dB/) | TE3 | | 8 | AG3 | BG3 |
| | 50mV(1dB/) | TE4 | | 16 | AG4 | BG4 |
| | SWEEP TIME | TE5 | | 32 | AG5 | BG5 |
| | VIDEO B.W. | TE6 | | 64 | AG6 | BG6 |
| | RETURN | RT | | 128 | AG7 | BG7 |
| | RETURN | RT | | A ↔ B | AC | BC |
| | TRACE DET NORMAL | TD1 | | | | |
| | POSI.P | TD2 | | | | |
| | NEGA P | TD3 | | | | |
| | SAMPL | TD4 | | | | |
| | RETURN | RT | | | | |
| | DISP FUNC B-A | TP1 | | | | |
| | INPUT-A | TP2 | | | | |
| | A ↔ B | TP3 | | | | |
| | RETURN | RT | | | | |
| | INTENSE | TC | | | | |

### 6.2.2 Outputting Setting Conditions

When outputting the setting data for the measurement parameters, use the OP command to directly call the setting data, or output the mode strings to inspect it.

Table 6-4 Data Output Commands

| Code | Data output commands |
|---|---|
| OP | Outputs the setting conditions |
| OM | Outputs the mode strings |

(1) OP Command (Output Interrogation Parameter)

Use the OP command to output the measurement parameter directly. After the OP command is entered, send the OP parameter code of the setting data to be output to the R4136. To output the central frequency, for example, send code "OPCF" to the R4136.

Example: OUTPUT 701; "OPCF"
A single OP command is valid for each statement. Therefore, the following programs cause an error.

Examples of incorrect programs:

```
1) OUTPUT 701; "OP"
   OUTPUT 701; "CF"

2) OUTPUT 701; "OP CF IG MF"

3) OUTPUT 701; "OPCF OPIG OPMF"
```

Table 6-5 OP Parameter Code

| Code | Parameter to be output |
|---|---|
| CF | Center frequency |
| IG | IF GAIN |
| MF | Marker frequency |
| ML | Marker level |
| RB | Resolution bandwidth |
| RL | Reference level |
| SP | SPAN/DIV |
| ST | Sweep time |
| VF | VIDEO FILTER |
| FA | START frequency |
| FB | STOP frequency |
| FO | Frequency offset |
| AT | Attenuator |

Description

① The separate coding of the OP command and parameter "CF" does not identify a parameter.

② The subsequent coding of two or more parameters ignores the second parameter and even if they are delimited by a comma. Only "OP CF" is valid in the program coding in 2) and 3).

③ Because the OP parameter code is used exclusively for the OP command, it is valid in the format of "OPxx". Do not mix the use of this parameter code with the other GPIB commands.

The measurement parameter data is output in the following format. Because the total number of data bytes is 20, verify the character strings with more than 20 bytes when outputting the data from the controller as a character string variable.

```
HHH␣ DDDDDDDDD.DDD E±D CRLF
                              Block delimiter
                              Exponential part of data
                              Imaginary part of data
                              Data polarity: Positive:space
                              "␣"; negative: "-"
                              Header
      20 bytes
```

Figure 6-3 Output Data Format of the Measurement Parameter

Example 6-3: Set the frequency span to 20 MHz with a step-key operation.

For the HP200 series

```
100 OUTPUT 701 ; "OP SP "
110 '
120 ENTER 701 ;S
130 IF S<=0.2E8 THEN 160
140 OUTPUT 701 ; "CD "
150 GOTO 100
160 IF S=0.2E8 THEN 190
170 OUTPUT 701 ; "CU "
180 GOTO 100
190 END
```

100 Outputs the frequency span setting data.
Frequency span
Data output
120 Reads the data.

130 Changes the data until 20 MHz
≀ is set according to step-key
180 operation.
190 Ends the program.

(a) Header

This is a code indicating the type of data (see Table 6-7). The header is ON ("HD 1") in the initial state. It can be omitted by using command "HD 0" if not required.

To output header, data must consist of character string variables.

Table 6-6 Header ON/OFF Commands

| Code | Header ON/OFF |
|---|---|
| HD0 | OFF |
| HD1 | ON (Initialization) |

Table 6-7 Header of the OP Output Data

| OP output data | Header | OP output data | | | Header |
|---|---|---|---|---|---|
| Center frequency (Hz) | CF | Reference level | | dB | RLD |
| Resolution bandwidth (Hz) | RB | | | dBm | RLM |
| SPAN/div. (Hz) | SP | | | dBμ | RLU |
| VIDEO FILTER (Hz) | VF | | | dBμ (EMF) | RLE |
| START frequency (Hz) | FA | | | dBμ/m (A) | RLA |
| STOP frequency (Hz) | FB | | | dBμ/m (B) | RLB |
| Frequency OFFSET (Hz) | FO | | | dBμ/m (C) | RLC |
| IF GAIN (dB) | IG | | | V | RLV |
| Attenuator (dB) | AT | Marker | Frequency (Hz) | | MF |
| Sweep time (sec) | ST | | Level | dB | MLD |
| | | | | dBm | MLM |
| | | | | dBμ | MLU |
| | | | | dBμ (EMF) | MLE |
| | | | | dBμ/m (A) | MLA |
| | | | | dBμ/m (B) | MLB |
| | | | | dBμ/m (C) | MLC |
| | | | | V | RLV |

Example 6-4: Output data under various measurement conditions with headers.

For the HP200 series

```
10  DIM A$ [25]
20  DIM B$ [25]
30  DIM C$ [25]
100 OUTPUT 701; "HD1 "
110 OUTPUT 701; "OPST"
120 ENTER 701; A$
130 OUTPUT 701; "OPRB "
140 ENTER 701; B$
150 OUTPUT 701; "OPVF "
160 ENTER 701; C$
170 PRINT A$
180 PRINT B$
190 PRINT C$
200 END
```

10 ~ 30 Sets up character string valuables A$, B$, C$, more than 20 bytes respectively.
100 Sets the header to ON.
110 Commands to output the sweep time data.
120 Writes the sweep time data into A$.
130 Commands output the RBW
140 Writes it into B$.
150 Commands output the VBW
160 Writes it into C$.
170 ~ 190 Displays the data with headers on the CRT.
200 Ends the program.

(b) Block Delimiter

A block delimiter indicates the end of a signal. There are four types of block delimiters as shown in Table 6-8. When commands or data are sent from the controller to the R4136, if their block delimiters apply to one of those in Table 6-8, the R4136 accepts the commands or data. The R4136 GPIB system does not operate normally when the block delimiter does not apply to any of those given delimiters. When fetching data from the R4136, you should set the R4136 block delimiter to equal the block delimiter to be sent to the receiving side (GPIB controller).

In this case, select it from the above four types, and specify the command. Note that the set delimiter remains valid unless otherwise changed later.

The block delimiter is set to DL3 when the power to the R4136 is turned on or when INSTR RESET is set.

Table 6-8 Block Delimiter Specifying Codes

| Code | Block delimiter | Number of bytes |
|---|---|---|
| DL0 | Outputs CR and LF. Outputs the single line signal EOI together with LF. | 2 |
| DL1 | Outputs LF. | 1 |
| DL2 | Outputs the single line signal EOI together with the last byte of data. | – |
| DL3 | Outputs CR and LF, but no single line signal EOI. (initialization) | 2 |

Example 6-5: Output LF as a block delimiter.

For the HP200

```
100 OUTPUT 701; "DL1 "
```

(2) Mode String: "OM" (Output Mode String Command).

To output an other measurement condition setting status which cannot be output using the OP command, read the mode strings as the R4136 internal flags and detect them. The mode strings consist of 12 bytes of binary codes, and each byte indicates a R4136 function setting status.

When the mode strings are output, the data delimiter adds the single line signal EOI to the last byte (12th byte). Note that the delimiter does not use codes CR and LF. The meaning of each mode string byte and the function with which mode strings can be called are shown in Table 6-9.

To output mode string use the "OM" (Output mode string) command. By sending the "OM" command, the analyzer outputs mode string when specified to talker.

Example 6-6: Detect the attenuator value by outputting the mode strings.

For the HP200

```
90  DIM M(12)
100 OUTPUT 701; "OM "
110 FOR I=1 TO 12
120 ENTER 701 ;M(I)
130 NEXT I
140 DISP M(1)
150 END
```

90 Secures 12 bytes of modulation M.
100 Instructs the mode strings output operation.
110 ~ 130 Fetches the mode strings.
140 Displays byte #1 (attenuator) of the mode strings.
150 Ends the program.

Table 6-9 Mode Strings (1/2)   * : Power ON state

| Byte # | Bit Usage 7654321 | Decimal value | Contents |
|---|---|---|---|
| | | | Attenuator |
| #1 | 0000000 | 0 | 0 dB * |
| | 0000001 | 1 | 5 dB |
| | 0000010 | 2 | 10 dB |
| | 0000011 | 3 | 15 dB |
| | 0000100 | 4 | 20 dB |
| | 0000101 | 5 | 25 dB |
| | 0000110 | 6 | 30 dB |
| | 0000111 | 7 | 35 dB |
| | 0001000 | 8 | 40 dB |
| | 0001001 | 9 | 45 dB |
| | 0001010 | 10 | 50 dB |
| | 0001011 | 11 | 55 dB |
| | | | Vertical scale |
| #2 | 0000000 | 0 | 10 dB/DIV * |
| | 0000001 | 1 | 5 dB |
| | 0000010 | 2 | 2 dB |
| | 0000011 | 3 | 1 dB |
| | 0000100 | 4 | LINEAR |
| | 0000101 | 5 | QP |
| | | | Trigger mode |
| #3 | 0000000 | 0 | MANUAL |
| | 0000001 | 1 | SINGLE |
| | 0000010 | 2 | VIDEO |
| | 0000011 | 3 | LINE |
| | 0000100 | 4 | FREE RUN * |
| | 0000101 | 5 | EXT |
| | 0000110 | 6 | TV-V |
| | | | MANUAL SWEEP |
| #4 | 0000000 | 0 | COARSE * |
| | 0000001 | 1 | FINE |
| | | | LENEAR |
| #5 | 0000000 | 0 | ×1 * |
| | 0000001 | 1 | ×2 |
| | 0000010 | 2 | ×4 |
| | 0000011 | 3 | ×8 |
| | | | QP |
| #6 | 0000000 | 0 | 10 kHz～150 kHz* |
| | 0000001 | 1 | 150 kHz ～30 MHz |
| | 0000010 | 2 | 30 MHz～1000 MHz |
| #7 | 0000000 | 0 | dBm * |
| | 0000001 | 1 | dBμ |
| | 0000010 | 2 | dBμ (EMF) |
| | 0000011 | 3 | dBpw |
| | 0000100 | 4 | dBμ/m(A) |
| | 0000101 | 5 | dBμ/m(B) |
| | 0000110 | 6 | dBμ/m(C) |
| | 0000111 | 7 | LINEAR |
| | | | Sampling mode |
| #8 | 0000000 | 0 | NORMAL * |
| | 0000001 | 1 | POSI. PEAK |
| | 0000010 | 2 | NEGA PEAK |
| | 0000011 | 3 | SAMPLE |
| | | | Averaging A |
| #9 | 0000000 | 0 | 4 * |
| | 0000001 | 1 | 8 |
| | 0000010 | 2 | 16 |
| | 0000011 | 3 | 32 |
| | 0000100 | 4 | 64 |
| | 0000101 | 5 | 128 |

Table 6-9 Mode Strings (2/2) * : Power ON state

| Byte # | Bit Usage 7654321 | Decimal value | Contents | |
|---|---|---|---|---|
| | | | Avaraging B | |
| #10 | 0000000 | 0 | 4 | * |
| | 0000001 | 1 | 8 | |
| | 0000010 | 2 | 16 | |
| | 0000011 | 3 | 32 | |
| | 0000100 | 4 | 64 | |
| | 0000101 | 5 | 128 | |
| | | | Frequency counter | |
| #11 | 0000000 | 0 | 1 kHz | * |
| | 0000001 | 1 | 100 Hz | |
| | 0000010 | 2 | 10 Hz | |
| | 0000011 | 3 | 1 Hz | |

| Byte # | Bit Usage 7654321 | Decimal value | Contents | |
|---|---|---|---|---|
| | | | CRT brightness | |
| #12 | 0000000 | 0 | Minimum | |
| | 0000001 | 1 | | |
| | 0000010 | 2 | | |
| | 0000011 | 3 | | |
| | 0000100 | 4 | | |
| | 0000101 | 5 | | |
| | 0000110 | 6 | | |
| | 0000111 | 7 | | |
| | 0001000 | 8 | | |
| | 0001001 | 9 | | * |
| | 0001010 | 10 | | |
| | 0001011 | 11 | Maximum | |

### 6.2.3 Inputting and Outputting the Trace Data

The trace data on the R4136 CRT consists of 701 points of data on the frequency axis. When inputting or outputting the trace data, input or output the 701 points of data in the order from left to right (from the low to high frequencies). Each point level data value is expressed with an integer from 0 to 511.

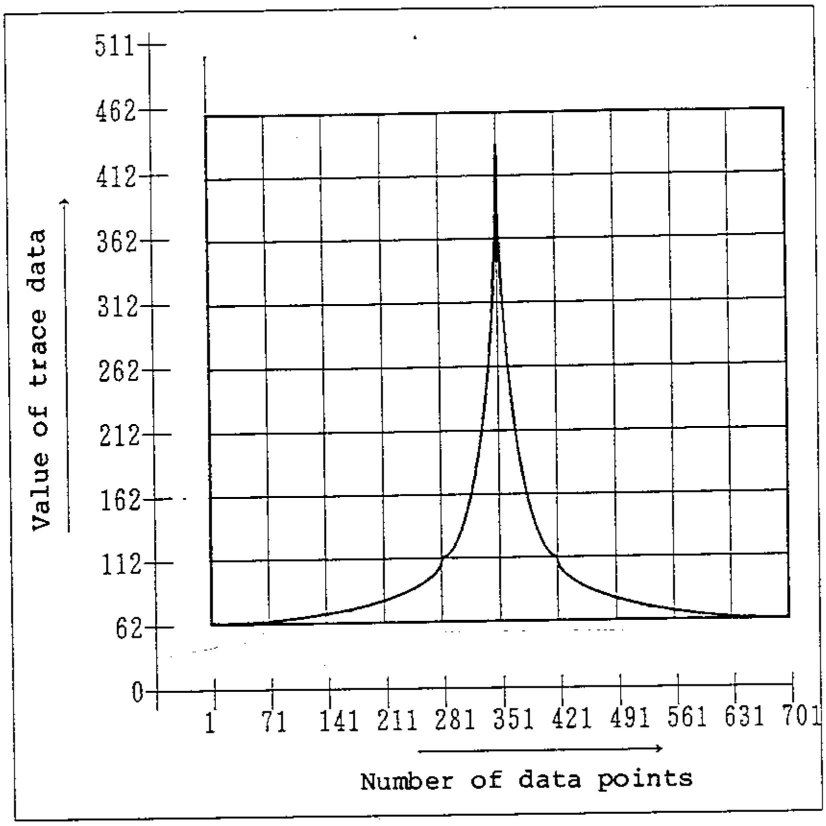



Figure 6-4 Relationship Between the CRT Graticule and Trace Data

The trace data can be output using the OP command, and be input using the IN command. There are two types of input/output methods: one with ASCII-code decimal and hexadecimal numbers, the other with the binary codes. To input or output data for each pointer sequentially, use the ASCII code as the operation is easier. When inputting or outputting a screen of data (701 points of data), use the binary codes as the processing is faster.

Table 6-10 Trace Data Specifying Codes

| Codes | Trace data to be input/output | | |
|---|---|---|---|
| TDA<br>TDB<br>TDW<br>TDC | Trace data in A memory *1<br>Trace data in B memory *2<br>Trace data of WRITE *3<br>Trace data after correction *4 | Decimal number | ASCII |
| THA<br>THB<br>THW<br>THC | Trace data in A memory<br>Trace data in B memory<br>Trace data of WRITE<br>Trace data after correction | Hexadecimal number | |
| TBA<br>TBB<br>TBW<br>TBC | Trace data in A memory<br>Trace data in B memory<br>Trace data of WRITE<br>Trace data after correction | Binary | |

*1. For trace modes such as view A, max A, avg A, etc.

*2. For trace modes such as view B, max B, avg A, etc.

*3. For WRITE mode

*4. For trace modes such as NORMALIZE (input-A, input-B), B-A, etc.
For trace modes such as CORR. WRITE, CORR. A view, etc. (Option 06)

(1) Outputting the Trace Data

When outputting the trace data, send the trace data specification code successively after sending the OP command.

(1-1) ASCII Code

Example 6-7: Output the trace data in decimal ASCII codes.

For the HP200

```
100 DIM A(700)
110 OUTPUT 701 ; "DL3"
120 OUTPUT 701 ; "OP TDA"

130 FOR I=0 TO 700
140 ENTER 701;A(I)
150 NEXT I
160 END
```

100 Prepares 701 integer valuables in array A (for one screen).
110 Sets the delimiter to CR, LF.
120 Outputs the A memory trace data in decimal ASCII code
Store in A memory in decimal ASCII code
Outputs the data
130 Enters the trace data in
~ variable array A
150 sequentially from point 1 through point 701.
Sets the number of loops to 701.

Example 6-8: Output the trace data in hexadecimal ASCII codes.

For the HP200

```
100 DIM A$(700) [4]
110 OUTPUT 701 ; "DL3"
120 OUTPUT 701 ; "OP THA"


130 FOR I=0 TO 700
140 ENTER 701;A$(I)
150 NEXT I
160 END
```

100 Prepares 701 string valuables in array A$ (for one screen).
110 Sets the delimiter to CR, LF.
120 Outputs the A memory trace data in hexadecimal ASCII code
....Store the data in A memory in hexadecimal ASCII code
.......Outputs the data
130 ~ 150 Enters the trace data in variable array A sequentially from point 1 through point 701.
Sets the number of loops to 701.

In this case, the data is expressed as four digits without a header, as illustrated below.

Trace data format (in ASCII code)

DDDD CRLF
- CRLF — Block delimiter
- DDDD — Trace data (for one point, 0511, for example)

When fetching the trace data as the character string variable, set the length of the character string variable to be used to four bytes or more for string verification.

(1-2) Binary Code

Example 6-9: Output the data in binary code (Word type).

For the HP200 series

```
100 DIM A(700)
110 OUTPUT 701 ; "DL2"
120 OUTPUT 701 ; "OP TBA"

130 ENTER 701 USING "%,W ";A(*)
140 END
```

100 Prepares 701 integer valuables in array A (for one screen).
110 Sets the delimiter to EOI.
120 Outputs the A memory trace data in binary code.
TBA: Trace data, binary, A memory
OP: Outputs the data.
130 Reads the upper and lower digit bytes of the first point trace data. Consecutively, reads the upper and lower digit bytes of the second point trace data, ... those in the 701st point data. Then converts it to word type and store in valuable A sequencially until receiving the EOI.

Example 6-10: Output the data in binary code (Byte type).

For the HP200 series

```
100 DIM A(1401)
110 OUTPUT 701 ; "DL2"
120 OUTPUT 701 ; "OP TBA"

130 ENTER 701 USING "%,B ";A(*)
140 END
```

100 Prepares 1402 integer valuables in array A (for one screen).
110 Sets the delimiter to EOI.
120 Outputs the A memory trace data in binary code.
130 Reads the upper and lower digit bytes of the first point trace data. Consecutively, reads the upper and lower digit bytes of the second point trace data, ... those in the 701st point data. Then store in valuable A sequencially not converting the byte size until receiving the EOI.

In this case the trace data for 701 points for one screen is output at the same time. Therefore set the controller so it accepts this data for 701 points at the same time. When the data is output in binary code, EOI is recognized as the delimiter. Continue the data entry until the EOI signal is detected on the controller side.

The format in binary code is given below.

```
DDDD ----- DDDD+EOI
                      EOI is added as a delimiter.
                      Low-order byte for the 701st point
                      High-order byte for the 701st point
                      Low-order byte for the second point
                      High-order byte for the second point
                      Low-order byte for the first point
                      High-order byte for the first point
```

Figure 6-5 Trace Data Format (Binary Code)

Data of one point consists of nine bits in binary code. Accordingly, the data for one point is expressed as two bytes: high-order and low-order bytes. When data is output to GPIB, the high-order byte for the first point is output first. Then the low-order byte for the first point is output, and the high-order byte for the second point is output in this order. Finally, the low-order byte for the last (701st) point is output.

(2) Inputting the Trace Data

Use the IN command to input the trace data to the R4136. Send the parameter code of the trace data immediately after sending the IN command to input the appropriate trace data. Use the parameter code for the trace data used in the output operation. The format of inputting trace data is same with that of outputting.

(2-1) ASCII Code

| |
|---|
| Example 6-11: Enter the trace data in decimal ASCII code. |

For the HP200 series

```
10 ! DIM A(700)
20 !
30 ! "TRACE DATA STORE "
40 !
50 !
100 OUTPUT 701 ; "IN TDA "


110 FOR I=0 TO 700
120 OUTPUT 701 ;A(I)
130 NEXT I
140 END
```

10!
20!
30! Prepares 701 pieces of trace
40! data in array A in advance.
50!
100 Sets up the mode for entering the trace data in R4136 memory A in decimal ASCII code.
.....Decimal ASCII code, memory A
.....Enters the trace data.
110 Sends 701 points of data to the
≀ R4136 in ASCII code
130 (repeats executing of the loop 701 times.*)

* : See the note mentioned below.

CAUTION

The R4136 automatically enters into the trace data input mode when it receive "IN xxx" command and exits from the data input mode when it complete 701 times of data input. 701 times counter system operates in this mode. Setting of a wrong number of loop or any other input than trace data may cause an erroneous operation of the analyzer.

Example 6-12: Enter the trace data in hexadecimal ASCII code.

For the HP200 series

```
10 ! DIM A$(700) [4]
20 !
30 ! "TRACE DATA STORE "
40 !
50 !
100 OUTPUT 701 ; "IN THA "
110 FOR I=0 TO 700
120 OUTPUT 701 ; A$(I)
130 NEXT I
140 END
```

10!
20!
30! Prepares 701 pieces of trace
40! data in array A in advance.
50!
100 Sets up the mode for entering the trace data in R4136 memory A in hexadecimal ASCII code.
 ..... Hexadecimal ASCII code, memory A
 ..... Enters the trace data.
110 Sends 701 points of data to the
 ~ R4136 in ASCII code
130 from the first point data to the 701st data sequentially. (repeats executing of the loop 701 times.*)

* See the note mentioned above.

In this case, the data is expressed as four digits without a header, as illustrated below.

```
DDDD CRLF
 |    └──Block delimiter
 └───────Trace data (for one point, 0511, for example)
```

Figure 6-6 Trace Data Format (ASCII Code)

(2-2) Binary Code

| Example 6-13: Enter the trace data in binary code. |
|---|

For the HP200 series

```
10 ! DIM A(1401)
20 ! "TRACE DATA STORE "
30 !
40 !
50 !
100 OUTPUT 701 ; "IN TBA "
110 OUTPUT 701 USING "#,B";A(*),END
120 END
```

10! (1402 bytes of trace data
20! for the 701 points is
30! assumed to have been
40! prepared in array A(I).)
50! Specify the trace data input
100 mode to R4136 memory A in binary code.
110 Enters the data all at once in the byte size, then add EOI to the last byte of the trace data.

In the binary code mode, enter a screen (701 points) of the trace data at the same time. In this case, be sure to add EOI to the last byte of the trace data because the R4136 continues data entries until it detects an EOI signal.

The trace data is input in binary code in the same format (see Figure 6-7 below) as when it is output in binary code.

```
DDDD ----- DDDD+EOI
                  └── EOI is added as a delimiter.
                 └─── Low-order byte for the 701st point
                └──── High-order byte for the 701st point
   └───────────────── Low-order byte for the second point
  └────────────────── High-order byte for the second point
 └─────────────────── Low-order byte for the first point
└──────────────────── High-order byte for the first point
```

Figure 6-7 Trace Data Format (Binary Code)

(3) Data Transmission Time for the Trace Data

Some examples of the transmission measurement program for trace data and their results, using a HP 200 series as the controller, are given below. Note that these are merely examples. The internal software operates on the principles of interrupt processing, and therefore the data transmission time varies depending on the various setting conditions.

Example 6-14: Output the data for one trace screen and indicate the time necessary.

(a) Decimal output

```
100 DIM A(700)
110 OUTPUT 701 ; "DL3 "
120 OUTPUT 701 ; "OPTDA "
130 J=TIMEDATE
140 FOR I=0 TO 700
150 ENTER 701 ; A(I)
160 NEXT I
170 DISP TIMEDATE-J
180 END
```

100 Prepare integer valuable array A[] for 701 data.
110 Sets delimiter to CR LF
120 Specify the output mode of trace data in memory A in decimal ASCII codes.
130 Reads the present time data and store it in integer valuable J.
140 Read the trace data from the
≀ first point to 701st point
160 sequentially(701 times loop).
170 Calculates the transmission time from the difference between the present time and time J and displays it on the CRT.

(b) Hexadecimal output

```
100 DIM A$(700) [4]
110 OUTPUT 701 ; "DL3 "
120 OUTPUT 701 ; "OP THA "
130 J=TIMEDATE
140 FOR I=0 TO 700
150 ENTER 701 ;A$(I)
160 NEXT I
170 DISP TIMEDATE-J
180 END
```

100 Prepare integer valuable array A[] for 701 data.
110 Sets delimiter to CR LF
120 Specify the output mode of trace data in memory A in hexadecimal ASCII codes.
130 Reads the present time data and store it in integer valuable J.
140 ~ 160 Read the trace data from the first point to 701st point sequentially(701 times loop).
170 Display the transmission time on the CRT.

(c) Binary output

```
100 DIM A(700)
110 OUTPUT 701 ; "DL2 "
120 J=TIMEDATE
130 OUTPUT 701 ; "OP TBA "
140 ENTER 701 USING "%,W";A(*)
150 DISP TIMEDATE-J
160 END
```

100 Prepare integer valuable array A[] for 701 data.
110 Sets delimiter to EOI.
120 Reads the present time data and store it in integer valuable J.
130 Specify the output mode of trace data in memory A in binary codes.
140 Read the upper order byte of the first point through 701st point sequentially (701 times loop).
150 Display the transmission time on the CRT.

Table 6-11 Transmission Time for Trace Data (example)

Units: second

| TRACE DATA | FREE RUN | SINGLE |
|---|---|---|
| Decimal output | 3.81 | 3.80 |
| Hexadecimal output | 2.36 | 2.36 |
| Binary output | 0.86 | 0.85 |

### 6.2.4 Service Request

Use the GPIB service request function to remotely detect various R4136 status as shown in Table 6-13. R4136 issues a service request to the controller on completion of a command being executed at the controller, or on reception of an unexecutable commands. The controller which received the service request sends the status byte to the R4136. The status byte can be read by performing serial polling.

The service request ON/OFF operation is executed by command S0 or S1. The status byte is cleared when it is read out, and can be cleared by command S2.

Table 6-12 SRQ ON/OFF Specification Code

| Code | Service request |
|---|---|
| S0 | Sends a service request. |
| S1 | Does not send a service request (Initial state). |
| S2 | Clears the status byte. |

Table 6-13 Status Byte

| Bit | Descriptions |
|---|---|
| 0 | Not used. |
| 1 | Set to "1" on completion of center frequency setting using the CF command. |
| 2 | Set to "1" on completion of sweeping. |
| 3 | Set to "1" on completion of averaging set counts. |
| 4 | Set to "1" on completion of marker peak search setting. |
| 5 | Set to "1" when SYNTAX ERROR (Receiving of undefined GPIB codes) occur. |
| 6 | Set to "1" when one of bits 0-5 and 7 is set to 1 when a service request (SRQ) is sent. |
| 7 | Not used. |

Example 6-15: Read the peak search completion with the status byte. (SRQ interruption is not used.)

For the HP200 series

```
100 OUTPUT 701 ; "S2"
110 OUTPUT 701 ; "PS"
120 S=SPOLL(701)
130 IF BIT (S,4)<>1 THEN 120
140 END
```

100 Clears the status byte.
110 Executes peak search.*
120 Reads the status byte and stores it in variable S.
130 Awaits until bit #4 is set to 1.
140 Ends the program.

*: See the note on the next page.

**CAUTION**

Setting of measuring conditions related with the service request such as the center frequency, peak search is recommendable to program in a single statement. Because output of the status byte will be delayed when these commands are accompanied with in the statement.

## 6.2.5 Input a Label

### (1) Input a Label

The label entry command "LA" or "LB1" is used to enter the label character in the screen of the spectrum analyzer from the remote controller. The entry format is as follows:

LA (or LB1) | (X, Y) | / . . . /

LA (or LB1): Label entry command

/ . . . /: Label characters
A character string enclosed by slashes (/) is to be displayed. Up to 64 characters can be entered at a time.

(X, Y): Cursor position for the start of the entry
X: Vertical axis of the screen (line number)
Y: Horizontal axis of the screen (column number)
Specify these positions in decimal numbers ranging from (0,0) to (25,63). The values outside this range cause an error.

Figure 6-8 Label Input Format

Note that the above setting must be made in a single line statement. The statement exceeding one line causes an error. And note the area where the labels are replaced by the function, data annotations or the area where label entry is ignored (See Figure 4-1 (p 4-4)).

(2) Delete a Label

To delete the input label characters, use label clear command "CE" or "LB2". The delete format is as follows:

| CE (or LB2) | $(X_s, Y_s - X_e, Y_e)$ |
|---|---|
| Label clear command | Start (Xs, Ys) and end (Xe, Ye) points of the character string to be deleted<br>Also specify these points in decimal numbers ranging from (0,0) to (25,63). The values outside the above range cause an error. |

Figure 6-9 Label Delete Format

Note that the above statement must also be made in a single line. The setting exceeding one line causes an error.

Example 6-16: Enter "R4136 LABEL!!" at the home position in the upperleft corner of the screen. Then the label is deleted three seconds later.

For the HP200 series

```
100 OUTPUT 701 ; "LA (0,0) / R4136  LABEL!!/"
110 WAIT 3
120 OUTPUT 701 ; "CE (0,0-0,13) "
130 END
```

100 Enter the label characters from the position of (0,0).
110 Wait for three seconds.
120 Delete the input label characters.

### 6.2.6 Precautions for Programming

The GPIB programs in the R4136 system are basically coded according to the front panel key operation procedure. As with the restrictions on the R4136 operating status, you should be careful with the following points:

(1) Counter Programming

When programming the R4136 frequency counter function, allow a waiting time according to the counter resolution. The standard waiting time can be obtained from the following formula:

Waiting time $\geq$ (Counter gate time*) + (Sweep time**) x 2

* : Counter gate time (reference value)

**: This second paragraph can be omitted when the sweep time is too small compared to the counter gate time.

Table 6-14
Relationship Between Counter Resolution and Gate Time

| Counter resolution | Gate time |
|---|---|
| 1 MHz | 2 μsec |
| 100 kHz | 20 μsec |
| 10 kHz | 200 μsec |
| 1 kHz | 2 msec |
| 100 Hz | 20 msec |
| 10 Hz | 200 msec |
| 1 Hz | 2 sec |

Example 6-17: Read the counter data.

For the HP200 series

```
100 DIM AS [20]
110 DIM BS [20]
120 OUTPUT 701 ; "PS"
130 OUTPUT 701 ; "MU5 "
140 WAIT  2
150 OUTPUT 701 ; "OP MF "
160 ENTER 701 ; AS
170 OUTPUT 701 ; "OP ML "
180 ENTER 701 ; BS
190 PRINT AS
200 PRINT BS
210 END
```

100 Prepares 26 bytes of character string variable F$ for the marker frequency data.
110 Prepares 14 bytes of character string variable L$ for the marker level data.
120 Displays the marker on the signal peak.
130 Sets the counter with a resolution of 1 Hz.
140 Waits for two seconds for the counter gate time.
150 Instructs the R4136 to output the counter frequency.
160 Receives the counter frequency data from the R4136.
170 Instructs the R4136 to output the marker level data.
180 Receives the marker level data from the R4136.
190 Displays the counter frequency.
200 Displays the marker level.
210 Ends the program.

(2) When Changing the Center Frequency with dBμ/m Units Indication

When the center frequency is changed in the MAX HOLD or two-screen mode, the calibration value of the frequency is calculated and displayed if the reference level (REF LEVEL) units are dBμ/m. Therefore, rewriting of the frequency value or level display during this period may be delayed. Consequently when changing the central frequency in units of dBμ/m, set approx. one second of waiting time.

(3) Summary of the Specific GPIB Codes Operations

① The following codes are not posted to the R4136 spectrum analyzer.

Table 6-15 The Specific GPIB Codes (1/3)

| Codes | Functions |
|---|---|
| DL0, DL1, DL2, DL3 | Specify the delimiter in the talker mode. |
| HD0, HD1 | Operate the header ON/OFF in the talker mode. |
| S0, S1, S2 | Control the service requests. |
| OM | Controls the mode strings. |
| OP | Specifies the type of data to be output. |
| IN | Enters the trace data. |

② The following commands ignore the subsequent codes. Therefore, use them separately, or specify them at the end of the statement.

Table 6-15 The Specific GPIB Codes (2/3)

| Codes | Functions |
|---|---|
| IP | Initialize R4136.<br>Example: "IP $\underline{\text{CF200MZ}}$"<br>This is ignored. |
| OP | Specifies the type of data to be output. |
| IN | Enters the trace data. |
| LA, LB1, LB2, CE | Control the label. |

③ The following codes require the specified parameter or data appended immediately after them.

Table 6-15 The Specific GP-IB Codes (3/3)

| Codes | Functions |
|---|---|
| OP... | Parameter which specifies the type of data to be output |
| IN... | Parameter which specifies the type of trace data |
| LA...<br>LB1...<br>LB2...<br>CE... | Data which specifies the label character to be entered and its position. |

### 6.2.7 Precaution on Initialization

(1) Factor of Initialization and its Details.

Table 6-16 shows the deferences of initialization by the factors among GPIB command "IP", the panel key INSTR PRESET and the other factors of initialization.

"Initialization of GPIB" means the following setting.

| | | | |
|---|---|---|---|
| Delimiter | : | "CR" "LF" | (DL3) |
| Header | : | ON, "HD1" | (HD1) |
| Service Request | : | Do not send. | (S1) |
| I/O data specification | : | Unspecified state. | |

Table 6-16 Causes of Initialization and Initial Settings

| Factor \ Contents | Initialization of R4136 | Initialization of GPIB |
|---|---|---|
| INSTR PRESET key | o | |
| IP command of GPIB code | o | |
| Changing of GPIB address | | o |
| Completion of plotter output | | o |
| Power on | o | o |

(2) Precaution for Using "IP" Command

When use the "IP" command, allow two seconds of waiting time.

| Example 6-18: Initialize the R4136. |
|---|

HP200 series

```
100 OUTPUT 701 ; "IP "
110 WAIT  2
 .
 .
```

100 Initializes R4136.
110 Waits two seconds.

(3) Precaution for Changing the GP-IB Address

Also allow one second of waiting time when send the command of changing the GPIB address.

| Example 6-19: Change the GPIB address of R4136 to 02. |
|---|

HP200 series

```
100 OUTPUT 701 ; "FN SF1 02 HZ "
110 WAIT  1
 .
 .
```

100 Change the address of R4136 (from 01) to 02.
110 Waits one second .

(4) Caution When Trigger Mode is Set to Single

There is a wait interval after setting to Single until the sweep is started.

| Example 6-20: Set the trigger mode to Single and start the sweep. |
|---|

HP200 series

```
100 OUTPUT 701;  "ST6"
110 WAIT 0.5
120 OUTPUT 701;  "SR"
 .
 .
```

100 Sets trigger mode to Single
110 The wait time is 0.5 sec.
120 Starts the sweep.

## 6.3 PROGRAMMING EXAMPLE

Example 6-21: Measure the peak level of the signal around 1 GHz.

For the HP200 series

```
100 OUTPUT 701;  "S0 "
110 ON INTR 7 GOTO 140
120 ENABLE INTR 7;2
130 GOTO 120
140 S=SPOLL(701)
150 OUTPUT 701;  "CF1GZSP50KZRL-10DB "
160 GOSUB 210
170 OUTPUT 701;  "PS OPML "
180 ENTER 701;A
190 DISP A
200 STOP
210 OUTPUT 701;  "S2 "
220 ON INTR 7 GOTO 250
230 ENABLE INTR 7;2
240 GOTO 230
250 S=SPOLL(701)
260 IF S=68 THEN 280
270 GOTO 210
280 RETURN
290 END
```

100 Sets the SRQ (service request) issuing mode for the R4136.
110 Branches to line 140 when an SRQ interrupt signal is generated.
120 Sets the mode with which the controller accepts an SRQ interrupt signal.
130 Repeats looping until an SRQ interrupt signal is issued to the controller.
140 Activates the serial polling operation in the R4136 when an SRQ interrupt signal is issued to the controller. (Lines 110 through 150 are for a single dummy processing of s service request immediately after the SRQ issuing mode is set in the R4136).
150 Sets the R4136 center frequency to 1 GHz, the frequency span to 50 kHz, and the reference level to -10 dBm.
160 Calls the subroutine from line 210.
170 Executes peak searching and outputs the marker level data.
180 Specifies the R4136 as the talker and substitutes the output level data for variable A.
190 Displays the level data.
200 Stops the program temporarily.
210 Resets the status byte of the R4136.

220 Branches to line 250 when an SRQ interrupt is generated.
230 Sets the mode with which the controller accepts an SRQ interrupt signal.
240 Repeats looping until an SRQ interrupt signal is issued to the controller.
250 Activates the serial polling operation, and substitutes the resultant data in available S.
260 Branches to line 280 when the R4136 status data shows a trace end.
270 Repeats looping until an SRQ interrupt signal is issued to the controller unless the R4136 status data shows a trace end.
280 Ends the subroutine.
290 Ends the program.

## 6.4 GPIB STANDARDS AND R4136 GPIB SPECIFICATIONS

(1) Bus Line

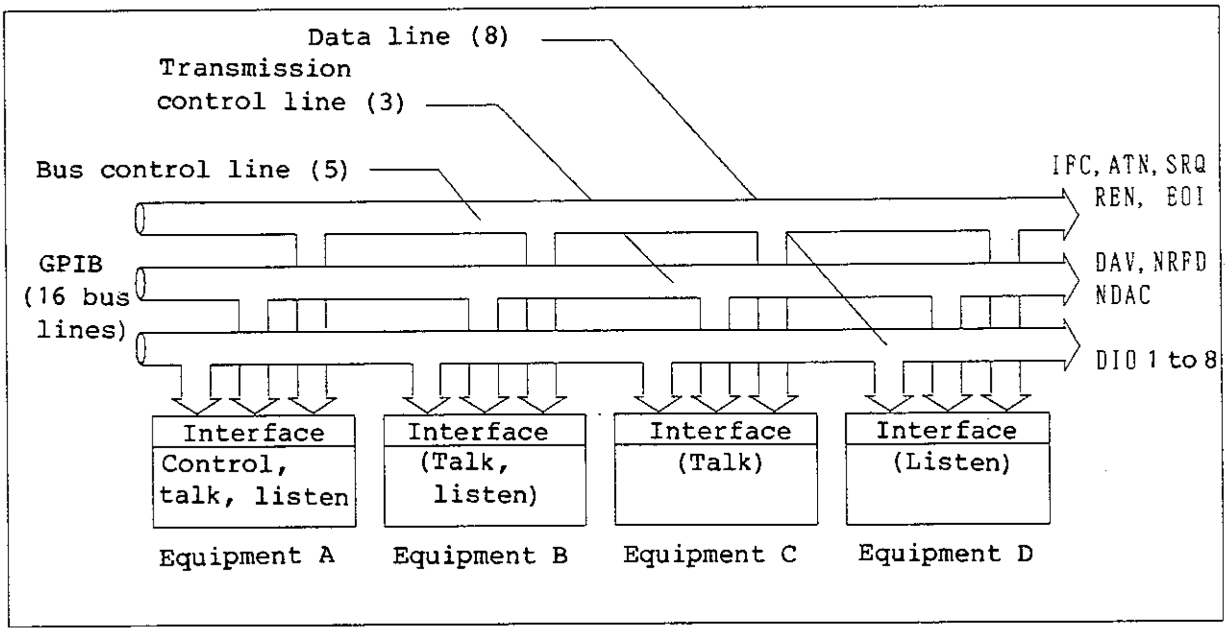



Figure 6-10 GPIB Bus Line Configurations

The GPIB bus cables include not only eight data lines but also three transmission lines (handshake lines) for controlling inter-unit asynchronous data transfer, and five bus control lines (control lines) for controlling the information flow on the bus.

- Data line:
  Eight parallel-bit serial-byte data lines are used for transferring inter-unit data in a bidirectional synchronous data transfer operation. As in an asynchronous system, the bus can interface between high-speed and low-speed units freely.
  The inter-unit data (message) to be transferred includes measurement data, measurement conditions (programs), and various commands, each in ASCII code.

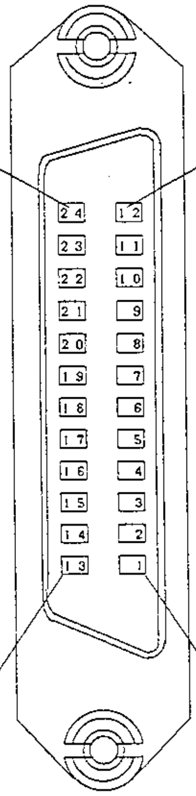
- Transmission control line (handshake line) transfers the following signals:
  DAV (Data Valid) : Indicates the data valid status.
  NRFD (Not Ready For Data) : Indicates the data receivable status.
  NDAC (Not Data Accepted) : Indicates the completion of data reception.

- Bus control line (control line) transfers the following signals:

| | |
|---|---|
| ATN (Attention) | : Discriminates whether information on the bus is address/command or other information |
| IFC (Interface Clear) | : Clears the interface mode. |
| EOI (End or Identify) | : Identifies the end of information transfer. |
| SRQ (Service Request) | : Requests a service from the controller at any unit. |
| REN (Remote Enable) | : Remote-controls a unit which can be remotely-controlled. |

(2) Connector: 24-pin GPIB connector, type 57-20240-D35A (AMPHENOL brand or equivalent connector)

| Signal name | Pin No. |
|---|---|
| GND LOGIC | 24 |
| GND (ATN) | 23 |
| GND (SRQ) | 22 |
| GND (IFC) | 21 |
| GND (NDAC) | 20 |
| GND (NRFD) | 19 |
| GND (DAV) | 18 |
| REN | 17 |
| DIO 8 | 16 |
| DIO 7 | 15 |
| DIO 6 | 14 |
| DIO 5 | 13 |




| Pin No. | Signal name |
|---|---|
| 12 | SHIELD |
| 11 | ATN |
| 10 | SRQ |
| 9 | IFC |
| 8 | NDAC |
| 7 | NRFD |
| 6 | DAV |
| 5 | EOI |
| 4 | DIO 4 |
| 3 | DIO 3 |
| 2 | DIO 2 |
| 1 | DIO 1 |

Figure 6-11 GPIB Connector Pin Assignment

(3) Specifications

Code used : ASCII code (Note that binary code is used for the packed format.)

Logical level : Logical 0: "high" level, +2.4 V min.
Logical 1: "low" level, +0.4 V max.

End of signal line: 16 bus lines are terminated as in Figure 6-2.

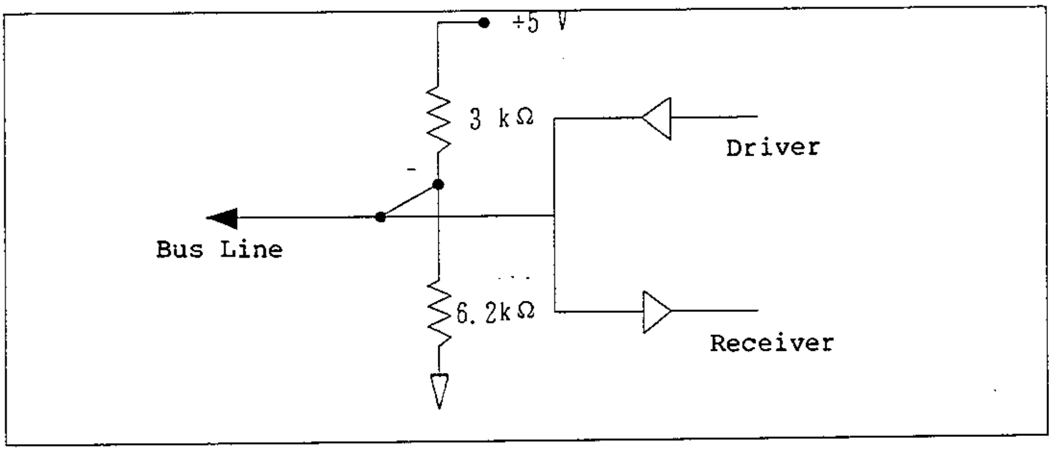



Figure 6-12 Signal Line Termination

Driver specification: Open collector system
"Low" level output voltage : +0.4 V max; 48 mA
"High" level output voltage: +2.4 V min; -6.2 mA

Receiver specifications:
"Low" level : +0.6 V max.
"High" level: +2.0 V min.

Length of bus cable:
Each cable should be 4 m or less, and the total length of all bus cables should not exceed 20 m (number of units to be connected to the bus x 2).

Address specification:
31 types of talker/listener addresses can be specified with key operations on the front panel.

(4) Interface Function: See Table 6-17

Table 6-17 GPIB Interface Functions of R4136

| Code | Functions and descriptions |
|---|---|
| SH1 | Source handshake |
| AH1 | Acceptor handshake |
| T6 | Basic talker, serial polling, unaddressed to talk if addressed to listen |
| L4 | Basic listener, unaddressed to listen if addressed to talk |
| SR1 | Service request function |
| RL1 | Remote function |
| PP0 | No parallel function available. |
| DC1 | Device clear function available. |
| DT1 | Device trigger function available. |
| C0 | No controller function available. Note that this function is validated when using the plotter. |
| E1 | Uses the open collector bus driver. Note that EOI and DAV use E2 (three-state bus driver). |

MEMO

# 7. OPTION 06 : MEMORY-CARD

The MEMORY-CARD can store the following types of data, which can, in turn, be read for various applications.

① Waveform data stored in trace A or B memory

② Waveform data stored in trace A or B memory and character data displayed on the CRT

③ Panel setting conditions

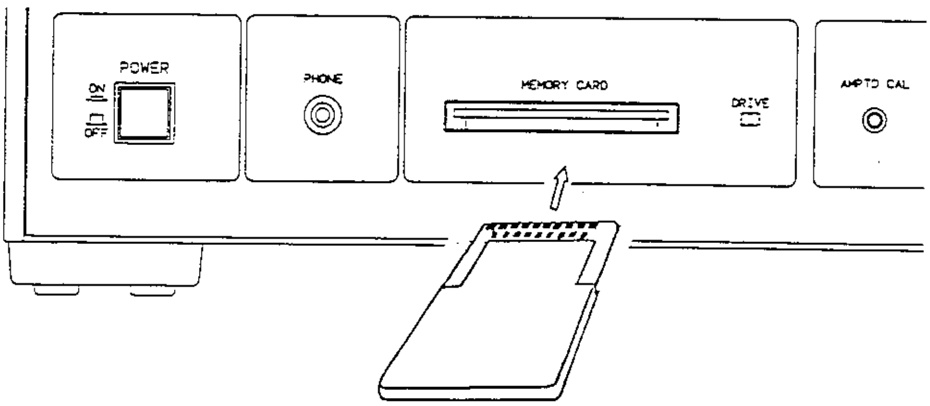
④ BASIC program created with the R4136 spectrum analyzer

⑤ Antenna correction data table

# 7.1 HANDLING THE MEMORY-CARD

## 7.1.1 Precautions in MEMORY-CARD Usage

(1) The MEMORY-CARD must always be inserted with the contact side facing the display screen.




MEMORY-CARD

Figure 7-1 Inserting MEMORY-CARD

(2) The LED lamp (DRIVE) below the MEMORY-CARD slot comes on while the MEMORY-CARD is being accessed. Always make sure this lamp is off before removing (or inserting) the MEMORY-CARD. Removing the MEMORY-CARD while the lamp is on can result in data writing or reading error.

If an incorrect action is taken by accident, switch the analyzer power off, and then on again. And if a mistake is made while writing data to the MEMORY-CARD, again switch the power off and on, and then re-initialize the MEMORY-CARD.

Take extra care not to apply undue force to the MEMORY-CARD when inserting or removing.

(3) If newly using the MEMORY-CARD, initialize it. Note that any data stored in the MEMORY-CARD will be cleared when it is initialized. (For how to initialize the MEMORY-CARD, see "7.1.3 (1)")

(4) MEMORY-CARD specifications

| | |
|---|---|
| Accessories : | 32 kbyte SRAM memory card<br>Power supply life 5 years approx. (when used in 0°C to 40°C range)<br>Connector removal/insertion count 50,000 times |
| Battery replacement: | Remove the two screws securing the battery holder cover, and replace the batteries. Use coin-shaped lithium batteries BR2016(3V) or equivalent. |

### 7.1.2 Configuration and Description of Softkey Menus

(1) Configuration of Softkey Menus

The softkey menus for the f key are configured as shown in A1.3.4 (4) - (d).

(2) Description of Softkey Menus

This section describes the softkey menus for the MEMORY-CARD.

①

| | |
|---|---|
| GPIB ADDRESS | |
| PLOTTER | |
| MEMORY CARD | Commences settings for access to the MEMORY-CARD. Displays the softkey menu ②. |
| MORE 1/2 | |

②

| | |
|---|---|
| INITIA LIZE | Displays the softkey menu ③ for initializing the MEMORY-CARD. |
| LOAD | Displays the softkey menu ④. |
| STORE | Displays the softkey menu ④. |
| DELETE | Displays the softkey menu ④. Deletes files registered in the MEMORY-CARD. |
| DIR LIST | Displays data on files registered in the MEMORY-CARD. |
| RETURN | Returns you to the softkey menu ①. |

③

| | |
|---|---|
| RUN | Initializes the MEMORY-CARD. (Any new MEMORY-CARD must be initialized. Note that any data stored in the MEMORY-CARD will be cleared when it is initialized.) |
| RETURN | Returns you to the softkey menu ②. |

④

| | |
|---|---|
| FILE TYPE | Displays the softkey menu ⑤ indispensable for accessing the MEMORY-CARD. |
| RUN | Executes the LOAD, STORE, or DELETE function, if necessary, to read, write, or erase data from, to, or from the MEMORY-CARD, respectively. |
| RETURN | Returns you to the softkey menu ②. |

⑤

| | |
|---|---|
| TRC A & CHAR | Stores in the MEMORY-CARD waveform data stored in trace A memory and character data currently displayed on the CRT. Also reads waveform data stored in the MEMORY-CARD into trace A memory and displays character data stored in the MEMORY-CARD on the CRT. |
| TRC B & CHAR | Stores in the MEMORY-CARD waveform data stored in trace B memory and character data currently displayed on the CRT. Also reads waveform data stored in the MEMORY-CARD into trace B memory and displays character data stored in the MEMORY-CARD on the CRT. |
| PROGRM | Stores in the MEMORY-CARD a program created during programming mode (set by pressing the PROGRAM key). Also reads a program stored in the MEMORY-CARD. |
| SET UP | Stores the current panel settings in the MEMORY-CARD. Also reads the current panel settings stored in the MEMORY-CARD to establish the settings. |
| TABLE | Stores in the MEMORY-CARD an antenna correction table created during programming mode (set by pressing the PROGRAM key). Also reads an antenna correction table stored in the MEMORY-CARD. |
| MORE 1/2 | Displays the softkey menu ⑥. |
| RETURN | Returns you to the softkey menu ④. |

⑥

| | |
|---|---|
| TRC A | |
| TRC B | |
| MORE 2/2 | Returns you to the softkey menu ⑤. |
| RETURN | Returns you to the softkey menu ④. |

⑦

| | |
|---|---|
| HOME PAGE | Specifies edition of the first page of the directory dump list stored in the MEMORY-CARD. |
| PREV PAGE | Specifies edition of the previous page of the currently displayed directory dump list stored in the MEMORY-CARD. |
| NEXT PAGE | Specifies edition of the next page of the currently displayed directory dump list stored in the MEMORY-CARD. |
| RETURN | Returns you to the softkey menu ②. |

### 7.1.3 Operating Procedures

(1) VOLUME INITIALIZE:

① Correctly insert the MEMORY-CARD.

② Press [f] [MEMORY CARD] [INITIA LIZE] [RUN] .

By the above operations, DRIVE LED of MEMORY-CARD lights. For normal termination, "00 NORMAL END" is displayed on the display, and DRIVE LED of MEMORY-CARD goes off.

(2) DATA STORE:

| Example: Write trace A data in file no. "01" in MEMORY-CARD. |
|---|

① Correctly insert the MEMORY-CARD.

② Store waveform data in trace A memory.

③ Press [f] [MEMORY CARD] [STORE] .

④ Press [0] [1] , and [GHz dB] or [MHz sec] or [kHz msec] .

⑤ Press [FILE TYPE] [MORE 1/2] [TRC A] [RETURN] [RUN] .

The MEMORY-CARD DRIVE LED comes on. If the operation is completed normally, "00 NORMAL END/" appears on the screen, and the DRIVE LED goes off again.

This procedure results in trace A data being stored in file no. "01" in the MEMORY-CARD.

Enter file numbers as decimal numbers from "01" to "32" (when 1 volume has 32 kbytes).

The maximum number of files which can be stored is,
19 when only storing trace data, but
14 when storing trace data and screen characters.

**CAUTION**

> If the maximum number of files is stored, rewriting to the same file number is no longer possible. Therefore, leave some blank space equivalent to one or two files.

(3) DATA LOAD:

> Example: Read trace data from file no. "01" in MEMORY-CARD to trace B memory.

① Correctly insert the MEMORY-CARD.

② Press [f] [MEMORY CARD] [LOAD] .

③ Press [0] [1] , and [GHz dB] or [MHz sec] or [kHz msec] .

④ Press [FILE TYPE] [MORE 1/2] [TRC B] [RETURN] [RUN] .

The MEMORY-CARD DRIVE LED comes on. If the operation is completed normally, "00 NORMAL END/" appears on the screen, and the DRIVE LED goes off again.

The above operations reads the trace data from the file No.1 into trace memory B. To display the trace data thus read on the CRT, perform the operation ⑤.

Enter file numbers as decimal numbers from "01" to "32" (when 1 volume has 32 kbytes).

⑤ Set trace view B mode.

And when already loaded in trace view B mode, the waveform data displayed on the screen can be updated by switching write mode on and off again.

(4) DATA UPDATE:

| | |
|---|---|
| Example: | Update trace data stored in file no. "01" in MEMORY-CARD to trace B memory.<br>* The MEMORY-CARD file number "01" already contains the trace data. |

① Correctly insert the MEMORY-CARD.

② Store waveform data in trace B memory.

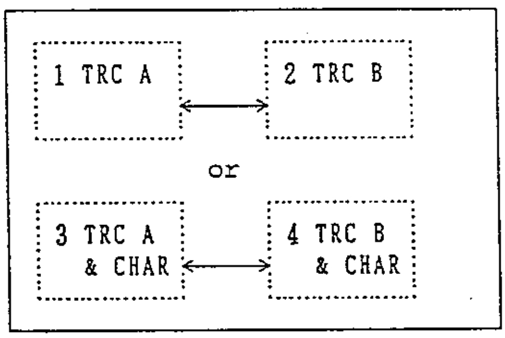
③ Press [f] [MEMORY CARD] [STORE] .

④ Press [0] [1] , and [GHz dB] or [MHz sec] or [kHz msec] .

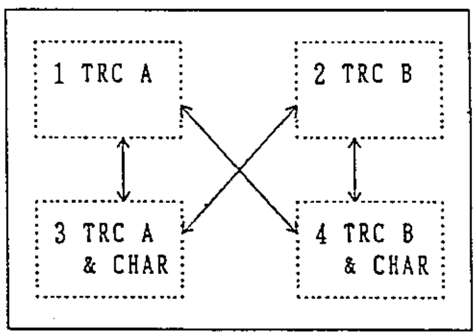
⑤ Press [FILE TYPE] [MORE 1/2] [TRC B] [RETURN] [RUN] .

The MEMORY-CARD DRIVE LED comes on. If the operation is completed normally, "00 NORMAL END/" appears on the screen, and the DRIVE LED goes off again.

To read this updated data, use procedure (3) DATA LOAD. The following files types can be updated.




Updating permitted between indicated files




Updating not permitted between indicated files

(5) DIRECTORY DUMP LIST

| |
|---|
| Example: Collate file data stored in MEMORY-CARD file no. "30". |

① Correctly insert the MEMORY-CARD.

② Press [f] [MEMORY CARD] [DIR LIST] .

An error message or the page 1 directory dump list (file no. 1 to 20) is displayed on the screen.

③ Press [NEXT PAGE] .

The page 2 directory dump list (file no. 21 and above) is displayed on the screen.

(5-1) MEMORY-CARD Directory Dump List Screen Format

```
DERECTORY OF [    1    ]     Card=[ 2  ]  Page:[ 3 ]
[   4   ]    1area  size=[ 5 ]   [     6     ]
NO  FILE-NAME      TYPE     PROT  BLOCKs   LENGTH
[7] [    8     ]   [ 9 ]    [10]  [ 11 ]   [ 12 ]
```

Figure 7-2 MEMORY-CARD Directory Dump List Screen Format

Legend

1: Volume name (10 characters)
2: Volume size xxxk (032k when 32 kbytes)
3: Page xx/xx (0x/02 when 32 kbytes)
4: Number of registered files and total number of files
   xxx/xxx (0xx/32 when 32 kbytes)
5: 1 area size xxx (normally 064)
6: Number of areas being used, and total number of areas
   xxxxx/xxxxx
7: File no. xxx
8: File name xxxxxxxxxx 10 characters
9: File type PROG : Program
   TRAC : Trace
   T&C : Trace & characters
   TABLE: Antenna correction table
   SET : Set up
10: Protection code xxx S: Secret
    Not in use as of R: Read
    16 Aug. 1987 W: Write
11: Number of blocks xxxxx (normally 00001)
12: Block length xxxxx (number of bytes)

(5-2) Example Display of MEMORY-CARD Directory Dump

```
DIRECTORY OF                     Card=032K Page:1/2
003/032     1area  size=064    00056/00428
NO  FILE-NAME      TYPE    PROT BLOCKs LENGTH
001
002  FILD002       T&C          00001  01914
003
004
005
006
007
008  FILD008       TRAC         00001  01402
009
010  FILP010       PROG         00001  00234
011
012
013
014
015  FILS015       SET          00001  00400
016
017
018  FILT018       TABLE        00001  01660
019
020
```

Figure 7-3 Example Display of MEMORY-CARD Directory Dump

File no. "2" is registered by trace and character data.
File no. "8" is registered by trace data.
File no. "10" is registered by program.
File no. "15" is registered by set up (panel setting).
File no. "18" is registered by the antenna correction table.

Note that file names are registered as FILD + file no. when trace data, FILP + file no. for programs, set up for FILS + file no. and FILT + file no. for antenna correction.

(6) SET UP

Executes SAVE/RECALL function of panel setting conditions using MEMORY-CARD.

SAVE : Stores a panel setting condition (data) to MEMORY-CARD.
RECALL: Loads and restores the setting condition saved by the SAVE function, as needed.

| Example: To store current panel settings to the file No. "25" in MEMORY-CARD. |
|---|

① Correctly insert the MEMORY-CARD.

② Press [f] [MEMORY CARD] [STORE] .

③ Press [2] [5] , and {[GHz dB] or [MHz sec] or [kHz msec]} .

④ Press [FILE TYPE] [SETUP] [RETURN] [RUN] .

The above operation causes the MEMORY-CARD DRIVE LED to turn on. When the function is completed correctly. "00 NORMAL END" appears on the screen, and the DRIVE LED goes off.

| Example: To restore panel settings (data) written in the file No. "25" in MEMORY-CARD. |
|---|

① Correctly insert the MEMORY-CARD.

② Press [f] [MEMORY CARD] [LOAD] .

③ Press [2] [5] , and {[GHz dB] or [MHz sec] or [kHz msec]} .

④ Press [FILE TYPE] [SETUP] [RETURN] [RUN] .

The above operation causes the MEMORY-CARD DRIVE LED to turn on. When the function is completed correctly, "RECALL * END" appears on the screen, and the DRIVE LED goes off.

(7) TABLE

This function can perform loading and store the correction data table created in the programming modes (PROGRAM [ ] CORR. TABLE ).

| Example: | When the created correction data table is registered in the file No. "10" of MEMORY-CARD (STORED). |
|---|---|

① Press [f] MEMORY CARD STORE .

② Press [1] [0] , and [GHz/dB or MHz/sec or kHz/msec].

③ Press FILE TYPE TABLE RETURN RUN .

The DRIVE LED on MEMORY-CARD lights.
For normal termination, "00 NORMAL END" is displayed and the DRIVE LED of MEMORY-CARD goes off.

| Example: | When the correction data table is written in the file No. "10" of MEMORY-CARD is recovered (LOAD). |
|---|---|

① Press [f] MEMORY CARD LOAD .

② Press [1] [0] , and [GHz/dB or MHz/sec or kHz/msec].

③ Press FILE TYPE TABLE RETURN RUN .

The DRIVE LED on MEMORY-CARD lights.
For normal termination, "00 NORMAL END" is displayed, and the DRIVE LED of MEMORY-CARD goes off.

The existing correction data table is replaced with the recovered table form MEMORY-CARD, and can be checked by PROGRAM to CORR. TABLE.

* For details of the correction, refer to [Chapter 7.5 ANTENNA CORRECTION].

### 7.1.4 List of Error Messages

Table 7-1 Error Messages

| Error code (hexadecimal) | Description |
|---|---|
| 01 | Not used |
| 02 | PARAMETER ERROR<br>File no. or other parameter setting error |
| 03 | VOLUME TYPE ERROR<br>MASKED ROM or ONE-TIME ROM type MEMORY-CARD used |
| 04 | POWER ERROR<br>MEMORY-CARD read, write, and check errors |
| 05 | NOT INITIALIZE<br>MEMORY-CARD not initialized |
| 06 | PROTECT ERROR<br>MEMORY-CARD is write-protected |
| 07 | SAME FILE ERROR<br>Fil already exists |
| 08 | Not used |
| 09 | NOT FREE FILE<br>The number of files which can be registered has been exceeded |
| 0A | NOT FREE USE AREA<br>The remaining blank user area has been exceeded |
| 0B | FILE NOT FOUND<br>The specified file has not been registered |
| 0C | Not used |
| 0D | FILE TYPE ERROR<br>The specified file type is incorrect. |

## 7.2 AUTOMATIC MEASURING PROGRAMMING MODE

Switching the R4136 Spectrum Analyzer to local control enables support of small-scale automatic measuring.

### 7.2.1 Description of Operation

(1) Program Generation

The following support is provided when generating programs in R4136.

- Input of BASIC statements by softkey operation
- Input of basic commands (CENTER, SPAN, START, STOP, REF-LEVEL) and numeric data by panel key operation.
- Input of characters using an encoder.

Programs are corrected by moving the cursor, and deleting and inserting data by the following keys.

INSR C　DELE C　INSR L　DELE L　⇒　⇐　ENTER　⇩　⇧

---

**CAUTION**

Once the program key (PROGRAM) is pressed, the key LED comes on and program generation/execution mode is started.

execution mode. If the program key (PROGRAM) is then pressed a second time, the LED lamp goes off, and the program generation/execution mode is exited.

---

(2) Editor Mode

The R4136 Spectrum Analyzer must be put into editor mode to enter BASIC programs.

Switch the R4136 power on and press the PROGRAM key. The

following softkey menu appears on the screen.

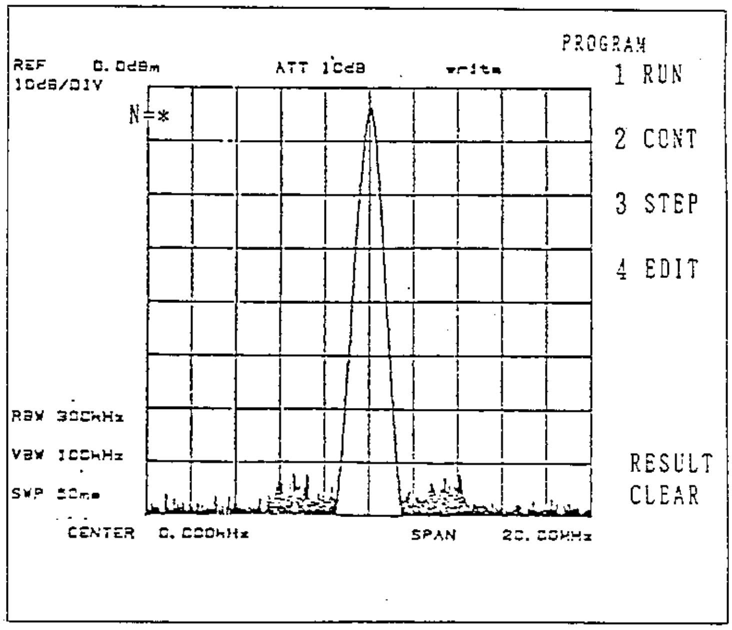



Figure 7-4 CRT Screen in Editor Mode (1/2)

Then press the softkey corresponding to the EDIT menu.

The screen display is changed in the following way.

```
***** R4136 EDITOR MODE Ver:1.0 ***** EDITOR

                                    1 RUN

                                    2 CONT

                                    3 STEP

                                    4 LIST

                                    5 NEW

                                    6 BASIC

                                    7 RETURN
```

Figure 7-4 CRT Screen in Editor Mode (2/2)

The analyzer is now in mode ready for program input. To reset the editing mode, press RETURN on the screen, or press the Program key PROGRAM again.

(3) Key Inputs:

Program input is executed front panel key, softkey, and encoder & editor key operations.

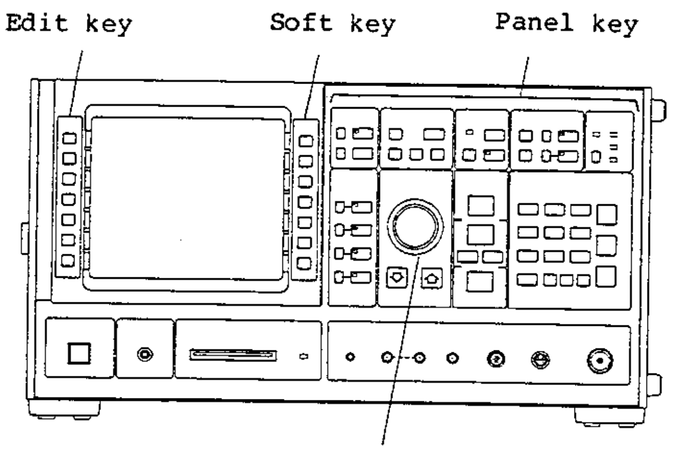



Figure 7-5 Program Input Keys

The following keys are allocated as GPIB codes. When pressed in edit mode, the code names are displayed.

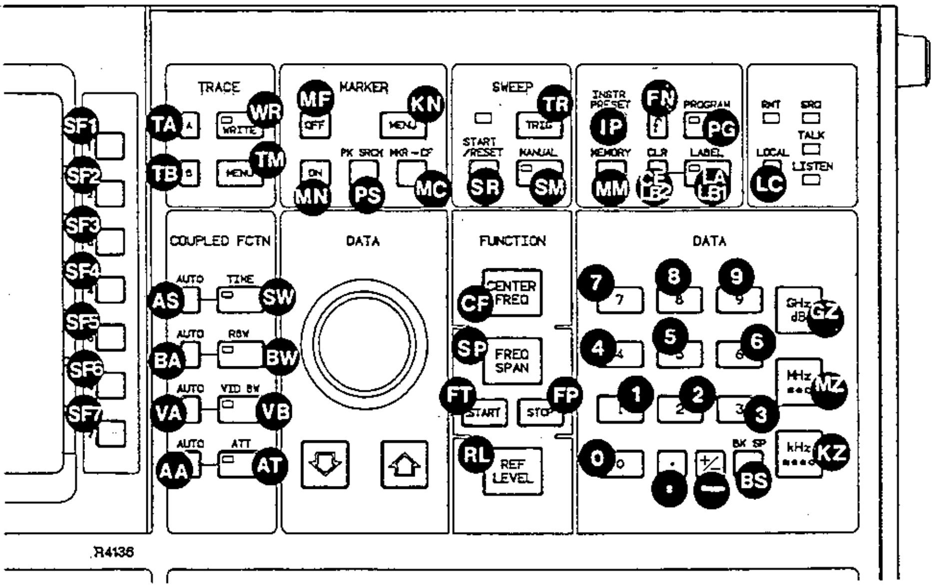
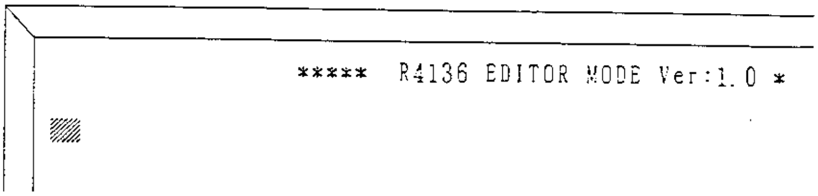



Figure 7-6 Allocation of GPIB Codes (Front Panel)

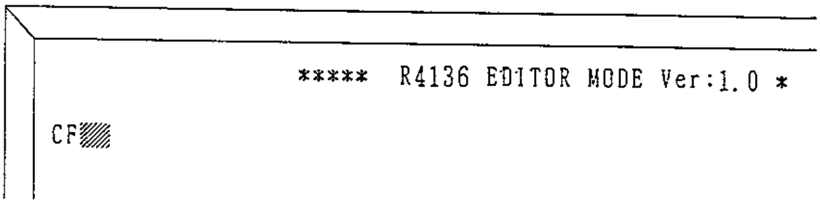
**CAUTION**

For INSTR PRESET ☐ in the panel keys, the code as edit is not allocated, if the key is pressed, preset will occur.

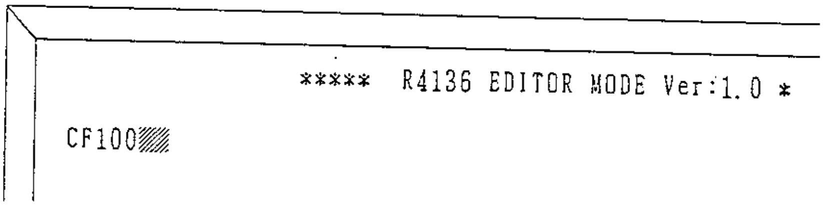
Example: To program CENTER 100 MHz in editor mode.



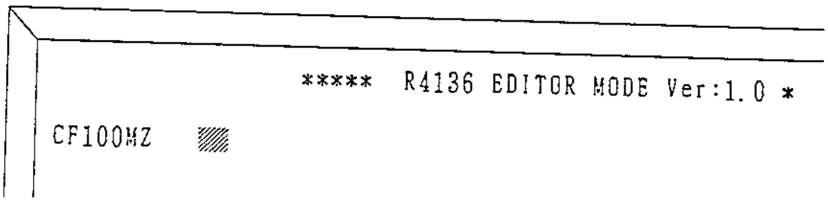

① Press the [CENTER FREQ] key.




② Press the [1] key once, and the [0] key twice.




③ Press the [MHz sec] key.



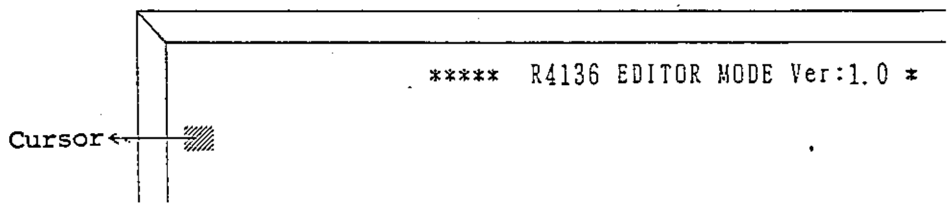
Characters are displayed at the cursor position when the encoder is turned during editor mode. The character is then entered by pressing the ⇒ or ⇐ editor key to move the cursor.

During this input by encoder and editor key,

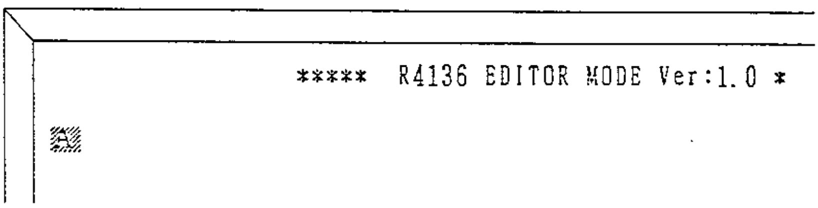
i. Upper case characters,
ii. Lower case characters, and
iii. Special characters,

are selected by pressing the LABEL key.

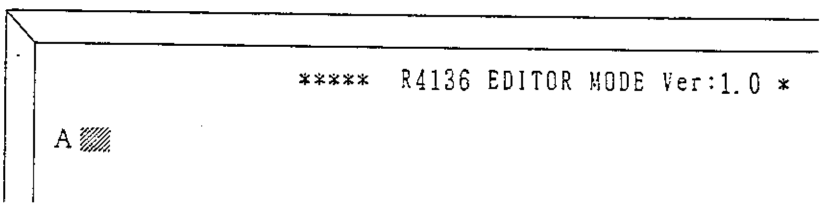
| |
|---|
| Example: To enter characters through the data knob and the edit keys during editor mode. |




① Turn the data knob in the clockwise direction.




② To enter "A", press the ⇒ editor key.

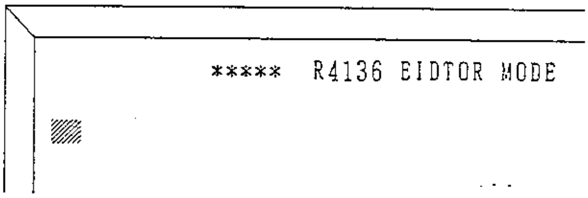


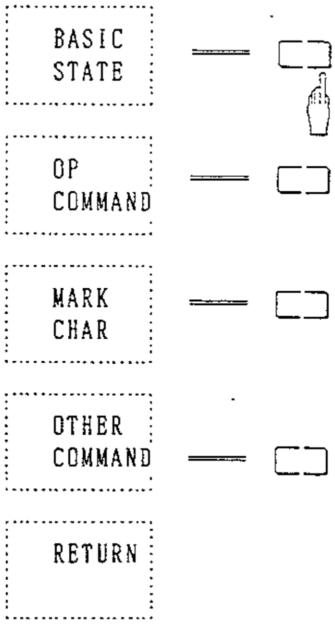
| |
|---|
| Example: Enter "OUTPUT *;" during editor mode. |

The software menu character is entered by pressing the softkey corresponding to the software menu.

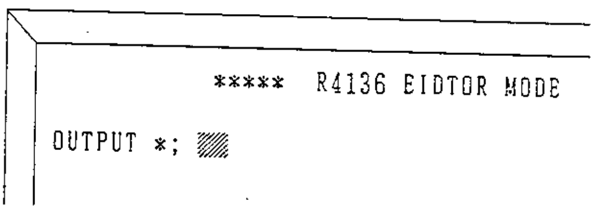
① Press [BASIC STATE] .

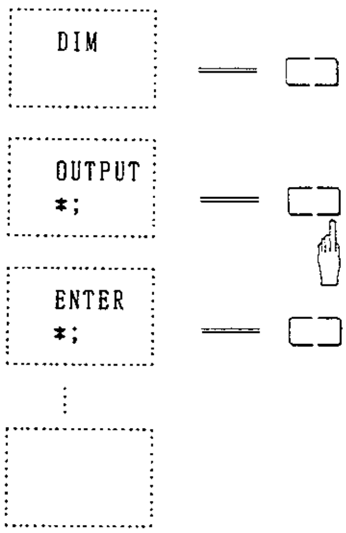
Softkey Menu    Software key




② Press [OUTPUT *] .



(4) Configuration of Softkey Menus

The softkey menus for the PROGRAM key are configured as shown in A1.3.4 (3).

(5) Description of Softkey Menus

①

| | |
|---|---|
| RUN | Executes a BASIC program created by the R4136. |
| CONT | Reexecutes a BASIC program created by the R4136. |
| STEP | Executes a BASIC program created by the R4136 on a line-basis. |
| EDIT | Displays the softkey menu ②. Be sure to select this menu when creating a program with the R4136 spectrum analyzer. Displays the softkey menu ⑱. |
| CORR. TRELE | |
| RESULT CLEAR | Erases the characters displayed on the screen after execution of a BASIC program created by the R4136. |

② An editor mode menu.

| | |
|---|---|
| RUN | Executes a BASIC program created by the R4136. |
| CONT | Reexecutes a BASIC program created by the R4136. |
| STEP | Executes a BASIC program created by the R4136 on a line-basis. |
| LIST | Displays a BASIC program created by the R4136. |
| NEW | Erases a BASIC program created by the R4136. Displays the softkey menu ③. |
| BASIC | To be selected when creating a BASIC program. Displays the softkey menu ④. |
| RETURN | Returns you to the softkey menu ①. |

③

| | |
|---|---|
| RUN | |
| RETURN | Returns you to the softkey menu ②. |

④

| | |
|---|---|
| BASIC STATE | Displays the softkey menu ⑤. |
| OP COMMAND | Displays the softkey menu ⑨. |
| MARK CHAR | Displays the softkey menu ⑫. |
| OTHER COMMAND | Displays the softkey menu ⑭. |
| PLOTTER | Displays the softkey menu ⑰. |
| RETURN | Returns you to the softkey menu ②. |

⑤

| | |
|---|---|
| | Indicates a BASIC statement menu of the R4136. |
| DIM | A statement that declares the definitions of array variables. (See "7.2.6 (4) R4136 BASIC statement syntax.") |
| OUTPUT *; | Sends data to the R4136 spectrum analyzer. |
| ENTER *; | Fetches data from the R4136. |
| DISP | Displays numerics on the CRT screen. |
| END | Terminates the program execution. |
| MORE 1/4 | Displays the softkey menu ⑥. |
| RETURN | Returns you to the softkey menu ④. |

⑥

| | |
|---|---|
| IF | To be used in conjunction with THEN or GOTO. |
| THEN | To be used in conjunction with IF. |
| FOR | To be used in conjunction with FOR ... TO ... STEP NEXT |
| TO | To be used in conjunction with FOR ... TO ... STEP NEXT |
| NEXT | To be used in conjunction with FOR ... TO ... STEP NEXT |
| MORE 2/4 | Displays the softkey menu ⑦. |
| RETURN | Returns you to the softkey menu ④. |

⑦

| | |
|---|---|
| STEP | To be used in conjunction with FOR ... TO ... STEP NEXT |
| GOTO | To be used in conjunction with IF or independently. |
| GOSUB | To be used in conjunction with GOSUB ... RETURN |
| RETURN SUB | To be used in conjunction with GOSUB ... RETURN |
| PAUSE | Temporarily stops the program execution. |
| MORE 3/4 | Displays the softkey menu ⑧ . |
| RETURN | Returns you to the softkey menu ④ . |

⑧

| | |
|---|---|
| WAIT | Interrupts the program execution for the specified period of time. |
| | Moves the cursor to the specified coordinates. |
| CURSOR | It also switches the normal measurement screen to the editor screen and vice versa. |
| SCLEAR | Clears the CRT screen. |
| !REM | A comment for a program |
| MORE 4/4 | Displays the softkey menu ⑤ . |
| RETURN | Returns you to the softkey menu ④ . |

⑨ An OP parameter menu in the GPIB of R4136.

| | |
|---|---|
| OP CF | Specifies a center frequency of the OP command. |
| OP SP | Specifies a span frequency of the OP command. |
| OP RL | Specifies a reference frequency of the OP command. |
| OP MF | Specifies a marker frequency of the OP command. |
| OP ML | Specifies a marker level of the OP command. |
| MORE 1/3 | Displays the softkey menu ⑩ . |
| RETURN | Returns you to the softkey menu ④ . |

⑩

| | |
|---|---|
| OP ST | Specifies a sweep time of the OP command.. |
| OP RB | Specifies a resolution bandwidth of the OP command. |
| OP VF | Specifies a video filter of the OP command. |
| OP AT | Specifies an attenuator of the OP command. |
| MORE 2/3 | Displays the softkey menu ⑪ . |
| RETURN | Returns you to the softkey menu ④. |

⑪

| | |
|---|---|
| OP FA | Specifies a start frequency of the OP command. |
| OP FB | Specifies a stop frequency of the OP command. |
| OP FO | Specifies a frequency offset of the OP command. |
| OP IG | Specifies an IF gain of the OP command. |
| MORE 3/3 | Displays the softkey menu ⑨ . |
| RETURN | Returns you to the softkey menu ④. |

⑫ Indicates the symbols used in creating a BASIC program with the R4136 as well as parallel I/O command menu of the R4136.

| | |
|---|---|
| CURSOR HOME | Moves the cursor 3 lines down from upper left corner of the screen. |
| CURSOR LAST | Moves the cursor 2 lines up from lower left corner of the screen. |
| " " | Enters quote marks " ". |
| ( ) | Enters parentheses ( ). |
| MORE 1/2 | Displays the softkey menu ⑬ . |
| RETURN | Returns you to the softkey menu ④. |

⑬ Display the symbols used to create BASIC programs with the R4136 Spectrum analyzer and the parallel I/O command menus.

| | |
|---|---|
| , | Enters command (,). |
| + | Enters a plus sign (+). |
| * | Enters an asterisk (*). |
| / | Enters an forward slash (/). |
| = | Enters an equal sign (=). |
| MORE 2/2 | Displays the softkey menu ⑫. |
| RETURN | Returns you to the softkey menu ④. |

⑭

| | |
|---|---|
| RETURN | Reassign line numbers. |
| MEMORY SIZE | Display memory size. |
| MORE 1/3 | Displays the softkey menu ⑮. |
| RETURN | Returns you to the softkey menu ④. |

⑮

| | |
|---|---|
| OUTPUT /; | Send data to parallel port. |
| ENTER /; | Read data from parallel port. |
| PCL | Initialize parallel port. |
| H | Initialize when hexadecimal data is specified. |
| B | Initialize when bit set/reset is specified. |
| MORE 2/3 | Displays the softkey menu ⑯. |
| RETURN | Returns you to the softkey menu ④. |

⑯

| | |
|---|---|
| TRACE A | Send trace A memory waveform data to parallel port. |
| TRACE B | Send trace B memory waveform data to parallel port. |
| WRITE | Send write memory waveform data to parallel port. |
| P CHANG | Change secondary port to parallel port. |
| S CHANG | Change parallel port to secondary port. |
| MORE 3/3 | Dispalys the softkey menu ⑭ . |
| RETURN | Returns you to the softkey menu ④. |

⑰

| | |
|---|---|
| RUN | |
| CANCEL | |
| RETURN | Returns you to the softkey menu ④. |

⑱

| | |
|---|---|
| DATA ENTRY | |
| ACTIVE CLEAR | |
| NEXT PAGE | |
| PREV PAGE | |
| MEMORY | Displays the softkey menu ⑳ . |
| PLOTTER | Displays the softkey menu ⑲ . |
| RETURN | Returns you to the softkey menu ①. |

⑲

| | |
|---|---|
| RUN | |
| CANCEL | |
| RETURN | Returns you to the softkey menu ⑱ . |

⑳

| | |
|---|---|
| SAVE | |
| RECALL | |
| RETURN | Returns you to the softkey menu ⑱ . |

(6) Description of Edit Keys

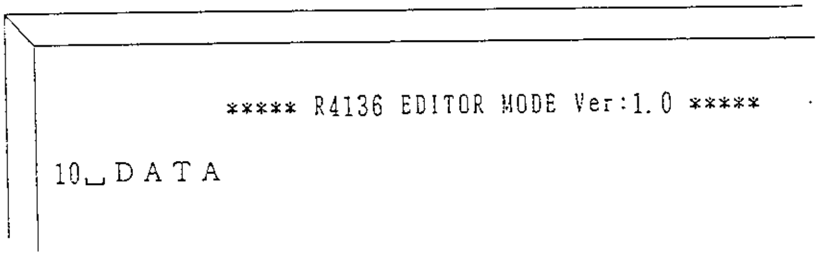
This section describes the edit keys and the panel keys that are provided on the left of the front panel.

Table 7-2 Description of Edit Keys

| | | | Desription |
|---|---|---|---|
| Edit key | (STOP) INSR C | (STOP) | When a BASIC program is being run in R4136, that program can be stopped by pressing this STOP key. |
| | | INSR C | Press the INSR C key to insert a character when editing a BASIC program in R4136. The cursor blinks on and off when this key is pressed. To cancel character insertion, press the key a second time. The cursor stops blinking. |
| | DELE C | DELE C | Press the DELE C key to delete a character when editing a BASIC program in R4136. |
| | INSR L | INSR L | Press the INSR L key to insert a line when editing a BASIC program in R4136. |
| | DELE L | DELE L | Press the DELE L key to delete a line when editing a BASIC program in R4136. |
| | ⇨ | | Press the ⇨ key to shift the cursor one character to the right while editing a BASIC program in R4136. |
| | ⇦ | | Press the ⇦ key to shift the cursor one character to the left while editing a BASIC program in R4136. |
| | ENTER (PAUSE) | ENTER | Always press the ENTER key at the end of a line when generating or editing a BASIC program in R4136. |
| | | (PAUSE) | Press the PAUSE key at to temporarily stop the program when executing a BASIC program in R4136. |
| Panel key | ⇩ | | Shift cursor down one line while editing a BASIC program in R4136. |
| | ⇧ | | Shift cursor up one line while editing a BASIC program in R4136. |

① INSR C editor key

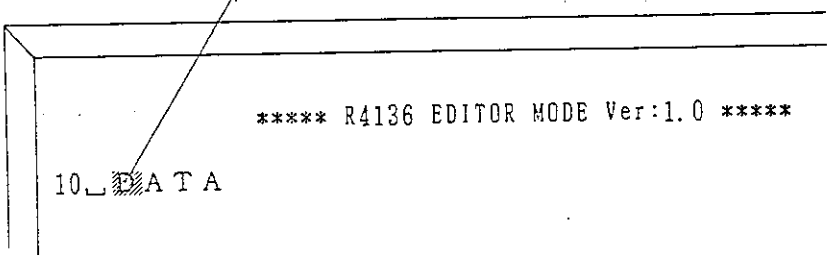
| |
|---|
| Example: Use the INSR C key to change DATA displayed on the screen to BDATA. |



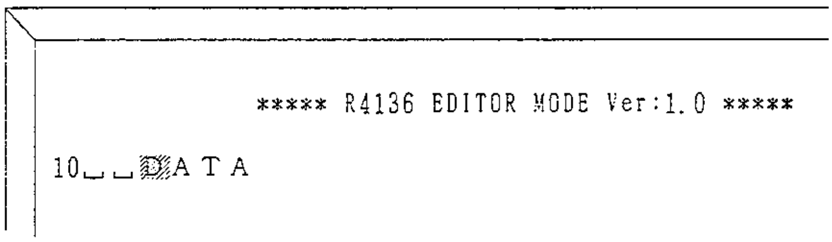

①-1 Shift cursor to the "D" of DATA.

①-2 Press the INSR C key.

Blinking on and off

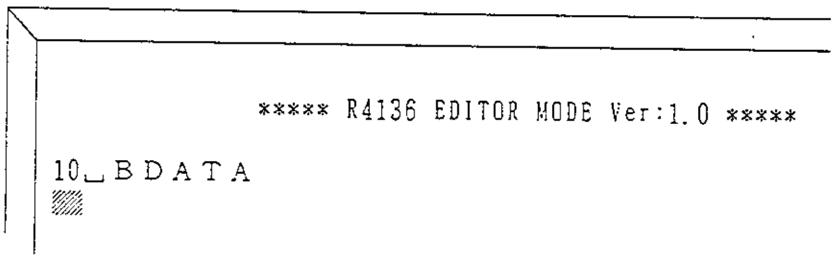



①-3 Press the CLR key (The space symbol has been assigned to this key.)




①-4 Move the cursor one character to the left, and using ◎ and the ⇒ key, insert the character "B".

①-5 Press the ENTER key to finish the editing.



② DELE C editor key

> Example: Use the DELE C key to change UPDATE SPA displayed on the screen to UPDATE.

②-1 Assume that the cursor is positioned at "P" in "SPA".

```
***** R4136 EDITOR MODE Ver:1.0 *****

10␣␣UPDATE␣S▒A
```

②-2 Press the DELE C key once.

```
***** R4136 EDITOR MODE Ver:1.0 *****

10␣␣UPDATE␣S▒
```

②-3 Press the DELE C key once.

```
***** R4136 EDITOR MODE Ver:1.0 *****

10␣␣UPDATE␣S▒
```

②-4 Move the cursor to the position of "S" and press the DELE C key once.

```
***** R4136 EDITOR MODE Ver:1.0 *****

10␣␣UPDATE␣▒
```

②-5 Press the ENTER key to finish the editing.

(7) Before commencing programming

A brief actual program is described here to outline the programming essentials.

(7-1) Deleting a program

Before executing a new program, always delete the old programs.

① First execute the LIST command to display any program which has already been entered.

PROGRAM [ ] → EDIT → LIST → ENTER [ ]

Since the R4136 contains no program when the power is switched on, no list is displayed if the LIST command is executed at that time.

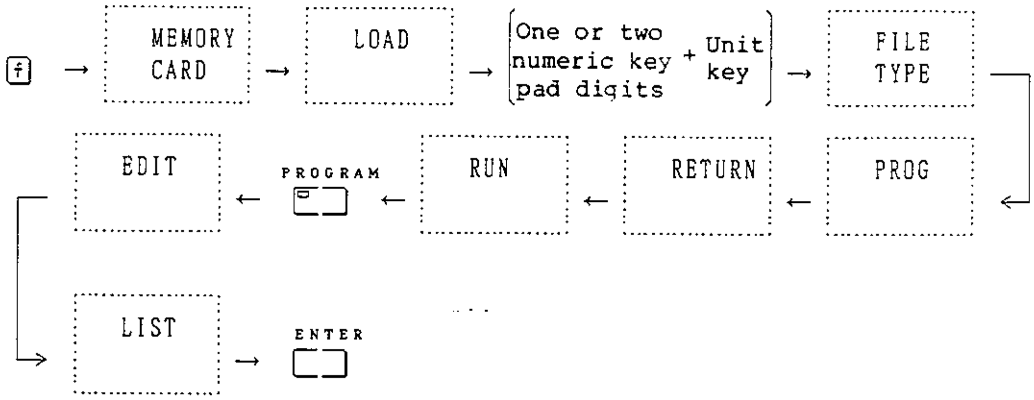
② If a program list is displayed appears when LIST is executed, that program must first be deleted. Execute the NEW command.

PROGRAM [ ] → EDIT → NEW → RUN

Note: The NEW command deletes any previously entered program.

(7-2) Reading an existing program (stored in MEMORY-CARD)

Although a new program is normally generated when the old program is deleted, an existing program stored in the MEMORY-CARD can also loaded. In this case, exit editor mode and activate load mode.



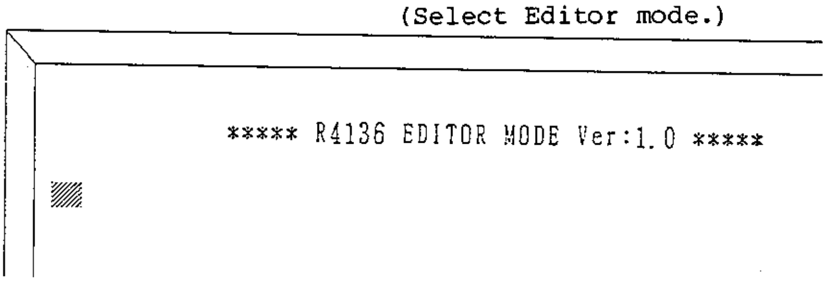

By the time this step is reached, the MEMORY CARD DRIVE LED has come on, and then gone off again with "00 NORMAL END/" appearing on the screen if the operation has been completed normally.

Note: The PROGRAM key LED goes off when editor mode is exited.

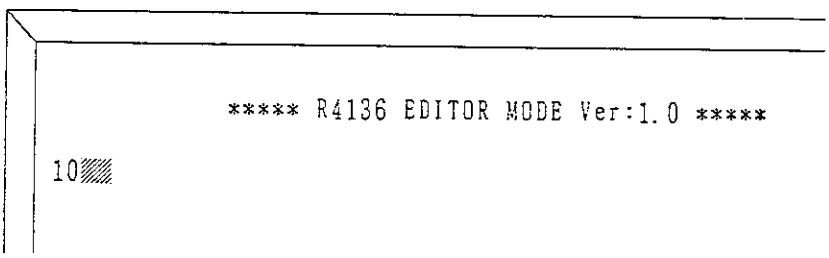
(7-3) Generating a new program

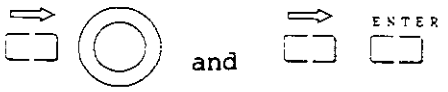
① When generating programs, PROGRAM → 4 EDIT

(Select Editor mode.)

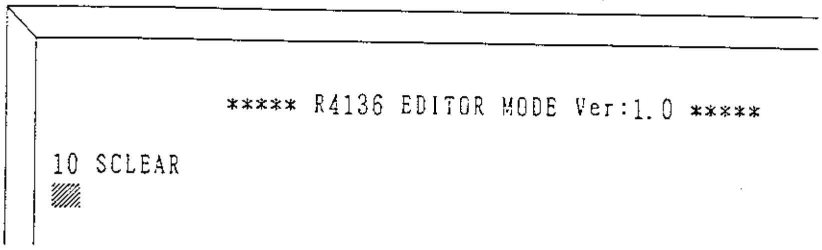


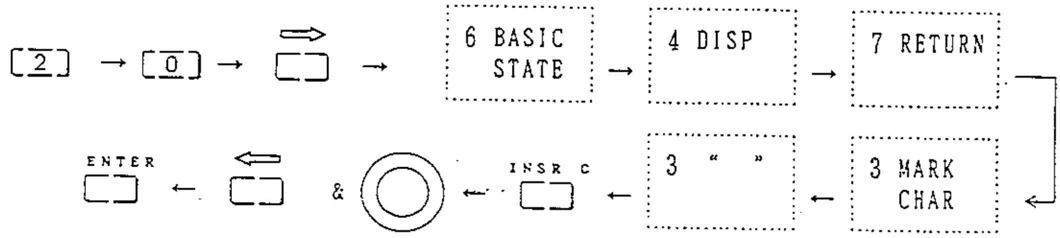

② [1] → [0] (Enter line number.)

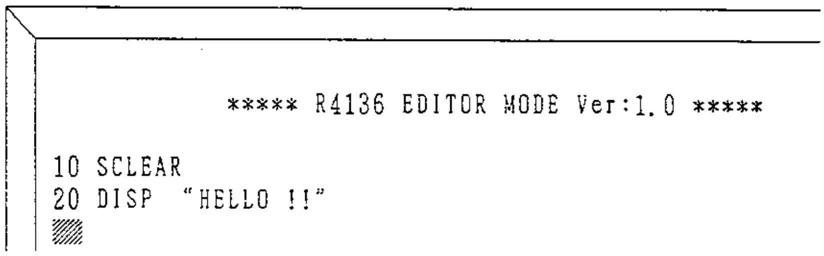


③ 

(Enter statement.)




④ 


⑤ Enter the following program using the above procedure.

```
10  SCLEAR
20  DISP "HELLO !!"
30  DISP "I am GPIB CONTROLLER"
40  DISP "Good-bye !"
50  END
```

Always press the ENTER key at the end of each line. In addition to input of that line, this action moves the cursor to the left hand side of the next line.
If the wrong key is pressed, use the BS (Back Space) key to delete the incorrect character, or shift the cursor back to the beginning of the error line and repeat input of that line. And if a different character is entered on top of a previous character, the former character is replaced by the new one. When a character change is made in an earlier line, the ENTER key must again be pressed.

If the LIST command is executed at this stage, the program list re-appears on the screen.

```
10  SCLEAR
20  DISP "HELLO !!"
30  DISP "I am GPIB CONTROLLER"
40  DISP "Good-bye !"
50  END
```

The number at the beginning of each line is called the line number, and when ENTER is pressed at the end of each line, that line is stored as part of the program. If, on the other hand, ENTER is pressed at the end of a line with no line number, that line only is executed immediately in "direct mode".

When a program is run, it is executed in the same sequence as the line numbers. A line number may be any integer number from 1 to 65535, and line numbers can be incremented by any step interval.

The character string following the line number is the command sent to the controller, and is usually called the "statement".

SCLEAR: Erase characters displayed on the CRT screen.
DISP : Display specified characters and numbers on the screen.
END : End of program.

(See the statement description for [7.2.6 Command and Statement Syntax])

These line numbers and statements must conform with certain syntax rules. Any infringement of these rules results in output of an error message and interruption of the program. For example, if line 30 in the above example is re-written as

```
30 WRITE("I am GPIB CONTROLLER"),
```

which does not conform to the syntax rules, an error is generated when the program is run, and the following error message is displayed on the bottom line of the screen.

```
:Syntax error in 30
```

One line can contain up to 50 characters, and a program of up to 22 lines can be displayed on a single screen.

(7-4) Generating a measurement program

| | |
|---|---|
| EXample: | Set a center frequency to 200 MHz and frequency span to 1 MHz. Then set the active marker. Center frequency and marker level value are read out and displayed on the controller screen. |

```
 10 OUTPUT  *;"IP"
 20 WAIT 1
 30 OUTPUT *;"CF200MZ"
 40 OUTPUT *;"SP1MZ"
 50 OUTPUT *;"PS"
 60 WAIT 0.5
 70 OUTPUT *;"OPCF"
 80 ENTER  *;CF
 90 OUTPUT *;"OPML"
100 ENTER  *;ML
110 CURSOR 10,5,2
120 DISP   "CF=",CF
130 DISP   "ML=",ML
140 END
```

| | |
|---|---|
| 10 | Outputs the INSTR PRESET setting. |
| 20 | Waits for a completion of the INSTR PRESET transaction. |
| 30 | Outputs a center frequency setting. |
| 40 | Outputs a frequency span setting. |
| 50 | Outputs a peak search. |
| 60 | Waits until the setting becomes stable. |
| 70 | Specifies reading of a center frequency data. |
| 80 | Stores the center frequency data to variable CF. |
| 90 | Specifies reading of a marker level data. |
| 100 | Stores the marker level data to variable ML. |
| 110 | Places the cursor to the point of X-axis 10 and Y-axis 5 on the controller screen. |
| 120 | Display |
| 130 | Display |
| 140 | Program end. |

- To store a program in MEMORY-CARD

① If the control screen is displayed (the key LED on), press PROGRAM to return to the measurement screen (the key LED goes off).

② Press f [MEMORY CARD] [STORE].

③ Enter a file No. of 1 or 2 digits with ten-key pad, and press a unit key.

④ Press [FILE TYPE] [PROG] [RETURN] [RUN].

The program can be stored by the above procedure. Check that a completion message appears on the measurement screen.

● To read a program from MEMORY-CARD

① Check that the measurement screen is displayed.

② Press [F] [MEMORY CARD] [LOAD] .

③ Enter a file No. of 1 or 2 digits with ten-key pad, and press a unit key.

④ Press [FILE TYPE] [PROG] [RETURN] [RUN] .

The program can be read by the above procedure.
Check that a completion message appears on the measurement screen.

⑤ Press PROGRAM key (key LED goes on).

⑥ Press [EDIT] [LIST] ENTER .

A program read from MEMORY-CARD is displayed on the control screen.
Check for the program content.

(8) Program Execution

① Running a program

To run a program, [RUN] or use ◎ and ⇒ to enter RUN and press the ENTER key.

Note: To run a program during a measurement display, use the CURSOR statement to switch the screen designation.
(See the cursor description for 7.2.6 (4).)

② Stopping a program temporarily

Press the PAUSE key to interrupt program execution temporarily. To release the pause status, either press the PAUSE key again, or press [CONT] .

③ Running a single program command

To run a program one command at a time, insert the PAUSE statement at the beginning of the program. Run the program executing commands one at a time by pressing STEP .

④ Stopping program execution

Press the STOP INSR C key to suspend program execution. To restart the program from the beginning, press RUN .

⑤ Direct mode execution

If a statement is entered without a line number, the controller executes that (single line) program immediately. Running a program in this way is said to "run a program in direct mode".

For example, if
  DISP 3*9

is entered without a line number and the ENTER key is then pressed, the controller immediately calculates "3 x 9" and displays the answer of "27".
Direct mode is useful when the result of a calculation is required immediately, and when checking the operation of a program line during program generation.

(9) Storing Programs in MEMORY-CARD

To store a BASIC program generated in R4136 in the MEMORY-CARD, first exit editor mode by pressing the PROGRAM key, and then shift to MEMORY-CARD operation.

f → MEMORY CARD → STORE → One or two numeric key pad digits + Unit key → FILE TYPE → PROG → RETURN → RUN

The MEMORY-CARD DRIVE LED comes on. If the operation is completed normally, "00 NORMAL END" appears on the screen, and the DRIVE LED goes off again.

Note: The PROGRAM LED goes off when editor mode is exited.

### 7.2.2 R4136 BASIC Control Statement Syntax and Usage

(1) Outline

This section describes the R4136 control statement syntax by using its graphic and descriptive representations to promote its intuitive understanding.

(2) Syntax Representations

① Graphic Syntax Representation

Graphic syntax representation breaks down a syntax into its components and links them on arrows.
The statement always proceeds in the direction of the arrows. If any arrows point to different directions, the statement proceeds in any one of the directions. If any arrows form a loop, the statement may pass through the loop any number of times.

② Descriptive Syntax Representation

Descriptive syntax representation uses the following symbols:
[ ]: Indicates that the enclosed part can be omitted.
< >: Indicates that the enclosed part can be omitted.
{ }: Indicates that the enclosed part can be repeated more than 0 time.
| : Indicates "or".

Example: [A] | [B] ..... Indicates [A] or [B].

The following are used in the graphic and descriptive representations:
- Numerical expression: Numerical constant, numerical variable, or numerical equation
- Character string expression: Character string constant

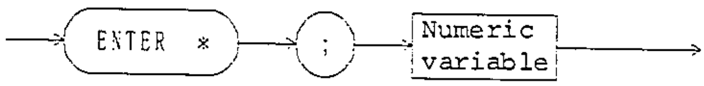
(3) Syntax of R4136 BASIC Control Statement

The R4136 BASIC control statement is described in the following order:
ENTER * .......... ①
OUTPUT * ......... ②

① ENTER *

Outline: Read data from R4136

Syntax




ENTER *: Numeric variable

Description: Enter data from R4136 itself, and store data as numeric value in BASIC variables.

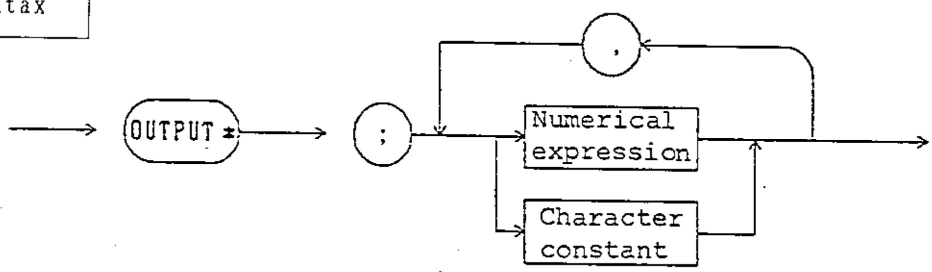
Example

```
10  DIM A(100)
 20  FOR I = 1 to 100
 30  ENTER *; A(I)
 40  NEXT I
```

② OUTPUT *

Outline: Send data to R4136

Syntax




OUTPUT * : Numerical expression | character string expression

Description

- Send numeric values and character strings. Numerical expressions and character string expressions can be mixed by partitioning with commas.
- If the result of operating on a numerical expression exceeds ±999999, use an exponential expression for output of the results.

(4) Local control over R4136 Spectrum Analyzer Using Talker Listener

Local control over the R4136 spectrum analyzer using the talker (ENTER*) and the listener (OUTPUT*) is almost equal to the function described in "6. GPIB: remote Programming" (see Chapter 6), only with the following differences:

Differences from the GPIB control (Chapter 6)

① The local control of the R4136 is always in the local state during program execution. (The LEDs such as REMOTE, etc. do not light)

② The command codes of softkey functions are not allocated, so, specify them as follows:

```
OUTPUT 701; "TN" (HP200 series: For display line ON)
        ↓
OUTPUT *  ; "TM SF1" (BASIC of option 06)
```

③ I/O of setting condition

- The mode strings (code: OM) cannot be output.
- The header (codes: HD0, HD1) and the delimiter (codes: DL 0 to 3) for TALKER cannot be specified.
- For input (code: IN) and output (code: OP) of the trace data, only ASCII specification of decimal number is effective.
- The variable for the character string cannot be output.
- The service request (codes: S0, S1, S2) cannot be used.

④ The plotter output cannot be controlled by means of programming.

⑤ The address setting becomes R4136 itself ("*"). R4135 for 4136.

### 7.2.3 Constants and Variables

The format and use of constants and variables indispensable in operations on numeric values are described below.

(1) Constant and variables

① Constants
The two types of constants are character and numeric constants.

```
              ┌(a) Character constants
Constants ────┤
              └(b) Numeric constants
```

(a) Character constants
A character constant is a collection of alphabetic characters and symbols enclosed by quotation marks (" ").

Note that the quotation marks (" ") themselves cannot form part of the constant.

Examples: "ABCDEF $?*"
"21-JUL-83"

(b) Numeric constants
A numeric constant is a positive or negative real number, or zero. The maximum number of valid digits in a numeric constant is 11, and the exponent can be expressed by E.

Examples: 12345678901
1.2345E6 (same as $1.2345 \times 10^{6}$)
5.4321E-6 (same as $5.4321 \times 10^{-6}$)

The range of numeric values which can be handled by R4136 is

$-9.9999999999 \times 10^{-127}$ to $-9.9999999999 \times 10^{+126}$,
$+9.9999999999 \times 10^{-127}$ to $+9.9999999999 \times 10^{+126}$, and 0.

Although the positive number sign (+) can be omitted, the negative number sign (-) cannot.

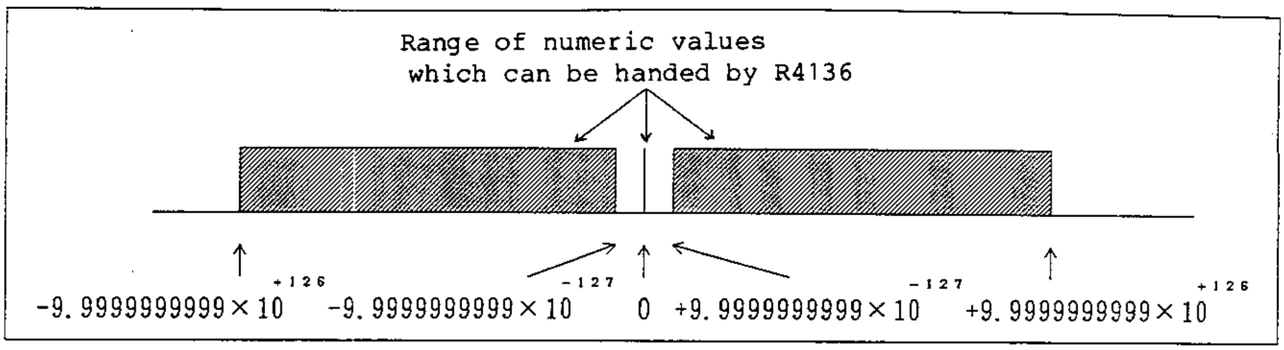



Figure 7-7 Range of Numeric Values

② Variables

A variable is a numbers whose value can change when operated on in a BASIC program.

The two types of variables are:

```
            ┌─(a) Simple numeric variables
Variables ──┤
            └─(b) Numeric array variables
```

Variables usually referred to as numeric variables are actually simple numeric variables.

In BASIC programs, numeric values are not often handled as constants, but are usually operated on after being substituted in a variable.

(a) Simple numeric variables
Simple numeric variable names are expressed as a single alphabetic character A thru Z, plus ten other characters consisting of upper case alphabetic characters, numeric characters, and/or an underline (_). If more than 11 characters are used in a variable name, all characters after the 11th are disregarded.

And also note that variables identical to keywords used in BASIC cannot be used.

Simple numeric variables:

1 alphabetic character (plus nine other alphabetic characters, lower case alphabetic characters, or alphanumeric characters)

Examples: A, B, A1, NA, AMPLITUDE

Symbols cannot be used in variable names.

Note that no alphabetic character or symbol can be used as simple numeric variable names. Also symbols cannot be used as variable (A$, etc.) of character strings.

(b) Numeric array variables
If each variable is given a separate variable name when generating a program to handle a large volume of data, that program will become very complex. For this reason, the numeric array variable capable of handling many items of data with a single variable name is used.

The numeric array variable consists of a simple variable name plus a number enclosed in parentheses.

Numeric array variable:

1 alphabetic character plus upper case alphabetic characters, numeric characters, underline (_), and (number)

Example: A(1), A(I-2), Band(X)

The numeric array variable number may be expressed as a constant, variable, or a formula. And the array may be declared in one or two dimensions.

When using a numeric array variable, the array size must be declared in advance with the DIM statement. If no DIM statement declaration is made, the array size is declared as 1 dimension (10) array automatically.

```
  5   SCLEAR
 10   DIM A(9)
 20   FOR I=0 TO 9
 30   A(I)=I
 40   NEXT I
 50   FOR I=0 TO 9
 60   DISP A(I)
 70   T=T+A(I)
 80   NEXT I
 90   DISP "Total=", T
100   DISP "Average=", T/10
110   END
```

In the above program example, 10 items of data are entered by panel key operation and stored in a numeric array called A. The data total and average are then displayed.

The array size declaration on line 10, DIM A(9), indicates that a 10-item array A(0) thru A(9) has been reserved.

In this case, the numeric array variable A is distinct from the simple numeric variable A.

### 7.2.4 Formula and Functions

(1) Formula

A formula consists of numeric constants, numeric variables, and functions coupled by operators and parentheses. And an element consisting only constants or only variables is also called a formula. Another name for a formula is numeric expression.

Operators used in BASIC programs differ a little from ordinary arithmetic expressions. See the following table.

Table 7-3 Operators

| | Operators used in ordinary arithmetic expressions | Operators used in BASIC |
|---|---|---|
| Addition | + | + |
| Subtraction | - | - |
| Multiplication | x | * |
| Division | ÷ | / |

When operating on a formula, the order of operating priority is determined by operators and parentheses.

① Operations within parentheses
② Functions
③ Multiplication and division
④ Addition and subtraction

Examples of arithmetic formula descriptions used in BASIC are listed below.

Table 7-4 Examples of Arithmetic Formula Descriptions

| Ordinary arithmetic expression | BASIC expression |
|---|---|
| $\frac{5x + 3}{-x + 2}$ | (5X+3)/(-X +2) |
| x X (-1) | X*(-1) |
| 3x+2y | 3*X+2*Y |
| $\frac{a+b}{2}$ | (A+B)/2 |

(2) Functions

The following numeric functions are used in R4136 BASIC.

Table 7-5 Numeric Functions

| | | | | | |
|---|---|---|---|---|---|
| AND, | "AND" | XOR, | "XOR" | NOT, | "NOT" |
| OR, | "OR" | COS, | "COS" | EXP, | "EXP" |
| ABS, | "ABS" | LOG, | "LOG" | LN, | "LN" |
| INT, | "INT" | SQR, | "SQR" | TAN, | "TAN" |
| SIN, | "SIN" | SGN, | "SGN" | PI, | "PI" |
| ATN, | "ATN" | BIT, | "BIT" | | |

### 7.2.5 Error Messages

If the R4136 BASIC interpreter detects an error in the program text when running a program by using the RUN command, or when a single line is executed in direct mode, an error message is generated.

(1) When run in direct mode

One of the error messages listed in Table 7-7 is displayed on the bottom line of screen.

(2) When run by RUN command

One of the error messages listed in Table 7-6 is displayed on the bottom line of screen, and the program list from the line above the line where the error occurred is displayed on the screen. And the line number of the error line is displayed on the right of the error message.

① During program execution

Table 7-6 Error Messages (During Program Execution) (1/2)

| Error message | Description |
|---|---|
| Syntax error | Incorrect syntax, or statement with ambiguous meaning |
| Missing operand | Error in operand |
| Out of Memory | The GOSUB statement nesting level is too large. The memory area which can be used by numeric arrays and character string variable has been exceeded.<br>This usable memory area varies according to program length. |
| Duplicate Definition | More than one DIM statement has been used for the same variable name. |
| Overflow | Operation result in excess of the range that can be handled in R4136. If an underflow occurs, the operation result is 0 and no error is generated. |
| NEXT without FOR | NEXT statement executed before FOR statement. Or, a NEXT statement has been included without a corresponding FOR statement. |

Table 7-6 Error Messages (During Program Execution) (2/2)

| Error message | Description |
|---|---|
| Subscript out of range | Numeric array variable or character string variable used without an array declaration by DIM statement. Or, the numeric array variable or character string variable exceed the range in the array declaration. |
| Undefined line number | Attempt to branch to line not containing a GOTO, GOSUB, or IF statement. |
| Division by zero | Attempt to divide number by 0. |
| Illegal function call | Value which cannot be calculated has been specified in function argument.<br>● LOG(0)<br>● LN(0)<br>● SQR(x) (x<0) |
| RETURN without GOSUB | Attempt to execute a RETURN statement without previous branching by GOSUB statement. |
| Invalid parameter | Attempt to set a meaningless parameter. |

② When editing a program

Table 7-7 Error Messages (During Program Editing)

| Error message | Description |
|---|---|
| Missing line number | Attempt to set a line number outside the 1 to 65535 range during program input. |
| Memory overflow ! | Program storage memory capacity exceeded as a result of input of a very long program. |
| Illegal direct | Cannot be executed in direct mode. |
| Parentheses mismatch | Odd number of parentheses. |

### 7.2.6 Command and Statement Syntax

(1) Outline

The syntax of commands and statements used by R4136 are described below using both diagrams and text to help the reader get a better understanding of program flow.

(2) Syntax Representation Methods

See 7.2.2 (2).

(3) R4136 GPIB Controller Command Syntax

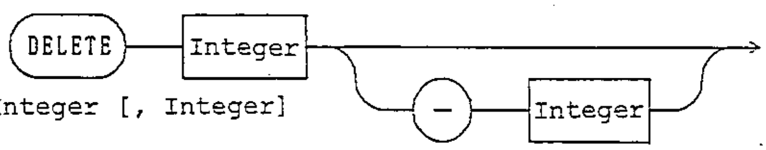
DELETE ........... See ①
LIST ........... See ②
NEW ........... See ③
RUN ........... See ④
RENUM ........... See ⑤
SIZE ........... See ⑥

① DELETE

Outline

Delete line from program

Syntax




DELETE Integer [, Integer]

Description

- Delete program line being entered
- Specify integer with value from 1 to 65535.
  Error message is generated if line number is not specified.

Example

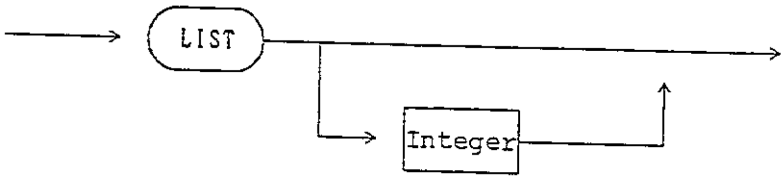
DELETE 10
DELETE 10 - 100

② LIST

Outline

Display program list on display screen.

Syntax




LIST [Integer]
Where integer is any value from 1 to 65535

Description

- Display 22 lines of program on the screen.
- If a line number is specified, the program list from that line number is displayed.
  LIST Line number

If no line number is specified, the program list is always displayed from the start of the program.

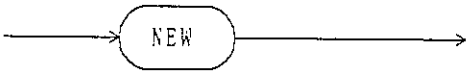
Example

LIST
LIST 100

③ NEW

Outline — Delete the BASIC program stored in memory.

Syntax




NEW

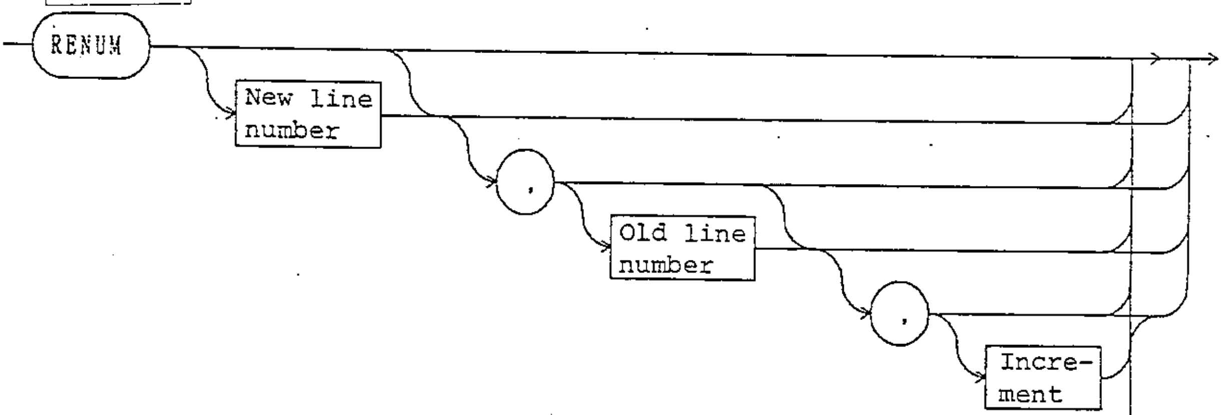
Description
- When the program already in memory is no longer required, execute this command.
- When selecting by softkey, press the softkey corresponding to "1 RUN".

Example — New

④ RENUM

Outline — Renumber the program lines

Syntax




RENUM [New line number] [, [Old line number] [, [ [Increment] ]

* New line number, old line number, and increment are all integer numbers (from 1 to 65535).

* Default values ten.

Description
- New line numbers are the new numbers allocated to the start of each line.
- Old line numbers are the line numbers used in the program before the start of the current renumbering.

- The increment is the step by which each new number is increased.
- The RENUM command also renumbers the line numbers used in GOTO and GOSUB statements to the corresponding new line numbers.

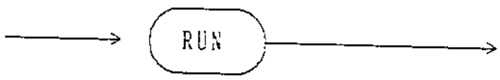
  If the line number corresponding to the number in the GOTO or GOSUB statement does not exist, the following error message is generated with the incorrect line number remaining unchanged.
  "Undefined line number XXXX in △ △ △ △"
  (where XXXX is the line number which does not exist, and △ △ △ △ is the new line number of that statement).
- Line numbers in excess of 65535 cannot be generated by the RENUM command. Nor can a change in program sequence be specified.

### ⑤ RUN

**Outline**

Run the BASIC program.

**Syntax**




RUN

**Description**

- Run the BASIC program from the first line.
- When the RUN command is executed, all variables are cleared prior to program execution, and array declarations etc are reset to "no setting" status.

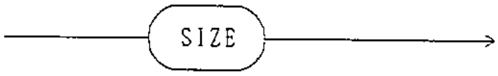
**Example**

Run

⑥ SIZE

Outline — Display the remaining memory size.

Syntax




SIZE

Description

- The number of bytes remaining in the program memory are displayed on the screen together with program memory usage.
- The program memory area has about 7.5 kbytes when empty.

Example

SIZE

```
Total= 7681 bytes ..... Total memory size
Free = 3840 bytes ..... Remaining memory
Used = 50%        ..... Utilization rate
```

(4) R4136 BASIC Statement Syntax

CURSOR .................... See ①

DIM ....................... See ②

DISP ...................... See ③

END ....................... See ④

FOR-TO-STEP ............... See ⑤
NEXT

GOSUB ..................... See ⑥
RETURN

GOTO ...................... See ⑦

IF GOTO ................... See ⑧
IF THEN

LET ....................... See ⑨

PAUSE ..................... See ⑩

REM ....................... See ⑪

SCLEAR .................... See ⑫

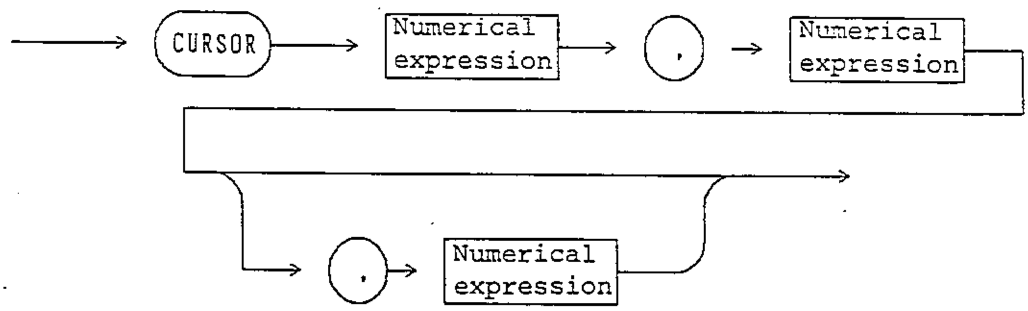
WAIT ...................... See ⑬

① CURSOR

Outline

Move cursor to specified co-ordinates.

Syntax




CURSOR Numerical expression Numerical expression
[, Numerical expression]

Description

- Move cursor to the position specified on the CRT screen.
- The first number enclosed in parentheses indicates the X axis co-ordinate, the second number the Y axis co-ordinate, and the third number the screen designation.
  CURSOR (X axis co-ordinate, Y axis co-ordinate, screen designation)
  The default screen designation is "2". And the X and Y co-ordinates must lie within the following ranges.
  $0 \leq$ X axis co-ordinate $\leq 49$
  $0 \leq$ Y axis co-ordinate $\leq 21$

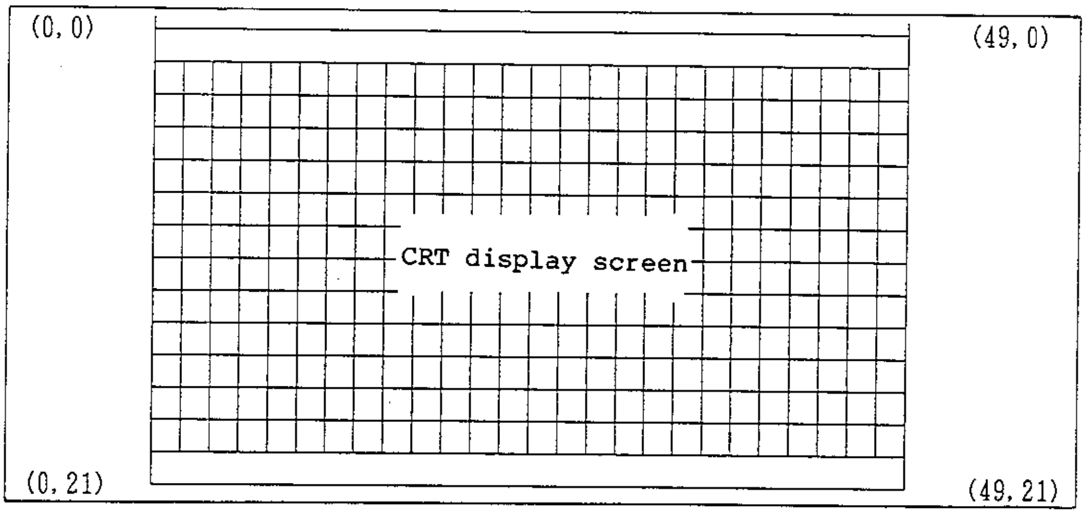



Figure 7-8 Range of Values on X and Y Coordinates on CRT Display

Screen designation:
1: Measuring display screen (screen 1)
2: Controller screen (screen 2)

**Example**

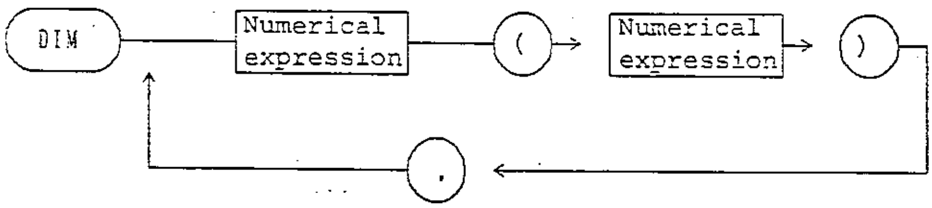
```
10 CURSOR 10, 5,2
20 CURSOR X*10, Y+5
```

### ② DIM

**Outline**

Array variable definition statement

**Syntax**




DIM<A>, (<B>) (<A>(<B>)
Note: The <A> and <B> are numerical expressions

**Description**

- When using array variables, the array variable name and array size must be defined by DIM statement. Using undefined array variables results in error generation.
- When an array declaration is made by DIM statement, the array variable of the specified size is stored in memory.
  Note, therefore, that if a very large array is declared, there will be insufficient room left for the BASIC program. (An error is generated and program execution is halted if the array size is greater than the memory size. (Out of memory))
- Any decimal places in the numerical expression indicating the array variable size are discarded, even if the result of the operation is a real number.

**Example**

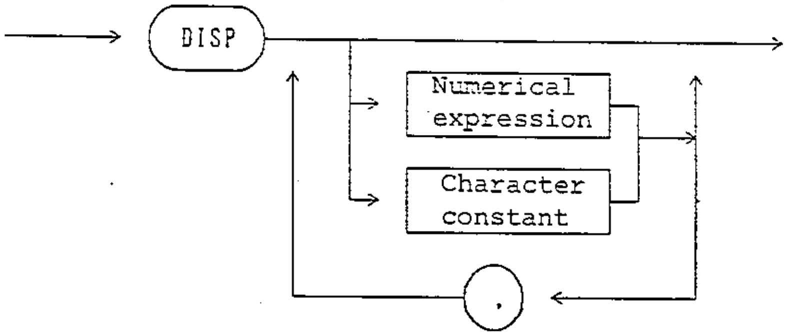
```
10 DIM A(100)
20 DIM B(20)
30 DIM C(I), D(J)
40 A(50)=100
```

③ DISP

Outline

Display numeric values or character strings on the CRT screen.

Syntax




DISP [Numerical expression | character constant]

Description

- If a number or numerical expression is placed after DISP, the results of an operation on that number or numerical expression is displayed on the CRT screen.
- And if a character string is placed after DISP, that character string is displayed on the screen.
- Several items of data can be displayed at the same time by partitioning the data with commas.

Example

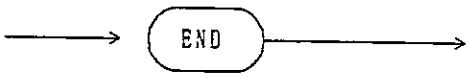
```
10 DISP 123.45
20 DISP 10*I
30 DISP "ABC"
40 DISP "Hz"
50 DISP "START=", M, "Hz"
```

④ END

Outline

Terminate program execution.

Syntax




END

Description

- When the END statement is executed, the program is forced to terminate irrespective of the current program status.

Example

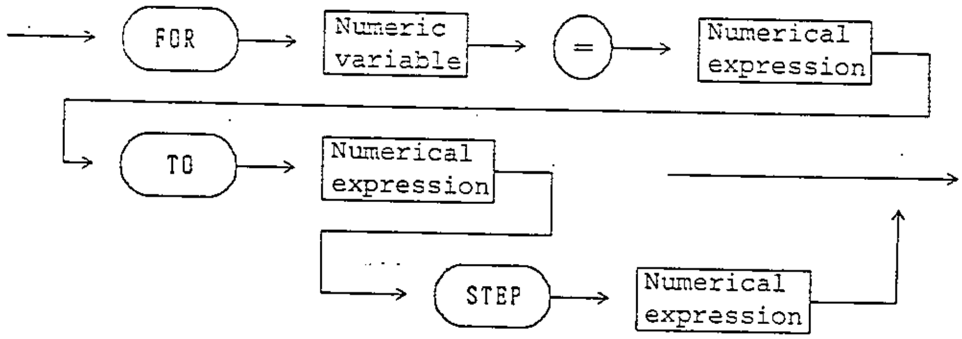
```
10 END
```

⑤ FOR-TO-STEP-NEXT

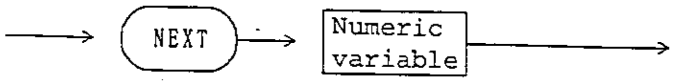
Outline

Form a loop (repeated processing) in the program with a pair of FOR and NEXT statements.

Syntax




FOR numeric variable = Numerical expression TO numerical expression [STEP numerical expression]




NEXT Numerical variable

Description

- Using the specified numeric variable as a loop (repetition) counter, the counter value is changed in incremental steps from the initial to the final value. When the counter value reaches or exceeds the final value, the loop is terminated. The counter is incremented/decremented by the NEXT statement. Therefore, the program between the FOR and NEXT statements is processed repeatedly.
- The initial and final values, and the incremental step are specified in the following way.
  FOR A=(Initial value) to (Final value)
  STEP (Incremental step)
- If STEP (increment) is omitted, the increment is automatically set to +1.
- FOR and NEXT statements can be nested.
- The numeric variable names of the loop counter used by a pair of FOR and NEXT statements must be identical. An error is generated if the names are not identical. (NEXT without FOR)
- If the value of the numeric variable being used in the loop counter is changed during repeated processing in a FOR to NEXT statement loop, the loop will not function properly.

Example

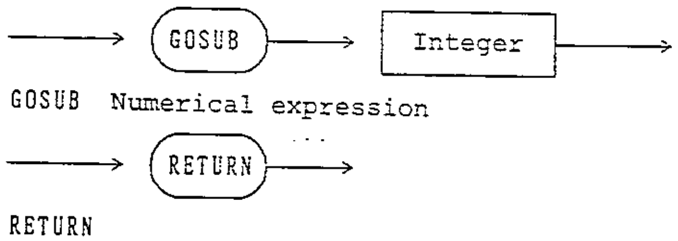
```
10 FOR I=0 TO 100
20 FOR J=A*10 TO B*20 STEP C
30 FOR K=10 TO -10 STEP -1
40 NEXT K
50 NEXT J
60 NEXT I
```

⑥ GOSUB
RETURN

Outline

Branch to and return from specified subroutine.

Syntax




Description

- Transfer processing control to the subroutine starting at the line number specified by the integer, and return (by RETURN statement) to the next statement after the GOSUB statement.
- Always insert a RETURN statement at the end of the subroutine to return the process to the main program.
- An error is generated if a RETURN statement is executed without branching to a subroutine. (RETURN without GOSUB)
- Since GOSUB - RETURN statements can be nested, branching to another subroutine from within a subroutine is possible. However, too much nesting will use up memory space, and result in the generation of an error. (Out of memory)

Example

```
10 GOSUB 1000
20 GOSUB 2000
30 END
1000 I=I+10
1010 RETURN
2000 GOSUB 3000
2010 A=I*100
2020 RETURN
3000 A=123
3010 RETURN
```

⑦ GOTO

Outline

Branch to the specified line number.

Syntax


GOTO Integer

Description

- Unconditional branching to specified line number.
- An error is generated if the specified line number does not exist in the program. (Undefined line number)

Example

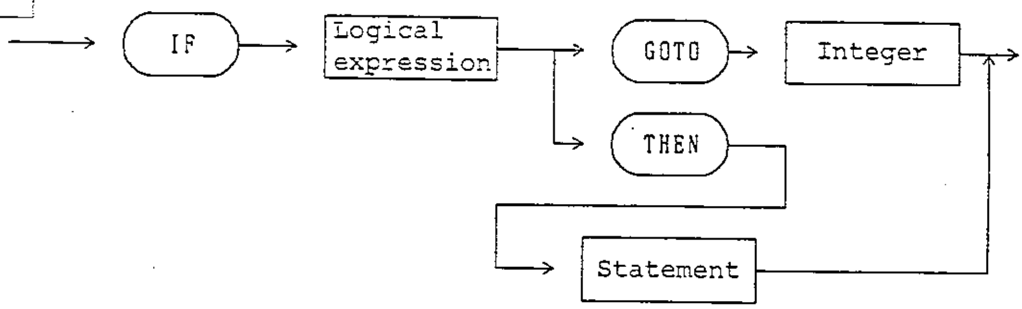
10 GOTO 100

⑧ IF GOTO
IF THEN

Outline

Conditional branching, and execution of specified statement.

Syntax




IF <Logical expression><A> | <B>

<A>::=GOTO Numerical expression

<B>::=THEN <Statement>

Description

- The program is branched and processed depending on whether the logical expression conditions are met or not.
- If the logical expression conditions are met, the THEN or GOTO statement.
  The THEN statement can be followed by a line number or an another statement. In this case, that line number has the same meaning as a GOTO statement. If followed by a statement, that statement is executed.

- If the logical expression conditions are not met, the program advances to the next line.
- The six logical expressions are summarized below.

Table 7-8 Logical Expression

| Logical Expression | Description |
|---|---|
| A=B | Condition met if A and B are equal. |
| A>B | Condition met if A is greater than B. |
| A<B | Condition met if A is smaller than B. |
| A>=B(A=>B) | Condition met if A is equal to or greater than B. |
| A<=B(A=<B) | Condition met if A is equal to or smaller than B. |
| A<>B(A < B) | Condition met if A and B are not equal. |

Both A and B in the above logical expressions may be numerical expressions. Note, however, that a numerical expression cannot be used in combination with a character string expression.

Example

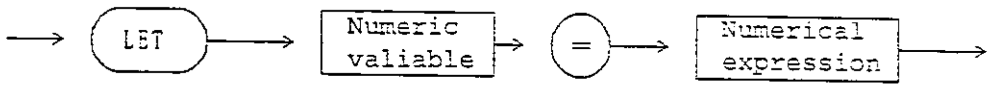
```
10 IF A=10 GOTO 1000
20 IF A+1=B*10 THEN DISP "OK"
30 IF B<>C GOTO 200
 :
```

⑨ LET

Outline

Substitute a variable.

Syntax




LET<A> | <B> { , <A> | <B> }
<A>, <B> ::=Numeric valiable = Numerical expression

Description

- Substitute a numeric variable or numerical expression. Since the equal sign "=" in this case means "substitute", it is not the same as the mathematics equal sign "=".
- LET can be omitted from the program.

Example

```
20 LET A=10
30 LET B=A*3, C=123
50 A=10: B=A*3: C=123
```

⑩ PAUSE

Outline

Stop program execution temporarily.

Syntax


PAUSE

Description

- Program execution is stopped until the CONT key is pressed.
- When a PAUSE statement is executed, "PAUSE" is displayed on the screen to indicate that the program has been stopped temporarily. If the CONT key is then pressed, program execution is resumed from the next statement.
- If the STEP key is pressed, the program is executed one line at a time from the PAUSE statement.

Example

```
10 PAUSE
```

(11) REM

Outline

Program comments.

Syntax

→ (REM) → [Character string] →

REM <Character string>

Description

- Use the REM statement to insert comments in the program.
- Since the REM statement is not executed, REM can be followed by any type of character string. Any character, number, or symbol can be used.
- The REM statement can be substituted by an exclamation mark "!".
- After a REM statement, the colon ":" cannot be used to partition strings into multiple statements. All characters including colons become part of the comment.

Example

```
10 REM "PROGRAM 1"
20 ! 1983-JUN-02
30 A=A+1:! INCREMENT A
```

(12) SCLEAR

Outline

Clear the CRT screen.

Syntax

→ (SCLEAR) →

SCLEAR

Description

- Characters displayed on the CRT display screen are cleared.
- At the same time that the screen is cleared, the cursor is moved to the home position.

Example

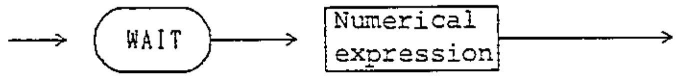
```
10 SCLEAR
```

⑬ WAIT

Outline

Stop program execution for the specified duration.

Syntax




WAIT Numerical expression

Description

- Program execution is stopped for a period equal to the time specified after WAIT.
- The unit of time is second. Any value from 0 to 65.535 seconds can be set.
- The wait duration set by the WAIT statement is subject to a certain amount of error due to various conditions occurring during program execution. And the period specified by the WAIT statement does not include the time taken to execute the WAIT statement.

Example

```
10 WAIT 1.0
20 WAIT I*10-5
```

(5) List of Commands and Statements

Commands

| | | |
|---|---|---|
| DELETE [n], [m] | : | Delete specified numbers. |
| LIST [n] | : | Display program list on CRT screen. |
| NEW | : | Erase previous program. |
| RUN | : | Run program. |
| RENUM | : | Renumber line numbers. |
| SIZE | : | Display remaining number of bytes. |

Statements

| | | |
|---|---|---|
| CURSOR X, Y | : | Cursor control |
| DIM | : | Array variable definition |
| DISP | : | Display on CRT screen |
| END | : | Terminate program |
| ENTER* | : | Input from R4136 itself |
| FOR-TO-STEP-NEXT | : | Loop processing |
| GOSUB | : | Branch to subroutine |
| GOTO | : | Unconditional branching |
| IF-GOTO | : | Conditional branching |
| IF-THEN | : | Conditional judgment |
| LET | : | Substitute |
| OUTPUT* | : | Output to R4136 |
| PAUSE | : | Stop program execution temporarily |
| REM (or !) | : | Program comments GOSUB |
| RETURN | : | Return from subroutine specified by GOSUB |
| SCLEAR | : | Clear entire CRT display screen. |
| WAIT | : | Wait for specified duration. |

### 7.2.7 Plotter Output

The basic program now displayed on the screen can be output on the plotter.

| |
|---|
| Example: Example of plotting a program on the upper left portion of four divisions using the plotter TR9835 manufactured by our company. (Single color, A4 size.) |

① Check that the LED lamp of PROGRAM [P] is turned off.

② Press [↵] [PLOT] [TR-PLOTER] [TR9835] .

③ Press [ALL] (or [DATA]) [SMALL] [4PICTURES] [UPPER LEFT] .

④ Press PROGRAM [P] to light the LED lamp.

⑤ Press [EDIT] [BASIC] [PLOT] [RUN] .

The plotter output is started. To stop the operation during the plotter output, press [CANCEL] .

⑥ When the plotter output is ended, press [RETURN] .

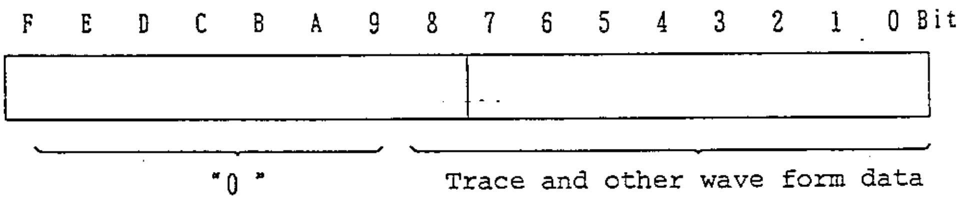
## 7.3 PARALLEL I/O

The parallel I/O function enables data to be transferred to and from R4136 via parallel ports. Note, however, that this function cannot be used when a program is generated using the R4136 BASIC programming function.

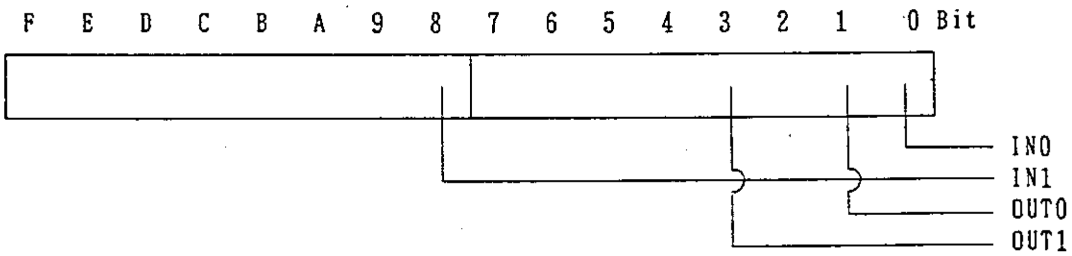
And avoid using the parallel I/O ports when connected up to a personal computer.

(1) Output Format

The trace data uses bits D0 thru D8. The output for the remaining bits is "0".




(2) Auxiliary Inputs/outputs




| Input/output value | OUT1 | OUT0 | IN1 | IN0 |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 2 | 0 | 0 | 1 | 0 |
| 3 | 0 | 0 | 1 | 1 |
| 4 | 0 | 1 | 0 | 0 |
| 5 | 0 | 1 | 0 | 1 |
| 6 | 0 | 1 | 1 | 0 |
| 7 | 0 | 1 | 1 | 1 |
| 8 | 1 | 0 | 0 | 0 |
| 9 | 1 | 0 | 0 | 1 |
| A | 1 | 0 | 1 | 0 |
| B | 1 | 0 | 1 | 1 |
| C | 1 | 1 | 0 | 0 |
| D | 1 | 1 | 0 | 1 |
| E | 1 | 1 | 1 | 0 |
| F | 1 | 1 | 1 | 1 |

Although the hardware configuration is as outlined above, the software input/output values used in local control are as listed in the table on the left.

## 7.3.1 R4136 Parallel I/O (BASIC) Control Statement Syntax and Usage

(1) Outline

This section describes the R4136 parallel I/O (BASIC) control statement syntax by using its graphic and descriptive representations to promote its intuitive understanding.

(2) Syntax Representation

See 7.2.2 (2).

(3) R4136 Parallel I/O (BASIC) Control Statement Syntax

The R4136 parallel I/O (BASIC) control statement is described in the following order:

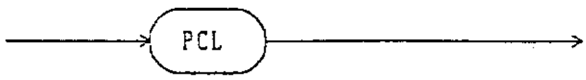
PCL .......... See ①
ENTER/ .......... See ②
OUTPUT .......... See ③

① PCL

**Outline**

Parallel I/O port initialization

**Syntax**




PCL

**Description**

- Parallel I/O port initialization
  Output from R4136 enabled. To enable input to R4136, use ENTER/.

**Example**

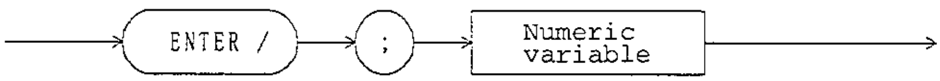
10 PCL

② ENTER/

**Outline**

Read data from parallel port

**Syntax**




ENTER /; Numeric variable

**Description**

- Input of data via parallel port or auxiliary port, and store data as numeric value in BASIC variables. Note that this involves waiting until input has been completed.

**Example**

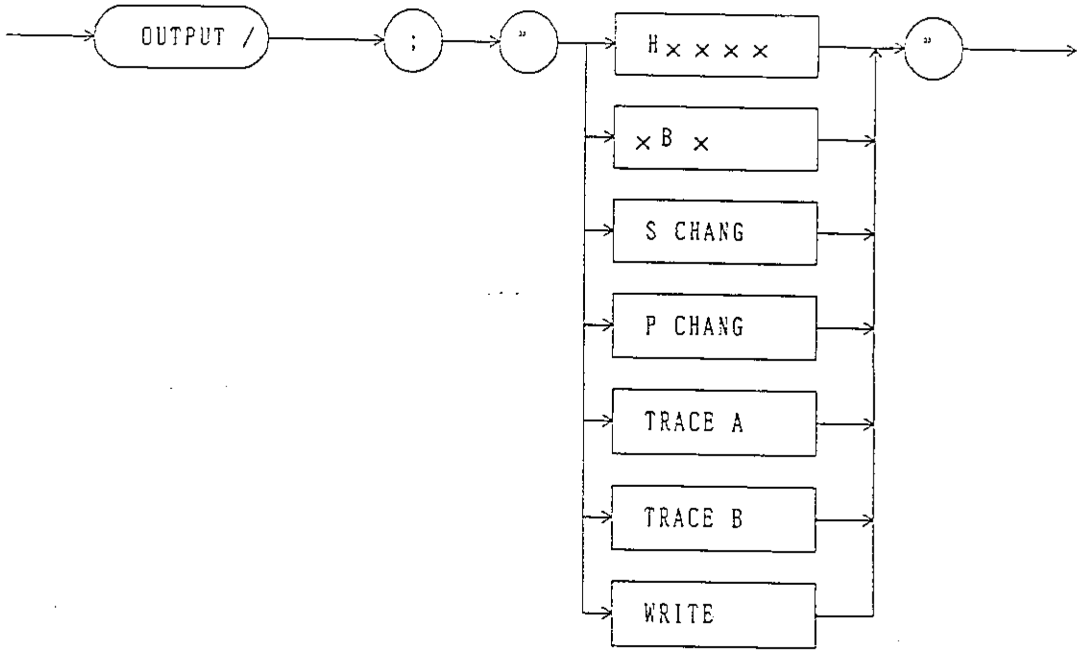
```
10  FOR I=0 TO 2
20  ENTER/; A(I)
30  NEXT I
```

③ OUTPUT/

Outline

Send data to parallel port

Syntax




OUTPUT / ; " { H ×××× or ×B× or S CHANG or P CHANG or TRACE A or TRACE B or WRITE } "

Description

| | | |
|---|---|---|
| Hxxxx | : | Specify hexadecimal data in four digits. |
| x Bx | : | Specify bit position (in hexadecimal) in the first (x) of the data (current I/O port) sent by the statement which most closely resembles this x Bx statement, and specify 1(set)/0(reset) in the next x. |
| S CHANGE | : | Specify change of parallel port to secondary port. |
| P CHANGE | : | Specify change of secondary port to parallel port. |
| TRACE A | : | Since all waveform data stored in trace A memory is sent to parallel ports, use this designation to change to parallel ports. |
| TRACE B | : | Since all waveform data stored in trace B memory is sent to parallel ports, use this designation to change to parallel ports. |
| WRITE | : | Send all write memory waveform data to parallel ports. |

Example

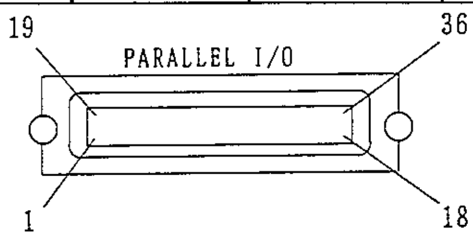
```
 1  OUTPUT/; "P CHANGE"
10  OUTPUT/; "H1248"
20  OUTPUT/; "OBO"
30  OUTPUT/; "TRACE A"
```

## 7.4 16-bit PARALLEL I/O

### 7.4.1 Connector Signal Specifications

Table 7-9 Connector Specifications

| Connector pin No. | Signal name | Connector pin No. | Signal name |
|---|---|---|---|
| 1 | GND | 19 | GND |
| 2 | D0 | 20 | D8 |
| 3 | D1 | 21 | D9 |
| 4 | D2 | 22 | D10 |
| 5 | D3 | 23 | D11 |
| 6 | D4 | 24 | D12 |
| 7 | D5 | 25 | D13 |
| 8 | D6 | 26 | D14 |
| 9 | D7 | 27 | D15 |
| 10 | DIR | 28 | GND |
| 11 | RFD/$\overline{\text{DAV}}$ | 29 | IN0 |
| 12 | $\overline{\text{ACK}}$ | 30 | IN1 |
| 13 | $\overline{\text{BE}}$ | 31 | OUT0 |
| 14 | $\overline{\text{RD}}$ | 32 | OUT1 |
| 15 | $\overline{\text{WR}}$ | 33 | C/$\overline{\text{D}}$ |
| 16 | $\overline{\text{CE}}$ | 34 | GND |
| 17 | GND | 35 | GND |
| 18 | NC | 36 | NC |



### 7.4.2 I/O Specifications

Level: TTL
Open collector output
IOL MAX 24 mA

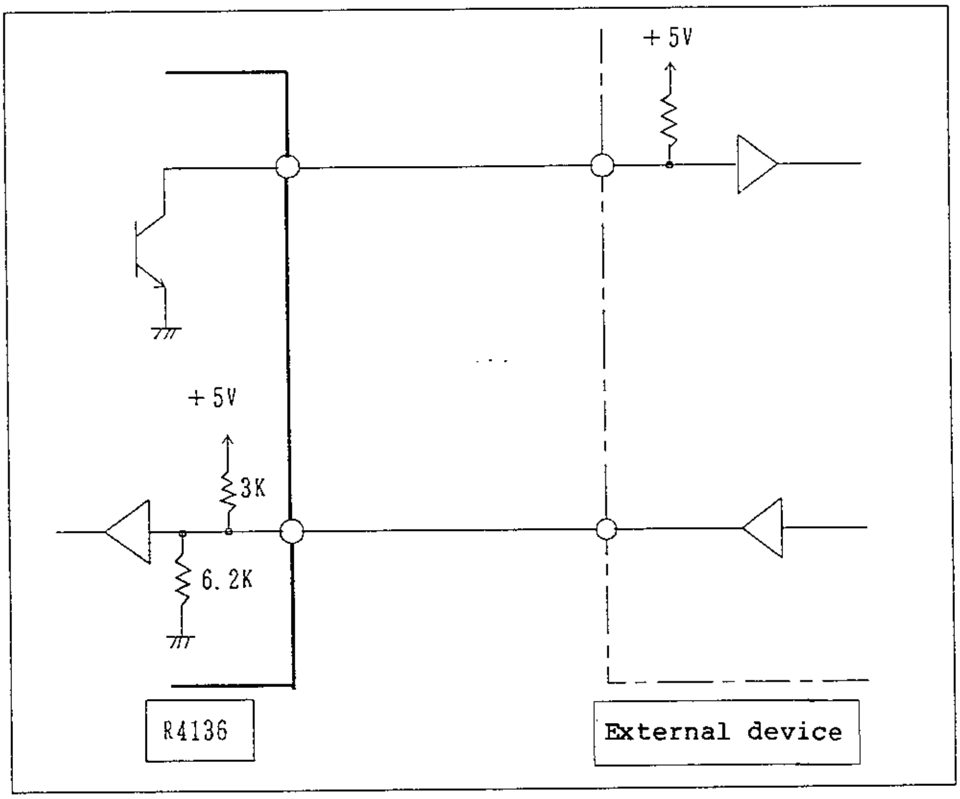



Figure 7-9 I/O Specifications

| | | |
|---|---|---|
| D0 to D15 | : | 16-bit I/O data |
| IN0 and IN1 | : | Auxiliary input |
| Out0 and OUT1 | : | Auxiliary output |
| DIR | : | Data direction "H" input, "L" output |
| RFD/$\overline{\text{DAV}}$ | : | Ready for data /Data valid |
| $\overline{\text{ACK}}$ | : | Acknowledge input |
| $\overline{\text{BE}}$ | : | Buffer enable (active low) |

Note: Open $\overline{\text{RD}}$, $\overline{\text{WR}}$, $\overline{\text{CE}}$ and C/$\overline{\text{D}}$.

### 7.4.3 Handshake Specifications

Two-line type interlock handshake requiring response from an external equipment.

(1) Output Handshake

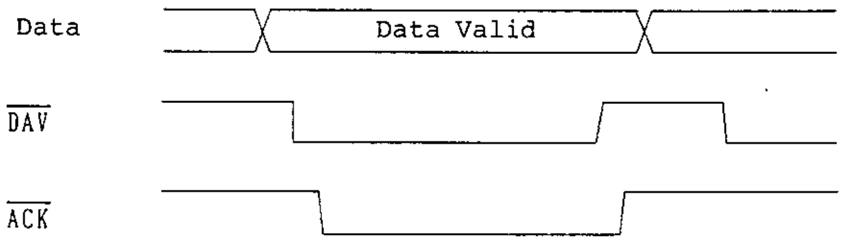



Figure 7-10 Output Handshake

Lowering the $\overline{DAV}$ to "L" transmit it to an external equipment that the output data is valid, when data is in buffer and ACK is "H". (External equipment is in ready-to-receive state.) When the external equipment lowers $\overline{ACK}$ to "L" to indicate receiving the data, $\overline{DAV}$ is restored to "H". Then, the external equipment raises $\overline{ACK}$ to "H" and requires the next data.

(2) Input Handshake

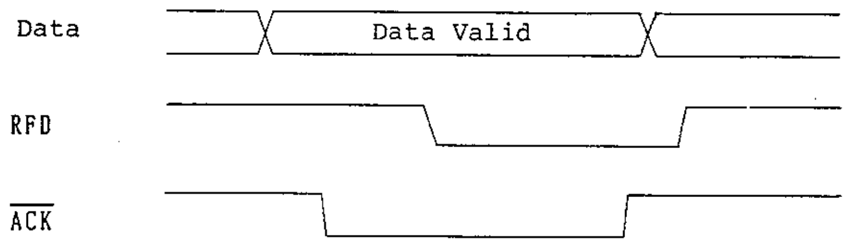



Figure 7-11 Input Handshake

RFD is raised to "H" to inform an external equipment of ready-to- receive state. When ACK is lowered to "L", input data is fetched. Then, receiving the input data is informed to the external equipment by lowering RFD to "L". When ACK is raised to "H" again, RFD is restored to "H" to indicate ready-to-receive state for the next data.

### 7.4.4 Auxiliary I/O

Auxiliary I/O line connected to the internal register is valid irrespective of $\overline{BE}$ signal. State of the external equipment can be monitored by the input line. And, I/O port can be used for latch output line to ACK terminal.

# 7.5 ANTENNA CORRECTION

## 7.5.1 Correcting Function

The correcting function is used when the frequency characteristics such as antenna correcting factor, etc. are corrected.

For the correction, the corrected measured result can be displayed on the CRT by inputting the frequency and the correcting value (level) in the program mode.

For the interval between the input correction data, calculate the correction value by means of straight line interpolation to perform correction (see the figure below).

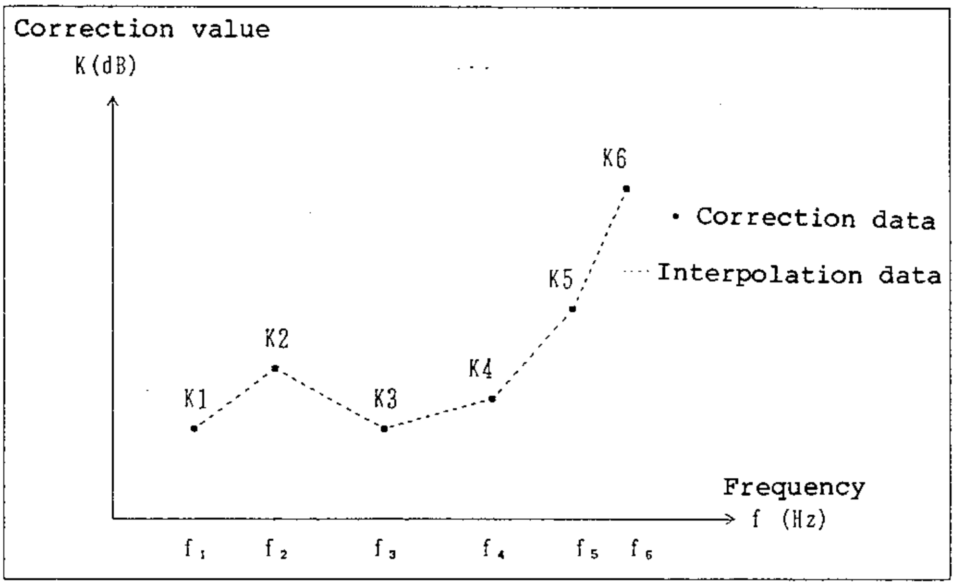



Figure 7-12 Correction Data and Interpolation Data

Since this interpolated correction data is stored in the B memory, it can be displayed on the CRT by the view B. For the interpolation data, the correction value is calculated with a frequency interval of 1/700 set span of R4136.

For the correction error, the smaller the set span and the smaller the change of correction value, the smaller the correction error.

For example, when the set span is set to $f_3$ (Hz) for start frequency and to $f_5$ (Hz) for stop frequency, the correction data can be calculated with a frequency interval of $\Delta f = f_5 - f_3/700$ (See the figure below).

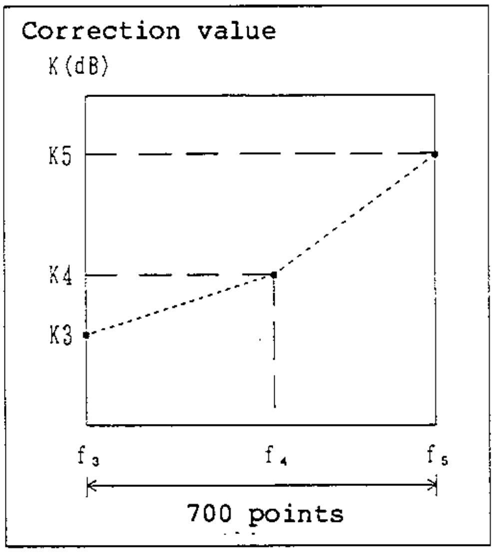



Figure 7-13 Amendment Error

The Max. error in this case is as follows:

$$3,\ 4 = \pm \frac{k_4 - k_3}{(f_4 - f_3)/\Delta f} \text{ (dB)} \quad \text{(The error between } f_3 \text{ and } f_4\text{)}$$

$$4,\ 5 = \pm \frac{k_5 - k_4}{(f_5 - f_4)/\Delta f} \text{ (dB)} \quad \text{(The error between } f_4 \text{ and } f_5\text{)}$$

Caution

The correcting function cannot be used for the linear level display and the log span display.

### 7.5.2 Configuration of Softkey Menus

(1) Configuration and Description of Softkey Menus when Correction Data is Created

- Configuration of Softkey Menus

When correction data is created, the softkey menus are configured as shown in A1.3.4 (3)-(c).

- Description of Softkey Menus

①

| | |
|---|---|
| RUN | |
| CONT | |
| STEP | |
| EDIT | |
| CORR. TABLE | Enters the correction data creation mode and displays the softkey menu ②. |
| RESULT CLEAR | |

②

| | |
|---|---|
| DATA ENTRY | Registers, changes, or deletes correction data after it is entered in the active area. |
| ACTIVE CLEAR | Clears the active area and actives [POINT] for inverse display. |
| NEXT PAGE | Displays the next page of correction data currently displayed on the CRT. |
| PREV PAGE | Displays the previous page of correction data currently displayed on the CRT. |
| MEMORY | Activates the memory function. |
| PLOTTER | Outputs on the plotter a correction table currently displayed on the CRT and displays the softkey menu ③. |
| RETURN | Exits from the correction data creation mode and returns you to the softkey menu ①. |

③

| | |
|---|---|
| RUN | Outputs correction data on the plotter. |
| CANCEL | Cancels plotting of correction data. |
| RETURN | Returns you to the softkey menu ②. |

④

| | |
|---|---|
| SAVE | Saves correction data in memory. |
| RECALL | Recalls data from menory. |
| RETURN | Returns you to the softkey menu ②. |

(2) Configuration and Description of Softkey Menus when Correction is Executed

- Configuration of Softkey Menus

When correction is executed, the softkey menus are configured as shown in A1.3.1 (1).

- Description of Softkey Menus

①

| | |
|---|---|
| DISP LINE ON | |
| DISP LINE OFF | |
| INPUT SEL. | |
| | |
| TRACE DET | |
| DISP FUNC. | Enters the correction execution mode and displays the softkey menu ②. |
| INTENS | |

②

| | |
|---|---|
| B-A | |
| INPUT -A | |
| A<->B | |
| INPUT -B | |
| CORR WRITE | Corrects WRITE waveforms and displays the softkey menu ③. |
| CORR A VIEW | Corrects waveforms stored in memory A. |
| RETURN | Returns you to the softkey menu ①. |

③

| | |
|---|---|
| AVG | Selects the AVeraGing function and displays the softkey menu ④. |
| MAX HOLD | Selects the MAX HOLD function and displays the softkey menu ⑤. |
| OFF | Clears the MAX HOLD function. |
| RETURN | Returns you to the softkey menu ②. |

④

| | |
|---|---|
| OFF | Clears the AVeraGing function. |
| STOP/ RESTR | Stops averaging when pressed once and restarts it when pressed twice. |
| 8 | Sets the number of times of averaging to 8. |
| 16 | Sets the number of times of averaging to 16. |
| 32 | Sets the number of times of averaging to 32. |
| 64 | Sets the number of times of averaging to 64. |
| 128 | Sets the number of times of averaging to 128. |

⑤

| | |
|---|---|
| OFF | Clears the MAX HOLD function. |
| STOP/ RESTR | Stops the MAX HOLD function when pressed once and restarts it when pressed twice. |

### 7.5.3 Creation of Correction Data Table

Precautions before creating the correction data.

① The correction data can be set up to a max. of 50 points. That is, straight line interpolation in the section for each point can be performed for 49 sections.
(However, setting at least 2 points is necessary)

② Setting for each frequency can be performed in the range of 0 to 4 GHz. The minimum unit is up to kHz.

③ The setting of each level (Correction value) can be performed in the range of −120 to +120 dB. The minimum unit is up to 0.01 dB.

④ When the power supply for this device is turned off, all the created correction data is erased, therefore, when the data is to be stored, either process by using the memory function (see section 7.5.5) or stored the data in the MEMORY-CARD (see section 7.1.4 (7)).

(1) Correction Data Creation Mode

When the keys are pressed in the sequence of PROGRAM [P] to [CORR. TABLE], the screen is changed over to the correction data creation mode shown in the figure below. This mode is used to create the data table using the correction value corresponding to each frequency band by inputting the point, frequency, and the correction value to perform straight line interpolation for each point.

When creation of correction data is ended, press the [RETURN] key to exit this mode.

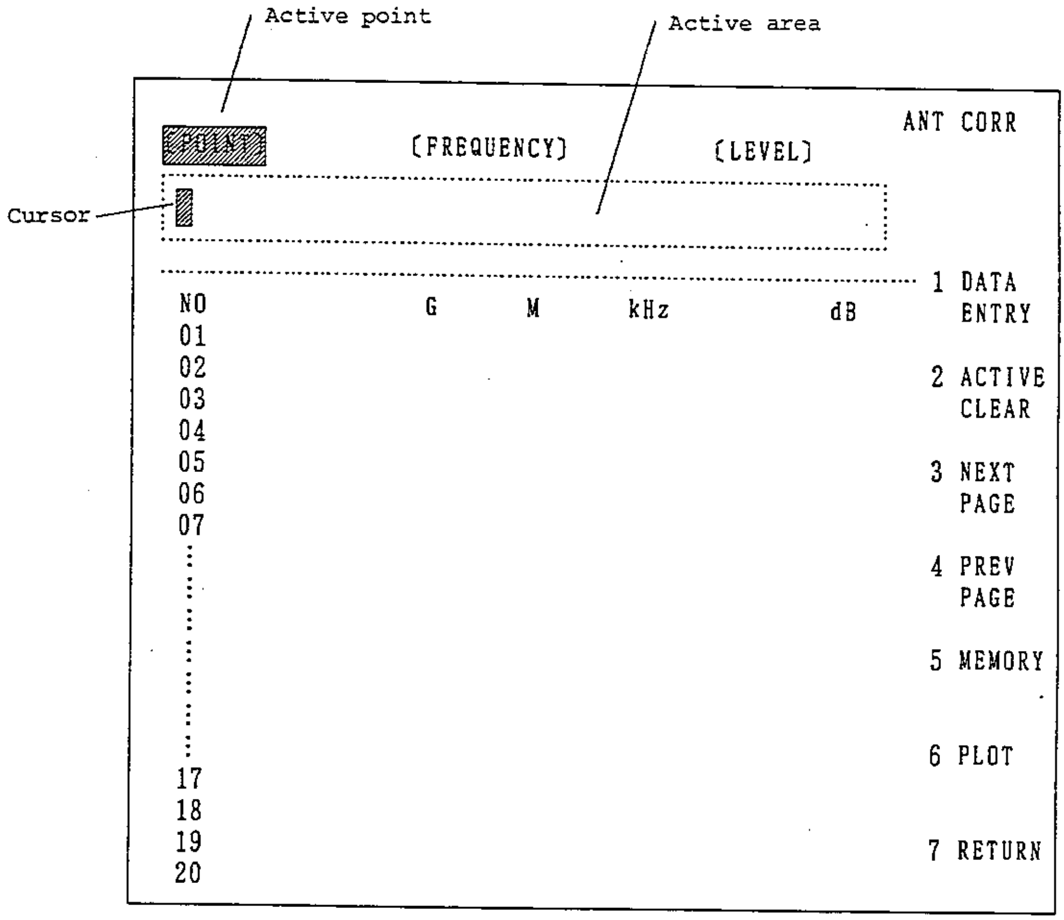



Figure 7-14 Display of the Correction Data Creation Mode

(2) Creation of Correction Table

① The keys used for creation of correction table

[0] to [9], [.] : Input the numeric data

[BK SP] : Erases the data being input.

[⇧] : Moves to the right by one active pointer

[⇩] : Moves to the left by one active pointer

[+/-] : Inputs or erase (-) to or from the level.

② Erasure of all correction tables

②-1 Erase the active area using the [ACTIVE CLEAR] key.

②-2 Adjust the active pointer to [POINT], and press the [DATA ENTRY] key after pressing the [+/-] key twice.

All correction tables are then erased. However, the correction table saved in the backup memory is not erased.

③ Registration to the correction table

Register the frequency and the level as one point data.

| Example: For the registration of frequency 95 MHz, level 11, and 0 dB. |
|---|

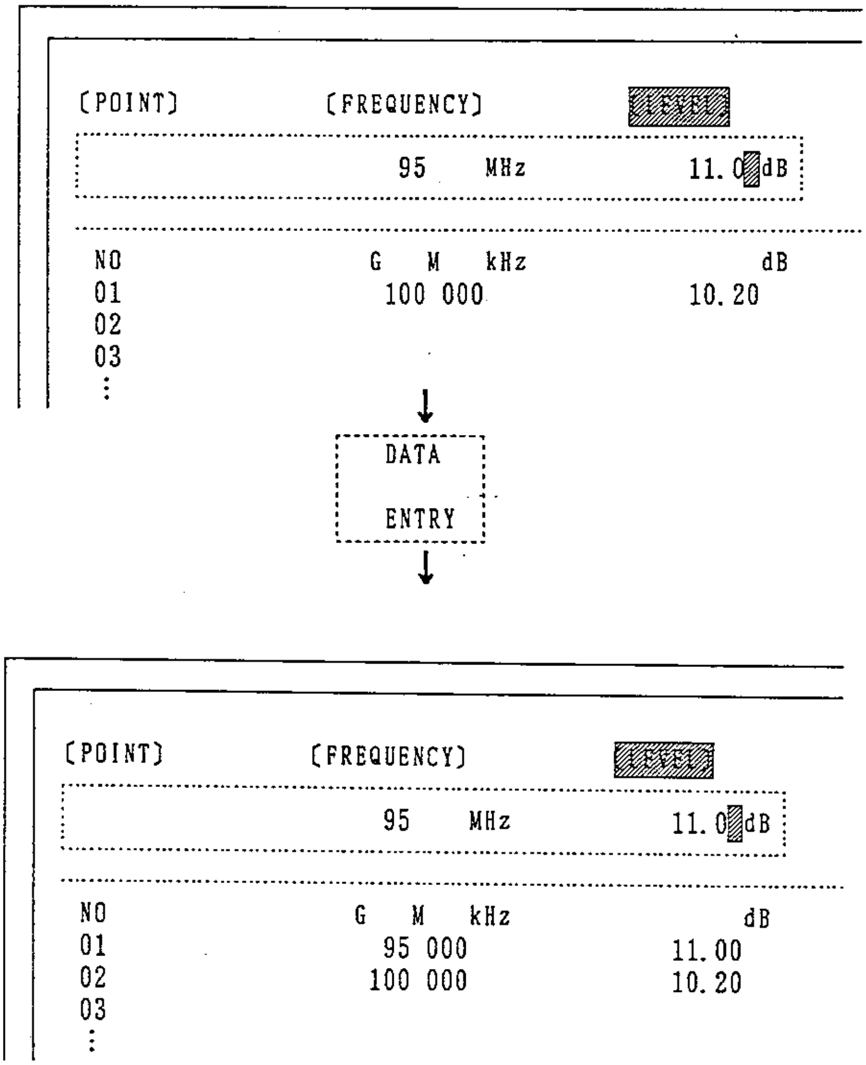
③-1 Adjust the active pointer to [FREQUENCY] and input [9] [5] [MHz sec].

③-2 Adjust the active pointer to [LEVEL] and input [1] [1] [0] [GHz dB].

③-3 When checking the input data, press [DATA ENTRY].

The correction data of one point can then be registered in the correction table.

When data of the same frequency as the data which has already been registered is to be registered, or when either the frequency or level is lacking, an error is assumed so, input the suitable data again.




By performing the above operations continuously, the correction data can be registered.

The correction tables are always displayed with the arrangement in the sequence of lower frequency changed, and No. of [POINT] is also automatically added.

④ Erasure of one point from the correction table

Erase one point from the data already registered in the correction table. The point to be erased is specified by No. of [POINT].

Example: For erasure of No. 2.

④-1 Erase the active area using the ACTIVE CLEAR softkey.

④-2 Adjust the active pointer to [POINT] and press the DATA ENTRY key after pressing [0] [2].

One point is then erased from the correction table. In this case, any data written in the frequency of active area or in the level area, causes an error, so be sure to erase the active area.

[POINT] [FREQUENCY] [LEVEL]

02

| NO | G M kHz | dB |
|---|---|---|
| 01 | 100 000 | 10.20 |
| 02 | 101 000 | 11.00 |
| 03 | 102 000 | 9.50 |
| 04 | | |
| ⋮ | | |

↓

DATA ENTRY

↓

[POINT] [FREQUENCY] [LEVEL]

02

| NO | G M kHz | dB |
|---|---|---|
| 01 | 100 000 | 10.20 |
| 02 | 102 000 | 9.50 |
| 03 | | |
| 04 | | |
| ⋮ | | |

⑤ Update one point of correction table

Update one point of the data already registered in the correction table.

The point to be updated is specified by No. of [POINT].

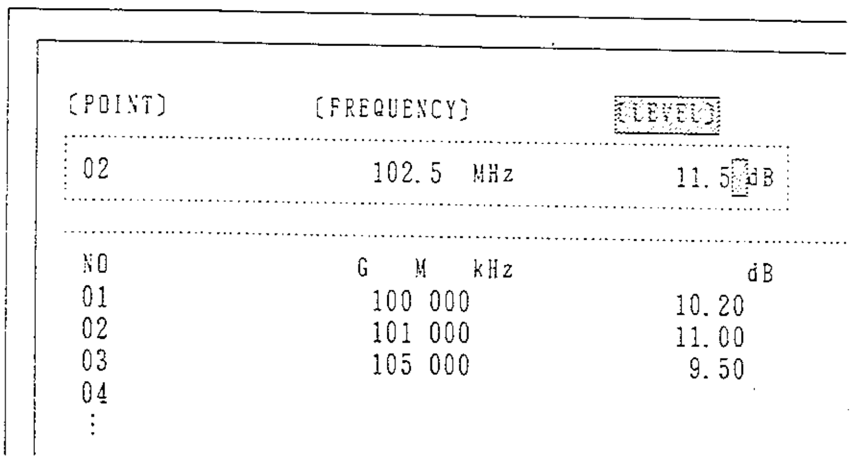
| Example: To update No. 2. |
|---|

⑤-1 Adjust the active pointer [POINT] and press [0] [2].

⑤-2 Adjust the active pointers of frequency and level to [FREQUENCY] and [LEVEL] respectively to input.

⑤-3 Press the DATA ENTRY key. The No. 2 correction table can then be updated.

In this case, when either frequency or level is lacking, an error is caused, so input the suitable data again.




↓

DATA ENTRY

↓

```
[POINT]            [FREQUENCY]            [LEVEL]

 02                   102.5  MHz          11.5 dB

 NO                 G   M   kHz               dB
 01                 100 000                10.20
 02                 102 500                11.50
 03                 105 000                 9.50
 04
 :
```

⑥ Correction table message

When the DATA ENTRY softkey is pressed, any message is always displayed on the lowest line of the display. The details are as follows:

entry ok ..... DATA ENTRY For normal termination

point error..... The point specification is not suitable (out of range of 1 to 50, etc.)

freq. error..... The specification of frequency is not suitable (such as, no unit/out of range of 0 to 4 GHz/the same value as the data already has been input)

level error..... The level specification is not suitable (such as, no unit/out of range of ±120 dB)

point over ..... When input exceeding 50 points is to be performed.

### 7.5.4 Execution of Correction

Execute the correction table created in the programming mode. (By means of RECALL of memory function or LOAD from MEMORY-CARD, the correction table is recovered optionally and also can be executed.) (See sections 7.5.5 and 7.1.4 (7).)

① Execution procedure

| | | | |
|---|---|---|---|
| TRACE [MENU] | DISP FNC | CORR. WRITE | : When the input is WRITE waveform. |
| TRACE [MENU] | DISP FNC | CORR. A VIEW | : When the input is the data stored in the A memory. |

By the operations mentioned above, the trace changes to the correction execution mode, and "corr. wr" or "corr. A" is displayed on the upper right of the screen.

The straight line interpolation data is written in the B memory setting the center of scale to 0 dB.

② Change of input signal or correction value

Even if the setting of input (center frequency, span, etc.) or change of correction value is performed during the correction execution mode, the correction is automatically performed again for every change.

③ Cancellation of execution of correction

When the trace mode is set to any mode except for "corr. XX", the execution of correction stops.

Example of execution of correction

When the signal shown in Figure b is corrected by means of the correction table shown in Figure a, the waveform shown in Figure c is taken. The straight line interpolation data is shown in Fig d.

ANT

| [POINT] | [FREQUENCY] | [LEVEL] |
|---|---|---|
| NO | G M kHz | dB |
| 01 | 199 500 | 0.00 |
| 02 | 199 600 | 10.00 |
| 03 | 199 700 | 5.00 |
| 04 | 199 800 | - 10.00 |
| 05 | 199 900 | 15.00 |
| 06 | 200 000 | 10.00 |
| 07 | 200 100 | 0.00 |
| 08 | 200 200 | 10.00 |
| 09 | 200 300 | 0.00 |
| 10 | 200 400 | - 5.00 |
| 11 | 200 500 | 0.00 |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |
| 18 | | |
| 19 | | |
| 20 | | |

Figure a

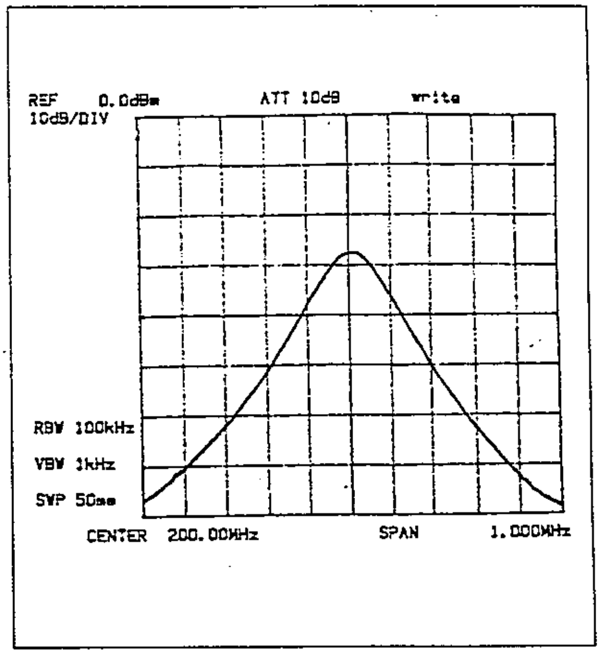



Figure b

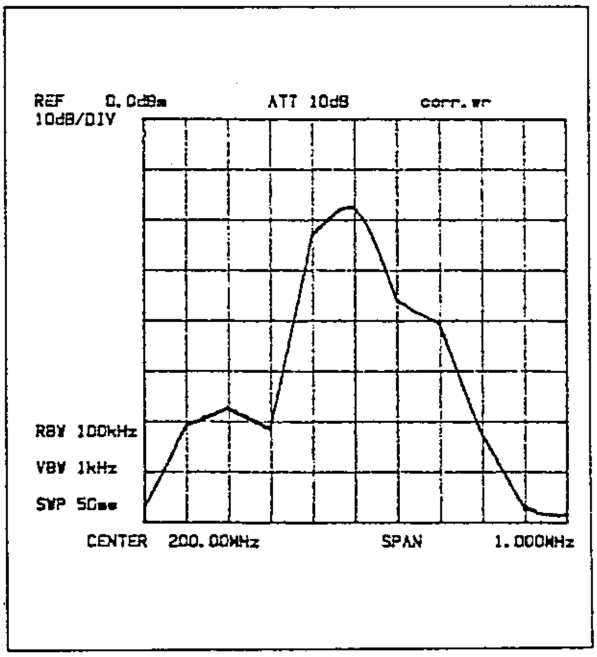



Figure c

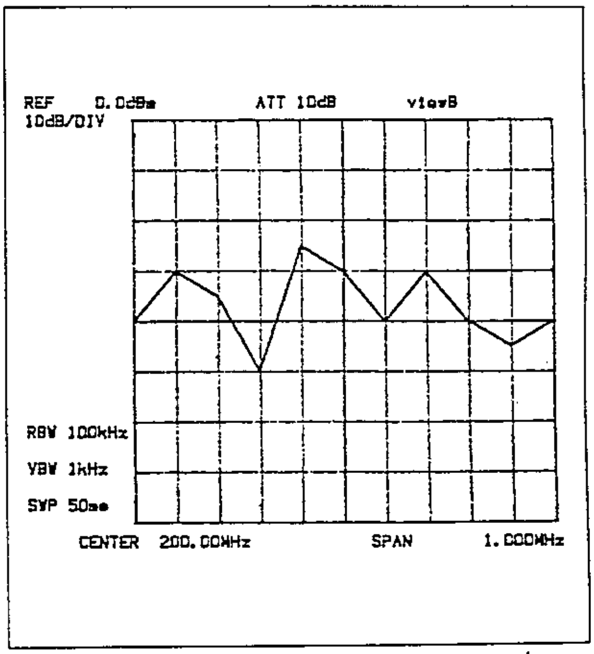



Figure d

Figure 7-15 Example of Execution of Correction

### 7.5.5 Memory Function

Since this device incorporates a backup memory to store the correction data, this function is used when data storage is required.

| | |
|---|---|
| MEMORY | : This menu is selected when the memory function is used. The menu is returned to the original softkey menu using the RETURN key. |
| SAVE | : This menu is selected when the correction data is stored (save). When the save is completed, "save end" is displayed on the lower part of the screen. |
| RECALL | : This menu is selected when the saved data is recovered (recall) as required. When the recall is completed, "recall end" is displayed on the lower part of the screen, and the screen is rewritten with the data recalled. |

### 7.5.6 Registration and Recall to MEMORY-CARD

For the operation method, refer to [7.1.4 (7) Table].

### 7.5.7 Plotter Output

The basic program now displayed on the screen can be output on the plotter.

| | |
|---|---|
| Example: | Example of plotting a program on the upper left portion of four divisions using the plotter TR9835 manufactured by our company. (Single color, A4 size.) |

① Check that the LED lamp of PROGRAM is turned off.

② Press f PLOT TR-PLOTER TR9835 ALL (or DATA) SMALL 4PICTURES UPPER LEFT.

③ Press PROGRAM to light the LED lamp.

④ Press CORR. TABLE PLOT RUN.

The plotter output is started. To stop the operation during the plotter output, press CANCEL.

⑤ When the plotter output is ended, press the RETURN.

MEMO

# 8. INSPECTION

## 8.1 INSPECTION AND SIMPLIFIED TROUBLESHOOTING

Should a problem occur in the equipment, check the problem using the following chart before contacting us for repair. If any of the remedies contained in the chart does not help solve the problem, please contact our CE head office (in CE center in Yokohama), nearest sales office or service agent (their address and telephone number are given at the end of this manual). We will charge for any repair work we do (even it is included in the chart).

Table 8-1 Troubleshooting

| Malfunction | Cause | Action to be taken |
|---|---|---|
| Power has not been supplied. | The power cable was not firmly inserted into the connector. | Turn off the power and reinsert the power cable. |
| | Line fuse blown | Replace the line fuse (see Page 1-8). |
| Waveform is not output on the CRT while SWEEP LAMP lights. | Not enough INTENSITY | Press TRACE MENU and select the softkey function INTENS to adjust the INTENSITY. (See Page 3-30.) |
| | The input cable and connector are not installed firmly. | Reinstall the input cable and connector firmly. |
| Sweeping operation failed. | The trigger was set to SINGLE. | Press TRIG and select the softkey function FREE RUN (See page 3-20). |
| | The WRITE LED did not light. | Press WRITE to set the WRITE memory display mode. |
| | The GPIB remote control mode was set. | Suspend program execution and press LCL. |
| Zero carrier is not displayed. Sweep does not occur when frequency span is 200 MHz or less. | INT/EXT switch of the reference frequency signal INPUT/OUTPUT pin on the rear panel is set to EXT although an external reference signal is not input. | INT/EXT selector is set to INT side. |
| The signal level is vague. | AMPTD CAL was not adjusted. | Input the CAL OUT signal and turn the AMPTD CAL control volume to adjust the reference level to -10 dBm. |
| Key functions are not valid. | The GPIB remote control mode was set. | Suspend program execution and press LCL. |

MEMO

# 9. SPECIFICATIONS AND ACCESSORIES PROVIDED

## 9.1 SPECIFICATIONS

### (1) Frequency

Frequency range : 0.5 kHz to 23 GHz (an external mixer can be connected)

Center frequency display : Displayed on the CRT screen (maximum resolution: 10 Hz)

Accuracy of center frequency display:

| | |
|---|---|
| When span ≦ 2 MHz | ±(3% of span + center frequency x reference oscillator accuracy + n x 100 Hz) |
| When span > 2 MHz | ±(2% of span + center frequency x reference oscillator accuracy + n x 50 kHz |
| At zero span | ±(Center frequency x reference oscillator accuracy + n x 30 Hz |

Reference oscillator accuracy: $2 \times 10^{-7}$/Week, $1 \times 10^{-6}$/Year or external reference time source (10 MHz)

Frequency span : LIN: 2 kHz to 25 GHz (±1%)
LOG: Decade 1, 2, or 3 is selected from the range from 10 kHz to 1000 MHz

Frequency span accuracy : LIN: ±3% (except during multiband sweeping)

Noise sideband :

| | |
|---|---|
| (-85 + 20 logn) dBc/Hz | Offset frequency from carrier: 1 kHz |
| (-100 + 20 logn) dBc/Hz | Offset frequency from carrier: 10 kHz |
| (-105 + 20 logn) dBc/Hz | Offset frequency from carrier: 20 kHz |

Residual FM : n x 50 kHzp-p or less (frequency span > 10 MHz)
: n x 20 kHzp-p or less
(10 MHz ≧ frequency span > 2 MHz)
: n x 30 Hzp-p or less (frequency span ≦ 2 MHz)

Frequency drift: n x 500 Hz/min (frequency span ≦ 2 MHz)
(center frequency is corrected at each sweep)

Resolution:

3 dB bandwidth : 30 Hz to 1 MHz, at 1.3 steps
6 dB bandwidth : 200 Hz, 9 kHz, 120 kHz
Bandwidth selectivity: 15:1 or less (60 dB : 3 dB resolution bandwidth ratio)
Bandwidth stability : ±20% or less; 200 Hz, 9 kHz, and 120 kHz comply with CISPR standards.

Marker display stability:

Normal mode : Center frequency accuracy + span stability
Counter mode: Reference oscillator accuracy + n x 30 Hz
(Span < 2 MHz)

*n = Degree of harmonic mixing

n = 1 0.5 kHz to 7.5 GHz
n = 2 7.2 GHz to 15.2 GHz
n = 3 14.9 GHz to 23 GHz

(2) Amplitude

Measuring range : -131 dBm to +30 dBm

Screen display range:

LOG mode: 80 dB at 10 dB/div.
: 40 dB at 5 dB/div.
: 20 dB at 2 dB/div.
: 10 dB at 1 dB/div.
: 5 dB/div. in QP mode
LIN mode: Set in 10 div.

Linearity:

LOG mode: ±0.15 dB/1 dB
: ±1 dB/10 dB
: ±1.5 dB/70 dB
LIN mode: ±5% of reference level

Reference level:

| | | |
|---|---|---|
| Display range | : | -69.9 dBm to +40 dBm (37.1 dBμ to 147 dBμ) set at 0.1 dB. |
| Accuracy | : | Less than ±2 dB in LOG mode (within the range from 0 to -59.9 dBm after corrected with 200 MHz and 10 dB input attenuation) |
| Unit | : | dBm, dBμ, dBμ (EMf), dBμ/m (dBμ/m: Calibration factor of antenna is internally corrected) |

Marker display resolution: 0.2 dB (10 dB/div.)
0.1 dB (5 dB/div.)
0.05 dB (2 dB/div.)
0.03 dB (1 dB/div.)

Dynamic range:

Average noise level (at 30 Hz resolution bandwidth and 0 dB input attenuation with 1 Hz video filter):
Less than -131 dBm + 0.8 f (GHz) dB (1 MHz to 3.6 GHz)
Less than -125 dBm (3.5 GHz to 7.5 GHz)
Less than -119 dBm (7.2 GHz to 15.2 GHz)
Less than -115 dBm (14.9 GHz to 23 GHz)

Second and third distortion:
Less than -70 dBc (at -30 dBm mixer input level and 10 MHz to 3.6 GHz frequency range)
Less than -100 dBc (at -0 dBm mixer input level and 3.5 GHz to 23 GHz frequency range)

Frequency response (at 10 dB input attenuation):
Less than ±1 dB (100 kHz to 2 GHz)
Less than ±2 dB (0.5 kHz to 3.6 GHz)
Less than ±1.5 dB (3.5 GHz to 7.5 GHz)
Less than ±2.5 dB (7.2 GHz to 15.2 GHz)
Less than ±4 dB (14.9 GHz to 23 GHz)

Residual response: Less than -100 dBm (at 100 kHz or more)
Video bandwidth : 1 MHz, 100kHz, 10 kHz, 1 kHz, 100 Hz, 10 Hz, 1 Hz

Resolution bandwidth selecting accuracy (at 300 kHz and +20°C to +30°C): ±1 dB (1 MHz to 100 Hz), ±2 dB (30 Hz)

(3) Sweep

| | | |
|---|---|---|
| Sweep time | : | 50 ms to 1000 s at 1, 2 and 5 intervals, and manual sweeping |
| Sweep time accuracy: | | ±15% (50 ms to 100 s), ±25% (200 s to 100 s) |
| Trigger mode | : | FREE RUN, LINE, VIDEO, TV-V EXT., SINGLE |

(4) Inputs

| | | |
|---|---|---|
| Input impedance | : | Approx. 50Ω |
| Connector | : | N-connector (changeable to SMA-connector) |
| Maximum input level: | | +30 dBm (with input attenuation greater than 20 dB) |
| Input attenuator | : | 0 to 55 dB at 5 dB increments |

Input attenuator selecting accuracy:
±0.5 dB at 50 MHz input frequency and 10 dB to 55 dB attenuation range

(5) Display

| | | |
|---|---|---|
| Display | : | Waveform, setting conditions and grids |
| CRT size | : | 7 inches |
| Trace | : | 2 screens for WRITE and VIEW-waveform |
| WRITE | : | Input signal is displayed at each sweep |
| STORE | : | WRITE waveforms are stored. |
| VIEW | : | Data stored in the memory is displayed. |
| MAX HOLD | : | Maximum signal level at points on the horizontal axis is displayed each time sweep is repeated after the measurement is started. |
| AVG | : | Average at each sweep is displayed when the measurement s started. |

(6) Outputs

Output signal for calibration:
-10 dBm ±0.3 dB
200 MHz ±(200 MHz x reference oscillator accuracy)

Probe power : ±15 V, 4-pin connector

Monitor output : Audible with approx. 8Ω earphone

GPIB data output and remote control:
The GPIB implements both data input/output and remote control. The contents displayed on the screen can be output to a plotter (TR9832/9835, R9833) by connecting it via the GPIB, not requiring the controller.

Recorder outputs (only WRITE waveforms are given as analog outputs):
X axis: Approx. −5 to +5 V at approx. 10 kΩ output impedance
Y axis: Approx. 0 to +4 V at approx. 220 Ω output impedance
Z axis: TTL level; Low at blanking

Video output : Approx. 1 V p-p at approx. 75Ω impedance, composite signals

3.58 MHz, IF output: Approx. 50Ω output impedance; approx. 0 dBm with screen full scale

226 MHz, IF output : Approx. 50Ω output impedance; approx. −20 dBm at −20 dBm mixer input level; approx. 15 MHz bandwith

1st local output: −5 dBm or more; approx. 3.7 GHz to 7.7 GHz
+7 dBm or more (For external mixer)
2nd local output: −5 dBm or more; 3.77 GHz 13.775GHz (at 2nd IF frequency shift)

(7) General Specifications

Operating environment range:
Temperature : 0°C to +50°C
Relative humidity: 85% or less

Storage temperature: −20°C to +60°C

Power source :

| Option No. | Standards | 32 | 42 | 44 |
|---|---|---|---|---|
| Line voltage (V) | 90 V to 110 V | 103 V to 132 V | 198 V to 242 V | 207 V to 250 V |

Line frequency : 48 to 66 Hz

Power consumption : 215 VA or less.

External dimensions: Approx. 424 (long) x 221 (high) x 500 (wide) mm

Weight : 32 kg or less

(8) Options

04: Occupied bandwidth measurement and adjacent channel leakage power measurement
06: Memory card

Other Optional Devices

| Option No. | Measurement Range (GHz) | Wave Guide Taper | Flange | 1st Local Osc Connecting cable |
|---|---|---|---|---|
| 11 | 18 to 26.5 | TR1662 | UG595/U | A01202 |
| 12 | 26.5 to 40 | TR1663 | UG599/U | |
| 13 | 18 to 40 | TR1662<br>TR1663 | UG595/U<br>UG599/U | |
| 15 | 18 to 26.5 | - | UG595/U | Use A01002 provided with R4136 |
| 16 | 26.5 to 40 | - | UG599/U | |
| 17 | 40 to 60 | - | UG383/U-U | |

Each of Opts. 15 to 17 does not require a wave guide taper.
The mixer for each of Opts. 11 to 13 uses TR1661.
The 1st local osc connecting cable for each of Opts. 11 to 13 is provided as an accessory.
Each of the above Opts. 11 to 17 is provided with data.

Electrical Properties of Optional Devices (typical values)

| Option No. | Measurement Range (GHz) | Sensitivity *1 | Calibrated Value *2 | Frequency Response After Calibration |
|---|---|---|---|---|
| 11 | 18 to 26.5 | -100 dBm +0.5 f (GHz) | +4 dB +0.5 f (GHz) | ±5 dB |
| 12 | 26.5 to 40 | -100 dBm +0.5 f (GHz) | +4 dB +0.5 f (GHz) | ±5 dB |
| 13 | 18 to 40 | -100 dBm +0.5 f (GHz) | +4 dB +0.5 f (GHz) | ±5 dB |
| 15 | 18 to 26.5 | -94 dBm | +11 dB | ±3 dB |
| 16 | 26.5 to 40 | -90 dBm | +14 dB | ±3 dB |
| 17 | 40 to 60 | -90 dBm | +14 dB | ±3 dB |

*1: 1 kHz resolution bandwidth, 10 Hz video filter, or after averaging.
*2: Absolute level is readable by adding to R4136 measurement reading.

## 9.2 ACCESSORIES

### (1) Coupler

- TR1625 RF Coupler

Frequency range: DC to 1500 MHz
Maximum input : 50 W
Coupling degree:
  DC - 1000 MHz ; 40 dB ± 1 dB
  1000MHz-1500 MHz; 40 dB ± 2 dB
Impedance : 50Ω/main & sub routes
V.S.W.R. :
  DC - 1000 MHz ; 1.5 or less
  1000MHz-1500 MHz; 2 or less
Insertion loss :
  DC - 1000 MHz ; 1 dB or less
  1000MHz-1500 MHz; 1.5 dB or less
Connector : Main route/N type, sub routes/ BNC type

- TR1626 RF Coupler

Frequency range: DC to 500 MHz
Maximum input : 50 W
Coupling degree: 40 dB ± 1 dB
Impedance : 50Ω/main & sub routes
V.S.W.R. : 1.5 or less
Insertion loss : 1 dB or less
Connector : Main route/N type, sub routes/ BNC type

### (2) Adapter

- BNCP-FJ Conversion Adapter

Withstand voltage : 500 Vac/1 min.
Insulation resistance: 500 MΩ/DC500 V
Contact resistance : 5 mΩ or less
V.S.W.R. : 1.2 or less/ 0.1 GHz or lower

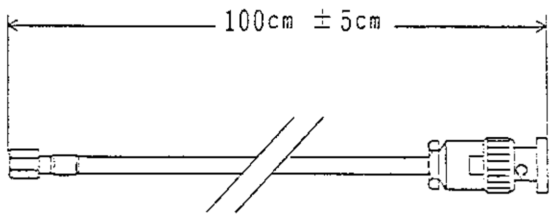
### (3) Earphone

- TR16191 Sound Monitor Earphone

TR4131/E Spectrum Analyzer is designed so that, when setting FREQuency SPAN to ZERO and centering the frequency with the turning knob, the demodulated wave can be not only displayed on CRT but also be listened by earphone.

### (4) Connection cable

Connection cable MC-37     BNC-SMA     DCB-FF1130X01-1



● GPIB connection cable

| Stock number | length |
|---|---|
| 408JE-1P5 | 0.5 m |
| 408JE-101 | 1 m |
| 408JE-102 | 2 m |
| 408JE-104 | 4 m |

(5) Antenna

● TR1711 Log-Periodic Antenna

This is an antenna for wideband reception with the frequency rage from 80 to 1000 MHz. Can be effectively used for radiowave surveillance and for analyzing interference waves generated in wide range.

Frequency rage : 80 MHz to 1000 MHz
Gain : 5 dB ($\lambda/2$ dipole antenna ratio)
Front/back ratio: 14 dB or more
V.S.W.R : 2.5 or less
Input/output impedance: 50 Ω
Weight : Antenna main only about 5 kg
Composition : log-periodic antenna (31-element 2 pcs, antenna main & balancer), angle adjuster ($45^\circ$ - $0^\circ$ - $90^\circ$), Supporting pole, tripod, measurement cable (10 meters with N type connector), element bag, antenna main bag.

● TR1722 Halfwave Dipole antenna

This antenna is used with the element length specifically changed in accordance with the measuring frequency in field strength and interference wave measurement with Spectrum Analyzer.

Frequency range: 25 MHz to 1000 MHz
Element 1: 25 MHz to 80 MHz
Element 2: 80 MHz to 250 MHz
Element 3: 250 MHz to 600 MHz
Element 4: 600 MHz to 1000 MHz
Transmission impedance: 50 Ω
Polarized wave : Horizontal and vertical switchable
Antenna height from ground: approx. 1 m to 4 m

Tripod : Folding type
Accessory coaxial cable: 50D, 2W, 10 m with N type connector

- TR1720 Loop Antenna

| | | |
|---|---|---|
| Frequency range | : | 100 kHz to 30 MHz |
| Antenna tuning section | : | Band 1 100 kHz to 200 kHz |
| | | Band 2 150 kHz to 300 kHz |
| | | Band 3 300 kHz to 600 kHz |
| | | Band 4 600 kHz to 1400 kHz |
| | | Band 5 1.4 MHz to 3.5 MHz |
| | | Band 6 3.5 kHz to 10 MHz |
| | | Band 7 10 MHz to 30 MHz |
| Loop Antenna section | : | 7 loop antennas for Band 1 to 7 |
| Vertical antenna section | : | Settable to total 2 meters and 1 meter |
| Impedance | : | 75 Ω or 50 Ω |
| Dimension and weight | : | |
| Tuning section | : | about 210(W) x 140(H) x 110(D)mm, 2 kg |
| Loop antenna section | : | about 3 kg/set |
| | | largr about 360(W) x 250(H) x 6(D)mm |
| | | small about 250(W) x 190(H) x 6(D)mm |
| Vertical antenna section | : | 2 m total 5-stages, 1 m flexible, 0.2 kg |
| Storing case | : | about 495(W) x 290(H) x 155(D)mm |
| | | aluminum made about 1.9 kg |

- TR17201 Active Antenna for frequencies in the range 10 kHz to 30 MHz

The TR17201 Active Antenna is used for electric field strength measurement, for frequencies between 10 kHz to 30 MHz. Equipped with a low-noice, wide-band amplifier, in which stable antenna factors can be gained, enabling direct and easy reading of the electric field strength.

| | | |
|---|---|---|
| Operating frequency | : | 10 kHz to 30 MHz |
| Antenna factor | : | approx. 10 to 13 dB |
| Output impedance | : | approx. 50 Ω |
| Input impedance | : | 1 MΩ min. (through antenna block) |
| Amplifier gain | : | 7 dB +2 dB nominal |
| Connector | : | BNC |
| Power source | : | 12.6 V with mercury cell (working life approx. 20 hours) |
| External dimensions | : | approx. 131(L) x 108(W) x 77(H)mm. |
| Weight | : | approx. 1 kg |

- TR17203 Active dipole Antenna for 25 MHz to 230 MHz.

Because the antenna factor of the electric field strength measurement for the frequencies between 25 MHz to 230 MHz is almost zero, the TR17302 enables direct reading of electric field strength over a wide area, when used together with the spectrum analyzer TR4131/E.

| | | |
|---|---|---|
| Operating frequency | : | 25 MHz to 230 MHz |
| Antenna factor | : | approx. 0 dB |
| Impedance | : | approx. 50 Ω |
| Connection pin | : | N type |
| Power source | : | 15 V DC (with 10 m long cable) |
| Weight | : | approx. 580 g |

- TR17204 Log-Periodic Antenna for frequencies between 200 MHz to 1000 MHz

The TR17204 enables the wide-band measurement of frequencies between 200 MHz 1000 MHz, without exchanging elements. Being compact and light, it can be used for transmitting and receiving, and is therefore suitable for immunity measurement in harmonics.

| | | |
|---|---|---|
| Operating frequency | : | 200 MHz to 1000 MHz |
| Antenna factor | : | approx. 14 dB to 25 dB at frequencies from 200 MHz to 1000 MHz |
| Impedance | : | approx. 50 Ω |
| Connection pin | : | N type |
| Average V.S.W.R. | : | 2.0 Max. |
| Average gain | : | approx. 7 dB |
| Antenna dimensions | : | approx. 750 (Length) x 750 (Max. Width) x 63.5 (Thickness) mm |
| Weight | : | approx. 2 kg |

- TR17205 Log Spiral Antenna for frequencies between 1 GHz to 10 GHz

The TR17205 conforms to the MIL standard and is used for EMI measurement of frequencies between 1 GHz to 10 GHz. It takes up little space and can easily be used in a sealed room.

| | | |
|---|---|---|
| Operating frequency | : | 1 GHz to 10 GHz |
| Average electric gain | : | 3.75 dB |
| Average V.S.W.R. | : | 2.0 Max. |
| Axial ratio | : | 1 dB Maz. |
| Average beam width | : | $50^{\circ}$ |
| Impedance | : | approx. 50 Ω |
| Polarized wave | : | circular polarization |
| External dimensions | : | approx. 381(Length) x 127 (Max. Diameter) mm. |
| Weight | : | approx. 3.6 kg |

- TR17206 Double-ridged Guide Antenna for 1 GHz to 18 GHz

TR17206 is the most suitable antenna for EMI measurement, and enables the wide-band measurement of the frequencies between 1 GHz to 18 GHz.

| | | |
|---|---|---|
| Operating frequency | : | 1 GHz to 18 GHz |
| Average electric gain | : | 10.7 dB (Isotropic) |
| Average V.S.W.R. | : | 1.5 Max. |
| Impedance | : | approx. 50 Ω |
| Average beam width | : | E Plane 53° |
| | | H Plane 48° |
| Connector | : | N Type |
| External dimensions | : | approx. 280(L) x 245(W) x 159(H) mm. |
| Weight | : | approx. 1.8 kg |

(6) Filter

MEP-293/MEP-294/MEP-295/MEP-29,TR14101

| Model name | | MEP-292 | MEP-293 | MEP-294 | MEP-295 | TR14101 |
|---|---|---|---|---|---|---|
| Item | | High-pass filter | High-pass filter | High-pass filter | High-pass filter | Rejection filter |
| Transceiver frequency band | | 27 MHz | 60 MHz | 150 MHz | 400 MHz | 800 MHz to 900 MHz |
| Operation frequency | | 26 MHz to 30 MHz | 50 MHz to 80 MHz | 120 MHz to 190 MHz | 335 MHz to 520 MHz | 800 MHz to 900 MHz |
| Filter characteristics | Cut-off frequency | 40 MHz | 100 MHz | 240 MHz | 670 MHz | 1200 MHz |
| | Damping characteristics | 35 dB Min. at 28 MHz or below, 40 dB Min. at 27 MHz. | 50 dB Min. at 70 MHz 30 dB Min. at 80 MHz. | 50 dB Min. at 170 MHz 30 dB Min. at 190 MHz. | 50 dB Min. at 470 MHz 30 dB Min. at 520 MHz | 35 dB Min. at 800 MHz to 900 MHz, 30 dB Min. at 800 MHz or below |
| | Pass band | 40 MHz to 300 MHz | 100 MHz to 1000 MHz | 240 MHz to 1000 MHz | 670 MHz to 1500 MHz | 1500 MHz to 3000 MHz |
| | Insertion loss (within pass band) | within 1 dB | within 2 dB | within 2 dB | within 2 dB | within 2 dB |
| Through characteristics | Pass band | DC to 300 MHz | - | - | - | DC to 1000 MHz |
| | Insertion loss (within pass band) | within 1 dB | - | - | - | within 1 dB |
| Characteristic impedance | | 50 Ω (BNCJ-BNCJ) | 50 Ω (NP-NJ) | 50 Ω (NP-NJ) | 50 Ω (NP-NJ) | 50 Ω (NP-NJ) |

(7) Bandpass Filter TR14201/14202/14203/14204

When a measurement conforming to CISPR standard is made with a spectrum analyzer, the following bandpass filters are used to remove any large signals which are outside the measuring band.

| Item | TR14201 | TR14202 | TR14203 | TR14204 |
|---|---|---|---|---|
| Pass band | 10 kHz to 150 kHz | 150 kHz to 30 MHz | 25 MHz to 300 MHz | 300 MHz to 1000 MHz |
| Insertion loss within pass band | within 1.5 dB | within 1.5 dB | within 1.5 dB | within 1.5 dB |
| Damping characteristics | 20 dB Min. at 3.5 kHz or below and at 300 kHz or above | 35 dB Min. at 30 kHz or below and at 60 MHz or above | 35 dB Min. at 12 MHz or below and at 600 MHz or above | 30 dB Min. at 150 MHz or below and at 1500 MHz or above |
| Characteristics impedance (connector) | approx. 50 Ω (NJ-NP) | approx. 50 Ω (NJ-NP) | approx. 50 Ω (NP-NJ) | approx. 50 Ω (NP-NJ) |

External dimensions: approx. 31(H) x 50(W) x 100(L) mm
Weight : approx. 350 g

(8) Recommended parts list (1/3)

| Parts name | Product name | Model | Recommended marker | Remarks |
|---|---|---|---|---|
| Probe | Active probe | *P-6201 | Sony Techtronics | DC-900 MHz power supply available asoption (w/pole and tripod) |
| | Active probe | *P6202A | Sony Techtronics | DC to 500 MHz (10:1) w/power supply |
| Pre-amplifier | Modular amplifier | *SAG-2047B | Urbantec Co., Ltd. | 0.5 MHz to 1000 MHz, 24 dB gain; NF6.5 dB, 15 V external power supply |
| | Modular amplifier | *SAU-3046M | Urbantec Co., Ltd | 5 MHz to 1500 MHz, 28 dB gain; NF4.7 dB, 15 V external power supply |
| Converting adapter | BNCJ-NCP converting adapter | BNCJ-NCP | Noble MUSEN Co., Ltd. | 75Ω |
| | NCP-NFJ converting adapter | NCP-NFJ | Hirose Electric Co., Ltd. | 75Ω (C15 type) |
| Impedance converter | 50Ω to 75Ω impedance converter | ZT-204NC | Tamagawa Electronic Co., Ltd. | NP-NCJ 10 MHz to 1000 MHz<br>Loss: Within 1 dB |
| | 50Ω to 75Ω impedance converter | ZT-130NC | Tamagawa Electronic Co., Ltd. | NP-NCJ DC to 2000 MHz<br>Loss: 6 dB |
| | 50Ω to 75Ω impedance converter | ZT-301 | Tamagawa Electronic Co., Ltd. | NP-NCJ 10 MHz to 1.5 MHz<br>Loss: Within 1 dB (for TR4131) |

(2/3)

| Parts name | Product name | Model | Recommended marker | Remarks |
|---|---|---|---|---|
| Stationary attenuator | Coaxial stationary attenuator | CFA-01 | Tamagawa Electronic Co., Ltd. | DC to 1000 MHz<br>Attenuation 10 dB<br>NP-NJ 1 W |
| | Coaxial stationary attenuator | CFA-10 | Tamagawa Electronic Co., Ltd. | DC to 1000 MHz<br>Attenuation 10 dB<br>NP-NJ 10 W |
| | Coaxial stationary attenuator | SFA-01 | Tamagawa Electronic Co., Ltd. | DC to 8 MHz<br>Attenuation NP-NJ 1 W |
| Artificial power line network | Artificial power line network | KNW-403D | Kyoritsu Electronic Co., Ltd. | 0.10 MHz to 30 MHz<br>250 V, 15 A max. 50Ω |
| | Artificial power line network | KNW-407 | Kyoritsu Electronic Co., Ltd. | 0.45 MHz to 30 MHz<br>220 V, 15 A max. 50Ω |
| EMI clamp | EMI clamp | KT-10 | Kyoritsu Electronic Co., Ltd. | 30 MHz to 1000 MHz<br>50Ω |
| Bridge | SWR Bridge | 60NF50 | Wiltron | 5 MHz to 2000 MHz,<br>N-connector, 50Ω,<br>Directionality 40 dB |
| | SWR Bridge | 60NF50-OPT1 | Wiltron | 5 MHz to 2000 MHz,<br>N-connector, 50Ω,<br>Directionality 46 dB |
| Filter (for removing DC inputs) | DC block | 3525 | Midwest | 0.1 GHz to 18 GHz<br>N-connector |
| | DC block | 3538 | Midwest | 0.1 GHz to 18 GHz<br>SMA-connector |
| Mixer | Wave guide mixer | WM490K | Sony Techtronics | 18 GHz to 26.5 GHz |
| | Wave guide mixer | WM490A | Sony Techtronics | 26.5 GHz to 40 GHz |
| | Wave guide mixer | WM490U | Sony Techtronics | 40 GHz to 60 GHz |

(3/3)

| Parts name | Product name | Model | Recommended marker | Remarks |
|---|---|---|---|---|
| Mixer | Wave guide mixer | WM490-2 | Sony Techtronics | 18 GHz to 40 GHz |
| | Wave guide mixer | WM490-3 | Sony Techtronics | 18 GHz to 60 GHz |
| Bridge | SWR bridge | 87A50 | Wiltron | 2 GHz to 18 GHz |
| Others | Bias tee | HB-NF-PJ | Hirose Electric Co., Ltd. | 900 MHz to 1350 MHz NFP-NFJ (C15 type) |
| | Earphone for video monitor | PR-30A | Ashida Onkyo | 8Ω, 3.5 mm earplug |

Please purchase the above products from their manufacturers or through us (charged).

The request for maintenance service should be forwarded to the manufacturer of the individual products.

# 10. THEORY OF OPERATION

This chapter describes the basic principle of operation of the R4136 spectrum analyzer by reference to the block diagram shown in Figure 10-1.

## 10.1 THEORY OF OPERATION

The analyzer can be divided in four sections; RF section for the conversion of an inputted signal (10 kHz through 3.6 GHz) to the IF signal of 3.58 MHz, IF section for determination of the resolution bandwidth, the display section for the definition of amplitude level and the control section for these sections.

### (1) RF Section

Input signals pass through the input attenuator (0 to 55 dB, t 5 dB increments) and are separated into two, depending on the frequency ranges of the signals, by the coaxial switch S1 whose switching action is determined by the frequency range of the signals. The switch sends out the signals ranging from 0.5 kHz to 3.6 GHz to the 1st mixer and the ones ranging from 3.5 GHz to 23 GHz to the harmonic mixer.

Those signals, ranging from 0.5 kHz to 3.6 GHz, which have been sent to the 1st mixer are mixed with signals synthesized by a 4 GHz to 8 GHz YIG tuned oscillator before being converted to approximately 4 GHz (3.99642 GHz) IF signals. The converted signals pass through the coaxial switch S4 which switches the IF signals from the external mixer, after which the unnecessary signals produced in the 1st mixer are removed by a 4 GHz band pass filter and then sent out to the 2nd mixer.

The 4 GHz signals sent to the 2nd mixer are mixed with a 3.77 GHz phase locked oscillator before being converted to 226.42 MHz 2nd IF signals.

The 3.5 GHz to 23 GHz signals, which have been selected by the coaxial switch S1 and sent to the harmonic mixer, are mixed with the signals synthesized by the 4 GHz-8 GHz YIG tuned oscillator. Thereafter, they pass through the switch S3 that switches the 226.42 GHz IF signals before being sent to S2.

At the 3rd mixer, the signals are mixed with 30 MHz signals from a reference frequency source and converted to the 3rd IF signals before being sent to the 4th mixer.

At the 4th mixer, the signals are similarly mixed with 30 MHz signals from the reference frequency source to produce 3.58 MHz final IF signals. They are, then, input to the IF section, at which the resolution bandwidth is determined.

(2) IF Section

This section is consisted of a L/C filter to determine the resolution bandwidth for the signal of 1 MHz through 10 kHz and X'tal filter to determine the resolution bandwidth for the signal of 3 kHz through 30 Hz and a step amplifier to determine the reference level.
The IF signal of 3.58 MHz passes through the IF filter to determine the resolution bandwidth and reference level, and then enters the log amplifier.

(3) Display Section

The IF signal enters the log amplifier to undergo log compression. When the signal is detected, it is AD converted and then processed to be displayed on the CRT.

(4) Control Section

In this section the data needed for the operation of above sections are processed by microprocessor and transported to each section.

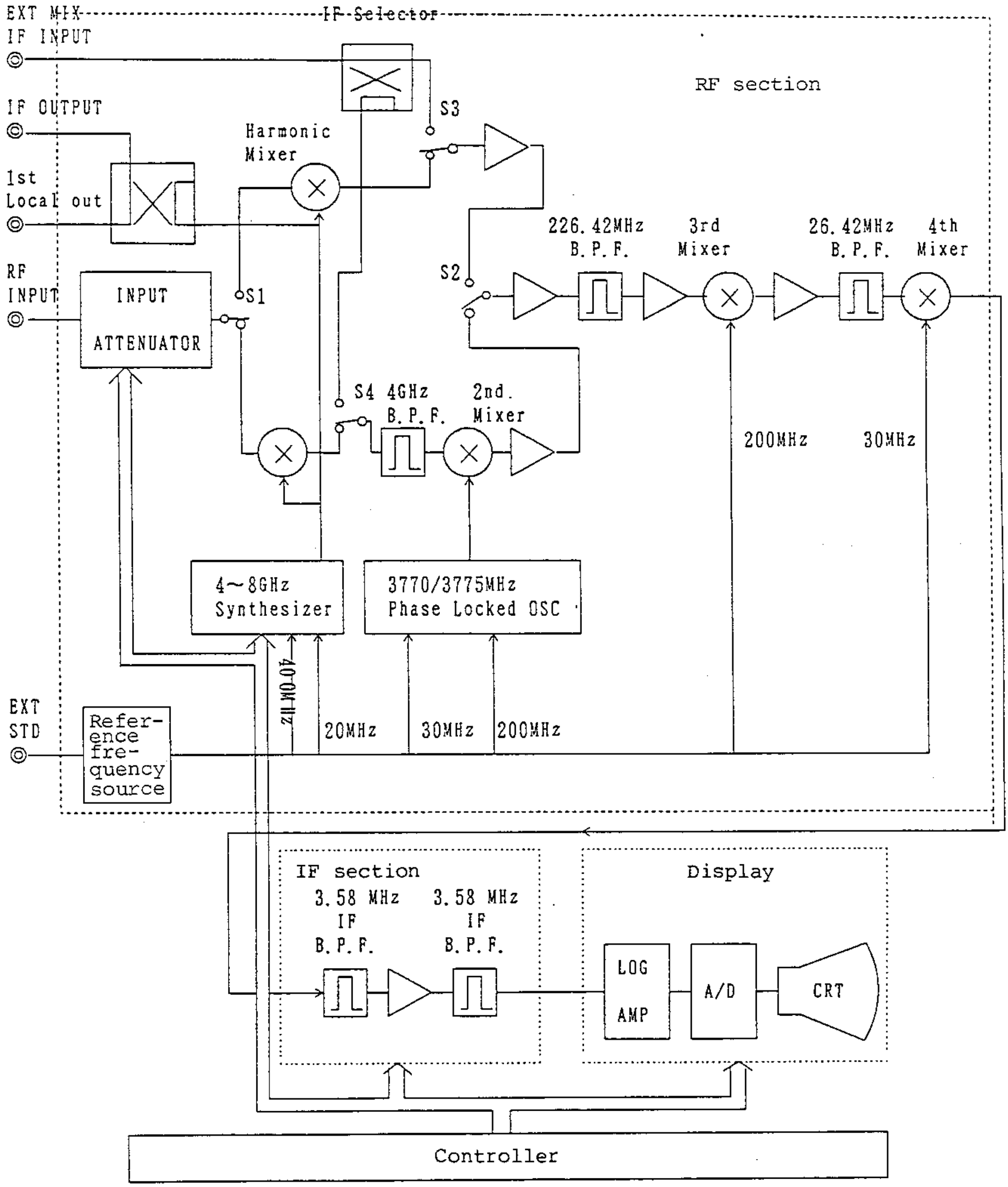



Figure 10-1 Block Diagram of the R4136

MEMO

# APPENDIXES

## A1.1 GLOSSARY

- IF Bandwidth

A spectrum Analyzer uses Band Pass Filter (B.P.F.) in analyzing individual frequency components which are composed in an input signal. The 3 dB down bandwidth of a B.P.F. is called an IF Bandwidth. (Figure A-1(a)). The characteristic of a B.P.F. must be considered in appropriate form depending on the sweep width and sweep speed. The R4136 is designed so that settings are automatically selected to the best. Spectrum resolution is improved as the bandwidth is set narrower in general so that sometimes the resolution of a Spectrum Analyzer is expressed with the narrowest IF Bandwidth. (Figure A-1 (b)).

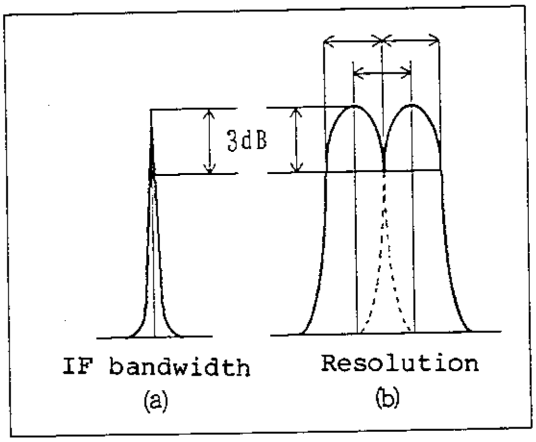



Figure A-1 IF Bandwidth

- Gain Compression

If an input signal is applied in excess of a level, CRT display does not indicated correct level but shows as if increase of the input signal level were compressed. This phenomenon is called Gain Compression and defines linearity of the input signal range of the Spectrum Analyzer. Practically used is the range up to the compression of 1 dB.

- Input Sensitivity

Input Sensitivity is an ability of a Spectrum Analyzer to detect the smallest signal. It is directly related with the noise generated in the Spectrum Analyzer itself and depends on the IF Bandwidth being used. Input Sensitivity normally means the Average Noise Level at the least IF Bandwidth of the Spectrum Analyzer.

- Maximum Input Level

It is the maximum permissible level at RF input of the Spectrum Analyzer. Permissible level can be changed in accordance with the input attenuator.

- Residual FM

Residual FM is used to mean short time stability of the local oscillator group built in a Spectrum Analyzer, and the drifting frequency bandwidth for a unit time is expressed in peak to peak. It also indicates the measurement limit in measuring residual FM for the object under measurement.

- Residual Response

It is to define the degree of level to which the spurious signal generated in the Spectrum Analyzer is restrained. It is due to a leakage signal like local oscillator output of the Spectrum Analyzer, and care is required in analyzing extremely small input signal.

- Quasi Peak Value Measurement

Reception interference noise in radio communications normally appears in a form of impulse. Such an interference energy is objectively evaluated with a value proportional to the quasi peak value. Quasi peak value is used to estimate such criteria as the measurement range and detection time constant. The JRTC specifications in Japan and CISPR Specifications in U.S.A. include the requirement.

- Frequency Response

This term is generally used to express an amplitude (frequency) characteristic of a frequency. With a Spectrum Analyzer, it means the frequency characteristic (flatness) of input attenuator and mixer, etc. for respective input frequency and is indicated in $\pm\Delta$dB.

- Zero Span

This is not perform frequency sweep but is tuned only to the frequency displayed at CRT display center. In this mode, the horizontal axis is not frequency but represents time axis as set by scan time.

- Spurious Signal

Spurious signal is undesired signal other than objective signal and is classified in accordance with characteristic of the signal as follows.

Harmonic: Specifies level of the harmonic which is generated in the Spectrum Analyzer (normally at mixer circuit) when ideal undistorted signal is applied to the Analyzer. It also expresses the ability of harmonic distortion measurement.

Adjacent spurious signal: is the small signal which appears in the neighborhood of the spectrum on the display when a pure single spectral signal is applied to a spectrum analyzer.

Nonharmonic spurious signal: is called a residual spurious signal with the frequency inherently generated in the spectrum Analyzer.

- Noise Sideband

Noise sideband is an ability commonly used in expressing oscillation purity of an oscillator. With a spectrum analyzer, noise generated in local oscillators and phase lock loops in particular appears in the neighbor of the spectrum under measurement and disturbs performance of the spectrum analyzer. It is therefore necessary for such an instrument to specify the range where noise sideband of external signals can be analyzed. Typical specifications for a spectrum analyzer are expressed as below.

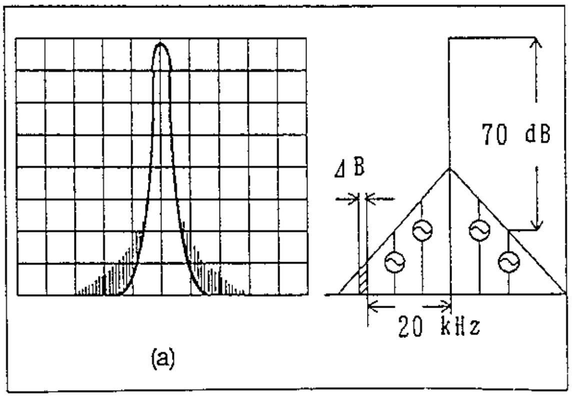



Figure A-2 Noise Sideband

The specification takes on an expression such as the noise sideband being -70 dB below the signal peak, 20 kHz away from the carrier, with 1 kHz IF Bandwidth. Generally used is an expression of the energy existing in a 1 Hz bandwidth (Figure A-2(b)). The above can be expressed in the 1 Hz bandwidth. Since the level is -70 dB with the 1 kHz bandwidth, the signal within the bandwidth of 1 Hz would be approximately 10 log 1 Hz/1 kHz (dB), that is, 30 dB lower. Alternately, the above can be said as -100 dB/Hz, 20 kHz away from the carrier with 1 Hz Bandwidth.

- Bandwidth Selectivity

The characteristic of bandpass Filter is not rectangular but assumes a damping characteristic similar to that in a Gaussian distribution. Consequently, when the two closely spaced signals are mixed, the smaller signal is hidden in the skirt of the larger one as shown in Figure (a) below. It is therefore necessary to specify the bandwidth at an appropriate area (60 dB), and the ratio of the bandwidths at 3-dB-down and 60-dB-down points is expressed as bandwidth selectivity.

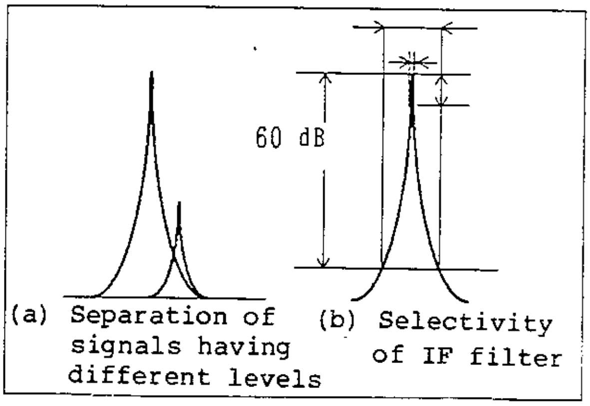



Figure A-3 Bandwidth Selectivity

- Bandwidth Accuracy

It is the accuracy of bandwidth for IF Filter and is expressed as the deviation to the nominal value at the 3-dB-down point. This ability is not necessarily considered in level measurements for normal continuous signals but in level measurements for noise signals.

- Bandwidth Switching Accuracy

Appropriate number of IF filters are prepared and used by switching in analyzing a signal into spectrum so as to obtain the optimum resolution for the scan width. The IF filters uniquely retain inherent loss, and switching to another filter causes an error corresponding to respective loss even in the case of measuring the same signal. This is defined as bandwidth switching accuracy.

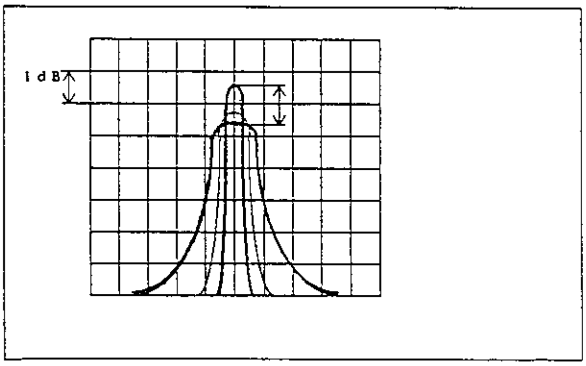



Figure A-4 Bandwidth Switching Accuracy

- Reference Level Display Accuracy

Absolute level of the input signal is read with a Spectrum Analyzer display in reference to the top horizontal line of the graticule. The level set to the top line is called the reference level. The reference level can be varied with the IF GAIN switch and Input Attenuator. It is expressed in dBm or dB . The absolute accuracy of the display is the reference level accuracy.

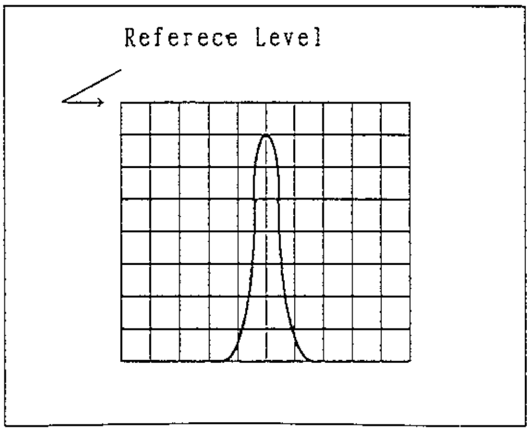



Figure A-5 Reference Level

- V.S.W.R.(Voltage Standing-Wave Ratio)

It is constant to represent impedance matching condition and is expressed by a ratio of the maximum and minimum values among the standing waves which are composed by traveling waves and reflected waves at the condition the Spectrum Analyzer is acting as a load to an ideal nominal impedance source. This is another expression of reflection coefficient and reflection loss, whose relation is described below. In the case the signal Eo supplied from the transmitter side is completely transmitted to the receiver (a Spectrum Analyzer) without any impedance loss, the signal EI received must be identical to Eo. If the signal is not completely transmitted due to mismatching, etc. but there is reflection back at the level $E_R$, the reflection coefficient is expressed as follows:

Reflection coefficient m
= reflected wave
$E_R$/travelling wave $E_O$

The ratio of reflected wave ER to traveling wave $E_O$ is reflection loss which is 20 log $E_R/E_O$ [dB]

V.S.W.R.
= $(E_O + E_R)(E_O - E_R)$

The relationship with reflection coefficient is:

V.W.W.R.= $(1 + |m|)/(1 - |m|)$

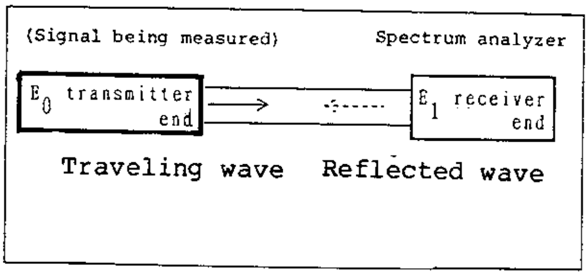



Figure A-6 V.S.W.R.

V.S.W.R. is in a range from 1 to infinity, and the matching is better as V.S.W.R. is close to 1.

● Spurious Response

It is the harmonic distortion generated in the input mixer circuit as the input level goes up, as shown in the figure below. The level range available in nondistrotion depends on fundamental input level and an example shown in the figure is -70 dB for the input level of -30 dBm. In practice, the input attenuator is effectively used to decrease the signal level to get it appropriate.

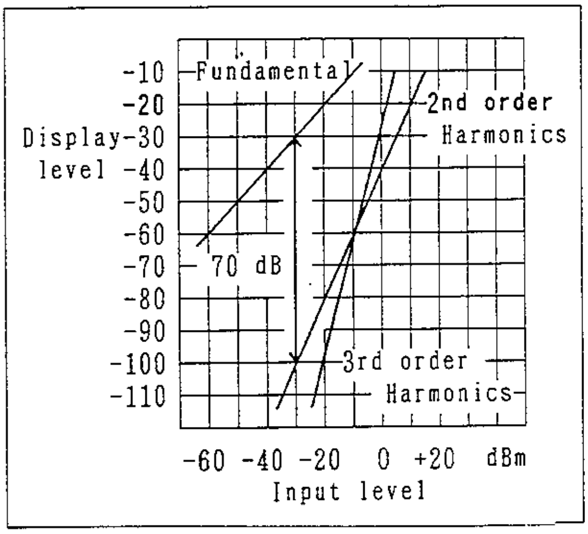



Figure A-7 Spurious Response

● YIG-tuned Oscillator

YIG-tuned Oscillator was reported by Griffiths in 1946 for the first time. Ferrite in garnet typified by a YIG (Yttrium Iron Garnet) single crystal has an extremely sharp electron spin resonance in frequency has linear proportional relationship with the impressed DC magnetic field over a wide frequency range. It enables wideband electronic tuning by varying excitation current of the magnetic which causes a DC magnetic field. ADVANTEST uses YIG Oscillator for the local oscillators of its Spectrum Analyzers and TR5200 series Automatic Microwave Frequency Counters.

## A1.2 LEVEL CONVERSION TABLE

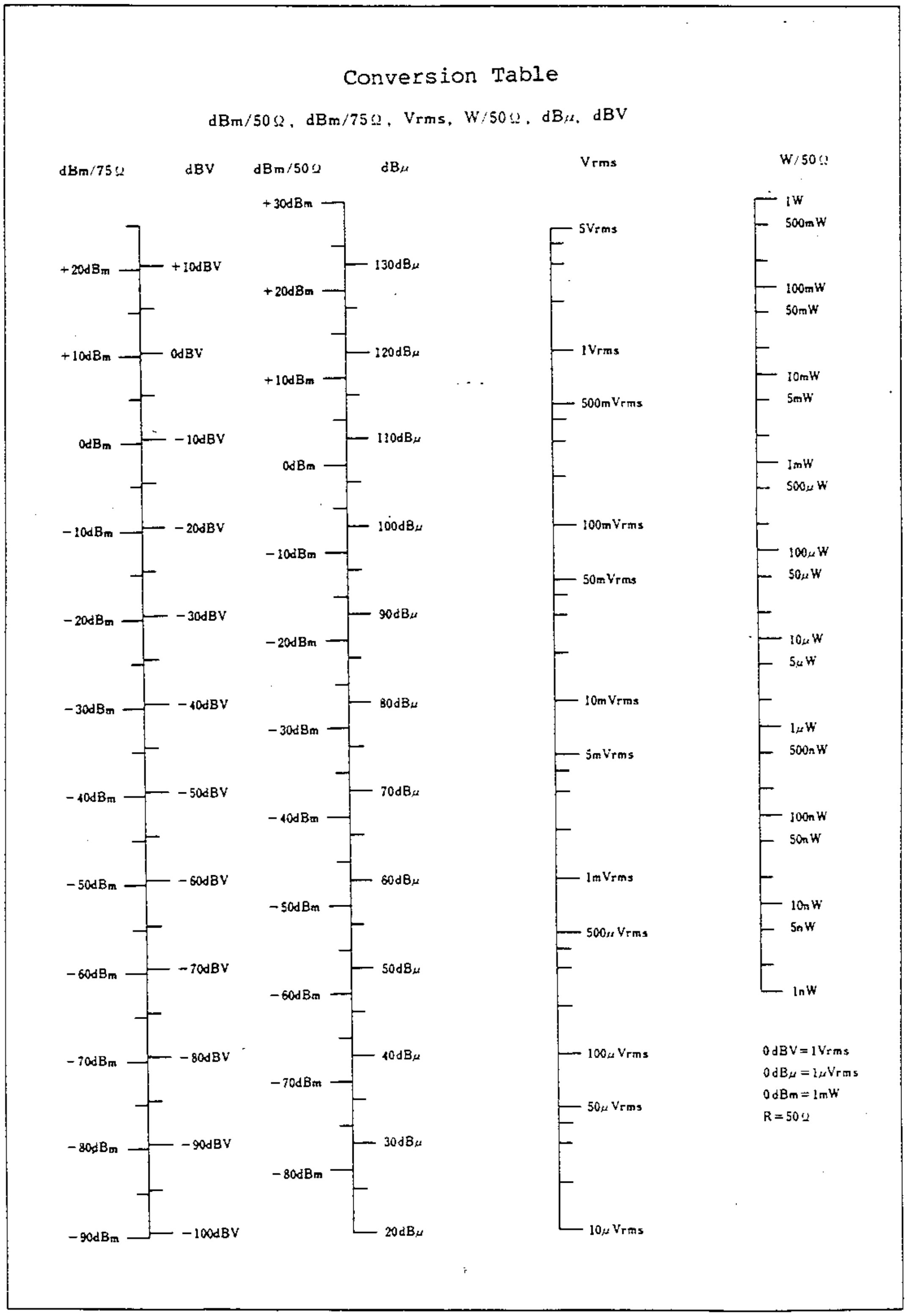
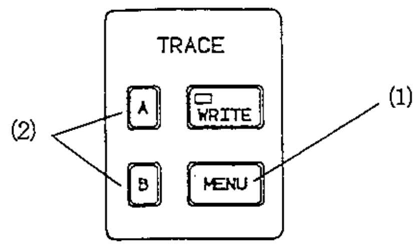



Figure A-8 Level Conversion Table

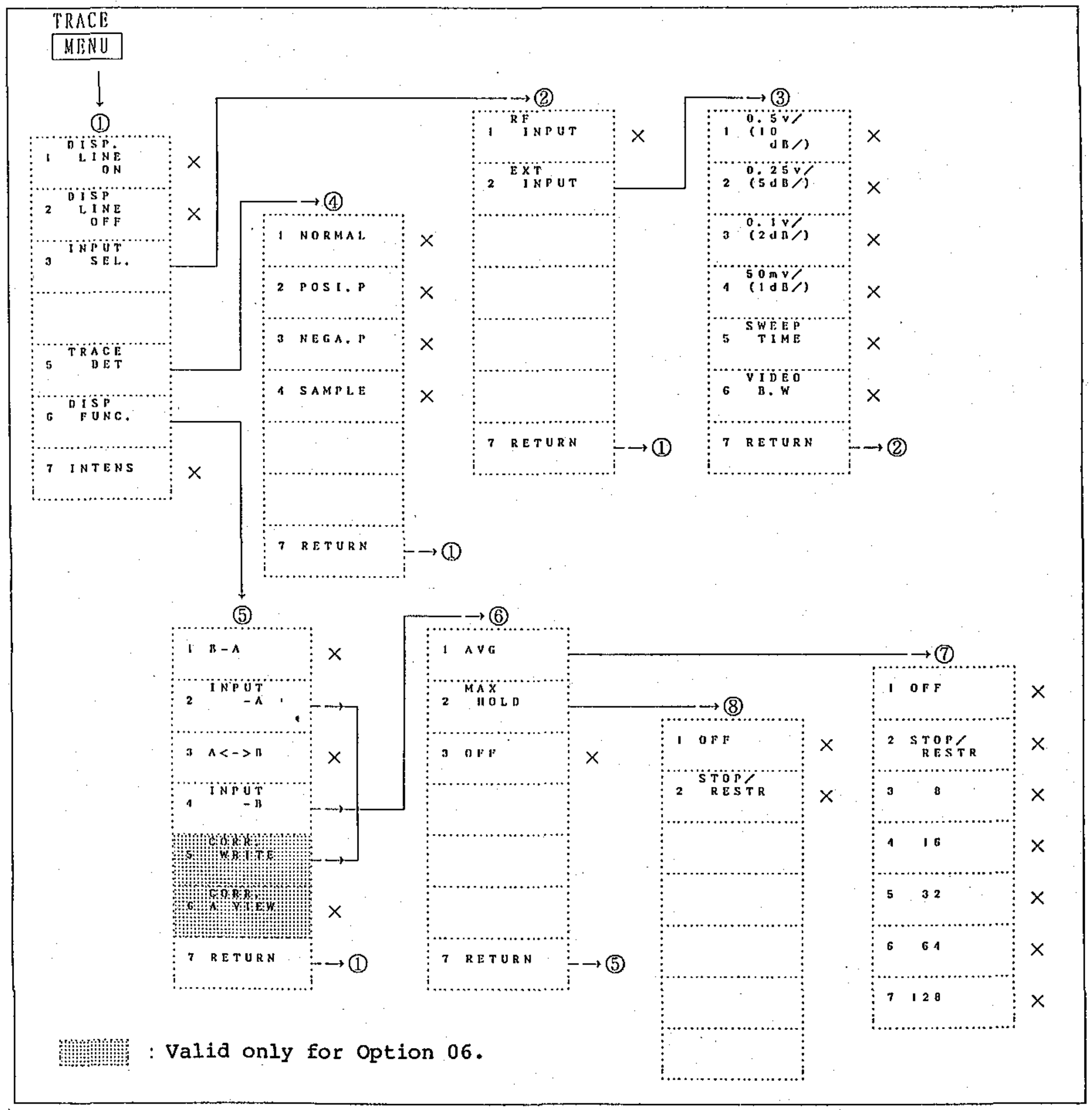
## A1.3 LIST OF PANEL KEYS AND SOFTKEY MENUS

The softkey menus are shown by section on the following pages and described by function in Chapters 3 and 4.

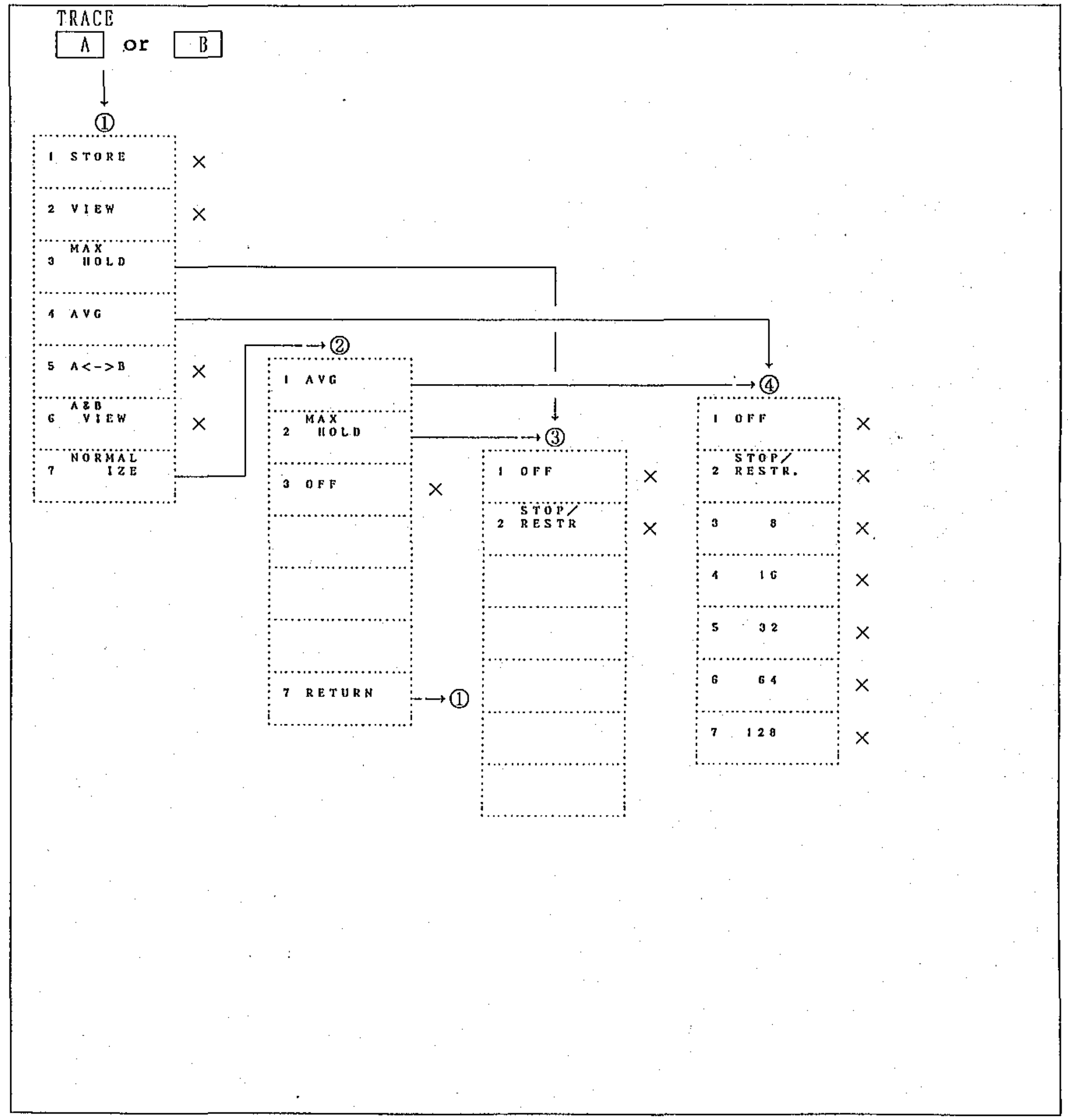
### A1.3.1 TRACE Section



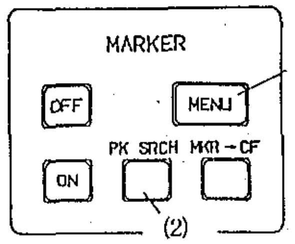
(1) MENU Key



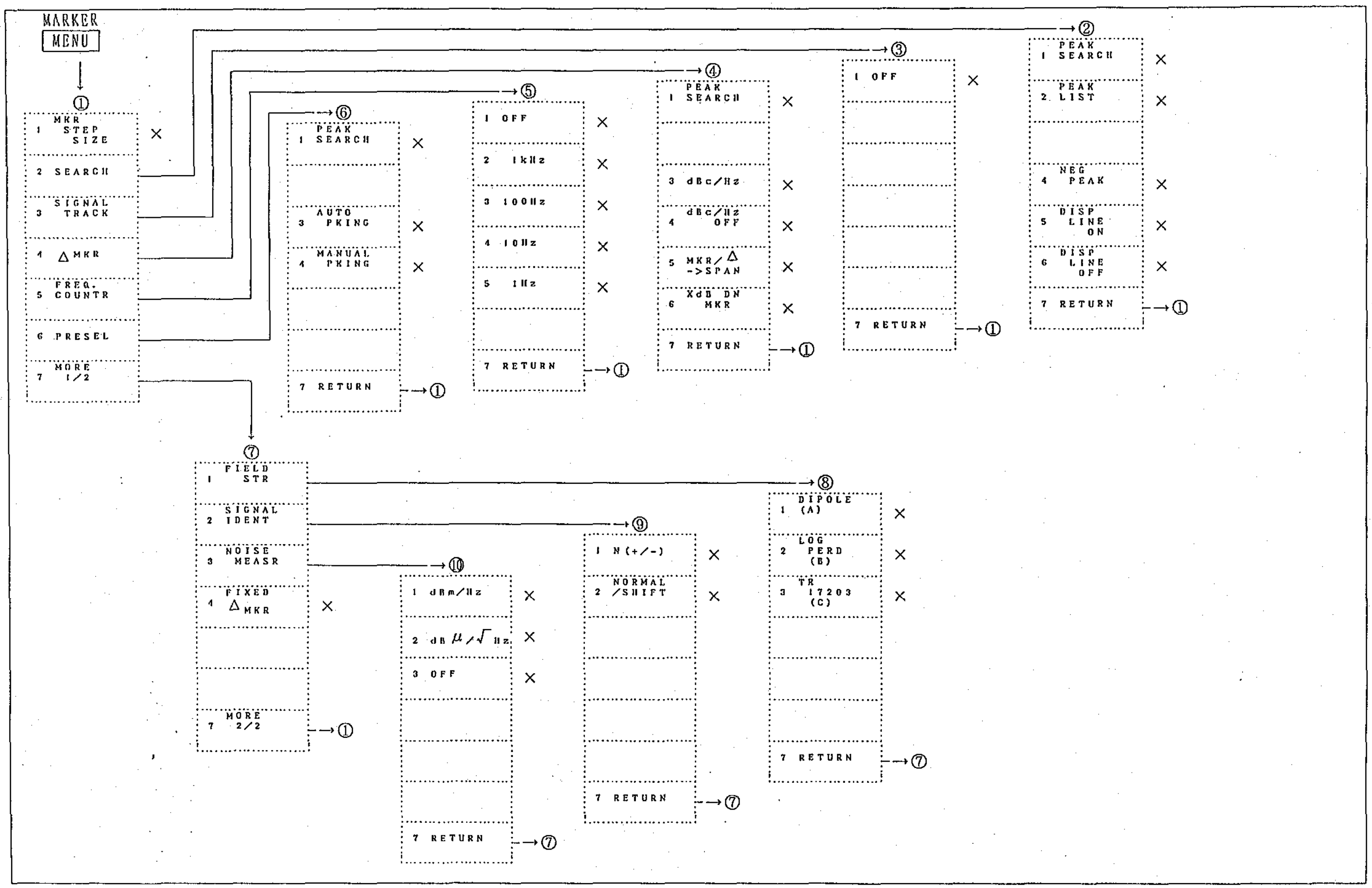

(2) A , B Key



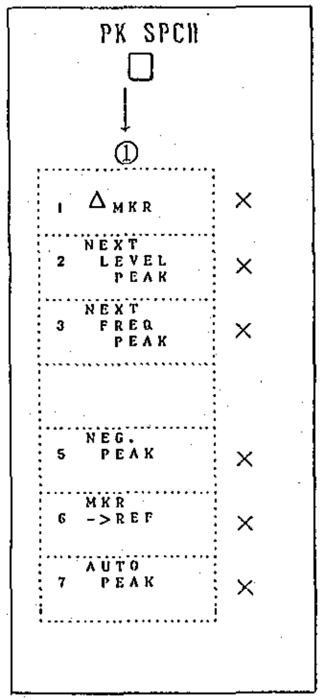
A1.3.2 MARKER Section




(1) MENU Key



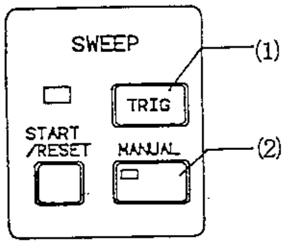

(2) PK SPCH Key



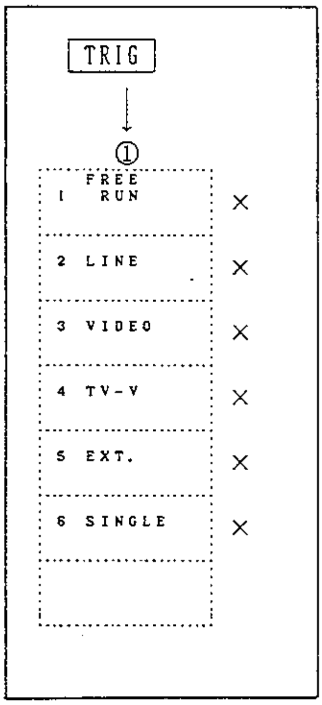



Aug 18/90

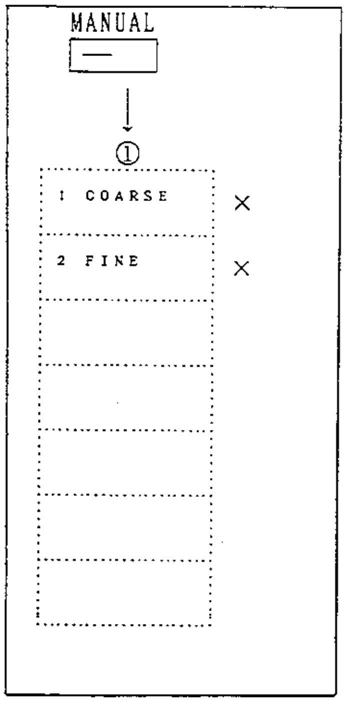
### A1.3.3 SWEEP Section



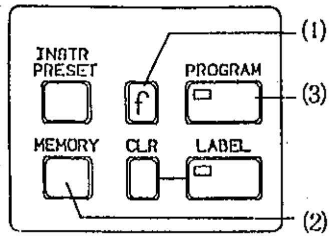

(1) TRIG Key



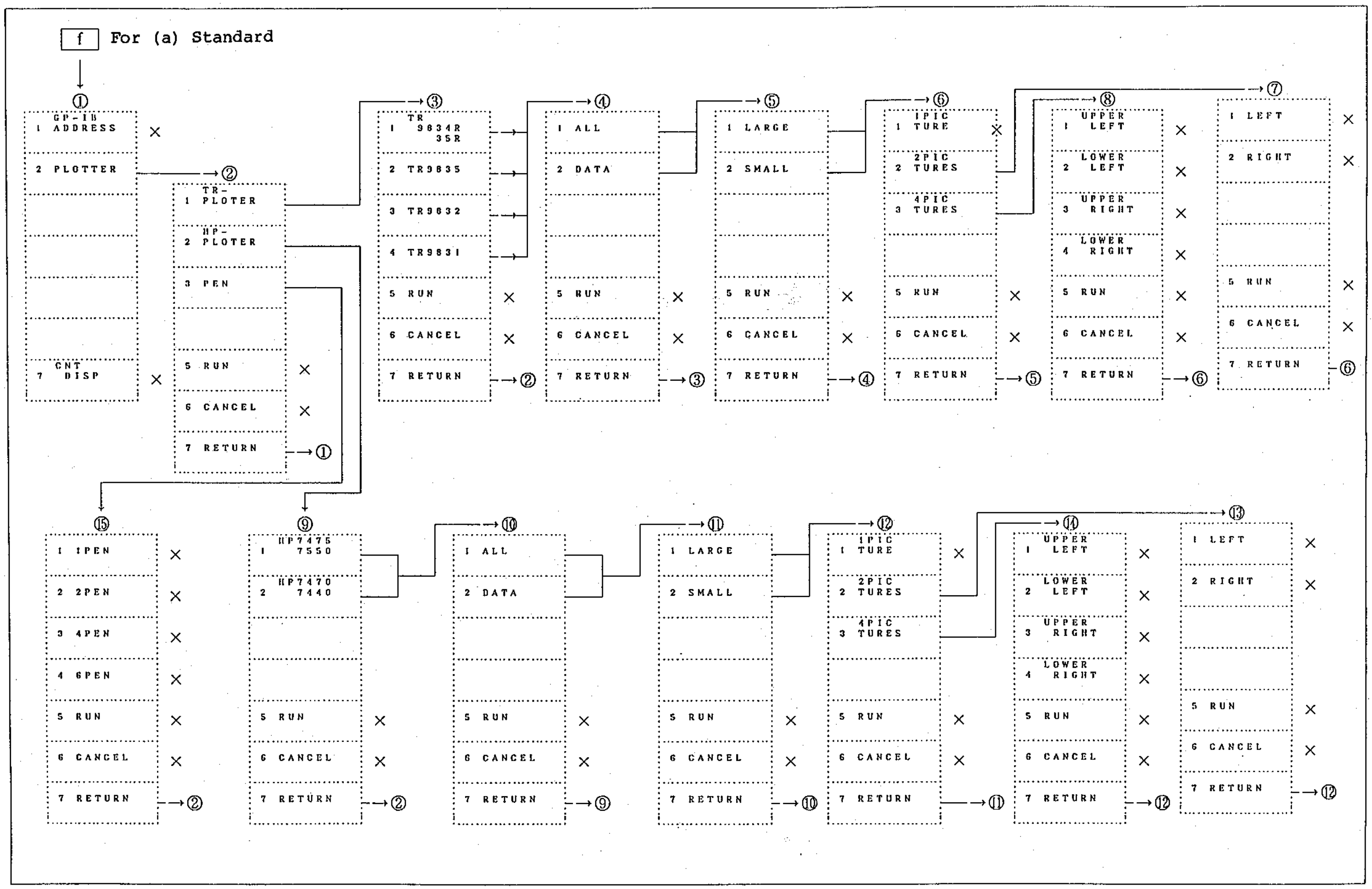

(2) MANUAL Key



A1.3.4 f And MEMORY

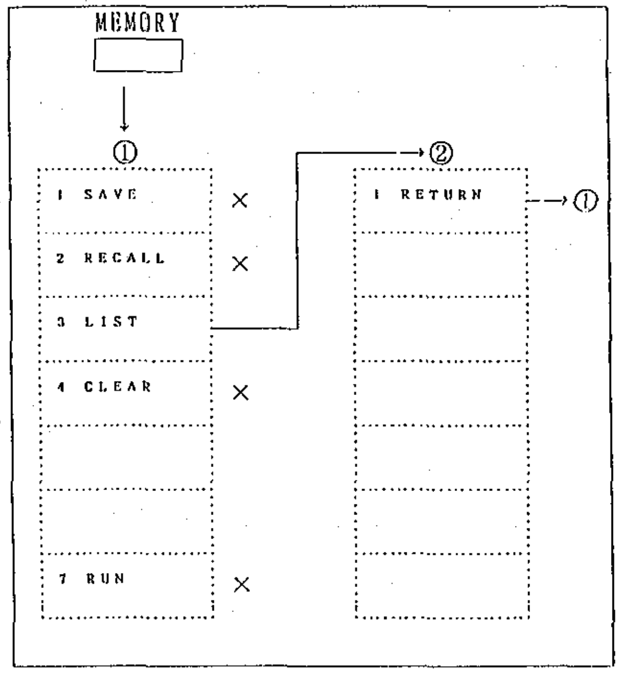



(1) f Key

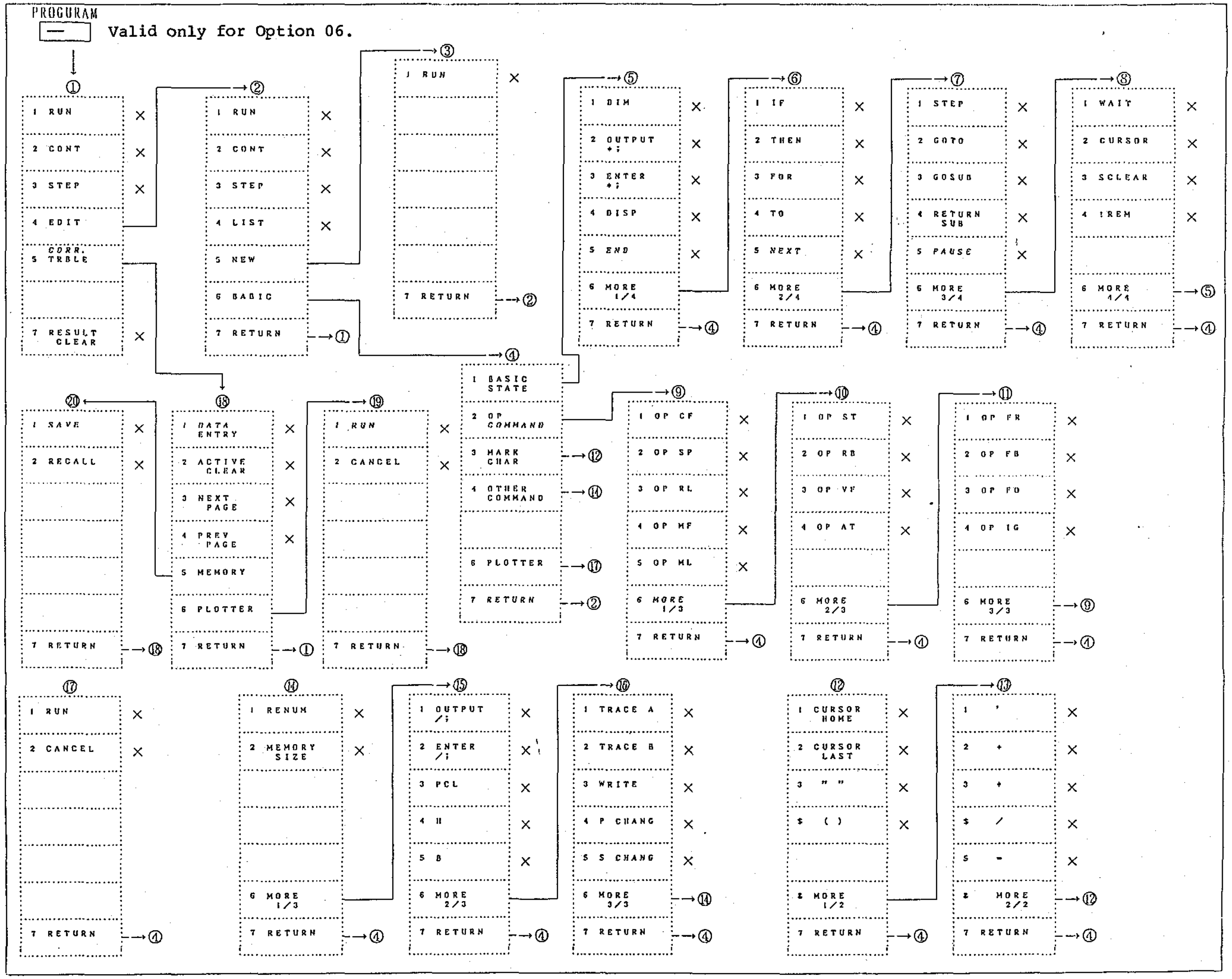


## A1.3 LIST OF PANEL KEYS AND SOFTKEY MENUS

(2) MEMORY Key

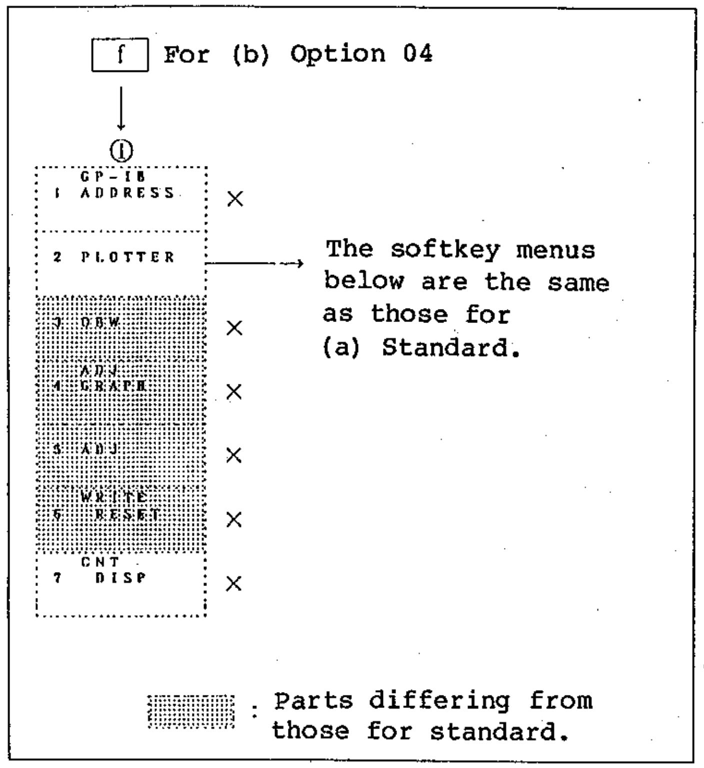


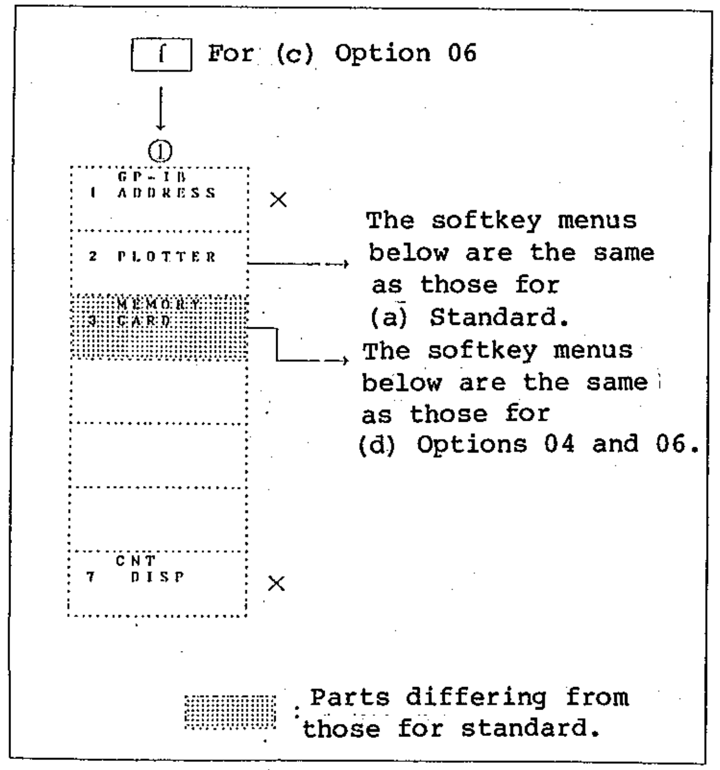

(3) PROGURAM Key

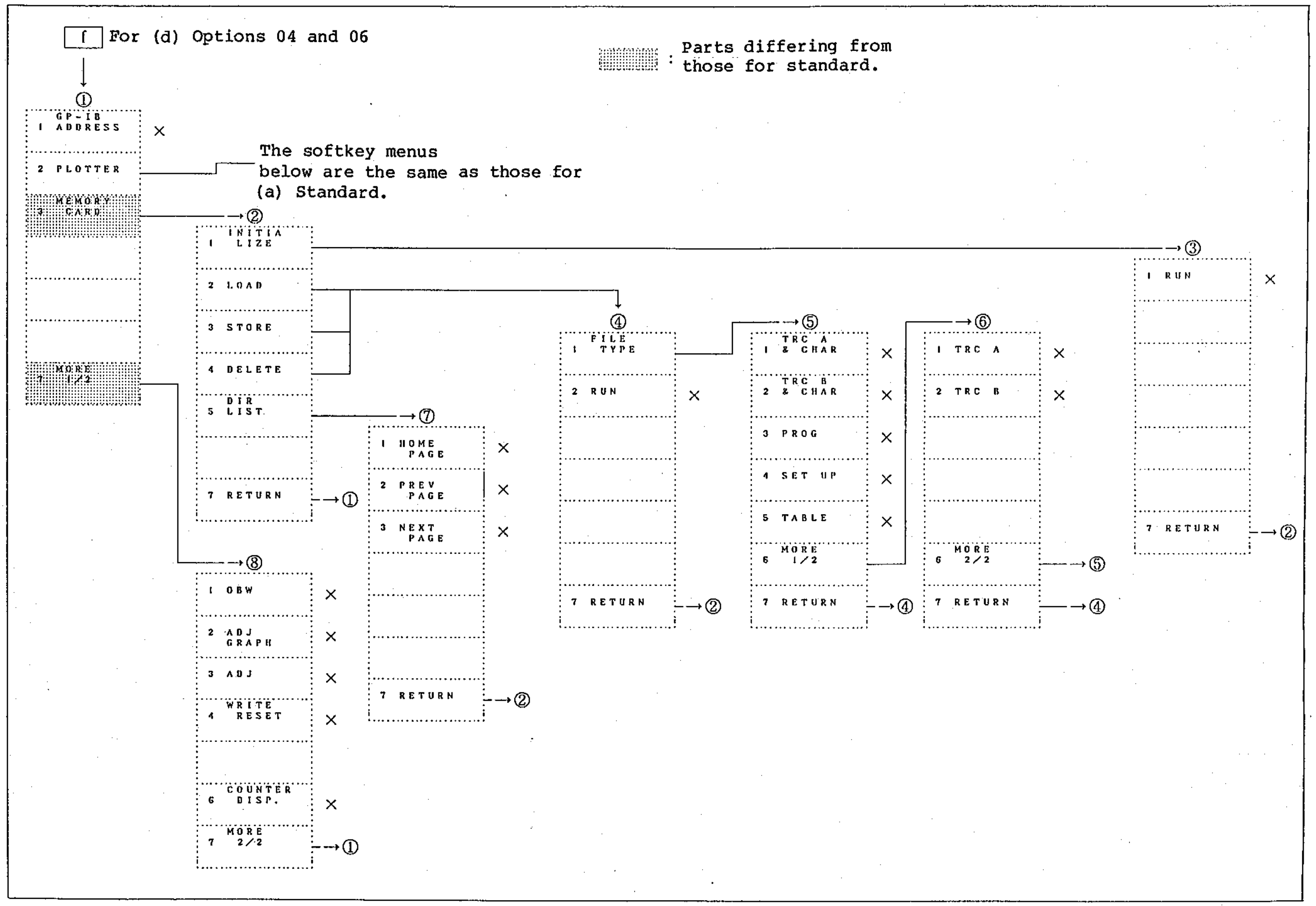




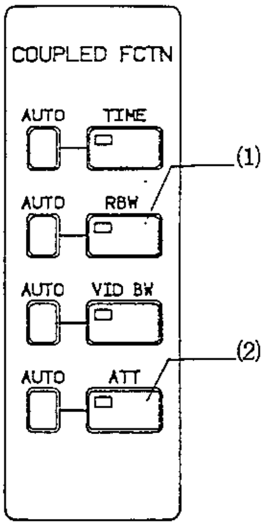

Aug 18/90


f For (b) Option 04
①
1 GP-IB ADDRESS
2 PLOTTER
3 OBW
4 ADJ GRAPH
5 ADJ
6 WRITE RESET
7 CNT DISP
The softkey menus below are the same as those for (a) Standard.
: Parts differing from those for standard.

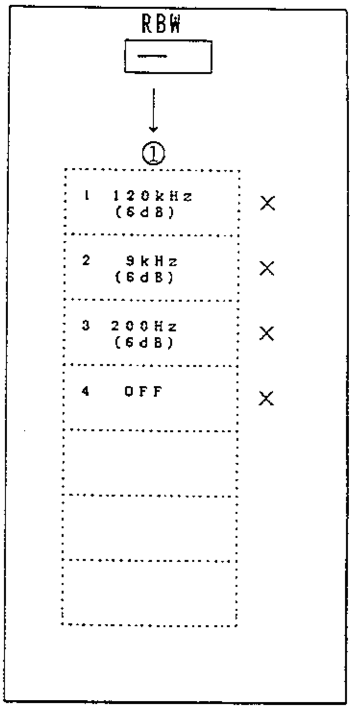

f For (c) Option 06
①
1 GP-IB ADDRESS
2 PLOTTER
3 MEMORY CARD
7 CNT DISP
The softkey menus below are the same as those for (a) Standard.
The softkey menus below are the same as those for (d) Options 04 and 06.
: Parts differing from those for standard.


f For (d) Options 04 and 06
: Parts differing from those for standard.
①
1 GP-IB ADDRESS
2 PLOTTER
3 MEMORY CARD
7 MORE 1/2
The softkey menus below are the same as those for (a) Standard.
②
1 INITIA LIZE
2 LOAD
3 STORE
4 DELETE
5 DIR LIST
7 RETURN
①
③
1 RUN
7 RETURN
②
④
1 FILE TYPE
2 RUN
7 RETURN
②
⑤
1 TRC A & CHAR
2 TRC B & CHAR
3 PROG
4 SET UP
5 TABLE
6 MORE 1/2
7 RETURN
④
⑥
1 TRC A
2 TRC B
6 MORE 2/2
7 RETURN
⑤
④
⑦
1 HOME PAGE
2 PREV PAGE
3 NEXT PAGE
7 RETURN
②
⑧
1 OBW
2 ADJ GRAPH
3 ADJ
4 WRITE RESET
6 COUNTER DISP.
7 MORE 2/2
①

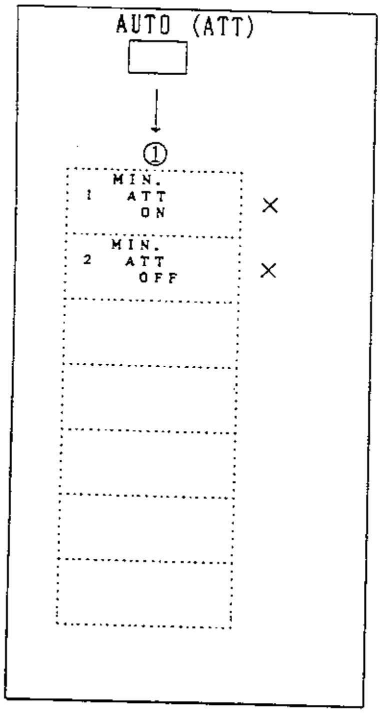
### A1.3.5 COUPLED FCTN Section



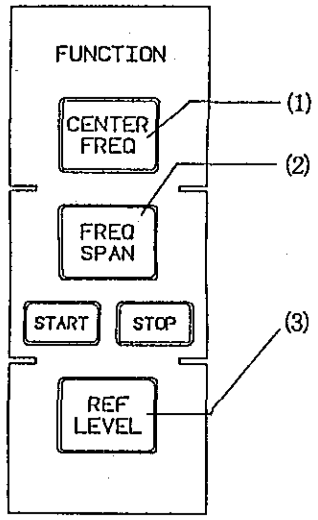

(1) RBW Key



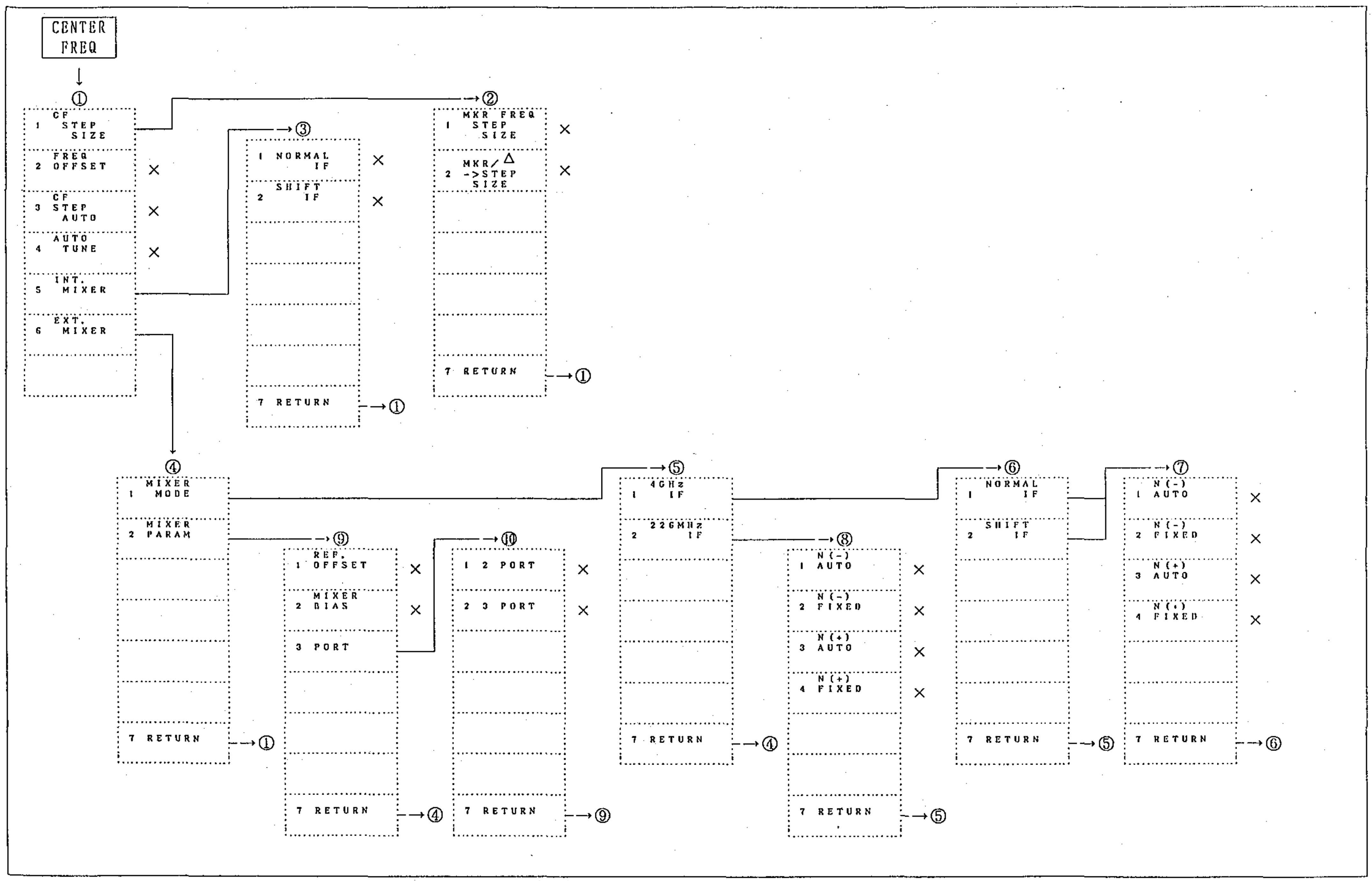

(2) ATT Key



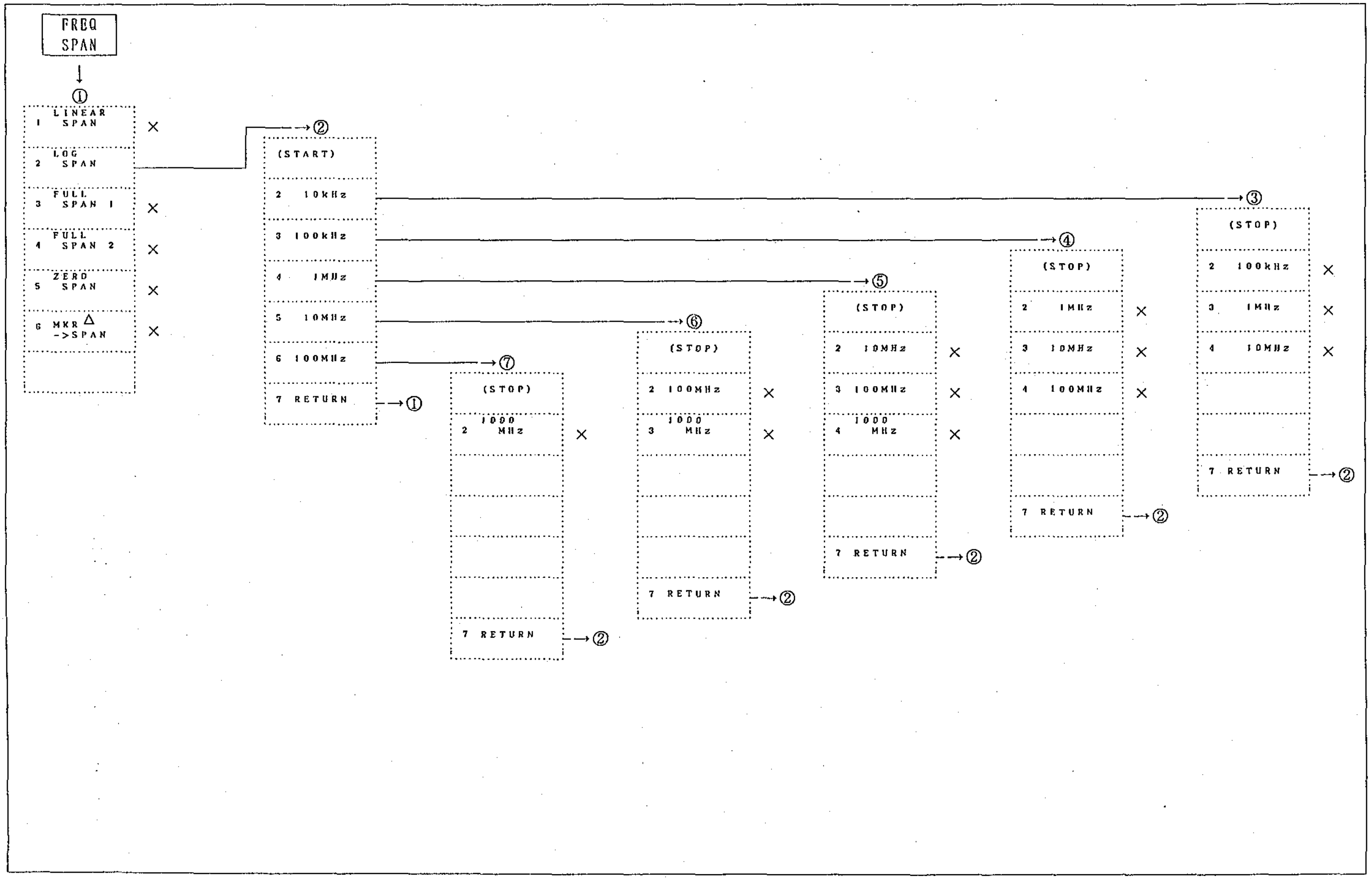
A1.3.6 FUNCTION Section



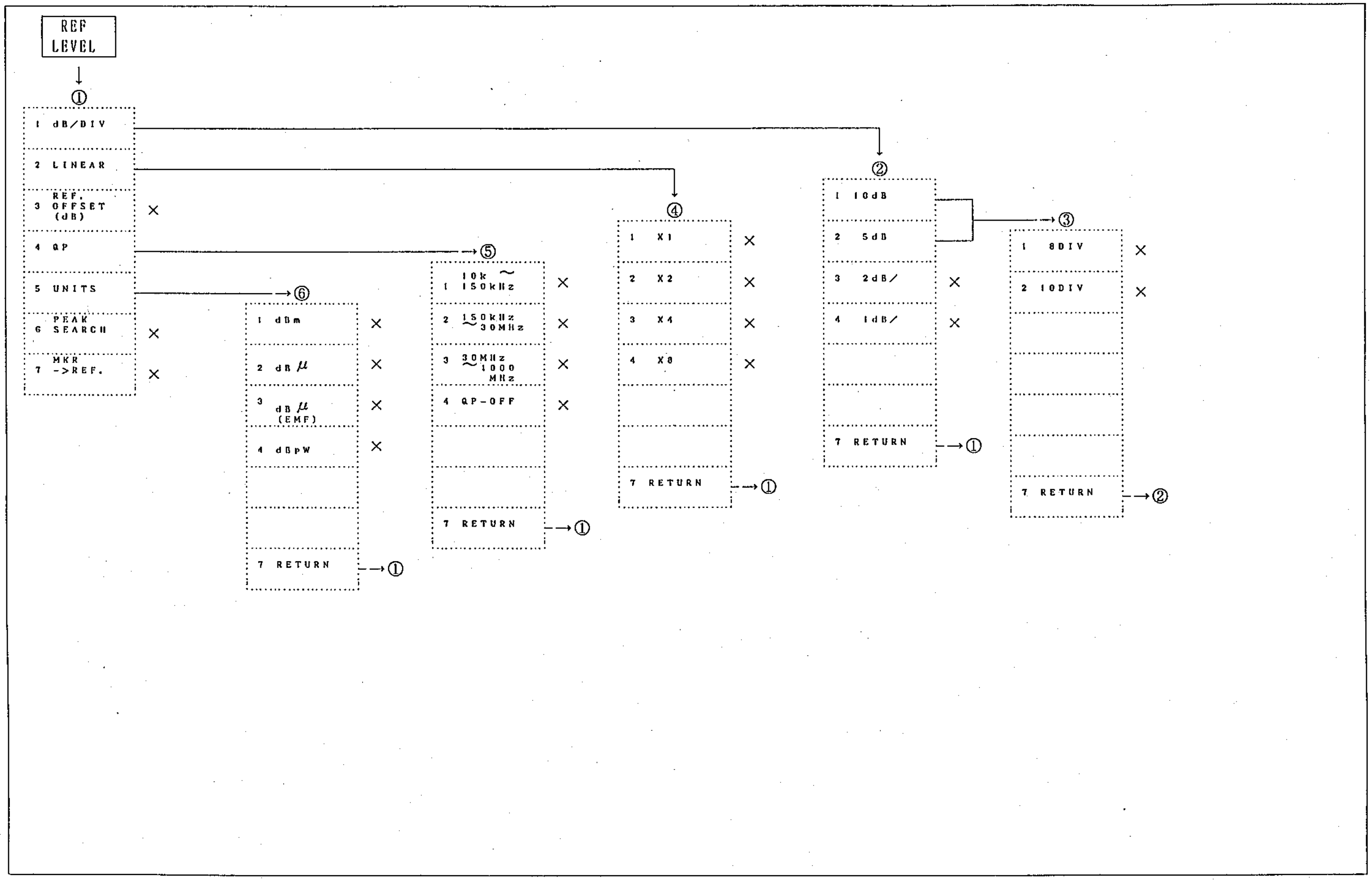

(1) CENTER FREQ Key



(2) FREQ SPAN Key



(3) REF LEVEL Key



# INDEX



(s.m. = softkey menu)

(s.m. = softkey menu)

[B]



[C]



[D]



(s.m. = softkey menu)

(s.m. = softkey menu)

(s.m. = softkey menu)

(s.m. = softkey menu)

(s.m. = softkey menu)

(s.m. = softkey menu)

[T]



[U]



[V]



[W]



[X]



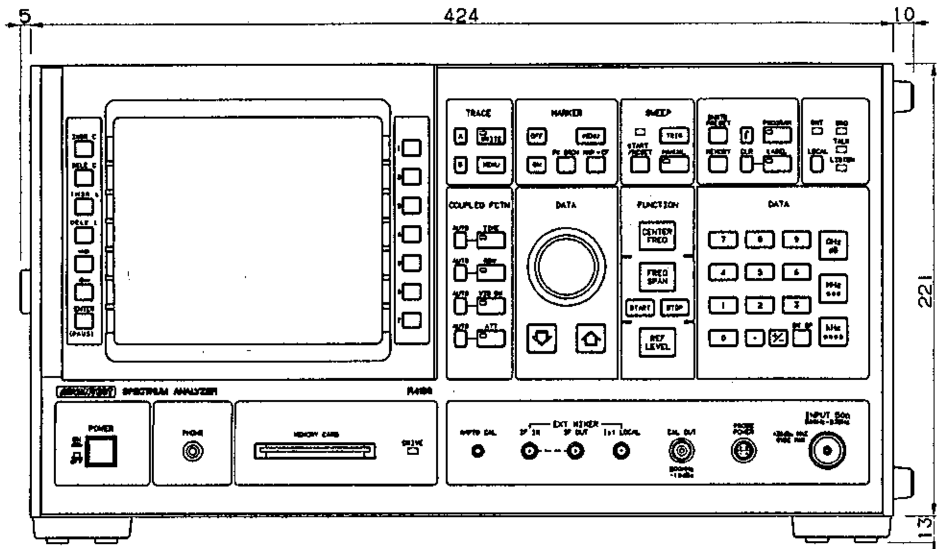
[Y]



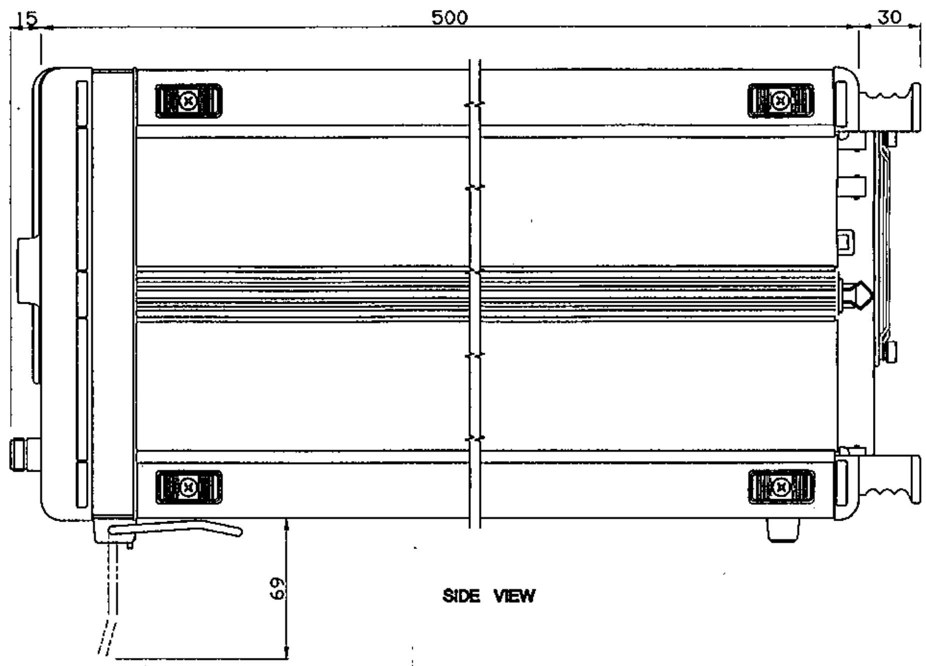
[Z]



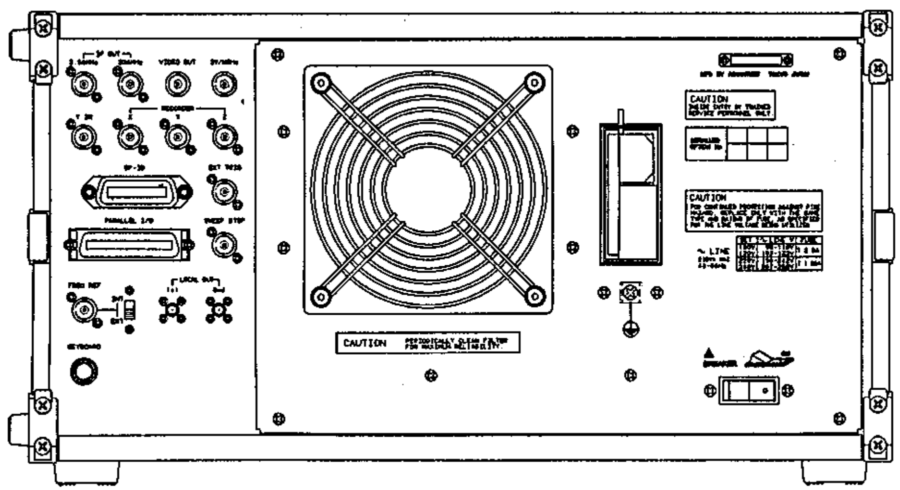
(s.m. = softkey menu)




FRONT VIEW




SIDE VIEW

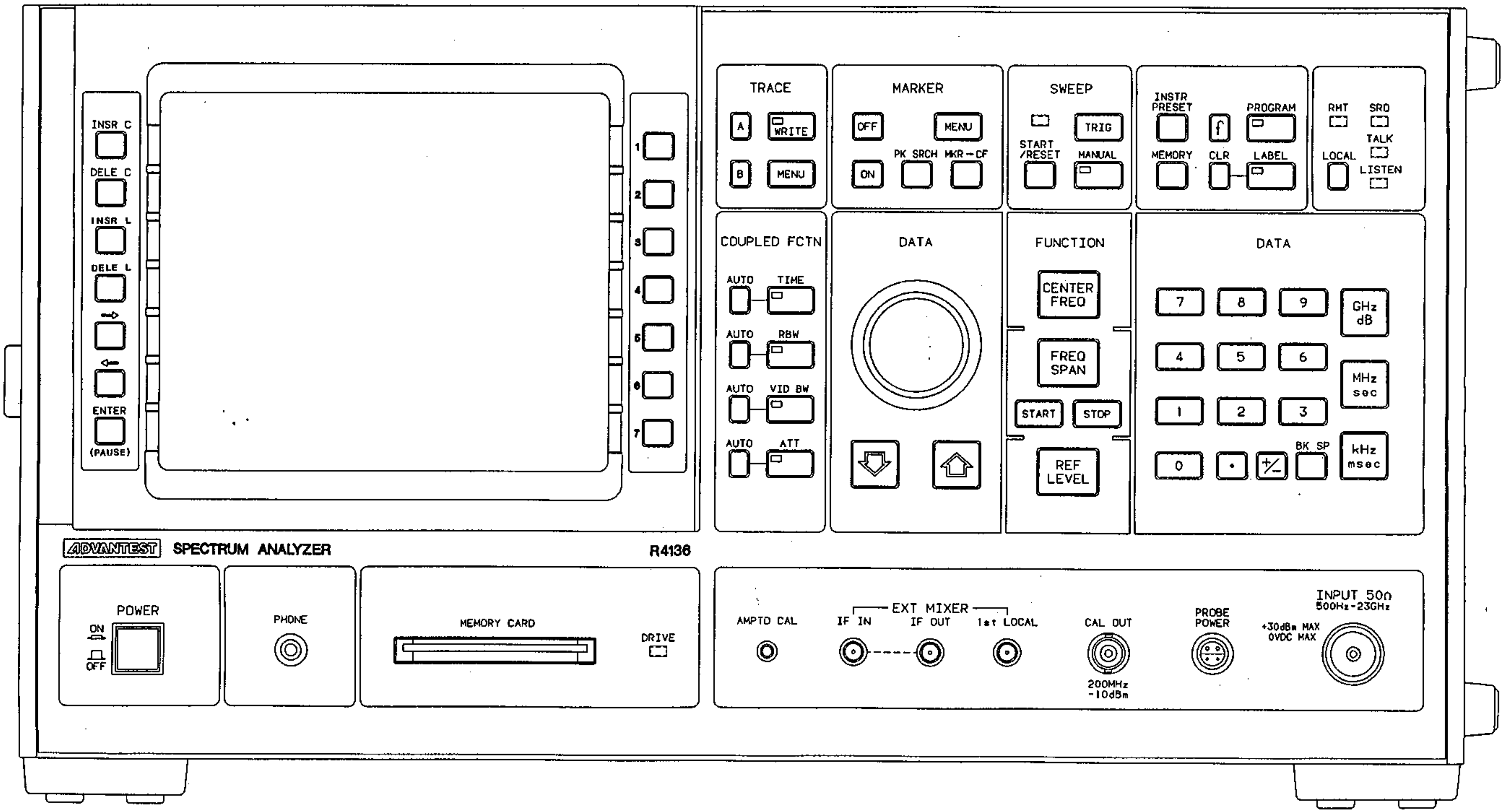


REAR VIEW

4136EXT1-9009-B

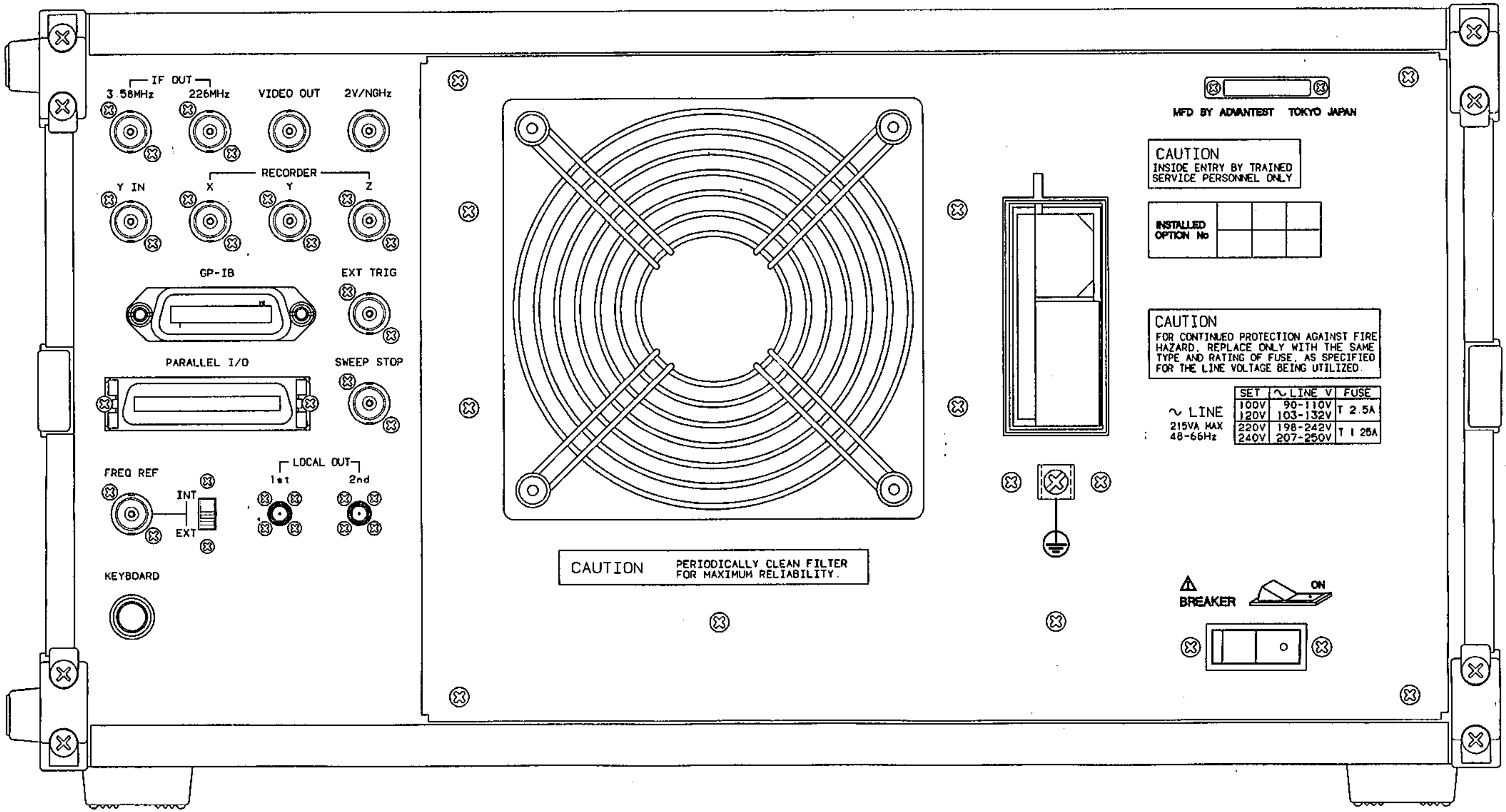
Unit : mm

# R4136
# EXTERNAL VIEW




4136EXT2-9009-B

R4136 FRONT VIEW




R4136 REAR VIEW

4136EXT3-9009-A

# IMPORTANT INFORMATION FOR ADVANTEST SOFTWARE

PLEASE READ CAREFULLY: This is an important notice for the software defined herein. Computer programs including any additions, modifications and updates thereof, operation manuals, and related materials provided by Advantest (hereafter referred to as "SOFTWARE"), included in or used with hardware produced by Advantest (hereafter referred to as "PRODUCTS").

## SOFTWARE License

All rights in and to the SOFTWARE (including, but not limited to, copyright) shall be and remain vested in Advantest. Advantest hereby grants you a license to use the SOFTWARE only on or with Advantest PRODUCTS.

## Restrictions

(1) You may not use the SOFTWARE for any purpose other than for the use of the PRODUCTS.
(2) You may not copy, modify, or change, all or any part of, the SOFTWARE without permission from Advantest.
(3) You may not reverse engineer, de-compile, or disassemble, all or any part of, the SOFTWARE.

## Liability

Advantest shall have no liability (1) for any PRODUCT failures, which may arise out of any misuse (misuse is deemed to be use of the SOFTWARE for purposes other than it's intended use) of the SOFTWARE. (2) For any dispute between you and any third party for any reason whatsoever including, but not limited to, infringement of intellectual property rights.

# LIMITED WARRANTY

1. Unless otherwise specifically agreed by Seller and Purchaser in writing, Advantest will warrant to the Purchaser that during the Warranty Period this Product (other than consumables included in the Product) will be free from defects in material and workmanship and shall conform to the specifications set forth in this Operation Manual.

2. The warranty period for the Product (the "Warranty Period") will be a period of one year commencing on the delivery date of the Product.

3. If the Product is found to be defective during the Warranty Period, Advantest will, at its option and in its sole and absolute discretion, either (a) repair the defective Product or part or component thereof or (b) replace the defective Product or part or component thereof, in either case at Advantest's sole cost and expense.

4. This limited warranty will not apply to defects or damage to the Product or any part or component thereof resulting from any of the following:

   (a) any modifications, maintenance or repairs other than modifications, maintenance or repairs (i) performed by Advantest or (ii) specifically recommended or authorized by Advantest and performed in accordance with Advantest 's instructions;

   (b) any improper or inadequate handling, carriage or storage of the Product by the Purchaser or any third party (other than Advantest or its agents);

   (c) use of the Product under operating conditions or environments different than those specified in the Operation Manual or recommended by Advantest, including, without limitation, (i) instances where the Product has been subjected to physical stress or electrical voltage exceeding the permissible range and (ii) instances where the corrosion of electrical circuits or other deterioration was accelerated by exposure to corrosive gases or dusty environments;

   (d) use of the Product in connection with software, interfaces, products or parts other than software, interfaces, products or parts supplied or recommended by Advantest;

   (e) incorporation in the Product of any parts or components (i) provided by Purchaser or (ii) provided by a third party at the request or direction of Purchaser or due to specifications or designs supplied by Purchaser (including, without limitation, any degradation in performance of such parts or components);

   (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;

   (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or

   (h) any negligent act or omission of the Purchaser or any third party other than Advantest.

5. **EXCEPT TO THE EXTENT EXPRESSLY PROVIDED HEREIN, ADVANTEST HEREBY EXPRESSLY DISCLAIMS, AND THE PURCHASER HEREBY WAIVES, ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, (A) ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND (B) ANY WARRANTY OR REPRESENTATION AS TO THE VALIDITY, SCOPE, EFFECTIVENESS OR USEFULNESS OF ANY TECHNOLOGY OR ANY INVENTION.**

6. **THE REMEDY SET FORTH HEREIN SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR BREACH OF WARRANTY WITH RESPECT TO THE PRODUCT.**

7. **ADVANTEST WILL NOT HAVE ANY LIABILITY TO THE PURCHASER FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, WITHOUT LIMITATION, LOSS OF ANTICIPATED PROFITS OR REVENUES, IN ANY AND ALL CIRCUMSTANCES, EVEN IF ADVANTEST HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND WHETHER ARISING OUT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE. TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

8. **OTHER THAN THE REMEDY FOR THE BREACH OF WARRANTY SET FORTH HEREIN, ADVANTEST SHALL NOT BE LIABLE FOR, AND HEREBY DISCLAIMS TO THE FULLEST EXTENT PERMITTED BY LAW ANY LIABILITY FOR, DAMAGES FOR PRODUCT FAILURE OR DEFECT, WHETHER ARISING OUT OF BREACH OF CONTRACT, TORT (INCLUDING, WITHOUT LIMITATION, NEGLEGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

# CUSTOMER SERVICE DESCRIPTION

In order to maintain safe and trouble-free operation of the Product and to prevent the incurrence of unnecessary costs and expenses, Advantest recommends a regular preventive maintenance program under its maintenance agreement.

Advantest's maintenance agreement provides the Purchaser on-site and off-site maintenance, parts, maintenance machinery, regular inspections, and telephone support and will last a maximum of ten years from the date the delivery of the Product. For specific details of the services provided under the maintenance agreement, please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest 's sales representatives.

Some of the components and parts of this Product have a limited operating life (such as, electrical and mechanical parts, fan motors, unit power supply, etc.). Accordingly, these components and parts will have to be replaced on a periodic basis. If the operating life of a component or part has expired and such component or part has not been replaced, there is a possibility that the Product will not perform properly. Additionally, if the operating life of a component or part has expired and continued use of such component or part damages the Product, the Product may not be repairable. Please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest's sales representatives to determine the operating life of a specific component or part, as the operating life may vary depending on various factors such as operating condition and usage environment.

# SALES & SUPPORT OFFICES

Advantest Korea Co., Ltd.
22BF, Kyobo KangNam Tower,
1303-22, Seocho-Dong, Seocho-Ku, Seoul #137-070, Korea
Phone: +82-2-532-7071
Fax: +82-2-532-7132

Advantest (Suzhou) Co., Ltd.
Shanghai Branch Office:
Bldg. 6D, NO.1188 Gumei Road, Shanghai, China 201102 P.R.C.
Phone: +86-21-6485-2725
Fax: +86-21-6485-2726

Shanghai Branch Office:
406/F, Ying Building, Quantum Plaza, No. 23 Zhi Chun Road,
Hai Dian District, Beijing,
China 100083
Phone: +86-10-8235-3377
Fax: +86-10-8235-6717

Advantest (Singapore) Pte. Ltd.
438A Alexandra Road, #08-03/06
Alexandra Technopark Singapore 119967
Phone: +65-6274-3100
Fax: +65-6274-4055

Advantest America, Inc.
3201 Scott Boulevard, Suite, Santa Clara, CA 95054, U.S.A
Phone: +1-408-988-7700
Fax: +1-408-987-0691

ROHDE & SCHWARZ Europe GmbH
Mühldorfstraße 15 D-81671 München, Germany
(P.O.B. 80 14 60 D-81614 München, Germany)
Phone: +49-89-4129-13711
Fax: +49-89-4129-13723

ADVANTEST

http://www.advantest.co.jp

ADVANTEST CORPORATION
Shin-Marunouchi Center Building, 1-6-2 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan
Phone: +81-3-3214-7500