MS2650/MS2660B/C Series
Spectrum Analyzer
Operation Manual
Vol. 2
(Detailed Operating Instructions)

10th Edition

- **For safety and warning information, please read this manual before attempting to use the equipment.**
- **Additional safety and warning information is provided within the MS2650/MS2660B/C Series Spectrum Analyzer Operation Manual Vol. 1 (Basic Operating Instructions). Please also refer to this document before using the equipment.**
- **Keep this manual with the equipment.**

ANRITSU CORPORATION

Document No.: M-W1251AE-10.0

Safety Symbols

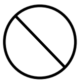
To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Ensure that you clearly understand the meanings of the symbols BEFORE using the equipment. Some or all of the following symbols may be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

Symbols used in manual

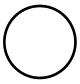
DANGER ⚠	This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.
WARNING ⚠	This indicates a hazardous procedure that could result in serious injury or death if not performed properly.
CAUTION ⚠	This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

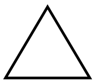
The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.



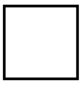
This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.



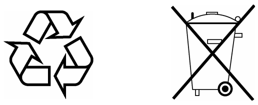
This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.



This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.



This indicates a note. The contents are described in the box.



These indicate that the marked part should be recycled.

MS2650/MS2660B/C Series
Spectrum Analyzer
Operation Manual Vol. 2 (Detailed Operating Instructions)

14 March 1997 (First Edition)
7 March 2008 (10th Edition)

Printed in Japan

Equipment Certificate

Anritsu Corporation certifies that this equipment was tested before shipment using calibrated measuring instruments with direct traceability to public testing organizations recognized by national research laboratories, including the National Institute of Advanced Industrial Science and Technology, and the National Institute of Information and Communications Technology, and was found to meet the published specifications.

Anritsu Warranty

Anritsu Corporation will repair this equipment free-of-charge if a malfunction occurs within one year after shipment due to a manufacturing fault, under the condition that this warranty is void when:

- The fault is outside the scope of the warranty conditions described in the operation manual.
- The fault is due to mishandling, misuse, or unauthorized modification or repair of the equipment by the customer.
- The fault is due to severe usage clearly exceeding normal usage.
- The fault is due to improper or insufficient maintenance by the customer.
- The fault is due to natural disaster including fire, flooding, earthquake, etc.
- The fault is due to use of non-specified peripheral equipment, peripheral parts, consumables, etc.
- The fault is due to use of a non-specified power supply or in a non-specified installation location.

In addition, this warranty is valid only for the original equipment purchaser. It is not transferable if the equipment is resold.

Anritsu Corporation shall assume no liability for injury or financial loss of the customer due to the use of or a failure to be able to use this equipment.

Anritsu Corporation Contact

In the event that this equipment malfunctions, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.

Notes On Export Management

This product and its manuals may require an Export License/Approval by the Government of the product's country of origin for re-export from your country.

Before re-exporting the product or manuals, please contact us to confirm whether they are export-controlled items or not.

When you dispose of export-controlled items, the products/manuals need to be broken/shredded so as not to be unlawfully used for military purpose.

Disposal Procedure

The product that you have purchased contains a rechargeable battery. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with your local solid waste officials for details in your area for recycling options or proper disposal.

Front Panel Power Switch

To prevent malfunction caused by accidental touching, the front power switch of this equipment turns on the power if it is pressed continuously for about one second in the standby state. If the switch is pressed continuously for one second in the power-on state, the equipment enters the standby state.

In the power-on state, if the power plug is removed from the outlet, then reinserted into it, the power will not be turned on. Also, if the lines is disconnected due to momentary power supply interruption or power failure, the power will not be turned on (enters the standby state) even if the line is recovered.

This is because this equipment enters the standby state and prevents incorrect data from being acquired when the line has to be disconnected and reconnected.

For example, if the sweep time is 1,000 seconds and data acquisition requires a long time, momentary power supply interruption (power failure) might occur during measurement and the line could be recovered automatically to power-on. In such a case, the equipment may mistake incorrect data for correct data without recognizing the momentary power supply interruption.

If this equipment enters the standby state due to momentary power supply interruption or power failure, check the state of the measuring system and press the front power switch to restore power to this equipment.

Further, if this equipment is built into a system and the system power has to be disconnected then reconnected, the power for this equipment must also be restored by pressing the front power switch.

Consequently, if this equipment is built into remote monitoring systems that use MODEMs, the standby function of this equipment must be modified.

ABOUT DETECTION MODE

This instrument is a spectrum analyzer which uses a digital storage system. The spectrum analyzer makes level measurements in frequency steps obtained by dividing the frequency span by the number of measurement data points (501). This method of measurement cannot detect the signal peak level if the spectrum of a received signal is narrower than these frequency steps.

To resolve this problem, this instrument usually operates in positive peak detection mode and normal detection mode. In the positive peak detection mode, the highest level within the frequency range between the sample points can be held and traced. In the normal detection mode, both the positive peak and the negative peak can be traced.

Positive peak detection mode should be used for almost all measurements including normal signal level measurement, pulsed noise analysis, and others. It is impossible to measure the signal level accurately in sample detection mode or in negative peak detection mode.

Use of sample detection mode is restricted to random noise measurement, occupied frequency bandwidth measurement for analog communication systems, and adjacent-channel leakage power measurement, etc.

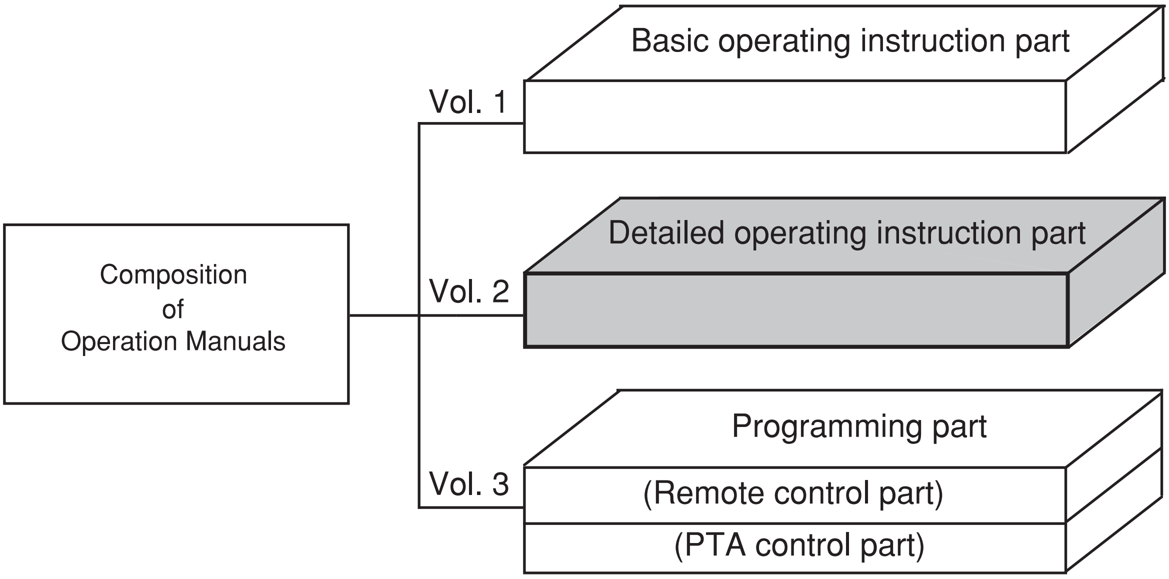
Measurement	Item
• Normal signal	POS PEAK
• Random noise	SAMPLE
• Pulsed noise	NORMAL (POSI-NEG)
• Occupied frequency bandwidth, adjacent-channel leakage power (for analog communication systems)	SAMPLE
• Occupied frequency bandwidth, adjacent-channel leakage power (for digital communication systems)	POS PEAK or SAMPLE

When a detection mode is specified as one of the measurement methods, make the measurement in the specified detection mode.

ABOUT THIS MANUAL

(1) Composition of MS2650/MS2660B/C series spectrum analyzer Operation Manuals

The MS2650/MS2660B/C Spectrum Analyzer operation manuals of the standard type are composed of the following three documents. Use them properly according to the usage purpose.



Basic operating instruction part:	Basic Operating Instructions: Provides information on the MS2650/ MS2660B/C series outline, preparation before use, panel description, basic operation, soft-key menu and performance tests.
Detailed operating instruction part:	Detailed Operating Instructions: Provides information on the detailed panel operating instructions on the spectrum analyzer that expand on the basic operation and soft-key menu in the Basic Operating Instruction Part.
Programming part:	Composed of the Remote Control Part and PTA Control Part. The Remote Control Part provides information on RS-232C remote control GPIB remote control and sample programs, while the PTA Control Part describes about PTA operation and PTL commands.

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BASIC OPERATION PROCEDURE

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SECTION 1
BASIC OPERATION PROCEDURE

The basic operation procedure of this equipment is explained here. The operations are listed on the right. Also, the explanation will advance assuming that a 500 MHz signal is applied to the input connector. Please read this manual while operating this equipment.

(☐ : Panel key, ___ : Soft key)

<Actual operations>

(I) Signal display
  1) Turn the power on,
  2) execute automatic calibration,
  3) set the signal to the center of the screen, and
  4) enlarge and display the signal.
(II) Marker operation
  Check of the zone marker function.
  The "marker → CF" function check.
(III) "Measure" function check
(IV) Screen hard copy

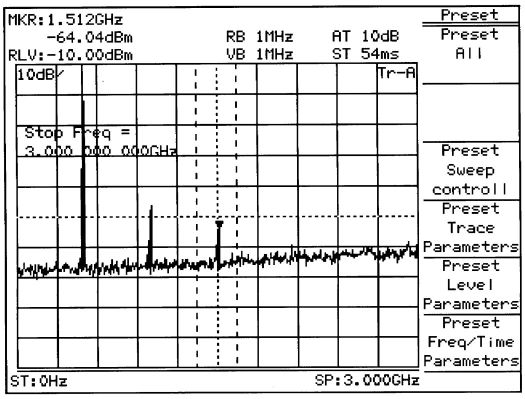
Signal Display

Turn the power on

Press the standby button on the rear panel, then press the power switch (0) on the front panel. In this case, continue pressing the power switch for one second or more.

Press [Preset] key.

Press Preset All key in the menu.



```
MKR:1.512GHz
   -64.04dBm          RB 1MHz    AT 10dB
RLV:-10.00dBm         VB 1MHz    ST 54ms
Stop Freq =
3.000 000 000GHz
ST:0Hz                        SP:3.000GHz
```

Fig. 1-1

The power is turned on/off only when the power switch is pressed for one second or more. This prevents the power from being turned on/off easily by mistake.

When [panel] key (hard key) is pressed, the related soft key menu is displayed.

Partial resettings are enabled. This resetting includes only the display-related resetting or the resetting of special modes such as zone sweep.

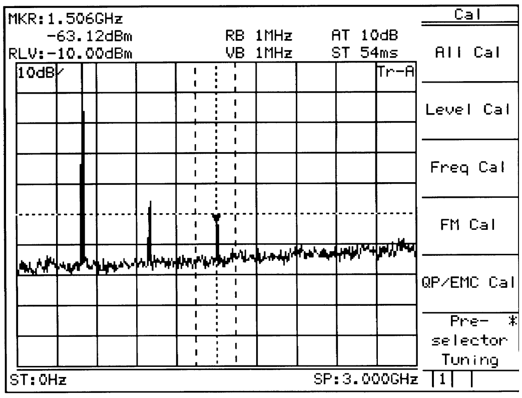
Execute automatic calibration

Wait after switching on the power supply of the machine (warm up period) till the internal temperature becomes stable. This period is approximately 10 minutes.

After warm up, execute automatic calibration.

Press Shift key then 0 (CAL) key.

Select All Cal from the menu displayed on the display.



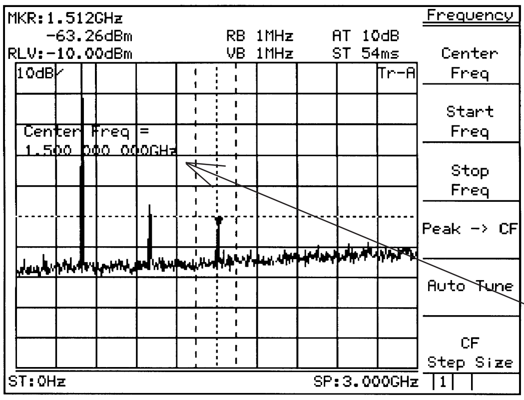
```
MKR:1.506GHz
    -63.12dBm          RB 1MHz    AT 10dB
RLV:-10.00dBm          VB 1MHz    ST 54ms
10dB/                                  Tr-A
ST:0Hz                          SP:3.000GHz
```

Fig. 1-2

Automatic Calibration is carried out by using an internal source without need for any external cable connection.
See "Detailed Operation Instructions" for detail information about contents of calibration.

Set the signal to the center of the screen

Press Frequency key.



```
MKR:1.512GHz
    -63.26dBm          RB 1MHz    AT 10dB
RLV:-10.00dBm          VB 1MHz    ST 54ms
10dB/                                  Tr-A
Center Freq =
1.500 000 000GHz
ST:0Hz                          SP:3.000GHz
```

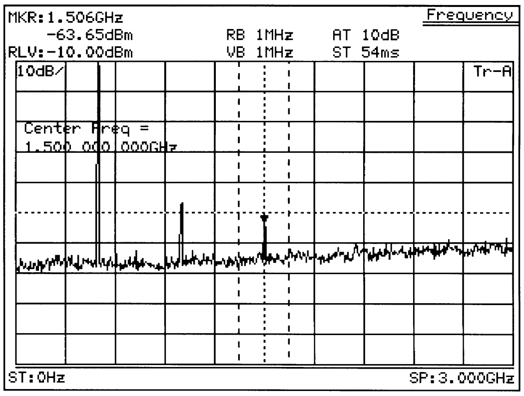
Fig. 1-3

When pressing Frequency, Span, Amplitude or Coupled Function key(s) which is used frequently, Center Frequency, Span, Reference Level, RBW or VBW function is selected and numeric value for the function can be entered into Entry area. This reduces key operation times.

This display section is called Entry area. Selecting the menu displays the current set value of the parameter. The set value can be changed by entering data in Entry area.

Press Menu On/Off key

The display of the soft key menu can be switched on/off using Menu On/Off key. When the menu disappears, the scale is enlarged. Also, when the menu is displayed, the scale is reduced.



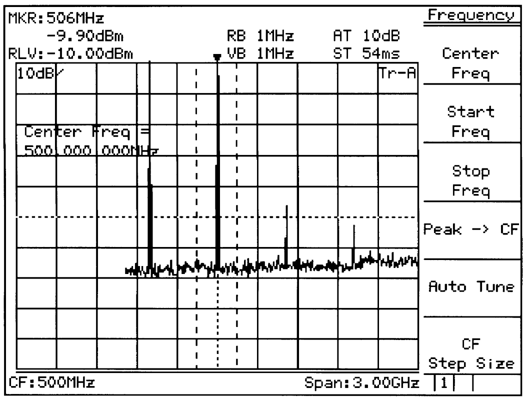
MKR:1.506GHz
-63.65dBm
RLV:-10.00dBm
RB 1MHz
VB 1MHz
AT 10dB
ST 54ms
Center Freq =
1.500 000 000GHz
ST:0Hz
SP:3.000GHz

Fig. 1-4

Press Menu On/Off key to return to previous screen.

Use the ten-key pad (numeric keys) to enter 500 MHz.

The following three methods to input numeric values to parameters are provided: direct input by the ten-key pad (numeric keys), up/down keys, and rotary knob.

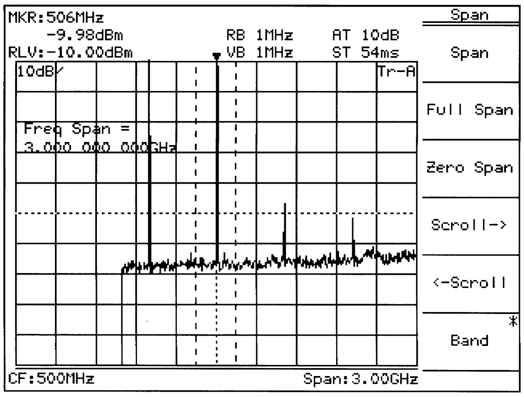


MKR:506MHz
-9.90dBm
RLV:-10.00dBm
RB 1MHz
VB 1MHz
AT 10dB
ST 54ms
Center Freq =
500 000 000MHz
CF:500MHz
Span:3.00GHz

Fig. 1-5

Enlarge and display the signal

Press Span key , then press the V down key several times to enlarge the signal display.



MKR:506MHz
-9.98dBm
RLV:-10.00dBm
RB 1MHz
VB 1MHz
AT 10dB
ST 54ms
Freq Span =
3.000 000 000GHz
CF:500MHz
Span:3.00GHz

Fig. 1-6

Marker Operation

Here, checks that the signal frequency and level are displayed in a marker display area. The zone marker automatically fetches the highest level signal within the zone and displays the frequency and level.

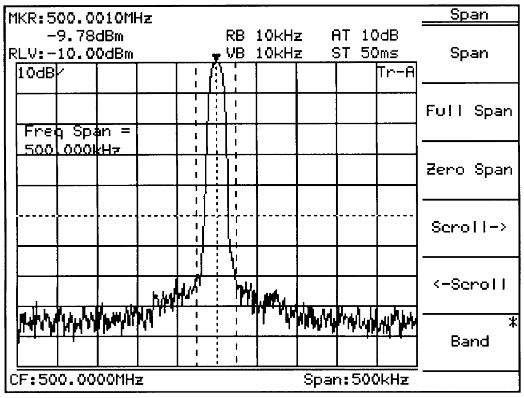


Fig. 1-7

To check Marker → CF function, shift the signal from the center intentionally.
Press Frequency key and More key in order, and then Scroll → key two times.

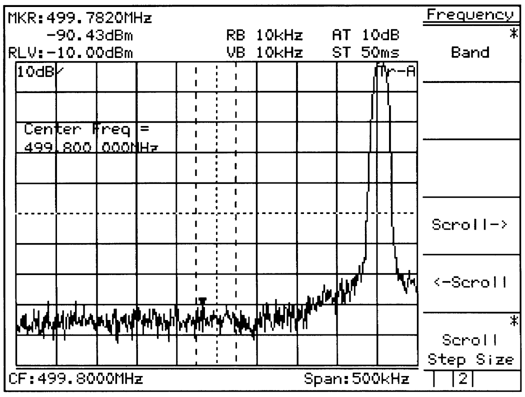


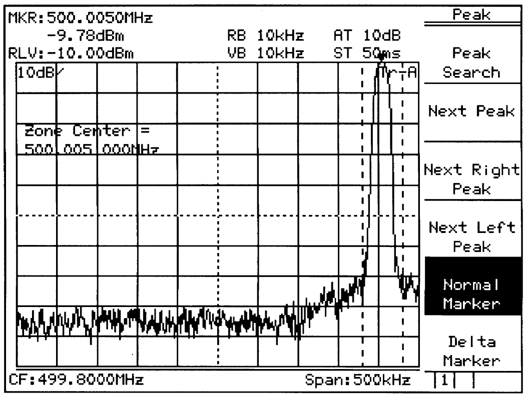
Fig. 1-8

The soft key menu marked by an asterisk on the upper right indicates that the menu can further be opened by pressing the key. Adversely, the soft key menu not marked indicates that the menu cannot be opened any more, so to speak, the end of menu opening.

The following items can easily be checked by the soft key menu tab: How many pages of the soft key menu being displayed currently are there?, and what page is displayed now?

To turn over the page, press More key.

Press Peak Search key.

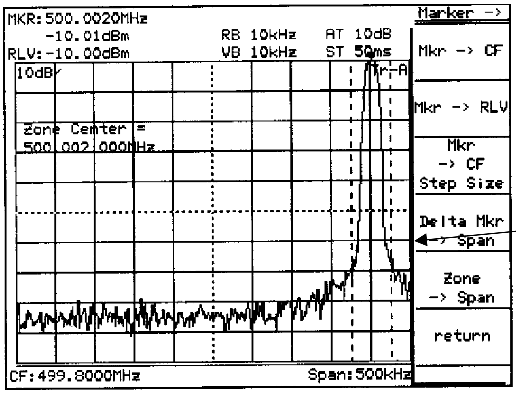


MKR:500.0050MHz
-9.78dBm
RLV:-10.00dBm
RB 10kHz VB 10kHz
AT 10dB ST 50ms
Zone Center = 500.005 000MHz
CF:499.8000MHz Span:500kHz

Fig. 1-9

*Advanced operation memo: It is convenient that the page can also be turned over by repeatedly pressing the panel key. This method is used when key (s), such as Measure key, has a number of pages. Besides, the Freq/Ampl and Marker-related keys do not turn over the page by repeatedly pressing the panel key. For these keys, because the first page is important specially, it should always be displayed when the panel key is pressed.

The marker fetches the signal.
Press More to open 2nd page, and press Marker → key.

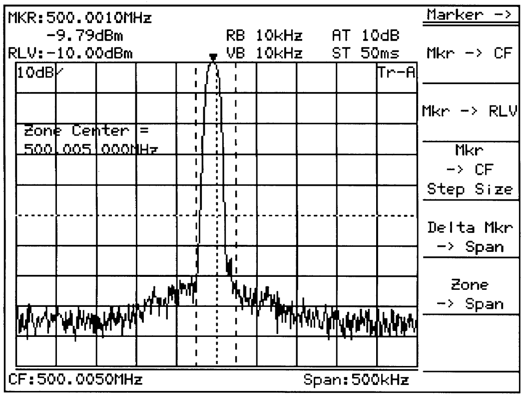


MKR:500.0020MHz
-10.01dBm
RLV:-10.00dBm
RB 10kHz VB 10kHz
AT 10dB ST 50ms
Zone Center = 500.002 000MHz
CF:499.8000MHz Span:500kHz

Fig. 1-10

When the soft key menu is pressed, a menu of function related to the menu is further displayed. In this case, as shown in the figure on the left, the thick line (the line on the preceding page) is displayed at the left of the soft key menu. This indicates that a new menu is overlapped with the preceding page.

Press marker → CF key.



MKR:500.0010MHz
-9.79dBm
RLV:-10.00dBm
RB 10kHz VB 10kHz
AT 10dB ST 50ms
Zone Center = 500.005 000MHz
CF:500.0050MHz Span:500kHz

Fig. 1-11

The page opened by pressing the soft key can return to the preceding page by the Return key. Besides, it can be checked that which soft key menu was pressed previously to open the current menu, as the menu title is displayed on the upper row of the soft key.

Here, return to the screen of Fig. 1-8 and ensure that the screen changes to that of Fig. 1-11 only by pressing the → CF key.

"Measure" Function Check

Press Preset key and Preset All key in order.
Press Peak Search key.
If the zero beat signal level (local feed through) is larger than the signal level and the marker fetches the zero beat level, press "Next peak" key and put the marker on the signal.

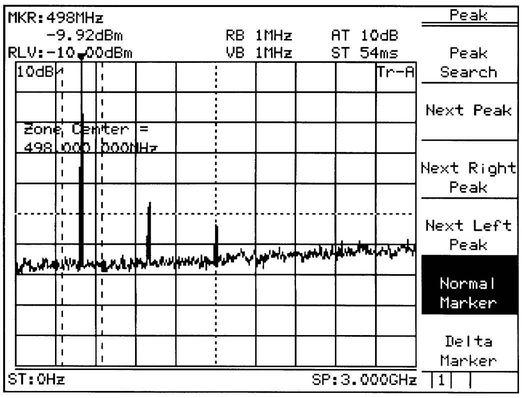


Fig. 1-12

Press the Measure key and Frequency Count key to set the function of high accuracy frequency measurement of the marker points.
Then, press the Count On key and start measurement.

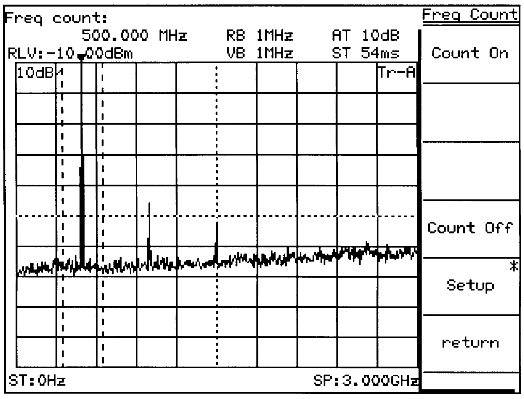


Fig. 1-13

The soft-key menu display can be switched On/Off by the Menu On/Off key.
However, keys that condition setting is not possible unless a menu is On unconditionally make the soft-key menu display On when pressing a panel key.

From the screen after executing measurement, press another panel key and change parameters, and then, pressing again the Measure key will automatically return to the menu of this screen and not to page 1 of the menu (page learning function).
It is a useful function when repeating measurement.

The frequency of marker points is displayed at the top left of the screen.
Incidentally, the internal counter correctly operates even at the full span condition, so an operation to reduce frequency span otherwise required is not necessary in this model.

Screen Hard Copy

The screen can be hard-copied with the VP-600 printer (Epson) via an RS232C interface, and the procedures are described below:

1) As illustrated below, connect the RS-232C connector and printer with an attached RS-232C cable.
2) Press the Copy key, and the currently displayed screen is hard-copied.
   If the printed copy is improper, check if the RS-232C interface is correctly set in the following sequence.
3) Press the Shift key and then the Interface key.
4) Press the Connect to Controller key several times to get None on the display, and press the Connect to Prt/Plt key several times and get RS-232C on the display.
   Now the printer can be operated with RS-232C.
5) Press the RS232C Setup key and set so that (or check if) the setting of RS-232C interface is the same between the main body and printer.
   (For the setting/checking of the RS-232C interface on the printer side, refer to the instruction manual of the printer.)
6) Press the Shift key and then the Copy Cont key.
7) Press the Printer/Plotter key and select Printer.
8) Press the Printer Setup key, and then press the VP-600 key.
9) Press the Magnify key several times and make the display 1×1.
10) Press the Copy key, and the currently displayed screen is hard-copied.

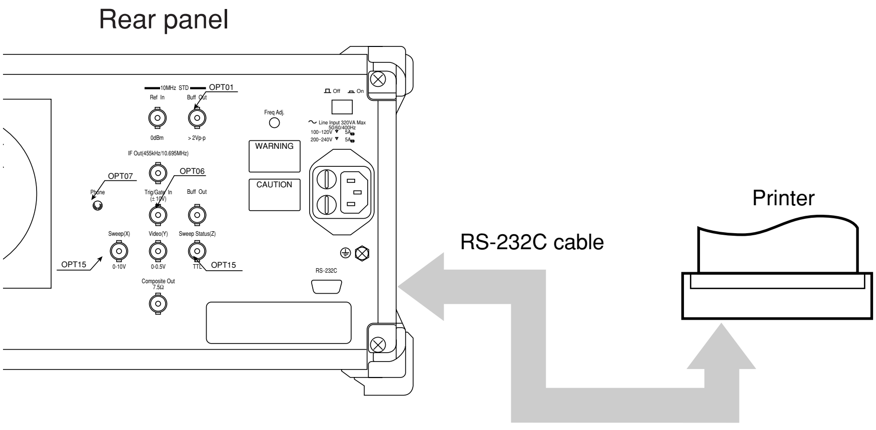


Fig. 1-14

SECTION 2

FREQUENCY/AMPLITUDE DATA ENTRY

This section describes the data entry function related to frequency and amplitude in the Freq/Ampl section on the front panel.

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SECTION 2
FREQUENCY/AMPLITUDE DATA ENTRY

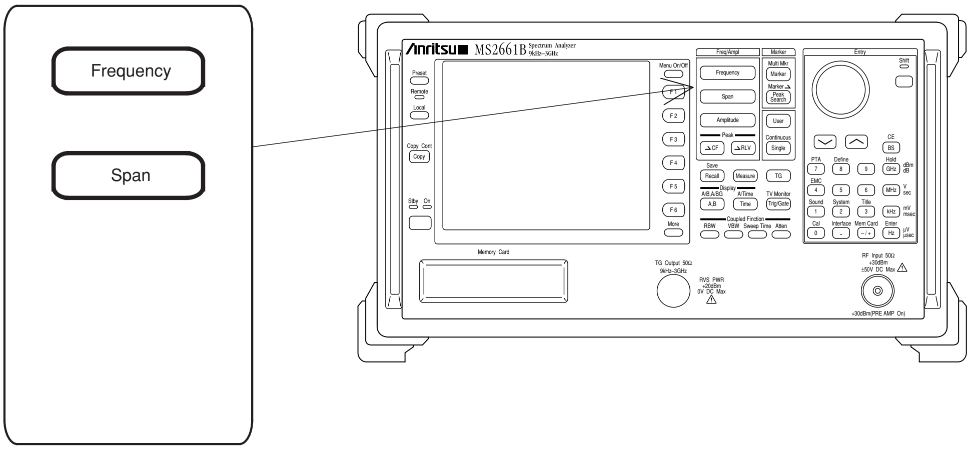
Setting Observation Frequency

The observation frequency of the spectrum analyzer is set in the following two modes:

- Center-Span
- Start-Stop

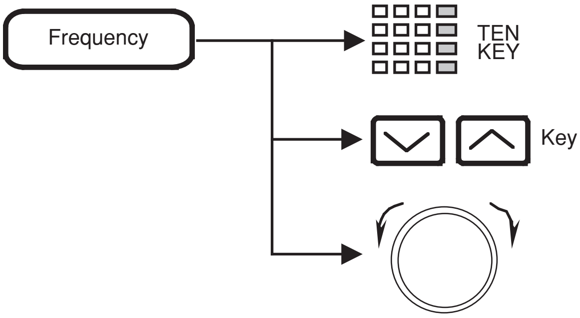
The frequency setting upper and lower limits are For the MS2651B/2661B/2661C, 0 to 3 GHz
For the MS2653B/2663B/2663C, 0 to 8.1 GHz, respectively.

The Frequency key is used as the header key for setting the frequency, and the Span key is used as the header key for setting the frequency span.



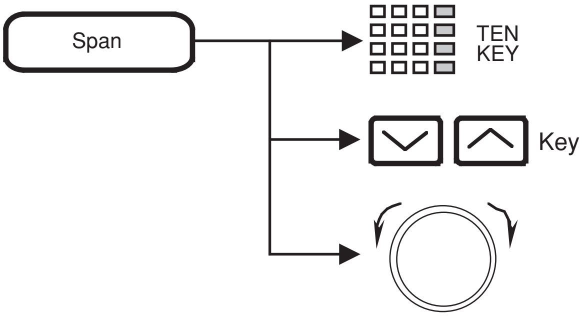
Center-Span Mode

(1) Setting center frequency

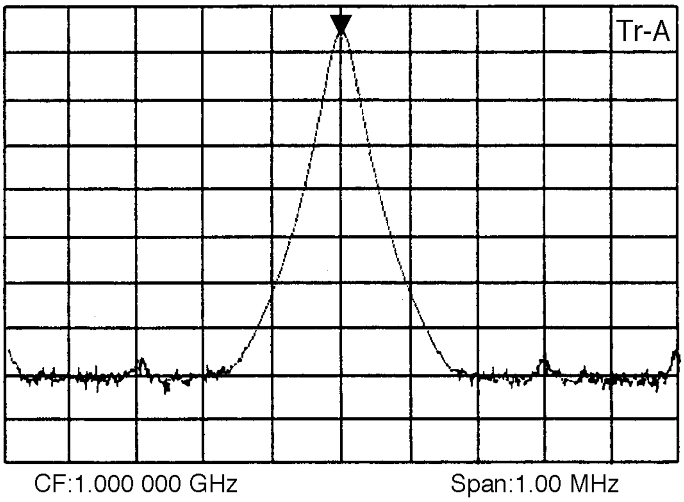


(Use the CF Step Size key to set the step size.)

(2) Setting frequency span



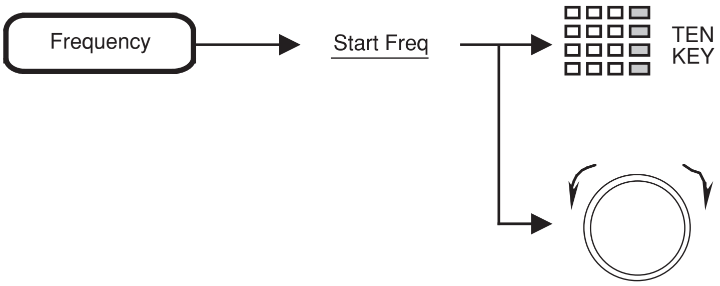
(1/2/5 sequence)



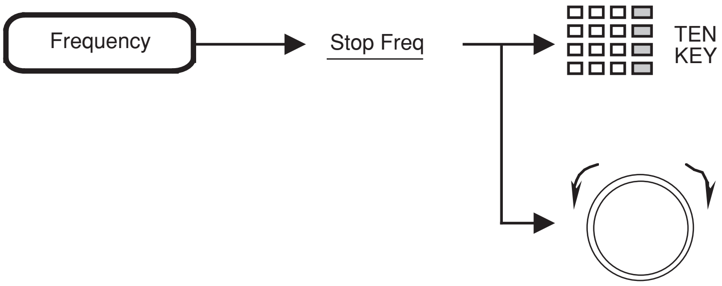
Note: *When frequency span is 200 kHz or less, warming up might be necessary until the observation frequency becomes stable after turning on the power.*
When "Warm Up" message is being indicated at the top right corner of the indicator, please wait for approximately 3 minutes, and start the measurements after the message disappears.

Start-Stop Mode

(1) Start frequency

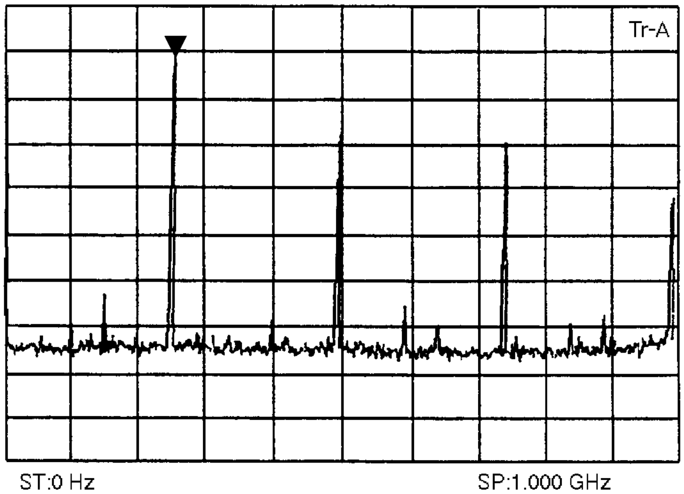


(2) Stop frequency

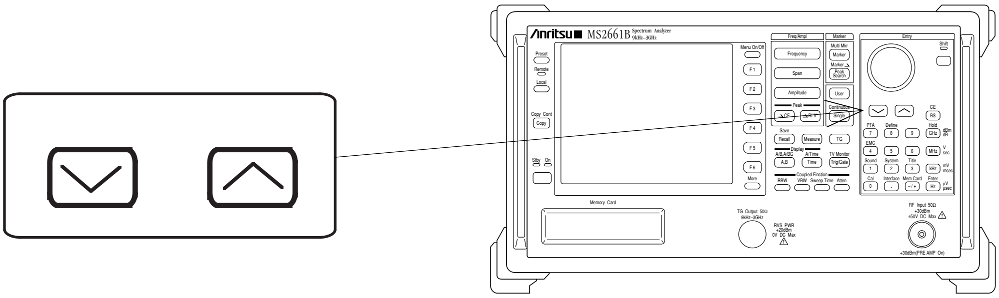


Notes:

- Because the ∨ and ∧ keys are the step keys for the center frequency, the start and stop frequencies are also changed.
- The stop frequency may also vary depending on the values of the frequency span setting resolution and start frequency.

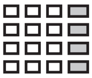


Setting Step Size with Step Keys



To use the ∨ ∧ keys to change the step size of the center frequency, register the step size as follows:

Frequency → CF Step Size →



TEN KEY

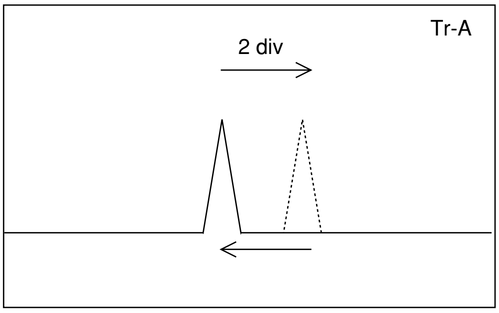
Setting Frequency Scroll Step Size

Frequency → Scroll Step Size
- 1 div
- 2 div
- 5 div
- 10 div

Select a step size. The selected scroll step size is highlighted.

- return

Return to the top menu.



Span → Scroll→

The waveform scrolls 2 divs to the right.

Span → ←Scroll

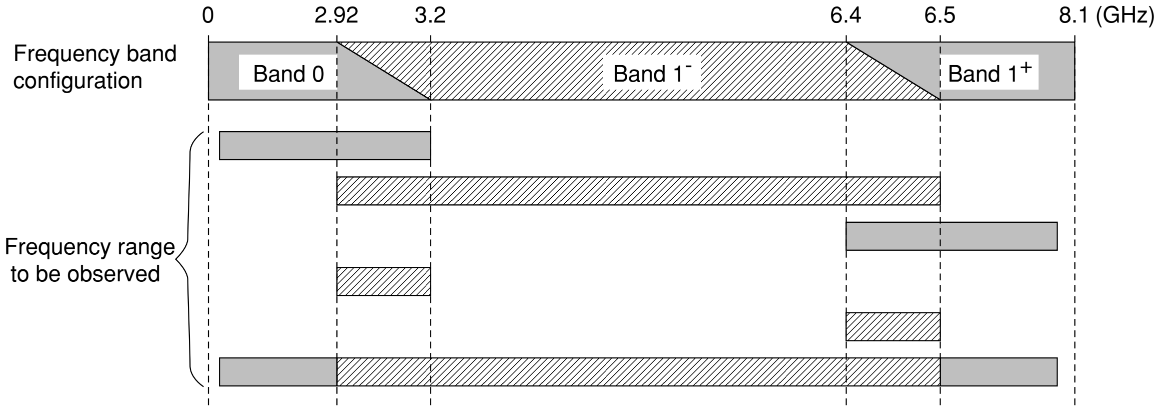
The waveform scrolls 2 divs to the left.

Fixing the frequency bands

This function is an MS2653B/2663B/2663C dedicated function. It cannot be used in the MS2651B/2661B/2661C.
In the MS2653B/2663B/2663C, the 0 to 8.1 GHz frequency range consists of the following three bands:

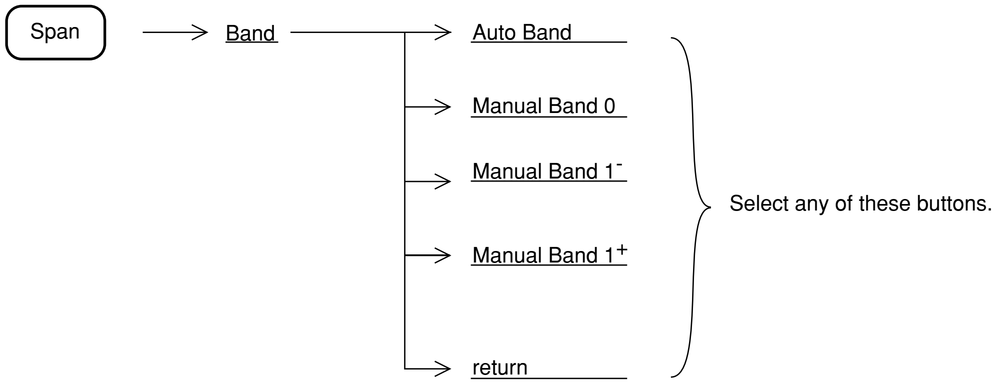
- Band 0 .... .0 to 3.2 GHz
- Band 1^- .... 2.92 to 6.5 GHz
- Band 1^+ .... 6.4 to 8.1 GHz

In the initial state, the Auto Band mode that is operated by selecting the optional frequency band is selected according to the range of frequencies to be observed.



Selection of frequency bands according to range of frequencies to be observed in Auto Band mode

Perform the following to set the frequency bands, for example, when the frequency bands are switched:



Setting Full Scan

In the normal operating state, pressing Preset the key allows the entire frequency range of the spectrum analyzer to be swept over the full span. However, this setting also initializes the parameters except the frequency range.

To set the full span and leave the other parameters unchanged, perform the following key operations.

Span → Full Span

For the MS2651B/2661B/2661C, 0 to 3 GHz
For the MS2653B/2663B/2663C Auto band, 0 to 8.1 GHz
For Band 0, 0 to 3.2 GHz
For Band 1-, 2.92 to 6.5 GHz
For Band 1+, 6.4 to 8.1 GHz

Setting Zero Span

The Spectrum Analyzer can operate as a selective level meter in which the horizontal axis is graduated as a time axis by setting the frequency span to 0 Hz. The rising and falling edges of burst waves can also be observed and measured.

Performing any of the following key operations allows the spectrum analyzer to operate in the zero panel (time domain) mode.

- Span → 0 → Hz
- Span → Zero Span
- Time

For further details on the zero span (time domain) mode, see SECTION 5, "SELECTING THE DISPLAY METHOD."

In the frequency and time domains, the RBW, VBW, Sweep time and other coupling functions time can be set to different values. For further details, see SECTION 9, "SYSTEM SETTING AND PRESET FUNCTION."

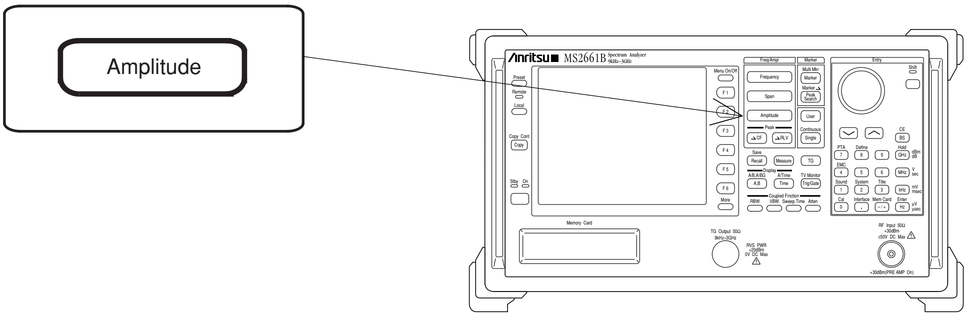
Setting Level Range

The table below shows the types of level display modes and the ranges of the reference level (top graticule of the amplitude scale) for the different modes. When a preamp (Option) is used, the entire reference level range is shifted 20 dB.

		50 Ω (standard)	75 Ω (with Opt.22) MS2651B/2661B/2661C only
Display mode	Units	Reference Level range	
Log scale	dBm	–100 to +30 dBm	–100 to +25 dBm
	dBμV	+7 to +137 dBμV	+8.8 to +133.8 dBμV
	dBmV	–53 to 77 dBmV	–51.2 to 73.8 dBmV
	V	2.24 μV to 7.07 V	2.74 μV to 4.87 V
	dBμV (emf)	+13 to +143 dBμV	+14.8 to +139.8 dBμV
	W	100 fW to 1.0 W	100 fW to 316 mW
	dBμV/m	––––––	––––––
Linear scale	V	224 μV to 7.07 V	274 μV to 4.87 V

dBm:	dBm unit system where 1 mW/50 Ω or 75 Ω is defined as 0 dBm.
dBμV:	dBμV unit system where 1μV is defined as 0 dBμV, and the terminal voltage display is terminated into 50 Ω or 75 Ω.
dBmV:	dBmV unit system where 1 mV is defined as 0 dBmV, and the terminal voltage display is terminated into 50 Ω or 75 Ω.
dBμV (emf):	dBμV (emf) unit system based on the open-voltage display, and dBμV +6 dB is fed as the output value.

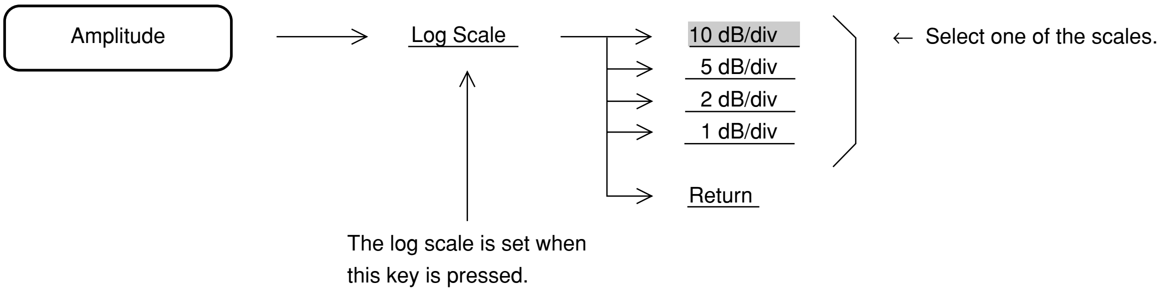
The Amplitude key is used as the header key for setting the amplitude level.



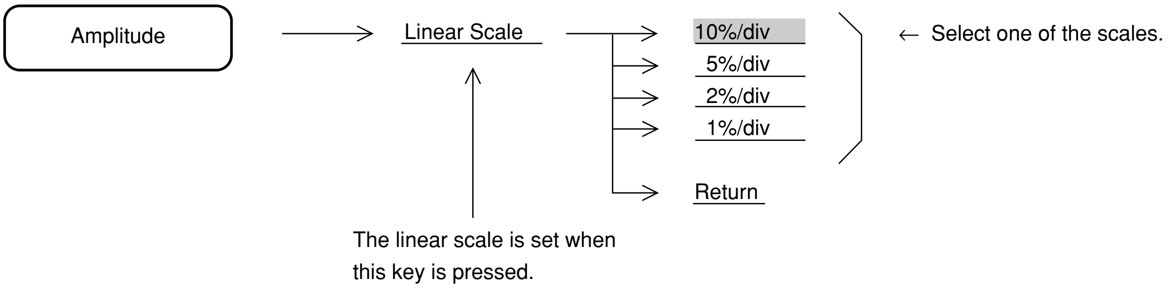
Setting Log/Linear Scale

To set the amplitude scale to log scale or linear scale, perform the following key operations.

(1) Setting log scale



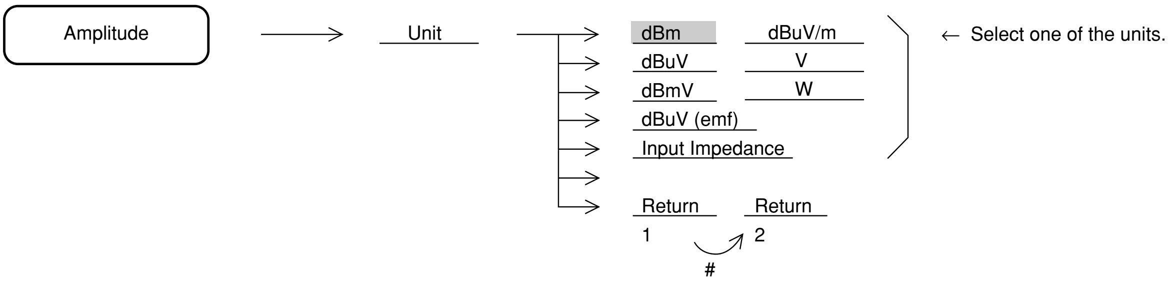
(2) Setting linear scale



The reference level remains constant, independent of switching between log and linear scales.
When the reference level is set to less than –60 dBm in the log scale mode, the reference level of the linear scale is switched to 224 µV/50 Ω or 274 µV/75 Ω.

Selecting Reference Level Units

In the log scale mode, the spectrum analyzer provides six types of reference level units: dBm, dBμV, dBmV, V, dBμV (emf), dBμV/m, and W. To select one of the reference level units, perform the following key operations.

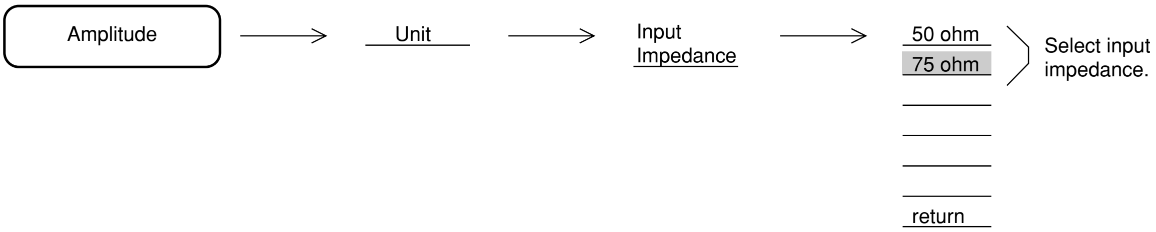


\# To turn the page, press the More key.

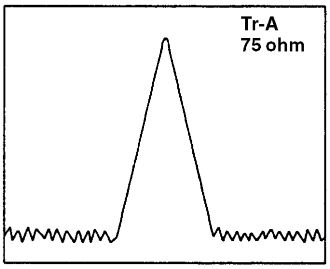
Because the reference level unit used for the linear scale is only V, there is nothing to select.

Selecting Input Impedance

This function is an standard: 50 Ω model dedicated function.
The input impedance of the spectrum analyzer is 50 Ω. Measurement with 75 Ω can be enabled by using 50 Ω→75 Ω Impedance Transformer. In this case, measured value is level converted.
When the input impedance is set to 75 Ω as shown in the figure below; measured value is level converted, and displayed according to the level unit of the dBμV/dBmV/dBμV (emf)/V.



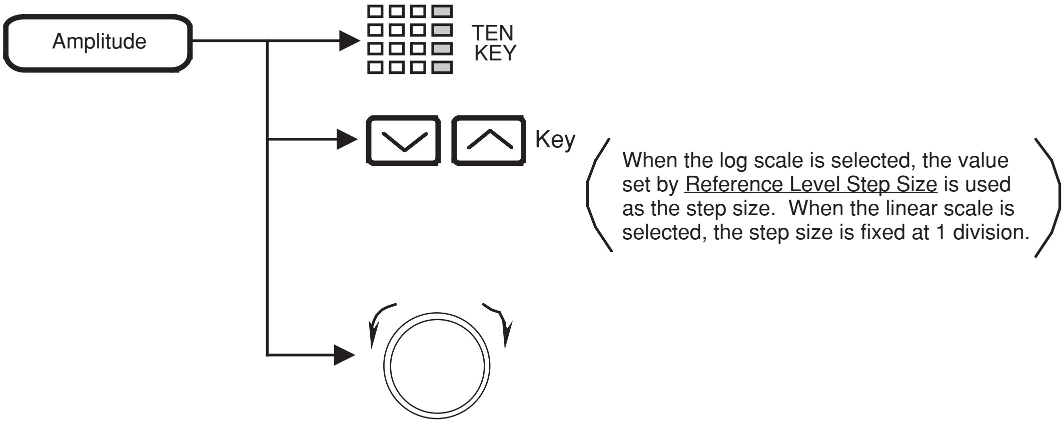
When the input impedance is set to 75 Ω, "75 ohm" is displayed at the top right of the waveform.



When the MA1621A is used as the 50 Ω→75 Ω Impedance Transformer, the insertion-loss frequency characteristics of the MA1621A must be compensated. The spectrum analyzer has the level-compensation function. (See p.2-16 "Setting 50 Ω→75 Ω Impedance Transformer (MA1621A)".)

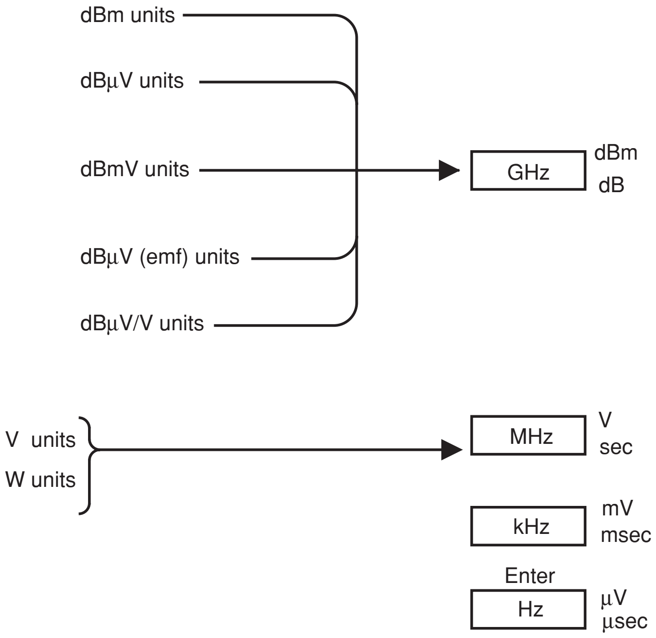
Setting Reference Level

Select the reference level (top graticule of the amplitude scale) by performing the following key operations.



(When the log scale is selected, the value set by <u>Reference Level Step Size</u> is used as the step size. When the linear scale is selected, the step size is fixed at 1 division.)

Use the unit key as follows, according to the set reference level unit.

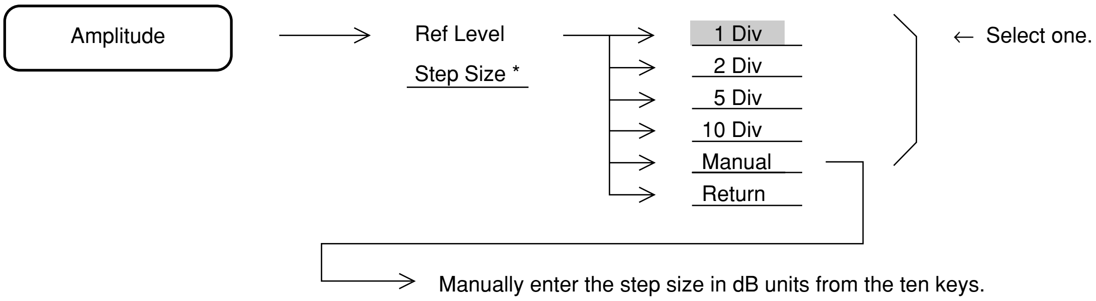


(For W units, read V as W.)

Setting Reference Level Step Size

To change the reference level with the ∨ ∧ keys, set the step size by performing the following key operations.

(1) Log scale

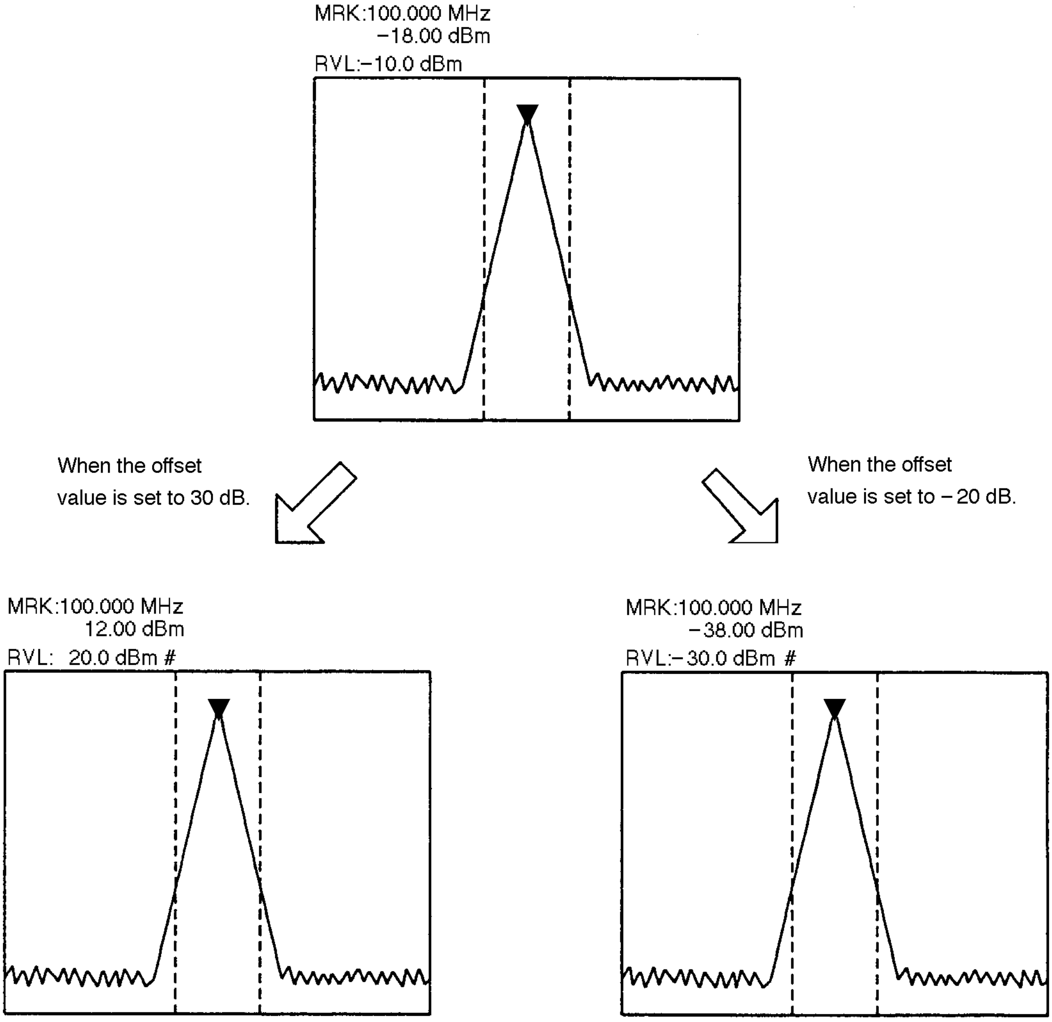


(2) Linear scale

Fixed at 1 division.

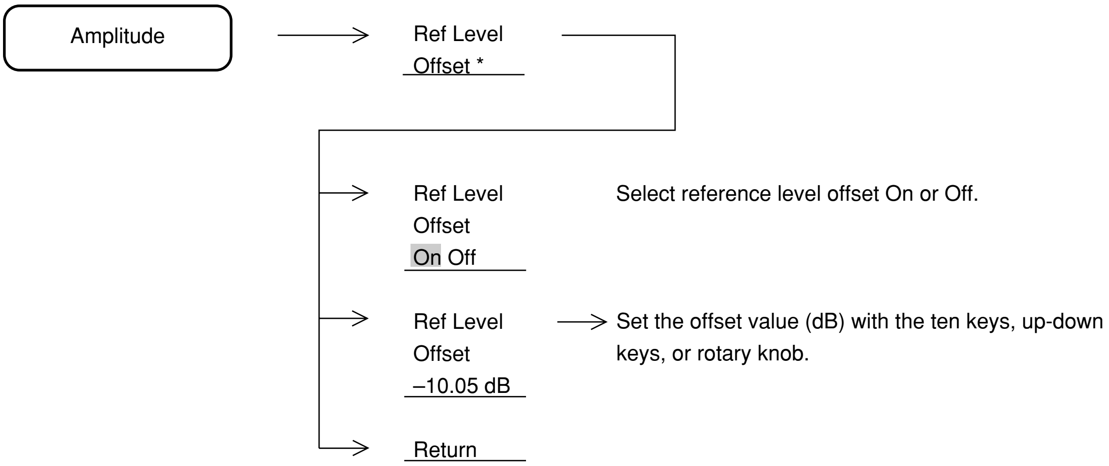
Offsetting Reference Level

The reference level and waveform trace can be displayed by adding a given offset.



The # is displayed to the right of the reference level display above the scale.

Turn the offset display On/Off and set its offset value by performing the following key operations.



Select reference level offset On or Off.

Set the offset value (dB) with the ten keys, up-down keys, or rotary knob.

The offset value setting range is from –100 to +100 dB. The offset value resolution is 0.01 dB.

The offset can be applied to each trace (A, B, BG, Time), but it cannot be applied when monitoring FM demodulated waveforms and when using A–B→A function.

Setting Attenuator

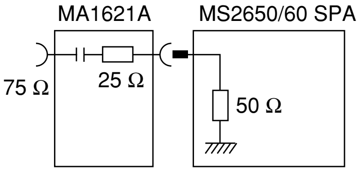
Press the Amplitude key, then press the Attenuator key.
Select manual setting or automatic setting.
For manual setting, enter the attenuator setting in dB units from the ten keys.

Preamp Setting

This function is an MS2651B/2661B/2661C dedicated function.
Press the Amplitude key, then press the Pre Ampl key.
Press the Pre Ampl On/Off key. The 20 dB preamp (Option) is turned On and Off. The preamp gain-frequency curve is also compensated.

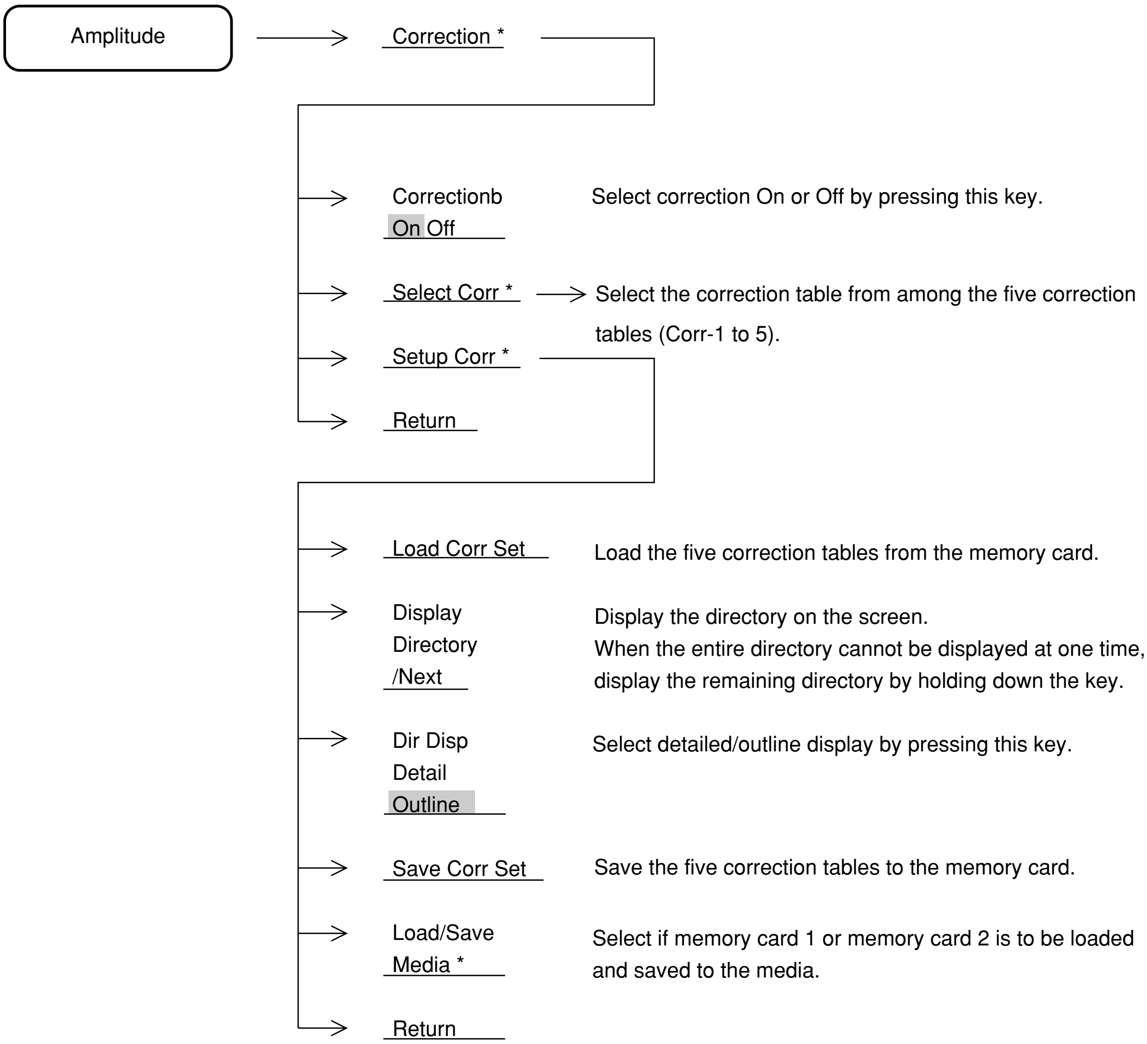
Setting 50 Ω→75 Ω Impedance Transformer

This function is an standard: 50 Ω model dedicated function.
When the optional MA1621A (75 Ω→50 Ω) impedance transformer is installed to the RF input attenuator (see the figure below), set the input impedance to 75 Ω.
Press the Amplitude key, then press the Input Transformer key.
Set the MA1621A to On with the On Off key.
When the input impedance is set to On; it is assumed that a 25 Ω resistor is connected in series with the input, the level is converted for 75 Ω, the insertion-loss frequency characteristic is corrected, and then the measured result is displayed.



Setting Level Frequency Correction Coefficient

This function corrects the level-frequency characteristics of the cables and pads (connected to the front end of the RF Input connector) so that the level becomes flat. Correction tables are written via the RS-232C or GPIB interface.



Correctionb On Off	Select correction On or Off by pressing this key.
Select Corr *	Select the correction table from among the five correction tables (Corr-1 to 5).
Setup Corr *	
Return	
Load Corr Set	Load the five correction tables from the memory card.
Display Directory /Next	Display the directory on the screen. When the entire directory cannot be displayed at one time, display the remaining directory by holding down the key.
Dir Disp Detail Outline	Select detailed/outline display by pressing this key.
Save Corr Set	Save the five correction tables to the memory card.
Load/Save Media *	Select if memory card 1 or memory card 2 is to be loaded and saved to the media.
Return	

For further details, see SECTION 8.

SECTION 3

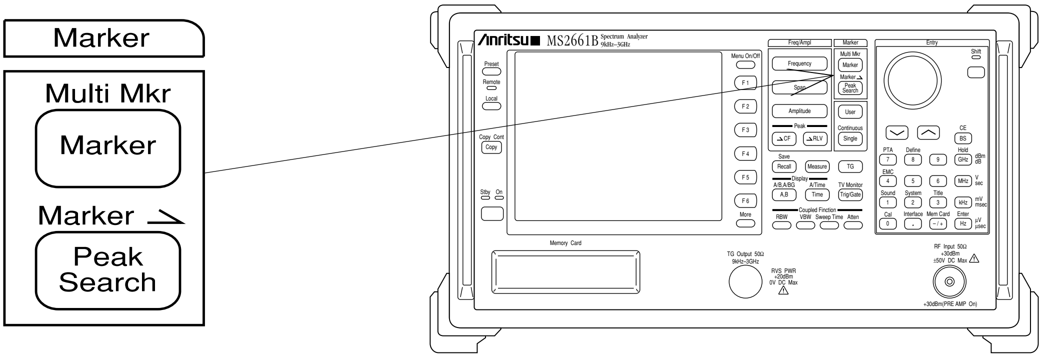
MARKER FUNCTIONS

This section describes the marker functions for improving the measurement efficiency, such as the zone marker, marker mode menu, marker search, and the parameters set by marker value.
For a description of marker tracking and zone sweep setting, see SECTION 6 SELECTING THE SWEEP METHOD.

TABLE OF CONTENTS

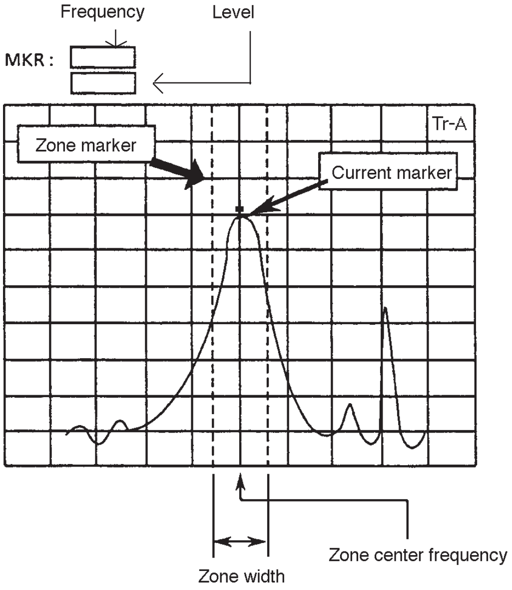
SECTION 3
MARKER FUNCTIONS

The keys inner section are used as the header keys for setting the marker functions.



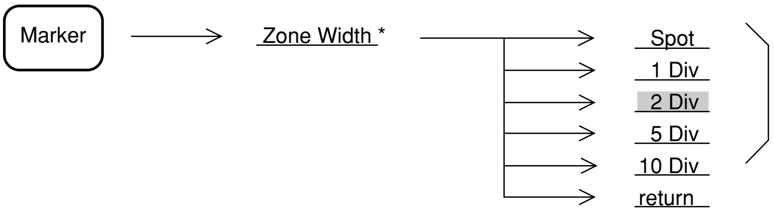
Changing Zone Marker Position and Width

The part enclosed in dotted lines in the center of the screen shown in the figure below is called the zone marker. The current marker within this zone marker normally moves to the maximum level.
The frequency (or time for time domain mode) and level at the current marker point (intensified point) are displayed at the top left-hand corner of the screen.



Changing Zone Marker Width

The zone marker width is initially set to 1 division, but can be changed from 1 point to 10 divisions by performing the following key operations.

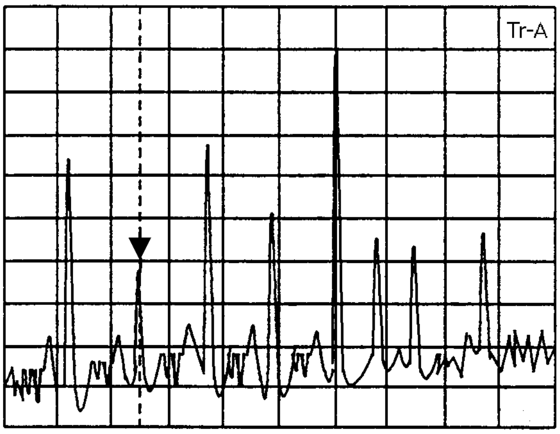


Select one. The selected zone width is highlighted.

The zone marker width can be arbitrarily set from 1 point to 10 divisions by rotary knob.
The zone marker width can be arbitrarily set from 1 point to 10 divisions by the corresponding frequency input from the ten keys.

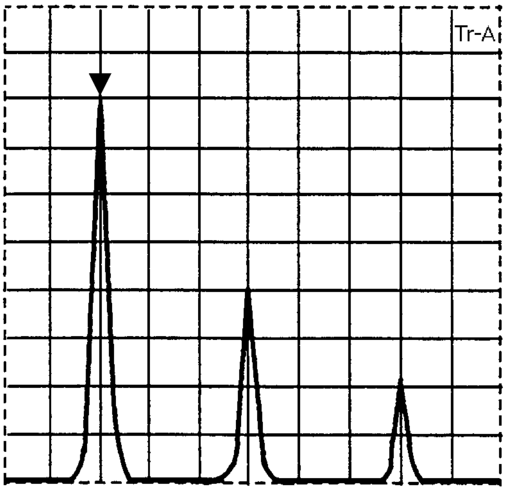
When the zone marker width is set to 1 point (Spot), the zone marker becomes a vertical line. This is called a spot marker. Since the marker center frequency and the current marker frequency coincide, the level at the desired frequency can be measured.

Example of Spot Marker (Zone Width: 1 Point)



If the zone marker is set to 10 divisions when the zone center frequency is at the center of the frequency axis on the screen, the current marker will always move to the maximum peak level over the entire range of the observation frequency.

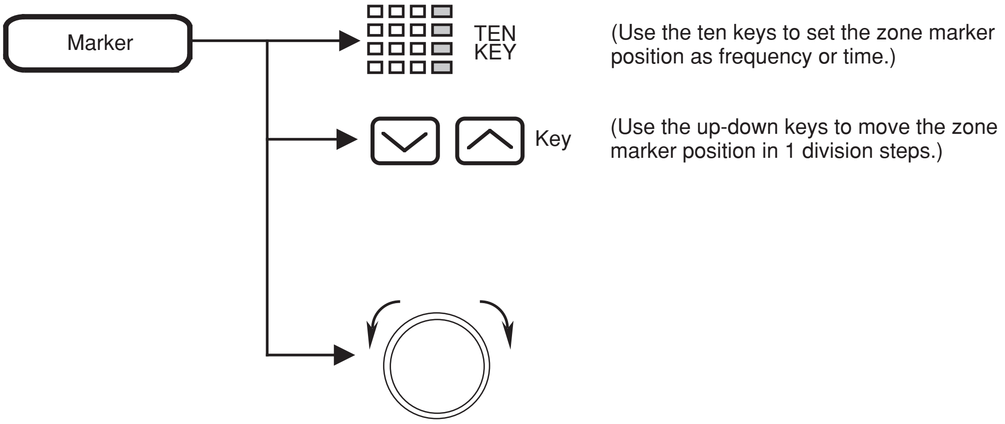
Example of Zone Width: 10 Divisions



Since the zone width in the time domain mode always becomes 1 (Spot), it cannot be changed.

Changing Zone Marker Position

The center frequency (time) of the zone marker is initially centered on the frequency (time) axis on the screen. By performing the following key operations, the zone marker can be moved from the left end to the right end of the frequency axis (time) on the screen.



In the delta marker mode, setting the zone marker center frequency (time) with the ten keys results in entry of the delta marker value (difference between reference marker and current marker).

Marker Mode

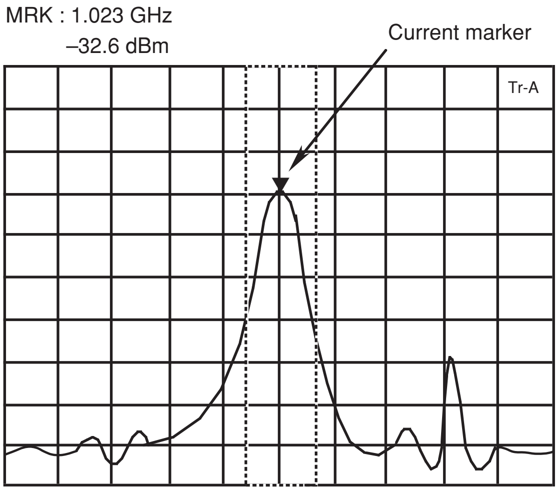
Three types of markers can be used with the spectrum analyzer: normal marker, delta marker, and multimarker.

Normal Marker

A single marker is indicated by ▼ at the maximum level within the zone marker. The frequency and level at that point are displayed digitally.

The normal marker is initially set to ON. When the current state is another marker mode, or when the normal marker is set to OFF, perform the following key operations to set the normal marker to ON.

Marker ——→ Normal Marker



The normal marker displays the absolute level. By setting a display line, the normal marker can also display the level relative to a given level specified as a reference line.

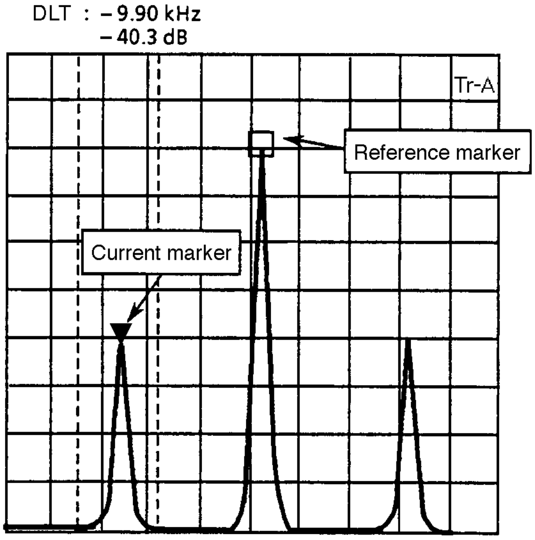
Delta Marker

The current marker position when the delta marker is set to On is fixed as the reference marker (reference point). Then, as the current marker is moved, the reference marker and current marker frequency (time) and level differences are displayed digitally as delta marker values.

In the delta marker mode, the reference marker is indicated by □.

To set the delta marker to On, perform the following key operations.

Marker → Delta Marker



Press the Delta Marker key in the delta maker mode. The reference marker moves to the current marker position and switches to the delta marker mode with that point as the reference point.

Varying the spectrum waveform in the delta marker mode does not change the marker frequency level. The reference marker is not necessarily always on the waveform because it remains unchanged. Also, when the reference marker cannot be positioned on the screen by changing the observation frequency and level and range, it is at the edge of the scale lines.

The marker mode at delta marker-ON becomes the normal mode when the scale mode is changed from log scale to linear scale and vice-versa. If the scale mode was changed, set the delta marker again.

Marker Off

Marker → Marker Off

The marker disappears from the screen. When the Normal Marker key is pressed, the marker is displayed.

Switching Marker Search Mode

Searching the maximum value (Peak) or minimum value (Dip) in the zone marker is selected by pressing this key. Usually select Peak.

Marker → Marker Search Peak Dip

(Display page 2 of the menu by pressing the More key.)

Display Line

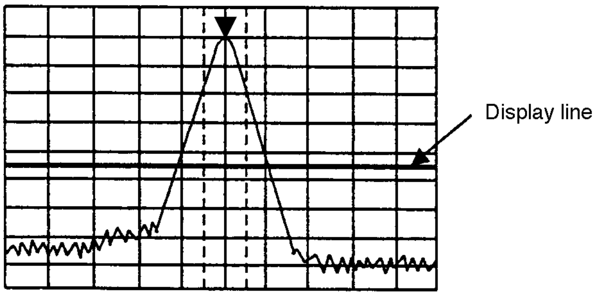
In the state in which a horizontal line which indicates a given level (frequency deviation for FM demodulated waveform display) is displayed on the scale, the display line can be used as the frequency response measurement guideline, or as the reference line of the marker level measurement or pass/fail judgement with a standard line.

Setting Display Line

To turn the display-line On and Off and to set the display-line level (frequency deviation), perform the following key operations.

Marker → Display Line *
(Display page 2 of the menu by pressing the More key.)

→ Display Line On Off	Turn the display line On and Off by pressing this key.
→ Display Line Level –50.00 dBm	Enter the display line level from the ten keys, etc.
→ Marker Level Abs Rel	Select if the marker level is set by absolute value or relative value (relative to display line) by pressing this key.
→ Return	



Display-line On and Off are common to all traces (A, B, BG, Time). Also, the display-line level is common except for FM demodulated waveform display.

The display-line level and Abs/Rel can be selected independently for each trace.

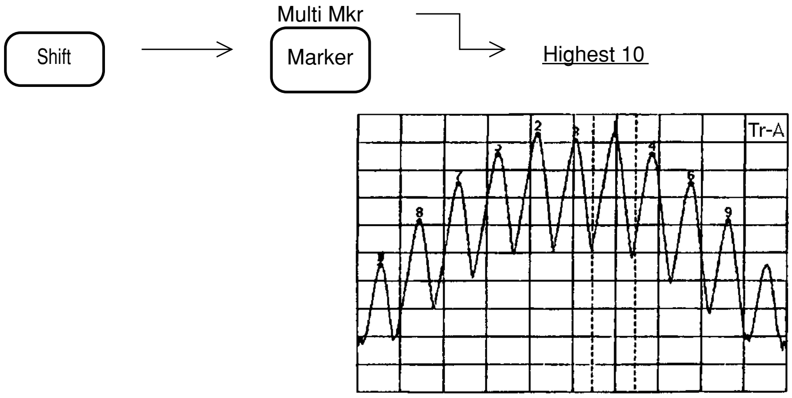
Multimarker

The spectrum analyzer has a marker function which displays up to ten markers displayed simultaneously. Multimarker can be set by the following four methods:

- Highest 10
- Harmonics
- Marker List
- Manual Set

Highest 10 Multimarker

Allocates up to 10 multimarkers in descending order of signal peak level displayed on the screen.



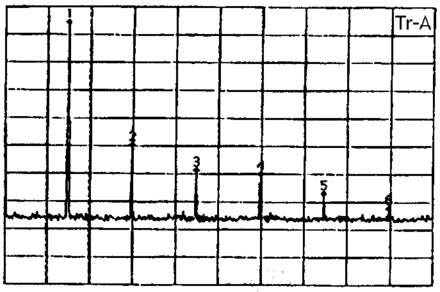
After executing Highest 10, an active marker (with the same functions as the current marker) moves to the peak point of the maximum level signal.

Note: Each multimarker has a zone as the same as the current marker, and is positioned at the maximum level point. So, when the next sweep is done after Highest 10 operation, each multimarker position may be changed. To protect this, execute the Highest 10 after stopping the sweeping or after narrowing the zone width.

Harmonics Multimarker

Allocates multimarkers to the 2nd to the 10th harmonic signals of the active marker signal as the fundamental signal.

Shift → Multi Mkr Marker → Harmonics



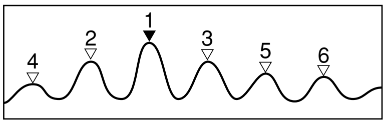
Note: If the fundamental and second harmonic signals are not separated by more than the marker zone width, or when there are larger level signals other than harmonic signals in the frequency range of the marker zone width centered at the harmonic signals, harmonic signals will be incorrectly detected. In this case, narrow the marker zone width.

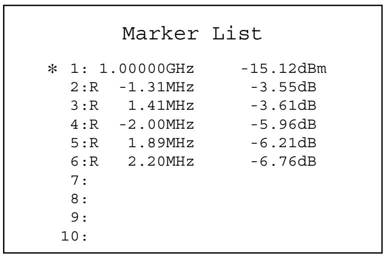
Marker List

Shift → Multi Mkr Marker → Marker List *

Marker List On Off	Turn the marker list display On and Off by pressing this key.
Freq/Time Abs Rel	Select frequency/time as absolute value or relative value (relative to frequency/time of active marker) display by pressing this key.
Level Abs Rel	Select level as absolute value or relative value (relative to active-marker level) display by pressing this key.
Return	

In Freq/Time Rel mode, frequency and time of the markers except active marker are displayed in relative values, and "R" marks are appended at the left.
In Level Rel mode, level of the markers except active marker are displayed in relative values,





```
               Marker List

  * 1: 1.00000GHz     -15.12dBm
    2:R  -1.31MHz      -3.55dB
    3:R   1.41MHz      -3.61dB
    4:R  -2.00MHz      -5.96dB
    5:R   1.89MHz      -6.21dB
    6:R   2.20MHz      -6.76dB
    7:
    8:
    9:
   10:
```

Manual Set

Allocates up to 10 multimarkers to arbitrary frequencies or time points.

Multi Mkr

Shift → Marker → Manual Set *

Change Active Maker No	Selects the active marker from among the markers that are currently On. Each time this key is pressed, the markers are scrolled and selected. #
Select Marker No 4	Specifies the marker number to be set to On or Off.
On with Auto Select	At the same time the marker number selected above is set to On, the selected marker is made the active marker. If the selected marker is already On, the next higher marker number of the markers set to Off is set to On. By holding this key down, the multimarkers are set to On one by one in ascending order of number. <Example> When marker No.4 is selected when marker Nos. 3, 4, 5, 8, and 9 are On, the markers are turned On in No., 6, 7, 10, 1, 2 order.
Off with Auto Select	Sets the marker of the selected No. to Off. If the selected marker is already Off, the next smaller marker No. of the markers set to On is set to Off. By holding down this key, the multimarkers are set to Off one by one in descending order of number. When the active marker is set to Off, the marker with the next smaller number is made the active marker. <Example> When marker No. 7 is selected to be set to Off when marker Nos. 3, 4, 5, 8 and 9 are On and marker No. 5 is made the active marker, the markers are set to Off in No. 6, 5, 4, 3, 9 order, then marker No. 8 becomes the active marker.

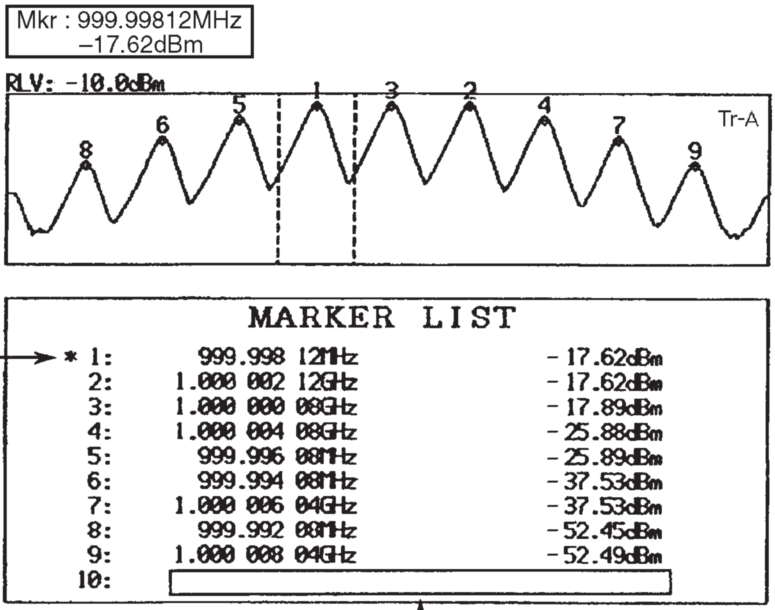
The active marker is indicated by the ▼ mark. The other marker Nos. are indicated by the ▽ mark. The active marker can be moved by using the ten keys, up-down keys, or rotary knob.

Continued

→ Clear All — Leaves only the marker number currently made the active marker and sets all the other multimarkers to Off. The active marker number is then reset to 1.

→ Return

Displays the active marker value.



```
Mkr : 999.99812MHz
      –17.62dBm
```

```
                 MARKER  LIST
* 1:     999.998 12MHz              - 17.62dBm
  2:   1.000 002 12GHz              - 17.62dBm
  3:   1.000 000 00GHz              - 17.89dBm
  4:   1.000 004 08GHz              - 25.88dBm
  5:     999.996 08MHz              - 25.89dBm
  6:     999.994 08MHz              - 37.53dBm
  7:   1.000 006 04GHz              - 37.53dBm
  8:     999.992 08MHz              - 52.45dBm
  9:   1.000 008 04GHz              - 52.49dBm
 10:
```

∗indicates the active marker.

Undisplayed markers are set to Off.

Multimarker Off

To return from multimarker to normal marker, perform the following key operations.

Shift → Multi Mkr / Marker → Multi Marker On Off

Marker Search

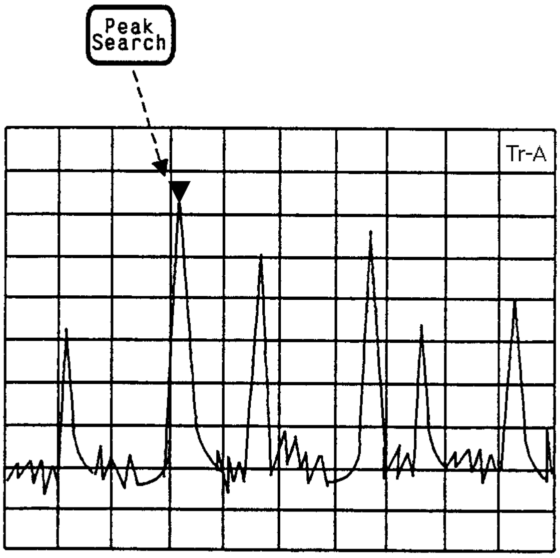
The spectrum analyzer has the following six marker search functions:

- Peak search
- Next Peak search
- Next Right Peak search
- Next Left Peak search
- Dip search
- Next Dip search

Peak Search

Peak Search detects the maximum level point from the entire trace in which a marker is displayed and moves the marker to that point.

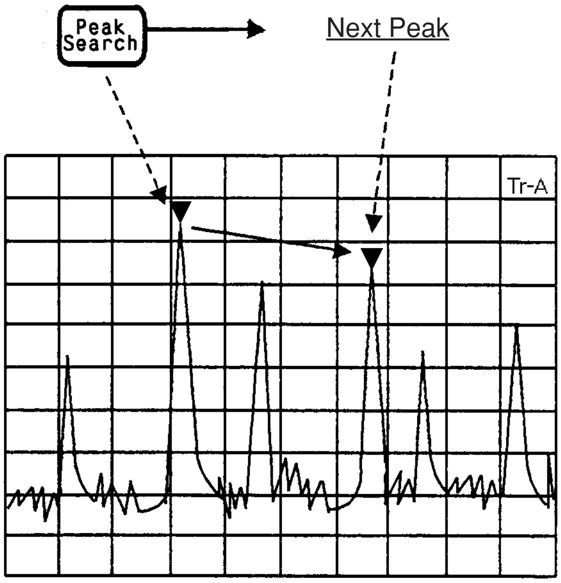
To Execute Peak search, perform the following key operations.



Next Peak Search

Next Peak Search detects the next largest peak relative to the current marker level and moves the marker to that point. (When there are two or more peaks with the same level on the screen, the leftmost peak is detected.)

Execute Next Peak search by performing the following key operations.

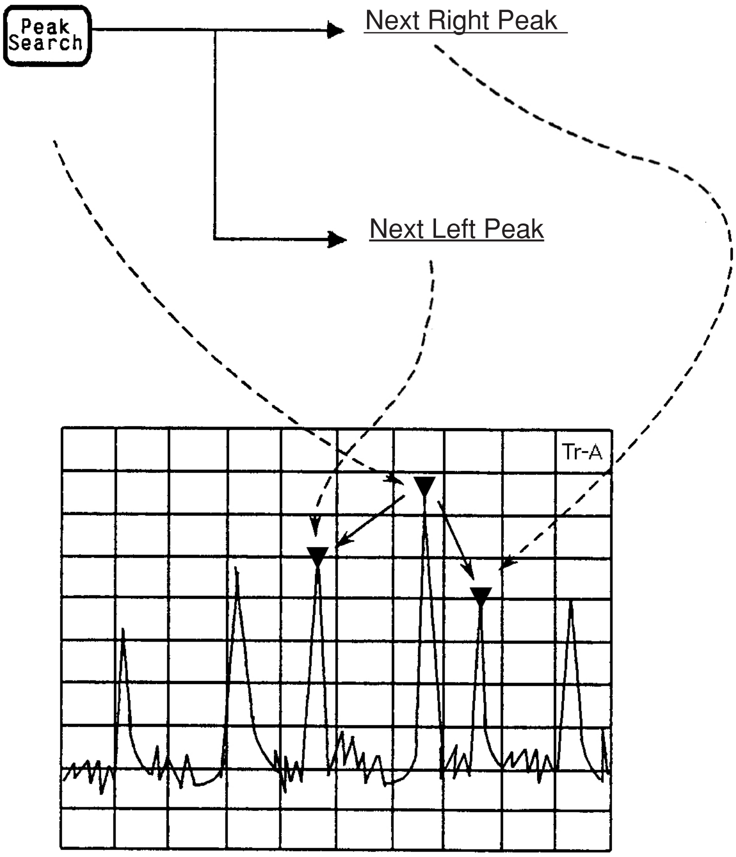


The next largest peaks can be detected and the marker can be moved to those peaks by executing Next Peak Search consecutively.

Next Right Peak Search/Next Left Peak Search

Next Right Peak search and Next Left Peak Search detect the adjacent peak level to the right or left of the current marker and move the marker to that point.

To execute Next Right Peak Search and Next Left Peak Search, perform the following key operations.



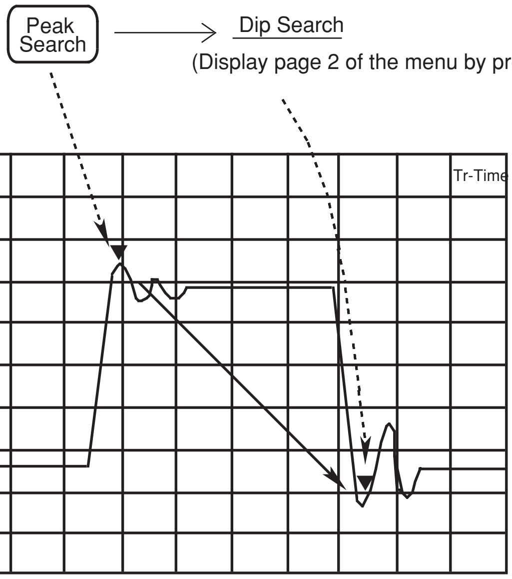
The adjacent peak level to the right or left can be detected and the marker moved to that peak by executing Next Right Peak Search or Next Left Peak Search consecutively.

Note: When marker search is executed, the marker is moved to the specified Peak or Dip point, and the zone marker center frequency is simultaneously moved to the marker point. After that, when sweep is executed within the zone marker, the marker moves to the maximum point within the zone marker. Therefore, marker search other than Peak search should be executed with sweep stopped or with the zone width set to 1 point (spot marker mode).

Dip Search

Dip search detects the minimum level point from the entire trace in which a marker is displayed and moves the marker to that point.

Execute Dip search by the performing the following key operations.



(Display page 2 of the menu by pressing the More key.)

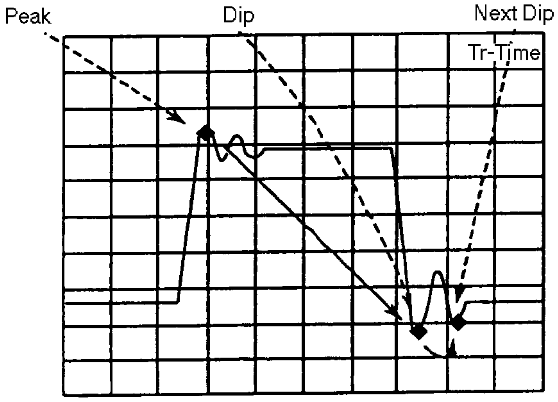
Time domain waveform

Next Dip Search

Next Dip Search detects the next smallest dip relative to the current marker level and moves the marker to that point. (When there are two or more dips with the same level on the screen, the leftmost dip is detected.) Execute Next Dip Search by performing the following key operations.

Peak Search → Next Dip

(Display page 2 of the menu by pressing the MORE key.)



Time domain waveform

The next smallest peaks can be detected one by one and the marker moved to the detected peaks by executing Next Dip Search consecutively.

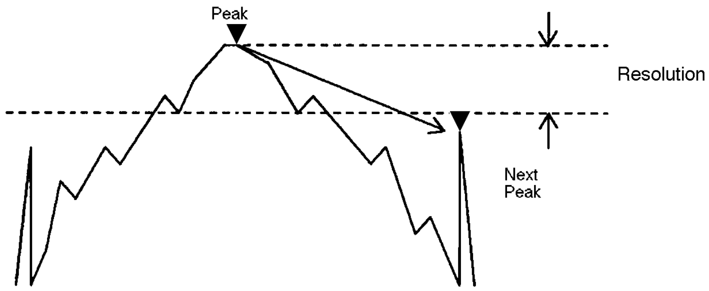
Setting Search Resolution

Sets the Peak and Dip search resolution. When searching for the next peak, etc., the marker moves to the point of the set resolution or higher.

Peak Search → Resolution 1.23 dB

(Display page 2 of the menu by pressing the More key.)

→ Enter the resolution in dB units from the ten keys.



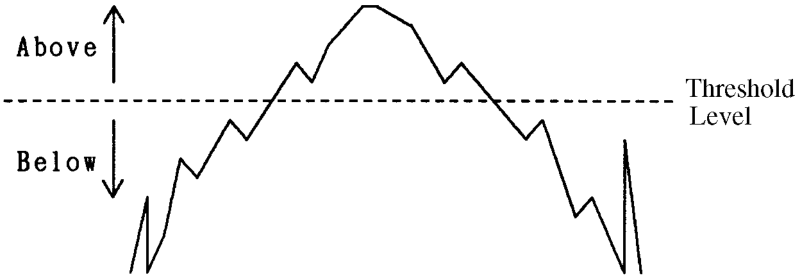
Setting Search Threshold

Sets the display line to the threshold and searches for the level above or below the display line.

Peak Search → Threshold *

(Display page 2 of the menu by pressing the More key.)

→ Treshold On Off	Turn threshold On and Off by pressing this key.
→ Search Above Below	Select search above or below the display line by pressing this key.
→ Threshold Level –50.00 dBm	Sets the display line level.
→ Return	



Setting Parameters Using Marker Values

The marker value can be set as the parameter value of the observation frequency, reference level, and so on. This facilitates observation of the desired waveform.

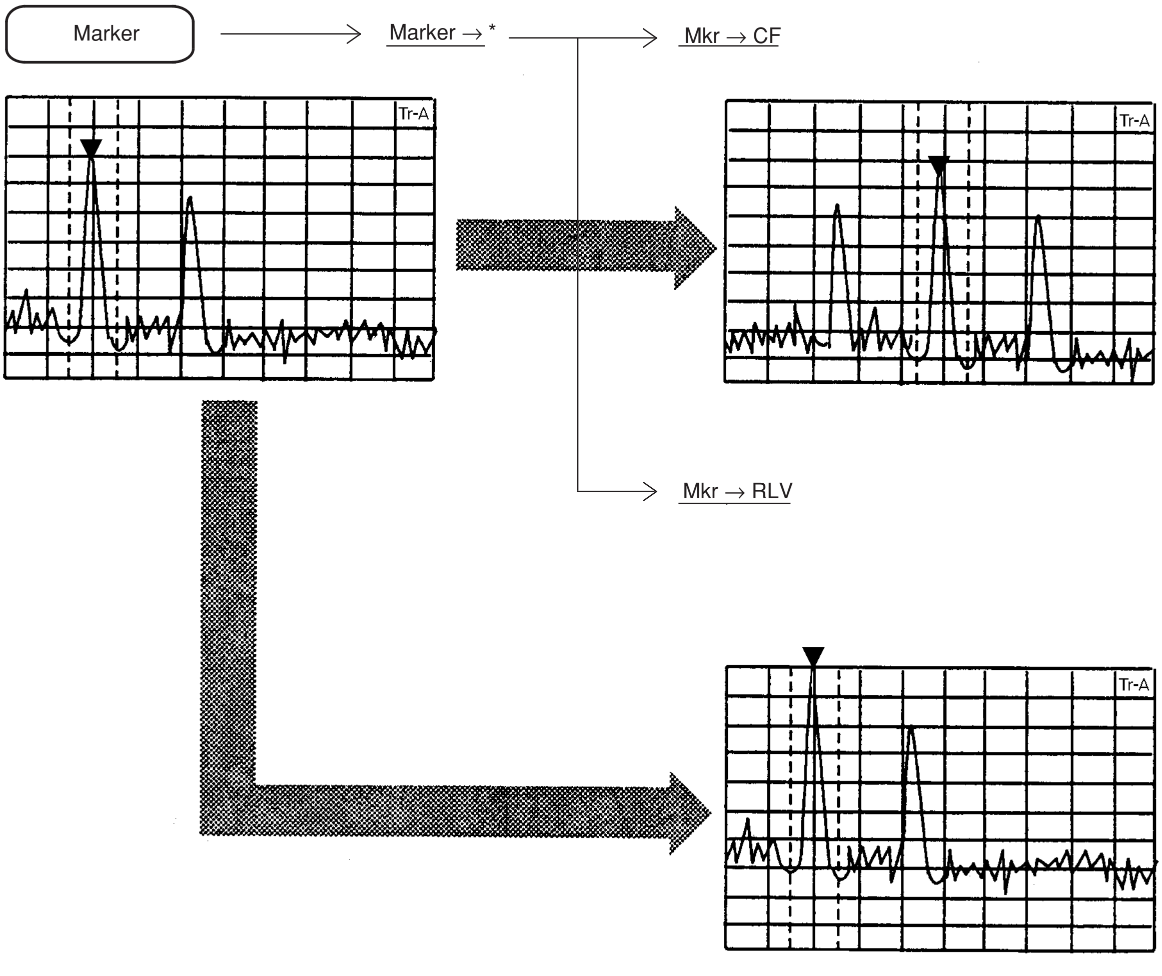
To set parameters using the marker value, the following settings are possible:

• Mkr → CF	Sets the marker frequency to the center frequency.
• Mkr → RLV	Sets the marker level to the reference level.
• Mkr → CF Step Size	Sets the marker frequency to the center frequency step size.
• Delta Mkr → Span	Sets the reference marker and current marker frequency to the start frequency and stop frequency, respectively.
• Zone → Span	Sets the zone marker center frequency and zone width to the center frequency and frequency span, respectively.

In the time domain mode, only Mkr → RLV is valid.

Mkr → CF/Mkr → RLV

Sets the current marker frequency or level to the center frequency or reference level.

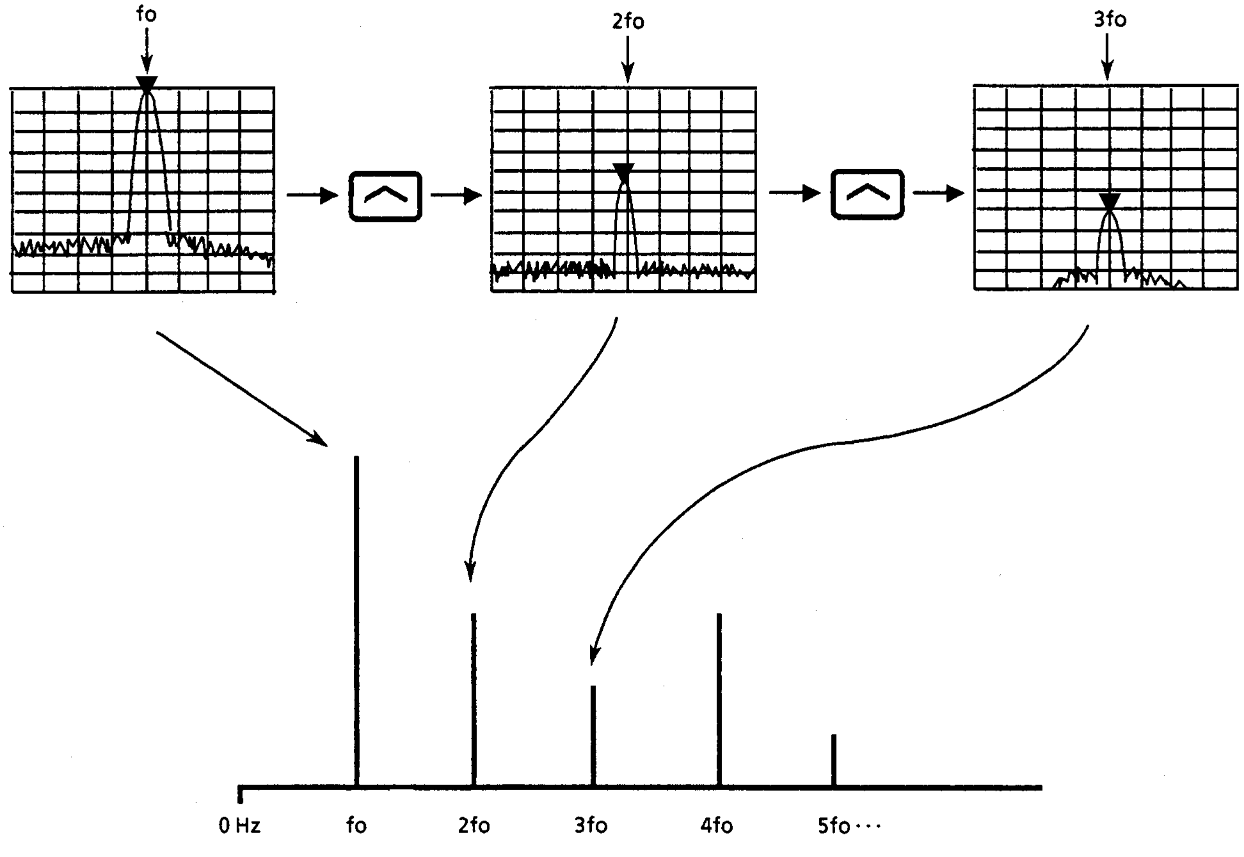


Mkr → CF Step Size

Sets the marker frequency to the center frequency step size (up-down keys resolution).

Marker ⟶ Marker → * ⟶ Mkr → CF Step Size

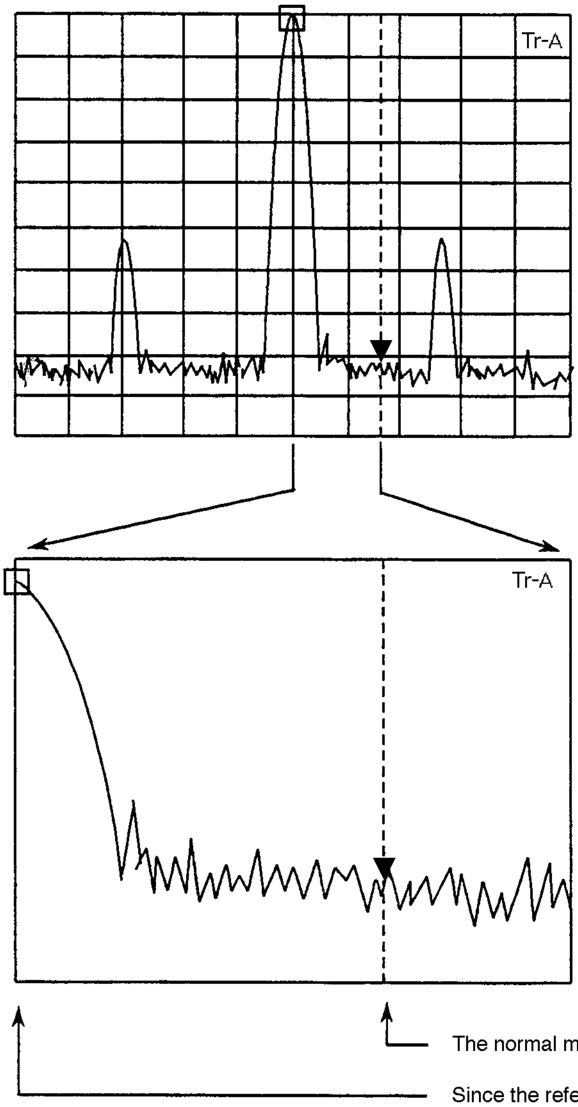
Although this action does not cause any change to appear on the screen, when the center frequency is changed with the up-down keys, the center frequency is changed with the marker frequency as the step size. This facilitates observation of harmonic waves.



Delta Mkr → Span

In the delta marker mode, this operation sets the delta marker mode current marker frequency and reference marker frequency to the start frequency and stop frequency, respectively.

Marker ⟶ Marker → * ⟶ Delta Mkr → Span



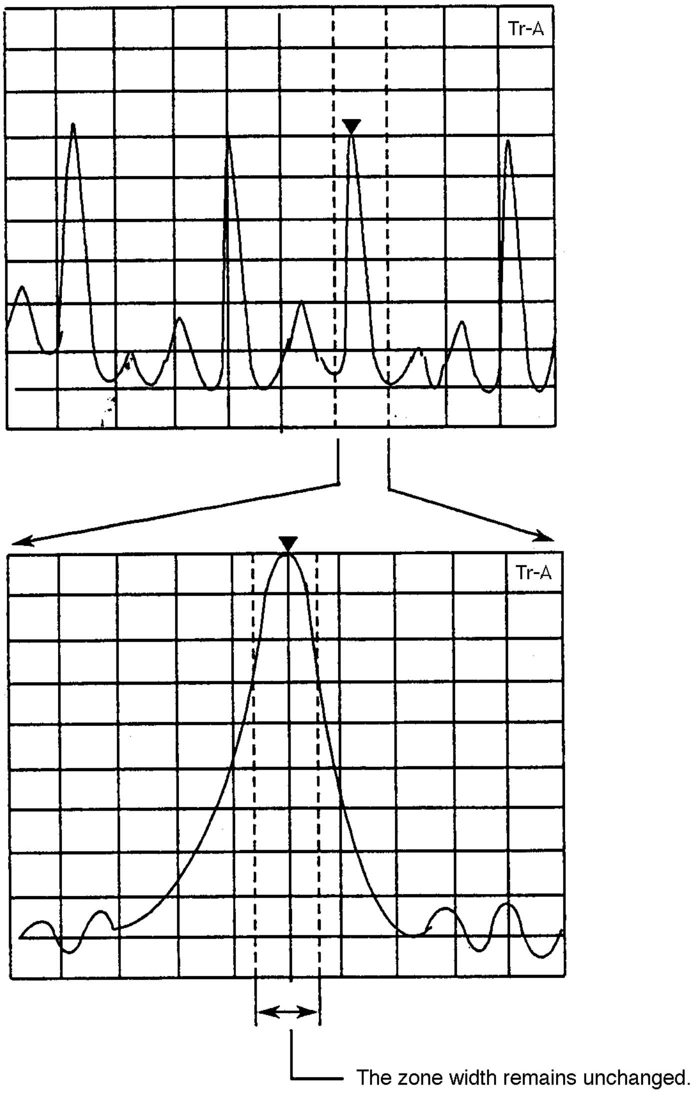
The normal marker position remains unchanged.

Since the reference marker is fixed relative to the frequency, it moves to the extreme left when the frequency span is changed.

Zone → Span

To set the zone marker center frequency and width to the center frequency and frequency span, respectively, perform the following key operations.

Marker ——→ Marker →* ——→ Zone → Span



SECTION 4

SIGNAL SEARCH FUNCTION

Signal search facilitates extraction of the objective signal Although the functions of signal search are similar to the marker function, this section only describes the Signal Search section

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SECTION 4
SIGNAL SEARCH FUNCTION

Detecting Peaks

The spectrum analyzer has the following three peak detection functions:

- Auto Tune
- Zone Marker
- Marker Tracking

SECTION 3 MARKER FUNCTION describes the Zone Marker function and SECTION 6 SELECTING THE SWEEP METHOD describes the Marker Tracking function.

Detecting the Maximum Peak Signal by Automatic Tuning

Frequency ⟶ Auto Tune

Pressing the Auto Tune key detects the maximum peak signal within the Back Ground (BG) and sets that signal frequency and level to the center frequency and reference level, respectively.

Notes:

- When executed at a frequency span of more than 100 MHz, the frequency span is set to 100 MHz. When executed at a frequency span of less than 100 MHz, that value is retained.
- When the Display mode was executed by trace Time, the instrument switches to trace A/Time and trace Time becomes the main trace. Also the Expand mode is set to Off.
- The input attenuator is set to Auto.
- In the initial state, the Auto Tune frequency range is set to 90 MHz to 3 GHz for the MS2651B/MS2661B/2661C, and 250 MHz to 8.1 GHz for the MS2653B/MS2663B/2663C. By changing the trace BG frequency range, the Auto Tune frequency range can also be set as follows:

  Start frequency

    Start frequency specified in trace BG
    However, except the 0 Hz to 3/100 frequency span range.

  Stop frequency

    Stop frequency specified in trace BG.

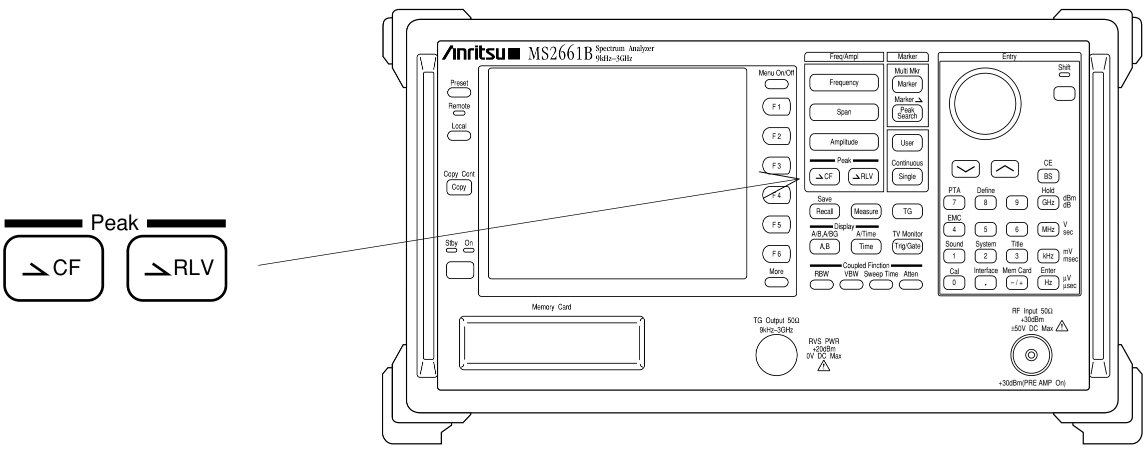
Moving the Measurement Point

This function moves the spectrum on the screen to the center to facilitate measurement. The following five functions can be used.

• Mkr → CF	Sets the marker frequency to the center frequency.
• Mkr → RLV	Sets the marker level to the reference level.
• Peak → CF	Sets the frequency of the maximum point on the screen to the center frequency.
• Peak → RLV	Sets the level of the maximum level point on the screen to the reference level.
• Scroll→, Scroll←	Scroll the observation frequency.

SECTION 3 MARKER FUNCTIONS describes the Mkr → CF and Mkr → RLV functions. SECTION 2 FREQUENCY/AMPLITUDE DATA ENTRY describes the scroll function.

This section describes the Peak → CF and Peak → RLV functions.

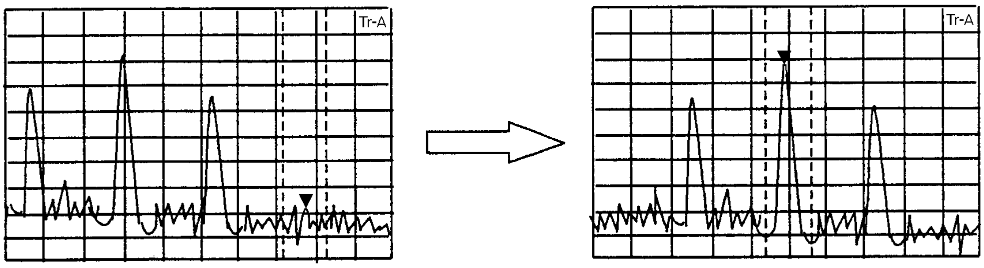


Peak → CF and Peak → RLV

The Peak → CF and Peak → RLV functions set the maximum level value displayed on the screen to the center frequency and reference level, respectively, and move the peak point to the center of the frequency axis on the screen and to the top level axis, respectively.

(1) Peak→ CF

CF Sets the maximum peak point and the zone marker to the center frequency.

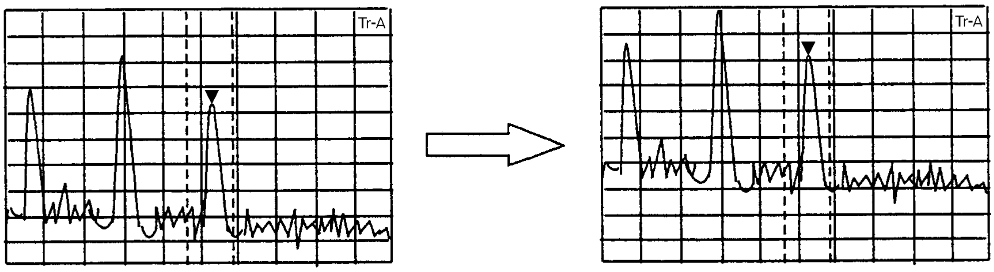


Notes:

- When the frequency at the maximum peak point is less than 0 Hz, the center frequency is set to 0 Hz.
- If there are two or more maximum peak points with the same level on the screen, the peak point with the lowest frequency is moved to the center frequency.
- Peak → CF does not operate in the following cases:
  - ① When zone sweep is On
  - ② In the time domain mode
  - ③ When A<Time is specified in the A/Time mode

(2) Peak → RLV

RLV Sets the maximum peak level to the reference level.



Note:

- If the level at the peak point exceeds the permitted range for the reference level, the reference level is set to the maximum (minimum) reference level that can be set.
- If the level at the peak point exceeds the reference level (scale over), one operation of the Peak→RLV may not be able to set the correct reference level. In this case, repeat the Peak→RLV operations a few times.

SECTION 5

SELECTING THE DISPLAY METHOD

This sections gives a detailed description of the display modes (Trace A/B, A/B, A/BG, Trace Time, A/Time), storage modes (Normal, Max Hold, Min Hold, Average, View, Cumulative, Overwrite), detection modes (Normal, Pos Peak, Sample, Neg Peak) and time domain analysis.

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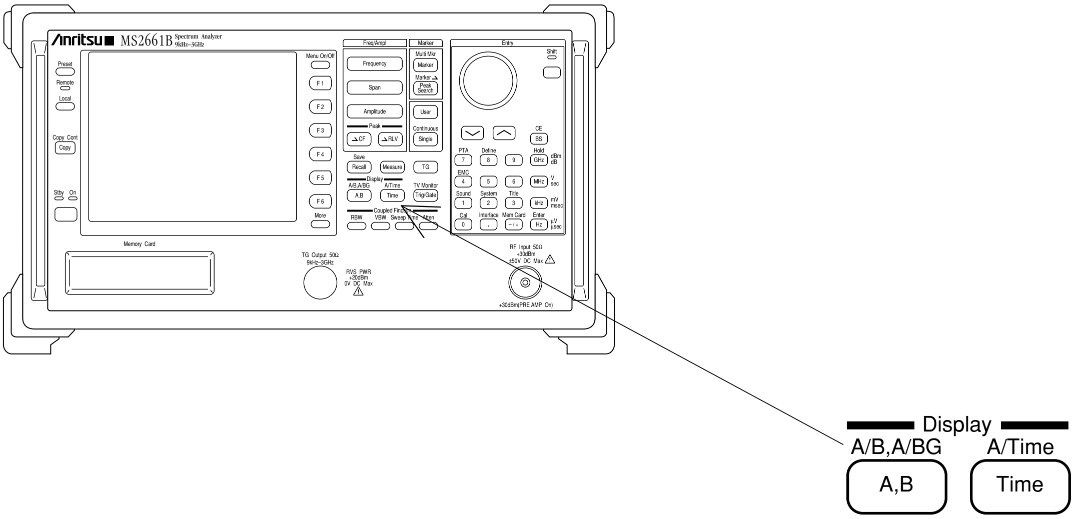
SECTION 5
SELECTING THE DISPLAY METHOD

The spectrum analyzer can display four trace modes (BG †, A, B, Time) in six Display modes (A, B, Time, A/B, A/BG, A/Time).
In the Display mode, the two keys of the Display section shown below are used.



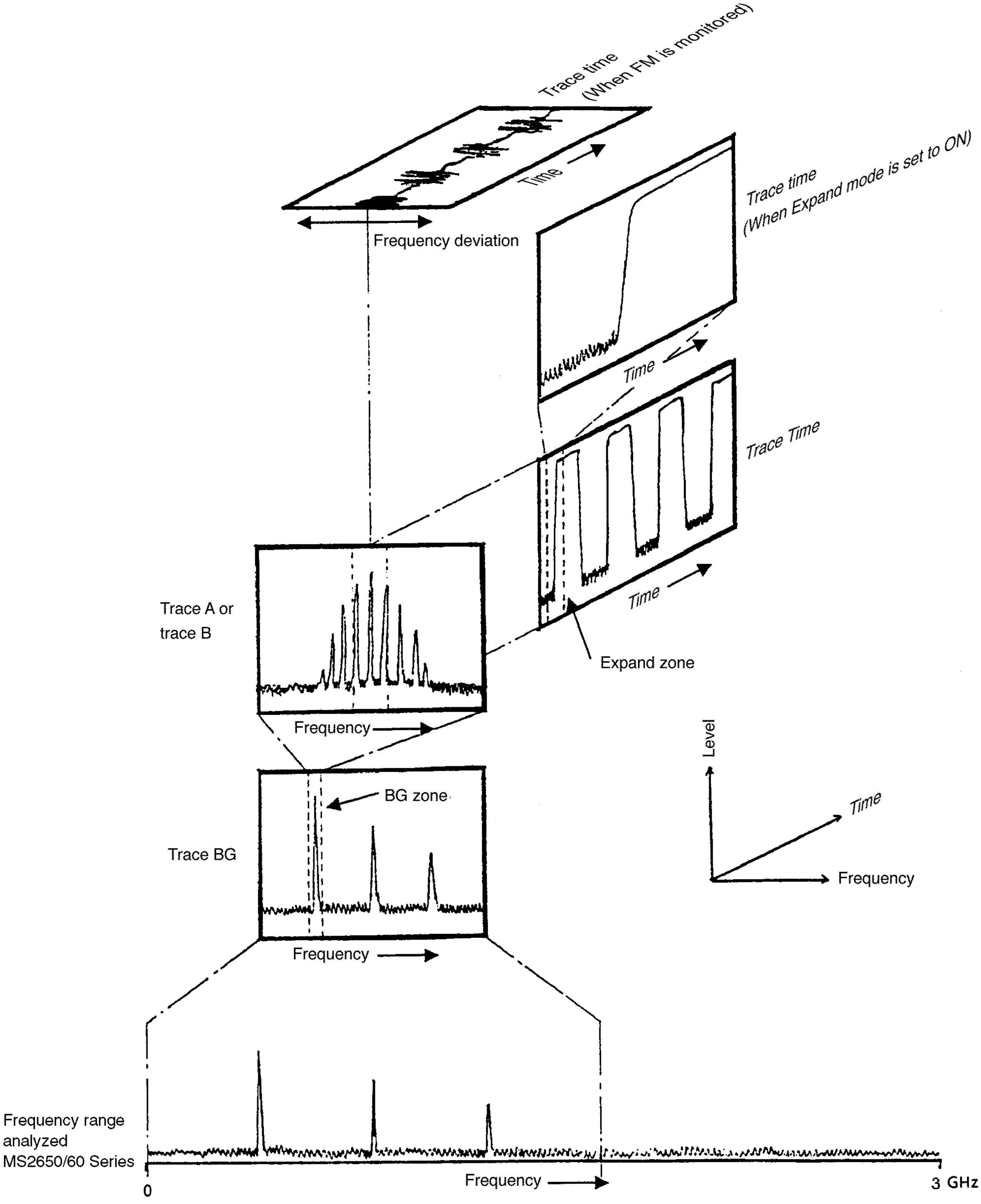
Display Mode

The following outlines the trace modes. The figure on the next pages shows the correlation between trace modes.

- Trace BG .... When the objective signal is measured in the trace A, B, or Time mode, the trace BG mode allows the frequency range to be observed to be pre-set to a wide band. The BG band is initially set to full span (0 to 3 GHz or 8.1 GHz).
- Trace A, trace B .... Used to analyze signals in the normal frequency domain. The BG zone within trace BG is expanded and displayed.
  Different frequency range can be observed by Trace A and Trace B.
- Trace Time .... Displays the time axis waveform at the center frequency of trace A. Trace Time can also display FM and EXT TRIG input signals, when monitored.

---

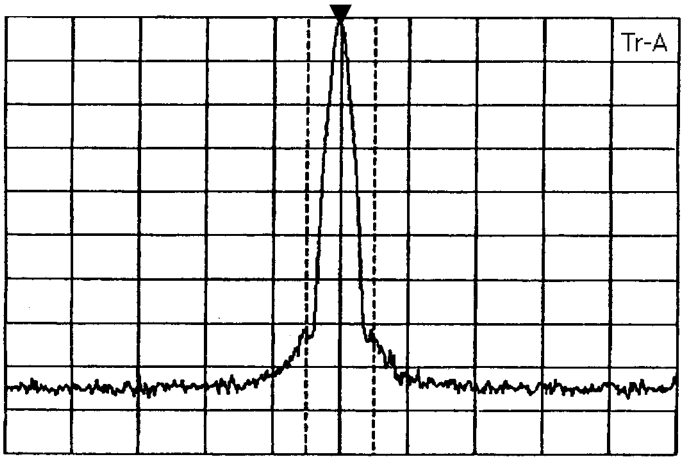
† BG (Back Ground)


Trace time
(When FM is monitored)
Time
Frequency deviation
Trace time
(When Expand mode is set to ON)
Time
Trace Time
Time
Expand zone
Trace A or
trace B
Frequency
BG zone
Trace BG
Frequency
Level
Time
Frequency
Frequency range
analyzed
MS2650/60 Series
0
Frequency
3 GHz

Trace A

Trace A is used to analyze signals in the normal frequency domain.

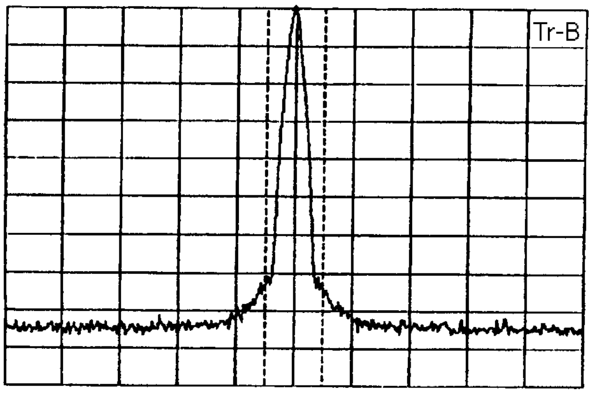
A,B ⟶ Trace A



Trace B

Like trace A, trace B is used to analyze signals in the normal frequency domain.
When used with trace A, it is possible to compare waveform A and waveform B.

A,B → Trace B



Parameters of the trace A and trace B can be set independently.

Moving the Trace

This function moves and adds the trace A and trace B displays once.

A, B → Trace Move *

A→B	Moves trace A to trace B and displays it.
B→A	Moves trace B to trace A and displays it.
A↔B	Swaps and displays trace A and trace B.
A+B→A	Adds trace A and trace B and displays the result at trace A.
Return	

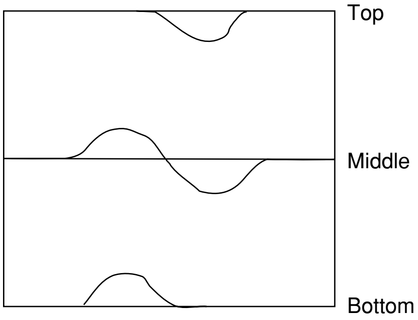
Set the move-destination-trace storage mode to View, and stop the sweeping before moving the trace.
If the trace A or trace B threshold is set to any other mode, the trace data will be displayed once, then updated.

Trace Computation

This function continuously displays the difference between trace A and trace B. Normally set trace B to the View mode before executing this function.

A, B → Trace Calc *

Normalize (A–B+DL) On Off	Turn the mode that subtracts trace B from trace A and adds the display line value and continuously displays it at trace A On and Off by pressing this key.
A–B→A On Off	Turn the mode that subtracts trace B from trace A and continuously displays it at trace A On and Off by pressing this key.
Ref Line	Selects if the A–B computed value=0 line is to be displayed at the top, middle, or bottom of the screen.
Return	

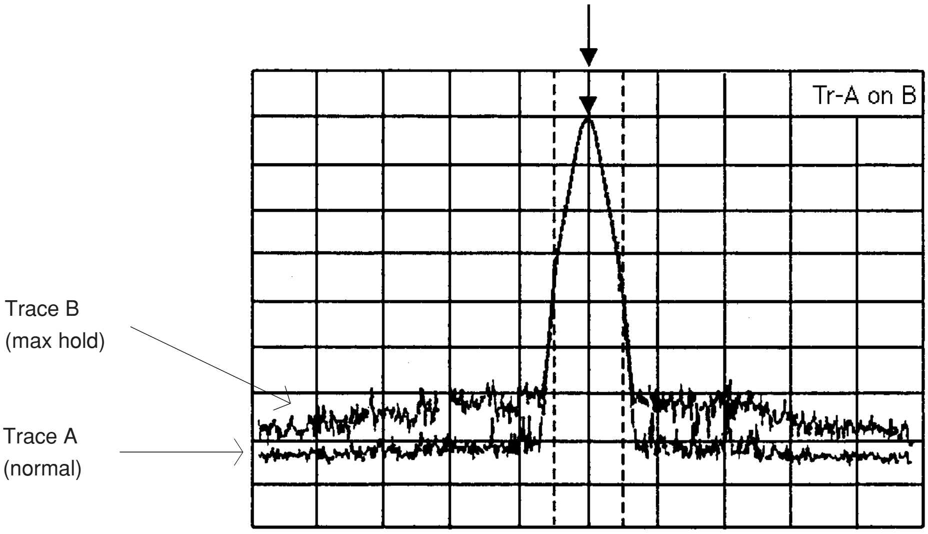


Trace A and Trace B Overwrite Display

Overwrites trace A and trace B on one screen. At this time, the trace B frequency range, reference level, and other parameters are the same as trace A.
However, in the threshold mode and detection mode, the parameters can be set independently at trace A and trace B. For instance, comparison measurement with a standard waveform and simultaneous observation of the same waveform in a mode different from the normal mode and max hold (or averaging, etc.) mode are possible.

A,B → Trace A on B

(Display page 2 of the menu by pressing the More key.)



Setting Active Trace

When trace A and trace B were overwritten on the same screen, select the marker trace by pressing this key.

A, B → Active Trace A B

(Display page 2 of the menu by pressing the More key.)

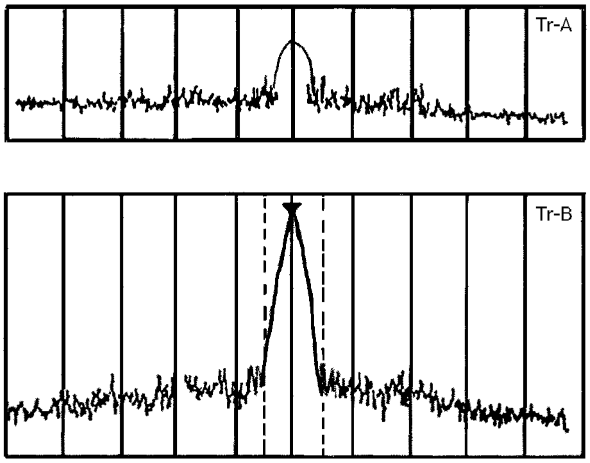
Trace A/Trace B Top and Bottom Split Display

When trace A and trace B are overwritten and displayed, the setup parameters are common. In this mode, however, the frequency, reference level, and other parameters can be set independently.
For instance, the reference wave can be observed at trace A and harmonics can be simultaneously observed at trace B.
When examining interference, the frequency that is the source of the interference and interference of a different frequency that is generated by the effect of the source frequency can be simultaneously observed.

Shift → A, B (A/B, A/BG)

A/B (A<B)	Simultaneously display trace A and trace B at the top and bottom. Display trace B larger than trace A.
A/B (A>B)	Simultaneously display trace A and trace B at the top and bottom. Display trace A larger than trace B.
A/BG (A<BG)	
A/BG (A>BG)	
Swp Contl	

- The large display is called the main trace and the small display is called the sub-trace.



Sub-trace

Trace A and trace B are displayed at the top and bottom, respectively.

Main trace

For A/B (A<B)

Setting Sub-trace Sweep

To set the sub-trace storage mode, perform the following key operations.

Shift → A/B, A/BG A, B → Swp Contrl *

Sub Trace Write	Set the sub-trace to the Over Write mode.
Sub Trace View	Set the sub-trace waveform to the View mode (continuously displayed without overwriting).
Stop	Temporarily stop sweeping without switching the storage mode.
Continue	Release temporary stop and resume execution.
Restart	Erase the trace waveform and restart sweeping.
Return	

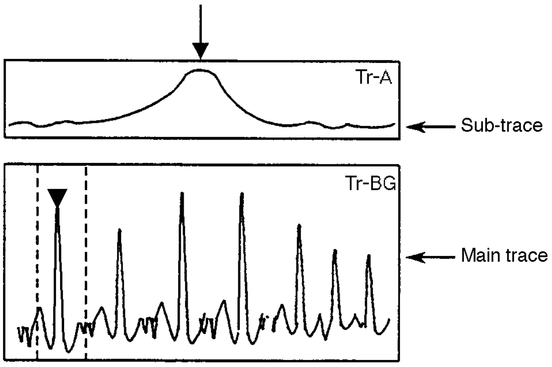
Trace A/Trace BG Top and Bottom Split Display

This mode simultaneously displays trace A and trace BG. It is used to extract a specific signal from a wide frequency range.

The conditions over a wide surrounding frequency range can be monitored while simultaneously observing the selected signal in detail.

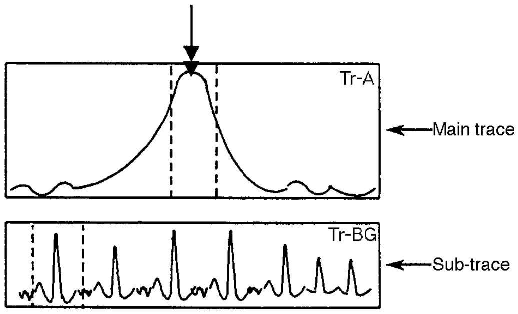
Shift → A, B (A/B, A/BG)

- → A/B (A<B)
- → A/B (A>B)
- → A/BG (A<BG) Simultaneously display trace A and trace BG at the top and bottom. Display trace BG larger than trace A.



In this mode, the frequency range of trace A can be specified by moving a marker (BG zone marker) on the BG main trace.

- → A/BG (A>BG) Simultaneously display trace A and trace B at the top and bottom. Display trace A larger than trace BG.
- → Swp Contl *



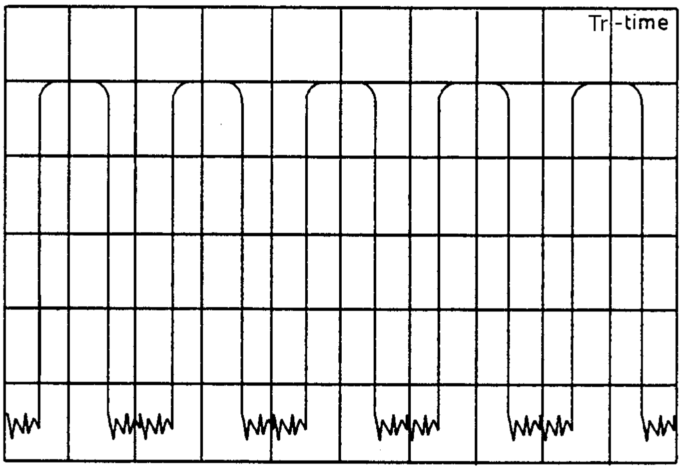
In this mode, the frequency range of trace A can be directly set while checking the trace A position (BG zone marker position) within BG.

Trace A and trace BG parameters other than reference level, vertical axis scale, and input attenuator settings are used independently. Each parameter can be set in the main trace (larger displayed side).

Marker operation is available only for the main trace.

Trace Time

Trace Time displays the time axis waveform at the center frequency of trace A or trace B. To display trace Time, press the Time key.



Time

Delay Time 10.0 ms	Sets the delay time from trigger to sweep. When a negative value is input, the waveform before the trigger is displayed up to one screen. (See paragraph 6.12 of CHAPTER 6.)
Time Span 200 us	Sets the time span (time domain sweep time).
Trigger Freerun Triggered	Select freerun or trigger sweep by pressing this key.
Trigger Source *	Selects the trigger signal source.
Storage *	Selects the storage display mode.
Detection * 1	Selects the detection mode.
FM Monitor *	Displays the FM demodulated waveform.
Expand * 2	Expands and displays part of the time domain waveform.

(Display page 2 of the menu by pressing the More key.)

Trace-A center frequency and Trace-Time tuning frequency is always common. Other parameters can be set independently. However, the following parameters can be used commonly by "Coupled function common/ independent setting mode" of Section 9.

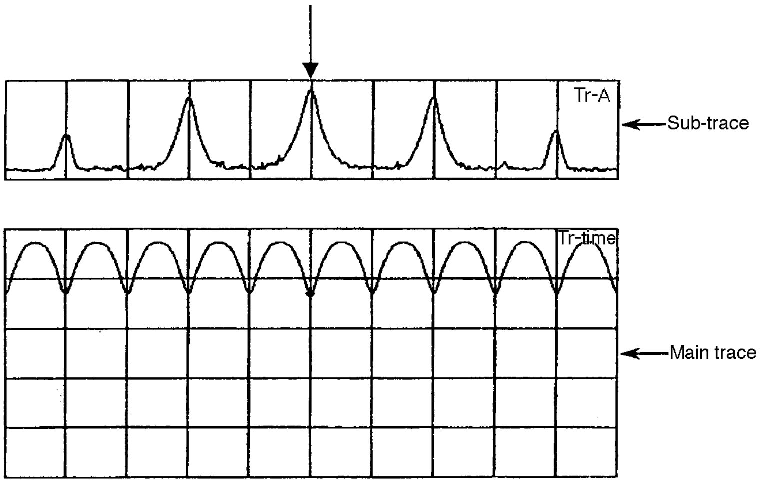
- Resolution bandwidth (RBW)
- Video bandwidth (VBW)
- Sweep time (Sweep Time/Time Span)

Trace A/Trace Time Top and Bottom Split Display

Trace A/Trace Time top and bottom split display simultaneously displays trace A and trace Time.

Shift → A/Time **Time**

→ A/Time (A<Time) Simultaneously display trace A and trace Time at the top and bottom. Display trace Time larger than trace A.



→ A/Time (A>Time) Simultaneously display trace A and trace Time at the top and bottom. Display trace A larger than trace Time.

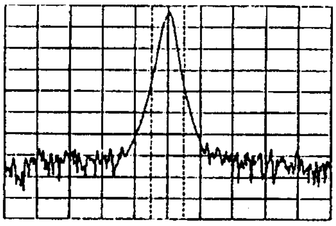
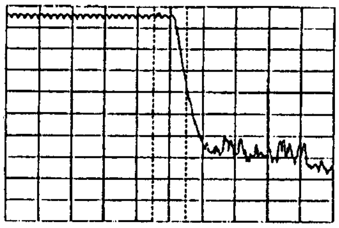
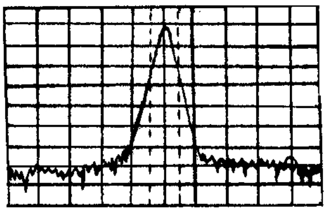
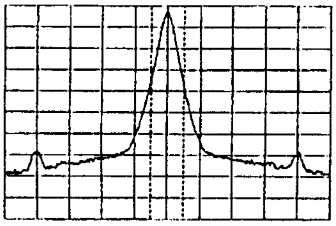
→ Swp Contl * (See Setting Sub-Trace.)

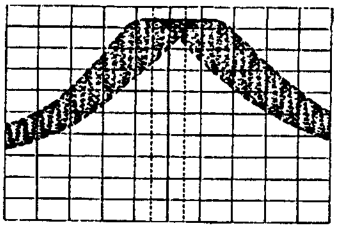
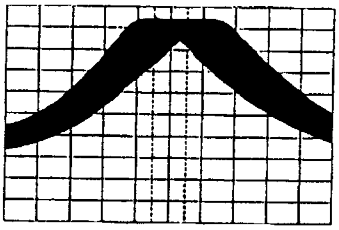
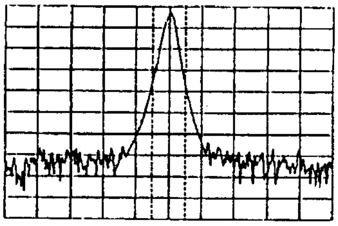
Each parameter can be set in the main trace (larger displayed trace). However, for common parameters (center frequency, reference level, input attenuator, and when system setting is coupled mode resolution bandwidth, video bandwidth, etc.), the sub-trace parameters can also be changed even when setting is performed at the main trace. Marker operation is only available for the main trace.

Storage Mode

The following seven storage modes can be selected for Display modes trace A, trace B, and trace Time.

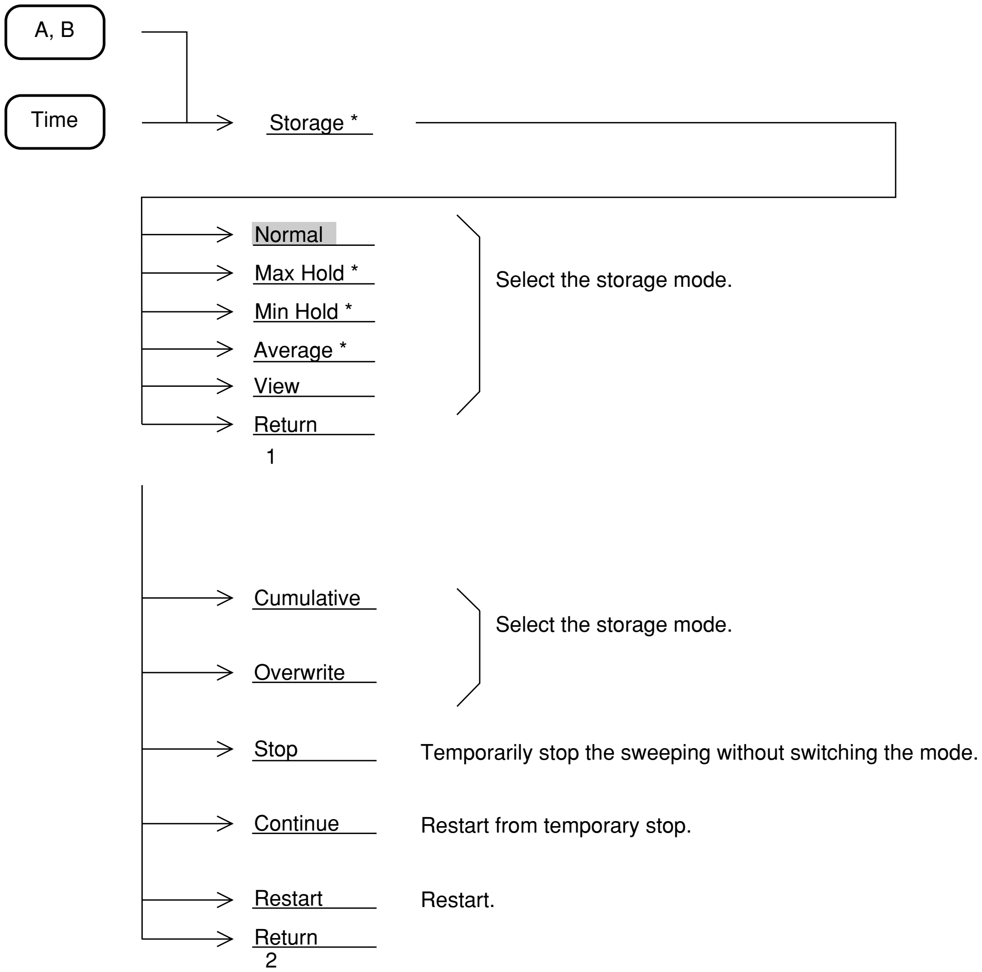
Types of Trace Modes (1/2)

NO.	Mode	Explanation	Display example
1	Normal	Refreshes and displays the trace data at each sweep. This is used for normal measurement.	
2	Max Hold	At each sweep, compares the new trace data with the old data at each X axis point, then displays the larger value data. It is used to record a frequency-drifting signal.	
3	Min Hold	At each sweep, compares the new trace data with the old data at each X axis point, then displays the smaller value data.	
4	Average	At each sweep, calculates the average data at each X axis point, then displays the averaged results. This mode is used to improve the S/N ratio. For further details on the averaging function, see page 5-18.	

NO.	Mode	Explanation	Display example
5	Cumulative	Displays the cumulative waveform at each sweep. The waveform data, which are not connected by lines, are displayed by plotting the data.	
6	Over write	Displays the waveform overwritten without deleting the old trace data.	
7	View	Continues displaying the waveform as it is, without refreshing the currently-displayed trace data. This mode is used to observe waveforms with the trace data stopped temporarily.	

Setting Storage Mode

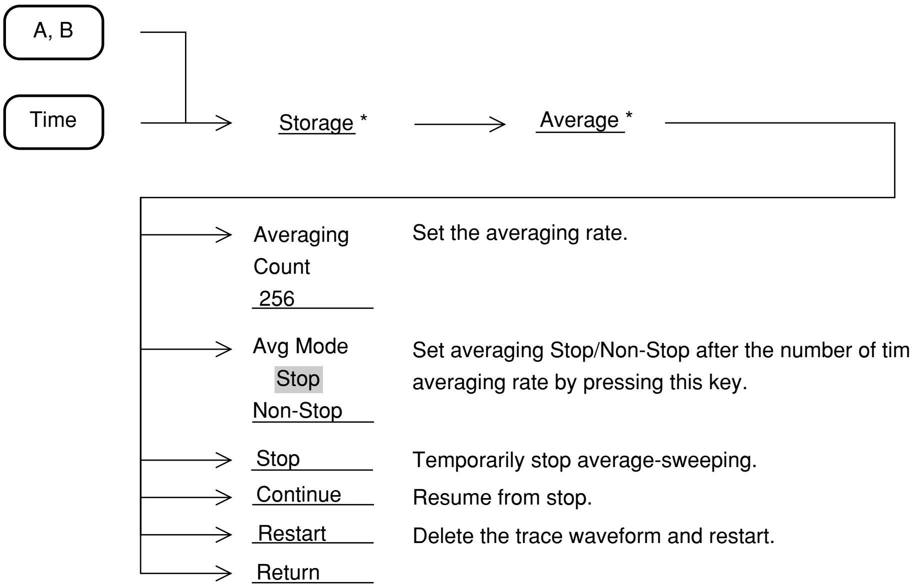
The storage mode can be selected by operating the function keys shown below while the spectrum analyzer is operating in the trace A, trace B, or trace Time mode.



(Display page 2 of the menu by pressing the More key.)

Averaging Function

The digital averaging function calculates the average data at each X axis point at each sweep and displays the results. It is executed by selecting Average in the trace A, trace B, and trace Time display modes.



Averaging Count 256	Set the averaging rate.
Avg Mode Stop Non-Stop	Set averaging Stop/Non-Stop after the number of times of averaging rate by pressing this key.
Stop	Temporarily stop average-sweeping.
Continue	Resume from stop.
Restart	Delete the trace waveform and restart.
Return	

The averaging function improves the S/N ratio depending on the averaging rate and the number of sweep repetitions as shown on the next page.
Digital video averaging is performed by the method shown below.

Averaging Rate = N

③Restart

①Stop

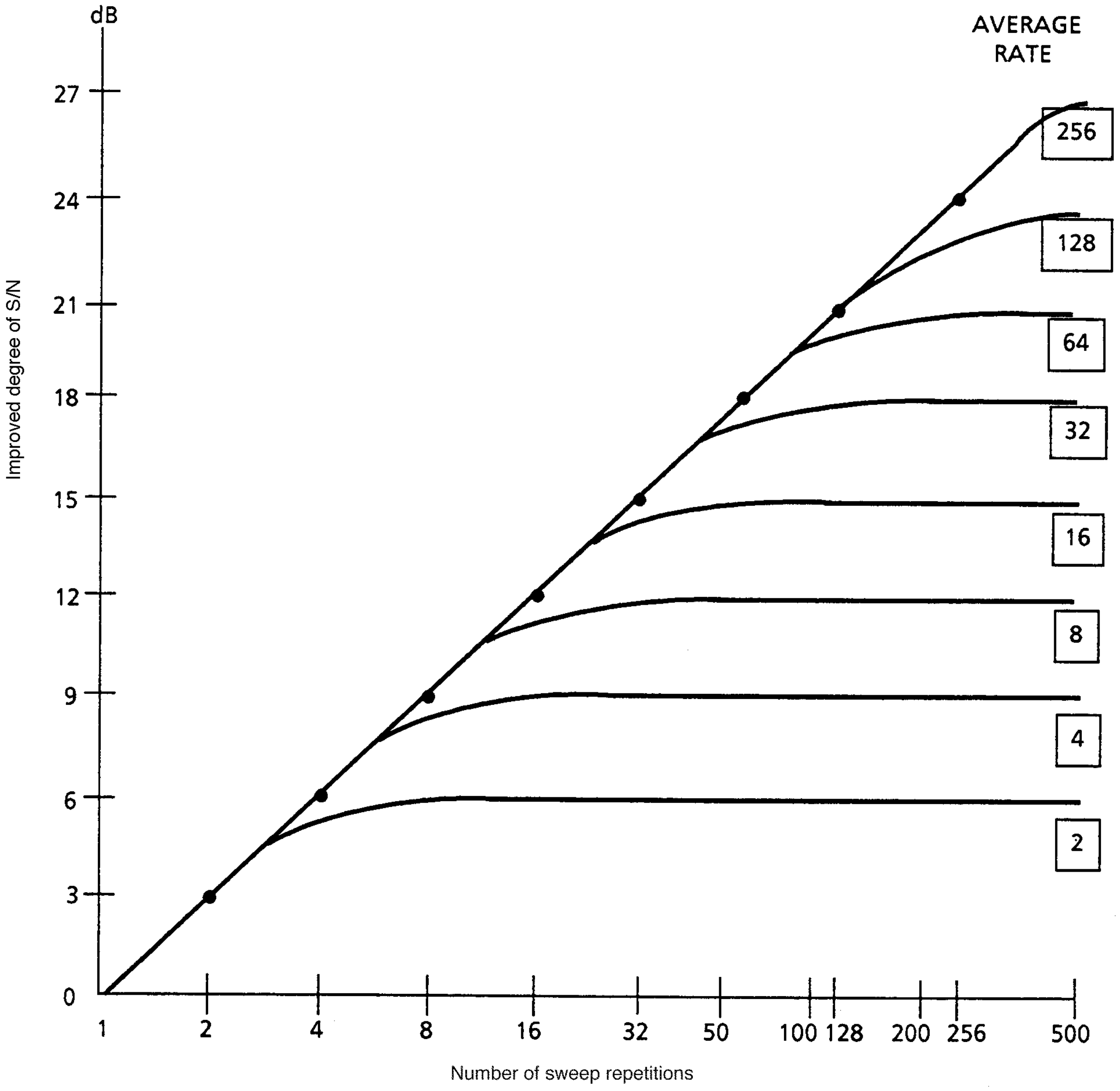
②Continue

Number of sweep repetitions	Measurement value	Displayed value
1	$M(1)$	$Y(1)=M(1)$
2	$M(2)$	$Y(2)=Y(1)+\frac{M(2)-Y(1)}{2}$
3	$M(3)$	$Y(3)=Y(2)+\frac{M(3)-Y(2)}{3}$
⋮	⋮	⋮
N–1	$M(N-1)$	$Y(N-1)=Y(N-2)+\frac{M(N-1)-Y(N-2)}{N-1}$
N	$M(N)$	$Y(N)=Y(N-1)+\frac{M(N)-Y(N-1)}{N}$
N + 1	$M(N+1)$	$Y(N+1)=Y(N)+\frac{M(N+1)-Y(N)}{N}$
N + 2	$M(N+2)$	$Y(N+2)=Y(N+1)+\frac{M(N+2)-Y(N+1)}{N}$
⋮	⋮	⋮

① Sweep stops after N repetitions. (When Avg Mode is Stop)

② The above stop condition is released by restarting sweep by Continue. The averaging operation resumes, while counting the number of sweep repetitions as N+1, N+2....

③ When Restart is performed during sweep or Stop, averaging is repeated from sweep count 1.



S/N Improvement by Digital Video Averaging

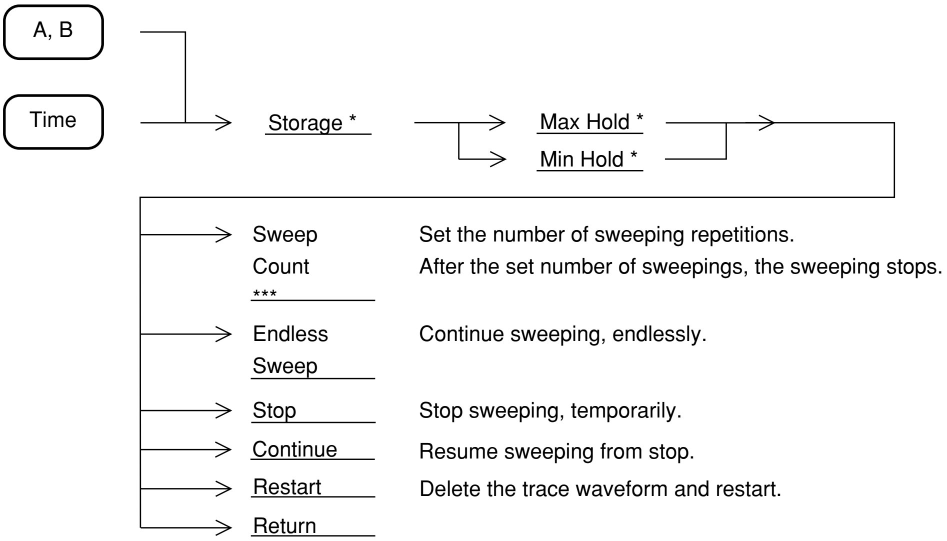
Averaging by video filter has the disadvantage that the sweep time becomes longer when the video bandwidth is narrowed to improve the averaging effect.

On the other hand, digital video averaging smoothes the trace display by averaging the digital data after A/D conversion at each sweep, without narrowing the video bandwidth (VBW). Since the video bandwidth (VBW) gets comparatively wider and the time required for each sweep can be shortened, the entire spectrum image can be verified quickly and the repetitive sweep can be stopped when the required smoothing has been obtained. The problem of averaging with the video filter is that the time required for each sweep becomes longer and it takes a long time to verify the entire spectrum image.

Since the averaging rate is initially eight, the above figure shows that an S/N improvement of 9 dB is obtained with eight sweeps.

Max Hold and Min Hold Functions

When Max Hold or Min Hold is selected, the sweeping can be performed by the number of specified repetitions, and then stops.



Sweep Count ***	Set the number of sweeping repetitions. After the set number of sweepings, the sweeping stops.
Endless Sweep	Continue sweeping, endlessly.
Stop	Stop sweeping, temporarily.
Continue	Resume sweeping from stop.
Restart	Delete the trace waveform and restart.
Return	

Detection Mode

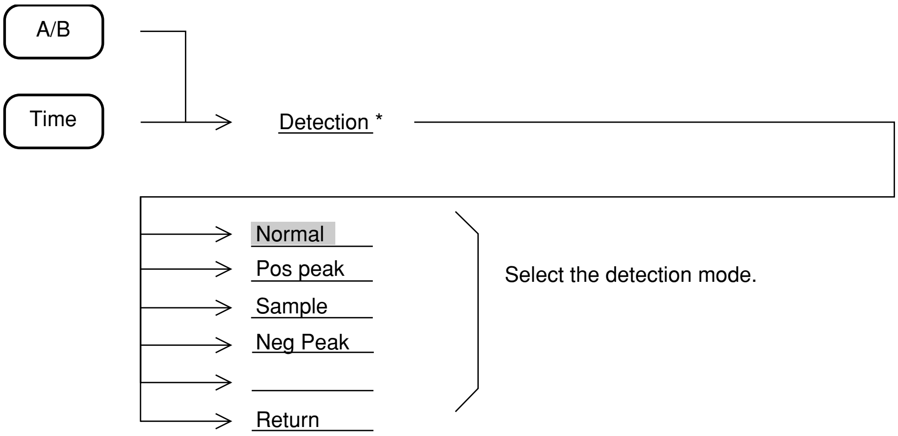
The detection mode can be selected from among Normal, Pos Peak, Sample, and Neg Peak for trace A and trace B.

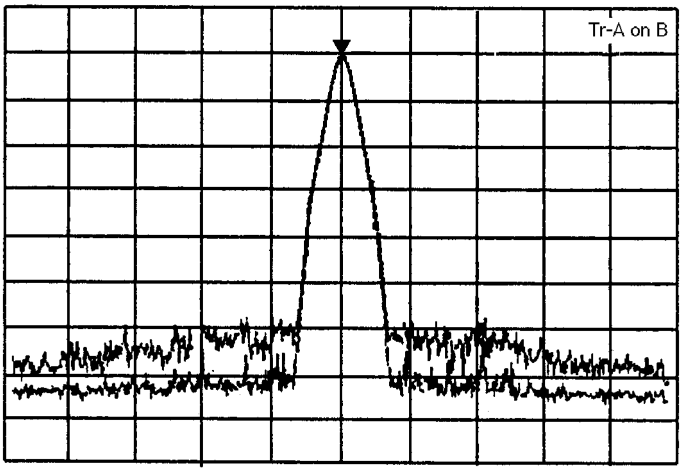
Normal	Traces the maximum value and minimum value between sample points.
Pos Peak	Traces the maximum value between sample points.
Sample	Traces the instantaneous value between sample points.
Neg Peak	Traces the minimum value between sample points.

However, trace BG is fixed at Pos Peak.
When the time span is under 20 ms at trace Time, only Sample is available.

Selecting Detection Mode

Select the detection mode for trace A, trace B, or trace Time by performing the following key operations.



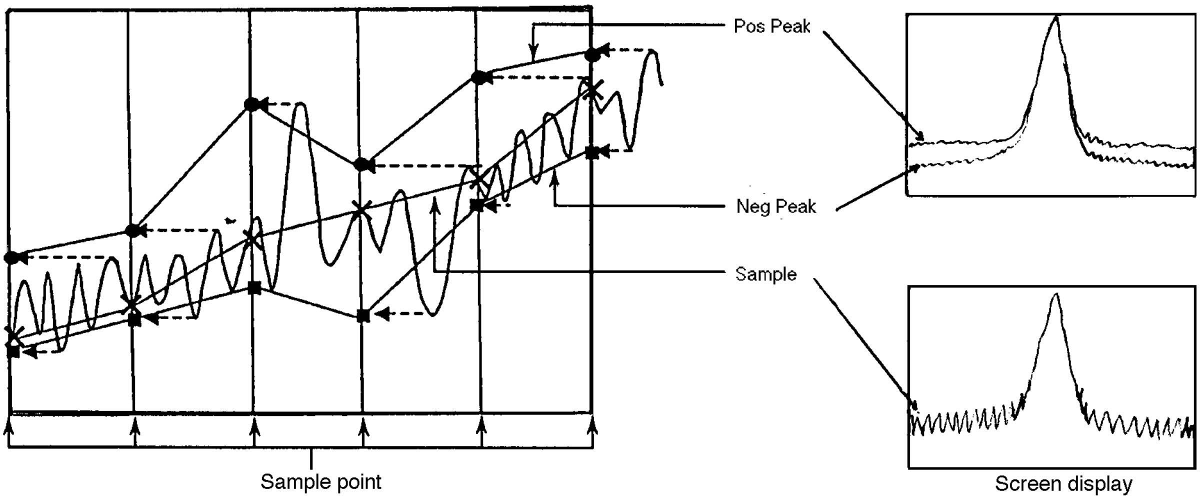


Waveforms when trace A is in the Pos Peak mode and trace B is in the NegPeak mode

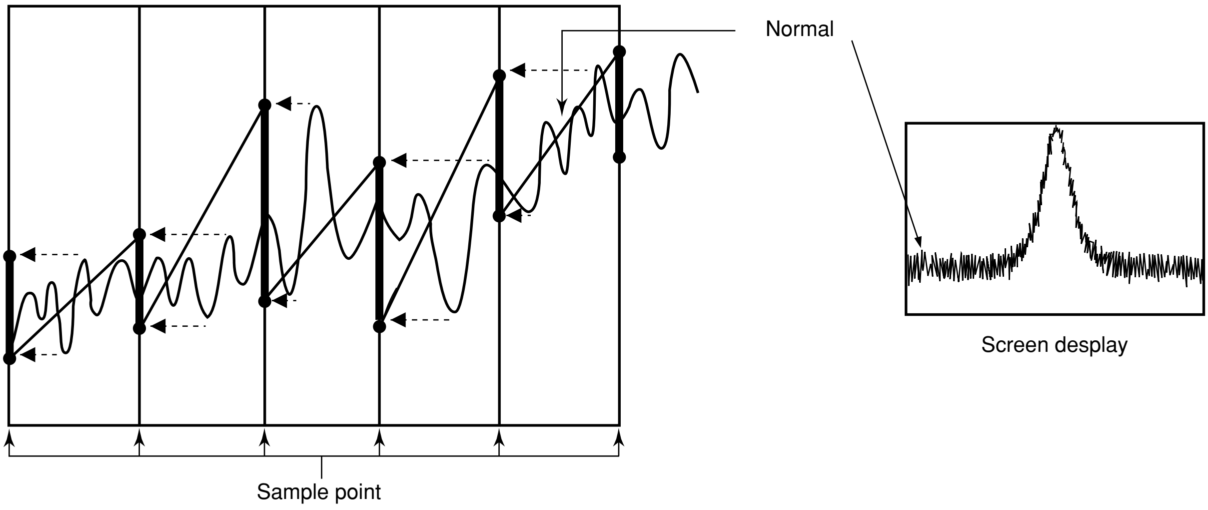
Selecting Measured Level by Detection Mode

The spectrum analyzer has 501 horizontal-axis measurement sample points. This corresponds to 501 storage trace memories.
The detection mode determines what type of measured value should be stored in the trace memory at each measurement sample point.

Detection mode	Description
Normal	Stores both the maximum level and the minimum level present between the current sample point and the next sample point and displays them on the screen. This mode is used in normal measurement.
Pos Peak	Holds the maximum level present between the current sample point and the next sample point, then stores the maximum value in the trace memory corresponding to the current sample point. Pos Peak is used to measure the peak value of signals near the noise level.
Sample	Stores the instantaneous signal level at each sample point to the trace memory. Sample is used for noise level measurement, time domain measurement, and other measurements.
Neg Peak	Holds the minimum level present between the current sample point and the next sample point, then stores the minimum value to the trace memory corresponding to the current sample point. The Neg Peak mode is used to measure the lower envelope side of a modulated waveform.



Note: When the detection mode is set to Sample or Neg Peak while the frequency span and resolution bandwidth are set so that the spectrum is displayed as discrete vertical lines, the spectrum peak is incorrectly displayed.



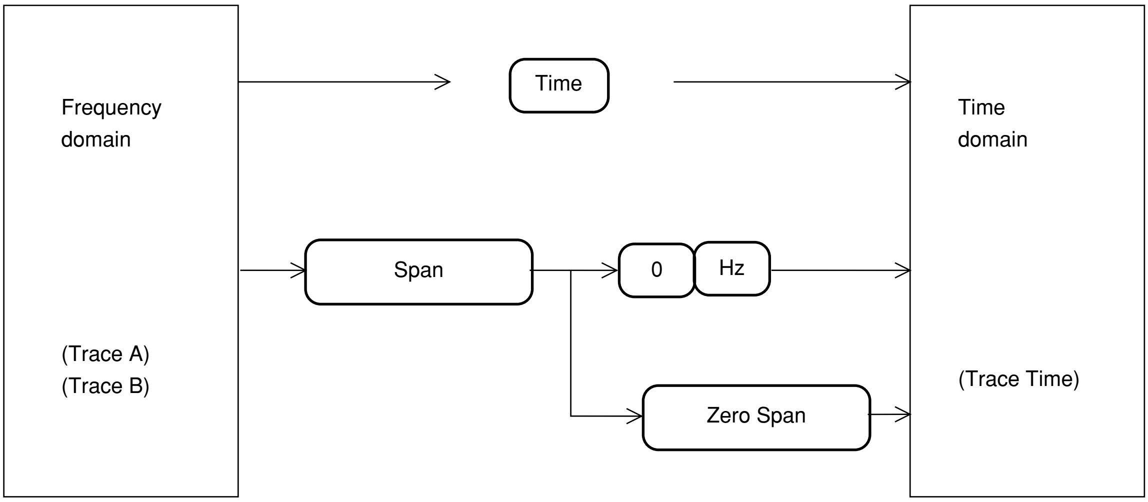
Normal traces and displays both Pos Peak and Neg Peak.

Time Domain

Since the spectrum analyzer stops sweeping the frequency when set to a frequency span of 0 Hz, the spectrum analyzer becomes a selective level meter that continues to receive only the center frequency. In this case, the horizontal axis of the time-axis sweep waveform is graduated in time and displayed on the spectrum analyzer screen. This display method is called "time domain display".
The spectrum analyzer time domain display has an Expand function for expanding the waveform time axis to create a more convenient display. It also has a special function for monitoring an FM demodulated waveform.

Setting Time Domain

The time domain can normally be set by pressing the Time key in the Display section. It can also be set by setting the frequency span to 0 Hz in the frequency domain mode.



The following parameters can be set independently in the frequency domain or time domain mode.

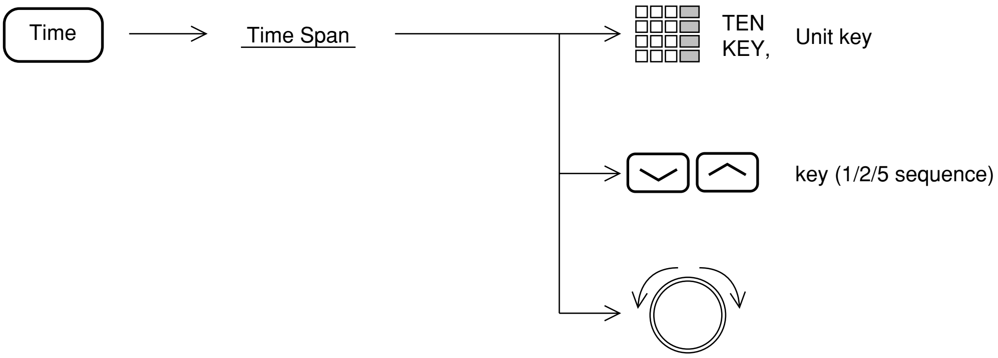
- Vertical scale mode (Log/Lin)
- Vertical scale range (10 dB/div, 10%/div, etc.)
- Storage mode (Normal, Max Hold, Average, etc.)
- Detection mode (Pos Peak, Sample, Neg Peak, Normal)
- Resolution bandwidth (RBW)
- Video bandwidth (VBW)
- Sweep time (Sweep Time/Time Span)
- Trigger switch (Freerun/Triggered)

The three parameters resolution bandwidth, video bandwidth, and sweep time can be selected in common or independently in the frequency domain or time domain mode when setting the system.

Note: The time domain mode marker function uses a spot marker. A zone marker cannot be used.

Setting Time Span

In the time domain mode, the measurement range on the horizontal axis does not set the frequency span, but sets the time span. To set the time span, perform the following key operations.

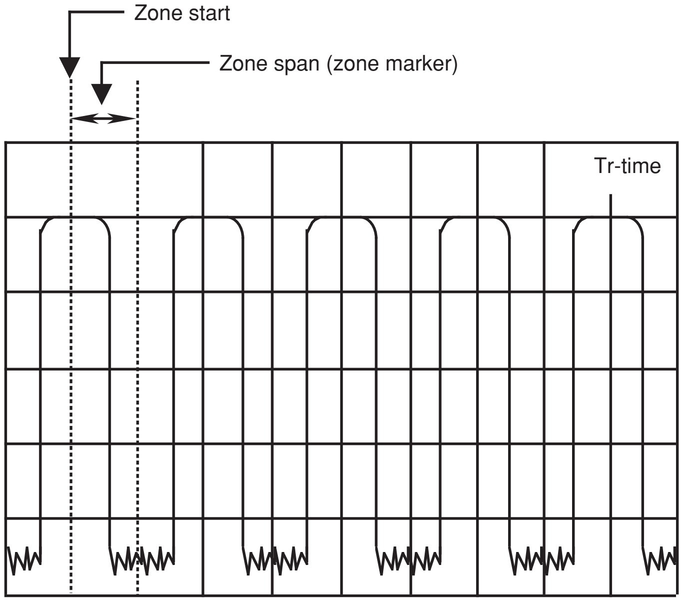


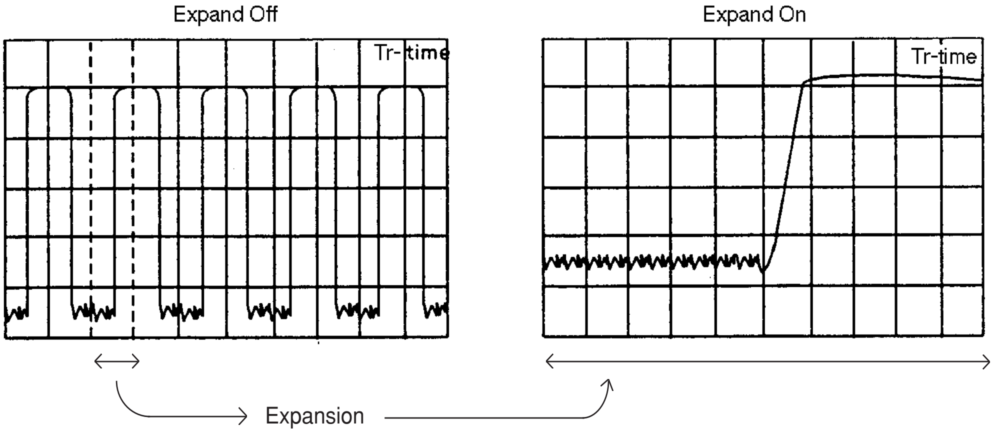
Time Domain Expanded Display

Part of the time domain time axis can be expanded and displayed.

Time → Expand *

→ Zone Start Point 50	Set the expansion zone start point.
→ Zone Span Point 50	Set the expansion zone width.
→ Expand Zone On Off	Select expansion zone marker display On or Off by pressing this key.
→ Expand On Off	Select expanded display On or Off by pressing this key.
→ Return	





The Expand mode cannot executed under the following conditions.

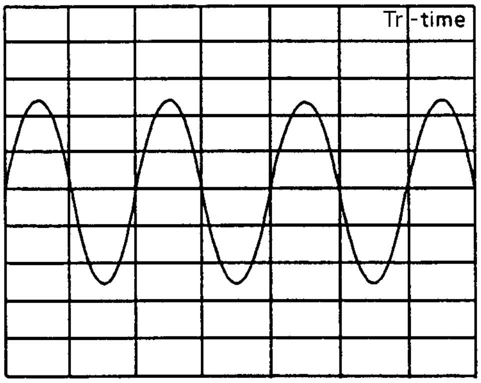
- Trigger mode .... Freerun

Monitoring FM Demodulated Waveforms

The spectrum analyzer contains an FM demodulator (Opt.05 FM demodulation waveform monitor) to display demodulated waveforms.

Time → FM Monitor *

→ FM Monitor On Off	Turn FM demodulated waveform display On and Off by pressing this key.
→ Range 2kHz/Div	Set the modulation frequency/division.
→ Demod Coupling AC DC	Select if the FM demodulation waveform is to be displayed by AC or DC coupling by pressing this key.
→ Return	



By using the FM demodulated waveform monitor function, frequency deviation can be easily measured.

To monitor an FM demodulated waveform, set the resolution bandwidth and video bandwidth as follows:

- Resolution bandwidth (RBW) .... When a signal not accompanied by an interference wave has been received, the resolution bandwidth should be made as wide as possible. If it is necessary to narrow the resolution bandwidth, the bandwidth should be made more than three times (frequency deviation + modulation frequency). Too narrow a resolution bandwidth results in a distorted modulation waveform.
- Video bandwidth (VBW) .... The video bandwidth should be made as narrow as possible although a bandwidth of more than ten times the modulation frequency is required. Setting a wide video bandwidth will degrade the S/N ratio. If it is necessary to set a wide bandwidth, digital averaging can be used to improve the S/N ratio.

Note:
- Because the demodulation frequency range depends on the FM demodulation range, if the FM demodulation range is switched to an FM signal with a high demodulation frequency, a different waveform will be observed.

  The following shows the demodulation frequency range corresponding to the respective FM demodulation ranges.

50, 100, 200 kHz/div range	DC or 50 Hz to 500 kHz
2, 5, 10, 20 kHz/div range	DC or 50 Hz to 50 kHz

- Usable RBW
  - For MS2651B/2661B/2653B/2663B: RBW ≥100 kHz
  - For MS2661C/2663C: RBW ≥1 kHz

SECTION 6

SELECTING THE SWEEP METHOD

This section describes the sweep mode, trigger sweep mode, zone sweep, and signal tracking and time gate functions.

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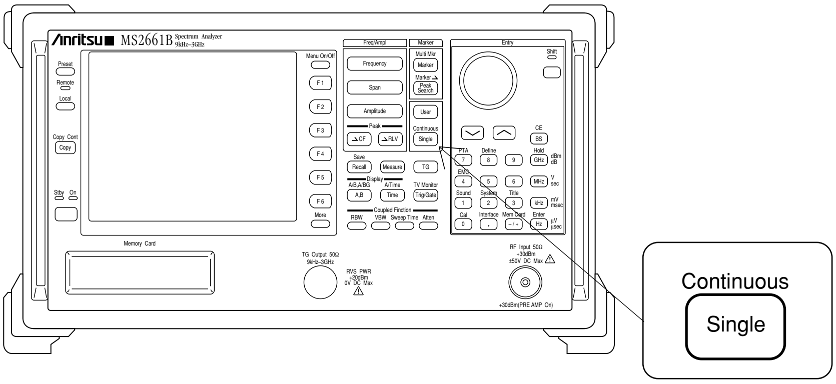
SECTION 6
SELECTING THE SWEEP METHOD

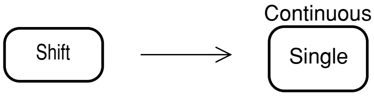
Sweep Mode

The spectrum analyzer sweep mode is set by using the following key.



Continuous Sweep Mode

When the trigger mode is set to Freerun, sweep is performed continuously. When the trigger mode is set to Triggered, sweep is executed each time the trigger conditions are met.
To set the continuous sweep mode, perform the following key operation. (The continuous sweep mode is initially set.)



Single Sweep Mode

When the trigger mode is set to Freerun, sweep is executed once immediately after the Continuous Single key is pressed.

When the trigger mode is set to Triggered, sweep is executed only once when the trigger conditions are met after the Continuous Single key is pressed.

To set (sweep start) the single sweep mode, operate the following key.

Continuous
Single

Trigger Mode

The spectrum analyzer trigger mode can be divided into Freerun and Triggered.
In the Triggered mode, Video, Wide IF Video, External, TV, or Line can be selected as the trigger source.
To use the Trigger mode, Option 06 Trigger/gate circuit is required.

Freerun

When the sweep mode is set to continuous, sweep is repeated continuously. When the sweep mode is set to single sweep, sweep is started immediately after the [Continuous / Single] key is pressed.
To set the Freerun mode, perform the following key operations. (The Freerun mode is initially set.)

[Trig/Gate] → Trigger
Freerun — Select Freerun by pressing this key.
Triggered

Triggered

When the conditions of the pre-selected trigger source are met, sweep is started.
To set the Triggered mode and to select the trigger source, perform the following key operations.

Trig/Gate

Trig/Gate	Trigger Freerun Triggered	Select Triggered by pressing this key.
	Trace Time	When this key is pressed, it is highlighted and the spectrum analyzer switches to the time domain mode.
	Delay Time 10.0ms	Set the delay time from the trigger.
	Time Span 200 us	Set the time span.
	Trigger Source *	

Video	Video trigger	Select the trigger source.
Wide IF Video	Wide IF video trigger	
External	External trigger	
TV	TV trigger	
Line	Line trigger	
Return		

Video Trigger

Sweep is started in synchronization with the positive leading edge or negative leading edge of the detected waveform.

To select the trigger level and trigger slope, perform the following key operations.

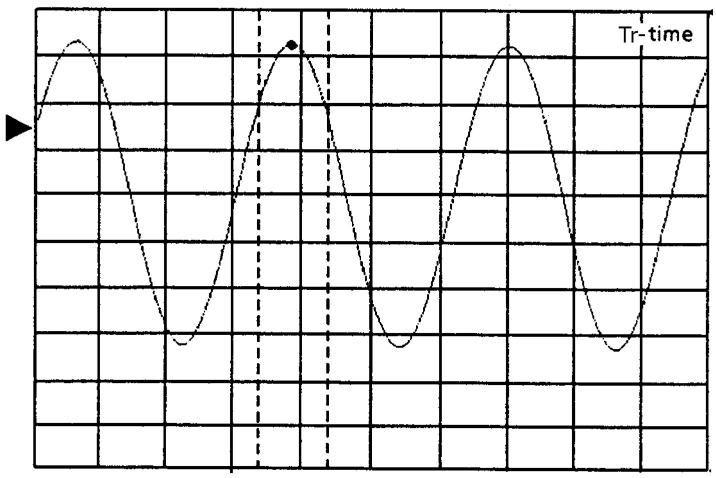
Trig/Gate → Trigger Source * → Video *

→ Trig Level –25 dB: Set the trigger level with the ten keys, up-down keys, or rotary knob.

→ Trig Slope Rise Fall: Select if the positive leading edge (Rise) or negative leading edge (Fall) is made the trigger slope by pressing these keys.

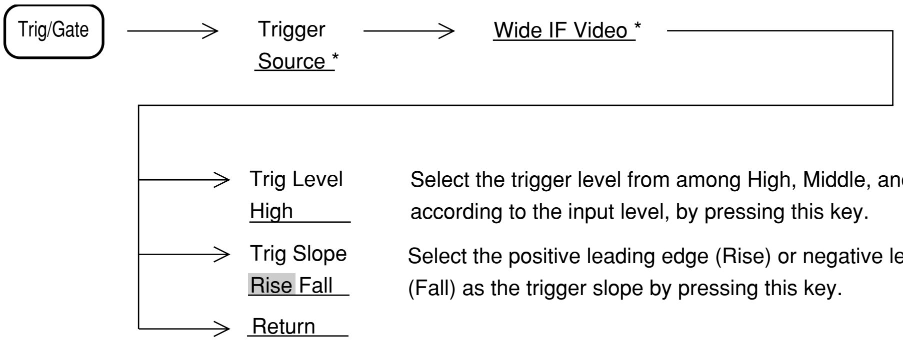
→ Return

The trigger level is indicated by displaying the trigger level indicator ▶ at the leftmost vertical line of the screen.



Wide IF Video Trigger

A wide bandwidth IF signal of at least 5 MHz is detected and sweep is started in synchronization with its positive leading edge or negative leading edge.
To select the trigger level and trigger slope, perform the following key operations.
Generally, there is no burst synchronizing signal and this signal is used as a burst wave gate control signal.



Select the trigger level from among High, Middle, and Low, according to the input level, by pressing this key.

Select the positive leading edge (Rise) or negative leading edge (Fall) as the trigger slope by pressing this key.

An indicator of appropriate trigger levels for Wide IF Video is listed below.

Trig Level	Mixer level*
High	–10 dBm (nominal)
Middle	–20 dBm (nominal)
Low	–30 dBm (nominal)

* This designed at 100 MHz.

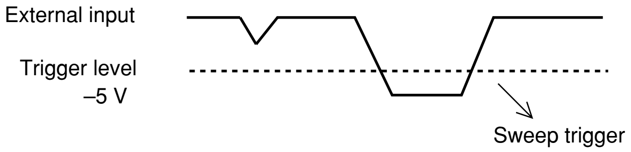
Actual trig level is dependent of frequency of input.
Mixer level is "actual input of RF input" – " RF attenuator value ", if the instrument has no preamplifier option installed.

External Trigger

Sweep is started in synchronization with the positive leading edge or negative leading edge of the signal waveform input to the Ext Input connector on the rear panel. To select the trigger level and trigger slope, perform the following key operations.

Trig/Gate → Trigger Source * → External *

–10 to 10V	Select the trigger level from –10 to +10 V and TTL.
TTL	
Trig Level –5 V	Set the trigger level when –10 to +10 V was selected.
Trig Slope Rise Fall	Select the positive leading edge (Rise) or negative leading edge (Fall) as the trigger slope by pressing this key.
Return	



(Example) When trigger level is –5 V and trigger slope is Rise

TV Trigger

This function detects the horizontal or vertical synchronizing signal of the TV signal and uses it to start sweep. It is an Option function.

To use the TV trigger function, Option 06 Trigger/gate sweep and Option 16 TV image monitor are required.

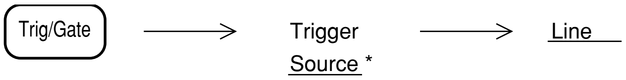
Trig/Gate → Trigger Source * → TV *

V-Sync	Trigger with vertical synchronizing signal
H-Sync Even	Trigger with horizontal synchronizing signal (even field)
H-Sync Odd	Trigger with horizontal synchronizing signal (odd field)
H-Sync Line No. 20	Set the horizontal synchronizing signal line number with the ten keys or rotary knob.
TV NTSC PAL	Select the TV signal system by pressing this key.
Return	

Note: TV trigger operates normally under the following conditions:
- Trace Time
- The peak level of the signal level exceeds 50% of the reference level.

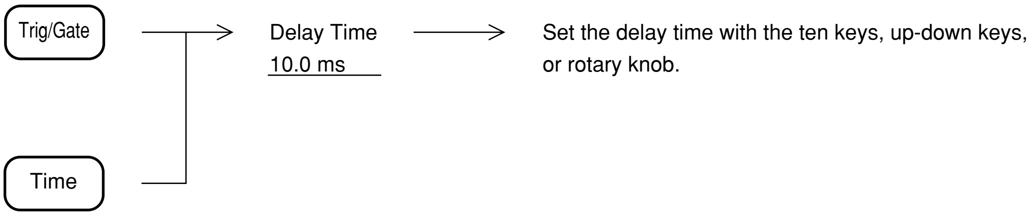
Line Trigger

This function starts sweep in synchronization with the AC power line frequency. Line trigger is conveniently used to observe power line-related hum waveform. With the line trigger function, the trigger level and trigger slope are not selected.

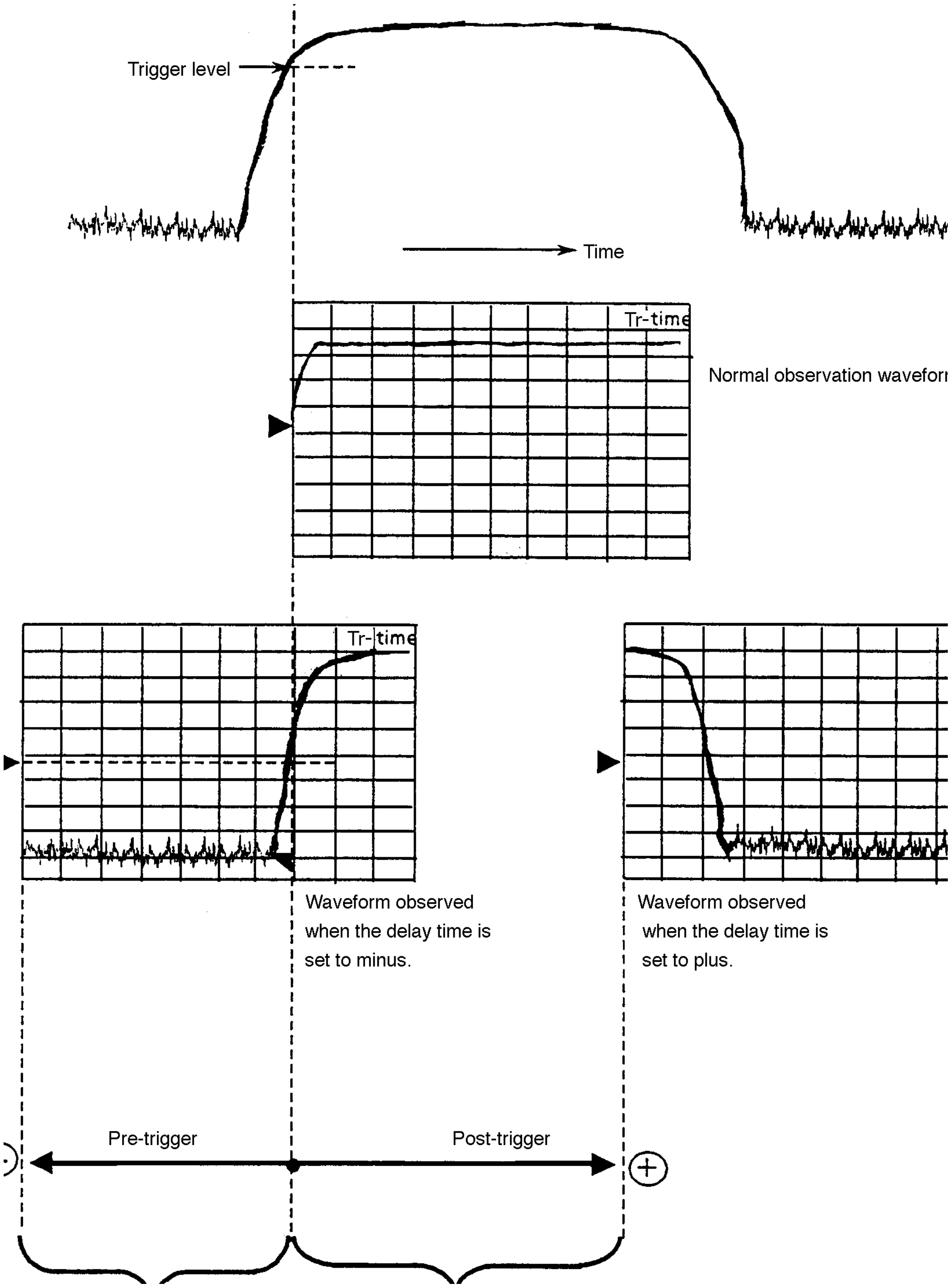


Delay Time

When the trigger mode is set to Triggered in the time domain mode, the trigger point is usually positioned at the left end of the screen. This, however, means that it is not possible to see the waveform before the trigger point and the waveform beyond the right end of the screen.
With the spectrum analyzer, a waveform away from the trigger point can be displayed by changing the delay time.
To set the delay time, perform the following key operations.



If the trigger point on the time axis on the screen was set by delay time, the trigger level indicator ▶ is displayed at the bottom of the screen.



Example of Waveform With Delay Time (when used with video trigger)

Zone Sweep and Signal Tracking

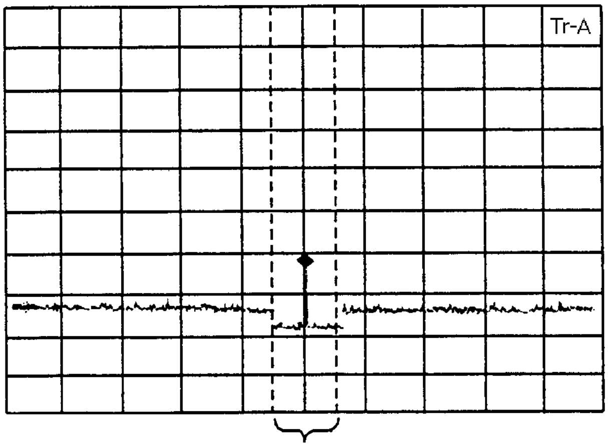
The spectrum analyzer has two sweep methods - zone sweep which sweeps only within the zone marker and a signal tracking function which detects the peak level frequency at each sweep, then moves it to the center of the zone marker.

Zone Sweep

Marker ——> Zone Sweep
On Off

(Display page 2 of the menu by pressing the More key.)

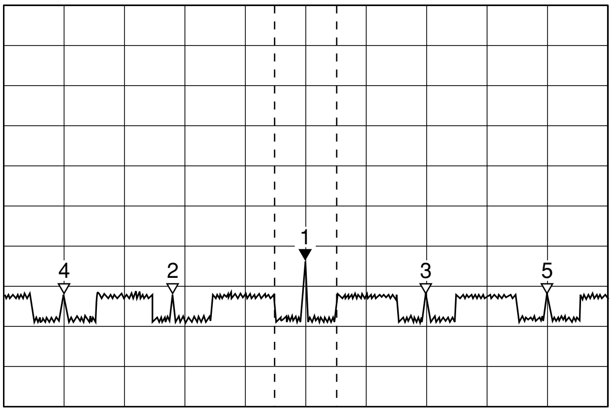
Zone sweep can be conveniently used to closely and quickly analyze part of the whole sweep range on the screen.



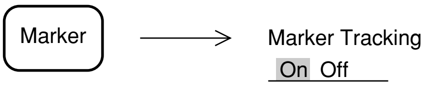
A signal masked by noise can be analyzed at high speed by setting zone sweep to On and adjusting the resolution bandwidth and video bandwidth.

Note: Zone sweep cannot be executed while the marker is Off or when the instrument is in the time domain mode.

When the multimarker function is on, Each multimarker in on state is sequentially zone-sweeped (multi-zone sweep).



Signal Tracking



(Display page 2 of the menu by pressing the More key.)

The signal tracking function moves the frequency of the signal of the peak level in the zone marker to the center of the zone marker at each sweep. This is convenient when tracking and analyzing a signal whose frequency drifts.

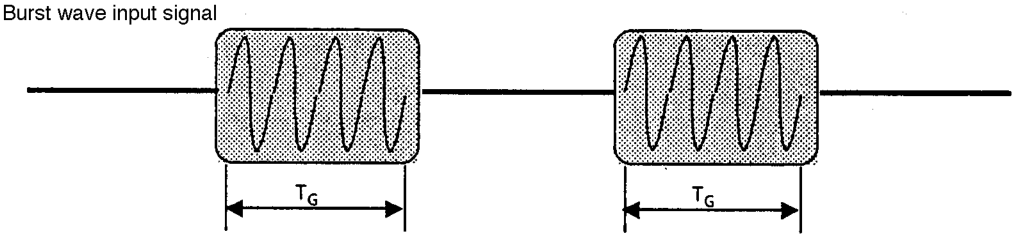
Note: The signal tracking function cannot be executed while the marker is Off or when the instrument is in the time domain mode.

Time Gate Function

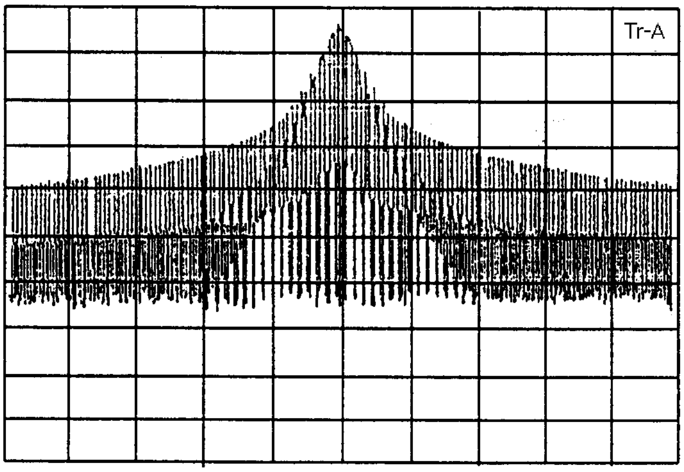
The time gate function is a sweep mode which turns the waveform data display On and Off by the gate control signal generated in the spectrum analyzer based on an external signal or video trigger signal.
Since the timing that displays the spectrum waveform can be set by using this mode, the spectrum when the burst signal is On can be analyzed.

In order to use the time gate function, an external trigger signal synchronized with burst wave On/Off or other signal change is required to create the gate control signal.

When an external synchronizing signal is unavailable, set the trigger source to wide IF video trigger. A synchronizing signal can be obtained internally.

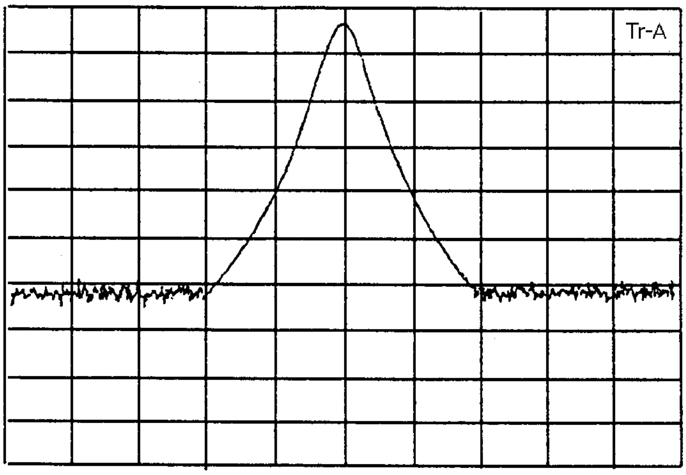


If the spectrum of the burst wave above is analyzed as it is,



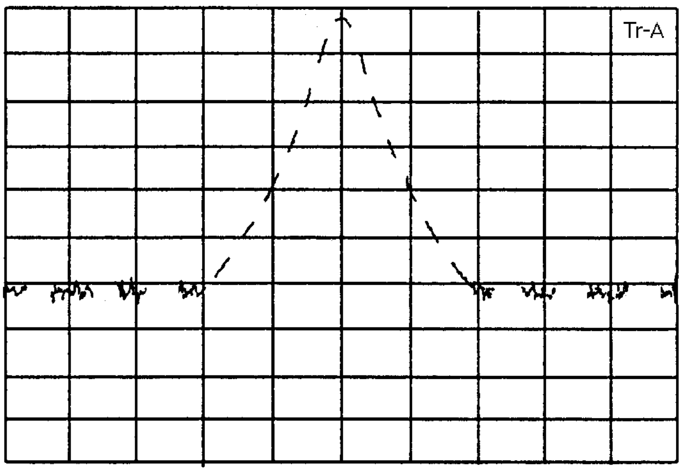
The spectrum spread by the positive leading edge or negative leading edge of the burst wave prevents the spectrum from being observed with the burst set to On.

If the spectrum can be analyzed only during the gate time T_G,

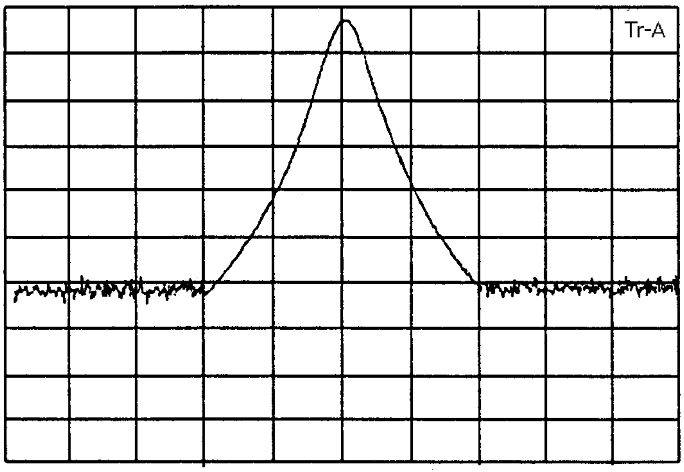


Only the spectrum when the burst is set to On is displayed.

When the time gate function is executed, sweep runs in the Freerun mode and only the waveform data validated by the gate control signal is refreshed. If the sweep period is not synchronized with the gate control signal, a perfectly shaped trace can be obtained by increasing the number of sweep repetitions.



Fewer Sweep Repetitions



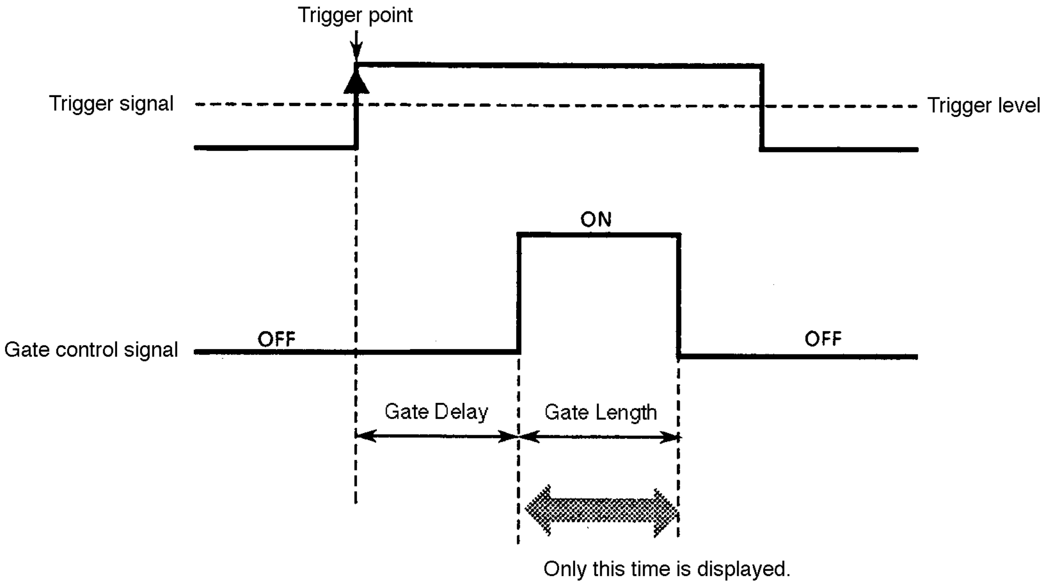
More Sweep Repetitions

Example of Frequency Spectrum Measurement on Burst Signal

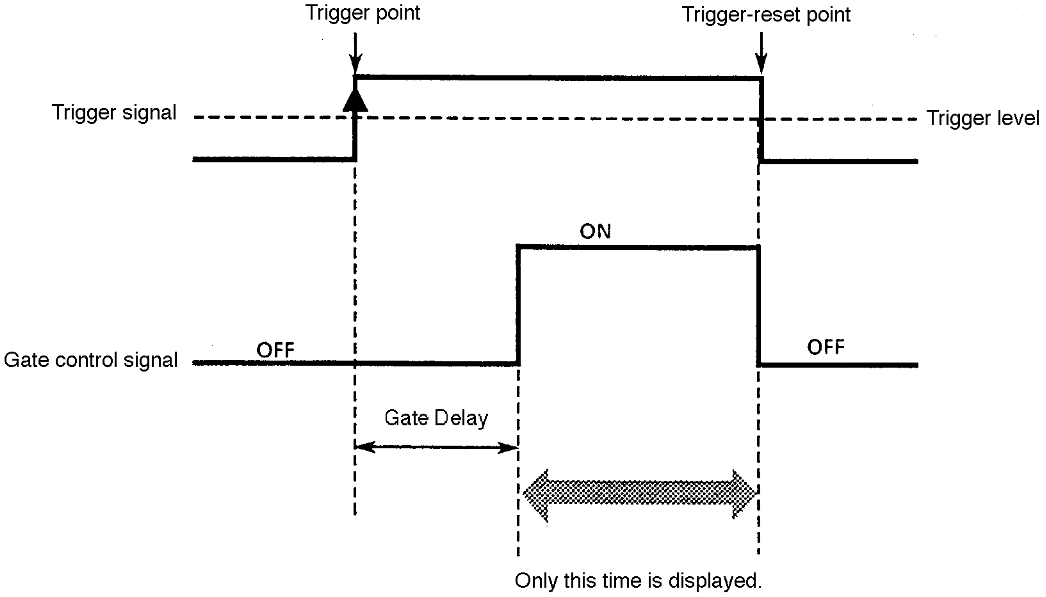
Creating a Gate Control Signal

If the point where an external trigger signal (Ext Input only) or a wide IF video trigger signal is triggered is assumed to be the reference position, the gate control signal remains On over the period from the point immediately after the Gate Delay time has elapsed from the reference position to the time set by Gate Length, or to the time reset by a trigger signal.

- Gate End: When Int selected



- Gate End: When Ext selected



To turn the gate time analysis function On and Off and to create the gate control signal, perform the following key operations.

Trig/Gate → (Display page 2 of the menu by pressing the More key.)

Gate Sweep On Off	Turn the gate function On and Off by pressing this key.
Gate Setup *	Set the gate function.
Stop	Stop gate operation.
Restart	Restart gate operation.
Trace Time	Set the time domain mode.
Trace A	Set the trace A (frequency domain) mode.

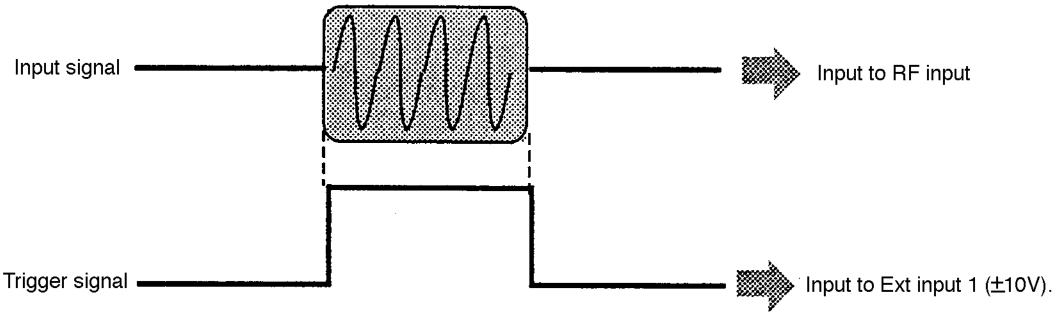
Setting Gate Function

Trig/Gate → Gate Setup *

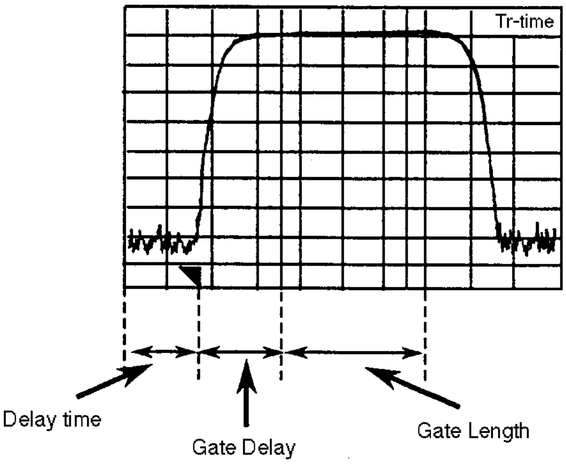
Gate Delay 0 us	Set the gate delay time.
Gate Length 10 ms	Set the gate time length.
Gate End Int Ext	Select the condition that closes the gate by pressing this key. When Gate End is set to Int and Gate Length is set to Ext, the gate is closed by an external signal.
Gate Trig Source	Select the gate trigger source from Wide IF Video and external.
return	

The time domain mode facilitates setting the gate control signal time. The following shows an example of how to use the Time Gate function that uses the time domain mode.

Step	Procedure
1	Input the following signals to the spectrum analyzer.

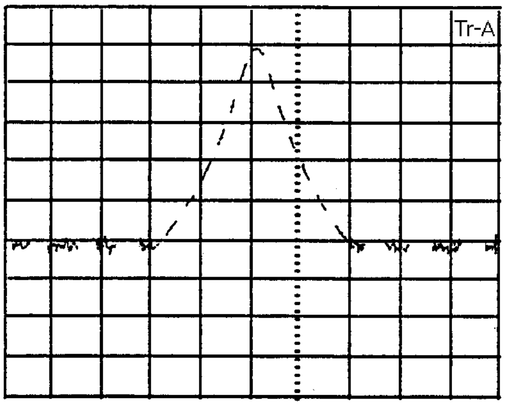


Step	Procedure
2	Display the waveform in the time domain mode. Synchronize the input signal by setting the trigger mode to Triggered and the trigger source to Ext Input 1 (–10 to 10V).

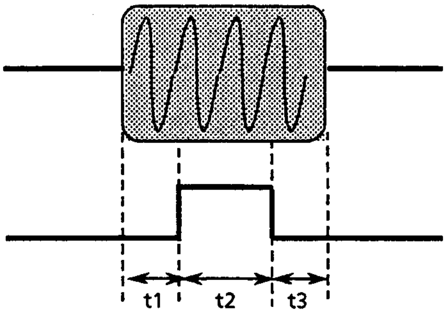


Step	Procedure
3	Set Gate to On. Vertical lines (gate cursor) should appear at the Gate Delay and Gate Length positions. Set Gate Delay and Gate Length to appropriate positions while observing the waveform. At this time, adjust the resolution bandwidth and video bandwidth in the time domain mode to equal those in the frequency domain mode, then set the gate cursor positions. The influence of spike-like noises independent of the conditions shown in Note ① described later can be avoided.

Step	Procedure
4	Set the frequency domain mode. The trigger mode becomes Freerun and the waveform data is displayed only for the time set by Gate Length.



Notes: ① The detector output is delayed compared to the positive leading edge of the input waveform when the resolution bandwidth (RBW) is narrowed in the frequency domain measurement mode. As a result, spike-like noises may appear on the trace. To prevent this from appearing, set Gate Delay and Gate Length to values that satisfy the following conditions.

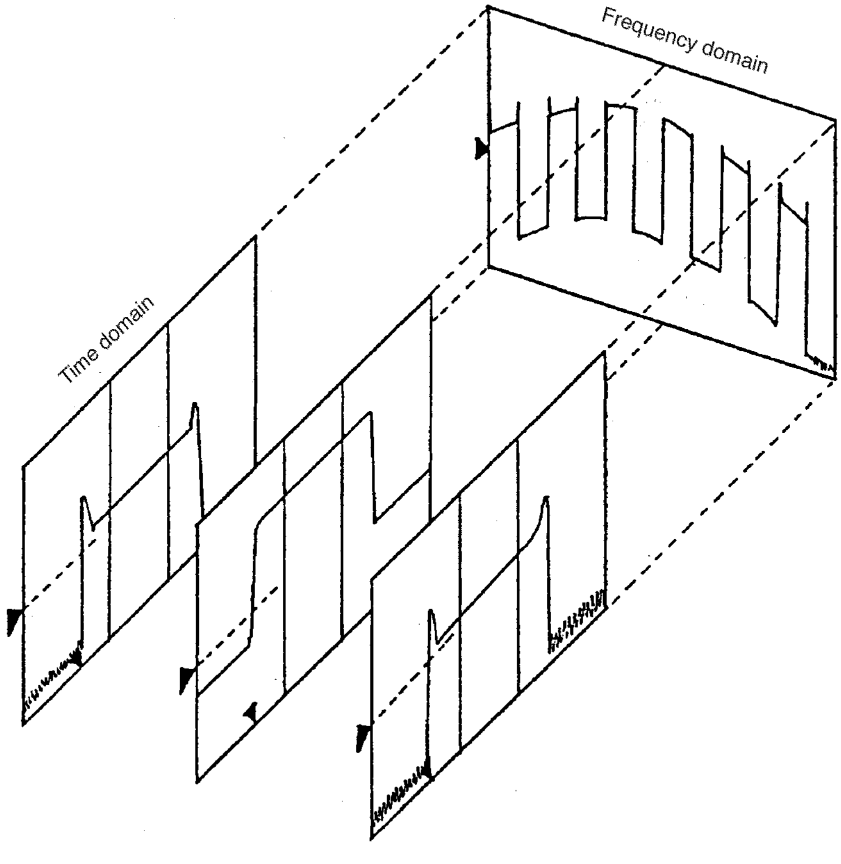


RBW	t1	t2	t3
1 kHz	≥3 ms	≥20 µs	≥1 µs
3 kHz	≥1 ms		
10 kHz	≥230 µs		
30 kHz	≥200 µs		
100 kHz	≥20 µs		
300 kHz	≥15 µs		
1 MHz 5 MHz	≥10 µs		

② When the resolution bandwidth (RBW) is extremely narrow for the frequency span, some waveforms cannot be displayed correctly. Set each parameter so that the following conditions are satisfied.

$$\text{RBW} \geq \frac{\text{Span}}{\text{Number of data points (501)}} \times 5$$

③ The Time Gate function can use a video trigger as the gate control signal. In this case, the gate control signal must be generated correctly so that a trigger can be normally set with the same RBW, VBW, and trigger level conditions at all frequencies within the frequency span observed in the frequency domain. (See the figure below.)



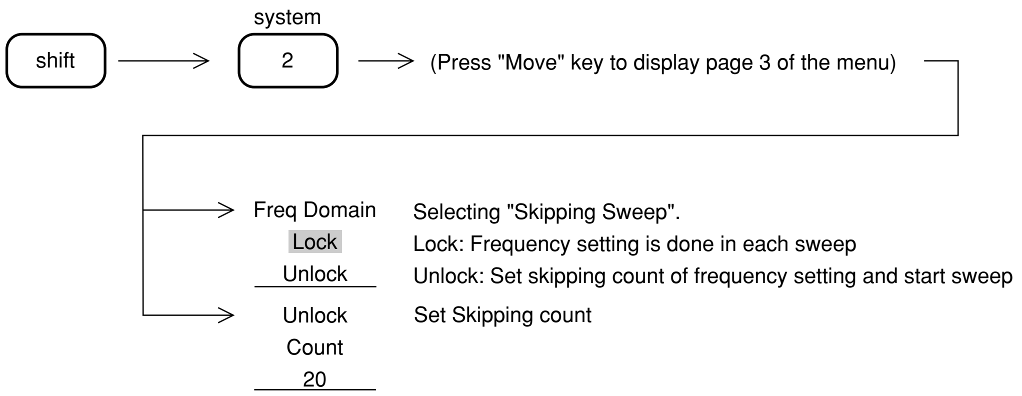
Trigger can be applied by the gate control signal created internally by setting the trigger source to Wide IF Video.

Domain Sweep

In conducting a sweep by traces A and B (frequency axes), a sweep operation consists of the procedures; setting a center frequency in each sweep, and moving observation frequency. (Lock and Roll)
When "Domain Sweep" function is selected, the frequency setting is done only once in a specified number (Domain count) of sweep operations, and the rest of the sweep operations are performed without this setting. When the frequency setting is performed, it is necessary to wait for the frequency to stabilize before a sweep can be started. By using "Domain Sweep" function, the time required for frequency to stabilize is saved, and the sweep repetition cycle can be shortened.

Note:
- *When using "Domain Sweep" function, the specifications on frequency such as frequency stability and frequency indicating determinacy are no longer assured.*
- *Selecting "storage mode=Max hold/Min hold/Average" in using "Domain Sweep" function, may result in making the errors between measured levels large. When using "Domain Sweep" function, it is suggested to select "storage mode=Normal".*
- *When a certain sweep duration or frequency span is set, sweep repetition cycle may not be shortened even though using "Domain Sweep" function.*

Using Domain Sweep



Selecting "Skipping Sweep".
Lock: Frequency setting is done in each sweep
Unlock: Set skipping count of frequency setting and start sweep

Set Skipping count

SECTION 7

COUPLED FUNCTION

This section describes the coupled function. Generally, the spectrum analyzer automatically selects the optimum values of the coupled function so that both the correct level and correct frequency values can be measured.
This is called the Auto Coupled Function.
This section mainly describes manual settings that are used to set the coupled function according to the application.

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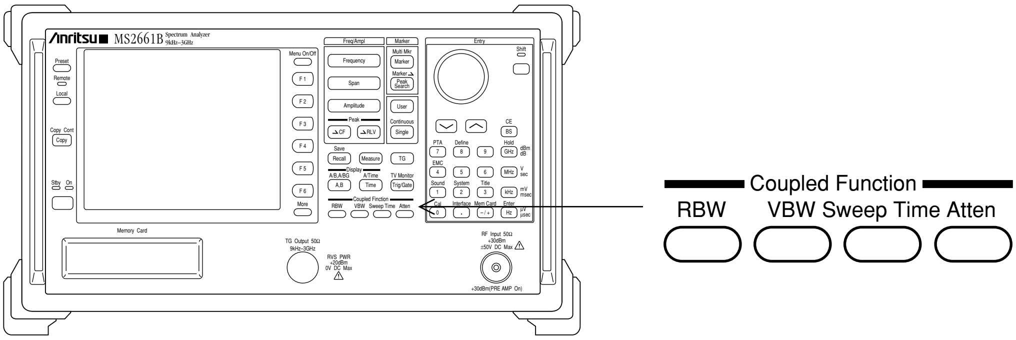
SECTION 7
COUPLED FUNCTION

The coupled function of the four functions Resolution Bandwidth (RBW), Video Bandwidth (VBW), Sweep Time, and Attenuation (Atten) is initially set to Auto so that the spectrum analyzer can automatically select the optimum setting.



From Auto to Manual Operation

Perform manual setting as follows:

RBW → Manual → Set the RBW with the ten keys, up-down keys, and rotary knob.

VBW → Manual → Set the VBW with the ten keys, up-down keys, and rotary knob.

Sweep time → Manual → Set the sweep time with the ten keys, up-down keys, and rotary knob.

Atten → Manual → Set the input attenuator with the ten keys, up-down keys, and rotary knob.

Resolution Bandwidth (RBW) and Sweep Time

To set the RBW and Sweep Time, perform the following key operations.

RBW	Manual →	Manually set the RBW with the ten keys, up-down keys, and rotary knob.
	Auto	Automatically set the RBW.
	RB/Span Ratio ON Off	Selects RB/Span Ratio On or Off.
	RB/Span Ratio 0.01	Sets the RB/Span Ratio.
	RB, VB, SWT Auto	Automatically set the RBW, VBW, and Sweep Time.
	All Auto	Automatically set the RBW, VBW, Sweep Time, and Atten.
Sweep Time	Manual →	Manually set the Sweep Time with the ten keys, up-down keys, and rotary knob.
	Auto	Automatically set the Sweep Time. (Note)
	RB, VB, SWT Auto	Automatically set the RBW, VBW, and Sweep Time.
	All Auto	Automatically set the RBW, VBW, Sweep Time, and Atten.

Note: Either of the two automatic set modes (Auto SWT: Hi-Lvl-Acc and Fast) can be selected. Normally, select the Hi-Lvl-Acc mode. See Section 9 for details.

(1) Auto mode

The RBW, Sweep Time, and VBW parameters are set to Auto so that even if the frequency span is varied, the respective parameters are automatically set to the optimum values so that frequency and level measurement errors do not occur.

The following shows the Swp Time Auto setting range:

- Lower limit value
  20 msec
- Upper limit value
  1000 sec

(2) Manual setting

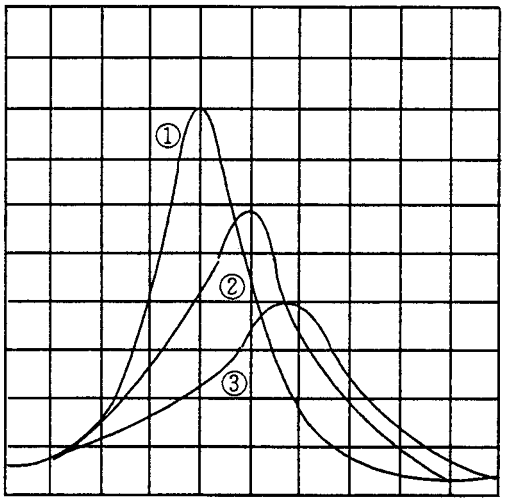
If RBW, VBW, and Sweep Time are set to the Auto mode, normal measurements can be made without considering their settings.
However, in the following cases, RBW should be set to the Manual mode.

General measurements: When observing two adjacent signals, increasing the frequency resolution by narrowing the RBW can reduce the noise level (a tenth part of the current RBW results in a 10 dB reduction).
However, if the RBW is too narrow, the spectrum waveforms will become too steep, the response characteristics become worse, and the sweep time will also become longer. Therefore, the RBW value should be determined to give a practical sweep speed.

Intermodulation distortion measurement: When measuring two signal intermodulation distortion with a comparatively wide frequency span and a reduced noise level, the RBW value should be narrowed by manual setting. However, the sweep time increases in inverse proportion to the square of the RBW.

The RBW can be selected from among the following by Manual setting:

- MS2651B/2661B/2653B/2663B
  1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 5 MHz
- MS2661C/2663C
  1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz
- 30 Hz, 100 Hz, 300 Hz (Option 02 Narrow RBW is required.)



① Optimum trace waveform
②, ③ UNCAL trace waveforms

Note: The spectrum traces on the screen are displayed as shown at the left according to the sweep time. The optimum sweep time gives a waveform like ①. However, a sweep time that is too fast decreases the waveform amplitude on the display as shown in ② and ③. Therefore, the apparent bandwidth gets wider, and the frequency also shifts. When waveform ① cannot be maintained, "UNCAL" is displayed.

Video Bandwidth (VBW)

To set the VBW, perform the following key operations.

VBW	Manual	Manually set the VBW with the ten keys, up-down keys, and rotary knob.
	Auto	Automatically set the VBW.
	Filter off	Set video filter to Off.
	VB/RB Ratio 1.0	Set the Auto mode VBW/RBW ratio with the ten keys, up-down keys, and rotary knob.
	RB, VB, SWT Auto	Automatically set the RBW, VBW, and Sweep Time.
	All Auto	Automatically set the RBW, VBW, Sweep Time, and Attn.

(1) Auto mode

When VBW is set to Auto, the product of the RBW set value multiplied by the VB/RB Ratio is set. Since VB/RB Ratio is initially set to 1, RBW and VBW are set to the same value.

By setting the VB/RB Ratio to a small value, since VBW is set to a narrow value according to the RBW setting, noise can be efficiently averaged.

Note: Since the VBW setting range is 1 Hz to 3 MHz, if an attempt is made to exceed this range, the VBW is set to 1 Hz or 3 MHz.

(2) Manual setting

When wanting to average the noise by making the VBW narrow without regard to the RBW set value, or when wanting to make the VBW wide to observe the waveform of signals modulated at a high frequency, use Manual setting.

The VBW value can be manually set from among the following values:

1 Hz, 3 Hz, 10 Hz, 30 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz, OFF

Note:
- When VBW ≥ RBW is set, noise is not averaged and the sweep speed is increased.
- Noise can also be averaged without narrowing the VBW (without decreasing the sweep time) by performing video averaging. For further details, see SECTION 5.

Input Attenuator (Atten)

To set the input attenuator, perform the following key operations.

Atten →

Manual	Manually set the input attenuator with the ten keys, up-down keys, and rotary knob.
Auto	Automatically set the input attenuator.
Pre Ampl On Off	Turn the input preamp On and Off by pressing this key.
All Auto	Automatically set the RBW, VBW, Sweep Time, and Atten.

(1) Auto mode

When the reference level is set while Auto is selected, the input attenuator is automatically set to the optimum value according to the reference level.

(2) Manual setting

When a signal with the same level as the reference level is input, the input attenuator value in the Auto mode is controlled so that high accuracy measurements can be made without being influenced by gain compression and the noise level can be reduced. However, when you want to measure a low level signal by raising the sensitivity when measuring nonharmonic spurious response and the spurious response of adjacent signals, measurement may be impossible because the Atten values in the Auto mode are too large. In this case, set the input attenuator manually according to the table above.

Reference Level and Input Attenuator (Manual)

Reference Level effective range (dBm)	Atten Manual (dB)
+30 to –30	70
+30 to –40	60
+30 to –50	50
+30 to –60	40
+20 to –70	30
+10 to –80	20
0 to –90	10
–10 to –100	0

A small input attenuator value can be set within the range at which internal mixer level = {(same input level as reference level) – (input attenuator set value) is –10 dBm or less.

For second and third harmonic measurements, the influence of internal distortion must be eliminated by decreasing the mixer input level. Because the internal distortion is –80 dB when the mixer input level is –30 dBm, when wanting to measure spurious harmonics up to –80 dB, the mixer input level must be made –30 dBm or less. In this case, set the input attenuator manually because the Atten value in the Auto mode is too small.

SECTION 8

AUTOMATIC CALIBRATION AND LEVEL CORRECTION FUNCTION

This section describes the internal calibration function and measuring system level correction function which minimize the spectrum analyzer measurement error.

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SECTION 8

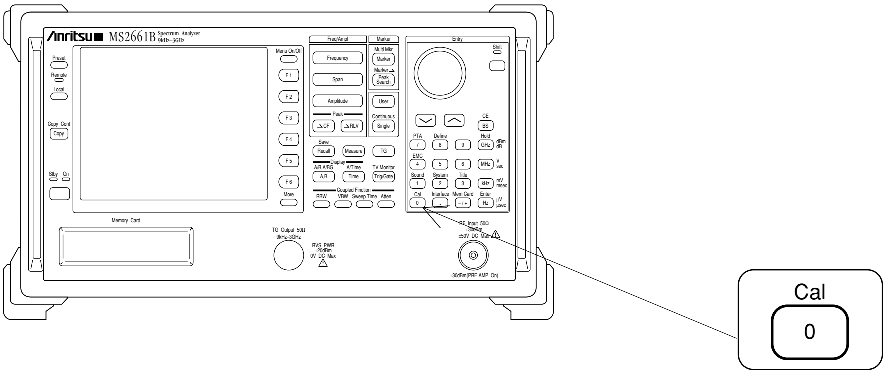
AUTOMATIC CALIBRATION AND LEVEL CORRECTION FUNCTIONS

Automatic Calibration Function ....CAL

The spectrum analyzer incorporates a 625 kHz calibration oscillator and a calibration attenuator, which perform automatic calibration so that the spectrum analyzer can minimize measurement errors and make high accuracy measurements.

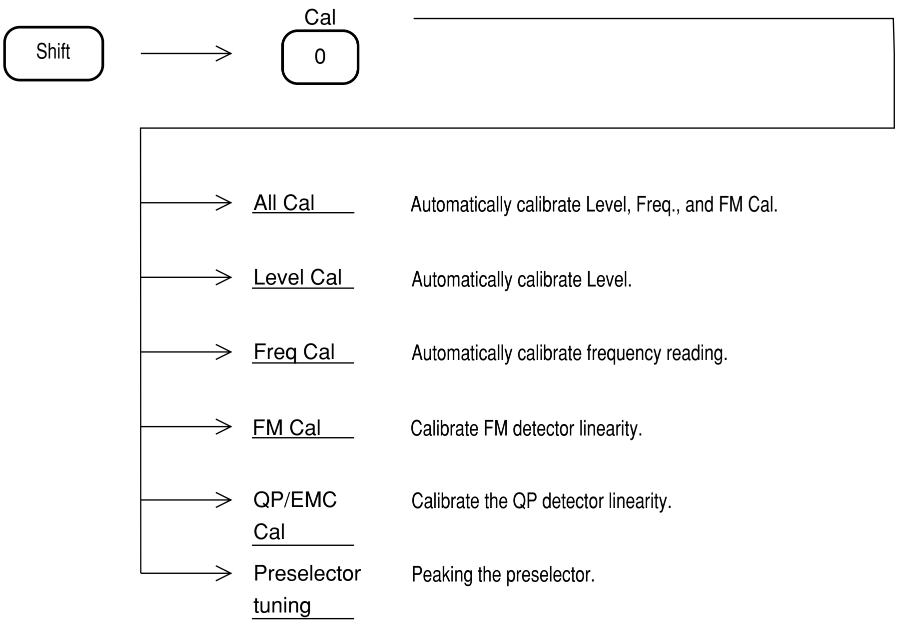
WARNING ⚠

If calibration is executed with an external signal applied to the RF input, the correct calibration value cannot be obtained. Perform calibration without applying a signal to the RF input connector.



Automatic Calibration

Execute spectrum analyzer automatic calibration by performing the following key operations.



All Cal	Automatically calibrate Level, Freq., and FM Cal.
Level Cal	Automatically calibrate Level.
Freq Cal	Automatically calibrate frequency reading.
FM Cal	Calibrate FM detector linearity.
QP/EMC Cal	Calibrate the QP detector linearity.
Preselector tuning	Peaking the preselector.

Details of Each Calibration Item

The following describes the items that are calibrated by the automatic calibration function and the items that are calibrated at the factory.

ALL CAL	LEVEL CAL	Reference level error calibration	Calibrates the absolute-value levels on the LOG/LIN scale.
		LOG-scale linearity calibration	Calibrates the LOG-scale linearity.
		IF Gain switching error correction	Calibrates the error caused by the IF gain from among the level errors when the reference level is switched.
		RBW switching error calibration	Calibrates the error when the resolution bandwidth (RBW) is switched.
		Detection-mode switching error calibration	Calibrates the level error when the detection mode (Pos Peak, Sample, Neg Peak) is switched.
		Input-attenuator/pre-amplifier switching error calibration	Calibrates the level error when the input-attenuator/pre-amplifier is switched.
	FREQ CAL	RBW center frequency calibration	Calibrates the center frequency error when the resolution bandwidth (RBW) is switched.
		RBW bandwidth measurement	Measures the RBW bandwidth used for noise measurement bandwidth conversion.
	FM CAL	FM detector linearity calibration	Calibrates the linearity of the FM detector for monitoring FM demodulated waveforms.
Factory Calibration		Frequency response calibration	Calibrates the amplitude frequency response over the entire band.

When ALL CAL is executed, the calibration data is retained by the built-in battery back-up even when the spectrum analyzer power is turned off. Therefore, it is not always necessary to execute automatic calibration each time the power is turned on. However, when a particularly high accuracy measurement is required, when the specifications are not met, or when the set-up circumstances have changed greatly (such as ambient temperature), execute automatic calibration again.

Notes:

- Since the built-in calibration oscillator is automatically connected internally when automatic calibration is executed, external connection is unnecessary.
- Unless the frequency span is taken into account, the measurement frequency error depends on the local oscillator frequency error and the IF center frequency error. The local oscillator is a synthesizer system and its frequency error depends on the frequency accuracy of the reference crystal oscillator or external reference signal input. Frequency-related automatic calibration calibrates the IF center frequency error.
- The RBW center frequency calibration data is not applied in the time domain mode (zero span).

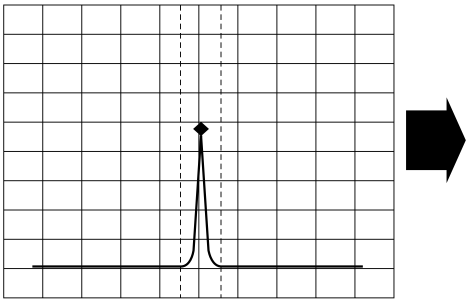
Preselector tuning

This function is an MS2653B/2663B/2663C dedicated function. It cannot be used in the MS2651B/2661B/2661C. Since this equipment is a superheterodyne type spectrum analyzer, it generates unrequired wave responses such as image responses and multiple responses.

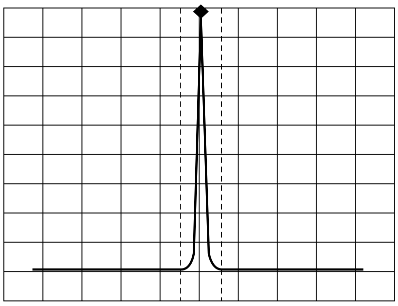
This equipment uses a preselector to remove these unrequired wave responses and to display only true signals on the screen. The preselector is a variable synchronous type bandpass filter that follows the receiving frequency of an analyzer. Since the MS2653B/2663B/2663C uses the preselector in the band 1- (2.92 to 6.5 GHz) and band 1+ (6.4 to 8.1 GHz), the peaking is described below:

In normal use, since the initial value of the peaking bias is set for each frequency, peaking is required only when the bias value is shifted purposely.

If it is shifted, the receiving level is decreased as shown in the diagram at the bottom left. Accordingly, perform peaking so that the maximum response can be obtained as shown in that figure.

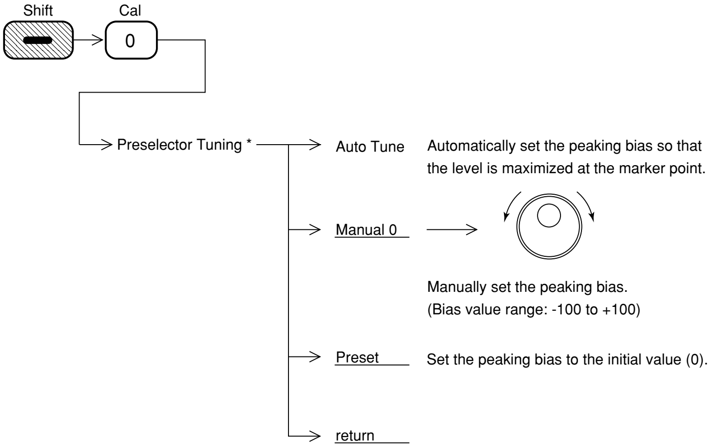


elector peaking



State of optimum peaking bias

Perform peaking using the following method.



Automatically set the peaking bias so that the level is maximized at the marker point.

Manually set the peaking bias.
(Bias value range: -100 to +100)

Set the peaking bias to the initial value (0).

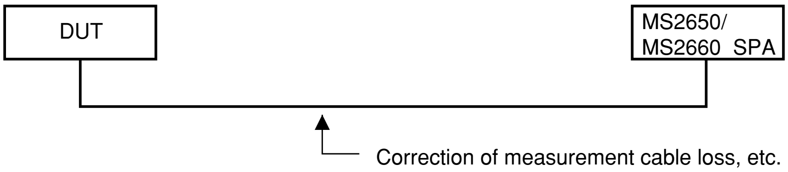
Note: Preselector Auto Tuning cannot be done when:

- The frequency span exceeds 500 MHz.
- The marker is OFF.
- Trace BG is the main trace in the trace A/trace BG indication.
- The FM/TRIG monitor mode is active in the Time Trace.

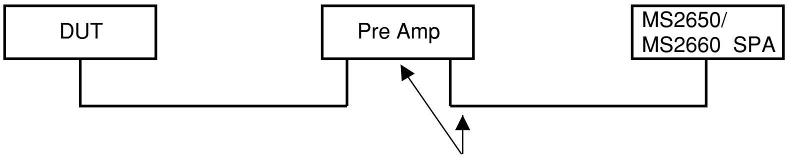
Measurement System Level Correction

When making measurements with a spectrum analyzer, it may be necessary to correct the error and gain of the measurement system. The following are examples of this.

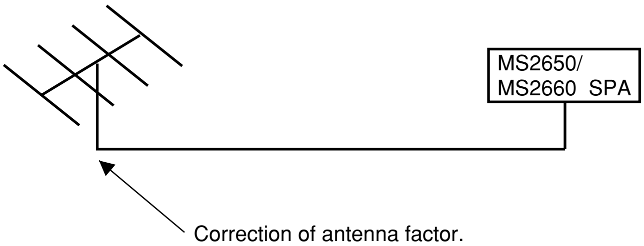
① Frequency characteristics and loss of measurement cables
② Frequency characteristics and loss of pre-amplifier, etc. connected to RF input connector
③ When wanting to measure the field strength with an antenna or near-field probe connected (antenna factor correction)



Correction of measurement cable loss, etc.



Correction of pre-amplifier gain and cable loss, etc.

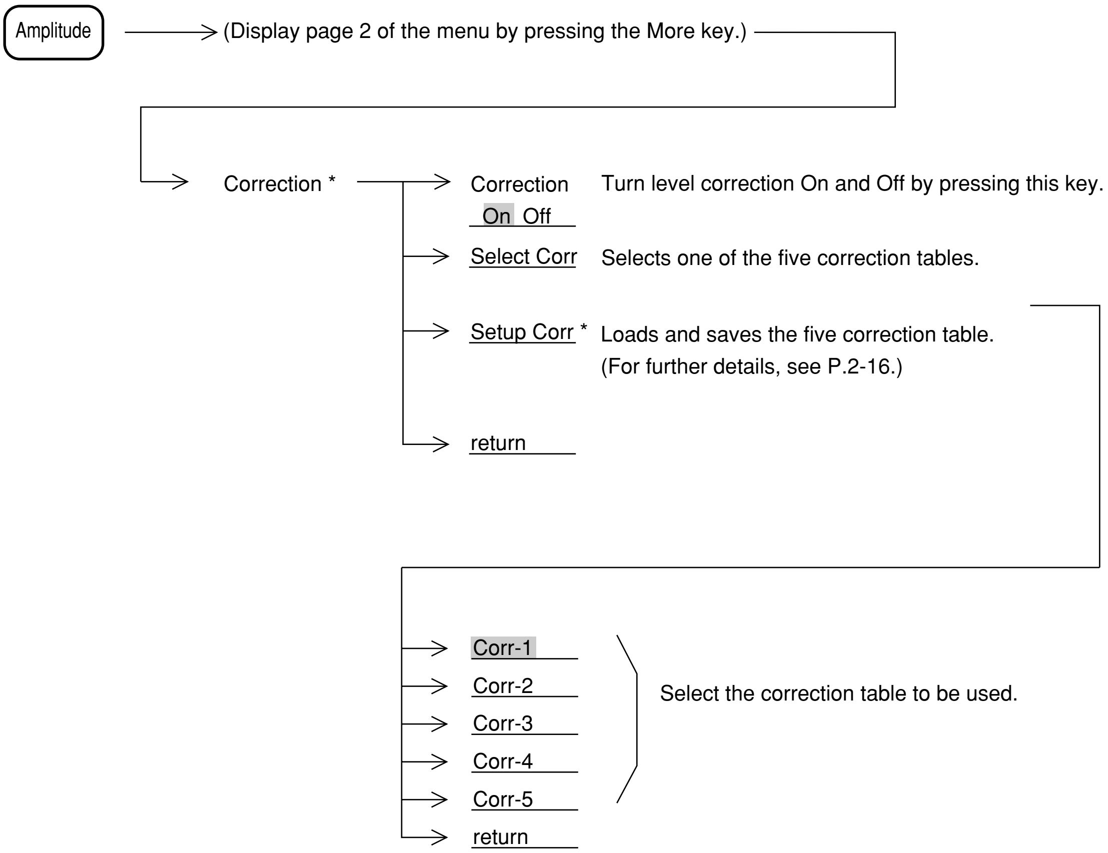


Correction of antenna factor.

The correction factors for these measurement systems can be stored in the internal memory to add the factor to the measured value and display the spectrum.

Up to five correction factors (maximum 150 points each) can be stored in the internal memory by storage from an external computer via an external interface or by using the internal PTA. For a more detailed explanation of these methods, refer to the Remote Control part of the separate operation manual.

The following shows the procedure for adding the correction factor to the measured value by using the correction data saved in advance.



(Display page 2 of the menu by pressing the More key.)

Turn level correction On and Off by pressing this key.

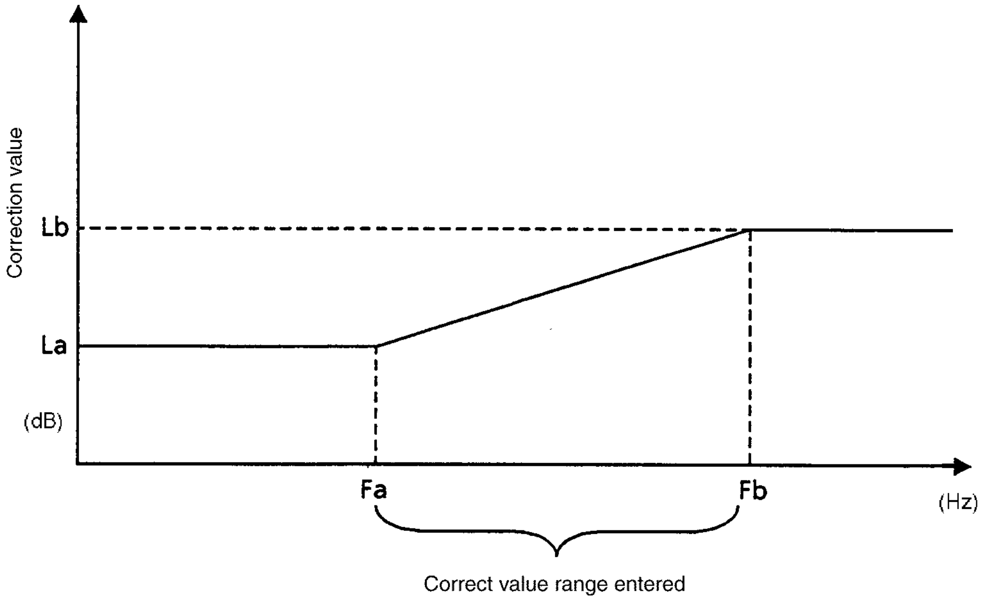
Selects one of the five correction tables.

Loads and saves the five correction table. (For further details, see P.2-16.)

Select the correction table to be used.

Press one of the Corr-1 to Corr-5 keys. The spectrum data is corrected and displayed by the corresponding correction value.

If the frequency range over which the correction values are entered is from Fa to Fb, displayed frequency ranges lower than Fa or higher than Fb have correction values applied as shown in the figure below. The correction value for frequencies lower than Fa is the same as that (La) for Fa and the correction value for frequencies higher than Fb is the same as that (Lb) for Fb.



Notes:
① No correction factor is entered at the factory. The correction values are all 0 dB.
② The correction value is backed-up by a battery. Therefore, once the value has been entered, it is not lost even after the power is turned off.
③ The Corr-1 to Corr-5 soft keys allow each menu label to have up to 20 characters. The labels can be entered from the remote control command only. For further details, refer to the Remote Control part of the separate Vol.3 operation manual.

SECTION 9

SYSTEM SETTING AND PRESET FUNCTION

This section describes the spectrum analyzer system setting method and the measurement parameters preset function.

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SECTION 9
SYSTEM SETTING AND PRESET FUNCTION

The following system parameters of the spectrum analyzer can be set depending on the usage objective.

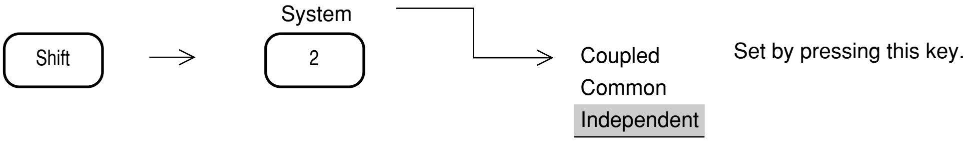
- Frequency domain and time domain coupled function value common/independent setting .... Coupled Common Independent
- Measurement parameters and date display type setting .... Display
- Screen display color (color pattern) setting .... Change Color
- Adjusting LCD brightness for comfortable viewing depending on vertical angle of observation .... LCD Brightness
- Setting Composite Out .... Composite Mode
- Setting Mode at Auto Sweep Time .... Auto SWT
- Setting Date/Time .... Set Date/Set Time
- Erasing warm up message .... Erase Warm up Message
- Power on state setting... Power On State
- Switching X-out, Z-out output specification in a zero span sweep........ Zero Span
- Setting skipping sweep... Freq Domain, Unlock count

These system settings are independent from, and are not affected by, the preset function.
However, they are included in the Save parameters described in SECTION 10, so the system settings may have changed when recalled.

Coupled Function Common/Independent Setting Mode

At factory shipment, the four coupled functions RBW, VBW, Sweep time (Time Span), and Atten are set to have the independent value for frequency domain and time domain.

When these coupling functions are desired to be used with the same sense of operation as zero span of a traditional spectrum analyzer, they can be set commonly by making the following system settings.



Common ••••••	The same values are set for both frequency domain and time domain.
Independent •••	Different values are set for frequency domain and time domain.

The Atten value cannot be set independently. When the coupled mode is set to Independent, "RB" and "VB" displayed at the top of the screen change to "RBt" and "VBt", respectively.

Note: The sweep time (time span) setting range and resolution in the frequency domain and the time domain differ as shown below. In some cases, the same values cannot be obtained even if the coupled mode is sent to Common.

Frequency domain

20 msec to 1000 sec
Resolution: High-order 2 digits

Time domain

12.5 µs, 25 µs, 50 µs, 100 µs to 1000 sec (with option 04)
Resolution: High-order 1 digit (100 µsec to 900 µsec)
High-order 2 digits (1 msec to 1000 sec)

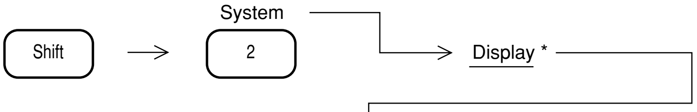
Example: After switching to the time domain mode to set the time span to 100 µsec when the sweep time is 300 msec in the frequency domain mode, the display mode returns to the frequency domain mode.

↓

Since the lower limit value of the sweep time that can be set in the frequency domain mode is 20 msec, the sweep time is set to the 20 msec nearest to 100 µsec. Then, when the display mode switches to the time domain mode, the time span is renewed to 20 msec.

Screen Display Type System Setting

This function selects the measurement parameters display type and date display type that are displayed on the screen.



Parameter Display Type-1: Select the screen display type from the three measurement parameters display types by pressing this key repeatedly.

Type-1 : Display marker value, title, RB, VB, and ST.
Type-2 : Make the marker value large and display RB, VB, and ST. Do not display title.
Type-3 : Make the marker value large and do not display RB, VB, and ST. Display title.

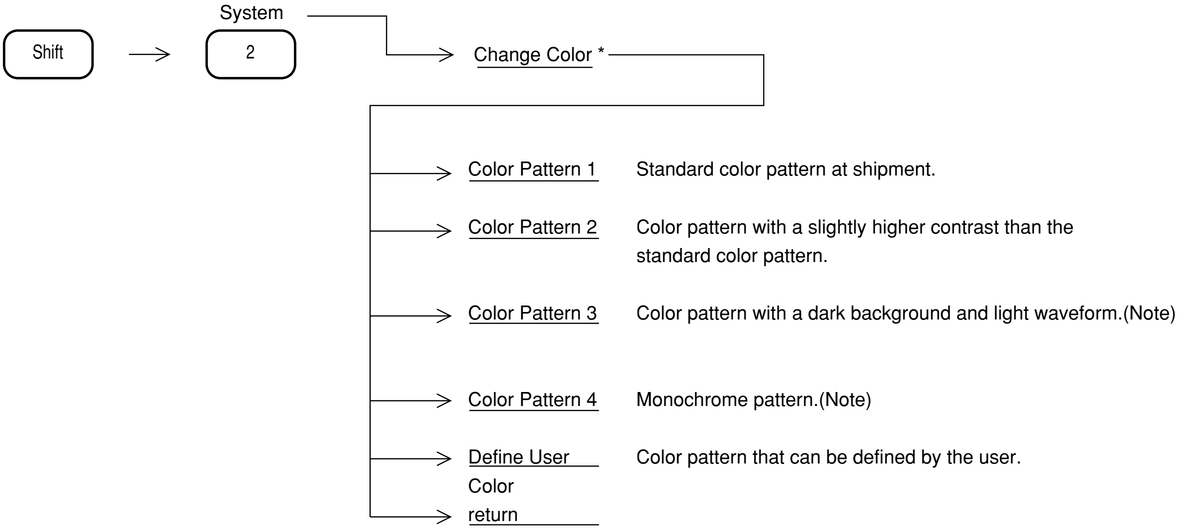
Clock Disp YY, MM, DD: Select the screen display type from among the three date display types by pressing this key repeatedly.

YYYY, MM, DD: Digitally display the date in year/month/day order.
DD, MMM, YYYY: Alphanumerically display the date in day/month/year order.
MMM, DD, YYYY: Alphanumerically display the date in month/day/year order.

return

Modifying Display Color (Change Color)

This function changes the color of the trace waveform, scale, measurement parameters, menu, and other items displayed on the screen. The color pattern can be selected from among four color patterns, or defined by the user.

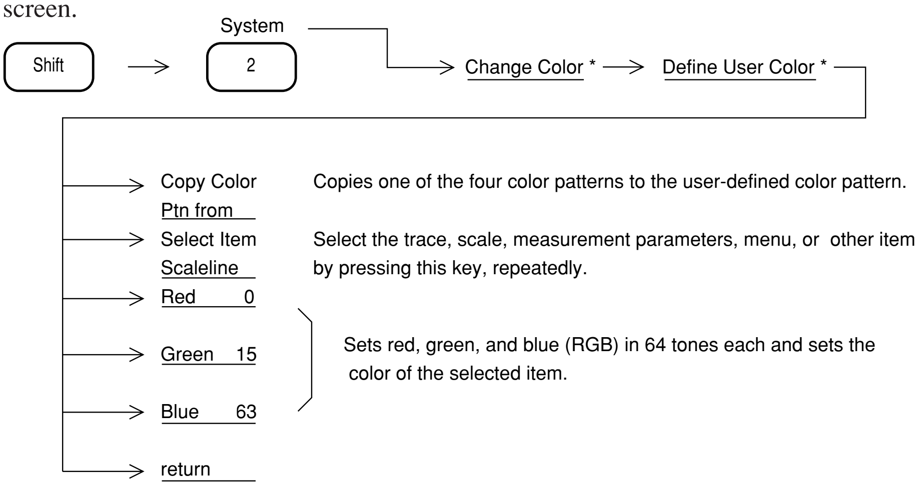


Color Pattern 1	Standard color pattern at shipment.
Color Pattern 2	Color pattern with a slightly higher contrast than the standard color pattern.
Color Pattern 3	Color pattern with a dark background and light waveform.(Note)
Color Pattern 4	Monochrome pattern.(Note)
Define User Color	Color pattern that can be defined by the user.
return	

Note: Mainly use color pattern 3 when using in the dark place.
Mainly use color pattern 4 when photographing the display screen.

User Definition of Display Color

The MS2650/MS2660B/C series spectrum analyzer has a color pattern function that allows the user to define the color of the trace waveform, scale, measurement parameters, menu, and other items displayed on the screen.



Copies one of the four color patterns to the user-defined color pattern.

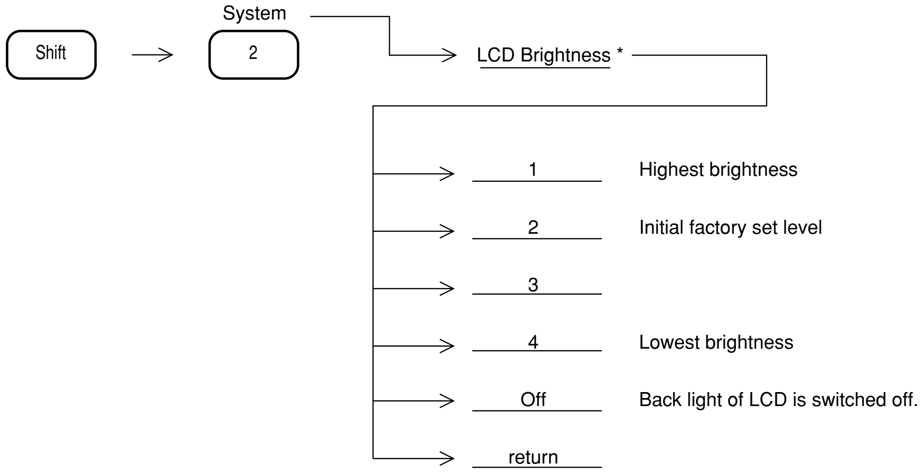
Select the trace, scale, measurement parameters, menu, or other item by pressing this key, repeatedly.

Sets red, green, and blue (RGB) in 64 tones each and sets the color of the selected item.

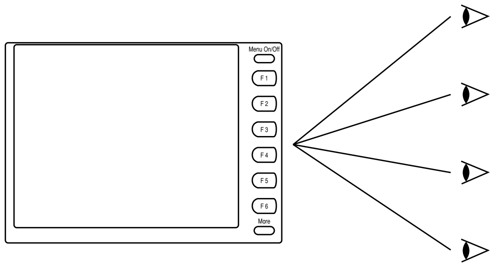
Note: *Marker, PTAScreen, Menufield, Menutext, EntryArea, Background, Scalefield, Scaleline, 2ndTrace, 1stTrace, Parameter, Displayline, Trigger, Zone, Temp/Mask, and MultiMarker can be selected.*

Adjusting LCD Brightness

LCD Brightness can be adjusted by the following key operations.



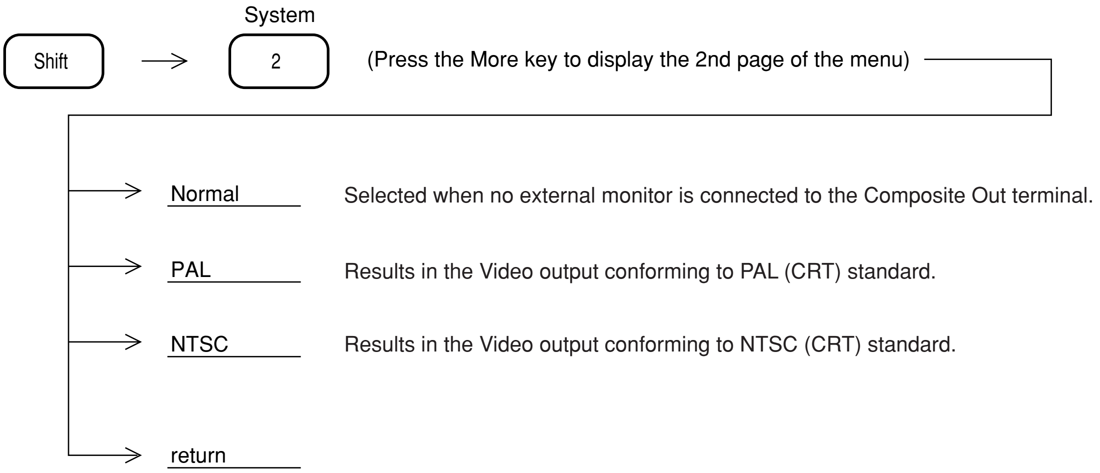
Note: *LCD type display have a particular range of angle for comfortable viewing depending on the level of brightness of the display.*
In this instrument level of brightness (see figure below) varies from 1 to 4 as the point of obsevation goes form above to below.



- When the display is in backlight off mode, the brightness can be brought back by either setting a display level 1 to 4 or by the PRESET key.
- LCD backlight off mode is useful when there is no need for human observation of the display. Also the speed of processing increased, if the backlight is switched off in remote controlled mode of operation.

Setting Composite Out

Switching of the Video signal from the Composite Out terminal at the rear panel is carried out by the following key operations.

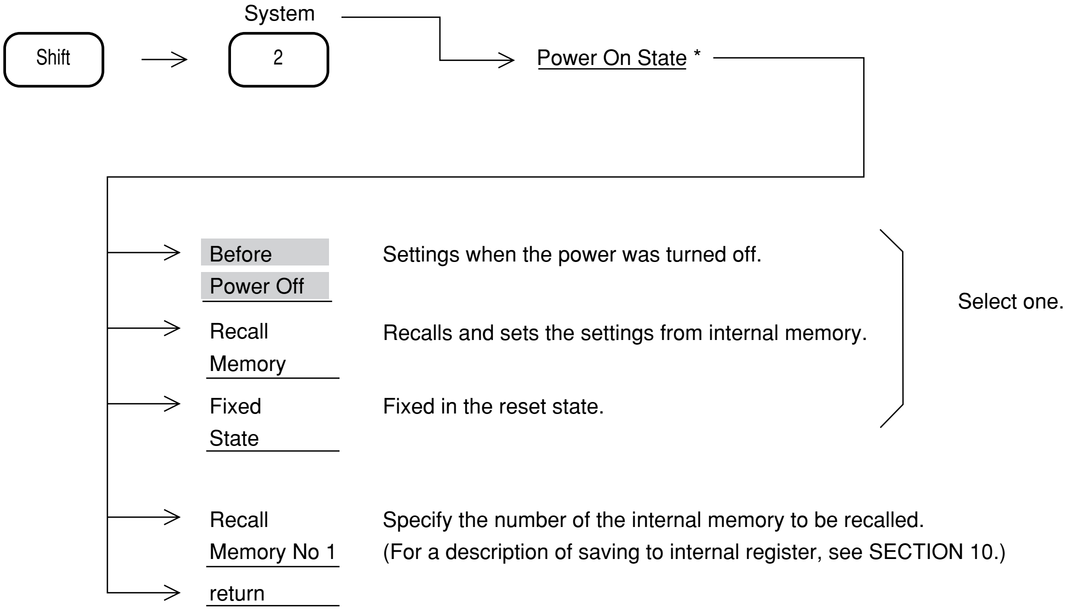


(Press the More key to display the 2nd page of the menu)

Normal	Selected when no external monitor is connected to the Composite Out terminal.
PAL	Results in the Video output conforming to PAL (CRT) standard.
NTSC	Results in the Video output conforming to NTSC (CRT) standard.
return	

Conditions Setting at Power-on

Set the state of the screen display when the power is turned on by performing the following key operations.

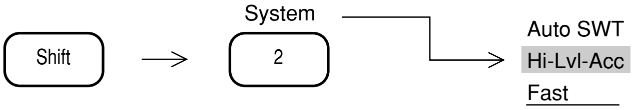


Before Power Off	Settings when the power was turned off.
Recall Memory	Recalls and sets the settings from internal memory.
Fixed State	Fixed in the reset state.
Recall Memory No 1	Specify the number of the internal memory to be recalled. (For a description of saving to internal register, see SECTION 10.)
return	

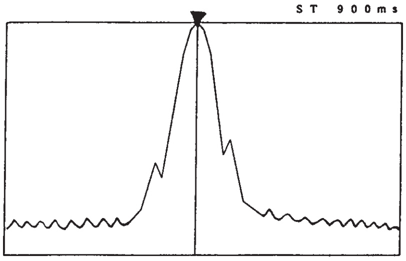
Select one.

Setting Mode at Auto Sweep Time

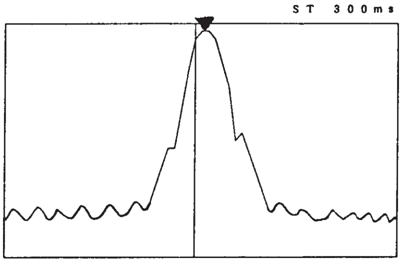
Set the sweep time mode when sweep time is Auto.
Normally, select the Hi-Lvl-Acc mode.
In Fast mode, the sweep time becomes fast, but level-measurement error may increase by approx. 1 dB.
Use this Fast mode in the relative-level measurement such as the adjacent channel leakage power.



Select sweep time mode by pressing this key when sweep time is AUTO.



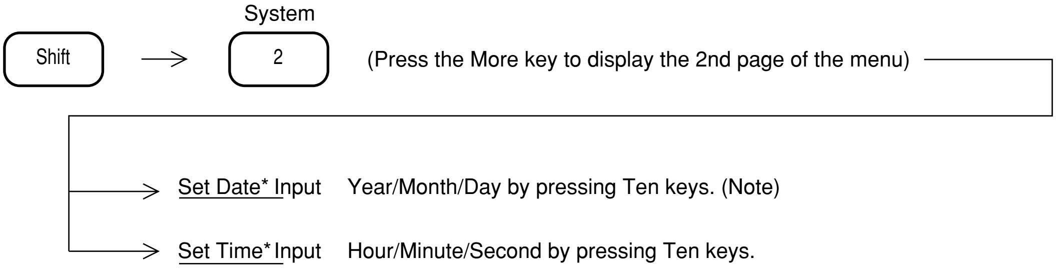
In Hi-Lvl-Acc Mode



In Fast Mode

Setting Date/Time

Set the date and time by performing the following key operations.



(Press the More key to display the 2nd page of the menu)

Set Date* Input Year/Month/Day by pressing Ten keys. (Note)

Set Time* Input Hour/Minute/Second by pressing Ten keys.

Note: For an example, when inputting 1st January 1996,

Input Year 1 9 9 6 Enter Hz

Month 1 Enter Hz

Day 1 Enter Hz .

Erasing Warm up Message

"Warm up" message is indicated on the top right of the display for about 3 minutes after turning on the power. This message is indicated because it is necessary to wait for frequency to stabilize when a frequency span is 200 kHz or less. This message can be erased.

System

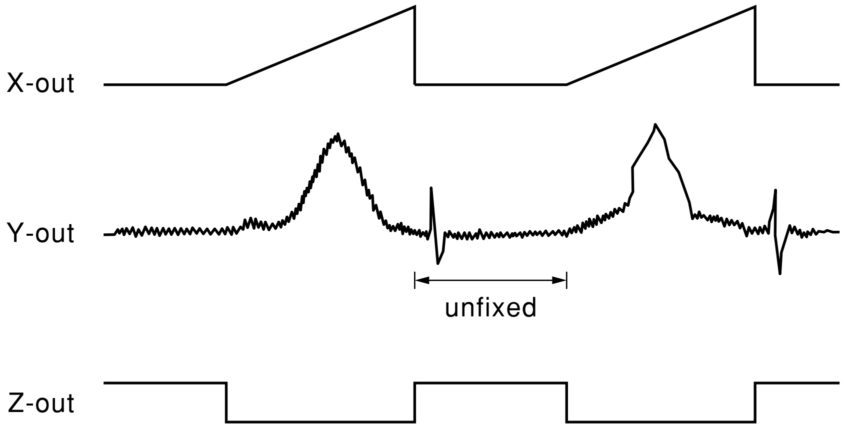
Shift → **2** → Erase Warm up Message

"shift system Erase Warm up Message" erases "Warm up" message.

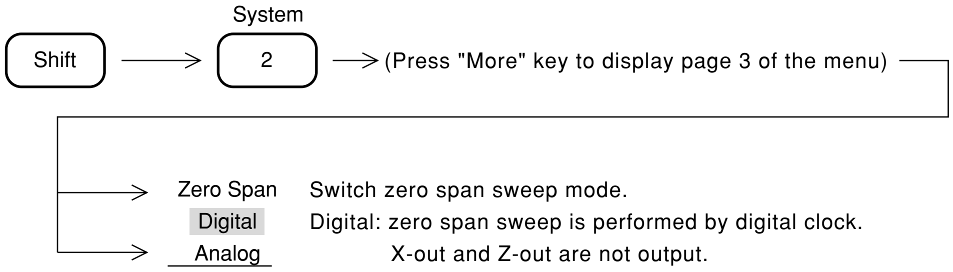
Switching "X-out, Z-out" output specification in a zero span sweep

Using Option 15, sweep signal output, image signals of spectrum analyzer (X, Y, Z:Y-out is the standard, and X-out/Z-out is an option) can be output and observed by an oscilloscope or the like.

When indicated waveforms are the traces A and B (frequency axes), each signal is output by the following timing.



Zero Span Sweep: When trace "Time" (time axis), normally Y-out only is output, and X-out and Z-out are not output. The mode in a zero span sweep is usually set at "Digital". When X-out and Z-out signals are necessary in a zero span sweep, set the zero-span mode at "Analog".



Switch zero span sweep mode.

Digital: zero span sweep is performed by digital clock.
X-out and Z-out are not output.

Analog: zero span sweep is performed by sweep rectangular signal in the same way as the frequency axes.X-out and Z-out are output synchronizing with the sweep.

Note: *When switching the zero span sweep mode to "Analog", a sweep duration is limited to 20 ms or more. Even if Option 04 high speed time domain sweep, is mounted, the duration cannot be set at less than 20 ms*

Setting Domain Sweep

Refer the section 6 "Selecting Sweep Method" "Skipping Sweep".

SECTION 10

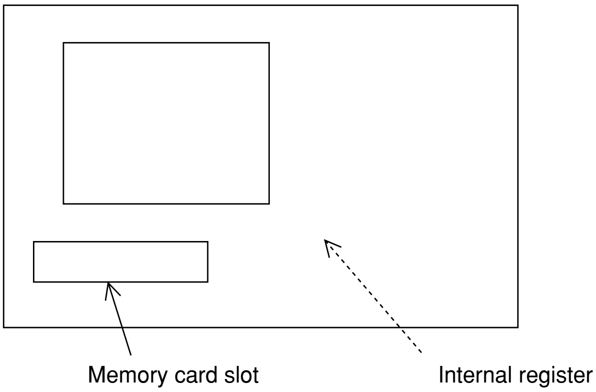
SAVE/RECALL FUNCTION

This section describes saving and recalling of the waveform and parameter data to and from internal register and memory card, respectively.
It also describes memory card file management.

TABLE OF CONTENTS

SECTION 10
SAVE/RECALL FUNCTION

The spectrum analyzer can save the setting conditions (Parameter) and waveform data (Trace) to internal register and memory card. These data can be recalled and used later.



Internal Register

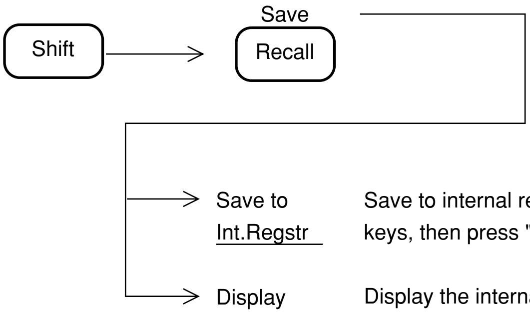
The internal register uses the RAM backed-up by a battery in the spectrum analyzer.
Up to 12 parameters and waveform data can be saved. Parameters and waveform data, or parameters only, can be recalled.

Memory Card

The memory card is an interface that corresponds to JEIDA Ver.4/4.1 type 2, and PCMCIA Rel.2.0, 2 slots.
Memory capacity can be selected from among 256kB, 512kB, 1024kB, and 2048kB.
Parameters and waveform data can be saved and parameter and waveform data, or parameters only, can be recalled.
(A 256kB memory can save more than 50 files.)
PTA programs created by external controller, etc. can also be uploaded and downloaded.

Saving Parameter and Waveform Data

To save the current parameters and waveform data and title to internal register or memory card, perform the following key operations.
When a title is necessary, enter it in advance. (See SECTION 12.)



Save to Int.Regstr	Save to internal register. Enter the register No. from the ten keys, then press "Enter" key.
Display Directory /Next	Display the internal register file No., date, and title directory. When the entire directory cannot be displayed on one screen, press this key again to display the next screen.

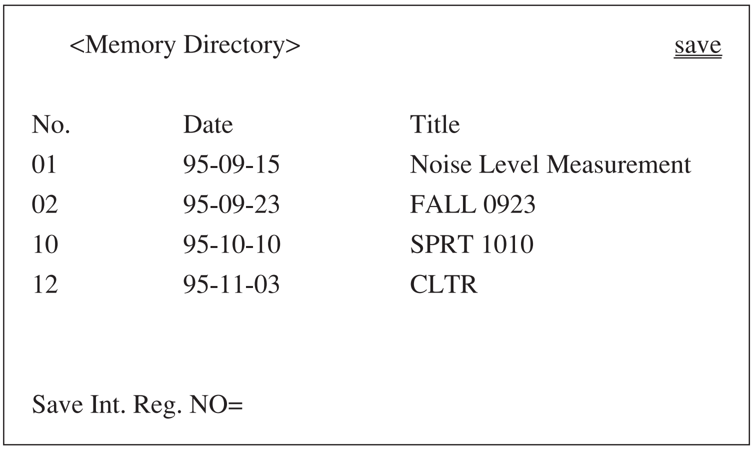
1

(Display page 2 of the menu by pressing the More key.)

Save to Mem Card	Save to memory card. Enter the file No. from the ten keys, then press "Enter" key.
Display Directory /Next	Display the memory card file No., date, and title directory. When the entire directory cannot be displayed on one screen, press this key again to display the next screen.
Dir Disp Detail Outline	Select memory card directory detail/outline display by pressing this key.
Select Save Media	Select save to memory card 1 or to memory card 2.

2

Note: Since the Save operation overwrites the data written using the same register/file number, check the directory before doing any saving.



<Memory Directory> save

No.	Date	Title
01	95-09-15	Noise Level Measurement
02	95-09-23	FALL 0923
10	95-10-10	SPRT 1010
12	95-11-03	CLTR

Save Int. Reg. NO=

Internal Register Directory Display Screen

Recalling Parameter and Waveform Data

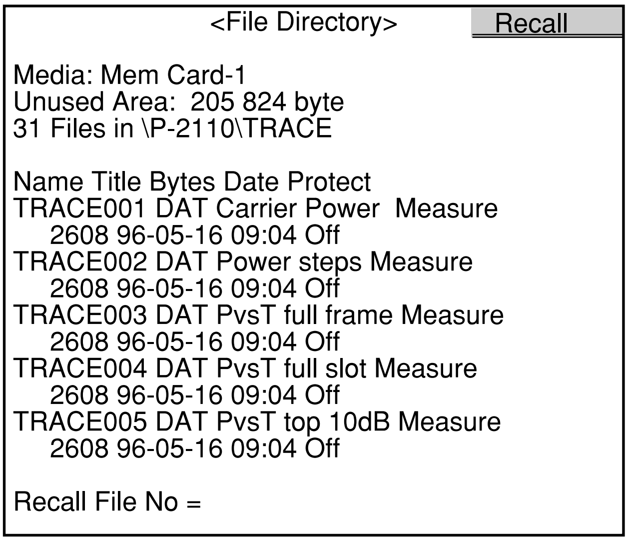
To recall the saved parameters and waveform data or parameters only from internal register or memory card, perform the following key operations.

Recall	
Reg-1 Reg-2 : Reg-12 1,2	Select and recall one from the 12 internal register.
Recall from Int.Regstr	Recall from internal register. Enter the register No. from the ten keys.
Display Directory /Next	Display the internal register No., date, and title directory. When the entire directory cannot be displayed on one screen, press this key again to display the next screen.
Recall Item 3	Select the item to be recalled.
Recall from Mem Card	Recall from memory card. Enter the file No. from the ten keys.
Display Directory /Next	Display the memory card file No., date, and title directory. When the entire directory cannot be displayed on one screen, press this key again to display the next screen.
Dir Disp Detail Outline	Select memory card directory detail display/outline display by pressing this key.
Recall Media	Select recalling to memory card 1 or to memory card 2.
Recall Item 4	Select the item to be recalled.

Notes: ① Waveform data should be saved in the View storage mode or in the state while stopped after a single sweep. Resweep immediately after recall clears from the screen display the data saves during continuous sweep.

② The Cumulative and Overwrite storage modes allow the last-swept waveform data to be saved.

③ Since the system settings described in SECTION 9 MEASUREMENT SYSTEM SETTING (Coupled Mode) are included in the parameters to be saved, they may have changed when recalled.



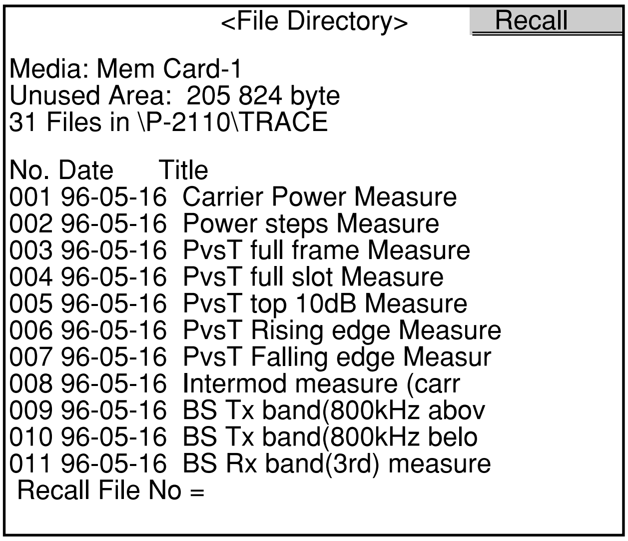
```
<File Directory>        Recall

Media: Mem Card-1
Unused Area:  205 824 byte
31 Files in \P-2110\TRACE

Name Title Bytes Date Protect
TRACE001 DAT Carrier Power  Measure
    2608 96-05-16 09:04 Off
TRACE002 DAT Power steps Measure
    2608 96-05-16 09:04 Off
TRACE003 DAT PvsT full frame Measure
    2608 96-05-16 09:04 Off
TRACE004 DAT PvsT full slot Measure
    2608 96-05-16 09:04 Off
TRACE005 DAT PvsT top 10dB Measure
    2608 96-05-16 09:04 Off

Recall File No =
```

(Detail)



```
<File Directory>        Recall

Media: Mem Card-1
Unused Area:  205 824 byte
31 Files in \P-2110\TRACE

No. Date      Title
001 96-05-16  Carrier Power Measure
002 96-05-16  Power steps Measure
003 96-05-16  PvsT full frame Measure
004 96-05-16  PvsT full slot Measure
005 96-05-16  PvsT top 10dB Measure
006 96-05-16  PvsT Rising edge Measure
007 96-05-16  PvsT Falling edge Measur
008 96-05-16  Intermod measure (carr
009 96-05-16  BS Tx band(800kHz abov
010 96-05-16  BS Tx band(800kHz belo
011 96-05-16  BS Rx band(3rd) measure
 Recall File No =
```

(Outline)

Memory Card Directory Display Screen

CAUTION ⚠

This notice relates to revision of software of ROM (0 to 3) from version (1.0 to 1.49) to version (1.50 & above).

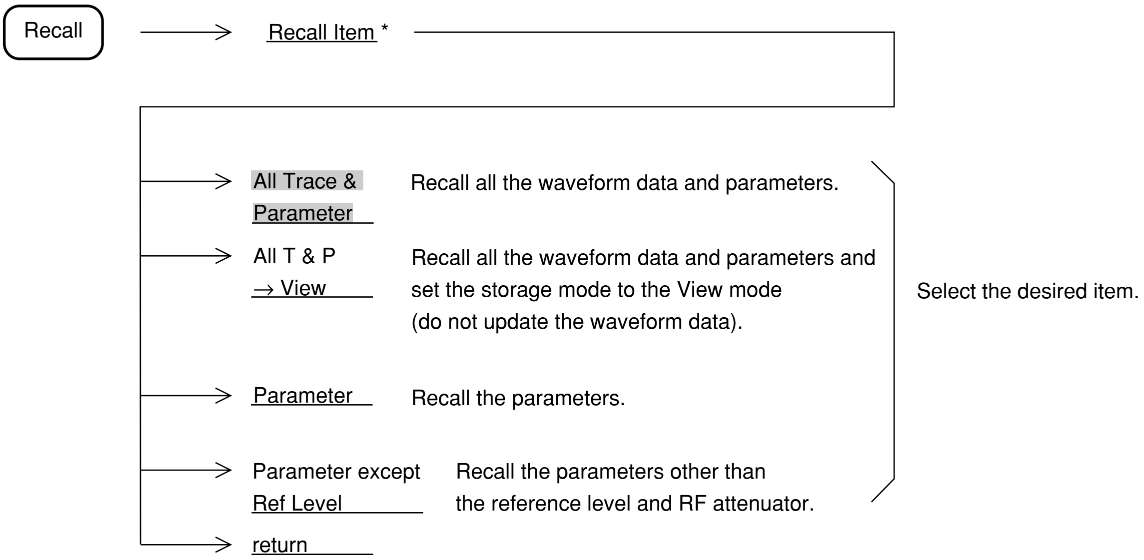
The data saved on a spectrum analyzer with a newer version can not be recalled on an analyzer with an older version.

However the data saved on an older version analyzer can be recalled on an analyzer with a newer version.

The version of the analyzer's ROM is displayed on the screen when the instrument is turned on.

Selecting Recall Item

Select the item to be recalled by performing the following key operations.

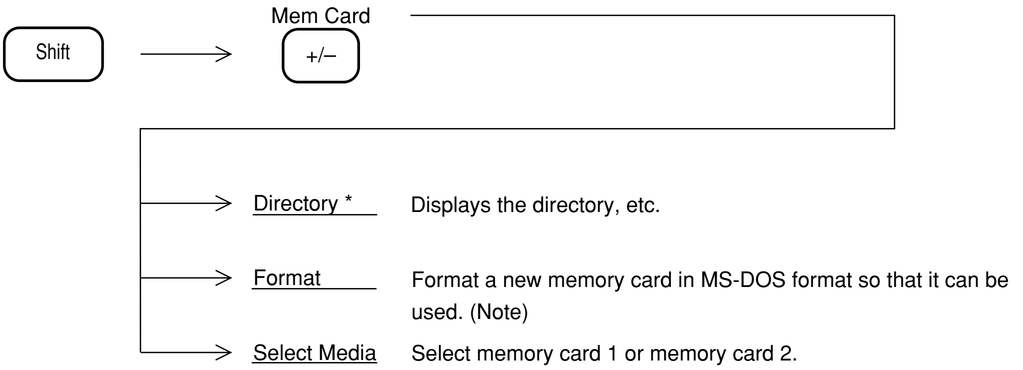


Recall → Recall Item *

All Trace & Parameter	Recall all the waveform data and parameters.	Select the desired item.
All T & P → View	Recall all the waveform data and parameters and set the storage mode to the View mode (do not update the waveform data).	
Parameter	Recall the parameters.	
Parameter except Ref Level	Recall the parameters other than the reference level and RF attenuator.	
return		

Memory Card File Management

This parameter describes the memory card format, file deletion, and write protect key operation.

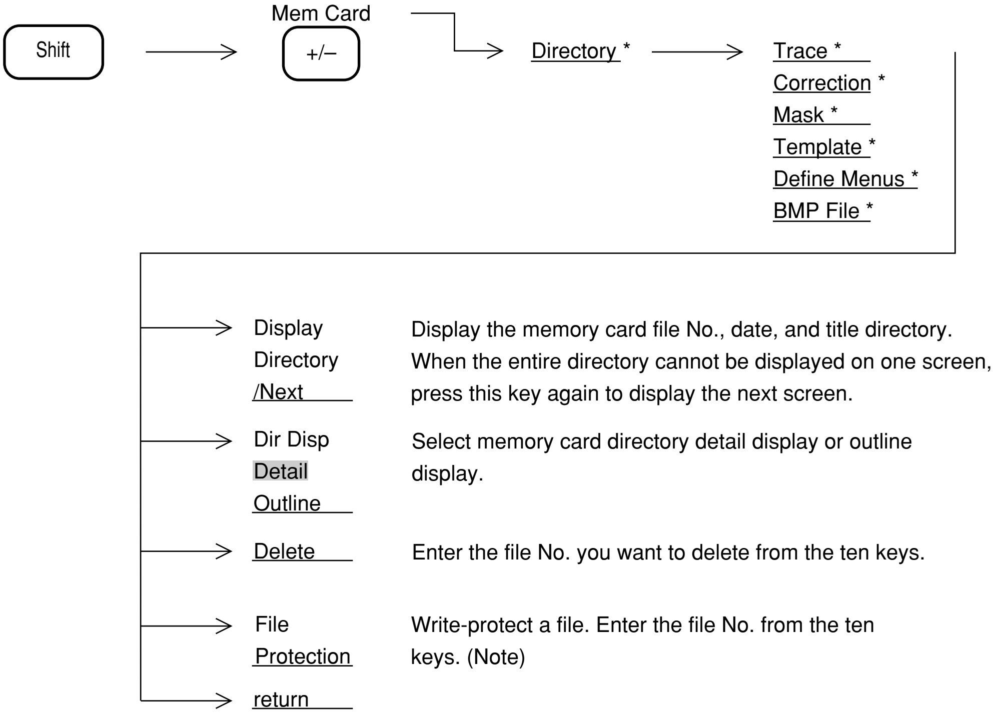


Directory *	Displays the directory, etc.
Format	Format a new memory card in MS-DOS format so that it can be used. (Note)
Select Media	Select memory card 1 or memory card 2.

Note: When a memory card is formatted, all the file contents are deleted even if they are write-protected as described below.
MS-DOS is a registered trade mark of the Microsoft Corporation.

File Deletion and Write Protect

To delete a file and set write protect, perform the following key operations.



Display Directory /Next	Display the memory card file No., date, and title directory. When the entire directory cannot be displayed on one screen, press this key again to display the next screen.
Dir Disp Detail Outline	Select memory card directory detail display or outline display.
Delete	Enter the file No. you want to delete from the ten keys.
File Protection	Write-protect a file. Enter the file No. from the ten keys. (Note)
return	

Note: The operation above releases write protection of the protected file.
Write-protected files are displayed with "protect" in the memory card directory displayed set to "on" and cannot be saved or deleted.
Note that the formatting deletes the protected file.

SECTION 11

COPY/SOUND MONITOR/TV IMAGE MONITOR

This section describes the COPY function for hard-copying the contents displayed on the screen, the SOUND function for monitoring an AM or FM modulated sound signal, and the TV-image monitor function for displaying a TV screen.

TABLE OF CONTENTS

SECTION 11
COPY/SOUND MONITOR/TV IMAGE MONITOR

Direct Plotting

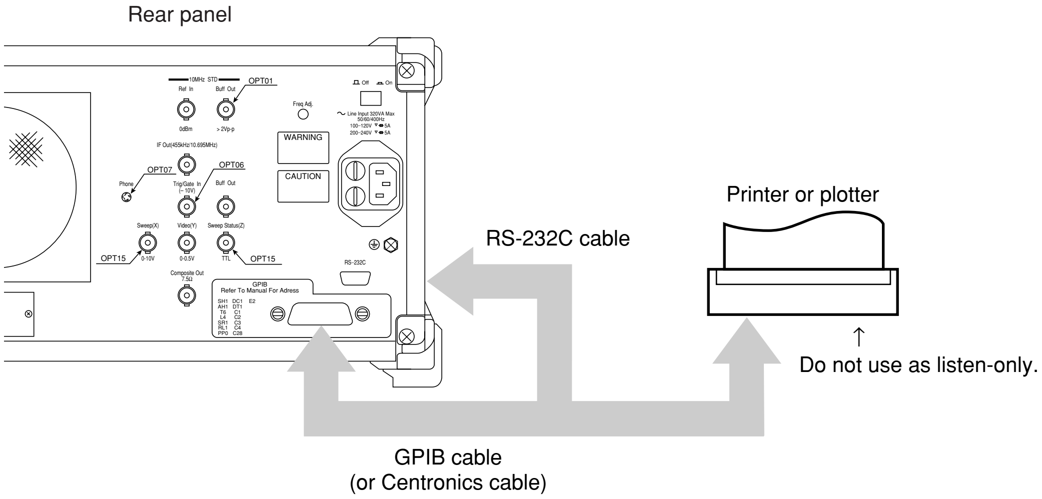
The spectrum analyzer can output a hard copy of the screen as follows:

① Using a printer via RS-232C interface.
② Using a printer via GPIB interface.
③ Using a printer via Centronics (Option) interface.
④ Output to a plotter in the specified format via RS-232C interface.
⑤ Output to a plotter in the specified format via GPIB interface.

However, the printer is limited to HP dot image and EPSON dot image types.
The plotter is limited to HPGL and GPGL types.

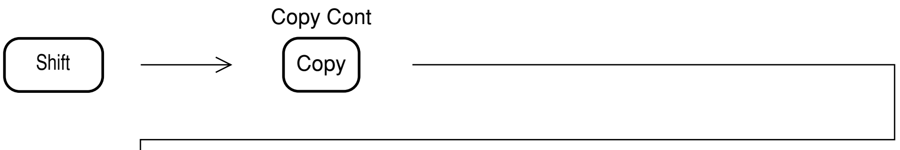
Connecting to Printer and Plotter

Connect the spectrum analyzer and printer/plotter as shown below.



Selecting a Printer/Plotter

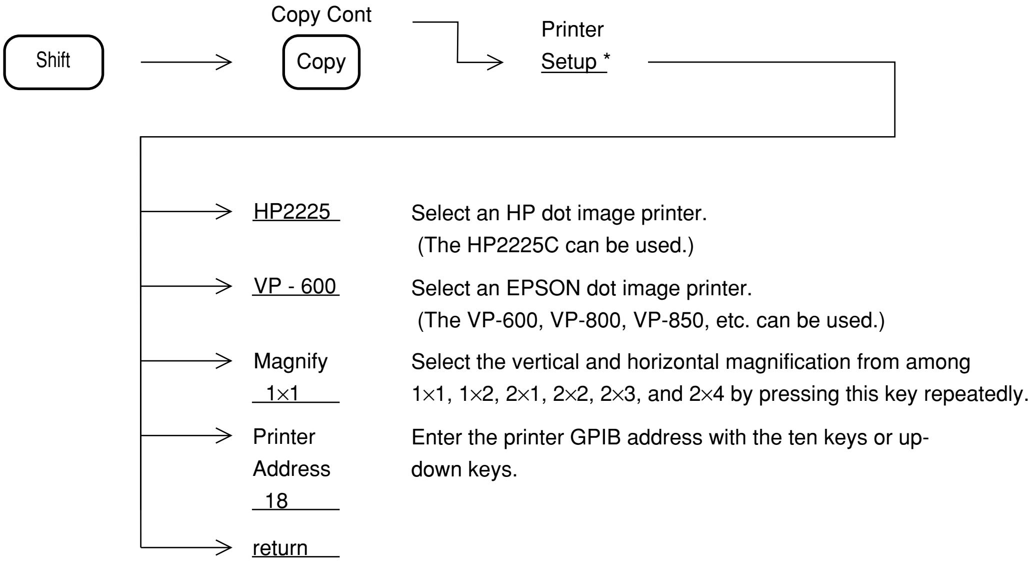
To select printer/plotter, set-up the printer/plotter, feed the paper, stop printing, etc., perform the following key operations.



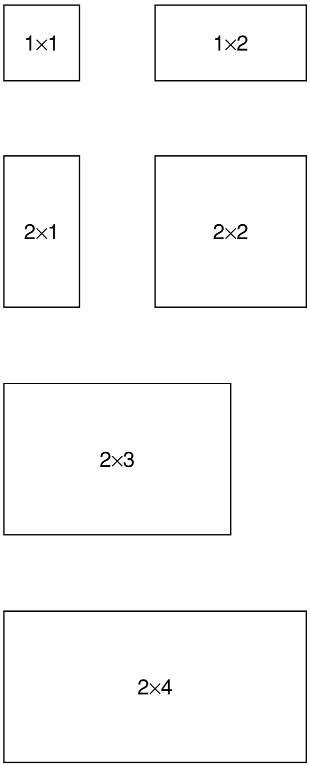
Printer	Select printer by pressing this key.
Plotter	Select plotter by pressing this key.
BMP file to Mem Card	Save the screen image data to memory card by pressing this key.
Paper Feed	Feed the printer paper.
Stop Print	Stop printing.
Plot Location Reset	Reset the plotter pen position to the initial value.
Printer Setup *	Set the printer type, printing size, and GPIB address.
Plotter Setup *	Set the Plotter type, chart size, chart position, item and GPIB address.
BMP file Save Media *	Select slot of the memory card to which screen image data is saved.

Selecting a Printer

To select the printer to use and to set its GPIB address, perform the following key operations.



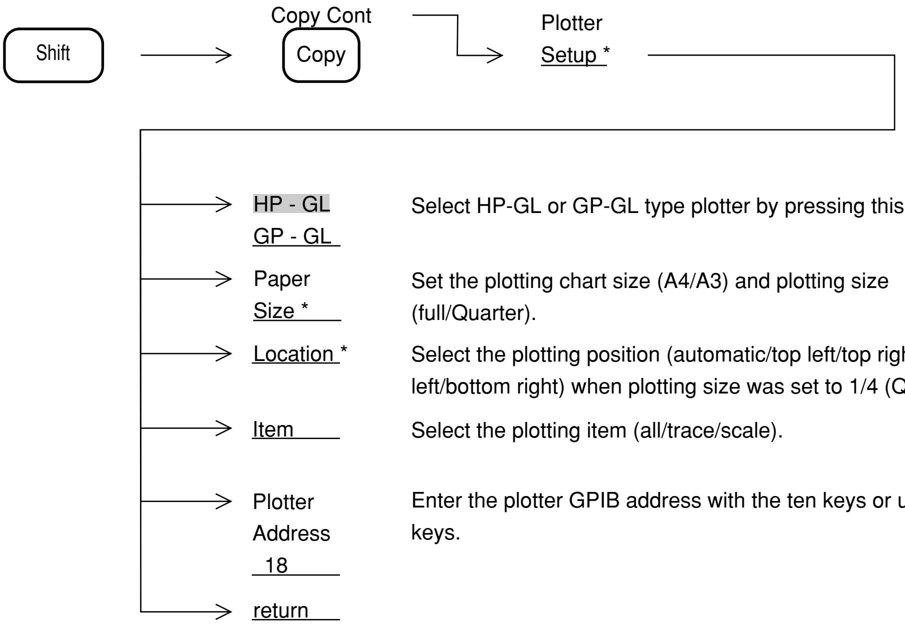
HP2225	Select an HP dot image printer. (The HP2225C can be used.)
VP - 600	Select an EPSON dot image printer. (The VP-600, VP-800, VP-850, etc. can be used.)
Magnify 1×1	Select the vertical and horizontal magnification from among 1×1, 1×2, 2×1, 2×2, 2×3, and 2×4 by pressing this key repeatedly.
Printer Address 18	Enter the printer GPIB address with the ten keys or up-down keys.
return	



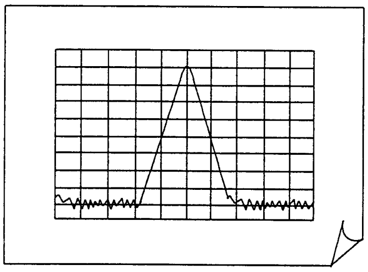
Print Magnification Selection

Setting the Plotter

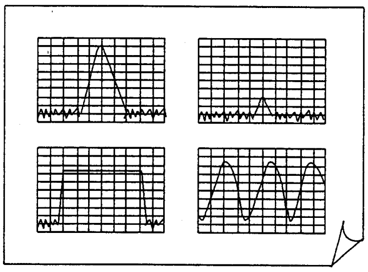
To select the plotter to use and to set its GPIB address, perform the following key operations.



HP - GL GP - GL	Select HP-GL or GP-GL type plotter by pressing this key.
Paper Size *	Set the plotting chart size (A4/A3) and plotting size (full/Quarter).
Location *	Select the plotting position (automatic/top left/top right/bottom left/bottom right) when plotting size was set to 1/4 (Quarter).
Item	Select the plotting item (all/trace/scale).
Plotter Address 18	Enter the plotter GPIB address with the ten keys or up-down keys.
return	



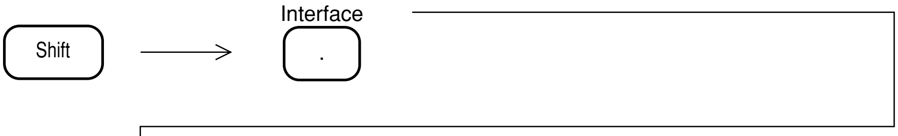
When Full Size is Specified for Plotting



When Quarter Size is Specified for Plotting

Setting Interface

To set the RS-232C baud rate and interface with external devices, perform the following key operations.



RS232C Setup *	Set the RS-232C baud rate (1200/2400/4800/9600), parity (Off/Even/Odd), data bit (7bit/8bit), and stop bit (1bit/2bit).
GPIB My Address 1	Enter the GPIB address of the spectrum analyzer from the ten keys.
Connect to Controller None	Select the external controller interface from among None, GPIB, and RS-232C by pressing this key repeatedly.
Connect to Prt/Plt RS232C	Select the printer/plotter interface from among None, GPIB, RS-232C, and Centronics by pressing this key repeatedly. (Note)
Connect to Peripheral None	Select the interface of peripherals other than printer/plotter from among None, GPIB, and RS-232C by pressing this key repeatedly.

Note: When GPIB is selected as the external controller, for Prt/Plt, select from None and RS-232C.

Executing Hard Copy

Start hard copy by pressing the $\overset{\text{Copy Cont}}{\boxed{\text{Copy}}}$ key. When the screen-image data saving is selected, saves the data to the memory card.

Note: Set the printer or plotter to the ON LINE mode.

Notes:
- Some printer and plotter models take a considerable time to output a hard copy. This may cause a time-out error in the spectrum analyzer and the hard copy operation may be interrupted.
  In this case, modify the time-out setting value via GPIB using an external controller.
  N_{88}-BASIC .... `PRINT Δ@1;"GTOUT Δ60"`
  PTL .... `PUT Δ"GTOUT Δ60"`

  Integer represented in units of second (s)

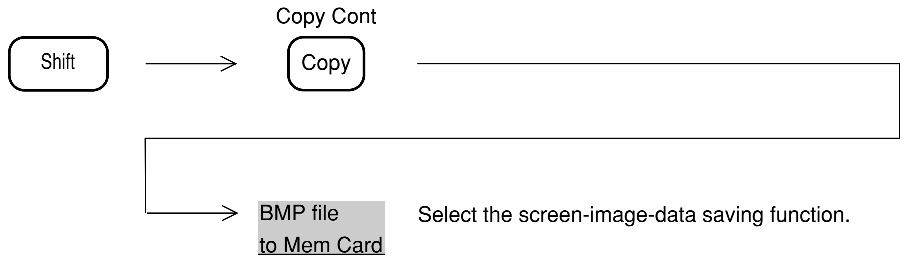
- Immediately after setting the copy execution, the sweep stops for a few seconds because of editing process of the data. After restarting the sweep, and beginning the printing at printer/plotter; the parameters etc. can be set. After completion of the current copying, perform the next copying.

Saving Screen Image Data to Memory Card

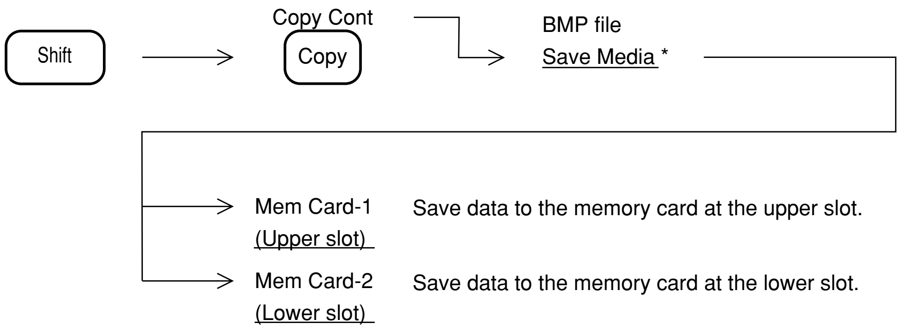
The screen display contents can be saved to a memory card as a BMP-format (standard image data format of the Windows) file. After saving, the file in the memory card can be opened on the Windows of PC.

Selecting Memory Card

To select the screen-image-data saving function and the memory-card slot at the front panel, perform the following key operations.



Select the screen-image-data saving function.



Save data to the memory card at the upper slot.

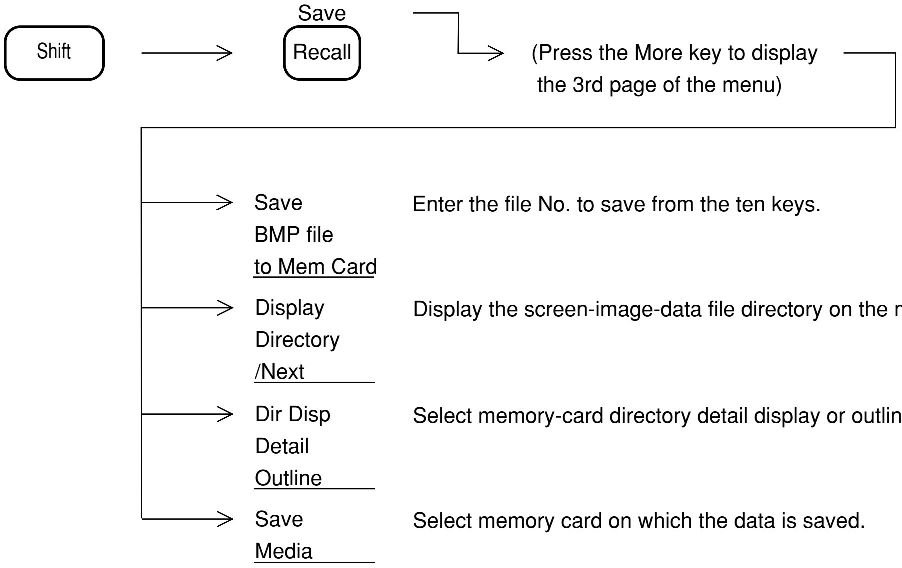
Save data to the memory card at the lower slot.

Executing Save

Saves the screen-image data to a memory card by pressing the Copy Cont Copy key.
File name to be saved is automatically numbered.
When the menu is displayed in this saving mode, it is also saved as it is.
Use the memory card which is formatted by the spectrum analyzer.

Executing Save by Specifying File Number

To save the screen-image data to a memory card by specifying a file number to be saved, perform the following key operations..



Save BMP file to Mem Card	Enter the file No. to save from the ten keys.
Display Directory /Next	Display the screen-image-data file directory on the memory card.
Dir Disp Detail Outline	Select memory-card directory detail display or outline display.
Save Media	Select memory card on which the data is saved.

After deleting the menu and data input in this saving mode, only the screen-image-data is saved.
Use the memory card which is formatted by the spectrum analyzer.

Displaying the Screen Image Data on PC

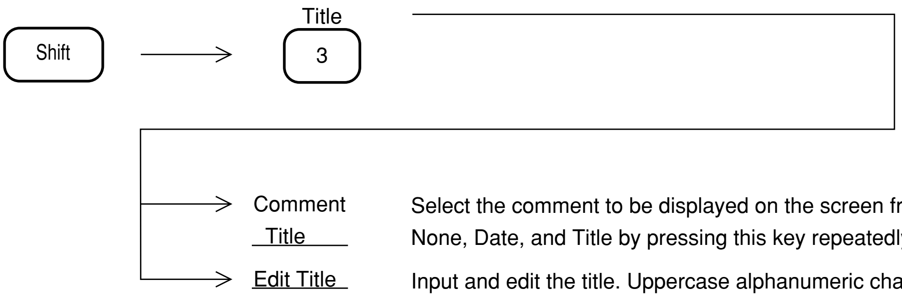
The saved screen image data can be displayed on a personal computer (PC) with a tool on PC (ex. the paint brush of Windows).
The saved files on a memory card are in the directory as shown below.

¥P-2110¥COPY¥COPY001.BMP

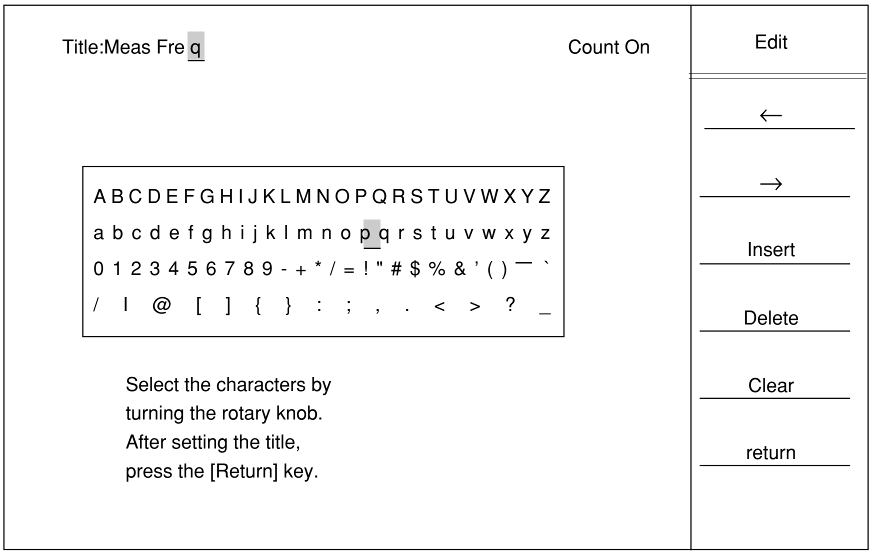
File No.

Displaying a Title

A character string of up to 19 letters can be displayed in the title display field at the top of the screen. To display a title character string, perform the following key operations.



Comment Title	Select the comment to be displayed on the screen from among None, Date, and Title by pressing this key repeatedly.
Edit Title	Input and edit the title. Uppercase alphanumeric characters, lower-case alphanumeric characters, numeric characters, and symbols can be used. Enter the characters with the rotary knob or up-down keys.



Title:Meas Freq

Count On

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
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
0 1 2 3 4 5 6 7 8 9 - + * / = ! " # $ % & ' ( ) ‾ `
/ | @ [ ] { } : ; , . < > ? _

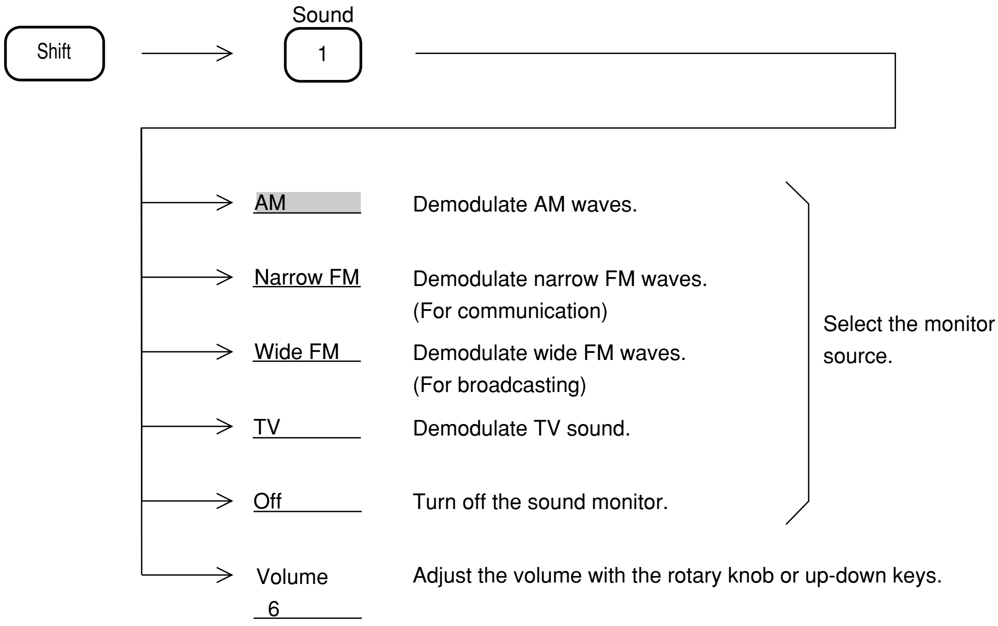
Select the characters by
turning the rotary knob.
After setting the title,
press the [Return] key.

Edit	
←	Move Title cursor to the left.
→	Move Title cursor to the right.
Insert	Insert one character.
Delete	Delete one character.
Clear	Clear Title.
return	

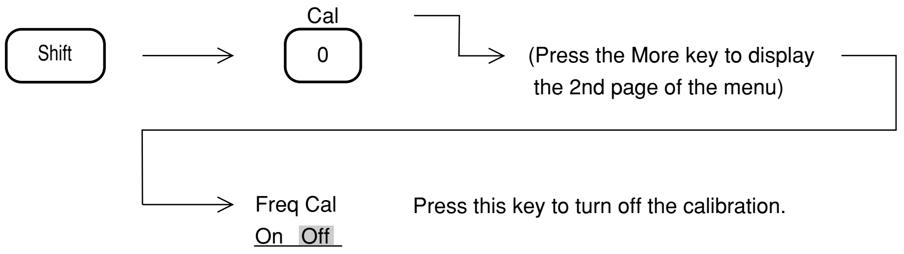
Title Edit Screen

SOUND Monitor

The spectrum analyzer has a SOUND monitor function which demodulates an AM or FM modulated signal so that the sound can be listened to using the built-in speaker.
To listen to the sound, first set the center frequency to the receiving frequency, then set the display mode to the time domain mode. Second, perform the following key operations, depending on the modulation system.



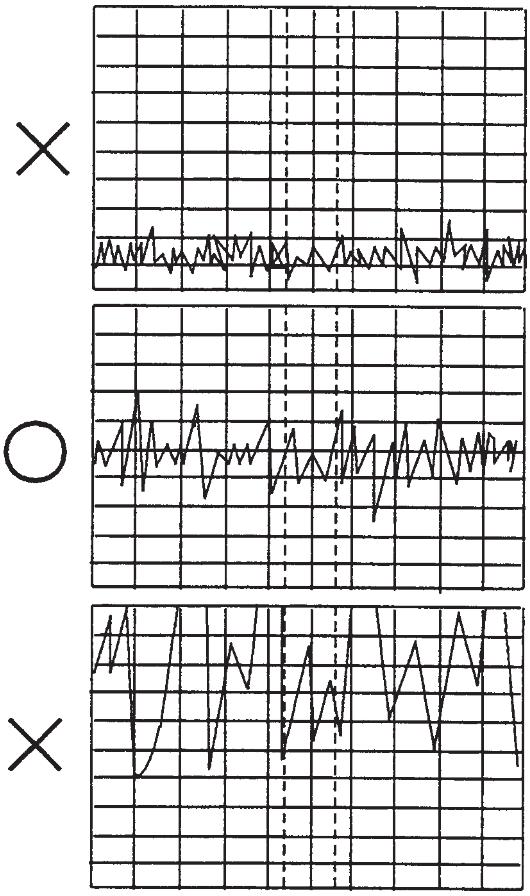
Note: In spite of setting the center frequency to the desired receive frequency, the sound may not be able to be monitored, correctly, because of the RBW center-frequency error calibration.
In this case, turn off the RBW center-frequency error calibration, as shown below.



When Freq Cal turned Off, the displayed waveform moves by the error amount.
When the Sound Monitor is not used, turn On the Freq Cal.

AM Wave Sound Monitor

Since the spectrum analyzer is not equipped with the AGC circuit that is used in general AM receivers, the reference level must first be set to the optimum value depending on the receiving level.
In the time domain display (linear scale) mode, set the reference level so that the waveform shown below is displayed.

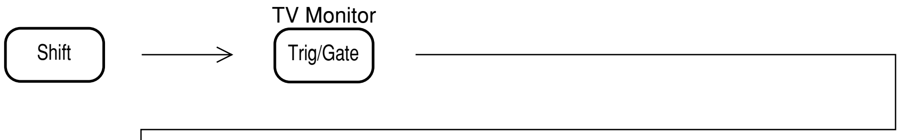


FM Wave Sound Monitor

An FM wave is different from an AM wave in that the sound output level is not changed by the input level. When compared to the reference level, a too low input level results in deterioration of the S/N ratio. Therefore, the input level should be set so that it is preferably equal to the reference level.

TV Image Monitor

The received TV picture by TV antenna dec. can be monitored on the screen by performing the following key operations.



(MENU1/2) Change into TV Moniter	Switch wavefrom display to/from TV monitor mode (Active while TV being shown)
Current Channel 6	Setting the TV channel by numeric entry or step key (Active while TV being shown)
Adjust Level	Optimize the input level to TV demodulator by input ATT. Be increased/decreased 10 dB steps by setp key. (Active while TV being shown)
Pre Ampl On Off	Turn ON/OFF the preamplifier built in to the Analyzer. Disable this function, option08 is not be installed. (Active while TV being shown)
TV Monitor Sound Volume 8	Adjust the volume of the sound monitor by step key. Disable this function, option07 is not be installed. (Active while TV being shown)
Channel * assign Japan TV	Access standard channel maps
(MENU2/2) TV NTSC PAL	Select the TV system (NTSC ro PAL)
Sound system 4.5MHz	
Standard * System M-NTSC	Select the standard TV system.
Offset Frequency 1.8MHz	Modify the local oscilator frequency to enable noise free reception. Preset value are 1.8 MHz-NTSC,2.62MHz-PAL. This value gets preset if FI (NTSC/PAL) is changed.
Setup * user channel	Load/save from/to memory card a user defined channel map for assignment instead of the standard channel maps available.

Note of key operation of the TV image monitor

1) An asterisk (*) sign at the right extreme of the menu item title indicates existence of a sub-menu under the item. It may or may not be accessible depending on the selection of other menu items.
2) Function keys other than the ones indicates as "(Active while TV being shown) are inactive after the display is switched to TV Monitor mode.
3) While display is in TV monitor mode Frequency key followed numeric entry can set channel directly and when followed by step key allows single channel increment/decrement.
4) While display is in TV monitor mode Amplitude key followed by step key allows signal level to be raised or lowered by taking input, attenuator and preamplifier though a pre-programmed sequence. (Preamplifier ON and 0 dB ATT, Preamplifier ON and 10 dB ATT, Preamplifier ON and 20 dB ATT, Preamplifier OFF and 0 dB ATT, Preamplifier OFF and 10 dB ATT, Preamplifier OFF and 20 dB ATT, Preamplifier OFF and 30 dB ATT etc. with attenuator changing in 10 dB steps.)

■ Channel map and countries covered by them

MS2650/MS2660 Channel assign	TV System	Countries
CCIR TV CCIR CATV	B/G/H PAL	Austria, Belgium, Denmark, Finland, Germany, Netherlands, Norway, Portugal, Spain, Sweden, Switherland, X-yugo, Afganistan, Algeria, Bahrain, Bangaladesh, Brunei, Cyprus, Ethiopia, India, Israel, Kuwait, Malta, Malaysia, Moldives, Oman, Pakisthan, Sierra-Leone, Singapore, Srilanka, Sudan, Tanzania, Thailand, Ugande, UAE, Yemen, Zimbabwe
US TV US CATV	M-NTSC	USA, Canada, Bahamas, Barbados, Bermuda, Bolivia, Mymmar, Cambodia, Chile, Colombia, Costa_Rica, Cuba, El_salvador, Equador, Greenland, Guam, Guatemala, Haiti, Hawai, Honduras, S_Korea, Mexico, Micronesia, Midway_island, Netherlands_antilles, Panama, Phillippines, Puerto_Rico, Saint_Lucia, Samoa, Venezula, Vergin_islands
UK TV	IPAL	UK, Hong_Kong
ITALY TV	B/G/H PAL	Italy, Albania, San_Marino
CHINA TV	DPAL	China
JAPAN TV JAPAN CATV	M-NTSC	Japan

Transmission standard of TV can be selected by the "Standard System" button of the software menu.

■ "USER" Channel

Following is a sample internal program for generating a table of channel numbers and their corresponding picture frequency to enable the user adapt the system to show only the channels in actual use at his place by defining them in to User defined TV/User defined CATV. It can be also be used to set channel assignment others than the standard charts provided. Please note that it is possible to SAVE/LOAD this table to memory card.

```
l0  DIM FREQ$(20)
20  DIM CMD$(50)
30  *START
40  INPUT"SELECT l:USER-TV OR 2:USER-CATV",SYS
50  IF SYS=1 GOTO *USERTV
60  IF SYS=2 GOTO *USERCATV
70  GOTO *START
80  *USERTV
90  PRINT"INPUT CH.NO,PICTURE FREQ(MHZ)(0,0,IS STOP)"
100 INPUT CH$,FREQ$
110 IF CH$="0" GOTO *EXIT
120 IF VAL(CH$)<1 GOTO *ERRDISP
130 IF VAL(CH$)>99 GOTO *ERRDISP
140 IF VAL(FREQ$)<40.0000 GOTO *ERRDISP
150 IF VAL(FREQ$)>900.0000 GOTO *ERRDISP
160 CMD$="USRTVDEF"+CH$+","+FREQ$+"MHZ"
170 PUT CMD$
180 GOTO *USERTV
190 *USERCATV
200 PRINT "INPUT" CH,NO,PICTURE FREQ(MHZ)(0,0 IS STOP)"
210 INPUT CH$,FREQ$
220 IF CH$="0" GOTO EXIT
230 IF VAL(CH$)<1 GOTO *ERRDISP
240 IF VAL(CH$)>99 GOTO *ERRDISP
250 IF VAL(FREQ$)<40.0000 GOTO *ERRDISP
260 IF VAL(FREQ$)>900.0000 GOTO *ERRDISP
270 CMD$="USRCATVDEF"+CH$+","+FREQ$+"MHZ"
280 PUT CMD$
290 GOTO *USERCATV
300 *ERRDISP
310 PRINT "Data out of range"
320 IF SYS=1 GOTO *USERTV
330 IF SYS=2 GOTO *USERCATV
340 *EXIT
350 STOP
```

■ Adjusting Brightness of display for comfortable viewing

It should be noted that degree brightness for comfortable viewing buries with the vertical angle of viewing for LCD type displays.

Refer section 9 for details.

SECTION 12

PTA/DEFINE FUNCTIONS

This section describes the PTA function which uses the spectrum analyzer as the controller and the define function which allows definition of PTA automatic measurement program execution, etc. by user key.

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SECTION 12
PTA/DEFINE FUNCTIONS

PTA Program Editing and Loading

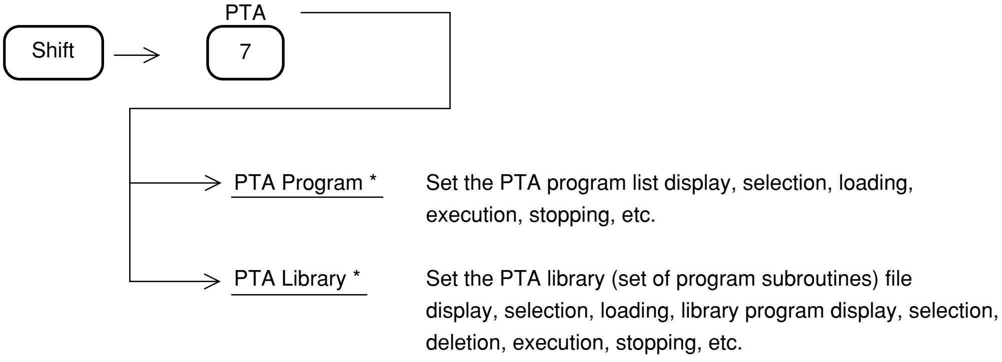
Input and edit the PTA program by external computer editor by PTL language (BASIC-like interpreter). For further details, refer to the operating instructions of the PTA Control part.

Load the edited program to the spectrum analyzer program memory (192 kilobytes) via the RS-232C/GPIB interface or a memory card.

The measurement data can be directly accessed as variables by system variable, system subroutine, and system function.

Setting PTA Program

To set a PTA program and library, perform the following key operation.

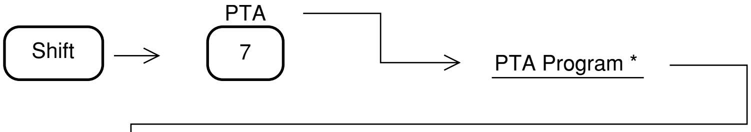


PTA Program * Set the PTA program list display, selection, loading, execution, stopping, etc.

PTA Library * Set the PTA library (set of program subroutines) file display, selection, loading, library program display, selection, deletion, execution, stopping, etc.

Loading and Executing PTA Program

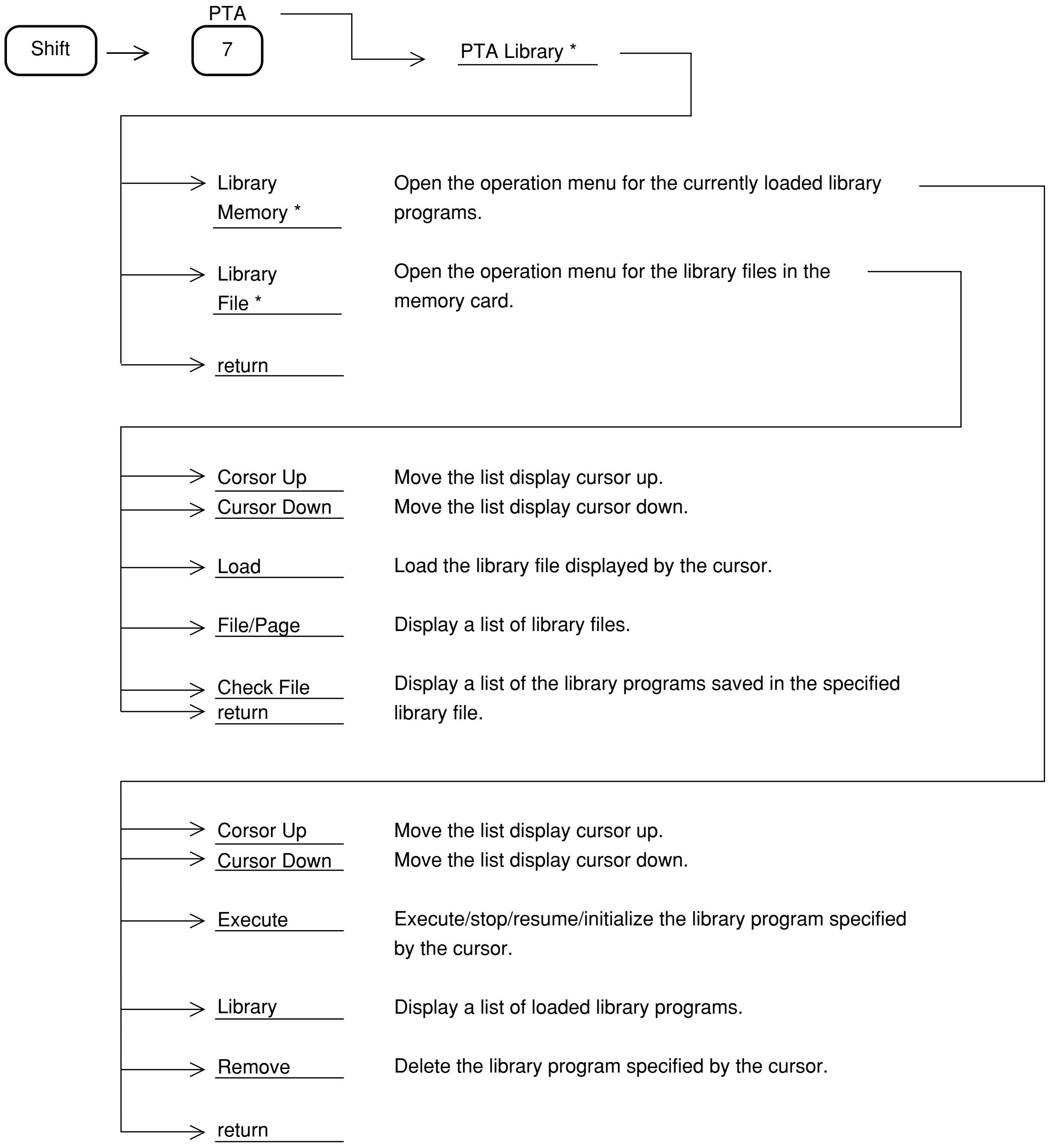
To load and execute a PTA program, perform the following key operations.



Run	Execute PTA program.
Stop	Stop PTA program execution.
Cont	Restart stopped execution.
Reset	Stop PTA program execution and initialize user-defined variables, etc.
Off	Turn off PTA.
1	
Prog List	Display PTA program files list.
Cursor Up	Move list display cursor up.
Cursor Down	Move list display cursor down.
Load	Load PTA program specified by cursor.
Run	Execute PTA program.
2	
F1	Switch 0/1 state of system variable EX1 used by PTA.
F2	Switch 0/1 state of system variable EX2 used by PTA.
F3	Switch 0/1 state of system variable EX3 used by PTA.
F4	Switch 0/1 state of system variable EX4 used by PTA.
F5	Switch 0/1 state of system variable EX5 used by PTA.
3	
Yes	Return character string "YES" for PTA program INPUT statement.
No	Return character string "NO" for PTA program INPUT statement.
4	

Loading and Executing Library Program

To load and execute a library program, perform the following key operations.



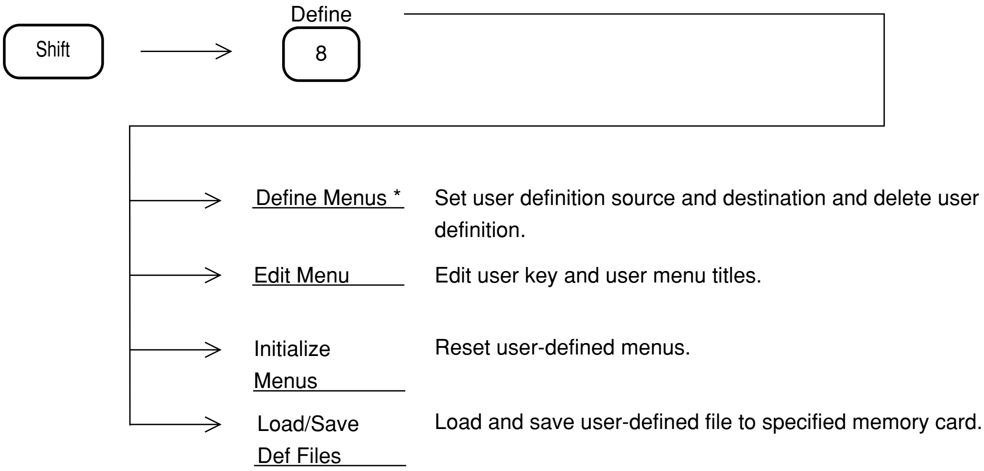
Library Memory *	Open the operation menu for the currently loaded library programs.
Library File *	Open the operation menu for the library files in the memory card.
return	

Corsor Up	Move the list display cursor up.
Cursor Down	Move the list display cursor down.
Load	Load the library file displayed by the cursor.
File/Page	Display a list of library files.
Check File	Display a list of the library programs saved in the specified library file.
return	

Corsor Up	Move the list display cursor up.
Cursor Down	Move the list display cursor down.
Execute	Execute/stop/resume/initialize the library program specified by the cursor.
Library	Display a list of loaded library programs.
Remove	Delete the library program specified by the cursor.
return	

User-Definition Function

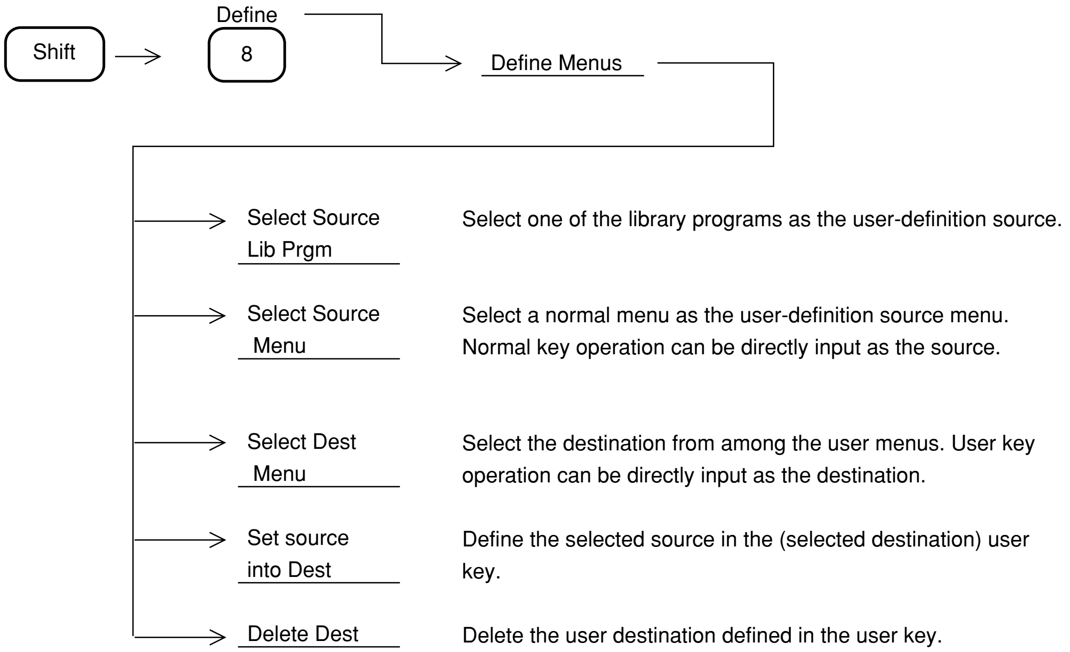
This paragraph describes the define function that allows definition of library program execution or normal key operation, etc. by user key.



Define Menus *	Set user definition source and destination and delete user definition.
Edit Menu	Edit user key and user menu titles.
Initialize Menus	Reset user-defined menus.
Load/Save Def Files	Load and save user-defined file to specified memory card.

Defining User Menu

To select the library programs or normal key operations, etc. that are frequently used and to define their function in the user keys, perform the following key operations.



Select Source Lib Prgm	Select one of the library programs as the user-definition source.
Select Source Menu	Select a normal menu as the user-definition source menu. Normal key operation can be directly input as the source.
Select Dest Menu	Select the destination from among the user menus. User key operation can be directly input as the destination.
Set source into Dest	Define the selected source in the (selected destination) user key.
Delete Dest	Delete the user destination defined in the user key.

Example of User-Definition Operation

To define the frequency count measurement function in the User1 F1 key, perform the following key operations.

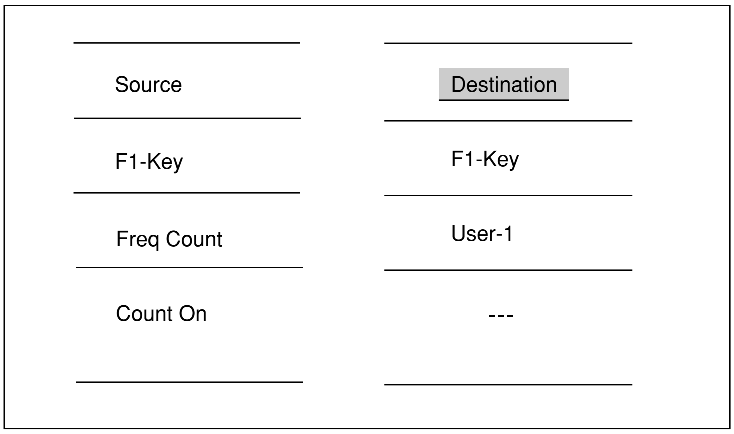
The following also explains an example of key operation which makes the title of that key "Meas Freq".

① Select the source by " Shift Define Define Menus Select Source Menu" key operation.

② Set frequency count measurement start at the source by " Measure Frequency Count Count On" key operation.

③ Select the destination by " Shift Define Define Menus Select Dest Menu" key operation.

④ Set the User1 F1 key as the destination by " User F1 " key operation.



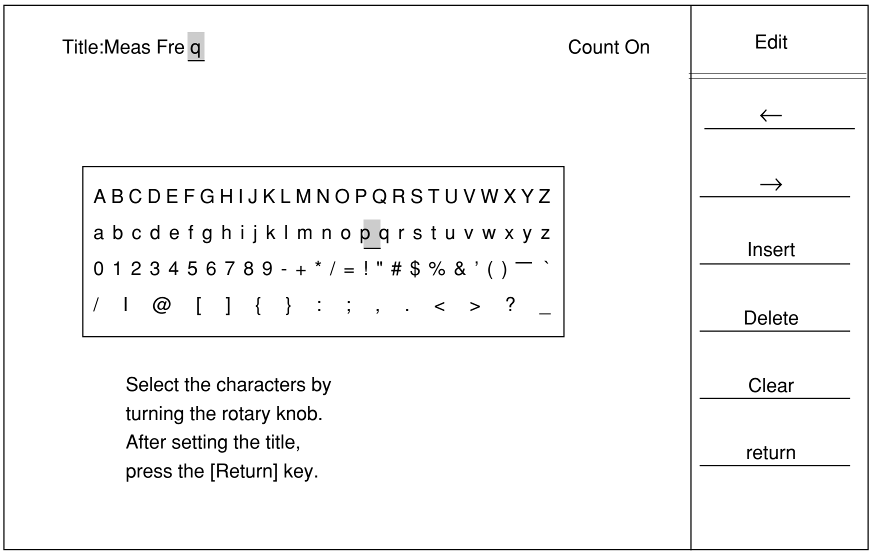
Source	Destination
F1-Key	F1-Key
Freq Count	User-1
Count On	---

User Definition Screen Display

⑤ Execute user key definition by " Shift Define Define Menus Set source into Dest" key operation.

⑥ Perform " Shift Define Edit Menu Select Source" key operation and select the User1 F1 key by " User F1 " key operation.

⑦ Perform Shift Define Edit Menus Edit F-key menu key operation and enter "Meas Freq" at the title edit screen shown below by rotary knob and soft key operation.



Title:Meas Freq Count On

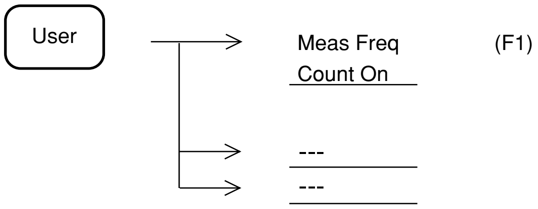
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z
0 1 2 3 4 5 6 7 8 9 - + * / = ! " # $ % & ' ( ) ‾ `
/ | @ [ ] { } : ; , . < > ? _

Select the characters by
turning the rotary knob.
After setting the title,
press the [Return] key.

Edit	
←	Move Title cursor to the left.
→	Move Title cursor to the right.
Insert	Insert one character.
Delete	Delete one character.
Clear	Clear Title.
return	

Title Edit Screen

⑧ Press the User key and check if the following is displayed at the F1 function key. Also press the User1 F1 key and check if frequency measurement is performed.



SECTION 13

MEASUREMENT

This section describes the Measure key and the operating procedure for actual measurement examples.

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SECTION 13
MEASUREMENT

Measure Measurement Function

Various application measurements can be selected by performing the following key operations.

Measure

Frequency Count *	Measure the marker frequency at high resolution. Select the resolution from among 1 kHz, 100 Hz, 10 Hz, and 1 Hz.
Noise Measure *	Measure the absolute value of the total noise power of the zone marker range.
C/N Ratio Measure *	Measure the carrier signal and noise power ratio.
Channel Power Measure *	Total power with in the zone indicated by zone marker is measured. It is possible to enter an arbitrary calibration value.
Occ BW Measure *	Measure the occupied bandwidth. Select the XdBDOWN mode or N% of POWER mode.
AdJ ch pwr Measure *	Measure the adjacent channel leakage power. Select the channel separation, channel bandwidth, measurement mode, ACP graph display On/Off, channel center line On/Off, channel BW line On/Off, and measurement low band/high band/both bands channel, etc.
Mask *	Set the frequency domain standard line and judge quality relative to the standard. Select the mask table, mask movement, measurement mode, mask table creation, mask table load/save, etc.
Time Template *	Set the time domain standard line and judge quality relative to the standard. Select the template table, template movement, measurement mode, table creation, table load/save, etc.
Burst AvgPower *	Measure the average power of a burst signal in the time domain. Select
Off	

Frequency Measurement Function

To measure the marker frequency at high resolution, perform the following key operations.

Measure	→ Frequency Count *	→ Count On	Start frequency measurement.
		→ Count Off	End frequency measurement.
		→ Set Up *	Select the measurement resolution from among 1 kHz, 100 Hz, 10 Hz, and 1 Hz.
		→ return	

Note:

- If the RBW is too small compared to frequency span, it takes more times to count because of the internal automatic tuning operation.
  Conversely, if the RBW is too large and another signal exists near the measurement signal (within the 20 multiple of the RBW), the automatic operation may catch it. So, select the appropriate RBW value.
- In the following cases, the frequency may not be counted correctly because of the undesired adjacent noise.
  ① Signal level is less than -30 dB from reference level.
  ② Level difference between signal and noise is less than 20 dB.

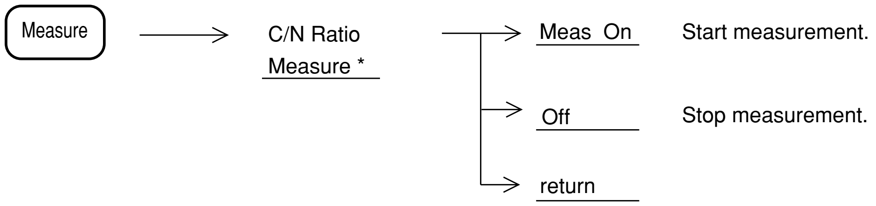
Measuring Noise Power

To measure the total noise power of the zone marker range, perform the following key operations.

Measure	→ Noise Measure *	→ Meas On	Start measurement.
		→ Off	End measurement.
		→ return	

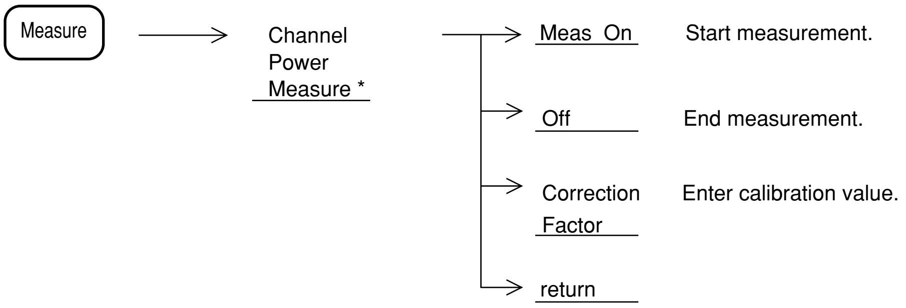
Measuring C/N Ratio

To measure the C/N ratio, perform the following key operations.



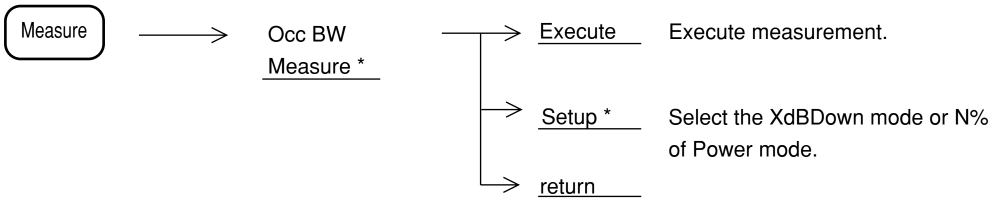
Channel Power

Total power with in the channel specified by zone marker is measured.
It is possible to set an arbitrary calibration value.



Measuring Occupied Bandwidth

To measure the occupied bandwidth, perform the following key operations.



Measuring Adjacent Channel Leakage Power

To measure the adjacent channel leakage power, perform the following key operations.

Measure → Adj ch pwr Measure *

→ Execute	Execute measurement.
→ Ch Sepa-1 12.5 kHz	Set channel separation to 12.5 kHz.
→ Ch Sepa-2 25.0 kHz	Set channel separation to 25.0 kHz.
→ Ch BW 8.5 kHz	Set the channel bandwidth.
→ Set Up *	Select the measurement mode, ACP graph display On/Off, and channel centerline/BW line display On/Off.
→ return	

Pass/Fail Judgment by Mask

To perform pass/fail judgment relative to the frequency domain standard line (mask), perform the following key operations.

Measure → Mask *

→ Check Pass/Fall	Execute pass/fail judgment relative to the standard line.
→ Selest Mask Table	Select one of the five mask tables.
→ Move Mask	Enter the frequency (Hz) and level (dB) and move the current mask.
→ Sert up Mask Table	Create a mask table and load and save it from memory card.
→ return	

Pass/Fail Judgment by Time Template

To perform pass/fail judgment by time domain template, perform the following key operations.

Measure	Time Template *	Check Pass/Fall	Execute pass/fail judgment by time template.
		Select Temp Table	Select one of the five template tables.
		Move Template	Enter the time (msec) and level (dB) and move the current template.
		Set up Temp Tbl	Create a template table and load and save it from memory card.
		return	

Measuring Burst Average Power

To measure the average power of a burst wave in the time domain mode, perform the following key operations.

Measure	Burst Avg Power *	Execute	Execute measurement.
		Start Point 100	Set the measurement start point of the burst signal on the screen with the ten keys or the rotary knob.
		Stop Point 200	Set the measurement end point of the burst signal on the screen with the ten keys or the rotary knob.
		return	

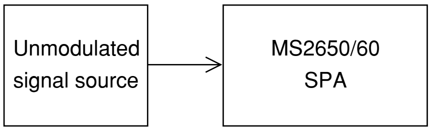
Measurement Examples

The following describes the measurement block diagram and measurement operating procedure of actual measurement examples.
In the measurement examples, [ ] indicates a panel key and F*: << >> indicates a soft key.

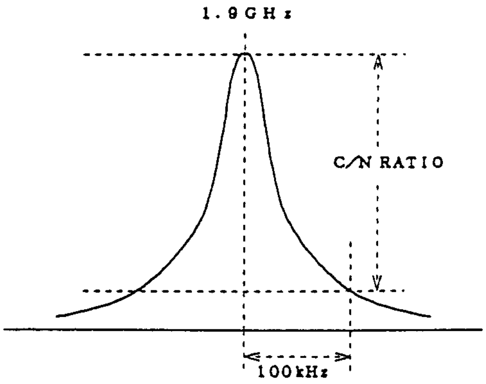
Example of C/N Ratio Measurement

- In C/N measurement, set the detection mode set to the Sample mode, unless specified otherwise. (Pressing [A,B] until F1: <<Trace A>> is displayed, then set the mode by pressing F1: <<Trace A>>, F6: <<Detection>>, and F3: <<Sample>>.)

(1) Measurement block diagram



- Center frequency : 1.9 GHz
- Offset frequency : 100 kHz



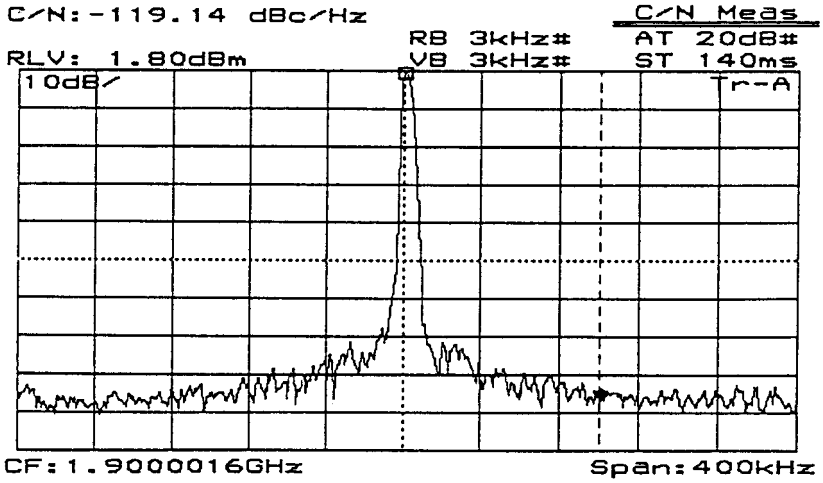
(2) Measurement procedure

Step	Procedure
1	[Preset], F1: <<Preset All>>
2	Span frequency setting : [Span], [4]m [0], [0], [kHz] Set to 3 or 4 times the offset frequency. (Here, the span frequency was set to 400 kHz.)
3	Reference level setting : [Amplitude], [2], [0], [dBm]
4	Center frequency setting: [Frequency], [1], [.], [9], [GHz]
5	RBW setting : [RBW], [3], [kHz]
6	Marker setting : [Marker], F5: <<Zone Width>>, F1: <<Spot>>
7	Peak (frequency, level) setting: After 1 sweep, press [→CF] and [→RLV].
8	Marker position setting : [Marker], F2: <<Delta Marker>>, [1], [0], [0], [kHz] (Becomes the offset frequency.)
9	C/N ratio measurement: : Press [Measure] until F3: <<C/N Ratio Measure>> is displayed, then press F3: <<C/N Ratio Measure>> and F1: <<Meas On>>. Each time sweep is refreshed, the measurement result is displayed at the upper left-hand corner of the screen.

★ Measurement result example: –119.14 dBc/Hz

★ When wanting to change the offset frequency and make measurement: Press [Marker], then set the offset frequency with the rotary knob or ten keys.

★ Change the RBW value and select the best C/N measurement value. Also make the ATT value minimum.



C/N: -119.14 dBc/Hz

C/N Meas

RB 3kHz#

AT 20dB#

RLV: 1.80dBm

VB 3kHz#

ST 140ms

CF: 1.9000016GHz

Span: 400kHz

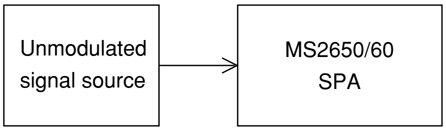
Example of C/N Ratio Measurement

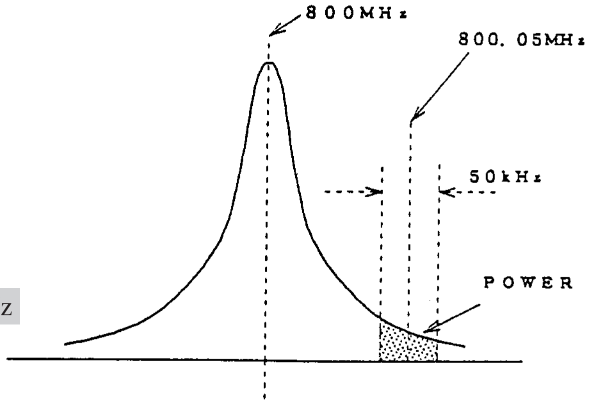
Note:
- When the marker frequency is moved at the reference marker point (peak point of the carrier signal), the measurement result does not become 0 dB.
  This is because the carrier signal (on which the reference marker is positioned) is considered as a noise, and the detector adds the correction value to the carrier.

Example of Power (Noise) Measurement (Frequency Domain, Continuous Wave)

- When making power measurements, set the detection mode to the Sample mode, unless specified otherwise. When measuring the carrier-off leakage power and adjacent channel leakage power of Japan digital cordless telephone systems (burst wave), set the detection mode to the Pos Peak mode.

(1) Measurement block diagram





- Center frequency : 800 MHz
- Span frequency width : 400 kHz
- Measurement center frequency : 800.05 MHz
- Measurement frequency bandwidth : 50 kHz

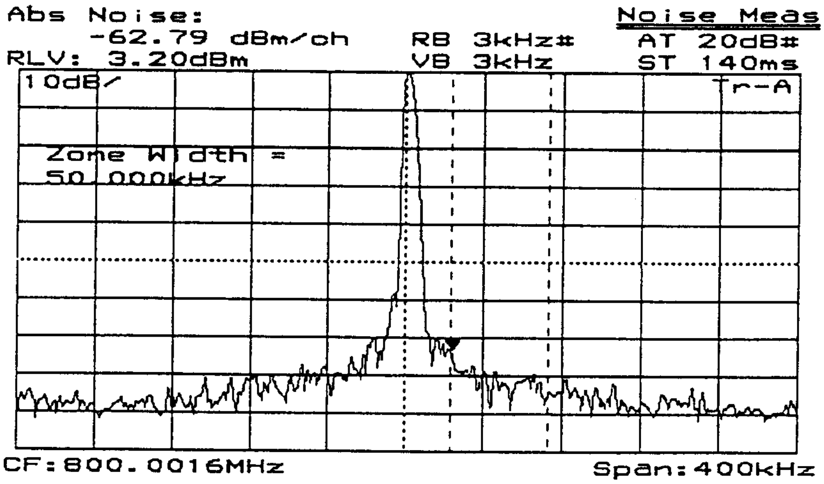
(2) Measurement procedure

Step	Procedure
1	[Preset], F1: <<Preset All>>
2	Span frequency setting : [Span], [4], [0], [0], [kHz]
3	Reference level setting : [Amplitude], [2], [0], [dBm]
4	Center frequency setting : [Frequency], [8], [0], [0], [MHz]
5	RBW setting : [RBW], [3], [kHz]
6	Peak (frequency, level) setting: After 1 sweep, press [→CF] and [→RLV].
7	Zone center position setting : [Marker], F5: <<Zone Width>>, F1: <<Spot>>, [Marker], F1: <<Normal Marker>>, [8], [0], [0], [.], [0], [5], [MHz]
8	Zone marker width setting : [Marker], F5: <<Zone Width>>, [5], [0], [kHz]
9	Measure power (noise) : Press [Measure] until F2<< Noise Measurement>> is displayed, then press F2: <<Noise Measure>> and F1; <<Meas On>>. Each time sweep is refreshed, the total power value of the zone marker range (measured value) is displayed at the upper left-hand corner of the screen.

★ Measurement result example: –70.81 dBm/ch

★ When wanting to change the zone marker position and make measurements: After pressing [Marker], set the position (frequency) with the ten keys.

★ Applications: *<u>Carrier-off leakage power (PHS)</u> measurement
*<u>Adjacent channel leakage power (PHS)</u> measurement

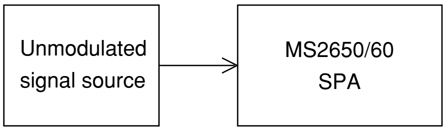


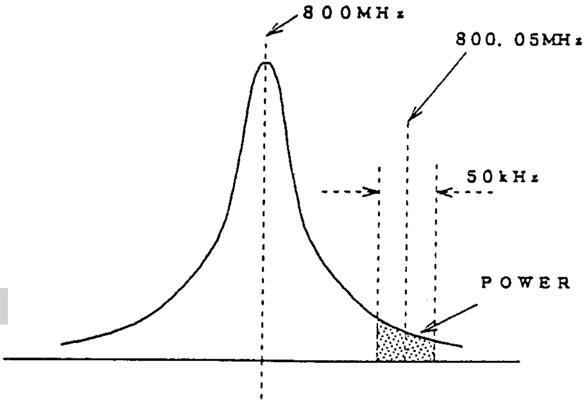
Example of Power (Noise) Measurement

Example of Channel Power Measurement (Frequency Domain, Continuous Wave)

- When making power measurements, set the detection mode to the Sample mode, unless specified otherwise. When measuring the carrier-off leakage power and adjacent channel leakage power of Japan PHS systems (burst wave), set the detection mode to the Pos Peak mode.

(1) Measurement block diagram





- Center frequency : 800 MHz
- Span frequency width : 400 kHz
- Measurement center frequency : 800.05 MHz
- Measurement frequency bandwidth : 50 kHz

(2) Measurement procedure

Step	Procedure
1	[Preset], F1: <<Preset All>>
2	Span frequency setting : [Span], [4], [0], [0], [kHz]
3	Reference level setting : [Amplitude], [2], [0], [dBm]
4	Center frequency setting : [Frequency], [8], [0], [0], [MHz]
5	RBW setting : [RBW], [3], [kHz]
6	Peak (frequency, level) setting: After 1 sweep, press [→CF] and [→RLV].
7	Zone center position setting : [Marker], F5: <<Zone Width>>, F1: <<Spot>>, [Marker], F1: <<Normal Marker>>, [8], [0], [0], [.], [0], [5], [MHz]
8	Zone marker width setting : [Marker], F5: <<Zone Width>>, [5], [0], [kHz]
9	Measure Channel Power : Press [Measure] until F4 << Channel Power measure>> is displayed, then press F4: <<Noise Measure>> and F1; <<Meas On>>. Each time sweep is refreshed, the total power value of the zone marker range (measured value) is displayed at the upper left-hand corner of the screen. F5: <<correction factor>>, an arbitrary calibration value can be entered.

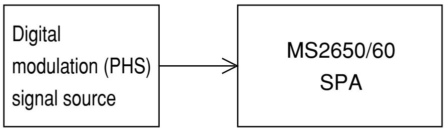
★ Measurement result example: –70.81 dBm, –152.72 dBm/Hz

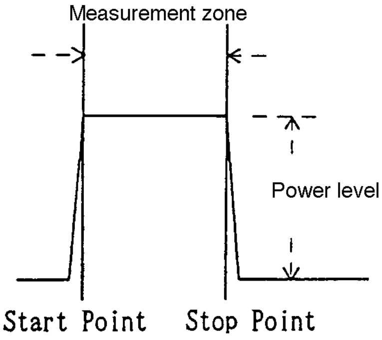
★ When wanting to change the zone marker position and make measurements: After pressing [Marker], set the position (frequency) with the ten keys.

Example of Power Measurement (Time Domain)

- Find the effective average value of the zone set by the two cursors on the screen.

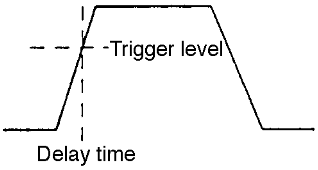
(1) Measurement block diagram





- Center frequency : 1.9 GHz
- Time span : 1 ms

(2) Measurement procedure

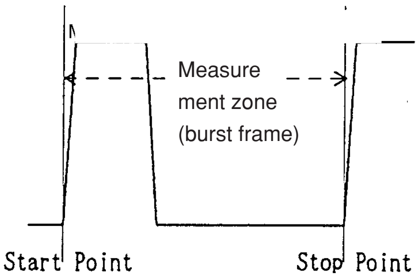
Step	Procedure	
1	[Preset], F1: <<All>>.	
2	Time domain	: [Time] or [Span], [0], [Hz]
3	Reference level setting	: [Amplitude], [2], [0], [dBm]
4	Center frequency setting	: [Frequency], [1], [.], [9], [GHz]
5	RBW setting	: [RBW], [1], [MHz]
6	VBW setting	: [VBW], [1], [MHz]
7	Time span setting	: [Time], F2: <<Time Span>>, [5], [msec]
8	Reference level setting	: After one sweep, press [→RLV] and [Amplitude] and raise the reference level about 3 dB with the rotary knob.
9	Time span setting	: [Time], F2: <<Time Span>>, [1], [msec]
10	Trigger setting	: Select Triggered with [Trig/Gate], F1: <<Trigger>>. F2: <<Trigger Source>>, F1: <<Video>> (Apply video trigger) Select rise with F5: <<Trig Slope>>. Press F1: <<Trig Level>>, then set the trigger level with the rotary knob.
11	Time delay setting	: Press [Trig/Gate], F5: <<Delay Time>>, then set the signal waveform to the left of center of the screen with the rotary knob. 

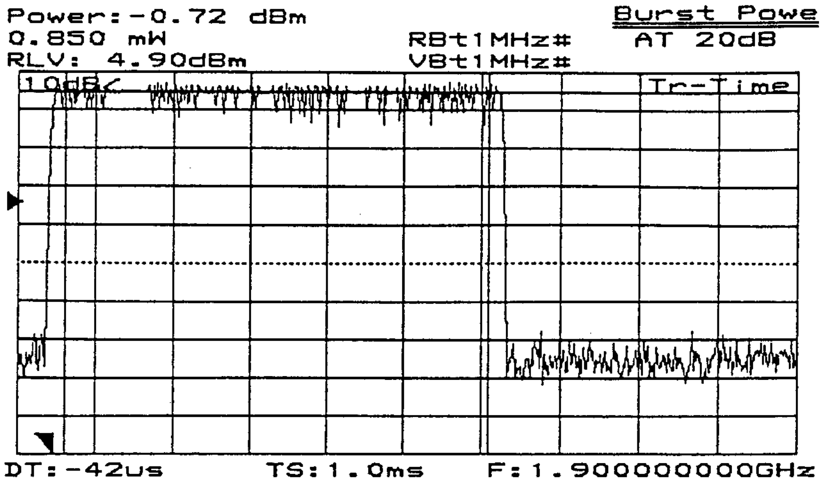
Step	Procedure	
12	Single sweep	: [Single]
13	Measurement preparation	: Press [Measure] until F2: <<Burst Avg Power>> is displayed, then press F2: <<Burst Avg Power>>.
	Measurement zone setting	: Press F3: <<Start Point>>, then set the measurement zone start position with the rotary knob. Press F2: <<Stop Point>>, then set the measurement zone stop position with the rotary knob.
14	Power measurement	: F1: <<Execute>>. The measured value is displayed at the top left-hand corner of the screen.

★ Example of measurement result: –16.84 dBm, 20.7 µW

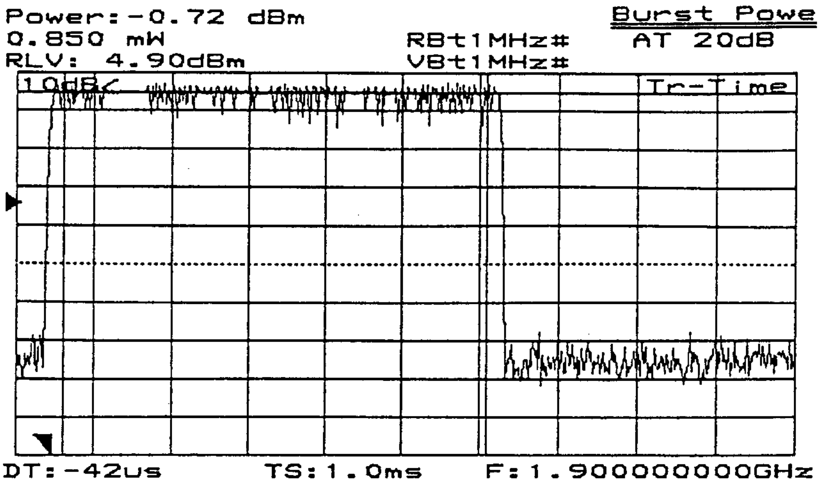
★ When finding the average power between burst frames, measurement should be performed by setting the measurement zone to the burst frame time.

★ Applications: * Spurious radiation strength measurement (PDC, PHS)
* Antenna power measurement (PDC, PHS)




Power: -0.72 dBm
0.850 mW
RLV: 4.90dBm
RB±1MHz#
VB±1MHz#
Burst Powe
AT 20dB
DT: -42us TS: 1.0ms F: 1.900000000GHz

Power Measurement (Time Domain) Example 1

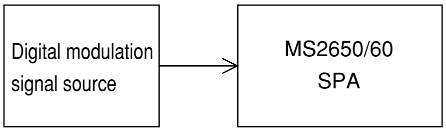


Power Measurement (Time Domain) Example 2

Example of Time Domain Peak Detection

- The time domain detection mode is initially set to the sample detection mode. When the time axis sweep time was set to more than 20 ms, the positive peak detection mode can be selected.

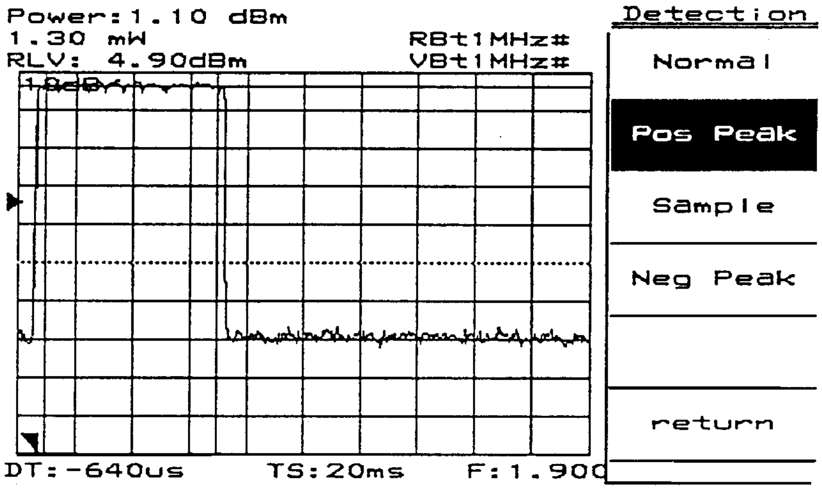
(1) Measurement block diagram



- Center frequency : 1.9 GHz
- Time span : 20 ms

(2) Measurement procedure

Step	Procedure
1	Set in accordance with steps 1 to 9 of the power measurement procedure of paragraph 5 Power Measurement (Time Domain). Set <<Time Span>> of step 7 to 20 ms.
2	DET MODE menu display : Press [Time] until F6: <<Detection>> is displayed. Select F6: <<Detection>>, F2: <<Pos Peak>>.

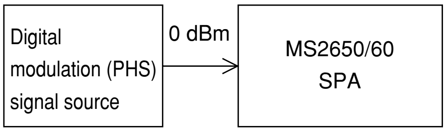

Power:1.10 dBm
1.30 mW
RLV: 4.90dBm
RBt1MHz#
VBt1MHz#
DT:-640us
TS:20ms
F:1.90C

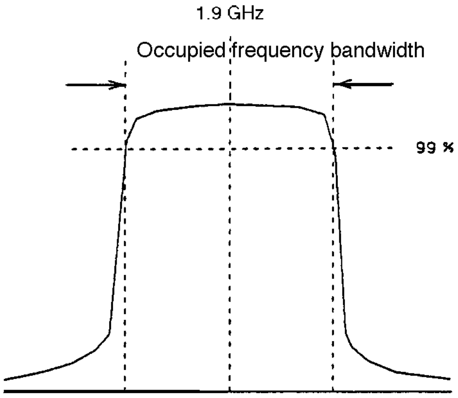
Example of Positive Peak Detection Mode

Example for Occupied Frequency Bandwidth (Burst Wave)

- For burst waves, set the detection mode to the Pos Peak mode.

(1) Measurement block diagram





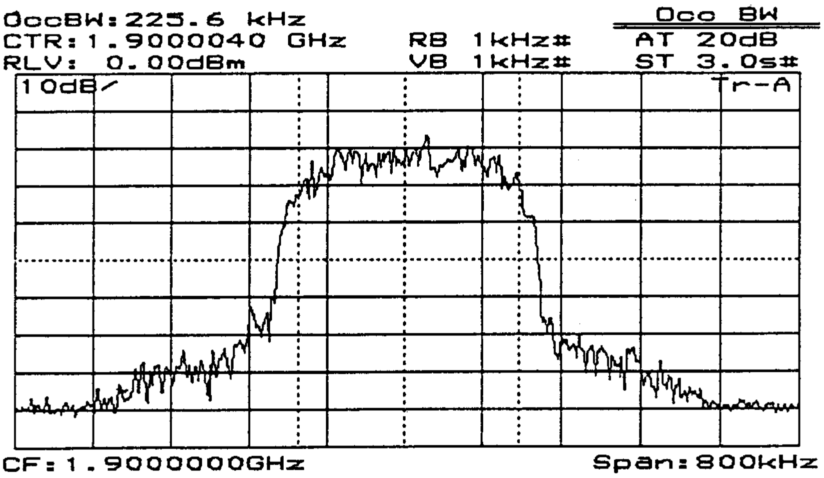
- Center frequency : 1.9 GHz
- Span frequency width : 800 kHz
- RBW : 1 kHz
- VBW : 1 kHz
- Sweep time : 3 s

(2) Measurement procedure

Span	Procudere
1	[Preset], F1: <<Preset All>>
2	Span frequency setting : [Span], [8], [0], [0], [kHz]
3	Reference level setting : [Amplitude], [0], [dBm]
4	Center frequency setting : [Frequency], [1], [.], [9], [GHz]
5	RBW setting : [RBW], [1], [kHz]
6	VBW setting : [VBW], [1], [kHz]
7	Sweep time setting : [Sweep Time], [3], [s]
8	Single sweep : [Sweep]
9	Measurement preparation : Press [Measure] until F1: <<Occ BW Measure>> is displayed, then press F1: <<Occ BW Measure>>.
10	99% method setting : Select N% of Pwr with F5: <<Setup>>, F1: <<Method>>. F2: <<N% Ratio>>, [9], [9], [Enter]
11	Occupied frequency bandwidth method: F6: <<Return>>, F1: <<Execute>>. The measured value is displayed at the top left-hand corner of the screen.

★ Example of measurement result: OccBW: 245 kHz, CTR: 1.899996 GHz

★ Application: Occupied frequency bandwidth (PDC, PHS, etc.)

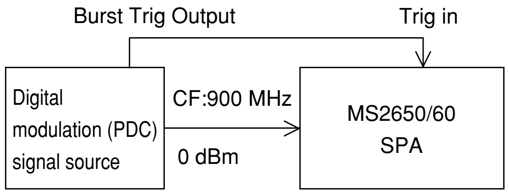


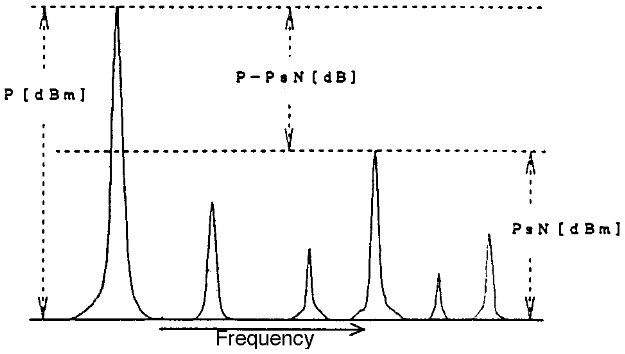
Example of Occupied Frequency Bandwidth Measurement

Example of Spurious Radiation Strength Measurement (Burst Wave)

- For burst waves, set the detection mode to the Pos Peak mode.

(1) Measurement block diagram





Detection:

- Sweep frequency range : 10 MHz to 3 GHz
- RBW : 1 MHz
- VBW : 1 MHz
- Sweep time : 60 s

Power measurement:

- Span frequency width : 0 Hz
- RBW : 100 kHz
- VBW : 10 kHz
- Sweep time : 20 ms

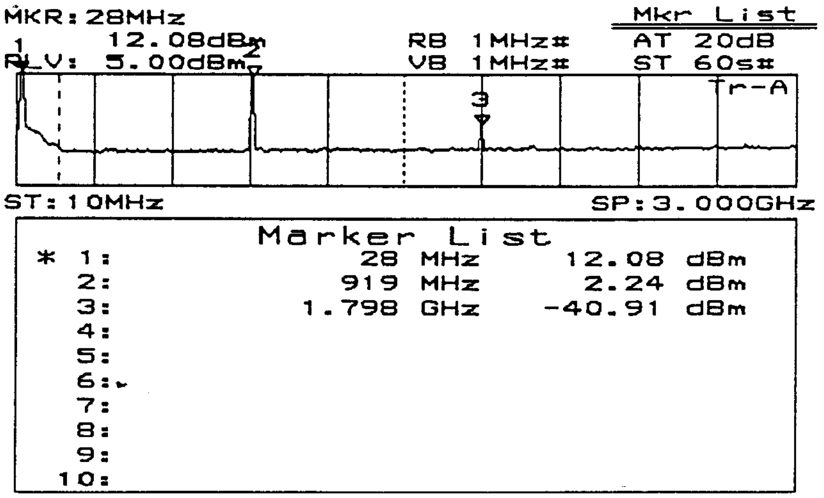
(2) Measurement procedure

Step	Procedure
	(A) Spurious detection
1	[Preset], F1: <<Preset All>>.
2	Sweep frequency range setting : [Frequency], F3: <<Start Freq>>, [1], [0], [MHz], F3: <<Stop Freq>>, [3], [GHz]
3	Reference level setting : [Amplitude], [5], [dBm]
4	RBW setting : [RBW], [1], [MHz]
5	VBW setting : [VBW], [1], [MHz]
6	Sweep time setting : [Sweep Time], [6], [0], [s]
7	Single sweep : [Single]

Step	Procedure
8	Multimarker setting : [Shift], [Marker] (Multi Mkr), F2: <<Highest 10>>, F5: <<Marker List>>. Main and spurious lists (frequency and level of each) are displayed.
	(B) Spuripus radiation strength measurement (Example: Assume that the frequency obtained from the list is 1.8 GHz.)
9	Time domain: [Marker], F3: <<Marker Off>>, [Time]
	The following measures the power by the same procedure as power measurement (time domain).
10	Center frequency setting : [Frequency], [1], [.], [8], [GHz]
11	RBW setting : [RBW], [1], [0], [0], [kHz]
12	VBW setting : [VBW], [1], [0], [kHz]
13	Press pressing : [Time] until F2: <<Time Span>> is displayed, then press F2: <<Time Span>>, [2], [0], [ms].
14	Trigger setting : Select Triggered with [Trig/Gate], F1: <<Trigger>>. Select Rise with F2: <<Trigger Slope>>, F3: <<External>>, F1: <<–10 to 10V>>, F5: <<Trig Slope>>. F4: <<Trig Level>>, [2], [V]
15	Press : [Trig/Gate], F5: <<Delay Time>>, then set Delay Time with the rotary knob so that the signal waveform moves to the left of center of the screen.
16	Single sweep : [Single]
17	Measurement preparation : Press [Measure] until F2: <<Burst Avg Power>> is displayed, then press F2: <<Burst Avg Power>>.
18	Measurement zone setting : Press F3: <<Start Point>>, then set the measurement zone start position with the rotary knob. Press F4: <<Stop Point>>, then set the measurement zone stop position with the rotary knob.
19	Power measurement : F1: <<Execute>>. The measured value (P_{SN}) is displayed at the top left-hand corner of the screen.

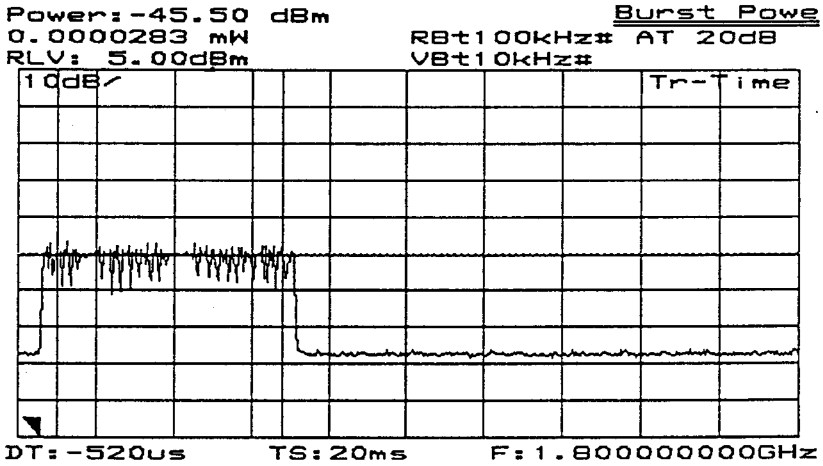
★ Example of measurement result: –57.05 dBm, 1.97 µW

Step	Procedure
	(C) Spurious ratio strength ratio (relative to carrier power)
20	Set the center frequency to the carrier frequency and measure the carrier power (P) by executing steps 15, 16, 17, and 18. Spurious radiation strength ratio: (P_{SN}) – (P) [dB]



```
                Marker List
 * 1:            28 MHz      12.08 dBm
   2:           919 MHz       2.24 dBm
   3:         1.798 GHz     -40.91 dBm
   4:
   5:
   6:
   7:
   8:
   9:
  10:
```

Example of Spurious Detection



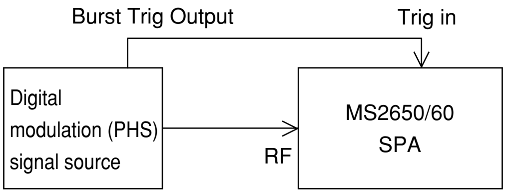
Example of Spurious Strength measurement

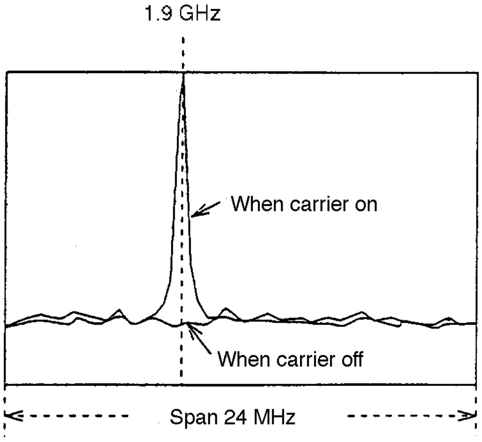
Examples of Carrier-Off Leakage Power Measurement (Time Domain Spectrum Analysis)

Example 1 When external trigger used

- Set the detection mode to the Pos Peak mode.

(1) Measurement block diagram

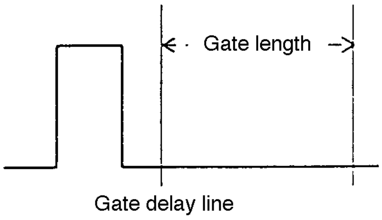




- Input signal frequency : 1.9 GHz
- Center frequency : 1906.55 MHz
- Span frequency width : 24 MHz
- RBW : 300 kHz
- VBW : 3 MHz
- Sweep time : 4 s

(2) Measurement procedure

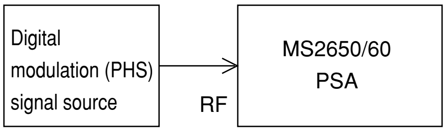
Step	Procedure
1	[Preset], F1: <<Preset All>>
2	Time domain setting : [Time]
3	Reference level setting : [Amplitude], [2], [0], [dBm]
4	Center frequency setting : [Frequency], [1], [.], [9], [GHz]
5	RBW setting : [RBW], [1], [MHz]
6	VBW setting : [VBW], [1], [MHz]
7	Time domain setting : [Time], F2: <<Time Sweep>>, [5], [msec]
8	Reference setting : After one sweep, press [→RLV].
9	Trigger setting : Select Triggered with [Trig/Gate], F1: <<Trigger>> and select Rise with F2: <<Trigger Source>>, F3: <<External>>, F1: <<–10 to 10>>, and F5: <<Trig Slope>>. F4: <<Trig Level>>, [2], [V]

Step	Procedure	
10	RBW setting	: [RBW], [3], [0], [0], [kHz]
11	VBW setting	: [VBW], [3], [MHz]
12	Gate setting	: Press [Trig/Gate] until F1: <<Gate Sweep> is displayed. Select On with F1: <<Gate Sweep>>. F2: <<Gate Setup>>, F1: <<Gate Delay>>, and set the gate delay line to the carrier-off region with the rotary knob. F2: <<Gate Length>>, and set the gate length as shown at the right. 
13	Span frequency setting	: [Span], [2], [4], [MHz]
14	Center frequency setting	: [Frequency], [1], [9], [0], [6], [.], [5], [5], [MHz]
15	Sweep time setting	: [Sweep Time], [4], [s], [Single]
	(A) Carrier-off leakage power value P (OFF)	
16	Multi Mkr setting	: [Shift], [Marker] (Multi Mkr), F2: <<Highest 10>>, F5: <<Marker List>> A carrier-off leakage power list (frequency and level of each) is displayed. At this time, if the message "Can not search" is displayed, press [Peak Search].
★	Example of measurement result: –82.57 dBm	
	(B) Carrier-on leakage power value P(ON)	
17	Turn off the gate	: Press [Trig/Gate] until F1: <<Gate Sweep>> is displayed. Select Off with F1: <<Gate Sweep>, then press [Single].
18	Marker setting	: [Peak Search] The power when the carrier is on is displayed.
★	Example of measurement result: –15.57 dBm. Carrier off/on power ratio: P (L)–P (O)	

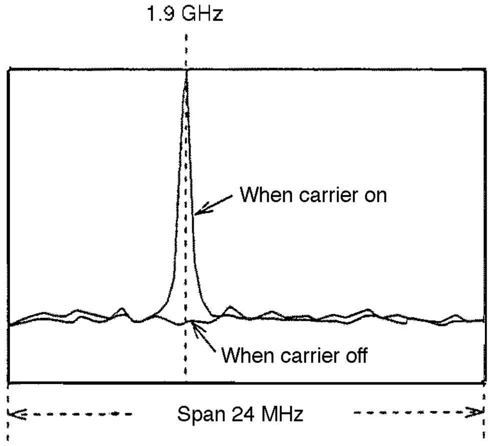
Example 2 When Wide IF Video trigger used

- Set the detection mode to the Pos Peak mode.

(1) Measurement block diagram

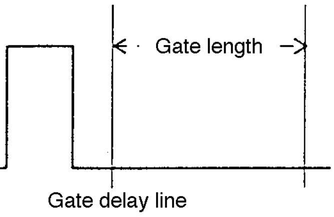


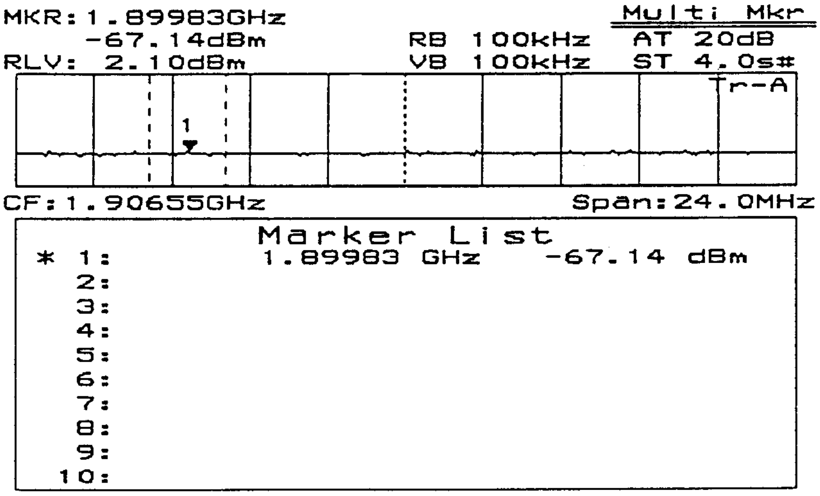
- Input signal frequency : 1.9 GHz
- Center frequency : 1906.55 MHz
- Span frequency width : 24 MHz
- RBW : 300 kHz
- VBW : 3 MHz
- Sweep time : 4 s



(2) Measurement procedure

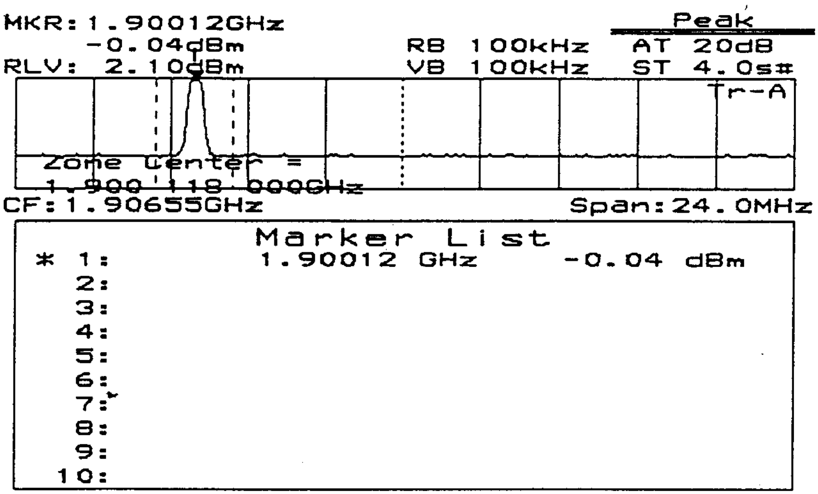
Step	Procedure
1	Select Independent with [Preset], F1: <<Preset All>>, [Shift], [1] (System), F1: <<Couple>>.
2	Reference level setting : [Amplitude], [2], [0], [dBm]
3	Center frequency setting : [Frequency], [1], [.], [9], [GHz]
4	RBW setting : [RBW], [1], [MHz]
5	VBW setting : [VBW], [1], [MHz]
6	Time span setting : [Time], F2: <<Time Span>>, [5], [msec]
7	Reference level setting : After 1 sweep, press [→RLV].
8	Trigger setting : Select Triggered with [Trig/Gate] and F1: <<Triggered>> and set to the level at which the trigger is to be applied by changing F1: <<Trigger Level>> to High, Middle, or Low. (Use Low as much as possible.)
9	RBW setting : [RBW], [3], [0], [0], [kHz]
10	VBW setting : [VBW], [3], [MHz]

Step	Procedure
11	Gate setting : Press [Trig/Gate] until F1: <<Gate Sweep>> is displayed. Select On with F1: <<Gate Sweep>>. Press F2: <<Gate Setup>>, F1: <<Gate Delay>> and set the gate delay line to the carrier-off region with the rotary knob. Press F2: <<Gate Length>> and set the gate length as shown in the figure at the right with the rotary knob. 
12	Span frequency setting : [Span], [2], [4], [MHz]
13	Center frequency setting : [Frequency], [1], [9], [0], [6], [.], [5], [5], [MHz]
14	Sweep time setting : [Sweep Time], [4], [s]
	(A) Carrier-off leakage power value P (L)
15	Multimarker setting : [Shift], [Marker] (Multi Mkr), F2: <<Highest 10>>, F5: <<Marker List>> A carrier-off leakage power list (each frequency and level) is displayed. At this time, if the message "Can not search" is displayed, press [Peak Search].
★	Example of measurement result: –82.57 dBm
	(B) Carrier-on leakage power value P(ON)
16	Turn off the gate : Press [Trig/Gate] until F1: <<Gate Sweep>> is displayed. Select Off with F1: <<Gate Sweep>>, then press [Single].
17	Marker setting : [Peak Search] The power when the carrier is on is displayed.
★	Example of measurement result: –15.57 dBm
	Carrier off/on power ratio: P (L)-P (O)



```
MKR:1.89983GHz                                  Multi Mkr
     -67.14dBm                RB 100kHz         AT 20dB
RLV:  2.10dBm                 VB 100kHz         ST 4.0s#
                                                     Tr-A
CF:1.90655GHz                                Span:24.0MHz
                    Marker List
 * 1:          1.89983 GHz     -67.14 dBm
   2:
   3:
   4:
   5:
   6:
   7:
   8:
   9:
  10:
```

Example of Carrier-Off Leakage Power P (L) Measurement

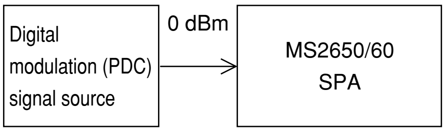


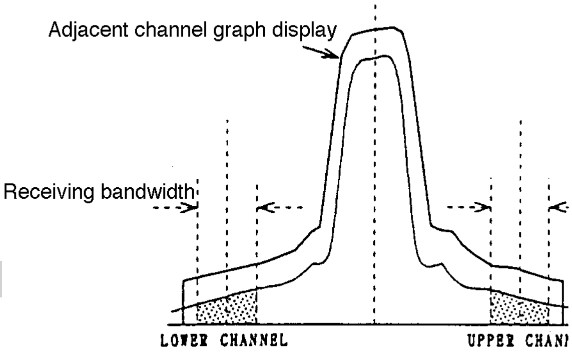
```
MKR:1.90012GHz                                    Peak
     -0.04dBm                 RB 100kHz         AT 20dB
RLV:  2.10dBm                 VB 100kHz         ST 4.0s#
                                                     Tr-A
 Zone Center =
 1.900 118 000GHz
CF:1.90655GHz                                Span:24.0MHz
                    Marker List
 * 1:          1.90012 GHz      -0.04 dBm
   2:
   3:
   4:
   5:
   6:
   7:
   8:
   9:
  10:
```

Example of Carrier-On Leakage Power P (O) Measurement

Example of Measurement of Adjacent Channel Leakage Power

(1) Measurement block diagram



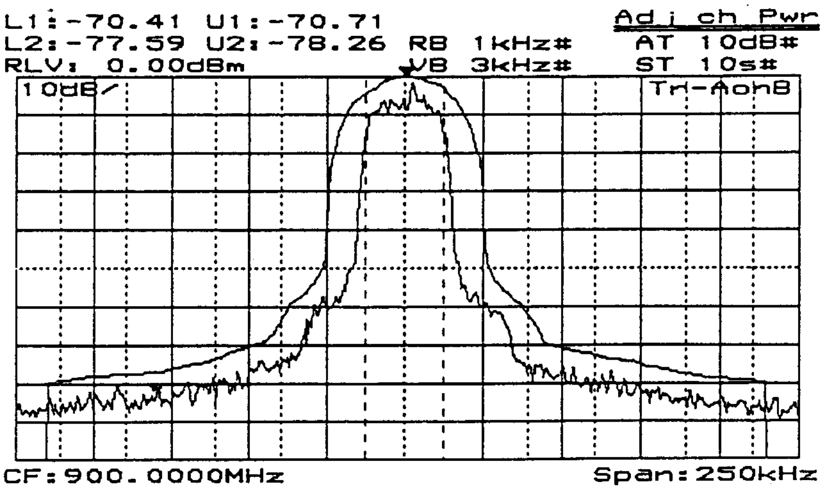


- Center frequency : 900 MHz
- Span frequency width : 250 kHz
- RBW : 1 kHz
- VBW : 3 kHz
- Sweep time : 10 s

(2) Measurement procedure

Step	Procedure
1	[Preset], F1: <<Preset All>>
2	Span frequency setting : [Span], [2], [5], [0], [kHz]
3	Center frequency setting : [Frequency], [9], [0], [0], [MHz]
4	RBW setting : [RBW], [1], [kHz]
5	VBW setting : [VBW], [3], [kHz]
6	Reference level setting : [Amplitude], [0], [dB]
7	Sweep time setting : [Sweep Time], [1], [0], [s]
8	ATT setting : Press [ATTEN], then set to the minimum value with the rotary knob.
9	Single sweep : [Single]
10	Measurement preparation : Press [Measure] until F2: <<Adj Ch Pwr Measure>> is displayed, then press F2: <<Adj Pwr Measure>>.
11	Adjacent channel setting : F2: <<Ch Sepa-1>>, [5], [0], [kHz] F3: <<Ch Sepa-2>>, [1], [0], [0], [kHz] (*1)
12	Receiving bandwidth setting: F4: <<Ch BW>>, [2], [1], [kHz]

Step	Procedure
13	Method of calculation : Select Total Pwr or Ref Level or Inband with F5: <<Setup>>, F1 to F3 <<Method>>. (*2)
14	Graph display : On page 2 of <<set up>> when On is selected with F1: <<ACP Graph>>, graph display is performed.
15	Channel display method : When On is selected with F2: <<Ch Center Line>>, a line which indicates the adjacent frequency center frequency is displayed. When On is selected with F3: <<Ch BW Line>>, a line which indicates the adjacent channel bandwidth is displayed. When On is selected with F4: <<Inband BW Line>>, a line which indicates the Inband is displayed.
16	Measurement channel setting: [More], F1: <<Both Channel>>, F6: <<return>>
17	Measurement: F1 : <<Execute>> The measured value is displayed at the top left-hand corner of the screen.



Example of Adjacent Channel Leakage Power Measurement

Note:

**1 Reference channel center-In total power method and Inband method, this is defined as the center of zone marker.*

In Reference level method, the display's center is defined as reference channel center.

**2 The reference value for each of the calculation method is defined as below.*

Total Power method: The total power of entire waveform displayed.

Ref Level method: The reference level value of the display.

Inband method: The total power in the "Inband" defined with marker zone center as reference channel center.

Example of Memory Card Use

If the measurement screen is stored in a memory card, the same measurement can be performed later by recalling the stored measurement screen. This eliminates troublesome setting of the measurement parameters each time and prevents setting errors. It is designed especially to shorten the measurement time when the setting operation is complex.

Storage method (Assume that the DATA number is 20.)

1) Measurement screen single sweep: [Single]
2) Press [Shift], [Recall] (save), [More] until F1: <<Save to Mem Card>> is displayed, then press F1: <<Save to Mem Card>>, [2], [0], [Enter].
   This completes saving of the screen parameters to Memory Card 20.

Recalling method (Assume that the DATA number is 20.)

1) Stored screen display : Press [More] until [Recall], F1: <<Recall from Mem Card>> is displayed, then press F1: <<Recall from Mem Card>>, [2], [0], [Enter].
2) Continuous sweep : [Continuous]

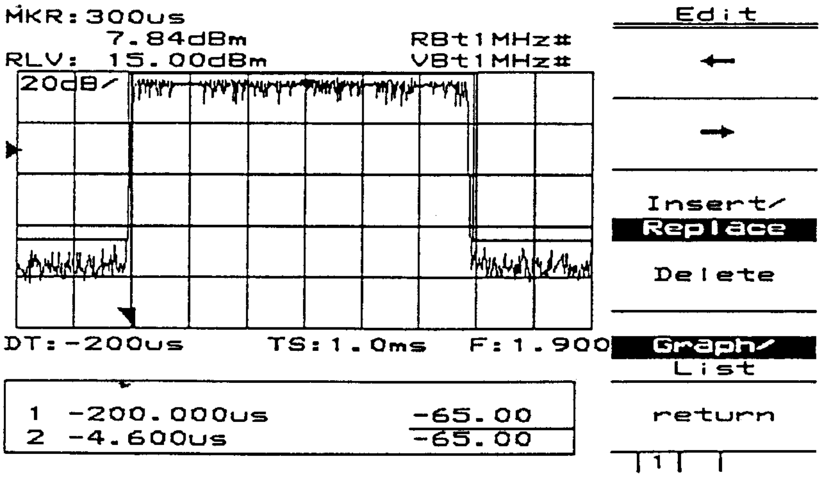
Example of Time Template Creation (PHS Transmit Signal)

1) Burst wave screen setting (time domain)

Time span	: 1 ms
Trigger	: –200 us
RBW	: 1 MHz
VBW	: 1 MHz
RLV	: +15 dBm

2) Template data overwrite method

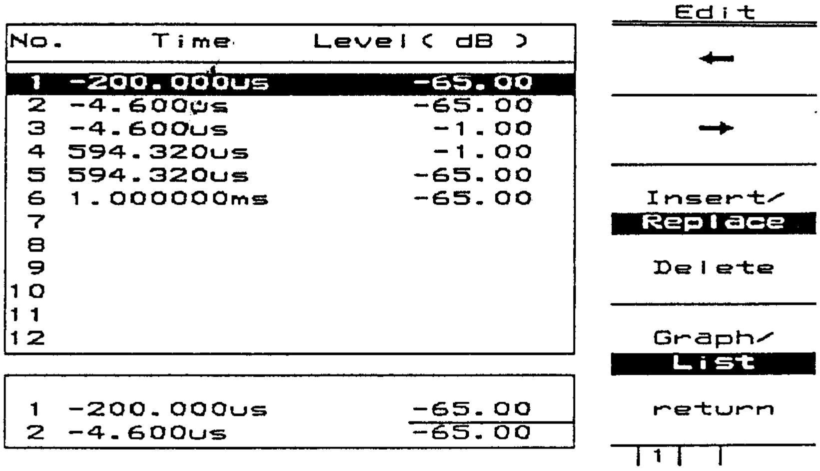
- Template scale number setting (No. 1 here):
  Press [Time], [Measure] until F1: <<Time Template>> is displayed, then press F1: <<Time Template>>, F5: <<Setup Temp Table>>, F1: <<Select Temp Table>>, F1: <<Temp-1>>, F6: <<return>>.
- Data write preparation: Select Relative with F2: <<Level>>.
  F3: <<Make Up Temp Table>>, [More], F2: <<Select Line>>, F1: <<Limit1 Upper>>, F6: <<return>>, [More] (Here, Limit1 Upper is specified.)
- Data write: Sequentially write the coordinates (time, level) of the template to be created in ascending order of time value.
  Write data by alternately repeating time setting and level setting.
  * Time setting (example: –200 us) : [+/–], [2], [0], [0], [us]
  * Level setting (example: –65 dB) : [+/–], [6], [5], [dB]
- Limit1 Lower write: Press [More], F2: <<Select Line>>, F2: <<Limit 1 Lower>>, F6: <<return>>, [More], then write the template coordinate data.



```
MKR:300us
         7.84dBm                       RBt1MHz#
RLV:  15.00dBm                         VBt1MHz#
DT:-200us        TS:1.0ms      F:1.900

 1  -200.000us                  -65.00
 2  -4.600us                    -65.00
```

TEMPLATE Creation Screen (Graph)

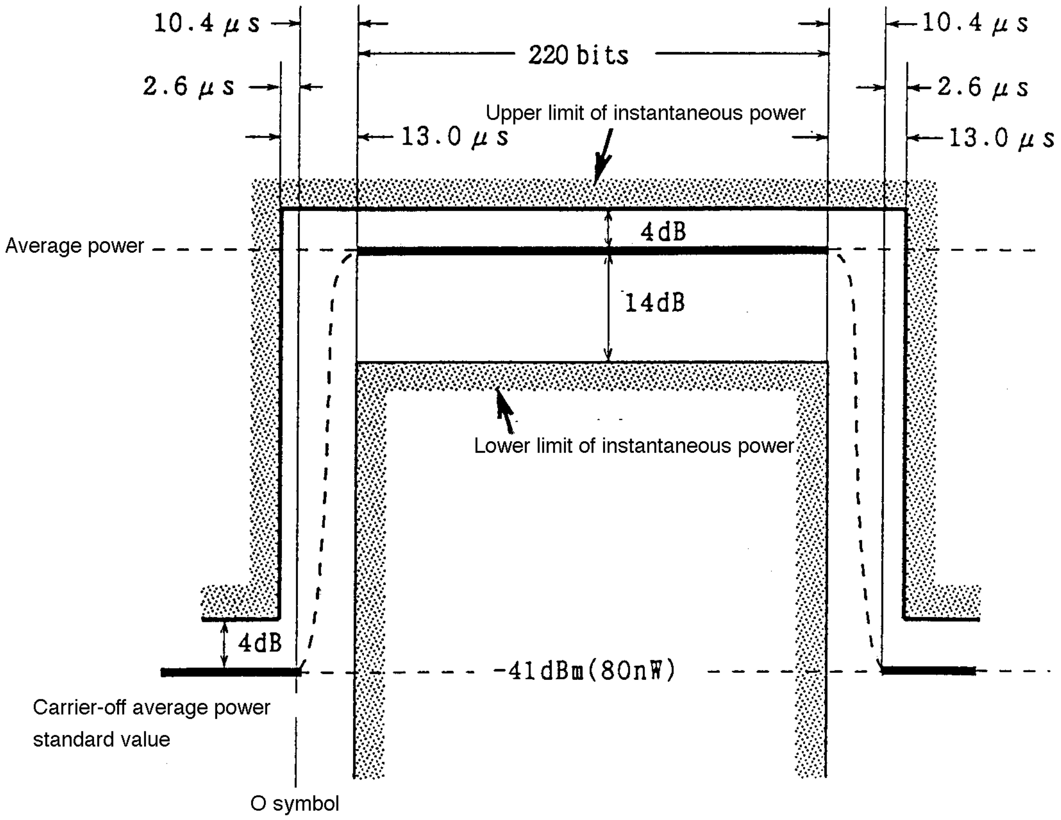


```
No.      Time        Level( dB )
  1  -200.000us          -65.00
  2  -4.600us            -65.00
  3  -4.600us             -1.00
  4  594.320us            -1.00
  5  594.320us           -65.00
  6  1.000000ms          -65.00
  7
  8
  9
 10
 11
 12

 1  -200.000us           -65.00
 2  -4.600us             -65.00
```

TEMPLATE Creation Screen (List)

3) Template coordinates (PHS: RCR STD-28)



Coordinate reference line (Trigger position → left end of screen: –200 µs)

When average power in burst of input signal is 19 dBm and SPA REF LEVEL is 24 dBm

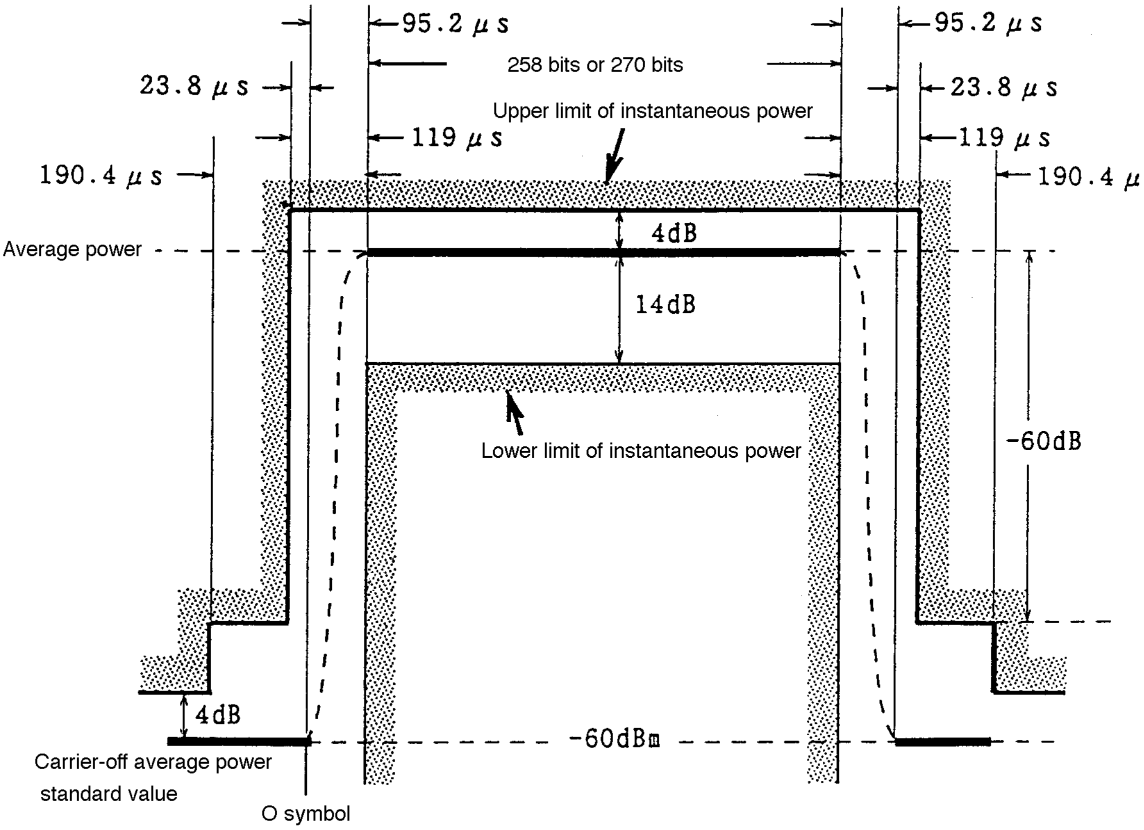
- Limit1 Upper coordinates

(1)	–200 µs,	–65 dB
(2)	–4.6 µs,	–65 dB
(3)	–4.6 µs,	–1 dB
(4)	594.32 µs,	–1 dB
(5)	594.32 µs,	–65 dB
(6)	1 ms,	–65 dB

- Limit1 Lower coordinates

(1)	8.40 µs,	–100 dB
(2)	8.40 µs,	–19 dB
(3)	581.32 µs,	–19 dB
(4)	581.32 µs,	–100 dB

4) Template coordinates (PDC-RCR STD-27B)



Coordinates standard line (Trigger position → screen left end: –1 ms)

When average power in burst of input signal is 10 dBm and SPA REF LEVEL is 15 dBm

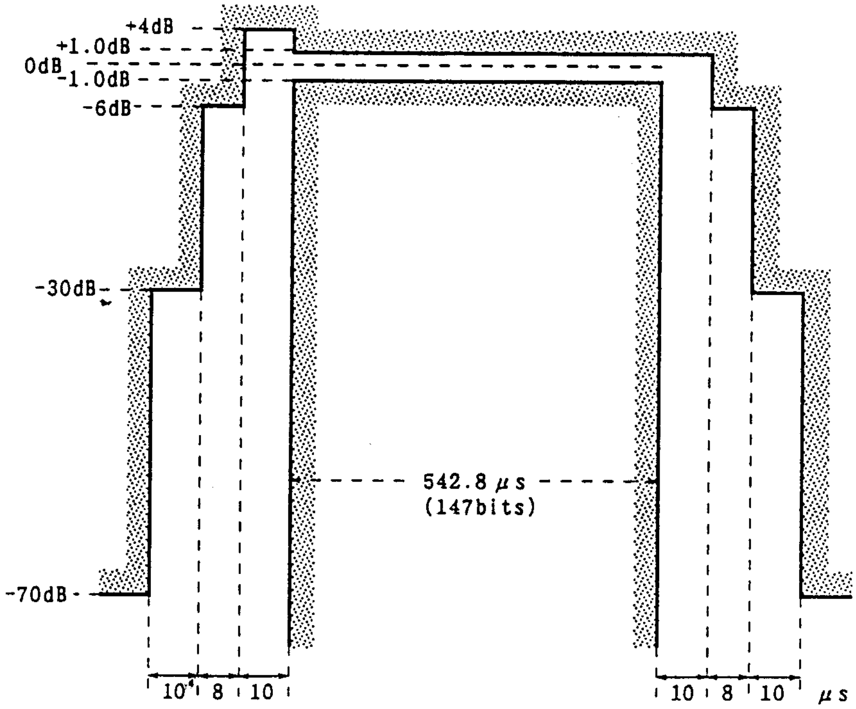
- Limit1 Upper coordinates

(1)	–1.7 ms,	–71 dB
(2)	–114.21 μs,	–71 dB
(3)	–114.21 μs,	–65 dB
(4)	42.81 μs,	–65 dB
(5)	42.81 μs,	–1 dB
(6)	6.6238 ms,	–1 dB
(7)	6.6238 ms,	–65 dB
(8)	6.6952 ms,	–65 dB
(9)	6.6952 ms,	–71 dB
(10)	8.3 ms,	–71 dB

- Limit1 Lower coordinates

(1)	76.19 μs,	–100 dB
(2)	76.19 μs,	–19 dB
(3)	6.5048 ms,	–19 dB
(4)	6.5048 ms,	–100 dB

5) Template coordinates (GSM, DCS1800)



Coordinates standard line (Trigger position → left end of screen: –75.0 µs)

- Limit 1 Upper coordinates

(1)	–75.0 µs,	–75 dB
(2)	–25.0 µs,	–75 dB
(3)	–25.0 µs,	–35 dB
(4)	–15.0 µs,	–35 dB
(5)	–15.0 µs,	–11 dB
(6)	–7.0 µs,	–11 dB
(7)	–7.0 µs,	–1 dB
(8)	3.0 µs,	–1 dB
(9)	3.0 µs,	–4 dB
(10)	555.8 µs,	–4 dB
(11)	555.8 µs,	–11 dB
(12)	563.8 µs,	–11 dB
(13)	563.8 µs,	–35 dB
(14)	573.8 µs,	–35 dB
(15)	573.8 µs,	–75 dB
(16)	625.0 µs,	–75 dB

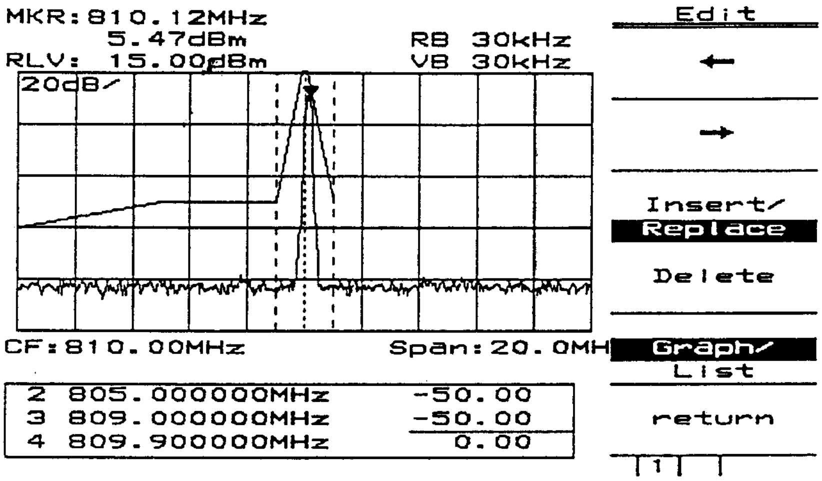
- Limit1 Lower coordinates

(1)	3.0 µs,	–100 dB
(2)	3.0 µs,	–6 dB
(3)	545.8 µs,	–6 dB
(4)	545.8 µs,	–100 dB

MASK Creation in Frequency Domain Mode

1) Mask data write method

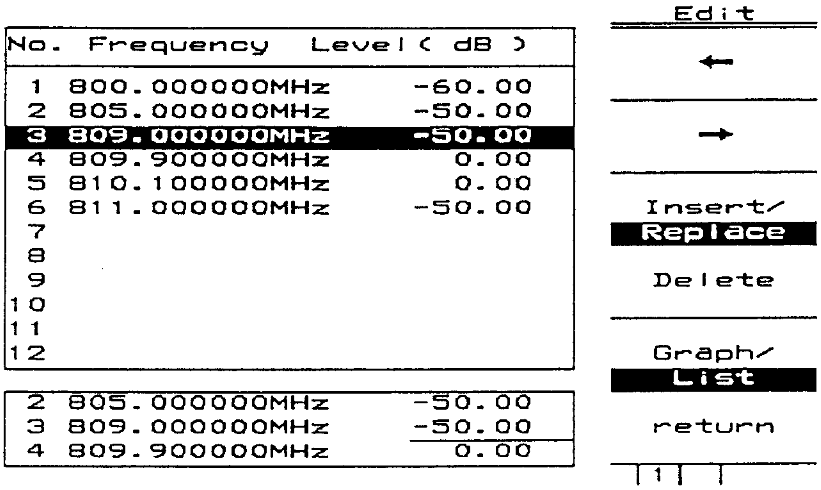
- Template scale number setting (Here it is 1.):
  Press [A, B] and F1: <<Trace A>> and press [Measure] until F3: <<Mask>> is displayed, then press F3: <<Mask>>, F5: <<Setup Mask Table>>, F1: <<Select Mask Table>>, F1: <<Mask-1>>, F6: <<return>>.
- Data write preparation: Select Relative with F2: <<Level>>.
  F3: <<Make Up Mask Table>>, [More], F2: <<Select Line>>, F1: <<Limit1 Upper>>, F6: <<return>>, [More] (Here, Limit1 Upper is specified.)
- Data write: Write the coordinates (frequency, level) of the template to be created in ascending order of time value.
  Write the data by alternately repeating time setting and level setting.
  - ∗ Frequency setting (example: 800 MHz): [8], [0], [0], [MHz]
  - ∗ Level setting (example: –60 dB): [+/–], [6], [0], [dB]
- Limit1 Lower write: Press [More], F2: <<Select Line>>, F2: <<Limit1 Lower>>, F6: <<return>>, [More], then write the mask data coordinates data.



MKR:810.12MHz
5.47dBm
RLV: 15.00dBm
RB 30kHz
VB 30kHz
20dB/
CF:810.00MHz
Span:20.0MH

2	805.000000MHz	-50.00
3	809.000000MHz	-50.00
4	809.900000MHz	0.00

MASK Creation Screen (Graph)



No.	Frequency	Level (dB)
1	800.000000MHz	-60.00
2	805.000000MHz	-50.00
3	809.000000MHz	-50.00
4	809.900000MHz	0.00
5	810.100000MHz	0.00
6	811.000000MHz	-50.00
7		
8		
9		
10		
11		
12		

2	805.000000MHz	-50.00
3	809.000000MHz	-50.00
4	809.900000MHz	0.00

MASK Creation Screen (List)

SECTION 14

TRACKING GENERATOR

This section describes the Tracking Generator (Option 20/23)'s function-key menus, Normalize/Instant-Normalize functions, measurement example of band-pass-filter transmission-characteristics/reflection-characteristics, and notes on active-device (including amplifier) measurement.

TABLE OF CONTENTS

CAUTION ⚠

Measurements using tracking generator at very low frequencies are beating to be affected by the local feed through.
To eliminate the effect of the local feed through on measurements at low frequencies, it is necessary to chose appropriate RBW.
The approximate value of appropriate RBW is less than or equal to 1/10 th of the lowest frequency limit under measurement.

■ TG Output connector

standard (50 Ω) : N-J
with Opt.23 (75 Ω) : NC-J

Connect the correct type connector to the TG output. If connect the difference type one, output connector may be damaged.

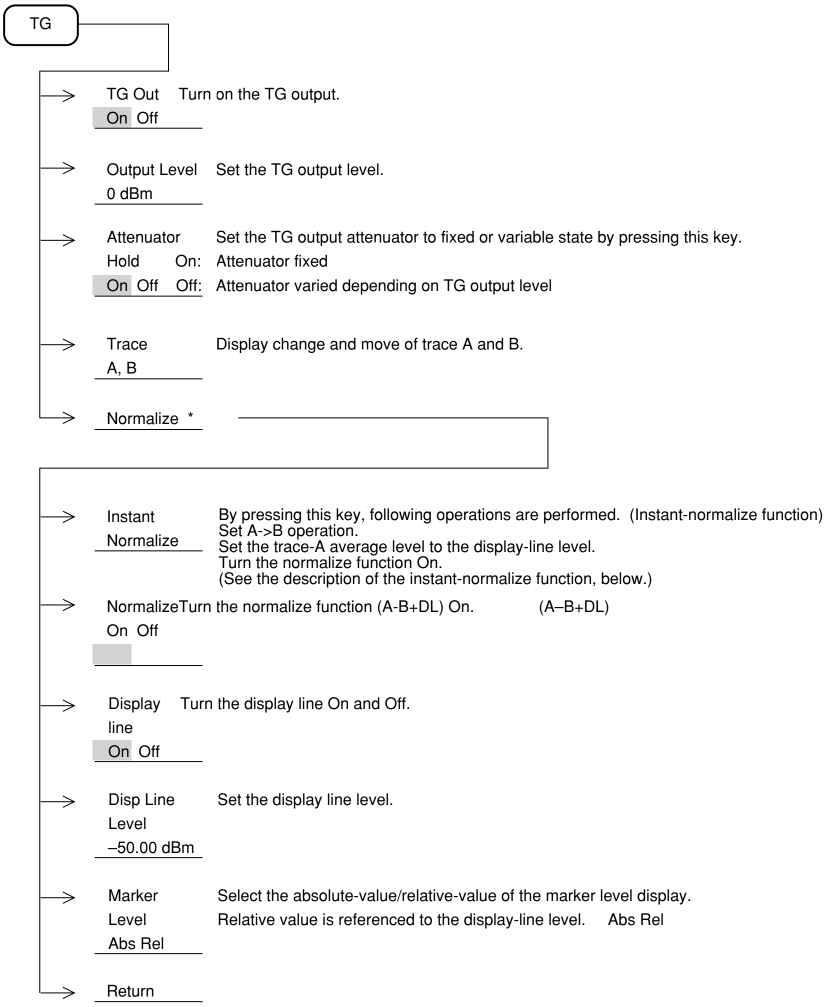
■ Bath the Spectrum Analyzer and the Device Under Test must be earthed.
If the D.U.T or the Spectrum Analyzer is not earthed, tracking generator unit may be damaged.

SECTION 14
TRACKING GENERATOR

Tracking Generator Menus

The Tracking Generator (TG, Option 20/23) can be installed to the spectrum analyzer to measure the transmission characteristics and reflection characteristics of the passive devices (filters etc.) and active devices (amplifier etc.).

To turn the output On/Off, set the output level, and compensate the insertion loss of the cables/bridges etc. (normalizing function), perform the following key operations.



TG Out On Off — Turn on the TG output.

Output Level 0 dBm — Set the TG output level.

Attenuator Hold On Off — Set the TG output attenuator to fixed or variable state by pressing this key.
On: Attenuator fixed
Off: Attenuator varied depending on TG output level

Trace A, B — Display change and move of trace A and B.

Normalize *

Instant Normalize — By pressing this key, following operations are performed. (Instant-normalize function)
Set A->B operation.
Set the trace-A average level to the display-line level.
Turn the normalize function On.
(See the description of the instant-normalize function, below.)

Normalize On Off — Turn the normalize function (A-B+DL) On. (A–B+DL)

Display line On Off — Turn the display line On and Off.

Disp Line Level –50.00 dBm — Set the display line level.

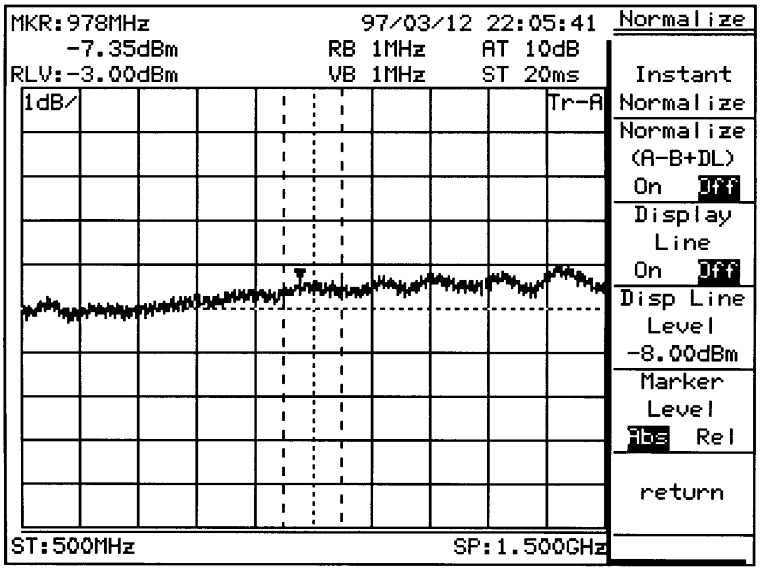
Marker Level Abs Rel — Select the absolute-value/relative-value of the marker level display.
Relative value is referenced to the display-line level. Abs Rel

Return

Normalize/Instant-Normalize Function

For accurate measurement of the transmission characteristics and reflection characteristics by using TG, the insertion-loss frequency characteristics of the cables/bridges etc. must be compensated.
The normalize function is used for this purpose.

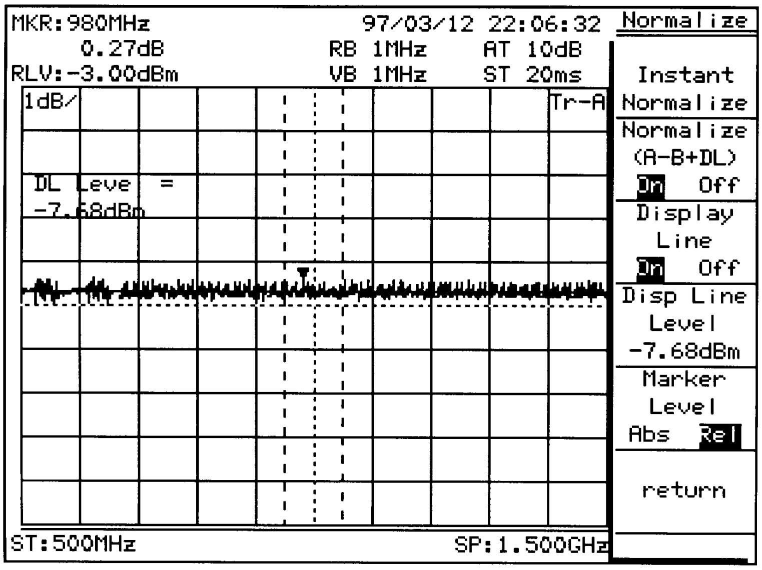
The following figure shows the frequency characteristics which is not compensated for the coaxial cable connected from the TG Output to RF Input. The figure shows approx. one dB frequency-characteristics ripple.



```
MKR:978MHz                   97/03/12 22:05:41
    -7.35dBm           RB 1MHz    AT 10dB
RLV:-3.00dBm           VB 1MHz    ST 20ms
1dB/                                  Tr-A
ST:500MHz                     SP:1.500GHz
```

Normalize (A-B+DL) Off
Display Line Off
Disp Line Level -8.00dBm
Marker Level Abs

The normalize function compensates this frequency-characteristics ripple.
The following figure shows the frequency characteristics which is compensated by the instant-normalize function.



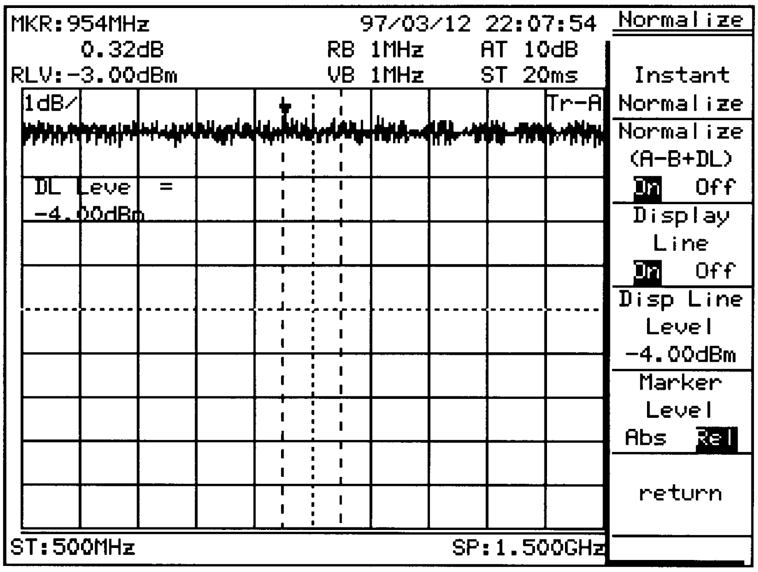
```
MKR:980MHz                   97/03/12 22:06:32
    0.27dB             RB 1MHz    AT 10dB
RLV:-3.00dBm           VB 1MHz    ST 20ms
1dB/                                  Tr-A
 DL Level =
 -7.68dBm
ST:500MHz                     SP:1.500GHz
```

Normalize (A-B+DL) On
Display Line On
Disp Line Level -7.68dBm
Marker Level Rel

By the instant normalize function, the compensated waveform is displayed at the averaged level of the previous uncompensated waveform. The marker level is displayed with the relative value referenced to the display-line level.

When using the normalize function, the waveform is displayed with reference to the display line. So, by changing the display -line level, the compensated waveform can be displayed at any position.

The following figure shows the waveform moved by one scale division below the top line, by changing the display-line level.



```
MKR:954MHz                 97/03/12 22:07:54
     0.32dB                RB 1MHz    AT 10dB
RLV:-3.00dBm               VB 1MHz    ST 20ms
1dB/                                     Tr-A
 DL Level =
 -4.00dBm
ST:500MHz                          SP:1.500GHz
```

Hereafter, transmission-characteristics/reflection-characteristics measurements of a band-pass filter (BPF) are described below for examples of the TG application.

Transmission Characteristics Measurement

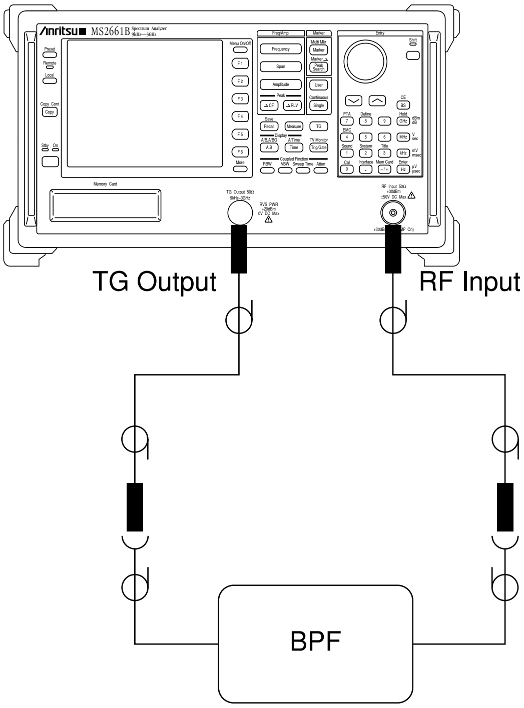
Typical transmission characteristics measurement of a BPF is described below.
BPF characteristics:

• Center frequency:	500 MHz
• 3dB bandwidth:	27 MHz
• Insertion loss:	-0.4 dB
• Input/Output connector:	N jack (50 Ω) or NC jack (75 Ω)

Characteristics Outline Measurement

(1) Setup

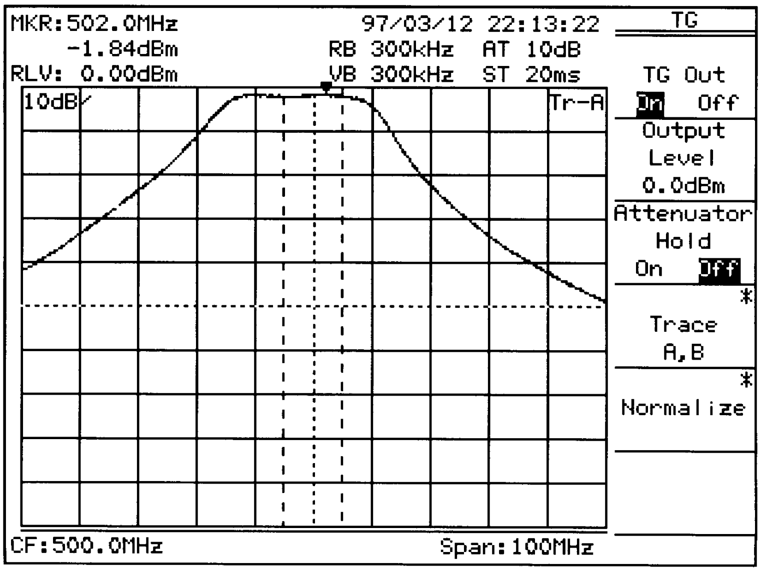
Connect the TG Output to BPF input, and BPF output to RF Input with a coaxial cable, respectively.



(2) Setting parameters and measuring characteristics outline

- Setting parameters
  - Initializing the spectrum analyzer
    [Preset]
  - Setting center frequency to 500 MHz
    [Frequency], [5], [0], [0], [MHz]
  - Setting span to 100 MHz
    [Span], [1], [0], [0], [MHz]
  - Setting reference level to 0 dBm
    [Amplitude], [0], [dBm]
  - Setting TG to On
    [TG], F1: <<TG <u>On</u> Off>>

The following figure is obtained as the measurement results.
When accurate results not required, each frequency and level can be read using marker. In this case, the marker unit is dBm and TG output level is 0 dBm, then the marker level indicates the insertion loss, directly.



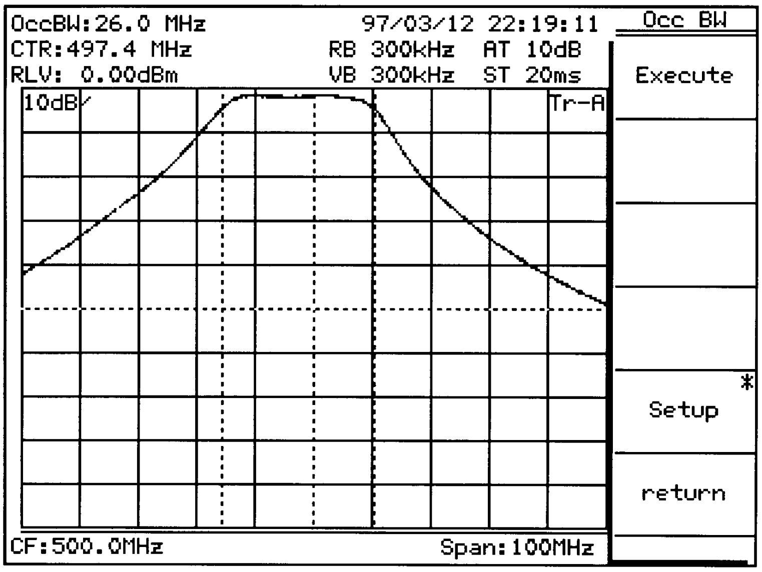
MKR:502.0MHz
-1.84dBm
RLV: 0.00dBm
97/03/12 22:13:22
RB 300kHz AT 10dB
VB 300kHz ST 20ms
CF:500.0MHz
Span:100MHz
TG Out On Off
Output Level 0.0dBm
Attenuator Hold On Off

- When the TG output level is set to other than 0 dBm, the insertion loss can be read in dB unit by setting the marker level display to the relative value from the reference level, as the following procedures.
  - Setting the display-line to On. Setting the display-line level to the same as the TG output level. Setting the marker level display mode to the relative value
    Displaying the 2nd page of the TG menu: [TG], F5: <<Normalize>>
    F3: <<Display Line On Off>>
    F4: <<Display Line Level>>, (Setting the display-line level to the same as the TG output level)
    F5: <<Marker Level Abs <u>Rel</u>>>

(3) Measuring center frequency and 3dB bandwidth

Using the measurement function of the occupied bandwidth, measures the center frequency and 3dB bandwidth of the BPF.

- Setting xdB method and 3dB Down of the Occ BW measurement
  Displaying the 2nd page of the Measure menu : [Measure], [More], F1: <<Occ BW>>, F5: <<Setup>>, F1: <<Method N% of Pwr xdB Down>>, F3: <<xdB Value>>, [3], [dBm]
- Executing the Occ BW measurement
  Displaying the 2nd page of the Measure menu: [Measure], [More], F1: <<Occ BW>>, F1: <<Execute>>

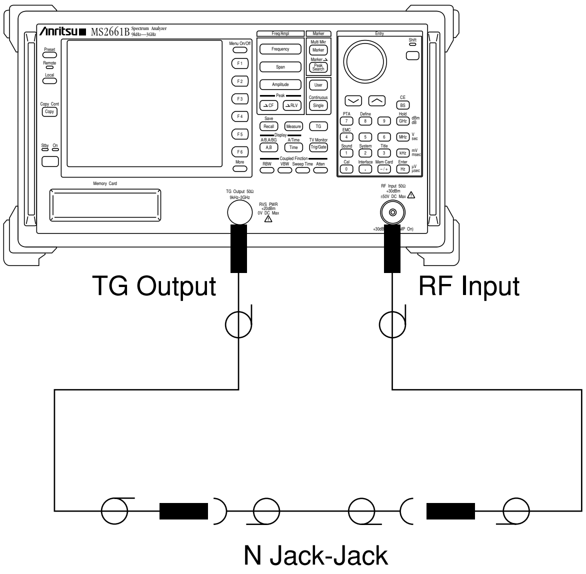


```
OccBW:26.0 MHz              97/03/12 22:19:11
CTR:497.4 MHz           RB 300kHz  AT 10dB
RLV: 0.00dBm            VB 300kHz  ST 20ms
CF:500.0MHz                       Span:100MHz
```

3dB-Bandwidth and Insertion-Loss Accurate Measurement

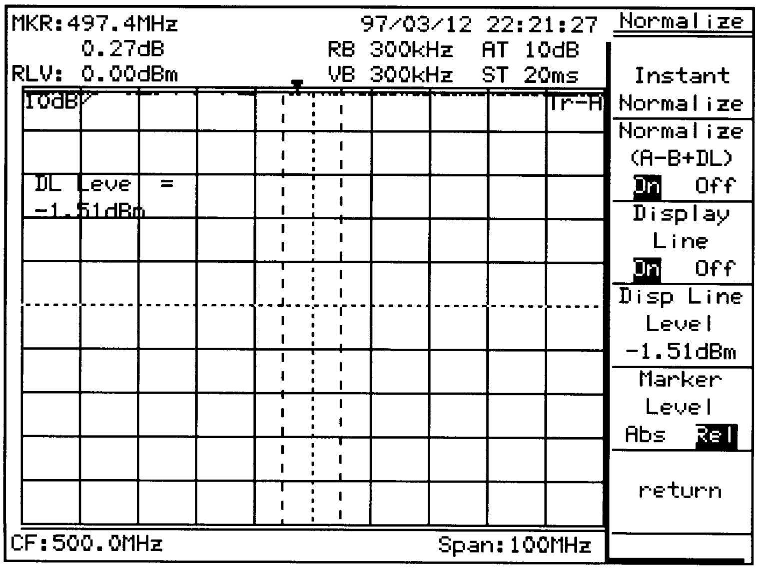
When accurate measurement required, the measurement level accuracy of the spectrum analyzer and insertion loss of the connecting cables must be considered. In this case, use the normalize function to calibrate these error factors.
Accurate 3dB-bandwidth/insertion-loss measurement procedure by using the normalize function, is shown below.

(1) Measuring and calibrating (normalizing) the compensation factor of measurement system
Remove the BPF, and connect only the coaxial cables.



Measuring the compensation factor of the measurement system to calibrate the frequency characteristics, as shown below.

- Initializing the spectrum analyzer
  [Preset]
- Setting center frequency to 500 MHz
  [Frequency], [5], [0], [0], [MHz]
- Setting span to 100 MHz
  [Span], [1], [0], [0], [MHz]
- Setting reference level to 0 dBm
  [Amplitude], [0], [dBm]
- Setting TG to On
  [TG], F1: <<TG On Off>>
- Executing the instant normalize function
  [More], Displaying the 2nd page of the TG menu : F1: <<Instant Normalize>>



```
MKR:497.4MHz              97/03/12 22:21:27
      0.27dB            RB 300kHz  AT 10dB
RLV:  0.00dBm           VB 300kHz  ST 20ms
10dB/                                  Tr-A
 DL Level =
-1.51dBm
CF:500.0MHz                    Span:100MHz
```

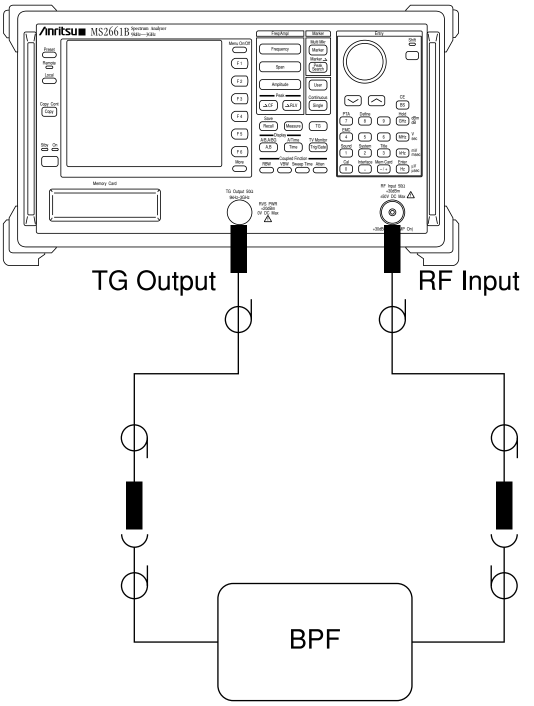
Note: Before executing the instant normalize function, turn the Normalize (A-B+DL) to Off, as shown below.

Displaying the 2nd page of the TG menu: [TG], [More], Turning the normalize (A-B+DL) function to Off: F2: <<Normalize (A-B+DL) On Off>>

The instant normalize function normalizes the current displaying Trace-A waveform.

(2) Setup

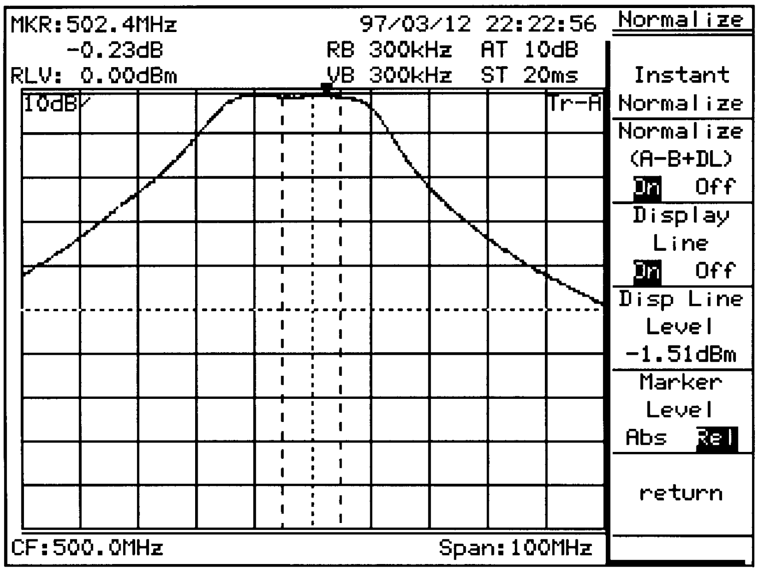
Connect the TG Output to BPF input, and BPF output to RF Input with a coaxial cable, respectively.



(3) Measuring characteristics

The following figure is obtained as the measurement results.

The marker level is displayed in the relative mode by setting the display-line level (normalized flat level) to the reference value. So, the marker level indicates the insertion loss, directly.



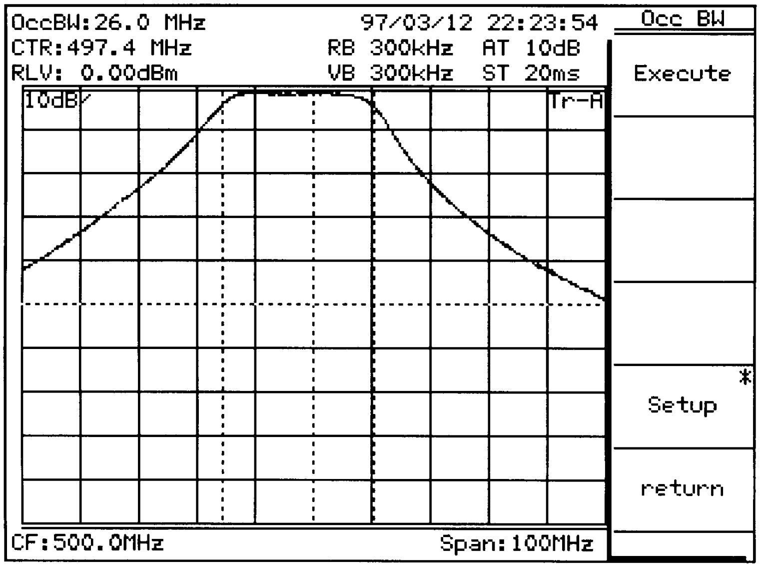
```
MKR:502.4MHz                97/03/12 22:22:56
    -0.23dB             RB 300kHz  AT 10dB
RLV: 0.00dBm            VB 300kHz  ST 20ms
10dB/                                    Tr-A
CF:500.0MHz                     Span:100MHz
```

(4) Measuring center frequency and 3dB bandwidth

Using the measurement function of the occupied bandwidth, measures the center frequency and 3dB bandwidth of the BPF.

- Setting xdB method and 3dB Down of the Occ BW measurement
  Displaying the 2nd page of the Measure menu : [Measure], [More], F1: <<Occ BW>>, F5: <<Setup>>, F1: <<Method N% of Pwr xdB DOWN>>, F3: <<xdB Value>>, [3], [dBm]
- Executing the Occ BW measurement

  Displaying the 2nd page of the Measure menu : [Measure], [More], F1: <<Occ BW>>, F1: <<Execute>>



OccBW:26.0 MHz 97/03/12 22:23:54
CTR:497.4 MHz RB 300kHz AT 10dB
RLV: 0.00dBm VB 300kHz ST 20ms
CF:500.0MHz Span:100MHz

Note: Use the well impedance-matched coaxial cables between the spectrum analyzer and the device under test (BPF).

Especially over 2 GHz frequency, the cable selection becomes important for the accurate measurement.

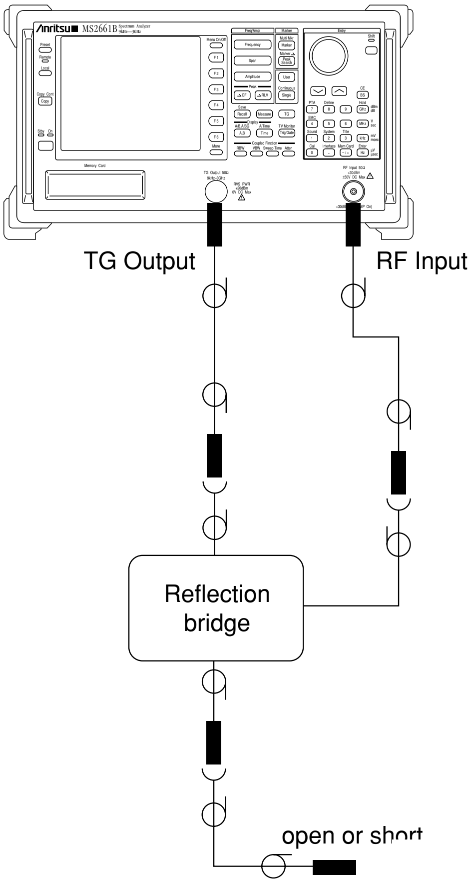
Reflection Characteristics Measurement

Reflection characteristics can be measured with a TG and a reflection bridge.
In this paragraph, reflection characteristics measurement of a BPF is described using the reflection bridge of the Wiltron 60NF50-1 or 62NF75.
BPF characteristics:

- Center frequency: 500.9 MHz
- 3dB bandwidth: 26.6 MHz
- Input/Output connector: N plug (50 Ω) or NC plug (75 Ω)

In the reflection characteristics measurement, since the insertion loss of the reflection bridge is large, use the normalize function.

(1) Measuring and calibrating (normalizing) the compensation factor of measurement system
As shown below, connect the TG Output to the Input port of the 60NF50-1 or 62N75, and the RF Input to the Output port of the 60NF50-1 or 62N75, with a coaxial cable, respectively.
Set the Test port of the 60NF50-1 or 62N75 to open or short. Over 2 GHz, short is recommended to reduce the capacitive effect.



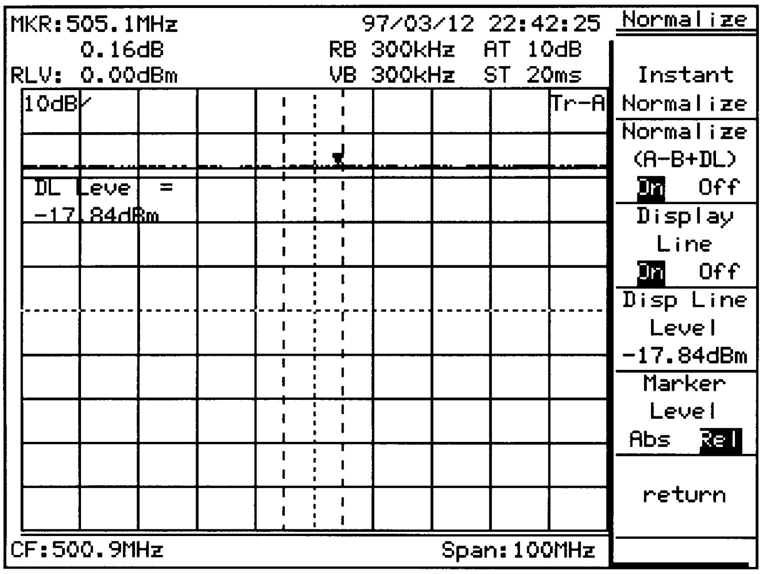
Measuring the compensation factor of the measurement system to calibrate the frequency characteristics, as shown below.

- Initializing the spectrum analyzer
  [Preset]
- Setting center frequency to 500.9 MHz
  [Frequency], [5], [0], [0], [.], [9], [MHz]
- Setting span to 100 MHz
  [Span], [1], [0], [0], [MHz]
- Setting reference level to 0 dBm
  [Amplitude], [0], [dBm]
- Setting TG to On
  [TG], F1: <<TG On Off>>
- Executing the instant normalize function
  Displaying the 2nd page of the TG menu: [More], F1: <<Instant Normalize>>

Note: Before executing the instant normalize function, turn the Normalize (A-B+DL) to Off, as shown below.

Displaying the 2nd page of the TG menu : [TG], [More], Turning the normalize (A-B+DL) function to Off: F2: <<Normalize (A-B+DL) On Off>>

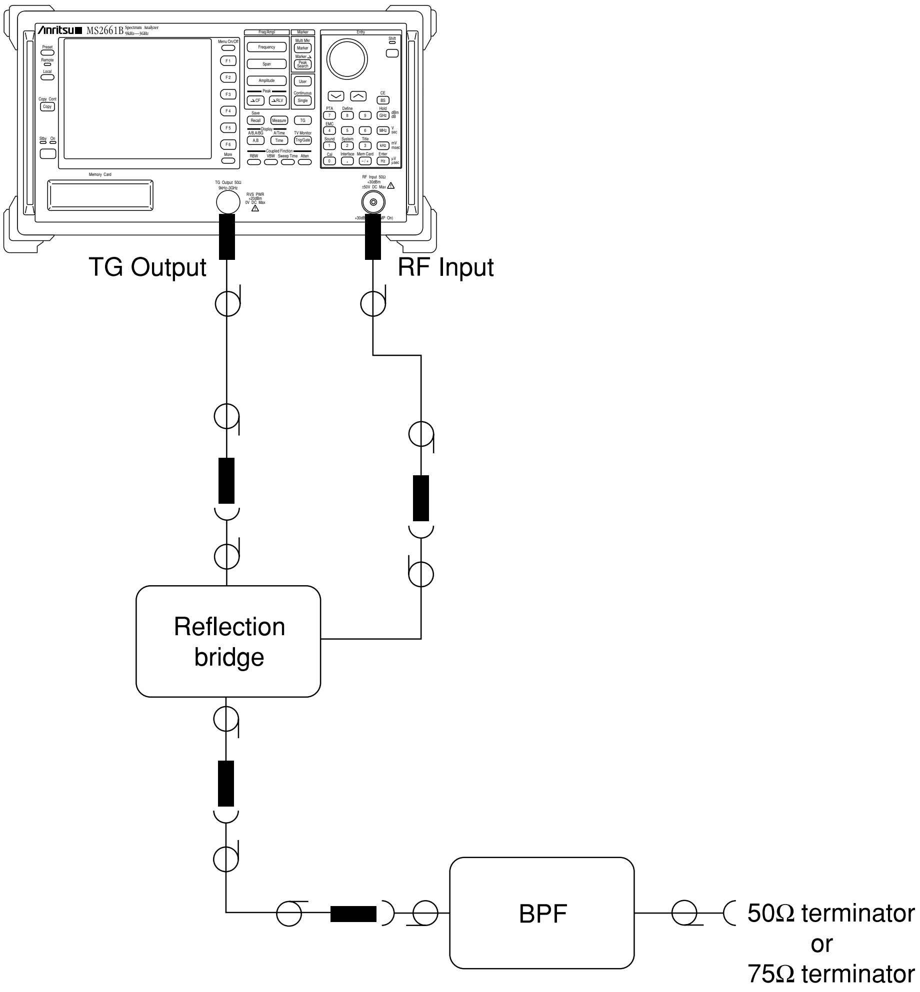
The instant normalize function normalizes the current displaying Trace-A waveform.



```
MKR:505.1MHz              97/03/12 22:42:25
     0.16dB           RB 300kHz  AT 10dB
RLV: 0.00dBm          VB 300kHz  ST 20ms
10dB/                                  Tr-A
DL Leve =
-17.84dBm
CF:500.9MHz                   Span:100MHz
```

(2) Setup

Connect the BPF to the Test port of the 60NF50-1 or 62N75.



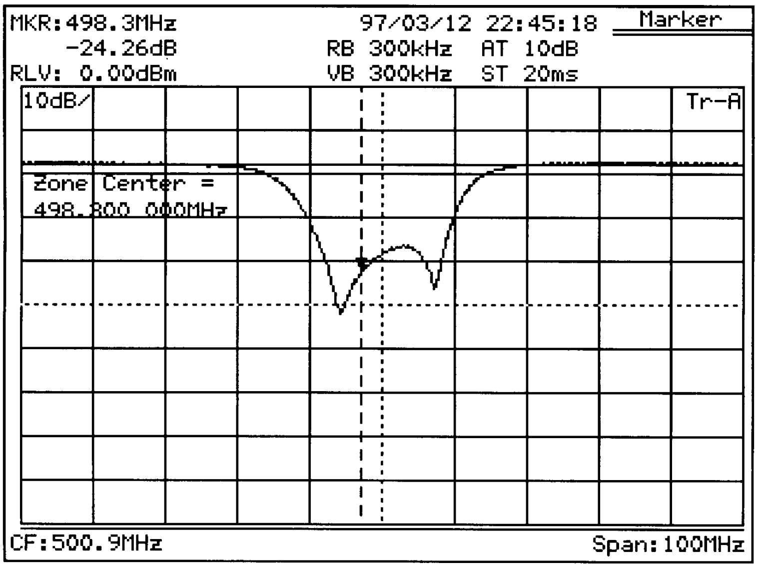
(3) Measuring characteristics

The following figure is obtained as the measurement results.

The marker level is displayed in the relative mode by setting the display-line level (normalized flat level) to the reference value. So, the marker level indicates the refraction loss, directly.

Take the following procedure.

- Turning the marker function to On (Normal mode)
  [Marker]
- Sets the marker zone width to Spot
  [Marker], F5: <<Marker Width>>, F1: <<Spot>>, F6: <<Return>>
- Moving the marker to the desired point to be measured by rotary knob



```
MKR:498.3MHz          97/03/12 22:45:18
    -24.26dB          RB 300kHz  AT 10dB
RLV: 0.00dBm          VB 300kHz  ST 20ms
 Zone Center =
 498.800 000MHz
CF:500.9MHz                        Span:100MHz
```

Notes on Active Device Measurement

When measuring any active device (including an amplifier etc.), notes the following cautions.

CAUTION ⚠

- Maximum DC voltage ratings: RF Input ±50 Vdc (standard), or ±100 Vdc (with Option 22), TG Output 0 Vdc
- Maximum AC power ratings: RF Input +30 dBm, ±10 dBm, When Option 08 Pre-amplifier is On. TG Output +20 dBm, +25 dBm for Option 22
- NEVER input a >+30 dBm (+10 dBm for Option 08) and >±50 Vdc power to RF Input.
- NEVER input a >+20 dBm and >0 Vdc reverse power (reflected power from DUT/power-splitter/directional-coupler) to TG Output.
- Excessive power may damage the internal circuits.

When measuring the transmission characteristics of any active device including an amplifier, note to decrease the TG output level by the amount of the amplifier gain. The procedures and notes are the same as the BPF, described in the previous paragraphs.

SECTION 15

EMC, Measurement of Field Strength

This section gives the explanation and cautions on the operation procedure of field strength measurement using MS2650/60B series spectrum analyzer, and EMC measurement by combining the analyzer with Option 12 or 13.

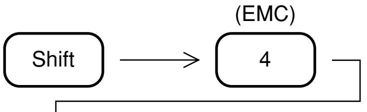
TABLE OF CONTENTS

Section 15
EMC, Measurement of Field Strength

Section 15 EMC, Measurement of Field Strength
This section gives the explanation and cautions on the operation procedure of field strength measurement using MS2650/60B/C series spectrum analyzer, and EMC measurement by combining the analyzer with Option 12 or 13.

Menu of EMC

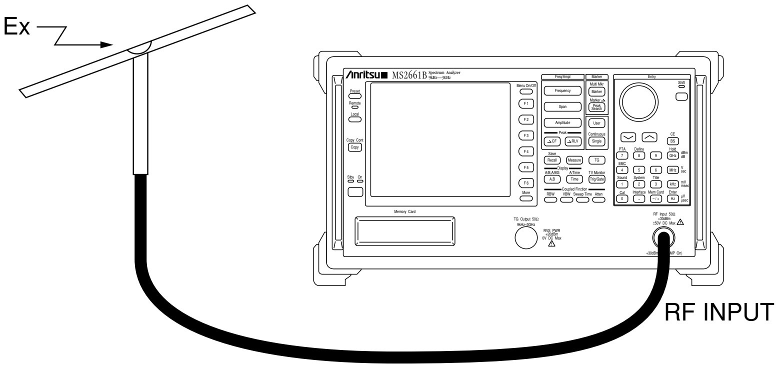
This system is equipped with field strength measuring functions such as an antenna factor correction function or the like. Also, by mounting Option 12 or 13 and QP detector, EMC (conduction jammer, radiation jammer) measurement utilizing a QP/Average detector can be performed.



QP/EMC On Off	Press this key to use QP/Average detector. (Need OPT 12 or 13)
QP Det	Sets the detection mode at "QP Detection". (Need OPT 12 or 13)
Average Det	Sets the detection mode at "Average Detection". (Need OPT 12 or 13)
Peak Det	Sets the detection mode at "Peak Detection". (OPT 12 or 13 not required)
RBW Manual	Manual setting of RBW. When a QP/Average detector is used, RBW for EMC measurement (200 Hz, 9 k Hz, 120 k Hz: Opt 12, or 9 k Hz, 120 k Hz: Opt 13) only can be selected.
RBW Auto	Automatic setting of RBW. When a QP/Average detector is used, an optimum RBW for EMC measurement is selected automatically in accordance with stop frequency (or tuning frequency).
Antenna Factor *	Selects/operates antenna correction factor for performing field strength measurement.
Unit *	Selects the unit for level indication.
QP/EMC Cal	Performs internal calibration for performing the measurement using a QP/Average detector.

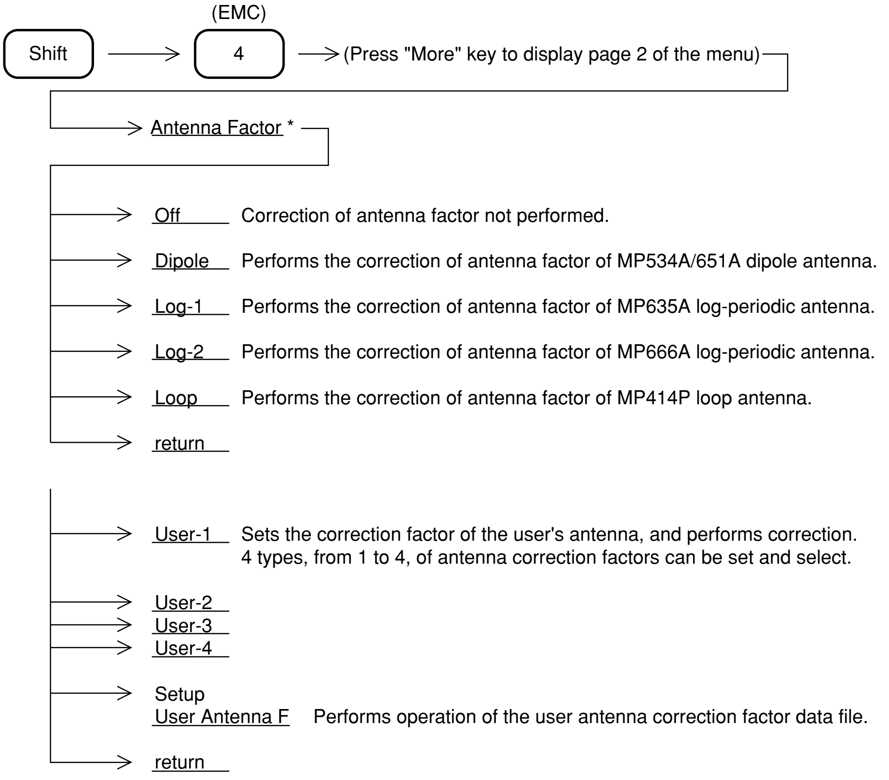
Field Strength Measurement

In field strength measurement, incoming wave is received and measured by connecting a measuring antenna and RF Input connector of a spectrum analyzer with a coaxial cable as in the illustration below.



Direct Measurement of Field Strength Using a Designated Antenna

The system has a built-in antenna factor correction process for the purpose of measurements using antenna. By selecting an antenna to be used from the menu, field strength can be directly indicated.



Off Correction of antenna factor not performed.

Dipole Performs the correction of antenna factor of MP534A/651A dipole antenna.

Log-1 Performs the correction of antenna factor of MP635A log-periodic antenna.

Log-2 Performs the correction of antenna factor of MP666A log-periodic antenna.

Loop Performs the correction of antenna factor of MP414P loop antenna.

return

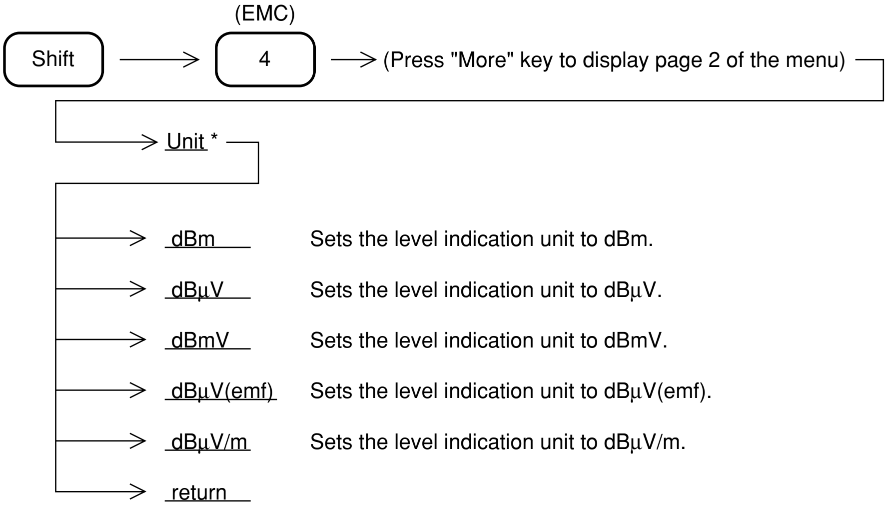
User-1 Sets the correction factor of the user's antenna, and performs correction.
4 types, from 1 to 4, of antenna correction factors can be set and select.

User-2
User-3
User-4

Setup
User Antenna F Performs operation of the user antenna correction factor data file.

return

When an antenna to be used is selected, the indication unit of the levels is set to "dBµV/m" automatically. Correction factors of some antennas are defined by open terminal. In that case, set the unit at "dBµV (emf)" (open terminal).



dBm	Sets the level indication unit to dBm.
dBµV	Sets the level indication unit to dBµV.
dBmV	Sets the level indication unit to dBmV.
dBµV(emf)	Sets the level indication unit to dBµV(emf).
dBµV/m	Sets the level indication unit to dBµV/m.
return	

Method to Seek Field Strength by Calculation

Generally, field strength is given by (Ex=Px+K0).

Px: measured value (dBμV)
K0: antenna calibration factor (dB) .... The factor for converting the measured voltage {dBμV (final value)} into field strength (dBμV/m)

a. Set the level indication unit to dBμV, and measure the received signal by dBμV.
b. Refer the chart attached to the antenna for the value K0, and calculate the appropriate field strength.

Note
In some antennas, the antenna calibration factor is defined by the following;

Ex=Px-K0
Px: measured value (dBμV (emf))
K0: antenna calibration factor (dB)

In this case, press [F6] function key to select UNIT dBμe, and measure the received signal by dBμV (emf).

User Antenna Factor Setting, Save/Load to /from a Memory Card

User Antenna Factor Setting

An user antenna factor can be programmed from a personal computer using RS232C or GPIB interface, or using PTA program. Following is an example of PTA program when programming from PTA.

```
100 '####### Makeup Antenna Factor table #######
110 '------- MP534A -------
120 '
130 DIM UANTDT(200,2)
140 DIM TMPCF$(15),TMP$(50)
150 DIM ANTLBL$(30)
160 HOME & ERASE
170 LOCATE(2,10) & PRINT "Program running"
180 LOCATE(2,11) & PRINT "Please Wait a minute"
190 GOSUB *DTSET
200 GOSUB *SCRDT
210 HOME & ERASE
220 LOCATE(2,10) & PRINT "Finish"
230 STOP
240 '
250 '
260 '################ AntennaFactor data into table ################
270 *SCRDT
280 LOCATE(2,13) & PRINT ANTLBL$
290 WRITE 1000,"UANTF 1"
300 WRITE 1000,"ANTFCLR"
310 '
320 FOR I=0 TO DTSTP
330 L=DTSTP-I
340 LOCATE(5,14) & PRINT L
350 CFDT=UANTDT(I,0)*1E6
360 CRCDT=UANTDT(I,1)
370 TMPI$=STR$(I)
380 TMPCF$=STR$(CFDT)
```

```
390 TMPDT$=STR$(CRCDT)
400 TMP$=","+TMPCF$+","+TMPDT$
410 WRITE 1000,"ANTFACT ",I,TMP$
420 NEXT I
430 TMP$=""""+ANTLBL$+""""
440 WRITE 1000,"ANTLABEL 1,",TMP$
450 '
460 RETURN
470 '
480 '################### Correction data setting ##################
490 *DTSET
500 UANTDT(0,0)=23 & UANTDT(0,1)=-10   '<-------- Freq & Level
510 UANTDT(1,0)=25 & UANTDT(1,1)=-9.6
520 UANTDT(2,0)=26 & UANTDT(2,1)=-9.2
530 UANTDT(3,0)=27 & UANTDT(3,1)=-8.9
540 UANTDT(4,0)=28 & UANTDT(4,1)=-8.6
550 UANTDT(5,0)=29 & UANTDT(5,1)=-8.3
560 UANTDT(6,0)=30 & UANTDT(6,1)=-8.0
570 UANTDT(7,0)=31 & UANTDT(7,1)=-7.7
580 UANTDT(8,0)=32 & UANTDT(8,1)=-7.4
590 UANTDT(9,0)=33 & UANTDT(9,1)=-7.1
600 UANTDT(10,0)=34 & UANTDT(10,1)=-6.9
610 UANTDT(11,0)=35 & UANTDT(11,1)=-6.6
620 UANTDT(12,0)=36 & UANTDT(12,1)=-6.3
630 UANTDT(13,0)=37 & UANTDT(13,1)=-6.1
640 UANTDT(14,0)=38 & UANTDT(14,1)=-5.9
650 UANTDT(15,0)=39 & UANTDT(15,1)=-5.7
660 UANTDT(16,0)=40 & UANTDT(16,1)=-5.4
670 UANTDT(17,0)=41 & UANTDT(17,1)=-5.1
680 UANTDT(18,0)=42 & UANTDT(18,1)=-5.0
690 UANTDT(19,0)=43 & UANTDT(19,1)=-4.8
700 UANTDT(20,0)=44 & UANTDT(20,1)=-4.6
710 UANTDT(21,0)=45 & UANTDT(21,1)=-4.4
720 UANTDT(22,0)=46 & UANTDT(22,1)=-4.2
730 UANTDT(23,0)=47 & UANTDT(23,1)=-4.0
740 UANTDT(24,0)=48 & UANTDT(24,1)=-3.8
750 UANTDT(25,0)=49 & UANTDT(25,1)=-3.6
760 UANTDT(26,0)=50 & UANTDT(26,1)=-3.3
770 UANTDT(27,0)=52 & UANTDT(27,1)=-3.0
780 UANTDT(28,0)=54 & UANTDT(28,1)=-2.7
```

```
790 UANTDT(29,0)=56 & UANTDT(29,1)=-2.3
800 UANTDT(30,0)=58 & UANTDT(30,1)=-1.9
810 UANTDT(31,0)=60 & UANTDT(31,1)=-1.6
820 UANTDT(32,0)=62 & UANTDT(32,1)=-1.4
830 UANTDT(33,0)=64 & UANTDT(33,1)=-1.2
840 UANTDT(34,0)=66 & UANTDT(34,1)=-0.8
850 UANTDT(35,0)=68 & UANTDT(35,1)=-0.5
860 UANTDT(36,0)=70 & UANTDT(36,1)=-0.2
870 UANTDT(37,0)=72 & UANTDT(37,1)=0.0
880 UANTDT(38,0)=74 & UANTDT(38,1)=0.2
890 UANTDT(39,0)=76 & UANTDT(39,1)=0.5
900 UANTDT(40,0)=78 & UANTDT(40,1)=0.8
910 UANTDT(41,0)=81 & UANTDT(41,1)=1.1
920 UANTDT(42,0)=84 & UANTDT(42,1)=1.3
930 UANTDT(43,0)=86 & UANTDT(43,1)=1.6
940 UANTDT(44,0)=88 & UANTDT(44,1)=1.8
950 UANTDT(45,0)=91 & UANTDT(45,1)=2.1
960 UANTDT(46,0)=94 & UANTDT(46,1)=2.3
970 UANTDT(47,0)=96 & UANTDT(47,1)=2.6
980 UANTDT(48,0)=98 & UANTDT(48,1)=2.8
990 UANTDT(49,0)=101 & UANTDT(49,1)=3.1
1000 UANTDT(50,0)=104 & UANTDT(50,1)=3.3
1010 UANTDT(51,0)=106 & UANTDT(51,1)=3.5
1020 UANTDT(52,0)=108 & UANTDT(52,1)=3.7
1030 UANTDT(53,0)=111 & UANTDT(53,1)=3.9
1040 UANTDT(54,0)=114 & UANTDT(54,1)=4.1
1050 UANTDT(55,0)=116 & UANTDT(55,1)=4.3
1060 UANTDT(56,0)=119 & UANTDT(56,1)=4.5
1070 UANTDT(57,0)=121 & UANTDT(57,1)=4.9
1080 UANTDT(58,0)=127 & UANTDT(58,1)=5.2
1090 UANTDT(59,0)=132 & UANTDT(59,1)=5.6
1100 UANTDT(60,0)=137 & UANTDT(60,1)=5.9
1110 UANTDT(61,0)=142 & UANTDT(61,1)=6.3
1120 UANTDT(62,0)=147 & UANTDT(62,1)=6.6
1130 UANTDT(63,0)=152 & UANTDT(63,1)=6.9
1140 UANTDT(64,0)=157 & UANTDT(64,1)=7.2
1150 UANTDT(65,0)=162 & UANTDT(65,1)=7.5
1160 UANTDT(66,0)=167 & UANTDT(66,1)=7.7
1170 UANTDT(67,0)=172 & UANTDT(67,1)=8.0
1180 UANTDT(68,0)=177 & UANTDT(68,1)=8.3
```

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1190 UANTDT(69,0)=182 & UANTDT(69,1)=8.5
1200 UANTDT(70,0)=187 & UANTDT(70,1)=8.8
1210 UANTDT(71,0)=192 & UANTDT(71,1)=9.0
1220 UANTDT(72,0)=197 & UANTDT(72,1)=9.2
1230 UANTDT(73,0)=202 & UANTDT(73,1)=9.5
1240 UANTDT(74,0)=207 & UANTDT(74,1)=9.7
1250 UANTDT(75,0)=212 & UANTDT(75,1)=9.9
1260 UANTDT(76,0)=217 & UANTDT(76,1)=10.1
1270 UANTDT(77,0)=222 & UANTDT(77,1)=10.3
1280 UANTDT(78,0)=227 & UANTDT(78,1)=10.5
1290 UANTDT(79,0)=232 & UANTDT(79,1)=10.7
1300 UANTDT(80,0)=237 & UANTDT(80,1)=10.9
1310 UANTDT(81,0)=242 & UANTDT(81,1)=11.1
1320 UANTDT(82,0)=247 & UANTDT(82,1)=11.3
1330 UANTDT(83,0)=252 & UANTDT(83,1)=11.5
1340 UANTDT(84,0)=257 & UANTDT(84,1)=11.7
1350 UANTDT(85,0)=262 & UANTDT(85,1)=11.9
1360 UANTDT(86,0)=267 & UANTDT(86,1)=12.1
1370 UANTDT(87,0)=272 & UANTDT(87,1)=12.3
1380 UANTDT(88,0)=277 & UANTDT(88,1)=12.4
1390 UANTDT(89,0)=282 & UANTDT(89,1)=12.6
1400 UANTDT(90,0)=287 & UANTDT(90,1)=12.8
1410 UANTDT(91,0)=292 & UANTDT(91,1)=13.0
1420 UANTDT(92,0)=297 & UANTDT(92,1)=13.1
1430 UANTDT(93,0)=302 & UANTDT(93,1)=13.3
1440 UANTDT(94,0)=307 & UANTDT(94,1)=13.5
1450 UANTDT(95,0)=312 & UANTDT(95,1)=13.6
1460 UANTDT(96,0)=317 & UANTDT(96,1)=13.8
1470 UANTDT(97,0)=322 & UANTDT(97,1)=14.0
1480 UANTDT(98,0)=327 & UANTDT(98,1)=14.1
1490 UANTDT(99,0)=332 & UANTDT(99,1)=14.3
1500 UANTDT(100,0)=337 & UANTDT(100,1)=14.4
1510 UANTDT(101,0)=342 & UANTDT(101,1)=14.6
1520 UANTDT(102,0)=347 & UANTDT(102,1)=14.7
1530 UANTDT(103,0)=352 & UANTDT(103,1)=14.8
1540 UANTDT(104,0)=357 & UANTDT(104,1)=15.0
1550 UANTDT(105,0)=362 & UANTDT(105,1)=15.1
1560 UANTDT(106,0)=367 & UANTDT(106,1)=15.3
1570 UANTDT(107,0)=372 & UANTDT(107,1)=15.4
1580 UANTDT(108,0)=377 & UANTDT(108,1)=15.5
```

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1590 UANTDT(109,0)=382 & UANTDT(109,1)=15.7
1600 UANTDT(110,0)=387 & UANTDT(110,1)=15.8
1610 UANTDT(111,0)=392 & UANTDT(111,1)=15.9
1620 UANTDT(112,0)=397 & UANTDT(112,1)=16.1
1630 UANTDT(113,0)=402 & UANTDT(113,1)=16.2
1640 UANTDT(114,0)=407 & UANTDT(114,1)=16.3
1650 UANTDT(115,0)=412 & UANTDT(115,1)=16.4
1660 UANTDT(116,0)=417 & UANTDT(116,1)=16.5
1670 UANTDT(117,0)=422 & UANTDT(117,1)=16.7
1680 UANTDT(118,0)=427 & UANTDT(118,1)=16.8
1690 UANTDT(119,0)=432 & UANTDT(119,1)=16.9
1700 UANTDT(120,0)=437 & UANTDT(120,1)=17.0
1710 UANTDT(121,0)=442 & UANTDT(121,1)=17.1
1720 UANTDT(122,0)=447 & UANTDT(122,1)=17.2
1730 UANTDT(123,0)=452 & UANTDT(123,1)=17.4
1740 UANTDT(124,0)=457 & UANTDT(124,1)=17.5
1750 UANTDT(125,0)=462 & UANTDT(125,1)=17.6
1760 UANTDT(126,0)=467 & UANTDT(126,1)=17.7
1770 UANTDT(127,0)=472 & UANTDT(127,1)=17.8
1780 UANTDT(128,0)=477 & UANTDT(128,1)=17.9
1790 UANTDT(129,0)=482 & UANTDT(129,1)=18.0
1800 UANTDT(130,0)=487 & UANTDT(130,1)=18.1
1810 UANTDT(131,0)=492 & UANTDT(131,1)=18.2
1820 UANTDT(132,0)=497 & UANTDT(132,1)=18.3
1830 UANTDT(133,0)=502 & UANTDT(133,1)=18.4
1840 UANTDT(134,0)=507 & UANTDT(134,1)=18.5
1850 UANTDT(135,0)=513 & UANTDT(135,1)=18.6
1860 UANTDT(136,0)=518 & UANTDT(136,1)=18.7
1870 UANTDT(137,0)=520 & UANTDT(137,1)=18.8
1880 DTSTP=137'<---------------------------- Number of DATA
1890 ANTLBL$="  MP534A    Dipole"'<---------- Antenna Factor Label
1900 RETURN
```
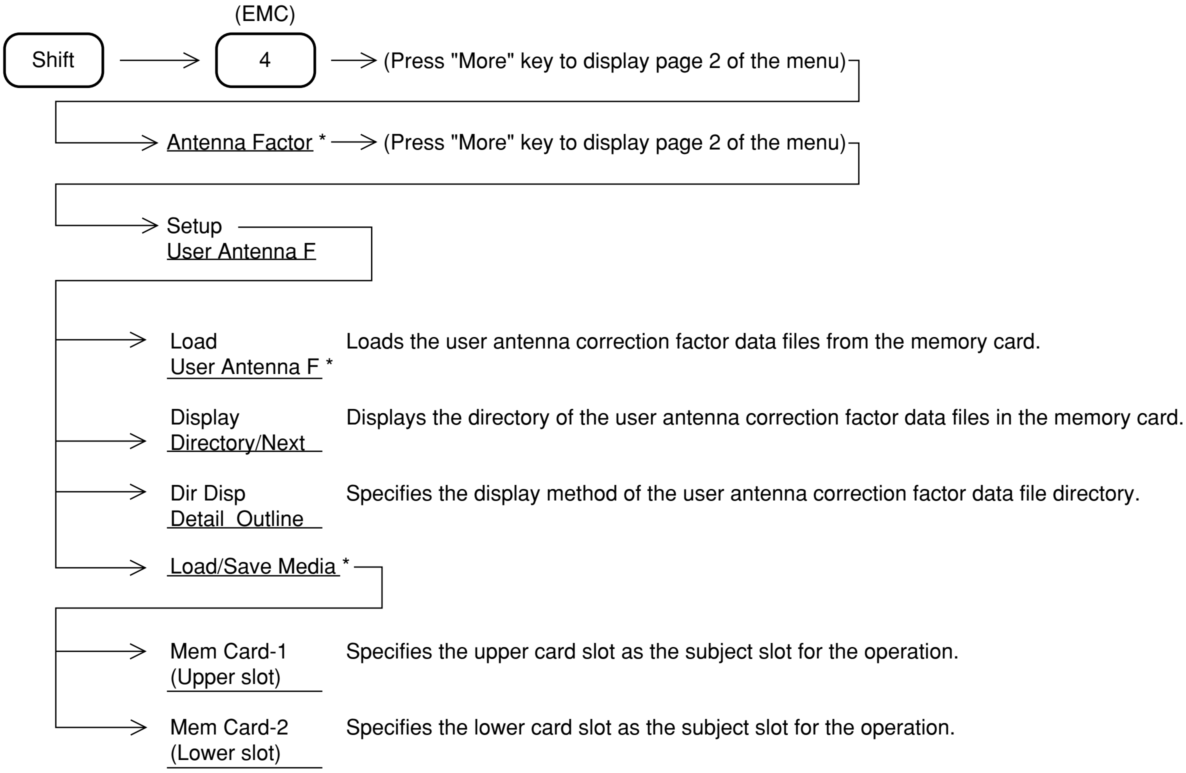

By attaching a label to the antenna correction factor, a label such as the name of the antenna can be displayed on the user antenna factor selection menu.

Save/Load of User antenna factor To/From a Memory Card

The antenna correction factor data programmed from RS232C/GPIB or PTA can be saved in a memory card. The antenna correction factor data saved in the memory card can be reused by loading.



Load User Antenna F *: Loads the user antenna correction factor data files from the memory card.

Display Directory/Next: Displays the directory of the user antenna correction factor data files in the memory card.

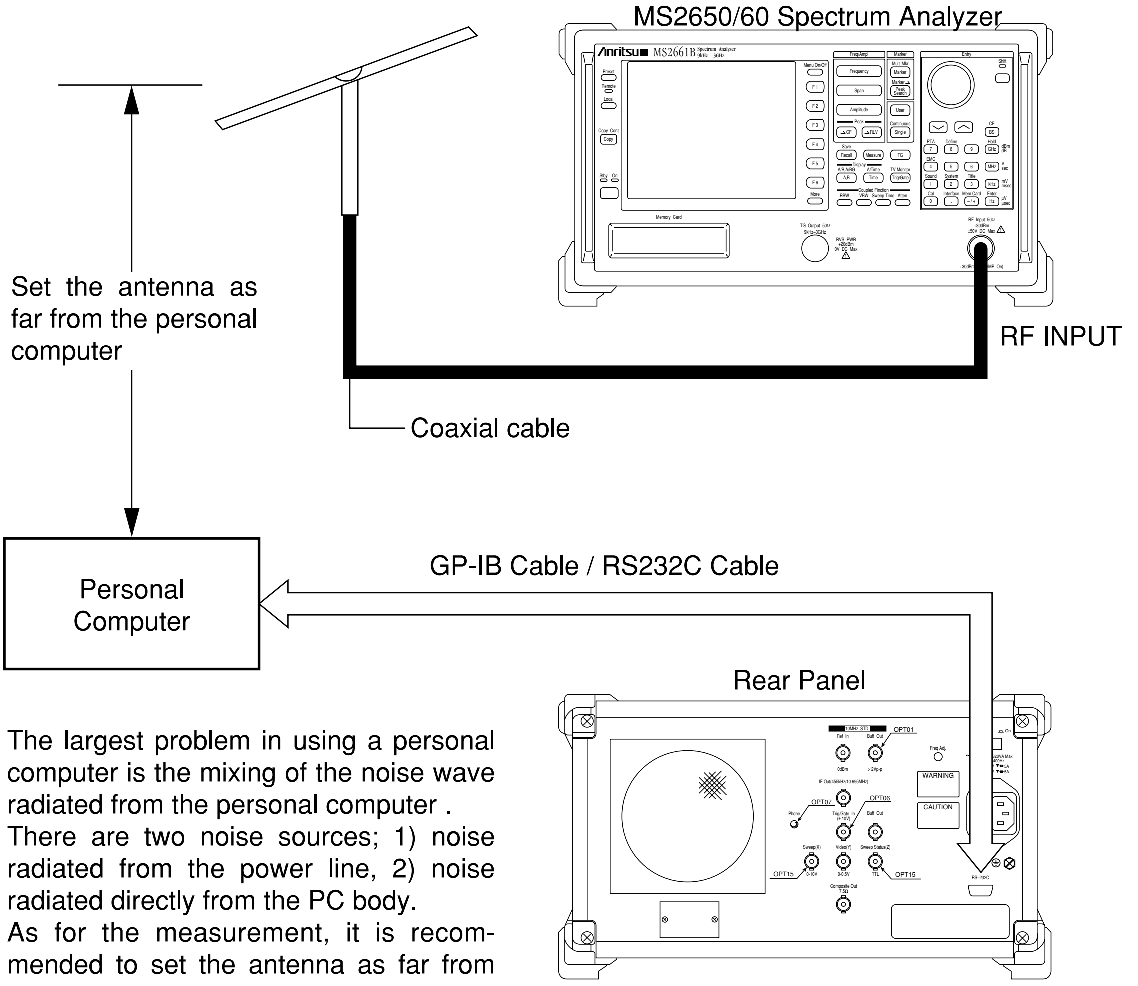
Dir Disp Detail Outline: Specifies the display method of the user antenna correction factor data file directory.

Mem Card-1 (Upper slot): Specifies the upper card slot as the subject slot for the operation.

Mem Card-2 (Lower slot): Specifies the lower card slot as the subject slot for the operation.

Caution: When Performing Field Strength Automatic Measurement

When automatically measuring field strength, it is done by RS232C or GPIB control. Since a personal computer is used in such a case, it is necessary to note the following;



The largest problem in using a personal computer is the mixing of the noise wave radiated from the personal computer .
There are two noise sources; 1) noise radiated from the power line, 2) noise radiated directly from the PC body.
As for the measurement, it is recommended to set the antenna as far from the personal computer , Interface cable, and AC line or the like as possible.
Also, utilizing the directivity of antenna, turn the antenna or place the other equipment so as to minimize the reception of the noise.

Caution: When Connecting With a Personal Computer

EMC Measurement

We often experience difficulties when watching TV or listening radio that the images don't appear properly or the sound is mixed with noise due to electric waves generated by home electrical appliances such as a vacuum cleaner, or information tools such as a personal computer.

Such noise may cause, not only a jam of other equipment, but also a serious accident. Therefore, it has to be controlled EMC (Electro Magnetic Compatibility) by regulations.

As for such regulations, CISPR has made an admonition, and presently, many nations are enforcing the regulations complying this admonition.

This system, by mounting Option 12 or 13, is capable of performing measurements in accordance with this admonition by CISPR.

Measurement of study

According to its propagation route, jammer is classified into two types, radioactive jammer and conductive jammer. These two types of jammers are measured by QP (Quasi-Peak) value detection and average value detection after selecting measuring frequency range and IF bandwidth as below.

Item	Frequency (IF bandwidth)	Detection mode	Explanation
Radioactive Jammer	10 to 50 kHz (6 dB bandwidth 200 Hz) 150 kHz to 30 MHz(6 dB bandwidth 9 kHz) 30 to 1000 MHz(6 dB bandwidth 120 kHz)	QP Detection	Propagated by radiated into the air, and jams other equipment.
Conductive Jammer	10 to 150 kHz (6 dB bandwidth 200 Hz) 150 kHz to 30 MHz (6 dB bandwidth 9 kHz)	QP Detection Average Detection	Conducted through power lines or connector lines and interferes other equipment.

Basic Idea of the Measurement

(1) When combining Peak detection mode and QP (Quasi-Peak) detection mode/Average detection mode to perform an effective measurement of a jammer, there are the following differences between Peak mode and QP/Average mode.

① Measured vales in QP/Average mode are smaller than that in Peak mode.

② Since the charging time constant in QP/Average mode is large, the time required for measurement is much longer than that in Peak mode when performing a frequency sweep.

From the reasons above, it is recommended to combine Peak mode in performing the measurement of jammers.

(2) Basic Measuring Procedure

① Receive the whole aspect of a jammer in Peak mode. (Trace A: frequency axis)

② Receive the subject jammer by zero sweep. (Trace Time: time axis)

③ Measure the level of the jammer by switching to QP/Average mode.

(3) Measured Value by Utilizing an Antenna

In measuring a radioactive jammer, the field strength (dB micro/m) of the jammer in (2)③ can be directly read by using a designated antenna. When using an antenna other than the designated antenna, follow the procedure below;

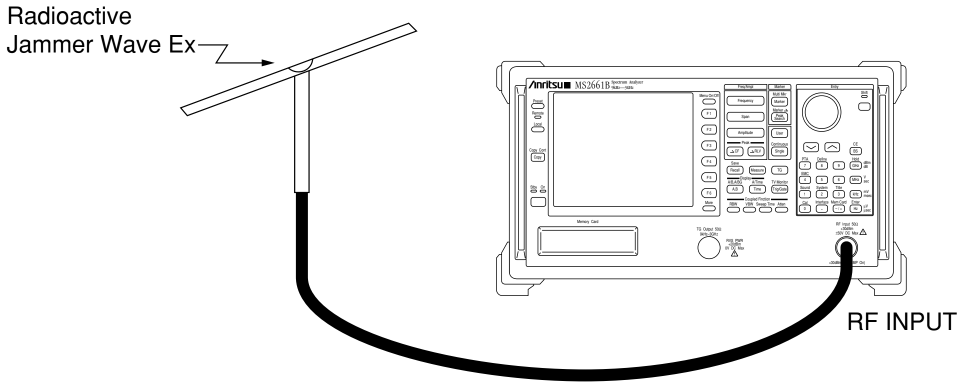
Measured Value = Measured Value of (2)③ – Antenna Factor at Measuring Frequency

By programming the antenna factor into the inner memory of the spectrum analyzer using RS232C or GPIB beforehand, the value can be read directly.

Refer the other for designated/non-designated antennas and field strength measurement itself.

Radioactive Jammer Measurement

(1) Measuring Block



Connect an antenna applicable to the measuring frequency bandwidth to the RF Input of this system.

(2) Measuring Procedure

<u>Preparation</u>

0 QP/EMC Cal :[Shift],[0:Cal],F5:<<QP/EMC Cal>>

<u>Receiving Jammer</u>

1 Preset :[Preset],F1:<<Preset All>>

2 QP/EMC On :Turn On QP/EMC

[Shift], [4:EMC], F1:<<QP/EMC>>
Turning QP/EMC On will set Log scale at 5 dB/Div, RBW at RBW (120 kHz) for EMC, and VBW Off.

3 Antenna Correction Factor Selection

:Select the correction factor of an antenna to be used. When the correction of the antenna factor is done by calculation, this step is unnecessary.
Press [More] key to display page 2 of the QP/EMC menu, F1:<<Antenna Factor>>, select an antenna to be used from Antenna F menu, and press F key, F6:<<return>>.
When one of the antenna correction factor is selected, the level unit is set at "dBμV/m".

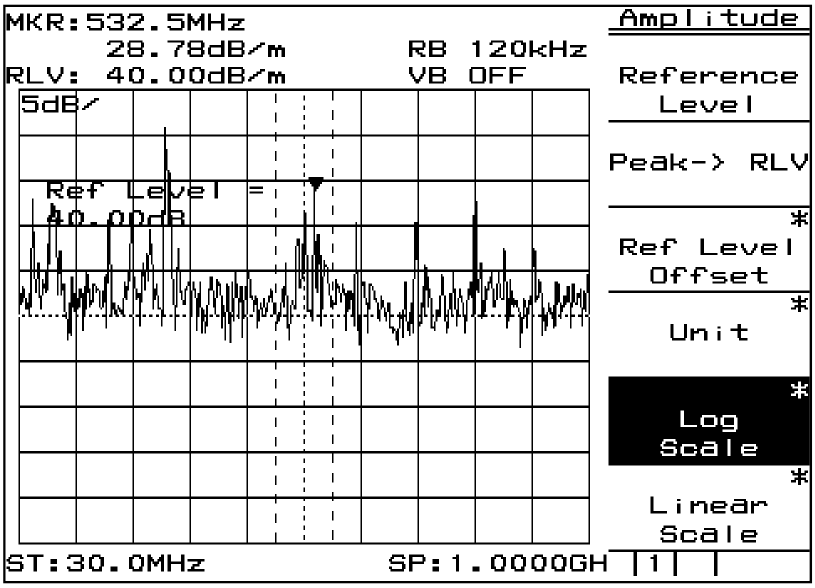
3' Setting Level Unit :When the correction of the antenna factor is done by calculation, set the level unit at "dBμV".
Press [More] key to display page 2 of QP/EMC menu, F2:<<Unit>>, F2:<<dBμV>>, F6:<<return>>.

4 Setting Measuring Frequency Band
: Set a measuring frequency band. (i.e. 30 M Hz to 1000 M Hz)[Frequency],F2:<<Start Freq>>,[3],[0],[M Hz],F2<<Stop Freq>>, [1], [0], [0],[0], [M Hz]

5 Setting RBW Appropriate to the Frequency Band
: Set RBW. (i.e. 120 k Hz)
[Shift],[4:EMC], Press [More] key to display page 1 of QP/EMC menu, F5:<<RBW Manual>>,,[1],[2],[0],[k Hz]

6 Setting Reference Level
: Set a reference level so as to display the signal with the maximum amplitude near the top line of a waveform indicating scale.
It is done by either method below;

- Press [->RLV]. If the maximum amplitude signal is not indicated near the top line, repeat pressing [->RLV] several times.
- Operate [Amplitude],[^],[V] key/knob to set the reference level at the optimum value.



```
MKR:532.5MHz
      28.78dB/m        RB  120kHz
RLV:  40.00dB/m        VB  OFF
5dB/
Ref Level =
40.00dB
ST:30.0MHz          SP:1.0000GH
```

Saturation Level Check

7 Setting Optimum Input Attenuator Value

: Check that the system is not saturated by lowering the attenuator value by 10 dB.
[Atten], Step[V] (Lowers the Attenuator Value by 10 dB)
If the change in jammer signal presently being observed is 1 dB or less, the saturation has not occurred. When the level change is 1 dB or more, take measurements according to the next clause (1) Response of the Saturation Level.

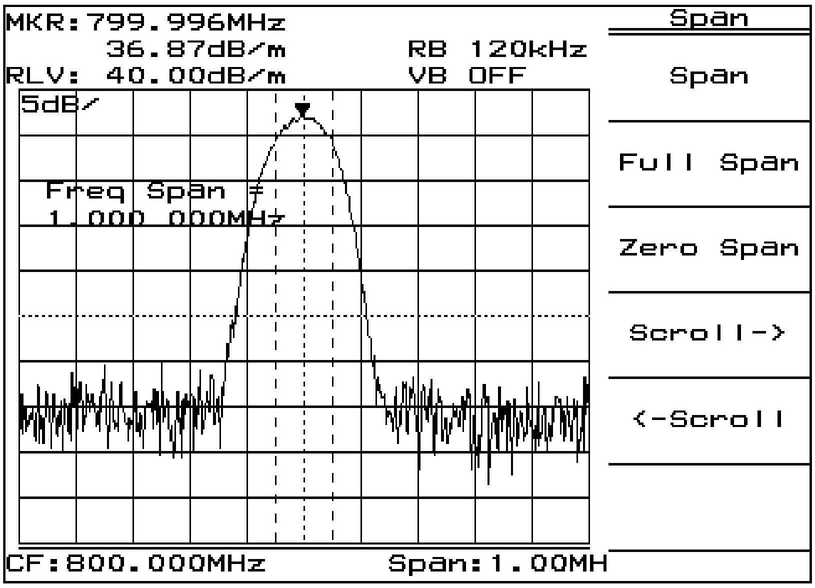
Tuning Observed Jammer

8 Setting Center Frequency

: Indicate an observed jammer at the center of waveform indication.
[Marker], operate the knob to match the marker to the observed jammer,
F6:<<Marker-> >>, F1:<<Mkr->CF>>

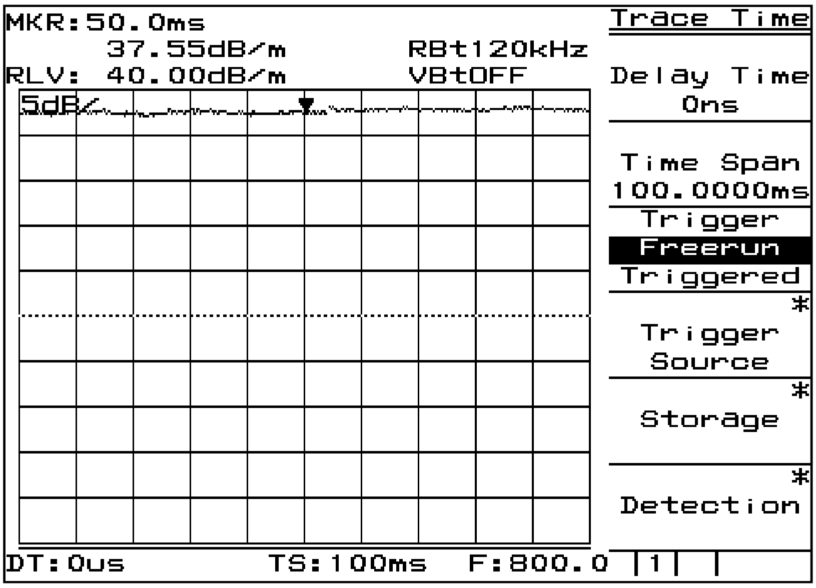
9 Narrowing Down Span

: Narrow down the frequency span to drive in the observed signal.
[Span],[V],[->CF] or match the marker to the observed signal,
"[Shift},{marker;Marker->],F1:<<Mkr-> CF>>"
Repeat the above process to narrow the frequency span down to approximately 10 times of RBW.



MKR:799.996MHz
36.87dB/m
RLV: 40.00dB/m
RB 120kHz
VB OFF
5dB/
Freq Span =
1.000 000MHz
CF:800.000MHz
Span:1.00MH

10 Zero Span : Set at Trace-Time (Zero Span Sweep)
[Time]



```
MKR:50.0ms
      37.55dB/m        RBt120kHz
RLV:  40.00dB/m        VBtOFF
5dB/
DT:0us          TS:100ms   F:800.0
```

Measurement by QP Detector

11 Setting Detection Mode to QP

: [Shift],[4:EMC],F2:<<QP Det>>

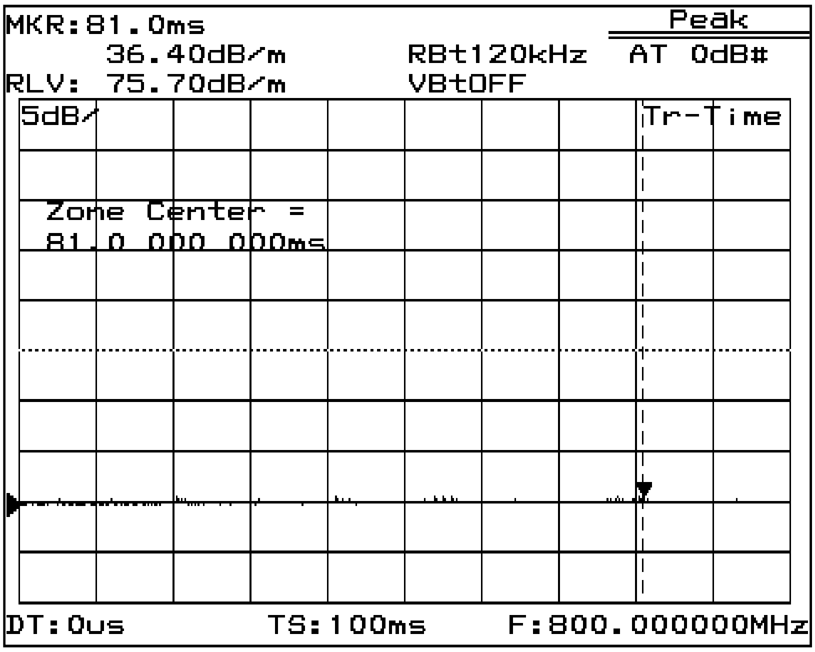
12 Adjusting Reference Level

: Adjust the reference level so as to set the level of the observed jammer at -40 dB line from the top of the indication scale.

Operate [Amplitude],[^],[V] key/knob to adjust the reference level.

At this time, make sure that the attenuator value does not vary. When the attenuator value varies, bring the attenuator value back to the value which has been the original set point before the reference level adjustment. When the attenuator value cannot be brought back, be aware that S/N degrades by as much as the varied value.

S/N ratio which does not cause a set point error is 12 dB or more.



MKR:81.0ms
36.40dB/m
RLV: 75.70dB/m
RBt120kHz
VBtOFF
AT 0dB#
Zone Center =
81.0 000 000ms
DT:0us
TS:100ms
F:800.000000MHz

13 Level Read-Out : Measurement of maximal level by the marker.
Press [Peak] and read the marker level as a measured value.
To add antenna factor by calculation, add the correction of the observed frequency to the measured value to obtain the final measured value.

Re-Reception of the Jammer

Use the trace A again to receive the jammer

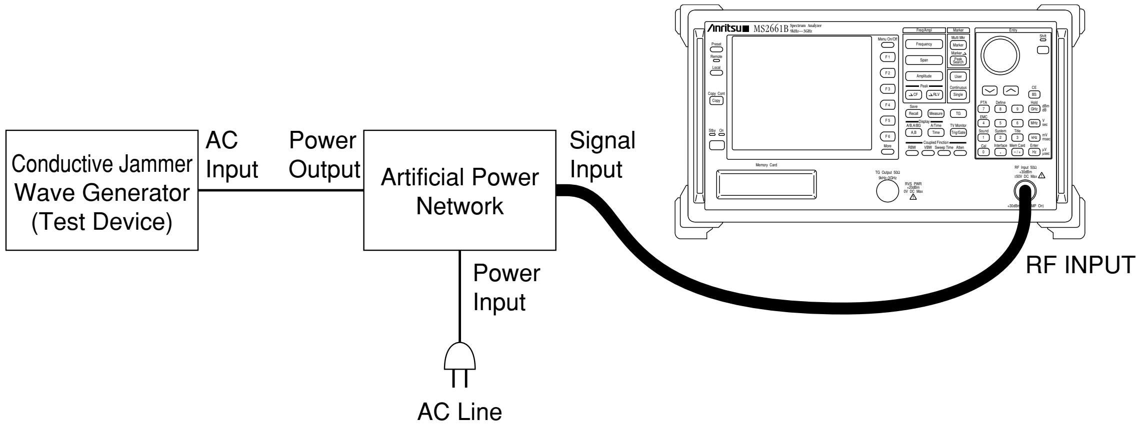
14 Setting Detection Mode to Peak
: [Shift],[4:EMC], F4<<Peak Det>>

15 Setting at Trace A : Set at Trace A (Frequency axis)
[A,B]

Repeat the procedure from 8 to 15 for each jammer

Conductive Jammer Measurement

(1) Measuring Block



Connect the output from Signal output of an artificial power network to the RF Input of the system.

(2) Measuring Procedure

<u>Preparation</u>

0 QP/EMC Cal : [Shift],[0:Cal], F5:<<QP/EMC Cal>>

<u>Receiving Jammer</u>

1 Preset : [Preset], F1:<<Preset All>>

2 QP/EMC On : Turn QP/EMC On
[Shift],[4:EMC], F1:<<QP/EMC>>
Turning QP/EMC On will set Log scale at 5 dB/Div, RBW at RBW (120 k Hz) for EMC, and VBW Off.

3 Setting Level Unit : Set the level unit at "dBμV".
Press [More] key to display page 2 of QP/EMC menu, F2:<<Unit>>, F2:<<dBμV>>, F6:<<return>>.

4 Setting Measuring Frequency Band
: Set a measuring frequency band. (i.e. 150 k Hz to 30 M Hz)
[Frequency],F2:<<Start Freq>>,[1],[5],[0],[k Hz],F2<<Stop Freq>>, [3],[0],[M Hz]

5 Setting RBW Appropriate to the Frequency Band

: Set RBW. (i.e. 9 k Hz)
[Shift],[4:EMC], Press [More] key to display page 1 of QP/EMC menu,
F5:<<RBW Manual>>,,[9],[k Hz]

6 Setting Reference Level

: Set a reference level so as to display the signal with the maximum amplitude near the top line of a waveform indicating scale.
It is done by either method below;

- Press [->RLV]. If the maximum amplitude signal is not indicated near the top line, repeat pressing [->RLV] several times.
- Operate [Amplitude],[^],[V] key/knob to set the reference level at the optimum value.

<u>Saturation Level Check</u>

7 Setting Optimum Input Attenuator Value

: Check that the system is not saturated by lowering the attenuator value by 10 dB.
[Atten], Step[V] (Lowers the Attenuator Value by 10 dB)
If the change in jammer signal presently being observed is 1 dB or less, the saturation has not occurred. When the level change is 1 dB or more, take measurements according to the next clause (1) . Response of the Saturation Level.

<u>Tuning Observed Jammer</u>

8 Setting Center Frequency

: Indicate an observed jammer at the center of waveform indication.
[Marker], maneuver the knob to match the marker to the observed jammer,
F6:<<Marker-> >>, F1:<<Mkr->CF>>

9 Narrowing Down Span

: Narrow down the frequency span to drive in the observed signal.
[Span],[V],[->CF] or match the marker to the observed signal,
"[Shift},{marker;Marker->],F1:<<Mkr-> CF>>"
Repeat the above process to narrow the frequency span down to approximately 10 times of RBW.

10 Zero Span : Set at Trace-Time (Zero Span Sweep)
[Time]

Measurement by QP Detector

11 Setting Detection Mode to QP
: [Shift],[4:EMC],F2:<<QP Det>>

12 Adjusting Reference Level
: Adjust the reference level so as to set the level of the observed jammer at -40 dB line from the top of the indication scale.
Operate [Amplitude],[^],[V] key/knob to adjust the reference level.
At this time, make sure that the attenuator value does not vary. When the attenuator value varies, bring the attenuator value back to the value which has been the original set point before the reference level adjustment. When the attenuator value cannot be brought back, be aware that S/N degrades by as much as the varied value.
S/N ratio which does not cause a set point error is 12 dB or more.

13 Level Read-Out : Measurement of maximal level by the marker.
Press [Peak] and read the marker level as a measured value.
Add the frequency band correction data of artificial power network and the measuring system in the observed frequency to the measured value, and set the sum as the final measured value.

Measurement by an Average Detector

14 Setting Detection Mode to Average
: [Shift],[4:EMC], F3<<Average Det>>

15 Level Read-Out : Measurement of maximal level by the marker.
Press [Peak] and read the marker level as a measured value.
Add the frequency band correction data of artificial power network and the measuring system in the observed frequency to the measured value, and set the sum as the final measured value.

Re-Reception of the Jammer

Use the trace A again to receive the jammer

16 Setting Detection Mode to Peak
: [Shift],[4:EMC], F4<<Peak Det>>

17 Setting at Trace A : Set at Trace A (Frequency axis)
[A,B]

Repeat the procedure from 8 to 17 for each jammer

Items to be Noted in Measurement

(1) Consideration on Saturation Level

In the case of receiving strong external waves or inappropriate level setting of the spectrum analyzer, distortion or saturation may occur inside the spectrum analyzer.

This distortion or saturation causes measurement errors. Therefore, consideration on such distortion or saturation level is essential in measuring jammers.

■ About the Use of MN1620A Preselector

When measuring jammers in the open air where external waves are strong, even if the level setting of a spectrum analyzer itself is appropriate, distortion or saturation occurs inside the spectrum analyzer due to the over-input. By this, the subject signal is masked and becomes very difficult to distinguish, resulting in errors in the measurement. In such a case, MN1602A preselector or an equivalent is necessary.

■ About the Level Setting

When the setting of an input attenuator is inappropriate, distortion or saturation occurs in an input mixer or the like. Therefore, it is essential to perform the setting of the input attenuator appropriately.

To check whether the saturation has occurred or not, the following methods are available;

① Lower the input attenuator value by 10 dB in Peak mode. At this time, if the change in jammer signal is 1 dB or less, the saturation has not occurred. When the level (In this system, when it comes close to the maximum sensitivity, this setting cannot be done. In such a case, use the next method.)

② Insert an attenuator which is capable of varying by 1 dB step, into the input terminal of this system. The one capable of 40 dB attenuation would be sufficient. Study on the relationship between reception level and each 1 dB step attenuation. 1 dB compression level is the lower limit of the saturation level. Up to this level, this system is capable of performing correct measurements.

(2) Measurement of Microwave

The sensitivity of the spectrum analyzer determines the measuring limit.

When sufficient sensitivity to meet CISPR standard cannot be obtained, H shall use Option 08 preamplifier, MH648A preamplifier or MN1602A preselector. In that case, please note that the saturation level of the system degrades by as much as the gain of the amplifier. S/N ratio which does not cause measuring errors is 12 dB or more.

(3) About Frequency Sweep and Sweep Duration

When measuring a jammer in QP mode, it is most desirable to do it by a zero sweep. However, it can be measured by a continuous sweep. In this case, in order to perform correct measurement, the sweep duration has to be long enough. Short sweep duration causes a level error by more than several dB. The reasons of this error are;

① Overshoot or ringing occurred in a filter which determines the resolution bandwidth.

② Large charge and discharge time constant and indicator time constant of the QP detector resulting in a longer time for obtaining the true value.

③ Lower possibility of acquiring pulses at the IF filter when pulse repetition frequency is as low as 1 to 2 Hz.
When measuring the strength of a jammer by sweeping a frequency close to the true value, consider the above and conduct the measurement with sufficient sweeping duration.

(4) About Unnecessary Radiation

Unnecessary radiation from this system is restrained to a sufficiently low level compared to CISPR standard. However, please be aware of the following in connecting peripherals.

① Composite Video (Connecting a Video Plotter)
Separate video signals are supplying clock signals (12.8 MHz, TTL level) to a video plotter. These signals may be radiated from the body of the video plotter.
Since the bands of composite video signal output terminal and video signals are wide, it is possible that these signals to be radiated from the video plotter.
Therefore, if these radiation may possibly be a problem, do not connect a video plotter or the like.

② Printing Devise
When printing by a printer or a plotter, by using a printer or X-y plotter with sufficiently low jammer radiation, and a shield type interface cable, the radiation of jammers can be restrained.
If the radiation from a printer/plotter may possibly be a problem in EMC measuring, do not connect a printer/plotter.

APPENDIX A

SOFT-KEY MENU

In this section, soft-key menu functions and its hierarchical system are described using a tree.

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APPENDIX A
SOFT-KEY MENU

In this section, soft-key menu functions and its hierarchical system are described using a tree.
Matters to be noted about the tree are shown below.

(1) Panel Key indicates a hard key on the front panel.

(2) Top menus are the menus at the top level which are displayed on the screen when the panel key is pressed. Lower menus indicates other menus below the top menus.

(3) When a soft key with an appended asterisk (*) is pressed in these menus, the menu moves to the lower menu indicated by the arrow symbol (->). However, if any not-supported-function soft key in an Option is pressed, an error message is displayed.

(4) When the Return key is pressed at a lower menu, the next-higher menu is returned.

(5) Menus with more than six items are split into several pages.

(6) The menu page construction and currently-displayed page are indicated in the lower part of the menu. To move to the next page, press the [More] key.

(7) Panel keys and soft keys prefixed by a sharp symbol (#) at the left of the menu frame, give an outline explanation of the function.

Soft-key Menu List

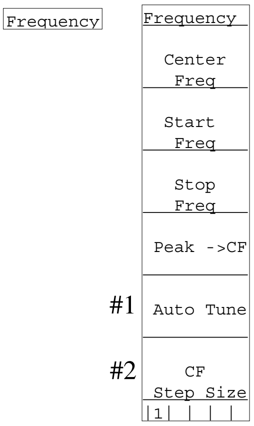
Menu	Menu Tree (page/28)
A) A/B,A/BG	16
A/Time	17
ACP Setup1	8
ACP Setup2	8
ACP Setup3	8
Adj ch Pwr	8
Amplitude	2
Attenuator	2 , 3
Avg Count	15
B) Burst Pwr	11
C) C/N Meas	7
Channel Power Measure	8
Cal	22
Change Clr	21
Check File	26
Copy Cont	20
Copy from	21
Correction	2
Count Setup	7
D) Def Files	27
Def Menus	27
Define	27
Define Clr	21
Detection	15 , 17
Dip	5
Directory	25
Disp Line	2 , 4
Display	21
E) Edit Menu	27
Expand	17
F) File Ope	25
FM Monitor	17
Format	25
Freq Count	7
Frequency	1

Menu	Menu Tree (page/28)
G) Gate	18
Gate Setup	18
H) Hold Count	15
I) Impedance	2
Initialize	27
Interface	23
Item	12 , 20
L) LCD Brightness	21
Lib Exec	26
Lib File	26
Lib Memory	26
Lib Prgm	27
Lib Remove	26
Lin Scale	2
Line	9 , 10
Load/Save	9 , 10
Location	20
Log Scale	2
Lvl Offset	2
M) Manual Set	4
Marker	4
Marker->	4 , 5
Mask Meas	9
Measure	7
Media	25 , 27
Media	2 , 9 , 10
Mem Card	25
Mkr List	4
Move Mask	9
Move Temp	10
Multi Marker	4
N) Noise Meas	7
Normalize	14

Menu Tree

Menu Tree (1 /28)

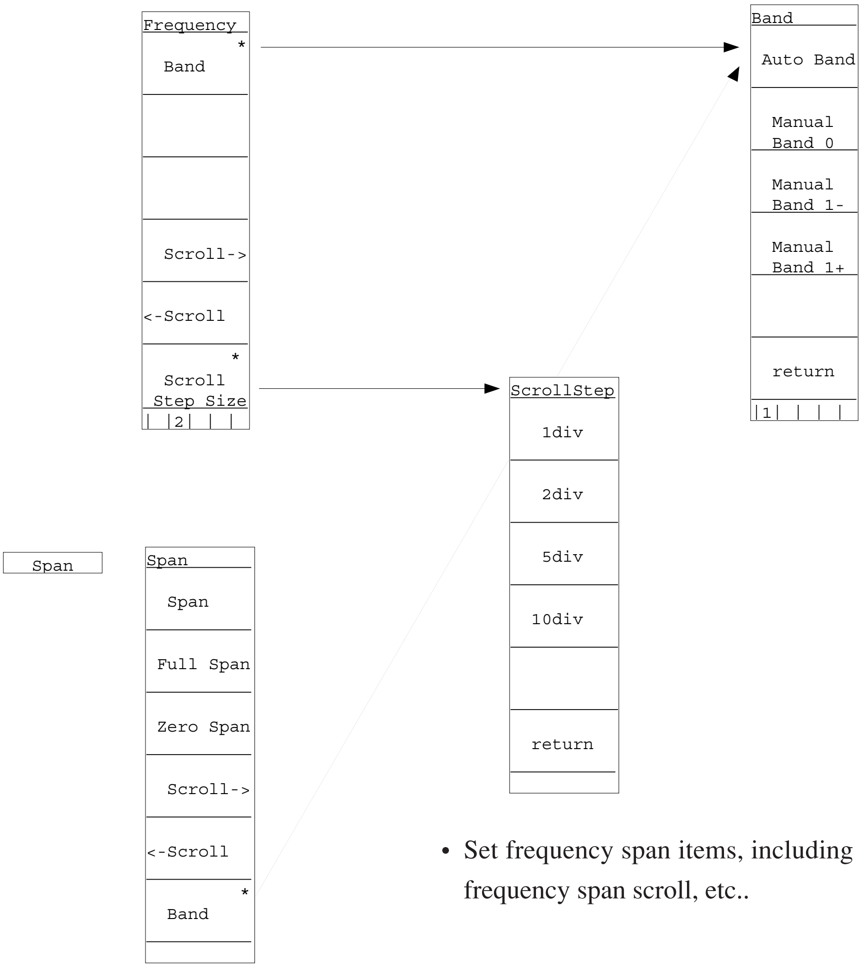
Panel Key — Top menu — Lower menues



- Set items related to frequency, including the center frequency, start/stop frequency, peak->CF, auto synchronization, frequency scroll step size and scroll step size, etc..

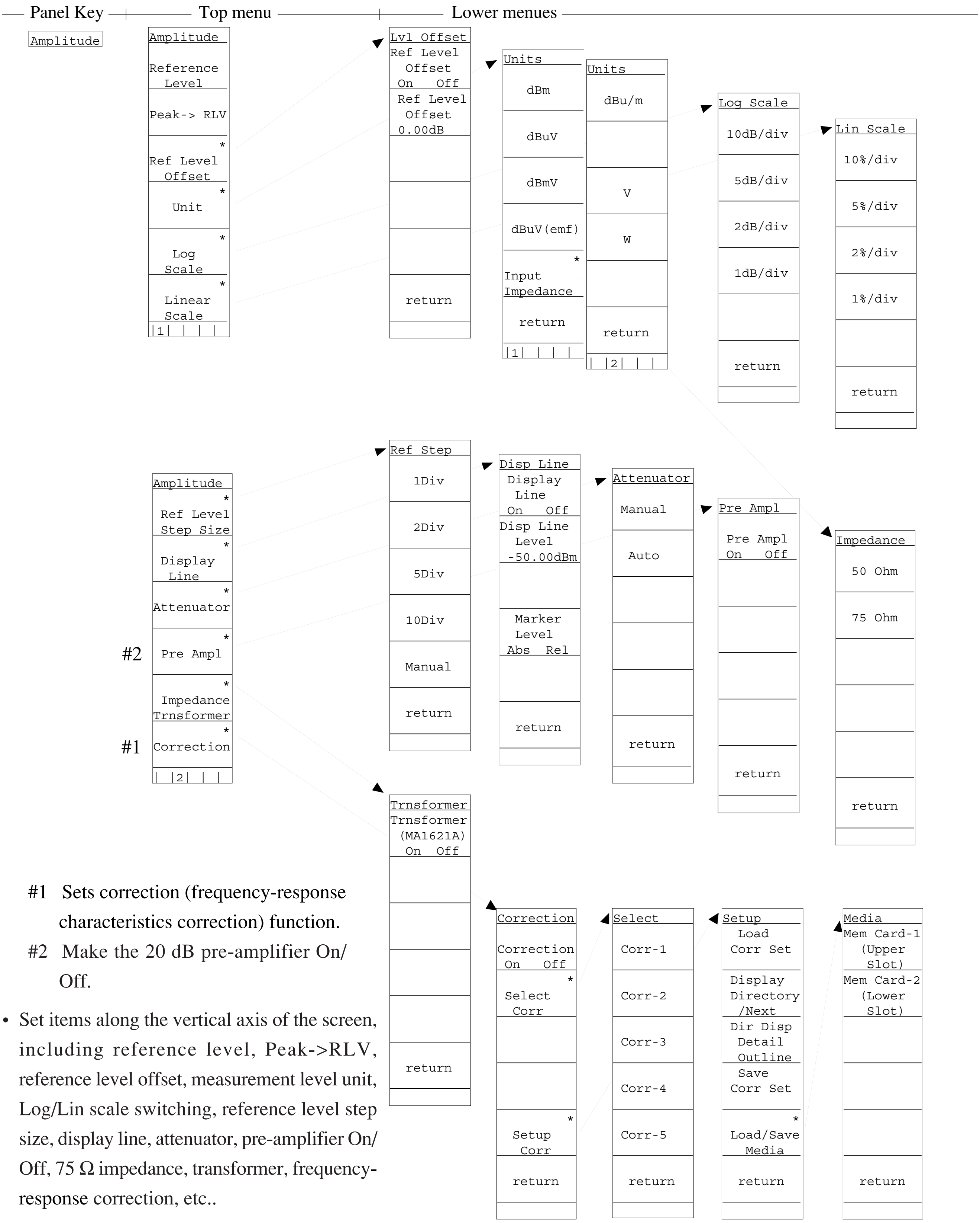
#1 Detects peak point in pre-specified (in BG range) span and automatically tunes the peak signal to the specified span.

#2 Sets frequency step size for changing center frequency.



- Set frequency span items, including frequency span, full span, zero span, frequency span scroll, etc..

Menu Tree (2/28)

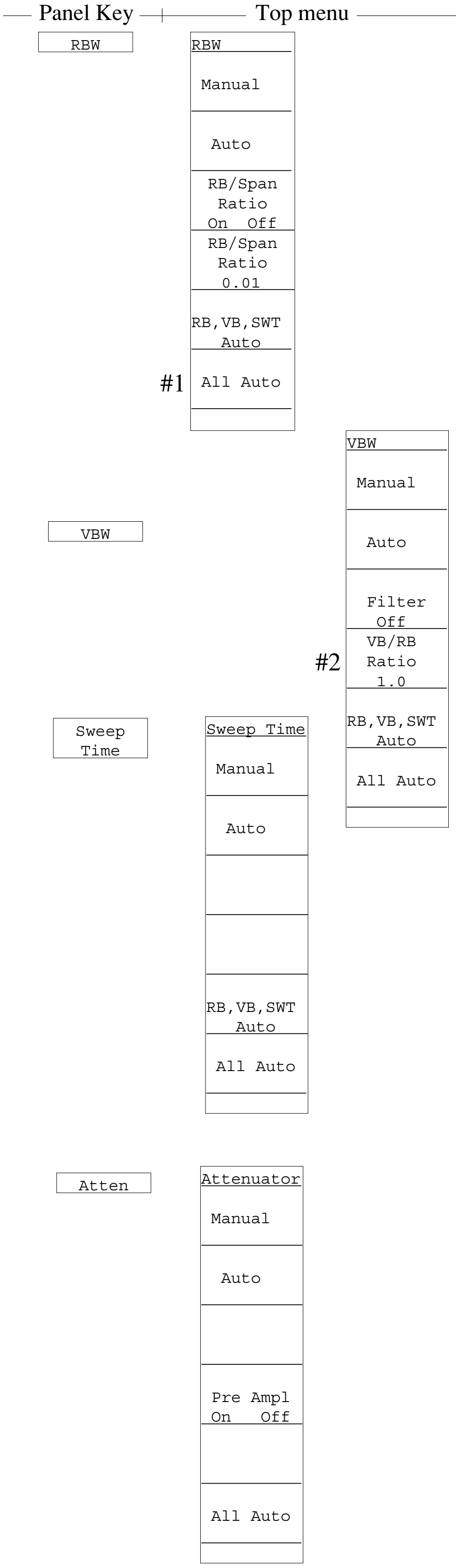


#1 Sets correction (frequency-response characteristics correction) function.

#2 Make the 20 dB pre-amplifier On/Off.

- Set items along the vertical axis of the screen, including reference level, Peak->RLV, reference level offset, measurement level unit, Log/Lin scale switching, reference level step size, display line, attenuator, pre-amplifier On/Off, 75 Ω impedance, transformer, frequency-response correction, etc..

Menu Tree (3/28)



- Set the manual/auto of resolution bandwidth, and auto (RBW, VBW and SWP only) or all auto.
- Set Ratio of RBW to Span when RBW is Auto and Ratio Mode is “on”.

#1 Sets RBW, VBW, Sweep Time, Atten all to Auto.

- Set the manual/auto of video bandwidth, and auto (RBW, VBW and SWP only) or all auto.

#2 Sets ratio of VBW to RBW when VBW is Auto.

- Set the manual/auto of sweep time, and auto (RBW, VBW and SWP only) or all auto.

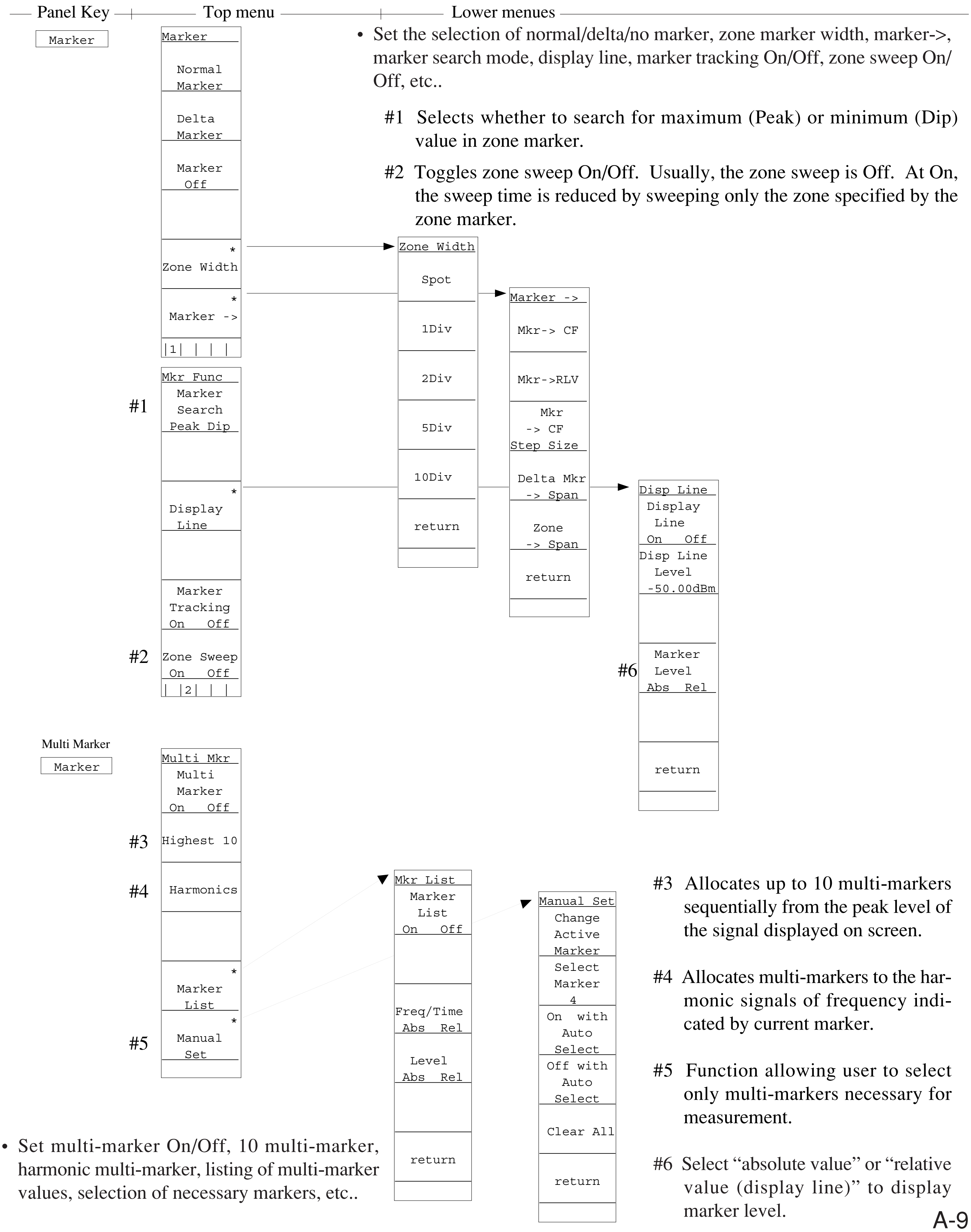
- Set the manual/auto of the input attenuator, On/Off of the pre-amplifier and all auto.

Menu Tree (4/28)

- Set the selection of normal/delta/no marker, zone marker width, marker->, marker search mode, display line, marker tracking On/Off, zone sweep On/Off, etc..

#1 Selects whether to search for maximum (Peak) or minimum (Dip) value in zone marker.

#2 Toggles zone sweep On/Off. Usually, the zone sweep is Off. At On, the sweep time is reduced by sweeping only the zone specified by the zone marker.



#3 Allocates up to 10 multi-markers sequentially from the peak level of the signal displayed on screen.

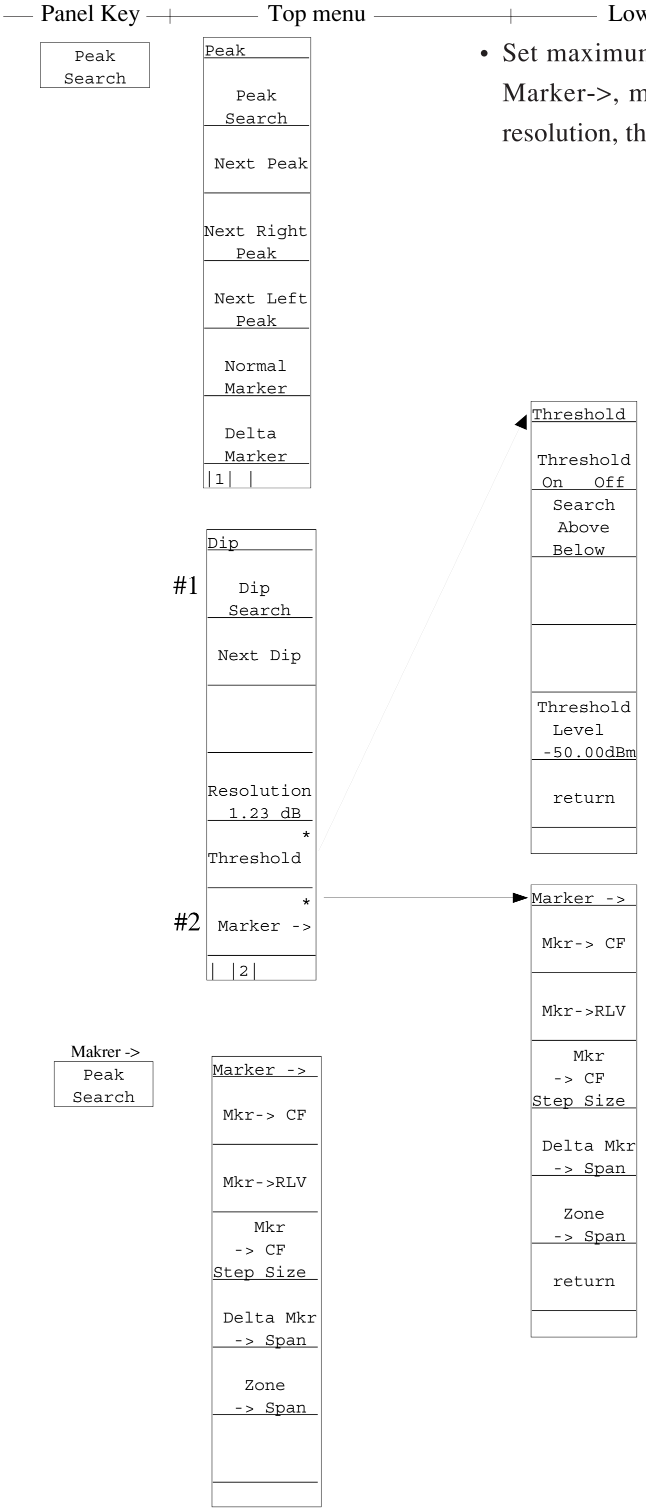
#4 Allocates multi-markers to the harmonic signals of frequency indicated by current marker.

#5 Function allowing user to select only multi-markers necessary for measurement.

#6 Select "absolute value" or "relative value (display line)" to display marker level.

- Set multi-marker On/Off, 10 multi-marker, harmonic multi-marker, listing of multi-marker values, selection of necessary markers, etc..

Menu Tree (5 /28)



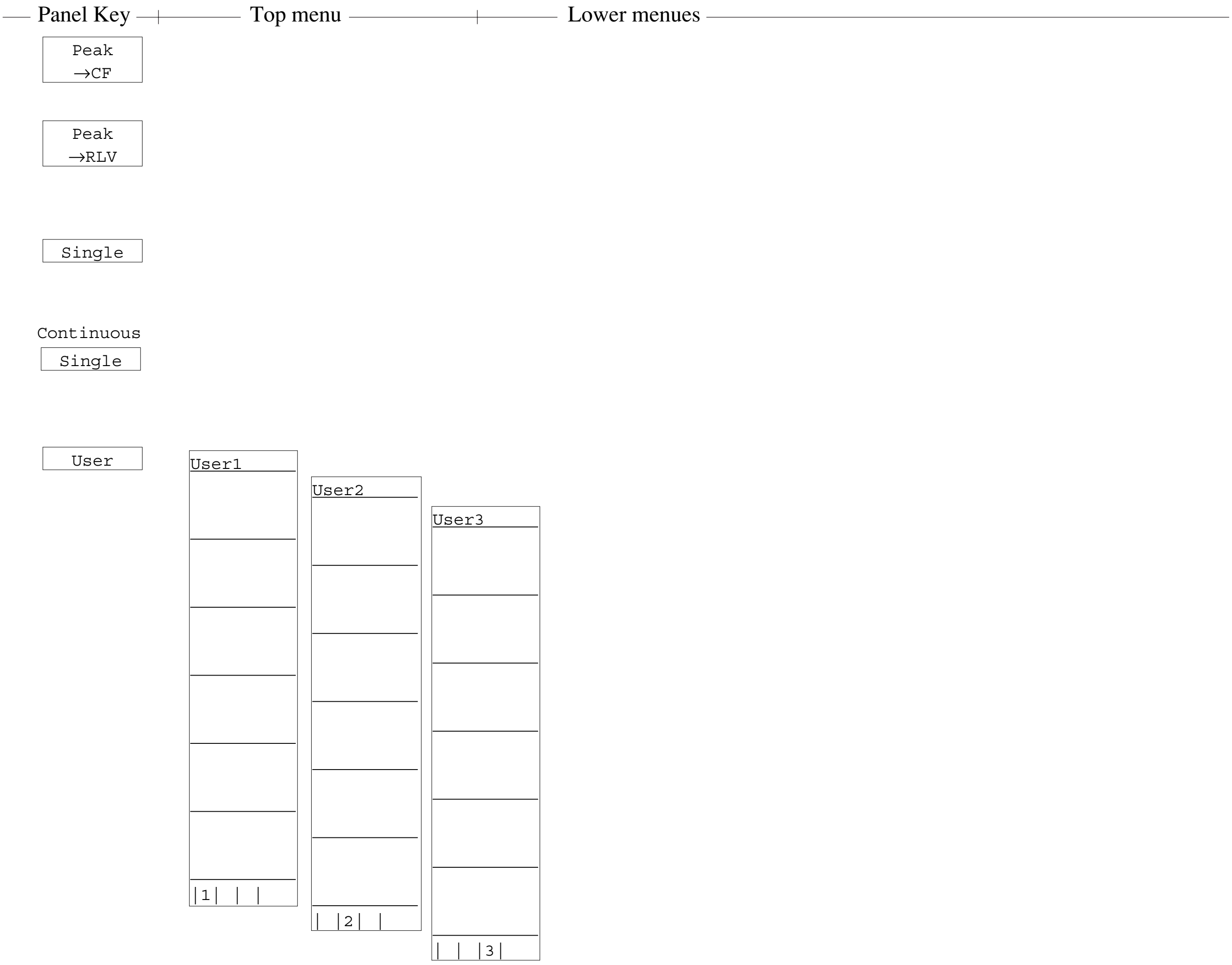
- Set maximum level search, next peak, next right peak, next left peak, Marker->, minimum level search, next minimum level, search level resolution, threshold level On/Off, etc..

#1 Searches for minimum (Dip) level.

#2 Sets peak-search level resolution.

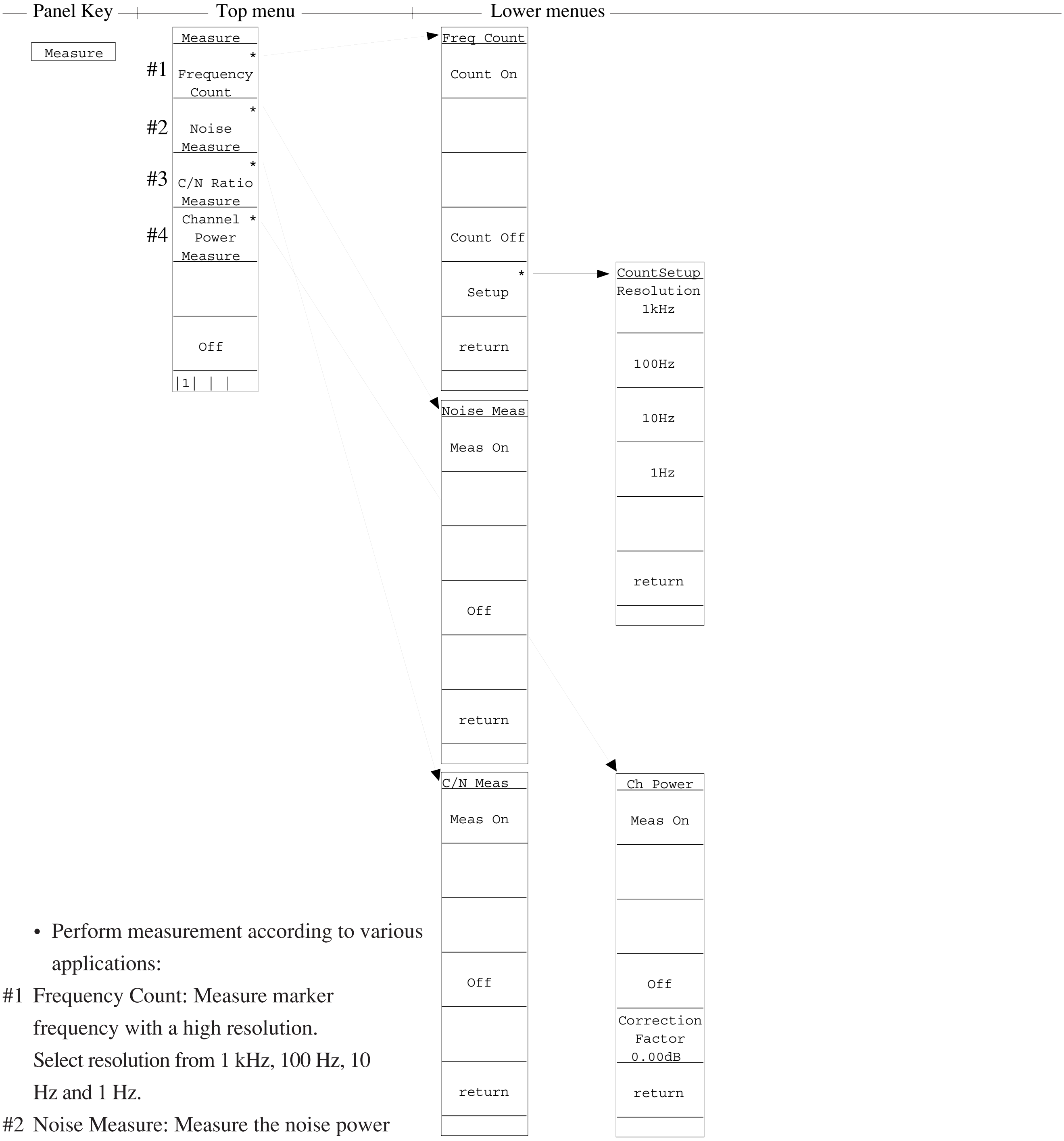
- Set marker value -> center frequency, marker value -> reference level, marker value -> CF step size, delta marker-> span, zone marker -> span, etc..

Menu Tree (6/28)



- The soft-key menu defined by the user is displayed. (See “User Define”.)

Menu Tree (7/28)



- Perform measurement according to various applications:

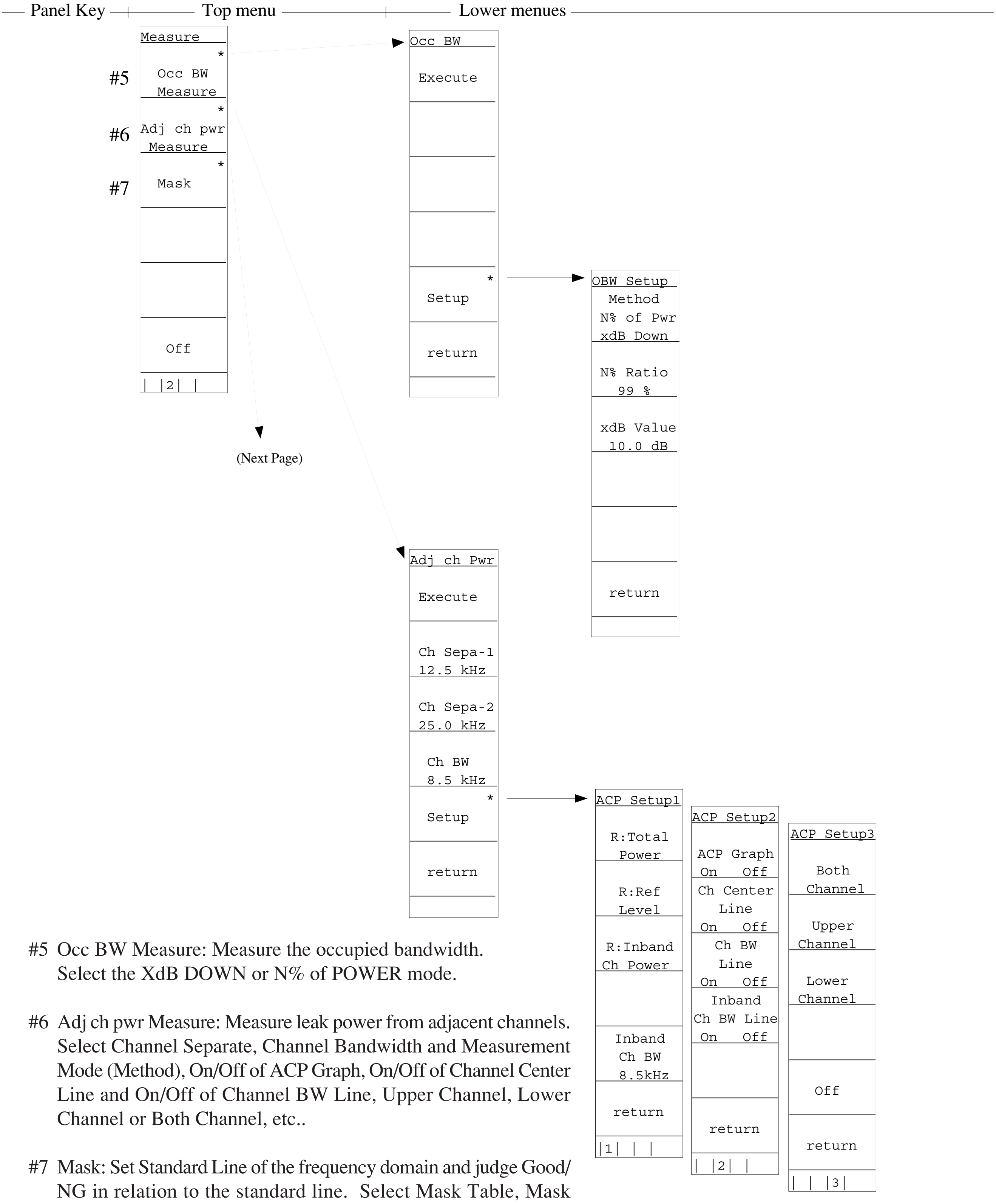
#1 Frequency Count: Measure marker frequency with a high resolution. Select resolution from 1 kHz, 100 Hz, 10 Hz and 1 Hz.

#2 Noise Measure: Measure the noise power within zone marker.

#3 C/N Ratio Measure: Measure the ratio of carrier signal and noise power. Reference marker of the delta marker shall be set to the carrier, and marker’s zone width specifies the power measured.

#4 Channel Power Measure: Power with in the band indicated by zone marker is measured. It is possible to set an arbitrary calibration value.

Menu Tree (8/28)

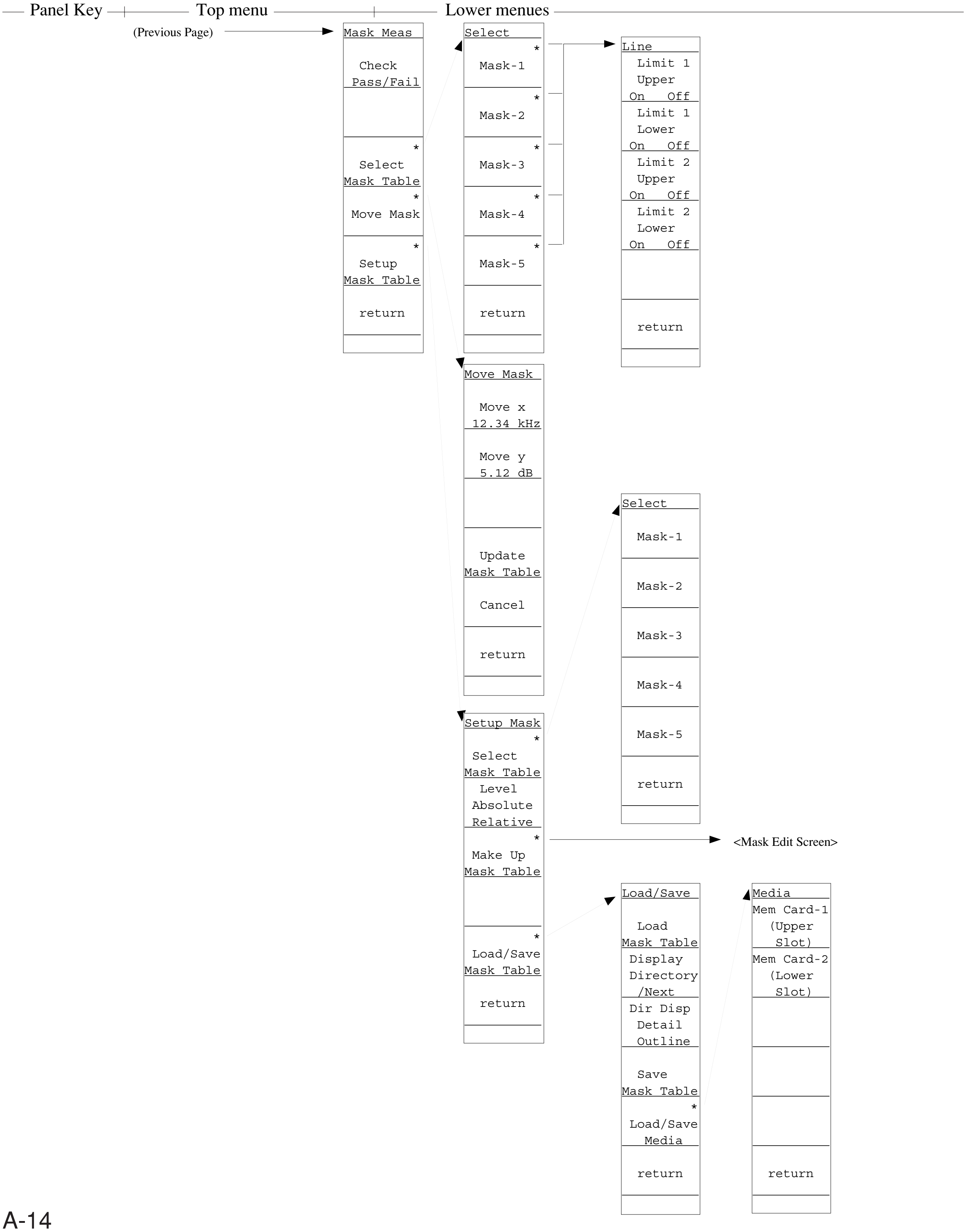


#5 Occ BW Measure: Measure the occupied bandwidth. Select the XdB DOWN or N% of POWER mode.

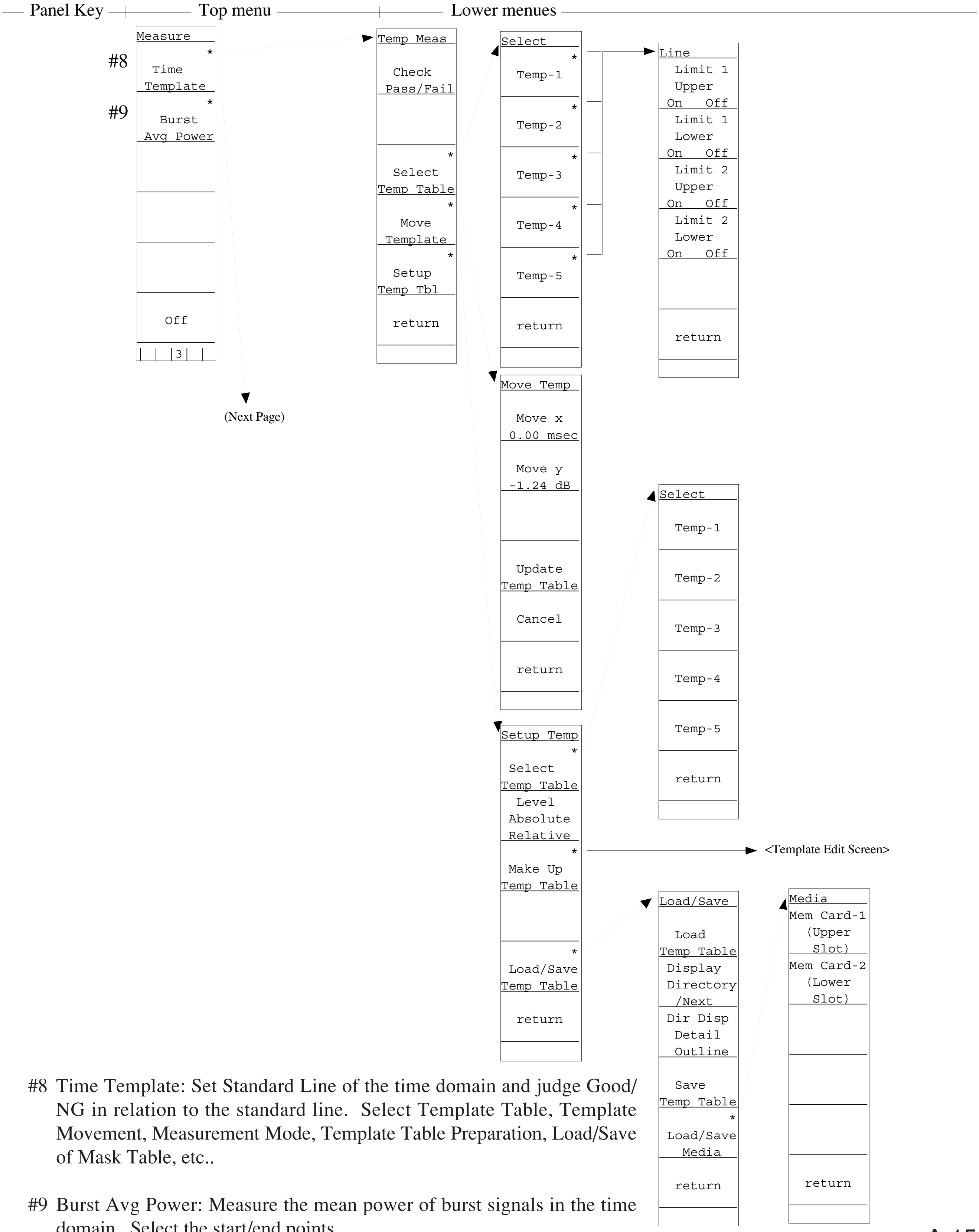
#6 Adj ch pwr Measure: Measure leak power from adjacent channels. Select Channel Separate, Channel Bandwidth and Measurement Mode (Method), On/Off of ACP Graph, On/Off of Channel Center Line and On/Off of Channel BW Line, Upper Channel, Lower Channel or Both Channel, etc..

#7 Mask: Set Standard Line of the frequency domain and judge Good/NG in relation to the standard line. Select Mask Table, Mask Movement, Measurement Mode, Mask Table Preparation, Load/Save of Mask Table, etc..

Menu Tree (9/28)



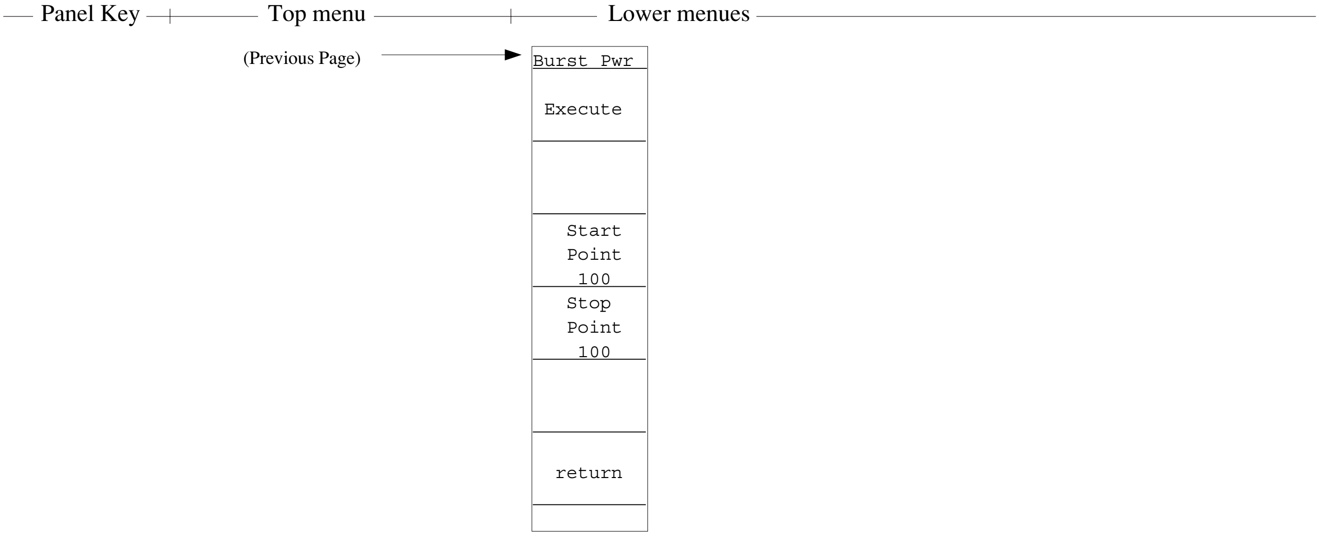
Menu Tree (10/28)



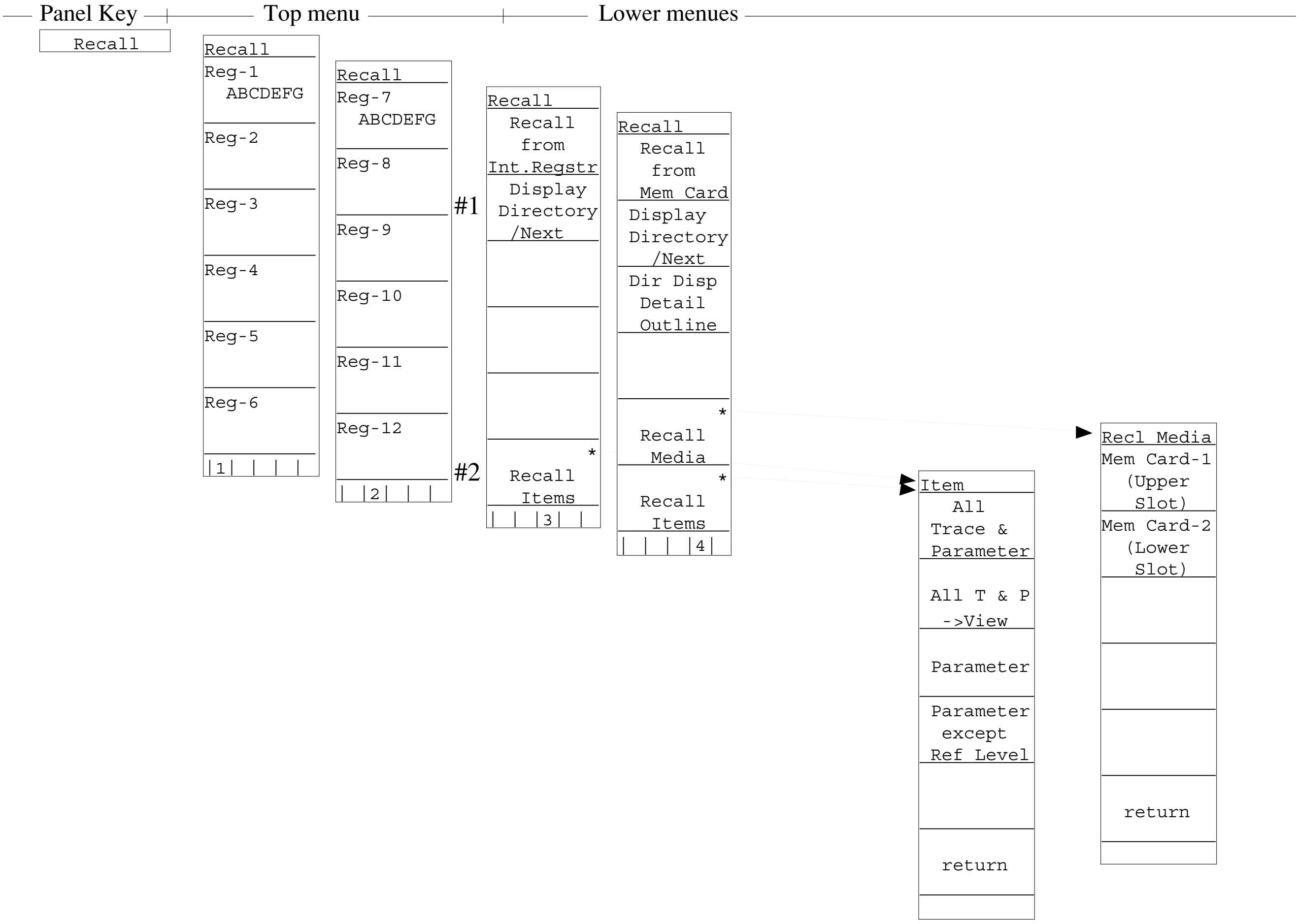
#8 Time Template: Set Standard Line of the time domain and judge Good/NG in relation to the standard line. Select Template Table, Template Movement, Measurement Mode, Template Table Preparation, Load/Save of Mask Table, etc..

#9 Burst Avg Power: Measure the mean power of burst signals in the time domain. Select the start/end points.

Menu Tree (11/28)



Menu Tree (12/28)

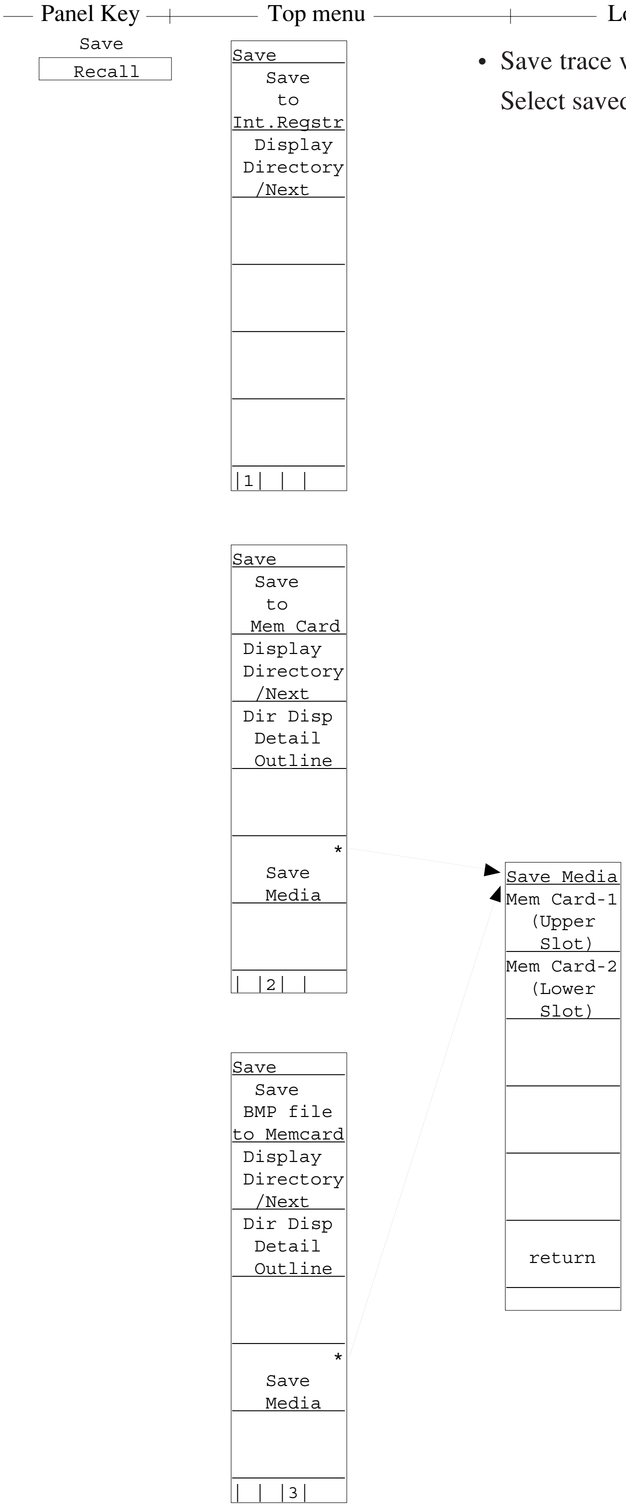


- Read out trace waveform/parameters from the internal memory or memory card. Select recall addresses and media/items, and display file directories.

#1 Displays list of internal-memory directories.

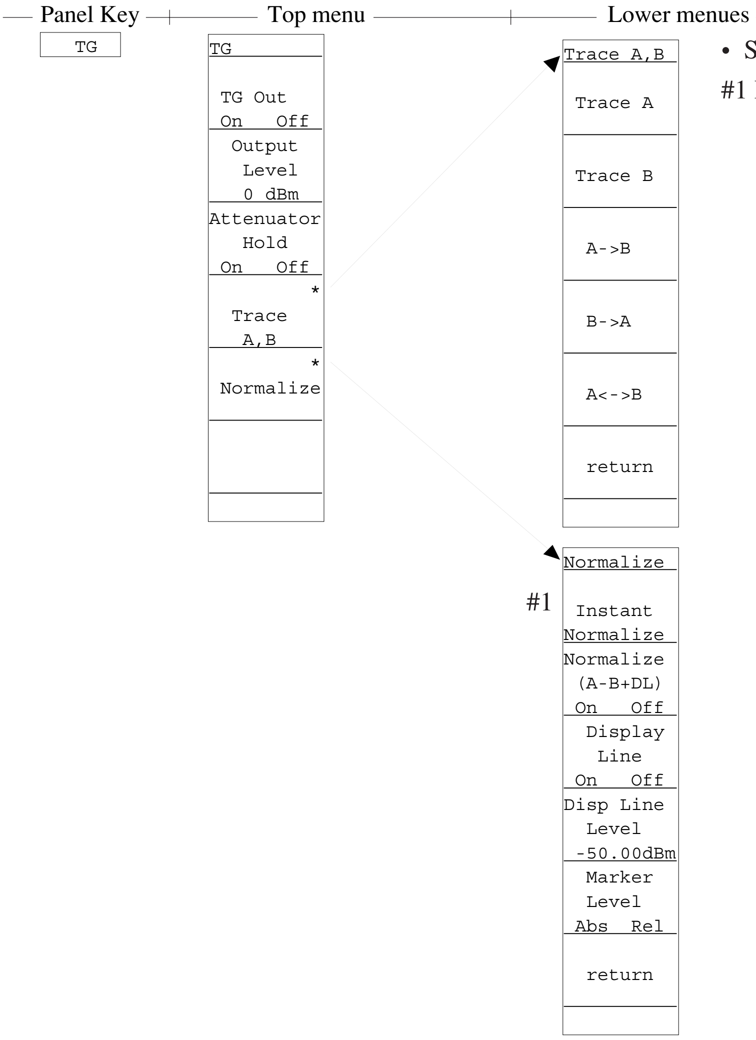
#2 Specifies items to be recalled (trace waveform, parameter, etc.).

Menu Tree (13/28)



- Save trace waveform/parameters to the internal memory or memory card. Select saved media, and display file directories.

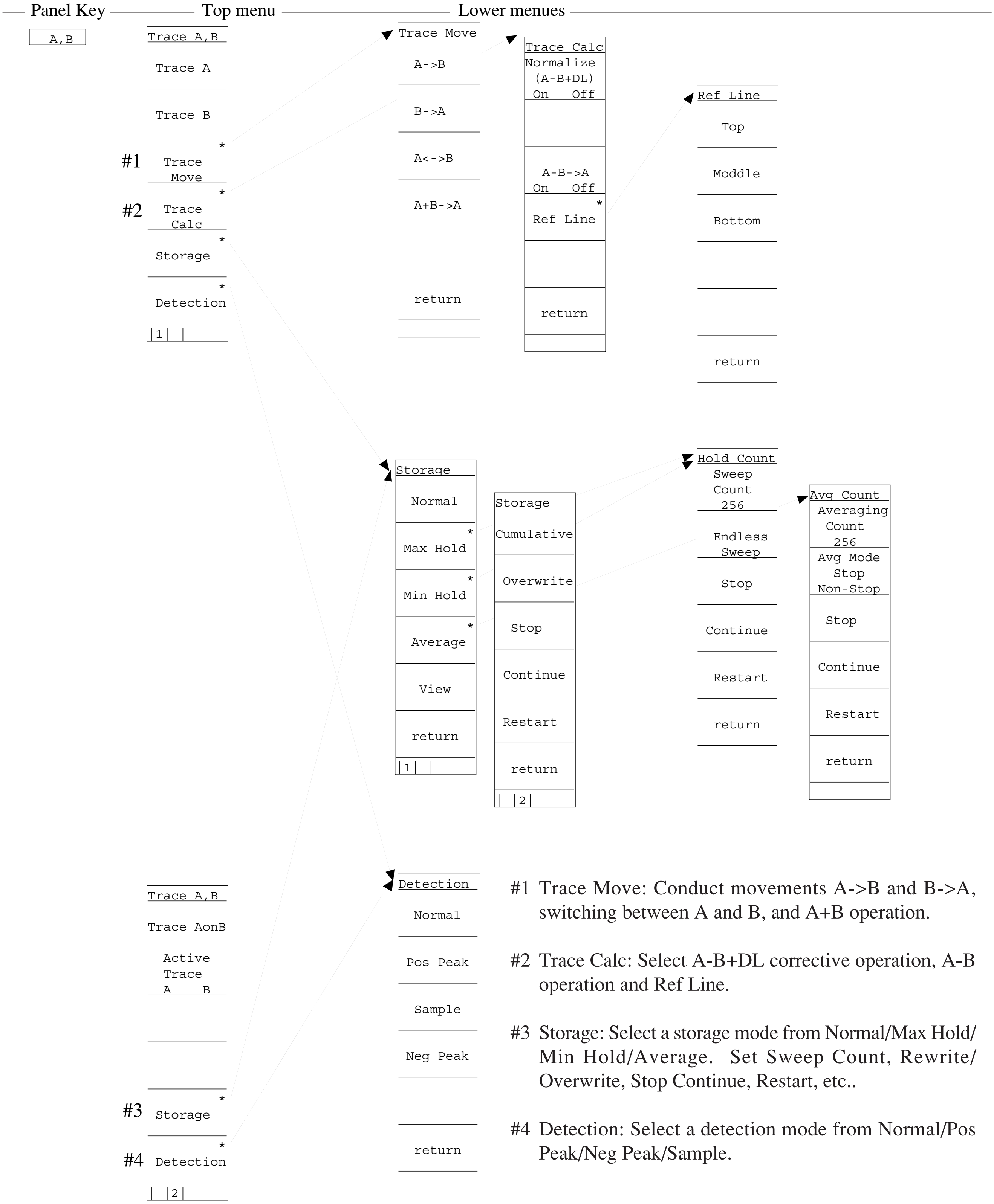
Menu Tree (14/28)



- Set ON/OFF and output level of tracking generator.

#1 Normalize trace-A waveform data, and display it.

Menu Tree (15/28)



#1 Trace Move: Conduct movements A->B and B->A, switching between A and B, and A+B operation.

#2 Trace Calc: Select A-B+DL corrective operation, A-B operation and Ref Line.

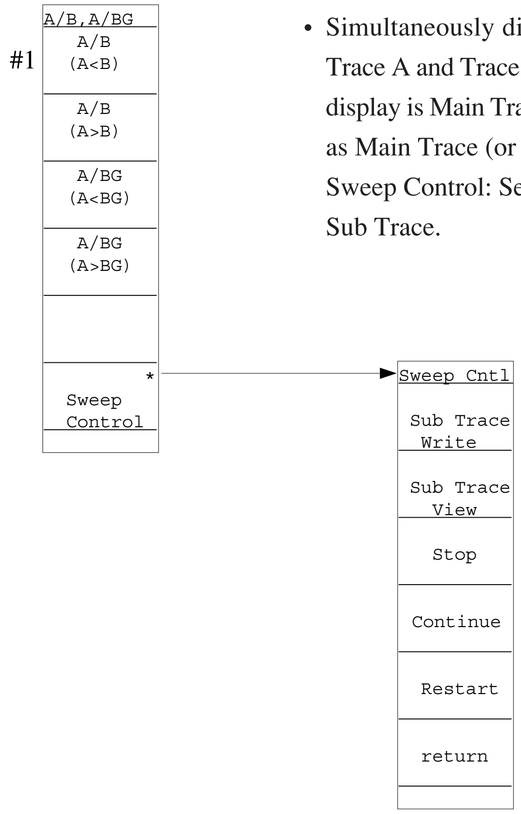
#3 Storage: Select a storage mode from Normal/Max Hold/ Min Hold/Average. Set Sweep Count, Rewrite/ Overwrite, Stop Continue, Restart, etc..

#4 Detection: Select a detection mode from Normal/Pos Peak/Neg Peak/Sample.

- Select Trace A/B, movement between Trace A/B, sum/difference operation between Trace A/B and Ref Line, and designate the storage and detection modes and Active Trace.

Menu Tree (16/28)

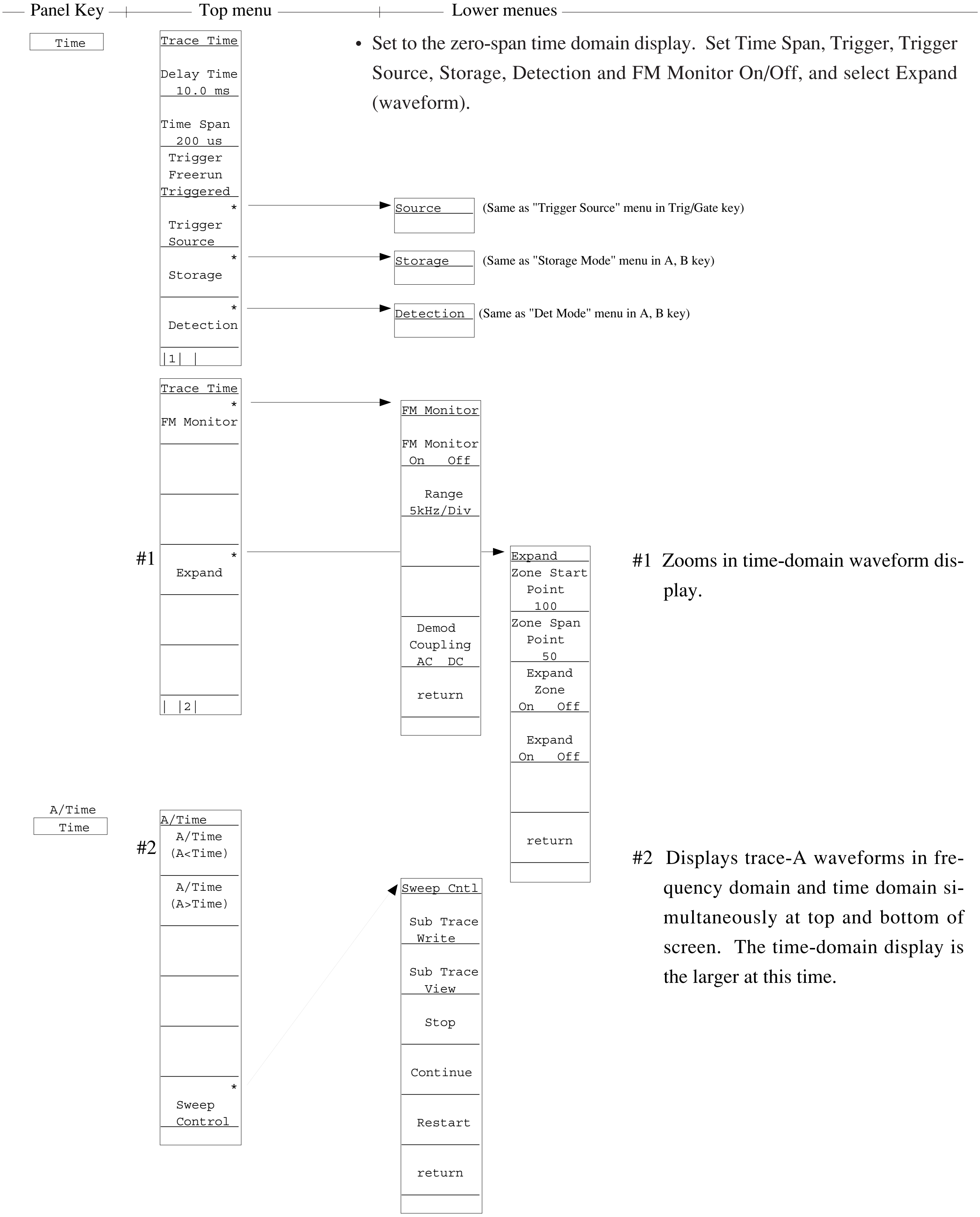
Panel Key — Top menu — Lower menues



- Simultaneously display two waveforms, namely Trace A and Trace B or Trace A and Trace BG (peripheral spectrum containing Trace A). The large display is Main Trace and the small one is Sub Trace; select which to display as Main Trace (or Sub Trace).
  Sweep Control: Set Stop/Continuous/Restart for sweep and Stop/Write for Sub Trace.

#1 Displays two traces A and B simultaneously at top and bottom of screen. The trace-B display is the larger at this time.

Menu Tree (17/28)



- Set to the zero-span time domain display. Set Time Span, Trigger, Trigger Source, Storage, Detection and FM Monitor On/Off, and select Expand (waveform).

(Same as "Trigger Source" menu in Trig/Gate key)

(Same as "Storage Mode" menu in A, B key)

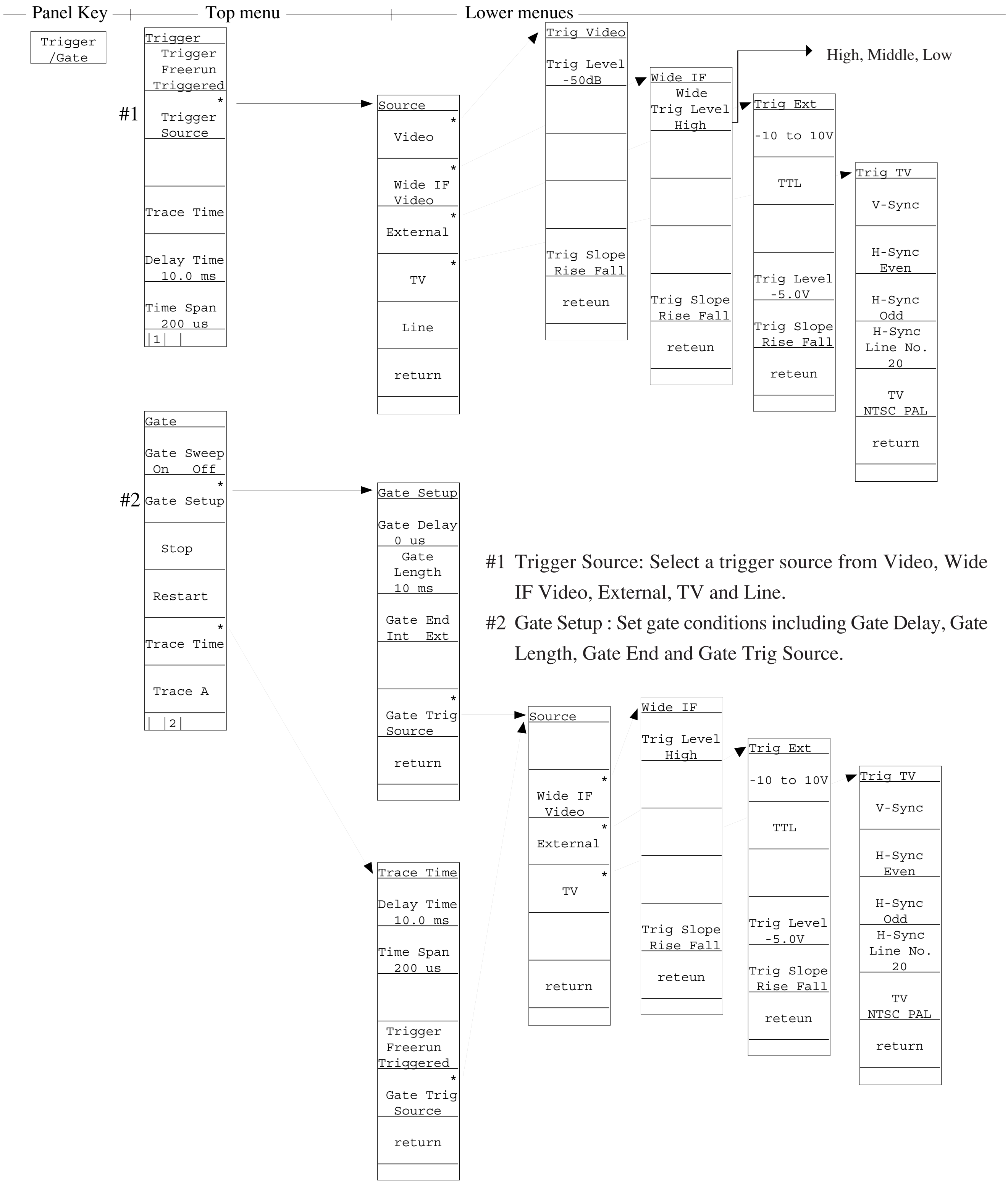
(Same as "Det Mode" menu in A, B key)

#1 Zooms in time-domain waveform display.

#2 Displays trace-A waveforms in frequency domain and time domain simultaneously at top and bottom of screen. The time-domain display is the larger at this time.

- Simultaneously display waveforms of Trace a and Time Domain.
Which to display as Main Trace (or Sub Trace) can be selected.

Menu Tree (18/28)

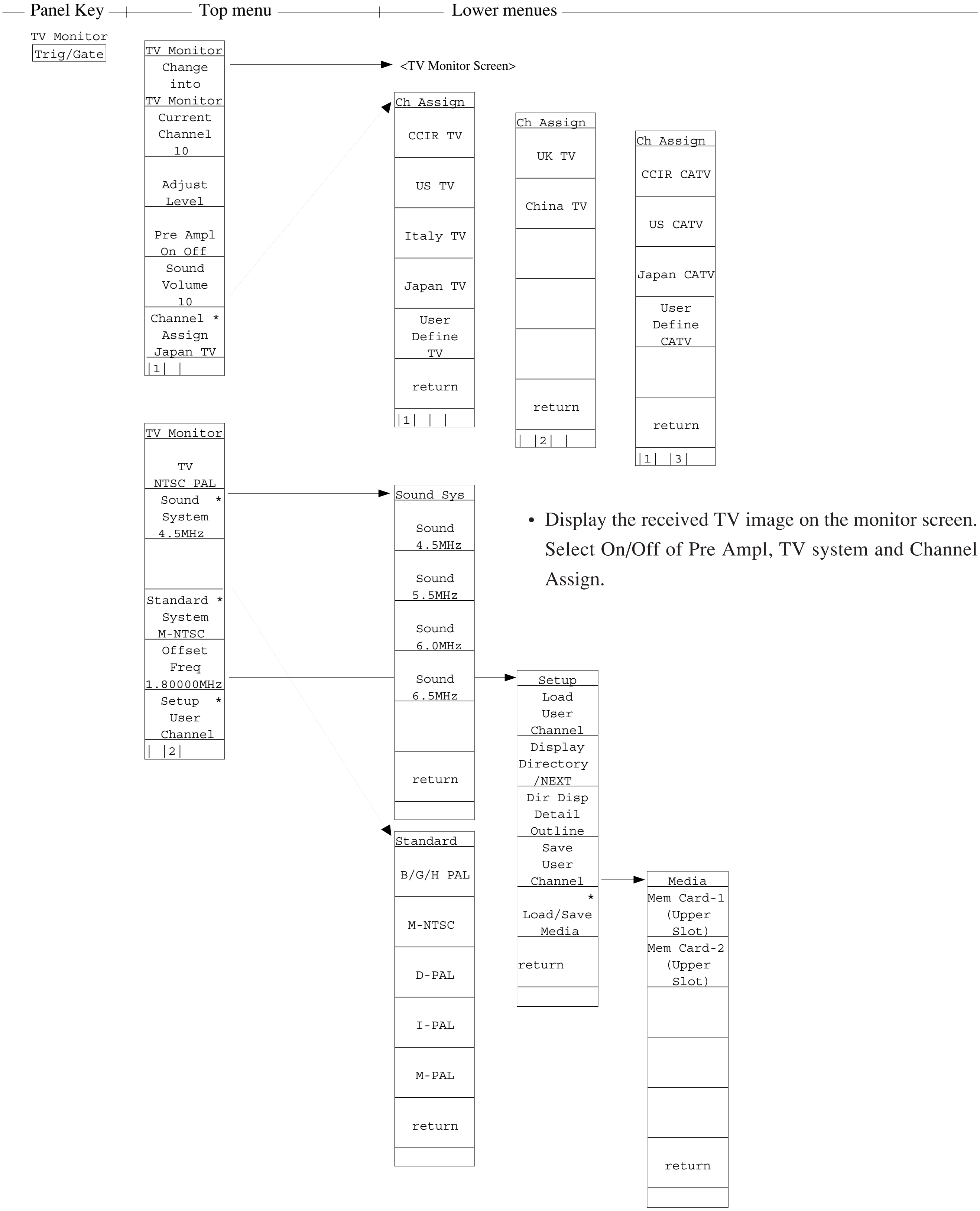


#1 Trigger Source: Select a trigger source from Video, Wide IF Video, External, TV and Line.

#2 Gate Setup : Set gate conditions including Gate Delay, Gate Length, Gate End and Gate Trig Source.

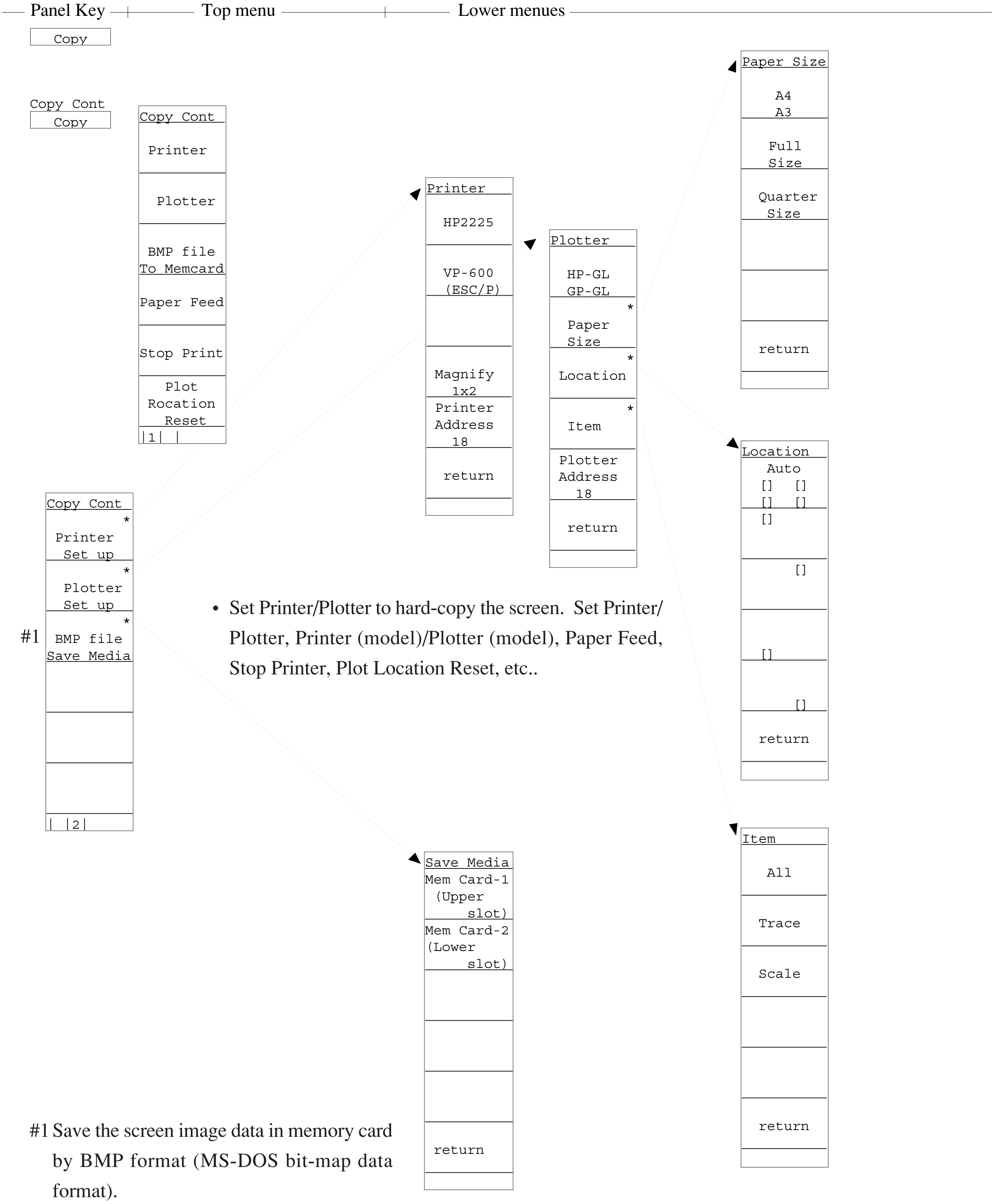
- Set gate functions for controlling the sweep start trigger and the writing of waveform data. Set the trigger mode, trigger source, trace time, delay time and time span. Select On/Off, Stop and Restart of Gate Sweep.

Menu Tree (19/28)



- Display the received TV image on the monitor screen. Select On/Off of Pre Ampl, TV system and Channel Assign.

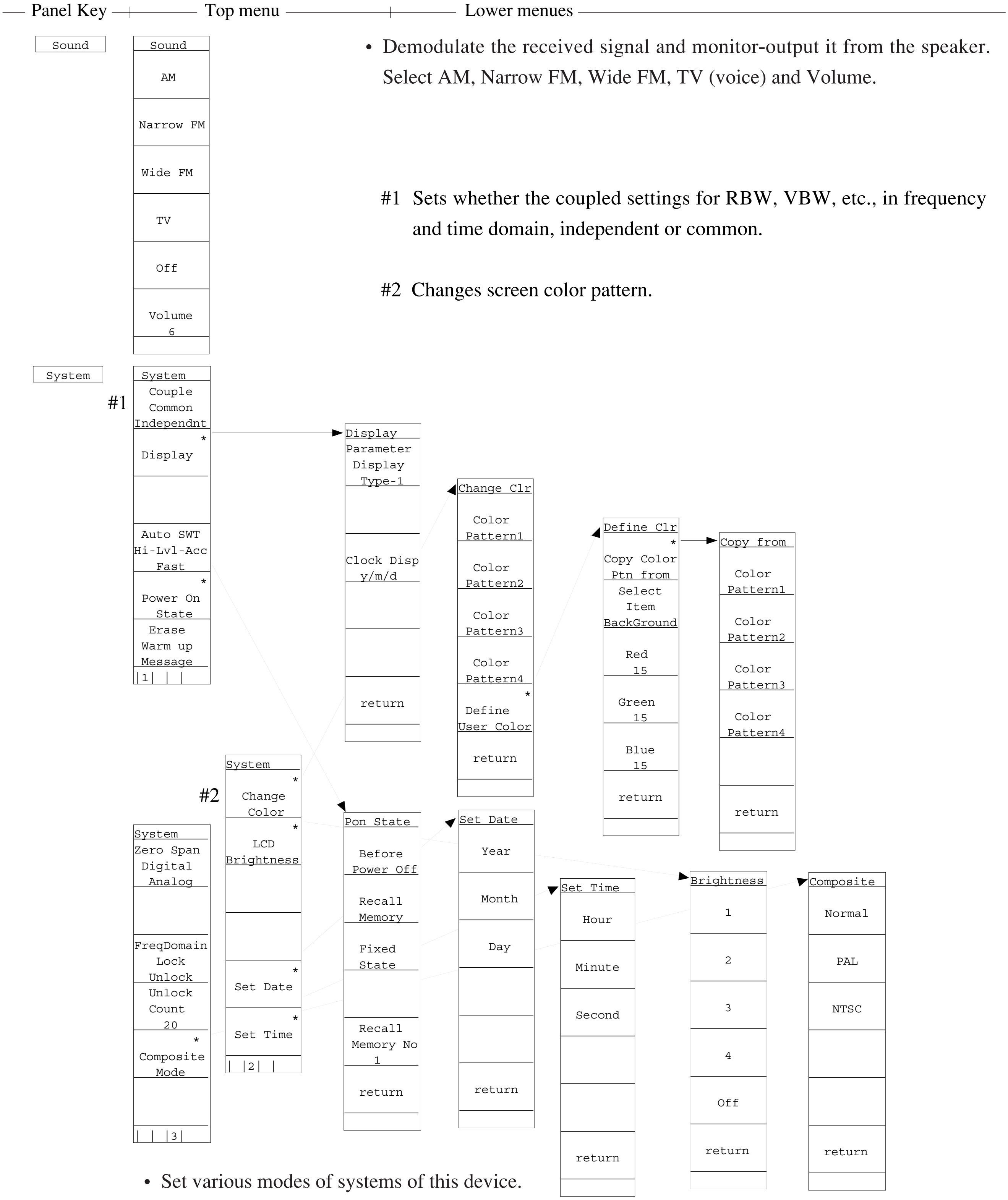
Menu Tree (20/28)



- Set Printer/Plotter to hard-copy the screen. Set Printer/Plotter, Printer (model)/Plotter (model), Paper Feed, Stop Printer, Plot Location Reset, etc..

#1 Save the screen image data in memory card by BMP format (MS-DOS bit-map data format).

Menu Tree (21/28)



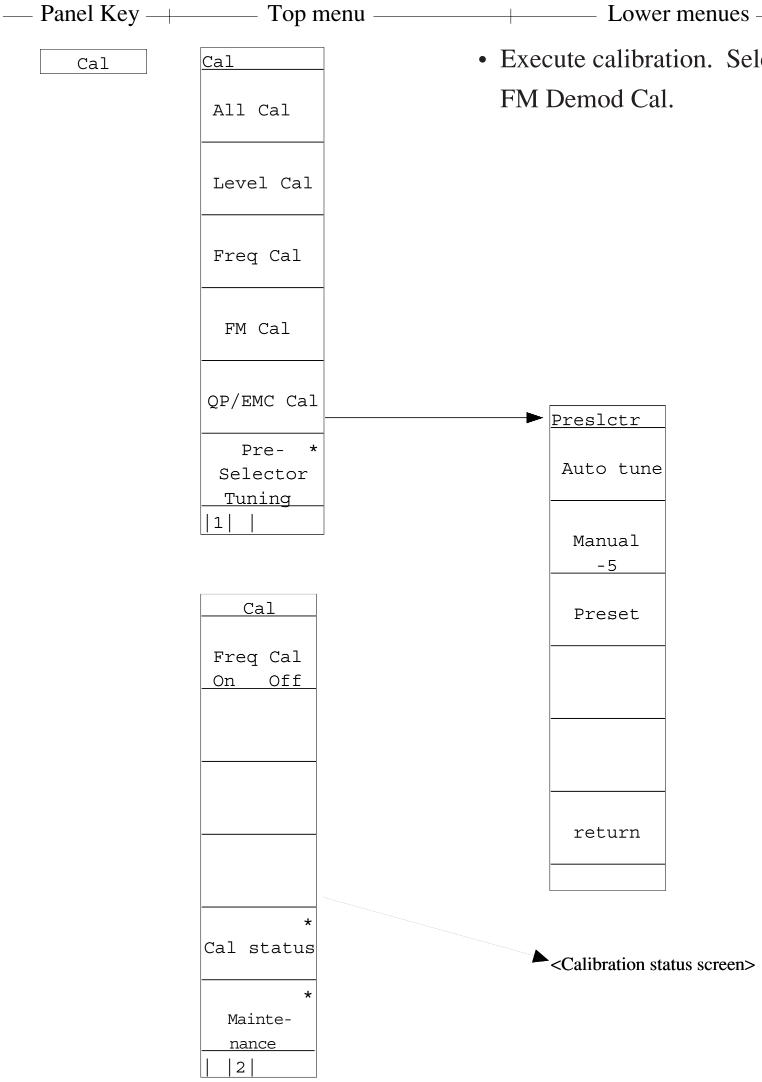
- Demodulate the received signal and monitor-output it from the speaker. Select AM, Narrow FM, Wide FM, TV (voice) and Volume.

#1 Sets whether the coupled settings for RBW, VBW, etc., in frequency and time domain, independent or common.

#2 Changes screen color pattern.

- Set various modes of systems of this device. Set Couple, Display, Color Pattern, Define User Color, Time Sweep, Power On State, etc..

Menu Tree (22/28)

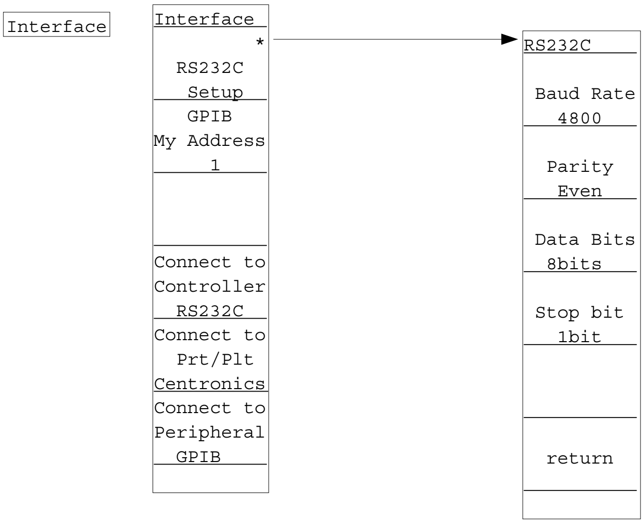


- Execute calibration. Select an item from All Cal, Level Cal, Freq Cal, and FM Demod Cal.

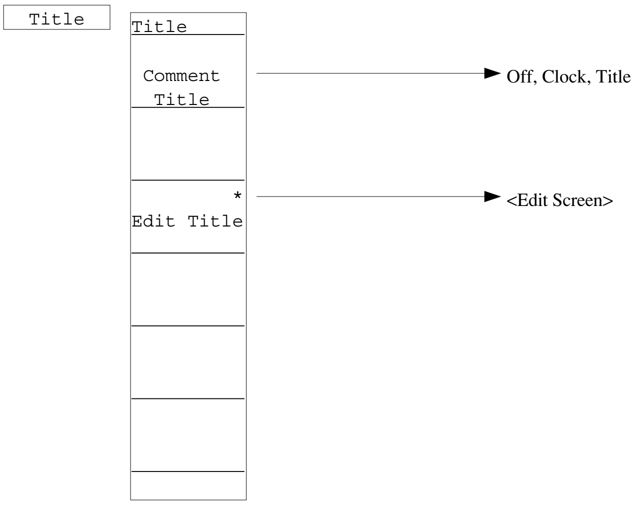
Menu Tree (23/28)

Panel Key — Top menu — Lower menues

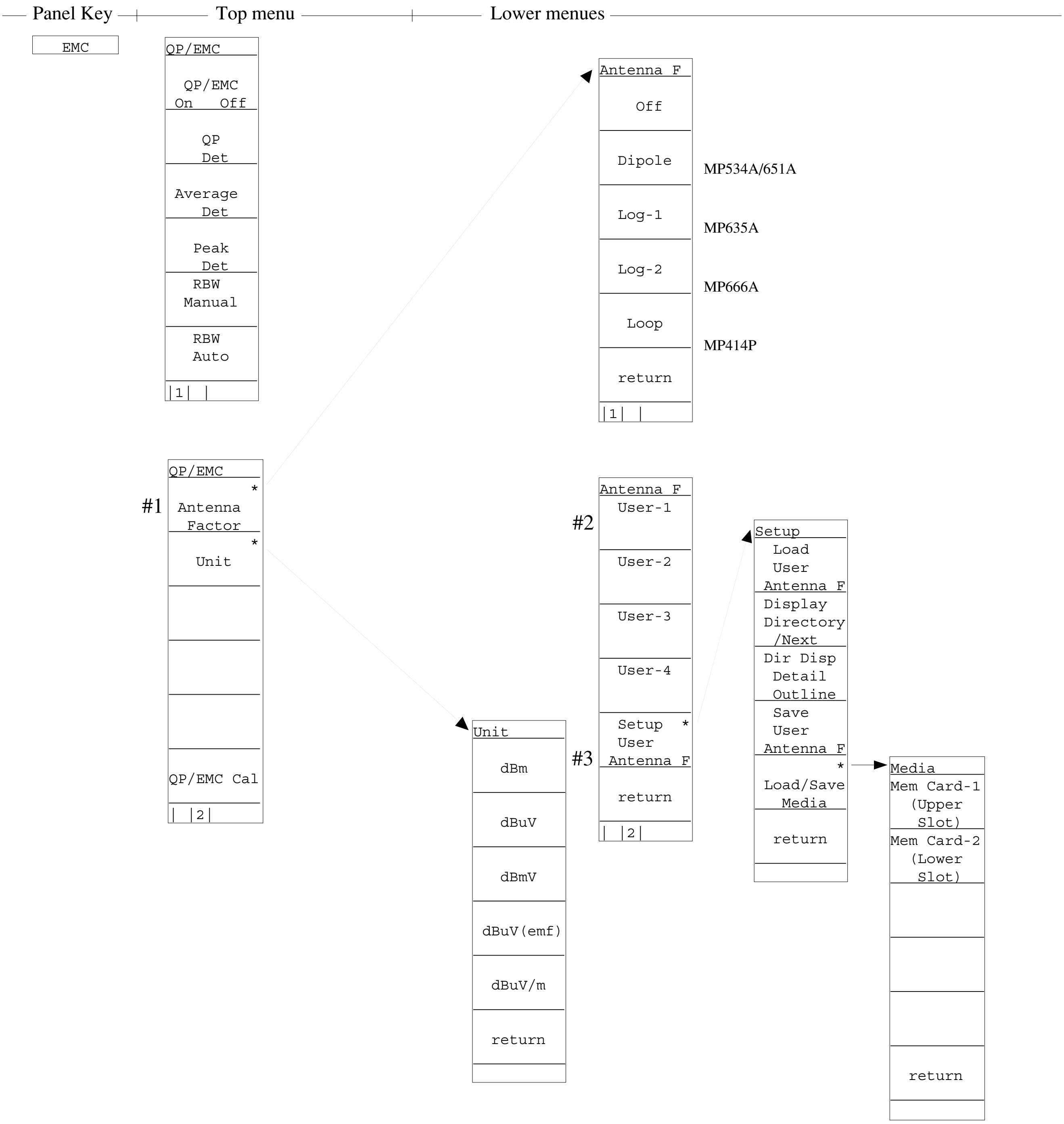
- Set interfaces for external devices to connect. Select RS232C, Centronics or GPIB, and set the RS232C interface, GPIB address, etc..



- Input a title to display on the screen.

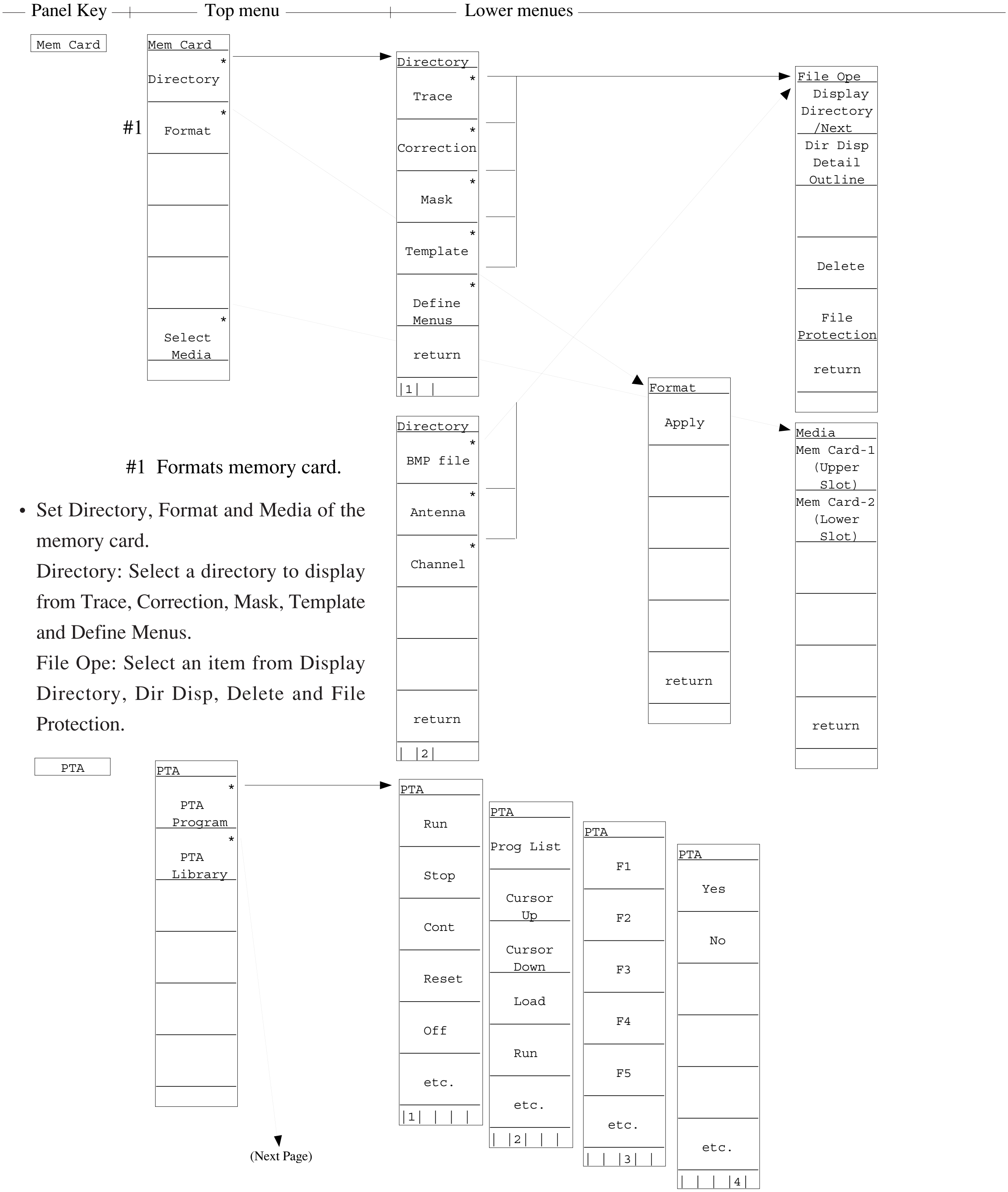


Menu Tree (24/28)



- Set the functions for QP detection/EMC measurement.
  #1 Correction on the frequency characteristic of the antenna to be used is performed prior to measurements.
  #2 When an user intends to use an own antenna, measurement is performed using its frequency characteristic correction data.
  #3 Load/Save a user’s antenna correction factor from/to memory card.

Menu Tree (25/28)

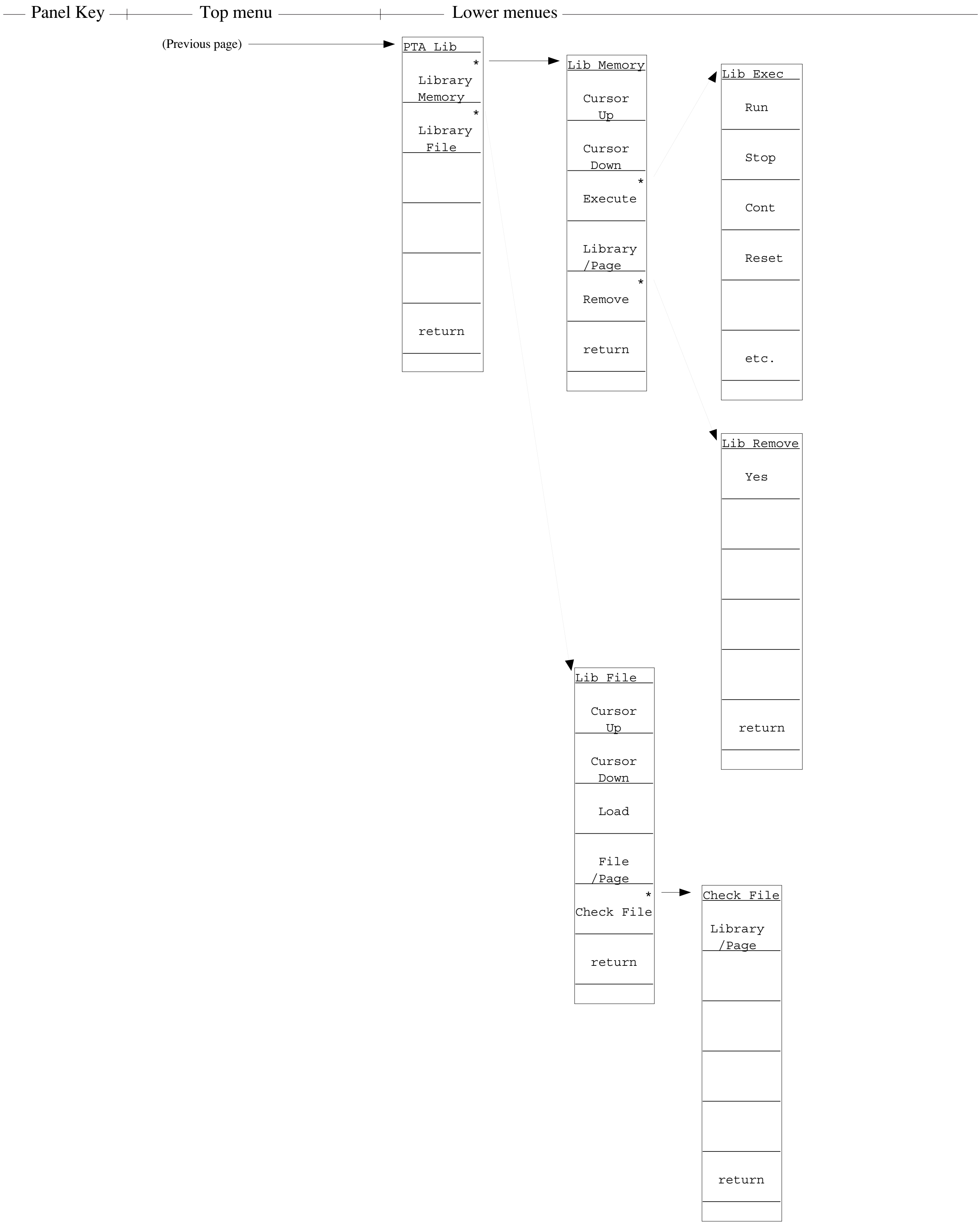


#1 Formats memory card.

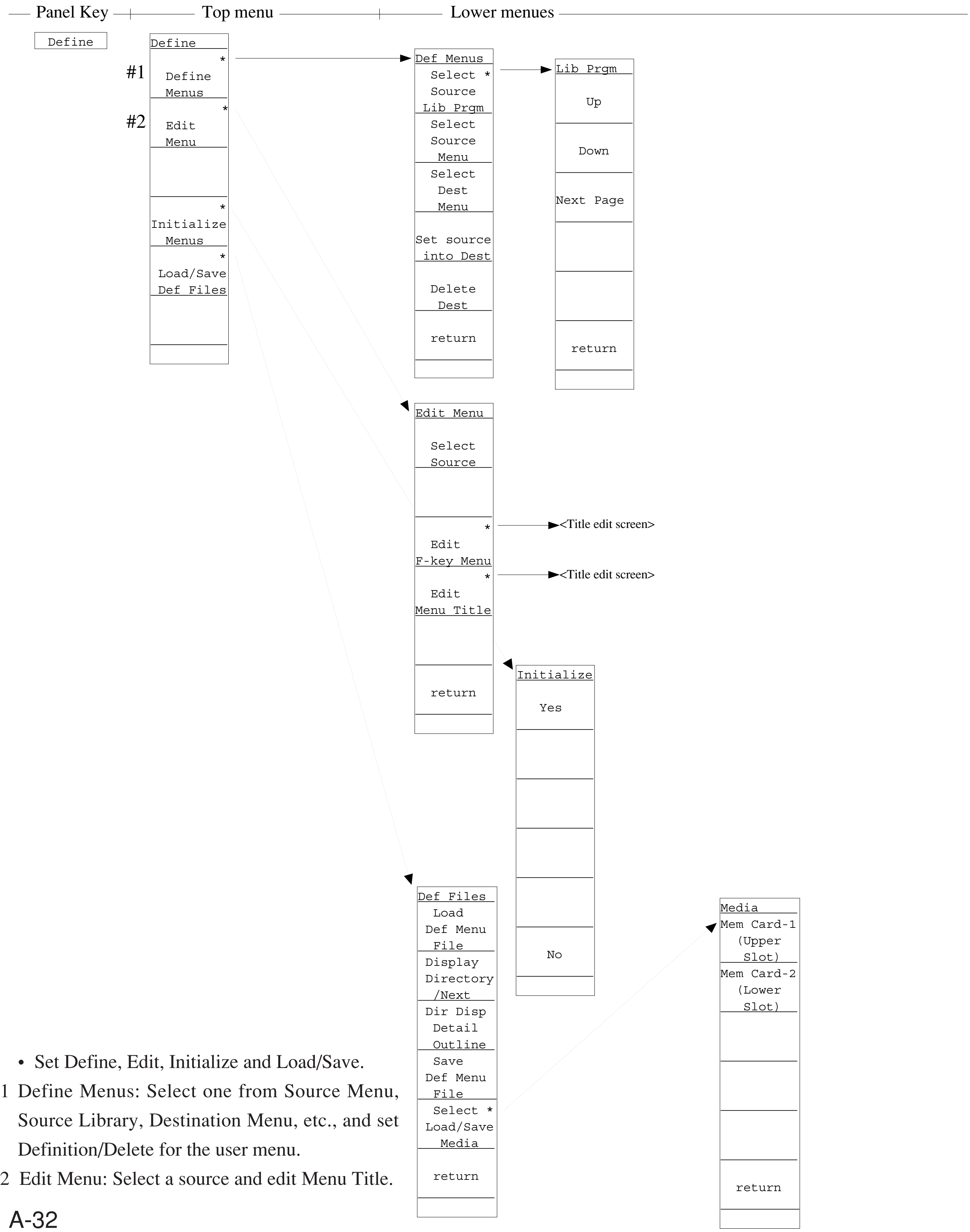
- Set Directory, Format and Media of the memory card.
  Directory: Select a directory to display from Trace, Correction, Mask, Template and Define Menus.
  File Ope: Select an item from Display Directory, Dir Disp, Delete and File Protection.

- Set PTA (personal test automation) that can build an auto measurement system without requiring external controllers.
  PTA Program: Select one from Run, Stop, Cont Reset, Prog List, Load, etc..
  PTA Library: Select one from Display/Run for the library program and Load/Check for the library file.

Menu Tree (26/28)



Menu Tree (27/28)



- Set Define, Edit, Initialize and Load/Save.

#1 Define Menus: Select one from Source Menu, Source Library, Destination Menu, etc., and set Definition/Delete for the user menu.

#2 Edit Menu: Select a source and edit Menu Title.

Menu Tree (28/28)

Panel Key	Top menu	Lower menues
Preset	Preset Preset All Preset Sweep controll Preset Trace Parameters Preset Level Parameters Preset Freq/Time Parameters	• Initialize measurement parameters. Select one from All, Sweep, Trace, Level and Freq/Time.
Hold		
Local		

APPENDIX B

KEYWORDS INDEX

The following lists the main keywords used in this operation manual and the number of the pages on which they are used. Use it to search for the soft keys, function descriptions, etc.

[KEYWORDS INDEX]