



Takeda Riken

TR4172 OPERATOR'S GUIDE



Takeda Riken Co., Ltd.

MANUAL NO. 4172-OPE-8307321



**Takeda Riken**

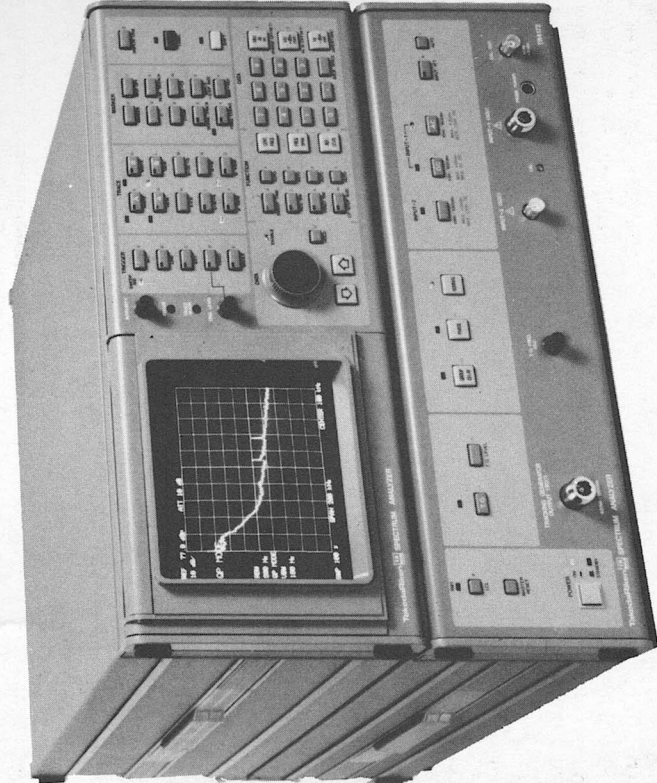
**TR4172**

**Spectrum Analyzer  
Operator's Guide**



We appreciate your purchase of Takeda Riken's **TR4172** Spectrum Analyzer. This operator's guide explains the basic operating procedures for the apparatus. Refer to the Instruction Manual for details.

The contents of this manual are subject to change without notice.



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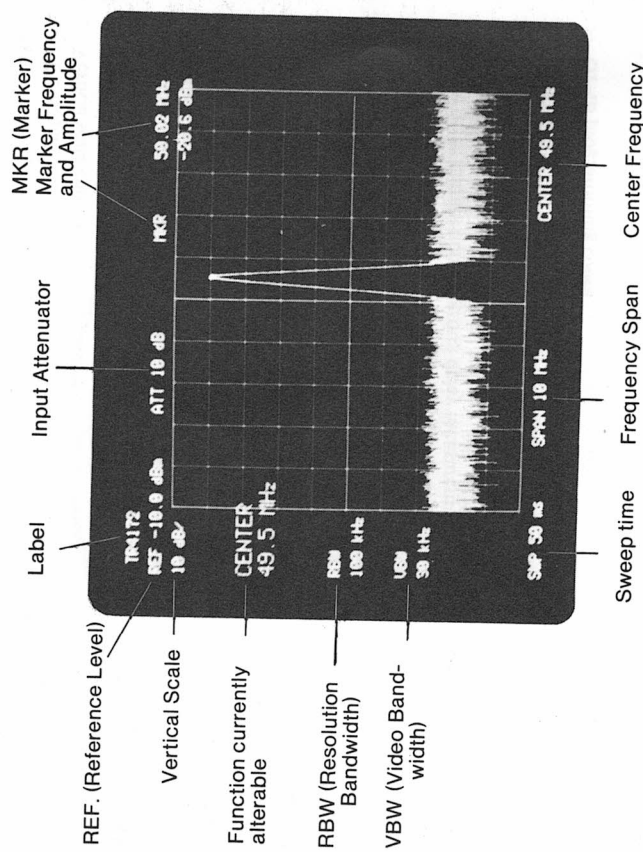
## 1. PANEL DESCRIPTION



Press the **MASTER RESET** key to clear all key settings in the **TR4172** and initialize it to the same settings as when it is switched on.

Center frequency	900 MHz	<b>T.G.</b>	OFF
Frequency span	1800 MHz	<b>TRIGGER</b>	INT.
Reference level	-10 dBm	<b>TRACE</b>	
<b>SWEEP TIME</b>	<b>AUTO</b> (50 ms)		
<b>RES. BW</b>	<b>AUTO</b> (1 MHz)	<b>A WRITE</b>	
<b>VIDEO BW</b>	<b>AUTO</b> (300 kHz)	<b>A' BLANK</b>	
<b>CF STEP SIZE</b>	<b>AUTO</b>	<b>B BLANK</b>	
<b>INPUT ATT.</b>	<b>AUTO</b> (10 dB)	<b>B' BLANK</b>	
<b>INPUT MODE</b>	<b>AC</b>	Others are all OFF.	
<b>NORMAL</b>	<b>ON</b>	All OFF	
<b>PHASE</b>	<b>OFF</b>	<b>DISPLAY LINE</b>	<b>OFF</b>
<b>GROUP DELAY</b>	<b>OFF</b>	<b>LABEL</b>	<b>OFF</b>
<b>DETECTION</b>	<b>NORM. D.</b>	<b>SHIFT</b>	<b>OFF</b>
		<b>INT. STD OUT.</b>	<b>OFF</b>
		Vertical scale	10 dB/DIV
		Drift cancel	ON

### CRT Display Readout



Press this key when the analyzer is in the remote operation mode under control of the GP-IB controller to return it to the local operation mode, in which keys on the front panel can be used, unless LOCAL LOCKOUT was set by the GP-IB controller.

Press this key to power on the LED above the key and the tracking generator.



To cut off the tracking generator, press the

SHIFT

Controls the output level of the tracking generator from 0 to 50 dB in 10 dB steps. To set the level, use the **DATA** keyboard, **DATA** knob, or **DATA** step keys.

Sets the group delay measurement mode.

Sets the phase measurement mode.


Sets the normal measurement mode.

#### INPUT-1

Couples the **INPUT-1** connector and the 1st mixer by DC to allow spectrum observation for frequencies from 50 Hz to 1800 MHz.

Couples the **INPUT-1** connector and the 1st mixer by AC to allow spectrum observation for frequencies from 10 kHz to 1800 MHz.

Used for the option 02 preamplifier.

Sets the RF attenuation level from 0 to 50 dB in 10 dB steps. Normally, the attenuator is left set to **AUTO**. To manually set attenuation level, press  (LED powers on) and input a desired value using the **DATA** keyboard, **DATA** knob, or **DATA** step switches.

To return the attenuator to the auto mode, press



AUTO

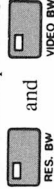
## FUNCTION Section



Activates the center frequency. The center frequency can be set to 0 Hz to 1800 MHz. The maximum number of digits (resolution) of the center frequency setting depends on the selected frequency span.



Activates the frequency span. The frequency span from one side of the CRT display to the other can be set to 100 Hz to 2000 MHz. Each division on the horizontal axis represents one tenth of the frequency span.



When the **RES. BW** and **VIDEO BW** keys are both set to **AUTO**, the resolution bandwidth and video bandwidth are both automatically set to the optimal level for the selected frequency span.

FULL SPAN



Pressing **SHIFT** **FULL SPAN** sets the frequency span and center frequency to 1800 MHz and 900 MHz, respectively. When **SHIFT** **↑** are














pressed, the frequency span becomes zero (the horizontal display axis becomes calibrated in time) and the analyzer is fixed tuned to the center frequency.



When **SHIFT** **↑** are pressed again, the zero frequency setting is cancelled.



Activates the reference level at the top graticule on the CRT display. The reference level can be set from -90 dBm to +50 dBm in 0.1 dB steps.

Setting keys	CENT. FREQ.	FREQ. SPAN	REF. LEVEL
Setting range	0 Hz to 180 MHz	100 Hz to 2000 MHz	-90 dBm to +50 dBm
<b>DATA</b> knob 	Fine adjustment 1/100 of FREQ. SPAN	Fine adjustment 100 Hz to 9 kHz; 10 Hz  10 MHz to 100 MHz; 1 MHz 100 MHz or over; 10 MHz Limited to a variable range.	Fine adjustment 0.1 dB
Step keys  	1/10 of FREQ. SPAN (1 division)	1-2-5 steps	10 dB steps 10 dB/DIV. (1 division)
<b>DATA</b> keyboard	Directly inputtable  	Directly inputtable  	Directly inputtable Positive value   Negative value  



Activates the sweep time. Sweep time can be set from 20 ms to 1000 s. When the analyzer is initially switched on, the sweep time control is set by the auto mode and sweep time is automatically set according to the frequency span, resolution bandwidth, and video bandwidth.  
 Note: Do not use the sweep time auto mode when measuring phase or group delay.



Activates the IF bandwidth (resolution bandwidth). The IF bandwidth can be set from 10 Hz to 1 MHz in 1-3 steps. When the analyzer is switched on, the IF bandwidth control is set by the auto mode. In this mode the IF bandwidth is automatically set according to the frequency span. When the **SWEEP TIME** key is set to **AUTO**, sweep time increases as the IF bandwidth is narrowed.



When **SHIFT** **LABEL** **P** **AUTO** are pressed, the IF bandwidth is set to 7 Hz (data not guaranteed).



Activates the video filter bandwidth (video bandwidth). The video bandwidth can be set from 1 Hz to 1 MHz in 1-3 steps. When the analyzer is switched on, video bandwidth control is set in the auto mode. In this mode the video bandwidth is automatically set according to the frequency span. Narrowing the video bandwidth requires longer sweep time.



Activates the center frequency step size for center frequency control using the step keys. When the analyzer is switched on, the center frequency step size control is set in the auto mode and step size is automatically set to one tenth the frequency span. Center frequency step size can also be set by the



MW/F SIZ  
 → 3 STEP SIZE

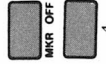
	SWEEP TIME 	RES. BW 	VIDEO BW 	CF STEP SIZE 
	20 ms to 1000 s	10 Hz to 1 MHz	1 Hz to 1 MHz	1 Hz to 1800 MHz
	Fine adjustment	1-3 steps	1-3 steps	Fine adjustment 1/100 of FREQ. SPAN
	1-2-5 step	1-3 step	1-3 step	1/100 of FREQ. SPAN
	Directly inputtable 	Directly inputtable 	Directly inputtable 	Directly inputtable 

## MARKER Section



Press the **MARKER** key to see a bright active marker appear at the center of the frequency display axis or at its previous position. Frequency and amplitude values for the marker point are displayed in the upper right corner. The marker can be moved along the trace continuously using the **DATA** knob, divided using the step keys, or to the location for a desired frequency using the **DATA** keyboard.

The marker becomes inactive when another function key is pressed.






Press the **MKR OFF** key to clear all markers and data for marker point.

Press the delta key to display two markers, one of which is active, on the display. The difference in frequency and amplitude between the two marker points are displayed in the upper right corner. Normal marker mode is restored when the **MARKER** key is pressed.



Press the **PEAK SEARCH** key to move the marker to the peak point of maximum amplitude spectrum on the CRT display.

To set the successive peak search mode to repeat peak searching after each sweep, press   . To cancel the successive peak search mode, press the **MKR OFF** key.



Use the **ZOOM** key with the **DATA** step keys to narrow the frequency span and move the marker to the center of the CRT display by substituting marker frequency for center frequency. In the zoom mode, the **DATA** knob and the **DATA** keyboard function move the marker horizontally.

To restore the normal marker mode, press the **MARKER** key.



Press the **MKR -> CF** key to substitute marker frequency for center frequency. When this key is pressed successively, wait until the sweep and subsequent waveform change, caused by previous setting, is completed.



Press the **SIGNAL TRACK** key to have the marker continue tracking the same signal and its frequency to be remain at the center of the display. To restore the normal marker mode, press this key again (lamp goes off). The display of the signal being tracked can be zoomed in by narrowing the frequency span. When the frequency span is narrowed using the **DATA** keyboard, the auto zoom mode is set.



- Press this key in the normal marker mode to substitute marker frequency for center frequency step size.
- Press this key in the delta marker mode to substitute the frequency difference between the two markers for the center frequency step size.
- When center frequency is changed in steps using the **CENT. FREQ.** key and step keys, the step size is substituted as explained in (1) or (2). To cancel the **MKR/Δ-STEP SIZE** function, press the **AUTO** key for **CF STEP SIZE**.



Press the **FREQ. COUNT.** (frequency counter) key to change the normal marker mode to the frequency counter mode. In the frequency counter mode marker frequency is directly counted by the built-in frequency counter.

The maximum frequency resolution that can be set is 1 Hz. To set the frequency resolution, press (least significant digit).



Press to set the tuned amp. mode in which the frequency of a signal with a level is more than 15 dB greater than the noise level where the marker point is measured. The marker frequency is not measured, but the frequency of the signal where the marker is located is measured. Frequency counter resolution is set the same way as in the frequency counter mode.



To restore the normal marker mode, press again. The LED goes off.



This key substitutes the amplitude level at the marker point for the reference level. If more than one marker is being displayed, the amplitude level at the active marker point is substituted.



This key sets the multi mkr (multi marker) mode in which two to ten markers can be displayed. The frequency and amplitude values displayed in the multi mkr mode are the active marker point. To set the **MULTI MKR** mode, press (number of markers to be displayed is input).



First marker (marker 1) is activated.

Second marker (marker 2) is activated.

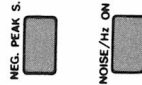
Nth marker (marker n) is activated.

To restore the normal marker mode, set the number of markers to 1.



Press

in the delta marker mode to automatically set center frequency and frequency span so the frequency span remains equal to the frequency range between the two markers. In this case, the two markers need not be active.



Press

in the marker mode to move the active marker to the negative peak point of the analysis data. (Negative peak search)



Press

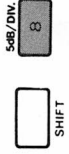
to set the noise level measurement mode. When the marker normalized to a 1 Hz noise power bandwidth to be read out setting the noise level measurement mode. To obtain the noise level over a bandwidth other than 1 Hz, add the following value to the readout:

$$10 \log_{10} \left( \frac{\text{bandwidth}}{1 \text{ Hz}} \right)$$

To cancel the noise level measurement mode, press

### Vertical Scale Control

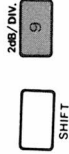
The vertical scale is normally set to 10 dB/div.  
The setting can be changed as follows:



5 dB/DIV.



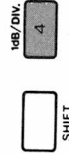
× 1 for linear scale



2 dB/DIV.



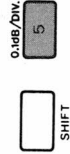
× 2 for linear scale



1 dB/DIV.



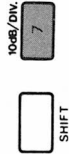
× 5 for linear scale



0.1 dB/DIV.1

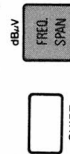


× 10 for linear scale

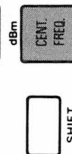


10 dB/DIV.

### Changing to dBμ representation



Reference level is represented in dBμV.



Reference level is represented in dBm.



## TRACE Section

The **TR4172** Spectrum Analyzer has four internal digital memories and can store up to four sets of waveform data, which can be arbitrarily superposed for display or plotting.



Press **WRITE A** key to have the contents of memory A rewritten every time a sweep is made and to have the updated memory contents displayed on the CRT. When the analyzer is switched on or when the **MASTER RESET** key is pressed, the write A mode is automatically entered.



Press the **VIEW A** key in the write A mode to stop updating the contents of memory A and freeze the waveform displayed on the CRT. If the **VIEW A** key is pressed in the blank A mode, the contents of memory A are again displayed on the CRT.



Press the **WRITE B** key to have the contents of memory B rewritten every time a sweep is made and have the updated memory contents displayed on the CRT.

The write A mode and write B mode cannot be used at the same time.



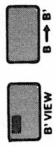
Press the **VIEW B** key in the write B mode to stop updating the contents of memory B and freeze the waveform displayed on the CRT. If the **VIEW B** key is pressed in the blank B mode, the contents of memory B are again displayed on the CRT.



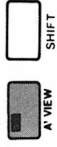
These keys transfer the contents of memory A to memory A', or contents of memory B to memory B'.



Each trace is generated from 1001 points across the graticule. Five hundred odd-numbered points from the 1001 points of trace A or B are written into memory A' or B' and the even-numbered 501 points are left in memory A or B.



To transfer contents of memory B to memory B', press



To transfer contents of memory A to memory A', press



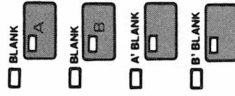
In the max. mode, the maximum signal response is held and displayed. At the end of each sweep in the max. mode, new data is compared with old data in memory for each of the 1001 points and the larger signal response is stored in memory.





Max. A mode



Max. B mode



Unnecessary traces can be blanked from the CRT using the **BLANK** key. To blank trace A, for example, press  **BLANK** .



Memory B, A', or B' can also be set in the blank mode in the same way. When memory is set in the blank mode, its contents are blanked from the CRT but remain unchanged in memory so they can be displayed again by pressing the **VIEW** key.

- If the **BLANK** key is pressed in the write mode, updating of the memory contents stopped and their display is blanked and the memory contents remain unchanged.
- If the **BLANK** key is pressed in the view mode, the frozen trace on the CRT is blanked and saved in memory.
- To reset the blank mode, press the **VIEW**, **WRITE**, or **MAX** key.
- If the **VIEW A** key is pressed in the **BLANK A** mode, the contents of memory A are displayed again on the CRT. This also applies to memories B, A', and B'.
- If the **WRITE A** key is pressed in the blank A mode, write A mode is entered causing the contents of memory A to be erased and the trace updated at the sweep rate to be displayed on the CRT. The same procedure applies to memory B.



Press the **A-B** key to exchange the contents of memory A with memory B and also the contents of memory A' and memory B'.



Press the **A-B-A** key to subtract the contents of memory B from those of memory A or from the result of the sweep. The results of the subtraction are stored in memory A. To reset the **A-B-A** mode, press  **SHIFT** .



Press the **B-DL-B** key, with memory B set in the view B mode, once subtract the Display line level from the contents (amplitude at each point) of memory B.







If the **B-DL-B** key is pressed in the write B mode, memory B enters the view B mode.

#### Markers on memories A, B, A', and B'

If the **WRITE** key or **VIEW** key for memory A or B, or the **VIEW** key for active marker moves to the area for memory for which the key is pressed. The marker location does not change with respect to the frequency axis. The locations of other non-active markers remain unchanged.

When memory A, B, A', or B' is set in the blank mode, the marker for that memory is also blanked from the CRT.
































Operation example: Direct reading of the filter insertion loss level using memories A and A', and Δ marker.

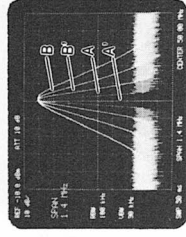
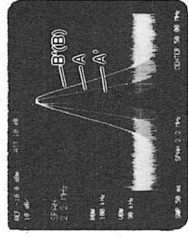
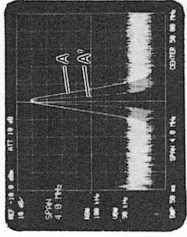
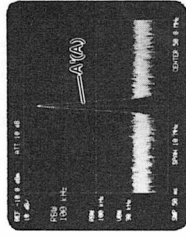
- ① Normalize the output waveform of the tracking generator. (See page 29)
- ②    (Entering waveform obtained without DUT connected into memory A')
- ③    (delta marker between memories A' and A)

④ Connect the DUT. The insertion loss level at any point can be directly read out by moving the marker using the **DATA** knob. To read marker frequency, press the **MARKER** key.

Operation example:

Simultaneous four-trace display using a 50 MHz calibration signal.

- ①               
- ②     
- ③     
- ④  
- ⑤    



Trace B' is blanked.







Trace A is blanked.

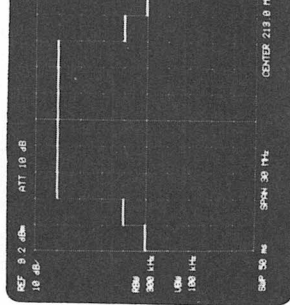
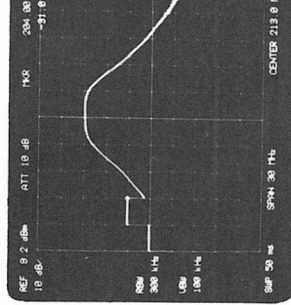
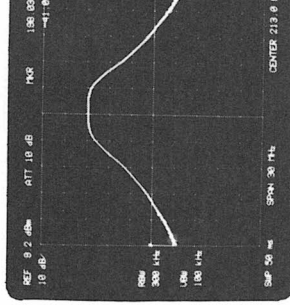
Trace A' is blanked.

### Writing Upper and Lower Limit Values

When using the TR4172 Spectrum Analyzer, the operator can write upper and lower values on its display from the front panel so he can tell at a glance whether the data observed is within the limits.

#### Sample operating procedure

- ①  VIEW
- ②  SHIFT  LABEL  Z  
DISPLAY LINE
- ③  (Marker moves vertically.)
- ④  (Marker moves horizontally.)

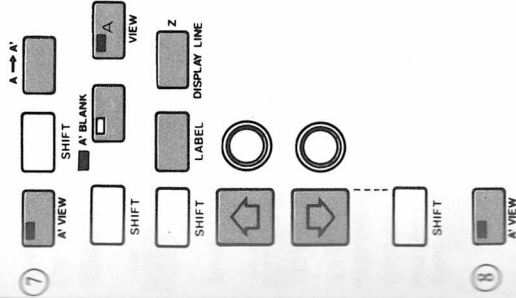


Subsequently, upper (or lower) limit values can be set using step keys and the **DATA** knob.

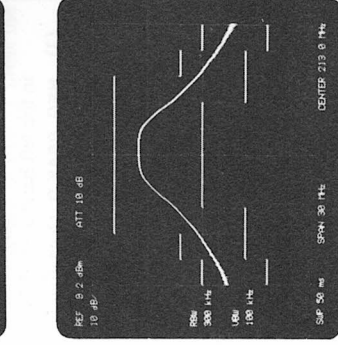
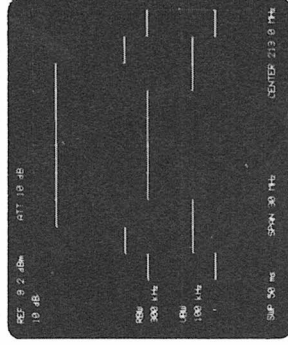
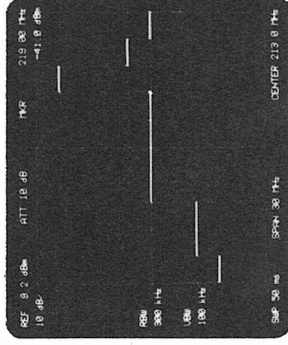
Turn the **DATA** knob, with the **BACK SPACE** key pressed, to move the marker horizontally along the upper (or lower) limit value currently displayed on the CRT.

Press the **SHIFT** key after writing all upper (or lower) limit values to erase the marker and restore the normal measurement mode.

If lower (or upper) limit values are to be also written in, proceed with steps ⑦ and ⑧, otherwise, go to step ⑨.



The upper and lower limit values stored in memories A and A' are displayed.



Connect a DUT and make observation.

**TRIGGER & SWEEP Section**

The keys in this section set the sweep triggering conditions.



Press the **INT.** (Internal) key to start sweeping automatically repeatedly internally.



Press the **LINE** key to start sweeping repeated in synchronization with line frequency.



Press the **EXT.** (External) key to start sweeping triggered by a TTL 1 signal sent, to the **EXT. TRIG.** connector on the rear panel.



Press the **VIDEO** key to start sweeping triggered by a video signal. video waveform trigger level can be changed by turning the **TRIG. LE** knob located on the left.



Press the **SINGLE** key to set the single sweep mode. In this mode a sweep made every time the key is pressed.



When  **SHIFT**  **LABEL**  **SWEEP TIME** are pressed, the current sweep is stopped and a new sweep is started from the left side of the screen.

**DETECTION**

The results of sweeping can be displayed by the following four methods:

- (1) **NORM. D.** (Normal Detection)

This is the normal detection mode entered when the analyzer is switched on. In this mode, positive and negative peak values are displayed at alternate points on the frequency axis.

To return from the detection mode to the normal mode, press  **SHIFT**  **NORM. D.**

- (2) **POSIT. PEAK D.** (Positive Peak Detection)

In this mode, the positive peak value obtained by sweeping for the specified period of time is displayed at each point on the frequency axis. To set this mode, press  **SHIFT**  **POSIT. PEAK D.**

When this mode is set, **POSIT. PEAK D.** is indicated in the left hand area of the screen.

- (3) **NEG. PEAK D.** (Negative Peak Detection)

In this mode, the negative peak value obtained by sweeping for the specified period of time is displayed at each point on the frequency axis. To set this mode, press  **SHIFT**  **NEG. PEAK D.**

When this mode is set, **NEG. PEAK D.** is indicated in the left hand area of the screen.



- (4) **SAMPLE D.** (Sample Detection)



In this mode, the instantaneous value obtained by sweeping is displayed at each point on the frequency axis. To set this mode, press  **SHIFT**  **SAMPLE D.** When

this mode is set, **SAMPLE** is indicated in the left hand area on the screen. When the averaging mode is entered, this mode is automatically set.

**SAVE AND RECALL**

The **TR4172** Spectrum Analyzer can save up to eight sets of key settings in registers and can recall them as required. It cannot save labels, markers, waveforms or display lines.

To save current key settings, press   then input a register number between one and eight. If the power supply is switched off, the built-in Ni-Cd battery retains the contents of the register.



To recall key settings saved in a register, press   then input register number.


**SAVE Register Alternate Sweep**

The **TR4172** Spectrum Analyzer can alternately measure two independent sets of conditions and simultaneously display the results of measurement using save registers 1 and 2 and the write A and write B modes.

①   (Write A and view B modes are set.)



② Set the first set of measurement conditions.

③   1 (The first set of measurement conditions are saved in



④  (Write B and view A modes are set.)

⑤ Change the save conditions as required.



⑥   2 (The second set of measurement conditions are saved in

⑦   (Save register alternate sweep 1)

If the **CENT. FREQ.** setting or **FREQ. SPAN** setting was changed in step ⑤, press the following keys:

  (Save register alternate sweep 2)

The display rate is lower in the save register alternate sweep 2 mode than in the save register alternate sweep 1 mode.

Press   to measure amplitude and phase alternately and display the results simultaneously.

Press   to measure amplitude and group delay alternately and display the results simultaneously.



## DISPLAY LINE



Press the **DISPLAY LINE** key to have a horizontal cursor line (display) appear on the CRT.

Move the display line vertically using the step keys (divide by division the **DATA** knob (fine adjustment)). The display line level is indicated in the upper left area and lower left corner on the screen.

To clear display line and level indications, press .

## HOLD



When the **HOLD** key is pressed, the **ENABLE** lamp goes off and data using the **DATA** knob, step keys, and **DATA** keyboard in the **DATA** section is not accepted. To reset the **HOLD** mode, press a key other than the **DATA** section.





## LABEL






When the **LABEL** key is pressed, the LED lamp located above the powers on, a cursor appears on the CRT and the label mode is entered in the label mode, the panel keys are not used to perform their normal function, but to input characters indicated in green to their right. Up characters can be entered per line. Numeric characters can be entered in the **DATA** keyboard. When label input is completed, press the **SHIFT** key.

To erase character strings written in the label mode, press .

Characters are also erased when the **MASTER RESET** key is pressed when the **POWER** key is set to **STANDBY**.

- To enter a space between characters, press .
- To backspace to correct the last character, press .
- To erase a character in a character string, press , position the cursor on the character to be erased by turning the **DATA** knob, press .

- To insert a character, press , position the cursor to where character is to be inserted, press  once, input the character then press  again.

- To correct a character, position the cursor on the character to be corrected, and overwrite the desired character.

**Video Averaging Mode**

The video averaging mode is used to average the continuous spectrum data and weighting it timewise.

The S/N ratio can be improved in less sweep time in this mode than by eliminating noise using the video filter.

Averaging can be done in the write A mode only.

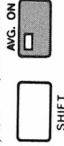
Amplitude averaging for each point on the frequency axis is calculated as follows:

$$\bar{Y}_n = \frac{n-1}{n} \cdot \bar{Y}_{n-1} + \frac{1}{n} Y_n \quad (n \leq N)$$

Where, N = number of settings

$Y_n$  = nth data

$\bar{Y}_n, \bar{Y}_{n-1}$  = nth averaged data, (n-1)th averaged data



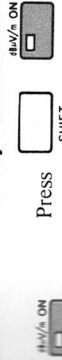
To set the video averaging mode, press


To set the number of averagings to be made, input the nth power of two (maximum 4096) using the DATA keyboard and press a unit key. When the analyzer is switched on, the number is set to 128.




To reset the video averaging mode, press

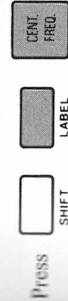
**Note:** Function key settings such as those for the center frequency and frequency span cannot be changed in the video averaging mode. To change these key settings, reset the video averaging mode once, then set it again.


**Electric Field Intensity Measurement (Refer to page 41)**

Press  to change the marker unit to dBmV/m for measuring electric field intensity.



Press  to cut electric field intensity measurement and equalize the marker unit with the reference level unit.

**Logarithmic Scaling for Frequency (LOG. Display) (For Operation Using Memory A)**


Press  to set the frequency axis (horizontal axis) as logarithmic representation. This also displays the center frequency and frequency span display to disappear and the **START** frequency (frequency at the right end of the horizontal axis).

The **START** frequency can be selected from 100 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz so the center frequency of the linear scale may be positioned near the center of the screen in the Log. display mode. The **STOP** frequency is 1000 times larger than the **START** frequency because the frequency span covers three decades. To reset the log. display mode, press a key other than the  $\Delta$  key.



### SHIFT Key Functions



When a key is pressed immediately after the **SHIFT** key, the special function, indicated by orange characters above it, is performed. Note that the zero frequency span and normal mode functions are not indicated.

### Double Shift Functions

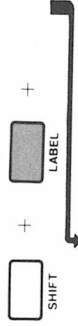
If some keys are pressed following  **SHIFT**, the functions listed in the following table will be performed.









Note: There are some double shift functions used only for servicing. If they are erroneously activated, making the analyzer unusable in normal condition, press the **MAS** **RESET** key.




















If  **SHIFT**  **H** are pressed, the help mode is entered and the double shift function list is displayed on the CRT.

To reset the help mode, press  **HOLD** or  **BACK SPACE**

### Double Shift Functions



Key	Function
	HELP (Displaying double shift function list)
	Successive peak search
	Error correction routine
	Error correction display list
	Writing upper and lower limit values
	Resetting sweeping
	Q.P. value (quasi-peak value) measurement, 10 kHz to 150 kHz
	Q.P. value measurement, 150 kHz to 30 MHz

	Q.P. value measurement, 25 MHz to 1000 MHz
	RES. BW 7 Hz
	Resetting Q.P. value measurement mode
	Logarithmic representation of frequency axis
	Impedance measurement (Option)
	Occupied bandwidth display (Option)
	X-Y recorder output (Option)
	Adjusting center frequency for every sweep (Drift prevention mode)
	Resetting drift prevention mode
	Starting internal standard oscillator output
	Stopping internal standard oscillator output
	Error correction clear
	SAVE register alternate sweep 1
	SAVE register alternate sweep 2
	Output to plotter <b>TR9834R/TR9831</b>
	Displayed information is plotted in A3 size.
	Displayed information is plotted in A4 size.
	Displayed waveform only is plotted in A3 size.
	Displayed waveform only is plotted in A4 size.

### Error Correction Routine

Correct absolute level errors due to resolution bandwidth switching using the cal signal.

Connect **CAL. OUT.** terminal and **INPUT-1** terminal via a cable, then press  SHIFT

execution is completed, the display error on the  $-20$  dBm Cal. signal for each resolution bandwidth setting is stored in internal memory. All subsequent measurements are automatically corrected by the stored error correction value with respect to reference level.

Press  SHIFT  **x**  to display the stored error correction value for each resolution bandwidth setting. To restore the normal mode, press any key.

Error correction values stored in memory are not erased even if the **MASTER RESET** pressed. To clear the values, press  SHIFT  LABEL  BACK SPACE

### Center Frequency Repositioning

When center frequency is 1500 MHz or below and frequency in between 10 MHz and kHz, or 10 kHz or below, the **TR4172** Spectrum Analyzer resets the center frequency every sweep to prevent frequency drifting.

To reset the frequency drift prevention mode to speed up rewriting on the screen, press  SHIFT  LABEL  **5**

The frequency drift prevention mode can be restored by pressing  SHIFT  LABEL  **4**  or the **MASTER RESET** key.

The frequency drift prevention mode for the center frequency and the frequency which are not in the above-mentioned ranges can be set by pressing  SHIFT  LABEL

**4**  to reset the frequency drift prevention mode in that case, press the **CENT. FF** key or **FREQ. SPAN** key.

### Internal Standard Oscillator Output On/Off

Press  SHIFT  LABEL  **7**  to make the 10 MHz standard oscillator output available via the **INT. STD OUTPUT** connector at a TTL level. Press  SHIFT  LABEL  **8**  cut the output.

## 2. BASIC OPERATIONS

## 2-1. Measuring Frequency and Amplitude Differences between Two Spectrums

1) Set the marker mode.

2) Set the marker at the peak point of a spectrum.

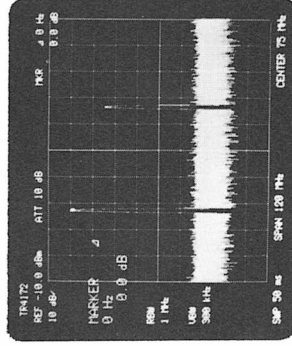


3) Set the delta mode.

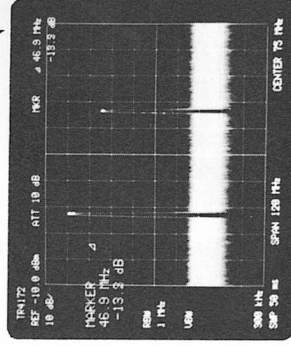
4) Set second marker at the peak point of the other spectrum.



5) Restore the normal marker mode.



Frequency and amplitude differences between the two spectrums are indicated.



## Center Frequency Step Size

When the **CF STEP SIZE** is set to **AUTO** (lamp in **CF STEP SIZE** key is off), the center frequency is automatically set to one tenth the frequency span. To set an arbitrary center frequency step size, use the following keys:

1)



CF STEP SIZE



The center frequency changes in 10 MHz steps.

2)



MARKER



The marker frequency is substituted for the center frequency step size.

3)



MARKER



The frequency difference between two markers is substituted for the center frequency step size.

## 2-2. Observing Fundamental Wave and Higher Harmonics



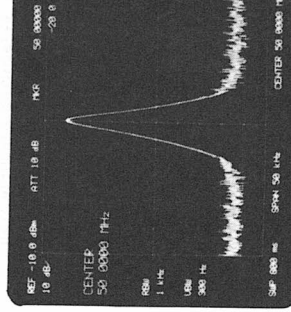
MARKER



(Set the marker at the peak point of the fundamental wave.)

FREQ.  
SPAN

(Zoom in on fundamental wave.)

MARKER/  
STEP SIZE

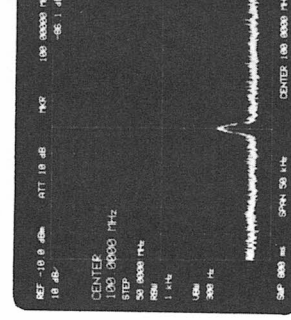
Substitute the marker frequency (fundamental wave frequency) for the center frequency step size. (**CF STEP SIZE** key lamp powers on.)

CENT.  
FREQ.

Observation of the second harmonic



Observation of the third harmonic



Each time the up key is subsequently pressed, the next higher harmonic can be observed.

## Auto Zoom mode

Press the **SIGNAL TRACK** key to have the marker to continue tracking the same signal. If the frequency span is narrowed in that state, the signal display is zoomed, tracking the signal at the center of the display. If the Data keyboard instead of the step key is used to narrow the frequency span, the auto zoom mode is entered.



MARKER

FREQ.  
SPAN

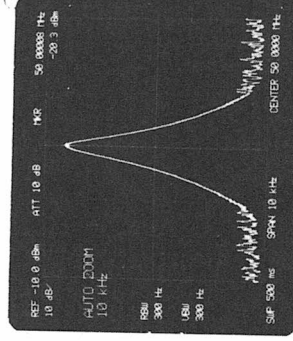
SIGNAL TRACK



1



O

MHz  
+dBm  
menu



Procedure for simultaneously observing fundamental wave, and second and third harmonics of radio transmitter

Assume transmission frequency is 144 MHz.

1 Connect transmitter output to the input terminal of the TR4172 using a RF coupler for attenuation.

2 When the analyzer is in the initial state, press the following keys:

(144 MHz)  
   (50 kHz)  
   (-10 dBm)

3 Store the fundamental wave in memory A.

4 Double the center frequency to observe the second harmonic. If the center frequency step size is set to 144 MHz, the center frequency is multiplied in an integral sequence (double, triple, and so on) each time the STEP UP key is pressed.

Press

or

PEAK SEARCH

then press

(the second harmonic in memory A is displayed).

5 Activate display B to display the third harmonic.

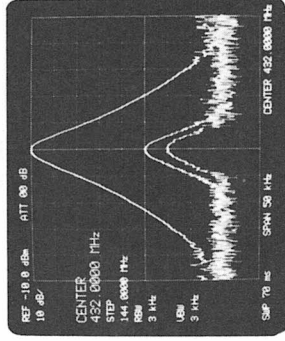
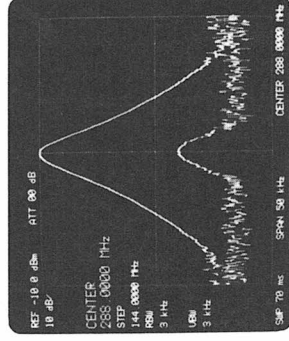
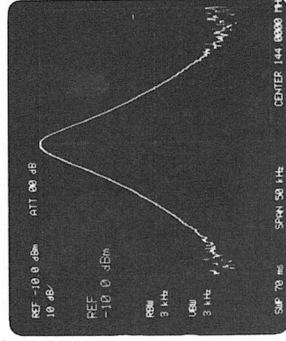
(Memory A is automatically set to the **VIEW** (still) mode.)

(The third harmonic is displayed in memory B)

6 The contents of memories A, A and B are now displayed together.

To further superpose the third harmonic, store it in memory B' by pressing

, and input the next waveform to activate display B.



### 2-3. Measuring Adjacent Noise Level

This is the procedure for measuring the adjacent noise level for 50 MHz oscillation.

#### (1) Measurement using video averaging function

Connect the output terminal of a 50 MHz oscillator to the **INPUT-1** terminal of **TR4172**.

- Note:
- If the oscillator output is directly coupled to the **TR4172**, the output frequency may change due to the input capacitance of the **TR4172**. If occurs, use a probe with less cable capacitance for the input connection.
  - The maximum input level allowable for the **TR4172** is +20 dBm when input attenuator is set at 20 dB or greater. Be careful not to apply an input level exceeding +20 dBm. Use an external attenuator if necessary.
- (2) With the **TR4172** in the initial state, press the following keys:



(Center frequency: 50 MHz)

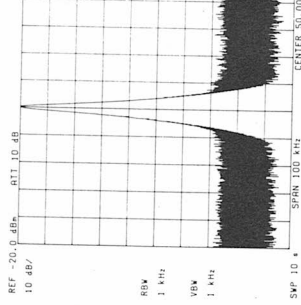


(Frequency span: 100 kHz)

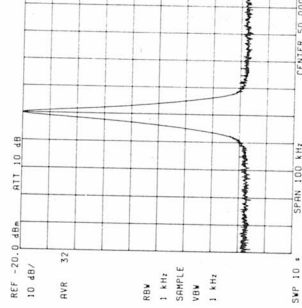


(Reference level: -20 dBm)

Since the **TR4172** in the initial state is in the auto modes, the sweep span, resolution bandwidth, and video bandwidth are automatically set to the optimum values according to the selected frequency span. They can also be set manually. To set the resolution bandwidth to 1 kHz, for example, press:



- (3) Repeat video averaging 32 times.



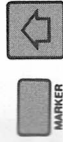
- Note:
- Video averaging mode can be set in the write A mode only.
  - The number of averages must be an nth power of 2, with a maximum of 4096.

- ④ Activate a marker and measure adjacent noise (for example, 20 kHz from the signal response).



MARKER

Since the frequency span is 100 kHz in this example, the marker can be moved 20 kHz by pressing the step key twice:



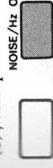
MARKER



- ② Measurement in the noise level measurement mode (NOISE/Hz)

When the effective value of noise level is measured (NOISE/Hz), the bandwidth conversion of an ideal rectangular filter is adjusted by the internal CPU so measurement accuracy is improved.

- ① Execute steps ① through ④ described in (1), and press



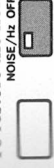
SHIFT

NOISE/Hz ON



- ②

To restore the normal mode, press



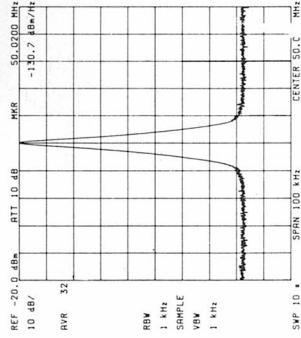
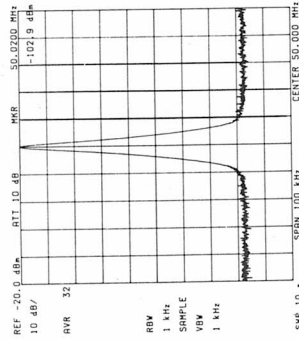
SHIFT

NOISE/Hz OFF

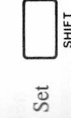


- ① To obtain the noise level over a bandwidth greater than 1 Hz, add the following value to the readout:

$$10 \log_{10} \left( \frac{\text{bandwidth}}{1 \text{ Hz}} \right)$$



### TUNED AMP. function



Set

SHIFT

TUNED AMP.



to enable the **TR4172** to function as a selective

amplifier, for precision on-air frequency measurement. The **TR4172** can make selective frequency measurements with high sensitivity to measure signals other than carrier frequency (as modulated signals) and compound signals, which cannot be measured with a frequency counter. Carrier and spectrum frequencies can also be accurately read with the stability of the standard oscillator for the built-in counter by using a marker to specify the target signal. In that case, marker setting errors or errors due to the local frequency do not occur.

#### 2-4. Measuring Crystal Filter Frequency Responses

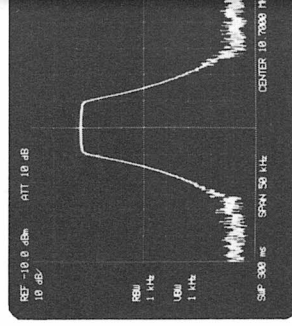
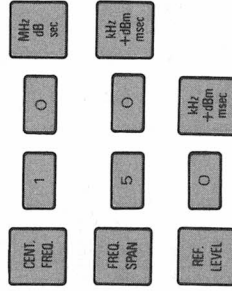
This paragraph describes how to measure insertion loss, ripple, 3 dB bandwidth, and attenuation of a communication-purpose IF crystal filter. The following explanation assumes a band-pass filter is used to operate under the following conditions:

- Center frequency: 10.7 MHz
- Passband: 10 kHz
- Insertion loss: 20 dB or less
- Ripple: Within  $\pm 1$  dB
- Attenuation: 70 dB or more

- ① Connect a filter (DUT) between the **TRACKING GENERATOR OUTPUT** and **INPUT-1**. Note:
  - If the input and output impedance of the DUT are not equal to those of the analyzer, equalize them.

- If filter insertion loss is too great, it may be impossible to secure adequate dynamic range. In such a case, connect a preamplifier (option 02) to the **INPUT-2** connector of the analyzer.

- ② With the analyzer in the initial state, press the following keys:

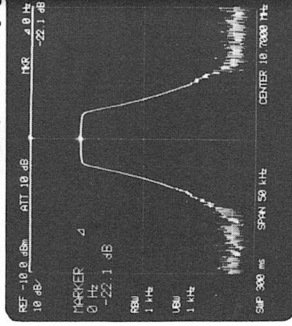


- ③ Disconnect the DUT, and interconnect the **TRACKING GENERATOR OUTPUT** connector and **INPUT-1** connector with a cable.

Press the **T.G.** key (lamp above key powers on), and check the output level of the tracking generator (T.G.). (T.G. output level is 0 dBm with the T.G. level set to 0 dBm) Since the frequency span is 50 kHz, a flat horizontal line should appear on the screen. If the line is not flat, align it with the display line by normalization. For the normalization procedure, see Frequency Response Compensation Using Display Line on page 29.

- ④ Measuring insertion loss

Connect the DUT between **TRACKING GENERATOR OUTPUT** and **INPUT-1**. The difference in level between the waveform obtained with the DUT connected and the one obtained without the DUT connected on the center frequency is the insertion loss. (See filter insertion loss measurement example on page 12.)



## Measuring passband



Set the delta marker display level to  $-3$  dB.



Set the delta marker to 0 dB level and read the frequency. The frequency difference between the two levels denotes the passband.

## Measuring ripple



(Set the peak of the signal response to the reference level.)

PEAK SEARCH



10B/DIV.



(Change the vertical scale.)

SHIFT

In this case, clear the frequency response compensation mode if it has been selected.



PEAK SEARCH



Set the delta marker to the minimum level of the signal response. Here the value of the delta marker display level denotes the ripple.

## Measuring attenuation

10dB/DIV.



SHIFT

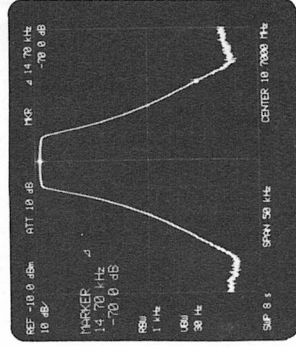
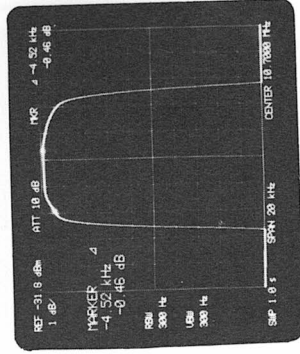
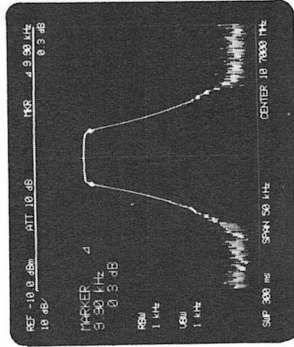
Use an input or output preamplifier as required.




PEAK SEARCH



Measure attenuation (X dB) using the delta marker.



## Frequency Response Compensation Using Display Line (1)

Procedure in which  SHIFT are used

①  WRITE (Write A mode is set.)

② Connect the **TRACKING GENERATOR OUTPUT** connector and the **INPUT** connector with a cable.

③  REF LEVEL   

Change the reference level and lower the frequency response with the DUT not connected to the level as shown to the right.

④  DISPLAY LINE   



Align the display line with the waveform shown with the DUT not connected. A more accurate alignment between them allows a wider dynamic range later.

⑤  SHIFT 

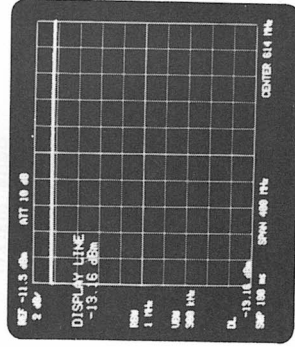
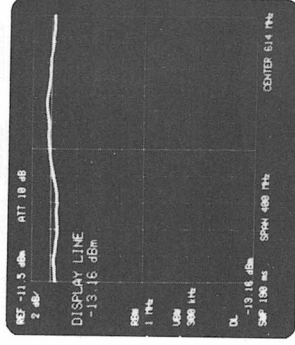
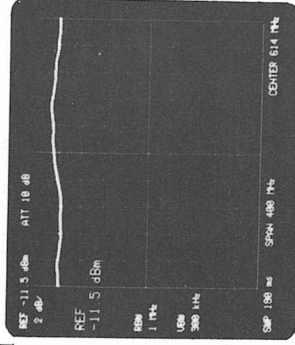
Frequency response compensation is made.

The A-B→A mode is entered, and the lamp in the key powers on.


To disable frequency response compensation and restore normal display, press

 OFF 


Note that memory B cannot be used while frequency response compensation is being made.



## Frequency Response Compensation Using Display Line (2)

Procedure in which  is used

B-DL → B

- ①  WRITE (Write B mode is set.)

- ② Connect the **TRACKING GENERATOR** **OUTPUT** connector and the **INPUT** connector with a cable.



- ③  REF LEVEL



DISPLAY LINE

- ④  B-DL → B


The difference between the frequency response with no DUT connected and the display line is stored in memory B and is displayed. Memory B enters the view B mode. Until this mode is reset, memory B is not usable for any other operation.

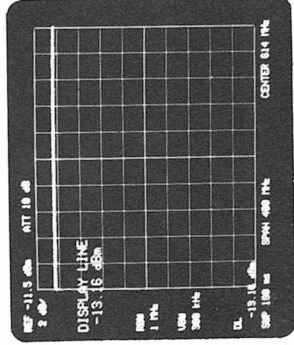
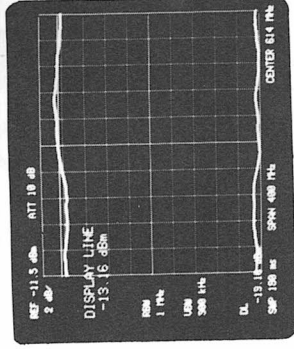
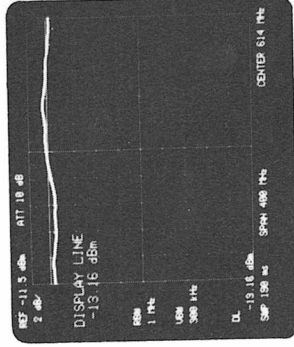
- ⑤  WRITE  A-B → A

Connecting a DUT with the analyzer in this state compensates the frequency response and the response is displayed.



Blank the contents of memory B from the screen to make observation easier.

To disable frequency response compensation, press   A-B → A



## 2-5. SAW Filter Phase Measurement

- 1 Connect an saw filter (DUT) between the **TRACKING GENERATOR OUTPUT** and **INPUT-1**.

Note: • Match the input/output impedance of the DUT with that of the analyzer if they are not equal.

- Generally, an saw filter causes a 20 dB insertion loss. Some filters contain an amplifier to compensate for the insertion loss. If the filter connected as the DUT contains such an amplifier, note the maximum output level of the tracking generator.

- 2 Use the shortest possible input cables.
- 3 Set the center frequency, sweep span, signal input/output conditions, and other necessary parameters.
- 4 Remove the DUT, and directly connect the **TRACKING GENERATOR OUTPUT** connector and **INPUT-1** connector with a cable.

Press the **G.D. OFFSET** key to flatten the phase slope.

For the procedure for adjusting electrical length, see page 33.



(PHASE OFFSET)

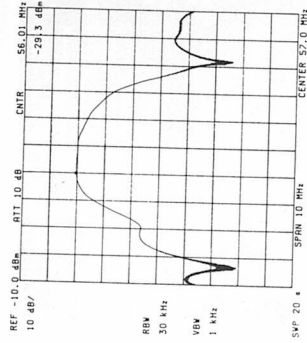


(Phase response is displayed.)

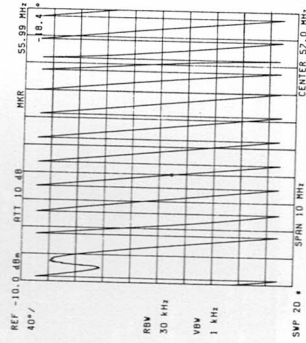
- 5 Connect the DUT between the **TRACKING GENERATOR OUTPUT** and **INPUT-1**.

The display resolution can be controlled from 80°/div. to 0.2°/div. using the DATA knob or step keys.

Note: When using the phase measurement mode, reset the Sweep Time Auto mode (press **SWEEP TIME** key the lamp in the key powers on) and set a proper sweep time.



Amplitude response of filter



Phase response of filter



### Simultaneous Measurement of Amplitude and Phase (Alternate Sweep)

1 Connect the DUT between the **TRACKING GENERATOR OUTPUT** and **INPUT-1**.

2 Press  , and measure the amplitude response of DUT to determine necessary measurement conditions.

3 Adjust the electrical length (see page 33) and determine the phase resolution. Using the **DATA** knob, set the shortest sweep time that does not affect phase data.

4  (Amplitude and phase data are displayed at the same time.)

5  (Normal mode is restored.)

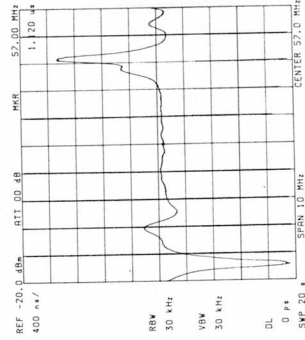
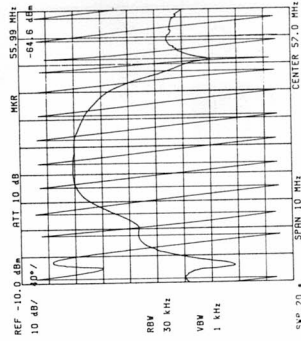
Either memory A or B is set in the write mode, and the other is set in the view mode. To clear unnecessary information, set one of them in the write mode and the other in the blank mode.

Note: Frequency response compensation and alternate sweeping cannot be done at the same time.

6  (The group delay of DUT is displayed.)

To improve the resolution for group delay measurement, resolution for phase measurement must be enhanced. Press the **PHASE** key to activate phase display and turn the **DATA** knob clockwise. Furthermore, carry out the following operations if required.

- Eliminating the group delay of the measuring system. (See page 37.)
- Video averaging (See page 37.)
- Narrow the video bandwidth to improve signal-to-noise ratio. For this, increase sweep time.
- Change the aperture. (See page 38.)
- Eliminate spike noise. (See page 39.)



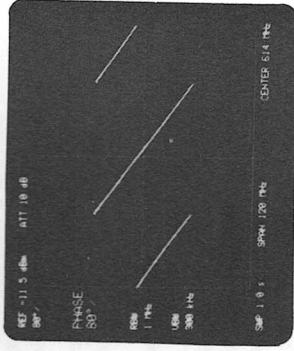
## Electrical Length Adjustment

To improve phase measurement accuracy, eliminate the phase error of the measuring system itself. To do this, disconnect DUT, interconnect measuring cables, and measure phase response of the measuring system. Electrical length must also be adjusted when a measuring condition, the **VIDEO BW** setting, for example, is changed.

①



(Phase is rotating in the measuring system.)



②



(G. D. OFFSET)

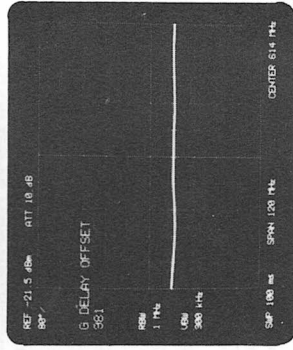
(Electrical length becomes adjustable.)



or



Flatten phase slope.

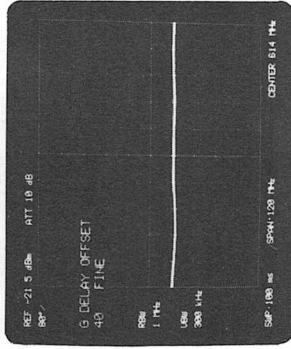


③



(G. D. OFFSET)

(Fine adjustment of electrical length)



Fine adjustment of the electrical length can be made by pressing the **G.D. OFFSET** key again. **G. DELAY OFFSET FINE** is displayed.

4

(Phase offset becomes adjustable.)



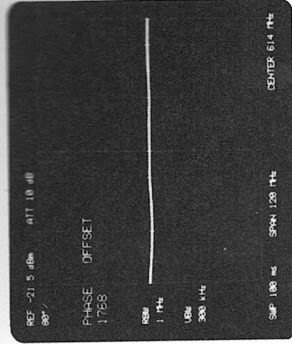
(PHASE OFFSET)



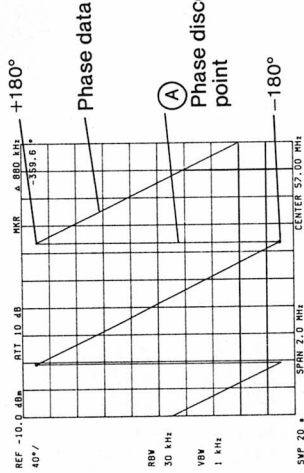
OR



Position the phase response trace at the center of the vertical scale. If the trace is not straight, make frequent response compensations using the display line. (See page 29.)



### Phase Display Example



- Shown above is a phase response display example for a saw filter covering the frequency range between 50 and 60 MHz. The example shows that phase lag increases with frequency.
- Ⓐ indicates a phase discontinuity point on the response display occurring at  $+180^\circ$  and  $-180^\circ$ .
- The center horizontal line (the fifth from the top) represents the zero phase.
- Numeric readouts indicate measurement conditions.
- This example shows that the filter has a phase lag (about  $360^\circ$  over a frequency band of about 880 kHz). For more precise measurement, use the delta marker mode.

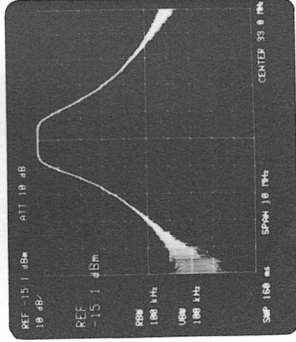
## 2-6. Band-pass Filter Group Delay Measurement

- ① Connect a BPF filter (DUT) between the **TRACKING GENERATOR OUTPUT** and **INPUT-1**.



②

Measure the passband response, and set the **T.G. LEVEL** and **INPUT ATT**.



③

- Remove the DUT, interconnect the **TRACKING GENERATOR OUTPUT** connector and **INPUT-1** connector with a cable, and observe the frequency response.

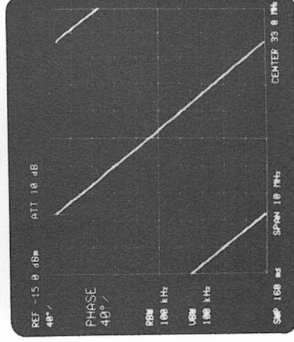


④

- (Phase response observation with no DUT connected)

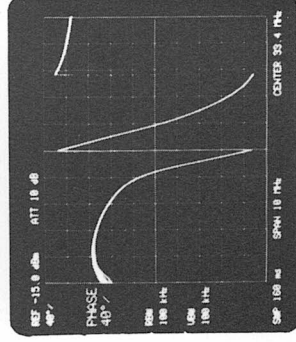
If the phase is sloping, adjust the electrical length. (See ① to ④ on page 33.)

If necessary, eliminate group delay in the measuring system. (See page 37.)



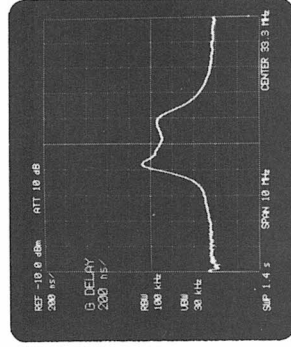
⑤

- Connect the DUT between the **TRACKING GENERATOR OUTPUT** and **INPUT-1**. Now, the phase response of the filter can be observed.





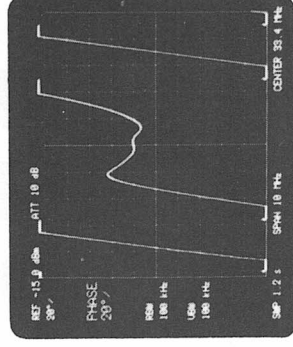
6 (Filter group delay observation)



7 To improve group delay resolution, improve phase resolution.



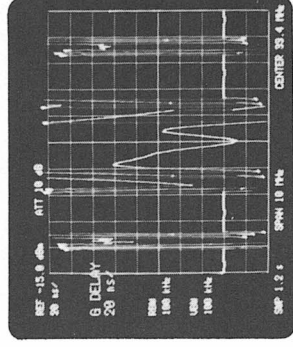
(Turn clockwise.)



Note: Enhancing the phase resolution to enhance group delay resolution in the passband of the filter may cause a phase overflow beyond the passband. If it occurs, press the **G.D.** **OFFSET** key to make the group delay offset controllable, and change the phase slope in the passband by turning the **DATA** knob.



8



- Do the following operation as required:
- Eliminate group delay in the measuring system.
  - (See page 37.)
  - Video averaging (See page 37.)
  - Narrow the video bandwidth to improve signal-to-noise ratio using the **VIDEO BW** key. For this, increase sweep time using the **SWEEP TIME** key.

## Eliminating Group delay in Measuring System

To eliminate group delay in the measuring system to improve group delay measuring accuracy, do the following procedure:

- 1 Remove the DUT, interconnect the measuring cables, and measure the group delay response of the measuring system.



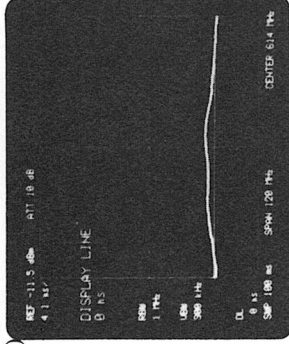
(The group delay response of the measuring system is stored in memory A.)

- 2

DISPLAY LINE



Align the display line to group delay 0 ns.



- 3

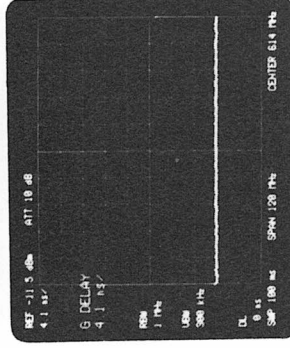


- 4

Reset the group delay elimination mode



by pressing



## Group Delay Measurement Including Video Averaging

- 1 Remove the DUT, interconnect measuring cables, and measure the group delay response of the measuring system.



(The group delay response of the measuring system is stored in memory A.)

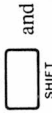
- 2



(Execution of video averaging. The number of averaging can be changed by the **DATA** keyboard.)

- 3 After completion of averaging, execute steps 2 and 3 explained in the foregoing Group Delay Elimination in Measuring System.

To reset video averaging mode, press



and



SHIFT

## Aperture Control

In general, raising group delay resolution lowers signal-to-noise ratio. Increasing the aperture, however, makes it possible to increase group delay resolution without sacrificing S/N ratio. For the **TR4172**, aperture is represented by the following equation:

$$\Delta F (\text{aperture}) = \frac{24}{1000} \times \text{frequency span}$$

← This can be increased up to 192/1000 in four steps.

Aperture control is possible only when group delay measurement resolution is not less than 4/frequency span.

① Press  and check that the above-mentioned condition for aperture control is satisfied.

②   (Aperture control becomes possible.)

**APERTURE 24** is displayed in the left side area on the screen.

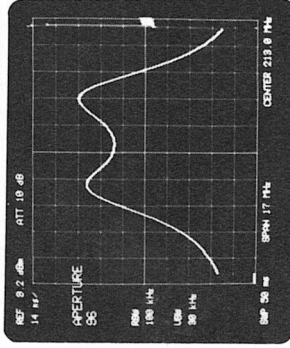
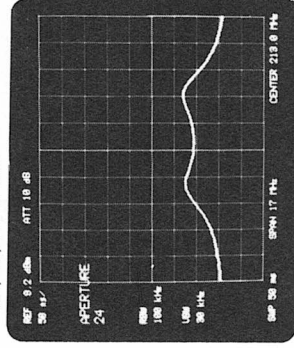
③ Using  or  , select a desired aperture value of 24, 48, 96 or 192.

Enlarging the aperture enhances resolution without deteriorating the S/N ratio. For example, changing the aperture from 24 to 48 with a resolution of 100 ns/div. enhances resolution to 50 ns/div.

④  (Aperture control mode is reset.)

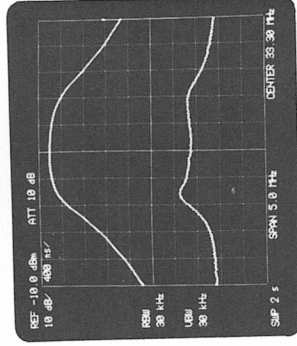
Note:

As the aperture is enlarged, the effective screen range is narrowed. Enlarging the aperture causes (aperture/2-12) points of the 1001 points on the frequency axis to be lost at the ends on both sides. For example, when aperture is enlarged from 24 to 192, effective screen range is narrowed by one division at the end on each side.



### Simultaneous Amplitude and Group Delay Measurement (Alternate Sweep)

- 1 Connect the DUT between the **TRACKING GENERATOR OUTPUT** and **INPUT-1**.
- 2 Press **NORMAL** to observe amplitude, and determine the necessary measurement conditions to be set.
- 3 Press **GROUP DELAY** and observe group delay.
- 4 **D. T. A. G.**  
 **SHIFT** and observe group delay.  
 **D. T. A. G.**
- 5  **SHIFT** (**D. T. A. G.** (Normal mode is restored.))



Note: The group delay-amplitude alternate sweep mode and the frequency response compensation mode cannot be used together.

### Spike Noise Elimination for Group Delay Measurement

- During group delay measurement, the signal response trace on the display may produce spike noise as shown in Figure A below. To eliminate such spike noise, either of the following methods may be used:
- a. Set a sufficiently long sweep time. (See Figure B.)
  - b. Adjust the electrical length to eliminate discontinuous points in phase response. Note that, in this case, the relative group delay is measured as group delay ripple and the absolute delay time cannot be measured.

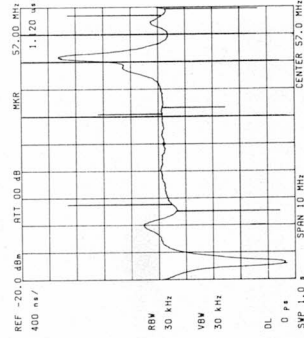


Fig. A

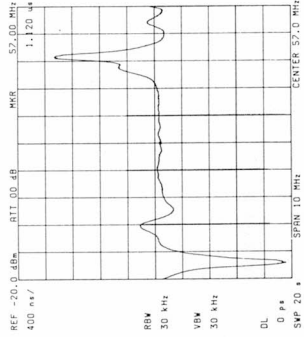


Fig. B







## 2-8. Electric Field Intensity Measurement

① Connect an antenna to the **INPUT-1** (50  $\Omega$ ) terminal of the **TR4172**. If the impedance of the antenna is not 50  $\Omega$ , match it to the terminal impedance using a matching circuit.

② Set the center frequency and frequency span.

③ Press  , and set the level readout unit to  $\text{dB}\mu\text{V}$ .

④ Press  to display a marker, and set the marker at the frequency spectrum to be measured using the **DATA** knob or step keys.



⑤ The marker point display level, that is, the relation between input terminal voltage  $e_x$  [ $\text{dB}\mu\text{V}$ ] of the **TR4172** and the actual electric field strength [ $\text{dB}\mu\text{V}/\text{m}$ ], is given by the following equation:

$$Ex = ex + K$$






Where:  $K$  = antenna coefficient

The antenna coefficient can be calculated as shown on page 42.





If the antenna used is Takeda Riken's **TR1722** half-wavelength dipole antenna, press

⑥  . The marker unit changes to  $\text{dB}\mu\text{V}/\text{m}$ , and electric field strength  $Ex$  corrected for antenna coefficient  $K$  can be read directly. In this case, cable loss ( $La$ ) is calculated for the supplied 5D2W, 10 meter cable. Use of any other cable will cause an error. Keep this in mind, particularly if the prepared cable is long.

If the antenna used is Takeda Riken's **TR1711** logarithmic periodic type antenna,

⑦ press     .  $Ex$  can be read directly with the antenna gain 5 dB offset. Again, cable loss is calculated for the supplied 5D2W, 10 meter cable.

⑧ Pressing   resets the electric field strength measurement mode, and

pressing     resets the offset mode.

## Antenna Calibration Coefficient

Generally, the relationship between the electric field strength  $E_x$  [dB $\mu$ /m] and input terminal voltage  $ex$  [dB $\mu$ ] of the measuring instrument is as follows:

$$Ex = (ex+6) + La - He + Ba$$

$$= ex + K \quad K = 6 + La - He + Ba$$

Where:  $He$  [dB] = Effective antenna length

$La$  [dB] = Cable loss

$Ba$  [dB] = Balun loss

$K$  [dB] = Calibration coefficient

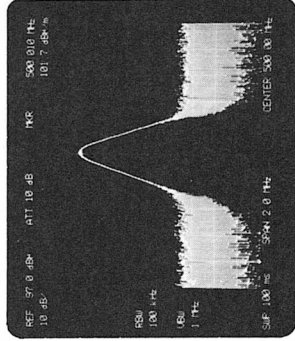
The calibration coefficient for a half-wavelength dipole antenna is calculated as follows:

$$K = 20\log\frac{\pi}{300}F + 6 + La = -33.6 + 20\log F + La$$

Where:  $F$  [Hz] = reception frequency

To obtain the calibration coefficient for a wide-band logarithmic periodic type antenna, the antenna gain (half-wavelength dipole antenna ratio: 5 dB for **TR1711**) is further subtracted.

$$K = -38.6 + 20\log F + La$$



Measurement display

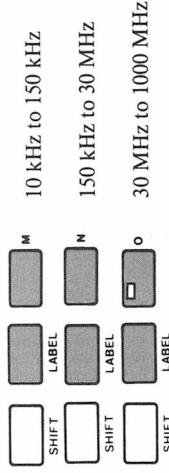
## 2-9. Q.P. Value Measurement Mode (Option)


If the **TR4172** is provided with option 01 for Q.P. value measurement, it can measure the quasi-peak value complying with C.I.S.P.R. standards.

## Q.P. Value Measurement Conditions Set by C.I.S.P.R. Standards

Frequency range	6 dB bandwidth	Charging time constant	Discharging time constant	Mechanical time constant
10 kHz to 150 kHz	200 Hz	45 ms	500 ms	160 ms
150 kHz to 30 MHz	9 kHz	1 ms	160 ms	160 ms
30 MHz to 300 MHz	120 kHz	1 ms	550 ms	160 ms
300 MHz to 1000 MHz	120 kHz	1 ms	550 ms	160 ms

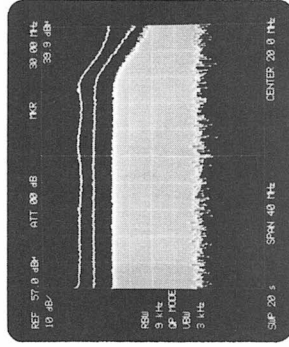
- Connect an antenna matching the frequency range for measurement to **INPUT-1** connector of the **TR4172**. If the impedance of the antenna is not  $50 \Omega$ , match it to the terminal impedance using a matching circuit.
- Set the target frequency as the center frequency and determine the frequency span.
- Make key settings for the measurement frequency range. **QP BW CHECK** is indicated on the left side of the display and the Q.P. check mode is entered.



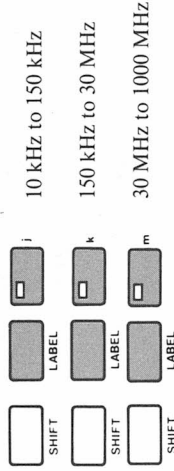
- Press  and change the input attenuation in 10 dB steps using the DATA knob or step keys to verify the waveform level on the display does not change. If the waveform level does not correspond, increase analyzer input attenuation or insert a band-pass filter in its input circuit.

- To cancel the Q.P. check mode, press   .

- ⑥ If the waveform level was constant after changing the input attenuation, press **REF. LEVEL**. Set the reference level so the peak output level is 20 to 30 dB below the top of the screen.



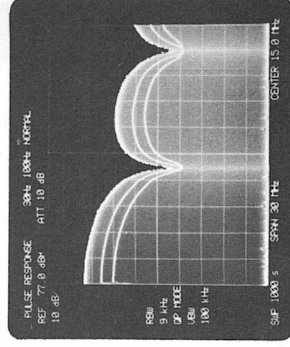
- ⑦ When the key settings for the measurement frequency range are made, **QP MODE** is indicated on the left side of the screen and the Q.P. measurement mode is entered.



- ⑧ As can be seen from the foregoing table, since a long time-constant circuit is used for Q.P. measurement, adequate sweep time must be set. As a guide, the proper sweep time can be determined as follows:

Frequency range	Sweep time
10 kHz to 150 kHz	1 second/200 Hz
150 kHz to 30 MHz	1 second/10 kHz
30 MHz to 1000 MHz	1 second/100 kHz





- If  SHIFT  dB $\mu$ V ON  are pressed and the antenna used is a Takeda Riken **TR1722** half-wavelength dipole antenna, the reference level unit is changed to dB $\mu$ V/m and the Q.P. value corrected for the antenna coefficient can be read directly. If a different antenna is used, calculate the Q.P. value after determining the value of K using the equation in 2.8.





















- ⑨ To reset the Q.P. measurement mode, press  SHIFT  LABEL  z  AUTO

**2-10. Impedance Measurement (Option)**

If the **TR4172** is provided with option 05 for impedance measurement, it can accurately measure VSWR, reflection coefficient, normalized impedance values with high sensitivity, and display polar coordinates and Smith charts.

When     are pressed, the impedance measurement mode is entered and keys in the **TRIGGER**, **TRACE**, and **MARKER** sections are assigned the following functions, which are different from their normal ones.

 <b>A</b> IN	 <b>B</b> LI	 <b>F</b> AW	 <b>G</b> AV	 <b>H</b> CH	 <b>I</b> AB	 <b>J</b> AZ	 <b>K</b> BW	 <b>L</b> BV	 <b>N</b> BB	 <b>O</b> BZ	 <b>R</b> Z0	 <b>S</b> SG	 <b>T</b> FC	 <b>V</b> PS	 <b>W</b> MC	 <b>Y</b> MR	 <b>Z</b> DL
<b>SMITH CHART</b> Smith chart display	<b>POLAR</b> Polar coordinates display	<b>WRITE MODE</b> Cancellation of measured data holding	<b>VIEW MODE</b> VIEW data holding	<b>HELP MESSAGE</b> ON/OFF	<b>MAG. CORRECTION</b> ON/OFF "MG-COR"	<b>MAG. CAL. "CAL"</b>	<b>EXIT OPTION</b> (Resetting impedance measurement CIRCLE mode)	<b>START STOP MARKER</b> ON/OFF	<b>PHASE CORRECTION</b> ON/OFF "PH-COR"	<b>PHASE CAL.-OPEN</b> "CAL<0>"	<b>MAG. X 10 ON/OFF</b> "X 10"	<b>PHASE CAL.-SHORT</b> "CAL<S>"	<b>CONTRAST</b>	<b>DATA POINTS DEC.</b> "1/2, --, 1/32"	<b>DATA POINTS INC.</b> "1/32, --, 1/2"	<b>MARKER → DISPLAY</b> CIRCLE	<b>DISPLAY CIRCLE</b> ON/OFF "DISPLAY CIRCLE"

**M** **BD**  
**MULTI MARKER LIST**  
IMP./VSWR/OFF**PHASE**  
OFFSET**PHASE**  
OFFSET**GROUP**  
DELAY  
OFFSET

These keys are not operable.



These keys perform their normal functions.

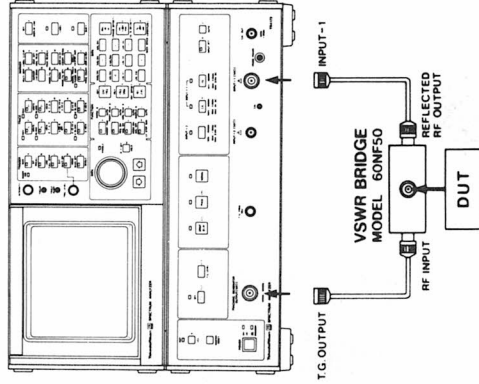
Note:  
Characters indicated below each key represent the GP-IB program code.

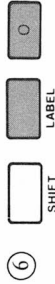
**(1) Calibration**

To measure reflection coefficients or impedance using a VSWR bridge, the analyzer must be calibrated to cancel VSWR bridge insertion loss, the electrical length of cables, and other error factors, beforehand.

- ① Connect a VSWR bridge to the **TR4172** as shown below.
- ② Connect the DUT to the VSWR bridge, and press the **T.G.** key. Observe the passband response of the DUT and set the center frequency, frequency span, and other parameters. Next, press the **T.G. LEVEL** key and set the tracking generator output to an appropriate level. The signal actually applied to the DUT is attenuated 6 dB to 7 dB lower than the tracking generator output level.
- ③ Press the **SWEEP TIME** key and set an appropriate sweep time.
- ④ Disconnect the DUT from the VSWR bridge, and connect a short or open connector. The short or open connector must be a good with a nearly ideal response over the operating frequency range. If a cable is used to connect the DUT, the cable may be left connected and the short or open connector may be connected to it.
- ⑤ Press the **PHASE** key and observe the phase display. Adjust the group delay offset to reduce phase rotation. (See page 35.)

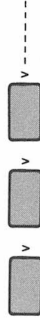
TR4172





(Impedance measurement is started.)  
Fig. a

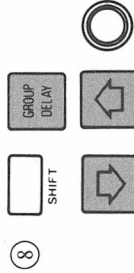
A smith chart appears on the screen, sweeping for impedance measurement is started, and measured data converted into polar coordinate data is displayed. For this measurement, decrease the number of display points beforehand to shorten display rewriting time and prevent the CRT from being damaged.



(DATA POINTS DEC. key function)



Align the display of measured data to the outermost circumference of the Smith chart.



Converge the display of measured data into as small a point as possible.

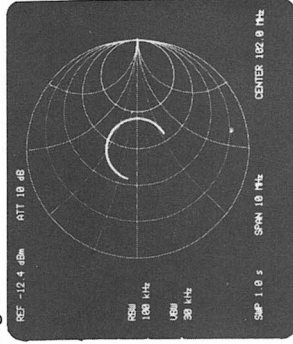


Fig. b

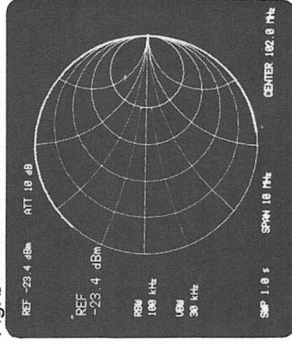
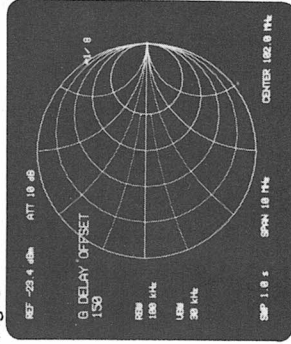
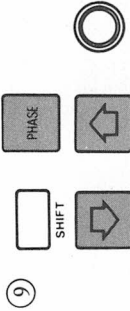


Fig. c







Cancel the phase offset.

If the DUT connection terminals have been opened, converge data display into the  $\infty \Omega$  point (right-hand side on the Smith chart. If they have been shorted, converge data display into the  $0 \Omega$  point (left-hand side)).

Calibration has now been completed.

Calibration can also be done in the amplitude and phase display mode using the same procedure and observing orthogonal coordinates. Since the data display is updated more quickly on orthogonal coordinates than on a Smith chart, calibration can be done more speedily using an orthogonal coordinate system than using a Smith chart.

If data display cannot be converged into the  $0 \Omega$  or  $\infty \Omega$  point, adjust the phase and amplitude responses (see page 49).

Fig. d Calibration with DUT connection terminals open

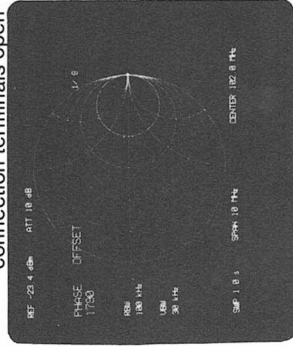
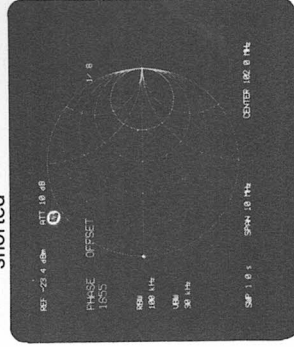


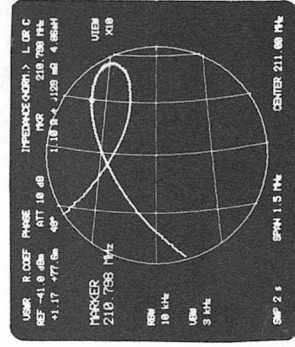
Fig. e Calibration with DUT connection terminals shorted



### Calibration in Enlargement Mode

The center part of a Smith chart display can be enlarged 10 times by pressing . These enlargements cause a slight phase error. To cancel the phase error, connect an open or short connector to the DUT connection terminals, and adjust the phase offset so the phase is  $0^\circ$  with an open connector connected or  $180^\circ$  with a short connector connected.

Similar adjustments can also be made to correct over-scale display. Pressing  restores the normal Smith chart mode, which requires calibration to be made using the phase offset.



## Frequency Response Correction

If the frequency response in the phase or amplitude domain is not flat, data display cannot be converged into a point (see Figure a).

- Frequency response correction in phase domain

① **N (PHASE CORRECTION)**

The phase correction mode is set, and **PH-COR** is indicated on the screen. The mode is reset when the key is pressed again.

- ② Press **O** (**PHASE CAL.-OPEN**) with the DUT connection terminals open, or **S** (**PHASE CAL.-SHORT**) with the DUT connection terminals shorted. Frequency response in the phase domain is automatically corrected.

- Frequency response correction in amplitude domain

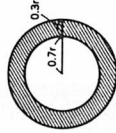
① **I (MAG. CORRECTION)**

Amplitude correction mode is set, and **MG-COR** appears on the screen.

② **J (MAG. CAL.)**

Frequency response in the amplitude domain is automatically corrected.

Correctable range (hatched)



If the frequency response is outside the correctable range, press **U**, (amplitude correction mode is reset)

and **REF. LEVEL**, and put data into correctable range using the **DATA** knob.

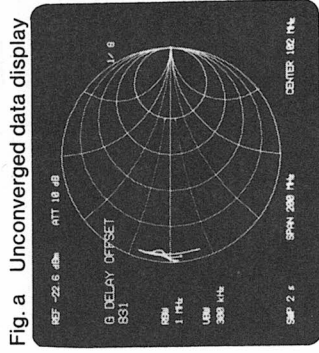


Fig. a Unconverged data display

Fig. b Frequency response correction in phase domain

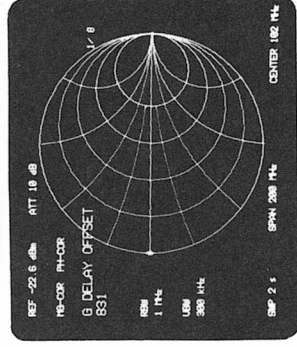
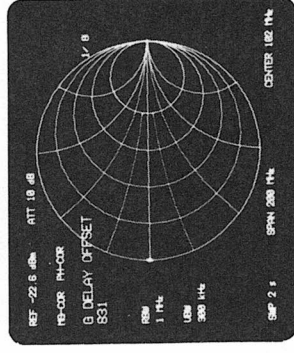


Fig. c Frequency response correction in amplitude domain



**(2) Measuring procedure**

After completing the calibration, connect the DUT to the VSWR bridge.

Note: Once calibration is done, do not press any key that changes measurement condition. If the center frequency, frequency span, or reference level is changed, calibration must be made again.

①



MARKER



Move the marker and data at the marker point is displayed. In the sample display shown at right, the following readouts are displayed:

Marker frequency: 102.50 MHz

VSWR: +1.94

Reflection

coefficient: +320 m (0.32)

Phase: 170°

Normalized impedance: 522 mΩ + j62.7 mΩ

Inductance: 4.86 nH

Impedance can be determined by multiplying both the real and imaginary parts of the normalized impedance by 50 (characteristic impedance of the bridge is 50 Ω.)

Marker data display is updated by every other sweep unless  A **G (VIEW)** is pressed. If  A **G (VIEW)** is pressed, marker data display is updated when the marker is moved. To cancel data holding, press  A **F (WRITE)**.

②



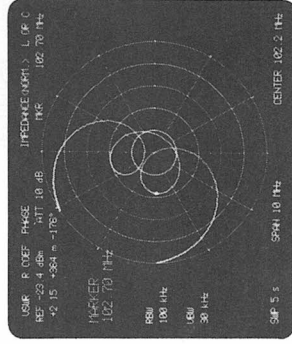
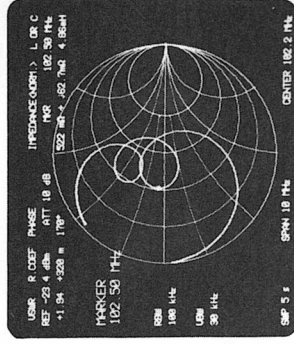
(Impedance measurement mode is reset.)

Center frequency and frequency span settings are retained so it is possible to measure the return loss in the normal measurement mode. Next, measure the impedance, in the impedance measurement mode, for comparison.

③

To shift from a Smith chart display to a polar coordinate display, press  B **P (POLAR)**.

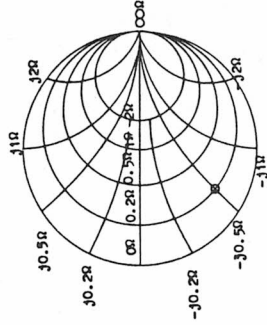
When this shift is made neither, the normalized impedance value nor serial-equivalent value of inductance or capacitance are displayed. If any label character is written, the data names at the top line are not shown on either the Smith chart or polar coordinate display.



## Reading charts and coordinates

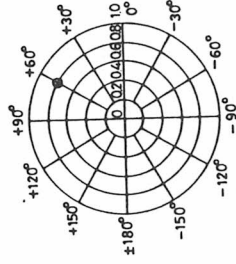
- **Smith chart**

Normalized impedance at the point marked with  $\bigcirc$  is  $0.2 \Omega - j0.5 \Omega$ .



- **Polar coordinates**

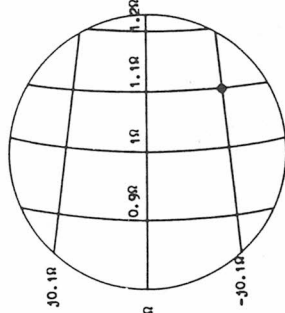
The reflection coefficient at the point marked with  $\bigcirc$  is  $0.8 \angle 60^\circ$ .



- **Enlarged Smith chart**

A Smith chart with the center portion enlarged tenfold allows normalized impedance values near 1 to be read with high resolution.

Normalized impedance at the point  $\bigcirc$  is  $1.1 \Omega - j0.1 \Omega$ .



(3) Additional features  
a. Display circle



**Z (DISPLAY CIRCLE)**

A concentric circle is shown with the coordinates displayed.



or

(The radius of the concentric circle can be changed.)

The VSWR and reflection coefficient values for points on the circumference of the concentric circle are digitally displayed on the screen. This circle with arbitrary coefficient values can be displayed to facilitate data adjustment and selection. To erase the circle, press **Z**

b. Start stop marker



**B (START STOP MARKER)**

The starting and stopping point of the displayed data are marked with an acute-angle triangle and an obtuse-angle triangle, respectively. Whereas the sweep starting frequency (corresponding to the left-hand side of the frequency axis of the orthogonal coordinates) and the sweep stopping frequency (corresponding to the right-hand side of the frequency axis of the orthogonal coordinates) are digitally displayed on the screen.

To clear the start and stop markers, press

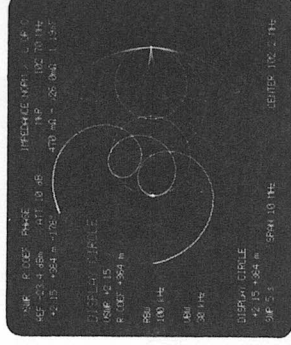
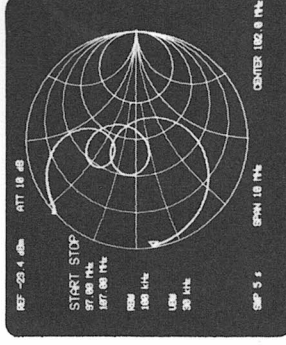
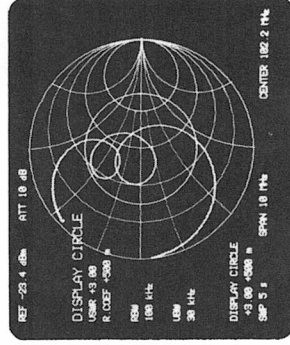


c. Marker → Display circle







**V (MARKER → DISPLAY CIRCLE)**

The marker and the display circle are superimposed.



## d. Multimarker list display function

- ① After completing calibration, press  and start impedance measurement.  and start impedance


- ②   The multimarker mode is entered.



- ③  (No. of markers: 2 to 10)


- ④   The first marker is activated. Move it to the desired position using the **DATA** knob.

- ⑤   The second marker appears and is activated, whereas the first marker is fixed.

Repeat this step the number of times as specified by the number of markers ( $2 \leq n \leq 10$ ).

- ⑥ Hold the measured data by pressing  (**VIEW MODE**).

( If  is pressed, all markers disappear, but the number and position of the markers are saved. Each time  is subsequently pressed, a saved marker appears.

- ⑦ When  (**MULTI MARKER LIST**) is pressed with markers ranging from two to ten displayed on the screen in the multimarker mode, a list of values of the frequency, normalized impedance, and serial-equivalent inductance or capacitance for each marker is displayed (Figure a). If, in that state, the same key is pressed again, a similar list of VSWR, the reflection coefficient and phase value is displayed (Figure b). In either case, active markers are identified by an asterisk (\*). Furthermore, if a display circle is displayed, whether a marker point is inside or outside the circle is indicated by **IN** or **OUT**.

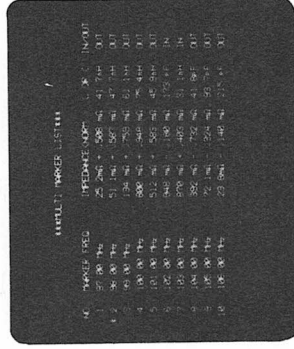


Fig. a

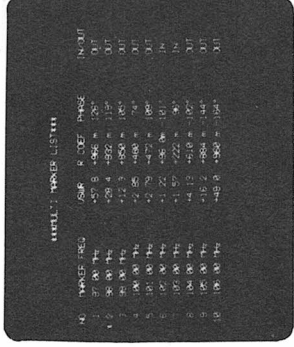




Fig. b

e. **Data point increase and decrease**

Measured data is usually displayed by 500 data points on the screen. The number can be changed in the range from 1/2 to 1/32 (in four steps) using the key shown below. When data display is expected to be concentrated in a small area on the screen, reduce the number of data points to prevent the CRT from being damaged. Reducing the number of data points also reduces the time required to convert measured data into polar coordinate data.

 **v** (DATA POINTS DECREASE)

Every time this key is pressed, the number of data points is halved unless it has been reduced by 1/32. The reduction factor is displayed on the screen.



 **w** (DATA POINTS INCREASE)

Every time this key is pressed, the number of data points is doubled.

f. **Contrast**

The intensity of data and scale display can be adjusted in four steps using  **r** (CONTRAST).

g. **Help message**

When  **h** (HELP MESSAGE) is pressed, a list of special key functions for use in the impedance measurement mode is displayed. The letter enclosed in quotation marks preceding each function name is the same as indicated on the right side of the key. The letters enclosed in quotation marks following each function name are the same as those displayed on the screen and denote the special function. This help message mode is reset when  **h** is pressed.

```




**** IMPEDANCE OPTION FUNCTION SUMMARY ****
'A' SMITH CHART
'R' MAG X10 ON/OFF 'X10'
'F' CLEAR WRITE MODE
'U' DATA POINTS DEC. '1/2,-,1/32'
'W' DATA POINTS INC. '1/32,-,1/2'
'L' START STOP MARKER ON/OFF
'Z' DISPLAY CIRCLE ON/OFF 'DISPLAY CIRCLE'
'Y' MARKER->DISPLAY CIRCLE
'M' MULTI MARKER LIST IMP/USUR/OFF
'I' MAG CORRECTION ON/OFF 'MG-COR'
'J' MAG CAL. 'CAL'
'N' PHASE CORRECTION ON/OFF 'PH-COR'
'O' PHASE CAL. -OPEN 'CAL<O>'
'S' PHASE CAL. -SHORT 'CAL<S>'
'T' CONTRAST
'H' HELP MESSAGE ON/OFF

'K' EXIT OPTION
  
```

2-11. X-Y Recorder Output (Option)

If the **TR4172** is provided with option 03 for X-Y recorder output, it allows the signal response and the graticule displayed on the screen to be plotted on an X-Y recorder.

① Connect the **X**, **Y**, and **Z** connectors on the rear panel of the **TR4172** to the **X**, **Y**, and **Z** input connectors of an X-Y recorder. The range of each output is from 0 V to about +5 V.

② Press    to set the X-Y recorder output mode. When this mode is set, the key functions change as follows:



**RECORD ALL**

All traces and graticules displayed on the screen are plotted.



**HOLD**

**PAUSE**

Pauses plotting when pressed once. Plotting is restarted when pressed again.



**SCALE**

only graticules are plotted.



**PEN UP**



**TRACE A**

Only trace A is plotted.



**PEN DOWN**



**TRACE B**

Only trace B is plotted.



**PEN UP/DOWN=LO/HI**



**TRACE A'**

Only trace A' is plotted.



**PEN UP/DOWN=HI/LO**



**TRACE B'**

Only trace B' is plotted.



**LOWER LEFT**

Moves pen to its lower left home position.



**SPEED**

Controls D/A conversion interval time.



**UPPER RIGHT**

Moves pen to its upper right home position.



Using



keys, adjust the X-Y recorder gain and offset to determine the size and position of the image to be plotted.



When any one of



is

pressed, plotting starts. Once plotting starts, only **HOLD** becomes valid. Pressing

of other keys is not allowed. If any of the above-shown keys is pressed to start plotting while plotting is paused by **HOLD**, the pen automatically returns to its lower left home position and restarts plotting.






⑤ Pressing resets the X-Y recorder output mode.



## 2-12. Connection to TR9834R/TR9831 Plotter

- ① Connect the GP-IB connector on the rear panel of the **TR4172** to the GP-IB connector of the **TR9834R** with a GP-IB cable (separately purchased).  
Set the **TR983R** to the listen only mode and switch it on.
- ② Make necessary settings for the **TR4172**.  
Of the information displayed on the screen, the characters, labels, graticules and the contents of memories A and A' are plotted with **PEN1**. The contents of memories B and B' are plotted with **PEN2**. Setting two pens to plot in different colors, therefore, makes it possible to plot two sets of information in different colors. Even if only one trace is plotted, trace and graticule can be plotted in different colors by storing the graticule in memory B. When using two pens, adjust their relative positions beforehand.

- ③ Press   , or, if a logarithmic scale is used, press 

and the following message is displayed.

**PLOT SIZE?**

- 1: **BIG**                    2: **SMALL**  
5: **B.D.**                    6: **S.D.**

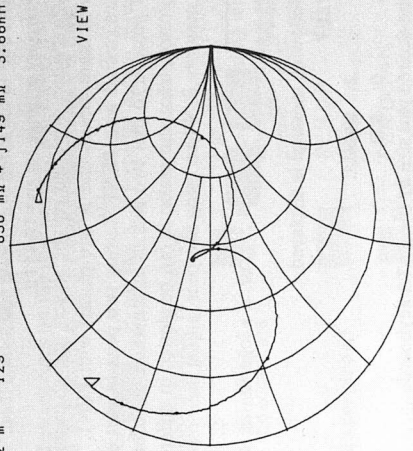
Specify the desired plot size by the **DATA** keyboard.

- If **1** is specified, displayed information is plotted as size A3.  
If **2** is specified, displayed information is plotted as size A4.  
If **5** is specified, displayed traces and markers are plotted as size A3.  
If **6** is specified, displayed traces and markers are plotted as size A4.

- ④ The plotter mode is reset upon completion of plotting.

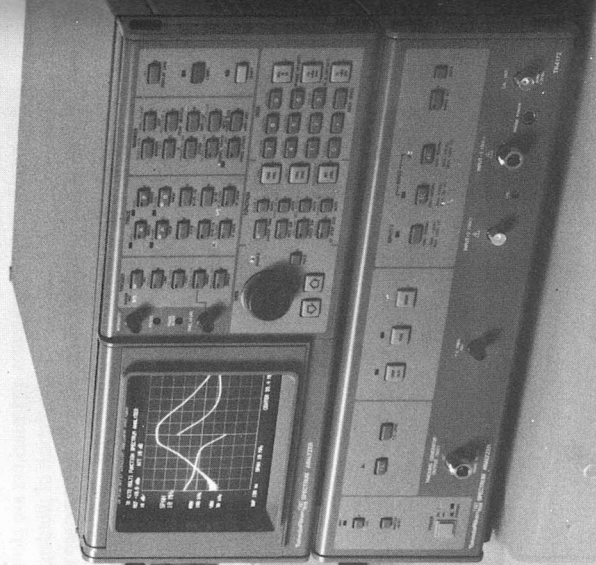
- Note:
- If a leaf of recording form is used, the **PROMPT** lamp of the **TR9834R** flashes on and off after completion of plotting, but the pen does not return to its home position. To return the pen to its home position in such a case, use the **POSITION** key of the plotter.
  - When the **TR4172** is connected to a **TR9834R** and used in the plotter mode, the **TR4172** functions as the controller. Do not connect any other controller or device to it.
  - To use a **TR9831** connected to the **TR4172** for plotting, set the **POWER** switch of the **TR9831** to **ON** while pressing its **FEED** key.

VSWR R.COEF PHASE IMPEDANCE<NORM.> L OR C  
REF -24.4 dBm ATT 10 dB MKR 6 210.00 MHz  
1.25 112 m 129° 858 mA + j149 mA 5.66nH



RBW 1 kHz  
VBW 1 kHz

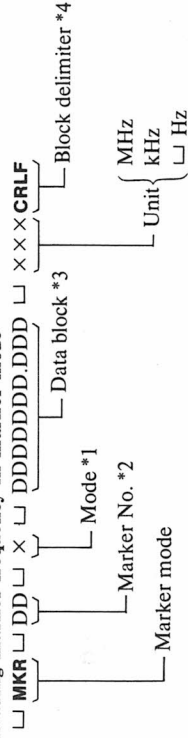
SMP 5 • SPAN 20 MHz CENTER 210.0 MHz



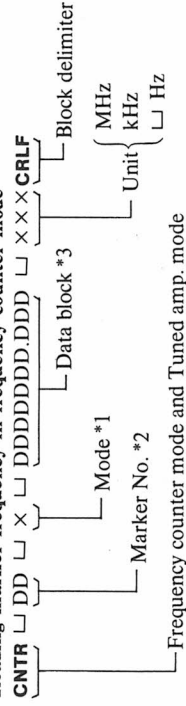
### 3. GP-1B

#### 3-1. Talker Format

##### (1) Reading marker frequency in marker mode



##### (2) Reading marker frequency in frequency counter mode



\*1 Mode:

“D” for delta mode

“Z” for zoom mode

“L” for other marker modes

\*2 Marker No.: L1 through 10. In the single marker mode, the marker number is “L L L” (Space codes).

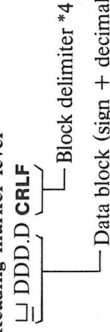
\*3 Data block:

The data length is fixed at 25 bytes, and a decimal point is output to the position corresponding to the one on the display. In either the marker or frequency counter mode, if the significant contents of the data block consist of fewer than 10 digits, space codes are filled in the remaining digits (10 digits—significant digits) and are shifted left to precede the MKR or CNTR code before output.

\*4 Block delimiter:

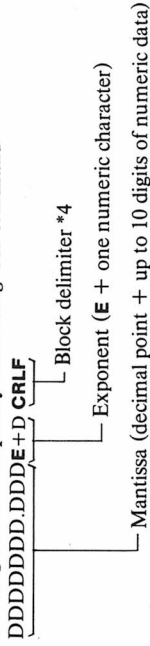
Two-byte code consisting of CR and LF. Single line signal EOI is also output as a block delimiter when LF is output.

##### (3) Reading marker level



The decimal point position corresponds to that on the display. In a read data stream, a positive sign is represented by a space ( ) code and a negative sign by a minus ( - ) code. If the data block contains three or fewer significant digits, space codes equal to (4 - number of significant digits) are shifted to the top positions before output.

(4) Reading marker frequency data using OA command



The decimal point position corresponds to the one on the display.

Exponent: E+6 = 10<sup>6</sup> ... (MHz)

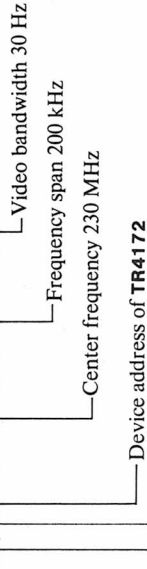
E+3 = 10<sup>3</sup> ... (kHz)

E+0 = 10<sup>0</sup> ... (Hz)

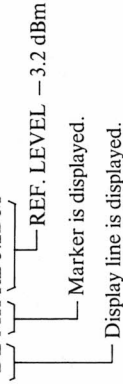
### 3-2. Programming

The TR4172 permits remote control of all front panel functions.

Example 1: wrt 7 01, "CF 230MZ SP200KZ VB30HZ



Example 2: wrt 701, "DL MK RE 3.2DM



**(1) Programming codes**

(When the analyzer is switched on or when its **MASTER RESET** key is pressed, code marked with  $\bigcirc$  are automatically selected.)

**FUNCTION**

Code	Description	Initially selected
CF	CENT. FREQ	
SP	FREQ. SPAN	
RE	REF. LEVEL	
SW	SWEEP TIME	
AS	SWEEP TIME AUTO	$\bigcirc$
RB	RES. BW	
BA	RES. BW AUTO	$\bigcirc$
VB	VIDEO BW	
VA	VIDEO BW AUTO	$\bigcirc$
CS	CF STEP SIZE	
CA	CF STEP SIZE AUTO	$\bigcirc$

**MEASUREMENT MODE**

GD	GROUP DELAY	
PH	PHASE	
NO	NORMAL	$\bigcirc$

**INPUT MODE**

PR	INPUT-2	
DC	INPUT-1 DC	
AC	INPUT-1 AC	$\bigcirc$
AT	INPUT ATT.	
TA	INPUT ATT. AUTO	$\bigcirc$

**TRACE**

AW	A WRITE	
BW	B WRITE	
AV	A VIEW	
BV	B VIEW	
CH	A $\leftrightarrow$ B	
BD	B-DL $\rightarrow$ A	
AB	A-B $\rightarrow$ A	
BB	B $\rightarrow$ B'	
AZ	A' VIEW	
BZ	B' VIEW	

**DATA**

Code	Description	Initially selected
0 to 9	0 to 9	
.	.	
MZ	MHz (dB) (PHASE OFFSET)	
KZ	kHz (G.D. OFFSET)	
HZ	Hz ( $\mu$ sec)	
DP	+dBm	
DM	-dBm	
SC	sec	
MS	msec	
UP	$\uparrow$	
DN	$\downarrow$	
HO	HOLD	
CU	COARSE UP	
MU	MEDIUM UP	Clockwise turn
FU	FINE UP	
CD	COARSE DOWN	Counterclockwise turn
MD	MEDIUM DOWN	
FD	FINE DOWN	

Note: The three degrees of DATA knob control

can be made for the following functions:

CENT. FREQ., FREQ. SPAN, MARKER,

REF. LEVEL, DISPLAY LINE, GROUP

DISPLAY OFFSET, PHASE OFFSET

**MARKER**

MK	MARKER	
MO	MKR OFF	
MT	$\Delta$	
PS	PEAK SEARCH	
ZO	ZOOM	
MC	MKR $\rightarrow$ CF	
SG	SIGNAL TRACK	
MP	MKR/ $\Delta$ $\rightarrow$ STEP SIZE	
FC	FREQ. COUNT.	
MR	MKR $\rightarrow$ REF.	

## TRIGGER

Code	Description	Initially selected
IN	INT.	0
LI	LINE	
EX	EXT.	
VT	VIDEO	
SI	SINGLE	

## SAVE

SA	SAVE	
RC	RECALL	

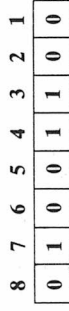
## TRACKING GENERATOR

TG	T.G. ON	
TL	T.G. LEVEL	
SHTG	T.G. OFF	

## OTHERS

SQ	Service Request Enable	
SR	Service Request Disable	0
DL	DISPLAY LINE	
LA	LABEL	
SH	SHIFT	
LC	LCL	
JP	MASTER RESET	
MF	MARKER FREQ. OUTPUT	
ML	MARKER LEVEL OUTPUT	
RD	MEMORY READ	
DR	DATA READ END STATUS BYTE RESET	
LD	LOAD MEMORY	
TI	TRACE INPUT	
TO	TRACE OUTPUT DATA	
OA	OUTPUT ACTIVE DATA	

## Status byte



- ↑ Changes from 0 to 1 when measurement ends.  
 ↑ Changes from 0 to 1 when averaging ends.  
 ↑ Set to 1 when either bit 3 or bit 4 is set to 1.

## Explanation

- Reading data settings (**OA**)  
 The settings of data such as center frequency, frequency span, resolution bandwidth, and marker frequency which are shown in large characters in the left-hand area on the screen and can be read in as numeric data without unit by using **OA**.
- Reading marker frequency (**MF**)  
 Since 23 marker frequency data are sent out, specify 23 or a larger number for the A\$ dimension.
- Reading marker level (**ML**)  
 Marker levels are read as unitless numeric data. Since eight marker level data are sent out, specify eight or a larger number (nine or a larger number for phase measurement) as the A\$ or A dimension.
- Reading vertical scale on screen  
 Vertical scale data can be read as numeric variables using **OA** and **LD73C50870DC**, or as character-string variables using **MF** and **LD73C670**.
- Reading displayed data  
 Amplitude data of each of the 1001 points on the frequency axis displayed on the screen can be read by using **RD**. For this, the starting address and the byte count of data to be read must be specified in hexadecimal notation. Trace memory A has address allocations C018 through C7E8, and trace memory B C818 through CFE8. Each data point displayed on the screen consists of two bytes. The low-order byte is read first and followed by the high-order byte. The data stored in memory A or B can be read out in decimal notation using **TO**. Reading in binary mode is also possible by command **LD8EB501**.
- Writing data onto screen  
 Data can be written onto the display screen by **LD**. To write it in decimal notation, use **TI**.

**(2) SHIFT function programming codes**

To use the SHIFT functions, set the corresponding **SH** codes and the programming codes corresponding to the respective keys.

**TRACE**

Code	Description
SHAW	Max. A mode
SHBW	Max. B mode
SHAV	Setting memory A in blank mode
SHBV	Setting memory B in blank mode
SHAZ	Setting memory A' in blank mode
SHBZ	Setting memory B' in blank mode
SHBB	A → A' function in view A' mode
SHAB	A-B → A mode

**DETECTION**

SHAS	NORM. D
SHBA	POSIT. PEAK D.
SHVA	NEG. PEAK D.
SHCA	SAMPLE D.

**Q.P. MEASUREMENT MODE (Option)**

SHLARB	10 to 150 kHz, 6dB BW 200 Hz
SHLAVB	150 kHz to 30 MHz, 6dB BW 9 kHz
SHLACS	25 MHz to 1000 MHz, 6dB BW 120 kHz
SHLACA	Resetting Q.P. measurement mode

**NOISE LEVEL MEASUREMENT**

SHZO	Noise level measurement set mode
SHSG	Noise level measurement reset mode

**ALTERNATE SWEEP**

SHCH	Measure phase and amplitude alternately and display results simultaneously.
SHBD	Measure group delay and amplitude alternately and display results simultaneously.
SHLAMZ	ALTERNATE SWEEP-1
SHLAKZ	ALTERNATE SWEEP-2
SHHO	ALTERNATE SWEEP OFF

**VERTICAL SCALE CHANGE**

Code	Description
SH7	10 dB/DIV.
SH8	5 dB/DIV.
SH9	2 dB/DIV.
SH4	1 dB/DIV.
SH5	0.1 dB/DIV.
SH1	LIN. x 1
SH2	LIN. x 2
SH3	LIN. x 5
SH0	LIN. x 10

**AVERAGING**

SHVB	AVG ON
SHCS	AVG OFF

**OTHERS**

Code	Description
SHEX	FULL SPAN (FREQ. SPAN 1800 MHz)
SHRE	REF. OFFSET
SHCF	REF. LEVEL value in dBm
SHSP	REF. LEVEL value in dB $\mu$ V
SHLACF	Logarithmic display
SHMP	Specify counter resolution
SHFC	Tuned amp. mode
SHMK	Multi mkr (multimarker) mode
SHMT	$\Delta$ → Span mode
SHPS	Neg peak search mode
SHDL	Display line-off
SHMO	Erase label character strings
SHMZ	Frequency response compensation
SHUP	Zero span
SHVT	Start electric field strength measurement
SHSI	Stop electric field strength measurement
SHLAPS	Successive peak search
SHLADL	Write upper and lower limit values
SHLASW	Reset sweeping
SHLACH	HELP (Displaying double shift function list)

**MANUAL CHANGES**

PRODUCT TR4172

CHANGE  
REFERENCE 4172-OPE-  
8307321

DATE January 20, 1984

1/2

## TR4172 Spectrum Analyzer Operator's Guide

- o Parts of description in "Antenna Calibration Coefficient" in page 42 should be corrected to read as follows.

Line 12,

$$\begin{aligned}
 K &= 20 \log \frac{\pi}{300} F + 6 + La + \underline{Ba} \\
 &= -33.6 + 20 \log F + La + \underline{Ba}
 \end{aligned}$$

Where:  $F$ [MHz] = reception frequency

⋮  
⋮  
⋮  
⋮

$$K = -38.6 + 20 \log F + La + \underline{Ba}$$



## OTHERS

Code	Description
SHLAMC	Error correction routine
SHLAMP	Error correction list
SHLABS	Error correction clear
SHLA0	Impedance measurement (Option)
SHLA1	Occupied bandwidth measurement (Option)
SHLA2	X-Y recorder output (Option)
SHLA4	Frequency drift prevention set mode
SHLA5	Frequency drift prevention reset mode
SHLA7	Start internal standard oscillator output
SHLA8	Stop internal standard oscillator output

**Learn Mode**

All settings on the front panel of the **TR4172** can be stored in memory of the associated controller so they can be recalled later.

**SHIN0 . . . . .**

Always specify the dimension as 94  $\{(2E+1) \times 2$  in hexadecimal notation}, and store it at address 7400.



# MANUAL CHANGES

PRODUCT

TR4172

CHANGE  
REFERENCE4172-0PE-  
8307321

DATE

January 20, 1984

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- o The following errata lists the change of the GPIB programming code.

Old code	New code	Description
FC	CN	FREQ. counter mode
SHFC	SHCN	TG counter mode
SHLACH	SHDN	HELP (Displaying double shift function list)

- o In the programming code table in page 64, the code "FC" stands for the FREQ. COUNT. key. Now name of the key has been changed to "FREQ. CNTR", and its GPIB code to "CN".



description
correction routine
correction list
correction clear
balance measurement (Option)
measured bandwidth measurement (Option)
oscillator output (Option)
frequency drift prevention set
frequency drift prevention reset
internal standard oscillator
internal standard oscillator
internal standard oscillator

on the front panel of the analyzer is stored in memory of the analyzer so they can be recalled.

Specify the dimension as 94 (hexadecimal notation), address 7400.

