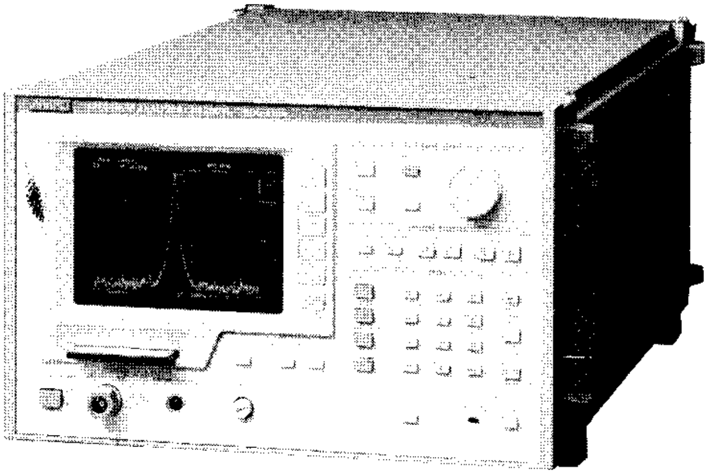
OPERATION MANUAL

SPECTRUM ANALYZER

MS2601A



ANRITSU CORP.

1988.05 x 150 NIV-4(Y)
Printed in Japan

CERTIFICATION

ANRITSU CORPORATION certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.
Anritsu further certifies that its calibration measurements are based on the Japanese Electrotechnical Laboratory and Radio Research Laboratory standards.

WARRANTY

All parts of this product are warranted by Anritsu Corporation of Japan against defects in material or workmanship for a period of one year from the date of delivery. In the event of a defect occurring during the warranty period, Anritsu Corporation will repair or replace this product within a reasonable period of time after notification, free-of-charge, provided that: it is returned to Anritsu; has not been misused; has not been damaged by an act of God; and that the user has followed the instructions in the operation manual.

Any unauthorized modification, repair, or attempt to repair, will render this warranty void.

This warranty is effective only for the original purchaser of this product and is not transferable if it is resold.

ALL OTHER EXPRESSED WARRANTIES ARE DISCLAIMED AND ALL IMPLIED WARRANTIES FOR THIS PRODUCT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF ONE YEAR FROM THE DATE OF DELIVERY. IN NO EVENT SHALL ANRITSU CORPORATION BE LIABLE TO THE CUSTOMER FOR ANY DAMAGES, INCLUDING LOST PROFITS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, ARISING OUT OF THE USE OR INABILITY TO USE THIS PRODUCT.

All requests for repair or replacement under this warranty must be made as soon as possible after the defect has been noticed and must be directed to Anritsu Corporation or its representative in your area.

Note:

1. The instrument is operable on a nominal voltage of 100 to 127 Vac or 200 to 250 Vac by changing the connections on the power transformer taps.

   The voltage and current ratings are indicated on the rear panel when the instrument is shipped from the factory.

   To operate on the other voltage, change the connections on the power supply transformer. The plate on the rear panel indicating the voltage and current ratings should be changed to the appropriate one. Order the plate from ANRITSU CORP. if needed.

2. In this manual, the power supply voltage and current ratings are represented by **Vac and ***A, respectively.

3. The relationship between power supply voltage and current rating is shown below.

**Vac	***A (Time-lag type)
100 to 127 V	T 3.15 A
200 to 250 V	T 1.6 A

Composition Of MS2601A Operation Manual

This operation manual consists of 12 sections and appendixes outlined below.

	Composition	Use
SECTION 1	GENERAL	. SECTIONs 1 to 4 describe how prepare and evaluate the MS2601A (simple checks or performance tests).
SECTION 2	PREPARATION	
SECTION 3	STARTING OPERATION AND SIMPLE PERFORMANCE CHECKS	. SECTIONs 1 to 3 also give background information for general operation of the MS2601A.
SECTION 4	CALIBRATION AND PERFORMANCE TESTS	
SECTION 5	OPERATION	. SECTION 5 is a detailed description of the front and rear panel controls shown in APPENDIX P. Beginners should read this section after reading SECTION 3.
SECTION 6	MEASUREMENT	. SECTION 6 explains the typical measurement procedure.
SECTION 7	PRINCIPLES OF OPERATION	. SECTION 7 explains the MS2601A block diagram.
SECTION 8	GP-IB GENERAL	. These sections explain the GP-IB programming for configuring an automatic measurement system by combining the MS2601A with a personal computer and other measuring instruments.
SECTION 9	GP-IB ADDRESSES	
SECTION 10	GENERAL FORMAT OF GP-IB DEVICE MESSAGE	
SECTION 11	DETAILS OF GP-IB DEVICE MESSAGE	
SECTION 12	PROGRAMMING	
APPENDIX A to O		Data for operation manual
P	Front and rear panel controls explanation	The MS2601A front and rear panel drawings and explanation are attached as a foldout at the end of this operation manual.

LEGENDS

WARNINGs, CAUTIONs, and Notes, and footnotes are used in this manual. Their meanings are given below:

(1) Hierarchy

The hierarcy priority is WARNING > CAUTION > Note > Explanatory footnote.

(2) Definition

WARNING: WARNING is used when there is a personal injury hazard.

CAUTION: CAUTION is used when the equipment may be damaged.

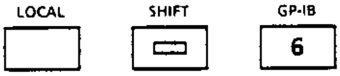
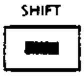
Note: Note is used to provide information about exceptions, corrections, and restrictions.

Explanatory footnote:

Explanatory footnotes provide comments on the same page as the text, figure or table. They are referenced by either an asterisk (*) or by combination of asterisk and numeral

OPERATION KEY REPRESENTATIONS

The operation keys in the descriptions of the operating procedure are represented as shown below.

Representation example			Meaning
			When only a key is shown in the operating procedure, it means press the key. Actions performed one or more times, such as [press several times], [press continuously], etc. are appended.
[LOCAL] [SHIFT] [GP-IB]			As a rule, key representations in the text are enclosed in [ ].
Key lamp	On		Lighting of a key lamp is represented by ■.
	Off		Turning off a key lamp is represented by □.

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SECTION 1

GENERAL

This section outlines the MS2601A Spectrum Analyzer, standard composition, options, application parts, peripheral equipment, and specification.

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1.1 Product Outline

The MS2601A Spectrum Analyzer has a wide bandwidth from 10 kHz to 2.2 GHz which includes the video band. A synthesized system is used for the local signal. Also, since an automatic calibration function is built in, measurement error is reduced to 1/3 of conventional Anritsu spectrum analyzers and very accurate measurements are possible. The MS2601A operability is furthered by use of a zone marker, a zone marker sweep, a frequency axis scroll, a unique new counting method, and a PMC (Plug-in Memory Card) which simplifies the measurement. Moreover, since PTA (Personal Test Automation) can be built in, a high-speed automatic measuring system can be configured easily.

Therefore, the MS2601A is very suited to productions line for various components and electronic devices.

The MS2601A has also a quasi peak (QP) detector to measure the EMI from data processing equipment.

■ Applications

The MS2601A can be used for development, adjustment, inspection, and maintenance of electronic components and devices in:

- AM, FM mobile radio equipment
- MCA, personal radio equipment
- Satellite broadcasting, TV equipment (tuners, converters, etc.)
- Data processing equipment such as personal computers for EMI (Electro-Magnetic Interference) measurement

1.2 Equipment Composition

This paragraph explains the MS2601A standard composition and options.

1.2.1 Standard composition

Table 1-1 lists the MS2601A standard composition.

Table 1-1 Standard Composition

Item	No.		Qty.	Remarks
Instrument	1	MS2601A Spectrum Analyzer	1	
Accessories supplied	2	50 Ω coaxial cable	1	Approx. 1 m long (S-5DWP•5D-2W•S-5DWP)
	3	50 Ω coaxial cable	1	Approx. 1 m long (BNC-P•RG-55/U•N-P)
	4	PMC BS32C1-A-30	1	SRAM*-type plug-in memory card (PMC) for MS2601A external memory, 32 kbyte memory
	5	Power cord	1	
	6	Fuse	1 set	***A 2
	7	Operation manual	1	

*SRAM: Static Random Access Memory

1.2.2 Options

Table 1-2 lists the MS2601A options sold separately.

Table 1-2 Options

Option No.	Name	Qty.	Remarks
01 (or 04)	PTA package	1	PTA (Personal Test Automation) is a personal computer function enabling high-speed calculation and control which is directly connected to the measuring system. It is programmed in the high level language PTL (Personal Test Automation Language).
	PTA operation manual	1	
	Keyboard (Option 01 only)	1	Program entry and editing is performed via keyboard. This is not provided in Option 04
02*	RS-232C interface package	1	Remote control by handheld computer
	RS-232C interface operation manual	1	

* Either RS-232C interface (Option 02) or GP-IB

1.3 Application Parts and Peripheral Equipment

Table 1-3 lists the application parts and Table 1-4 lists the peripheral equipment. All are sold separately.

Table 1-3 Application Parts

Name	Use/configuration	Remarks
Protective covers	For protecting front panel x 1 For protecting rear panel x 1	Covers cannot be used together with front handle Order No.: B0025
Front Handle kit		Order No.: B0038
Rack mount kit	Mounting in rack	For details see Appendix D (9). Order No.: B0215
Carrying Case	Hard-case for transportation/ with caster Hard-case for transportation/ without caster	Order No.: B0213 Order No.: B0214
Carrying Bag	Soft-case for transportation/ with caster Soft-case for transportation/ without caster	Order No. B0225 Order No. B0226
MP640A Divider	This is used to branch part of the transmitter output. The branched output is attenuated by approx. 40 dB.	For details see Appendix D (1).
MP520A/B/C/D CM Directional Coupler	For measuring transmitted power and spurious power	For details see Appendix D (2).
MP526A/B/C/D/G High-pass Filter	For eliminating the fundamental wave and measuring spurious	For details see Appendix D (3).
MP614A 50 Ω ↔ 75 Ω Impedance Transformer	This is used when the impedance of the DUT is 75 Ω.	For details see Appendix D (4).
MP612A RF Fuse Holder	This protects the input circuit from high power.	For details see Appendix D (5).
P6201 FET Probe (Tektronix)	This is used for in-circuit measurement.	
MP752A/B Nonreflective Termination	This is used for nonreflective termination of the RF signal load.	For details see Appendix D (6).

Table 1-4 Peripheral Equipment

Name	Use/configuration	Remarks
Cable	Cables for measurement and for interfaces are available.	For details see Appendix D (7).
PMC BS128C1-B-56	This is the SRAM-type plug-in memory card (PMC) for the MS2601A external memory. The memory capacity is 128 kbytes.	For details see Appendix D (8).
PMC BS32C1-A-30	This is the SRAM-type plug-in memory card (PMC) for the MS2601A external memory. The memory capacity is 32 kbytes.	For details see Appendix D (8).
Packet V Personal Technical Computer	This is used as a controller to configure an automatic measuring system via GP-IB or RS-232C interface.	For details see Appendix E.
DPR7713B Printer	Peripheral equipment for Packet V; direct plotting	With GP-IB interface
GD9411 Plotter (Graphtec in Japan)	Peripheral equipment for Packet V; direct plotting	With GP-IB interface
MH680A Tracking Generator	This is used for direct measurement of the transmission chaacteristic.	For details see Appendix K.
MH037A BCD Converter	This can be controlled by the PTA or personal computer via GP-IB. This is used for controlling jigs.	For details see Appendix F.
MS010A Multi-function selector	This can be controlled by PTA or personal computer via GP-IB. It is used with various types of scanner.	For details see Appendix G.
UA-455A Video Plotter	This hard-copies measured results from the MS2601A CRT.	For details see Appendix H.
MH648A Pre-amplifier	This is used to amplify extremely low-level signals for measurement.	For details see Appendix I.
MG655A Synthesized Signal Generator	This is used as signal generator for testing radio equipment.	For details see Appendix J.

Table 1-4 Peripheral Equipment (cont'd)

Name	Use/configuration	Remarks
Antenna	MP534A Dipole Antenna: 25 to 520 MHz MP651A Dipole Antenna: 470 to 1700 MHz MP635A Log-periodic Antenna: 80 to 1000 MHz MP636A Log-periodic Antenna: 300 to 1700 MHz MP414B Loop Antenna: 0.009 to 30 MHz MP415B Rod Antenna: 0.009 to 30 MHz	For details see Appendix L.
MZ126A Band Selector	This supplies the band switching signal and power when using the MP414B Loop Antenna or MP415B Rod Antenna.	For details see Appendix L.
MZ144A Battery Pack	This is an external power supply for field use.	For details see Appendix M.
MZ145B DC-DC Converter		
Artificial Mains Network MN423B MN424B MN425B	This is used to measure the conducted interference EMI.	For details see Appendix N.

1.4 Specifications

The MS2601A specifications are listed below.

<Frequency>

- ■ Measurement range

  10 kHz to 2.2 GHz

- ■ Setting range

  0 to 2210 MHz

- ■ Setting mode

  Center-span, Start-span

- ■ Center frequency
  - . Readout accuracy

    ±(100 Hz +2% of frequency span + tuning frequency x reference frequency accuracy)
    Frequency span ≧10 kHz, after automatic calibration

  - . Resolution 20 Hz

- ■ Start frequency
  - . Readout accuracy

    Same as center frequency readout accuracy

  - . Resolution 20 Hz

- ■ Frequency span
  - . Setting range

    1 kHz to 2000 MHz (1-2-5 sequence) and 2-digit, and 0 kHz settings

  - . Readout accuracy ≦±2%

■ Resolution bandwidth

. 3 dB Bandwidth

30 Hz to 1 MHz variable in 1, 3 sequence

. Accuracy ±20%

. Selectivity

≦15:1 (60 dB/3 dB bandwidth ratio)

■ Stability

. Residual FM

≦20 Hzp-p/0.1 s (frequency span ≦500 kHz)

. Drift

≦300 Hz/min. (frequency span ≦500 kHz, 1 hr after power-on, constant ambient temperature)

■ Sideband noise

≦-80 dBc (resolution bandwidth 100 Hz, video bandwidth 1 Hz, 10 kHz away from signal)

■ Reference oscillator

. Frequency 10 MHz

. Stability

Starting characteristics: ≦$\pm 5 \times 10^{-8}$ (20 min. after power-on with frequency 1 hr after power-on as reference)

Aging rate: ≦$\pm 2 \times 10^{-8}$/day, ≦$\pm 1 \times 10^{-7}$/year (referred to frequency after 24 hr operation)

Temperature characteristic: ≦$\pm 5 \times 10^{-8}$ (0° to 50°C referred to frequency at 25°C)

. External reference input

Frequency: 10 MHz

Level: 2 to 5 Vp-p

■ Marker

. NORMAL

Indicates marker point frequency

Readout accuracy: Same as center frequency accuracy

. Δ (delta)

Indicates frequency difference between two marker points

Readout accuracy: Same as frequency span accuracy

. Count

Indicates receiving signal frequency on the marker

. Resolution

1, 10, 100 Hz, switchable

. Accuracy

Readout frequency x reference oscillator frequency accuracy ±(2 counts or 20 Hz)

<Amplitude>

■ Measurement range

-130 to +20 dBm

■ CRT display range

. Scale

Scale line at top of screen is reference level

Vertical axis 8 divs at 10 dB/div

10 divs at other dB/div

- LOG display

  10 dB/div: reference level -70 dB
  5 dB/div: reference level -50 dB
  2 dB/div: reference level -20 dB
  1 dB/div: reference level -10 dB

- LIN display

  10%/div of reference level (units V)

- Linearity

  After automatic calibration (resolution bandwidth 100 Hz to 1 MHz)
  LOG: ±1 dB for 0 to -70 dB (10 dB/div, resolution bandwidth 100 Hz to 100 kHz)
  ±0.5 dB for 0 to -50 dB (5 dB/div)
  ±0.3 dB for 0 to -20 dB (2 dB/div)
  ±0.2 dB for 0 to -10 dB (1 dB/div)
  LIN: ±3% of reference level (full scale)

■ Frequency response

≦±0.5 dB (100 kHz to 2.0 GHz, input ATT 20 dB, temperature range from 20° to 30°C)

■ Reference level accuracy

- Setting range

  LOG: +20 to -100 dBm (resolution 0.1 dB)
  LIN: 2240 mV to 2.2 μV

- Accuracy

  After automatic calibration (frequency 50 MHz, frequency span ≦2 MHz; resolution bandwidth, video bandwidth, sweep time and input attenuator settings in AUTO)
  ≦±0.3 dB (0 to -50 dBm)
  ≦±0.75 dB (+20 to -70 dBm)

■ Resolution bandwidth switching deviation

≦±0.3 dB (after automatic calibration)

■ Dynamic range

- Average noise level

  ≦-120 dBm (resolution bandwidth 300 Hz, video filter 1 Hz, frequency 1 MHz to 2 GHz)

- 2nd and 3rd harmonics

  ≦-75 dB (input level -30 dBm, input attenuator 0 dB, frequency 5 to 800 MHz)

- Residual response

  ≦-100 dBm (frequency ≧500 kHz, input attenuator 0 dB, input 50 Ω termination)

■ Marker

- NORMAL

  Displays marker position level

- Δ (delta)

  Displays level difference between two markers

■ Video bandwidth

1 Hz, 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, OFF

■ Level units

dBm, dBμV, dBmV, V, dBμV (emf), dBμV/m

■ QP detection

- 6 dB bandwidth

  200 Hz, 9 kHz, 120 kHz

- Electrical charging time constant

  45 ms (6 dB bandwidth 200 Hz, frequency range 10 to 150 kHz)

  1 ms (6 dB bandwidth 9 kHz, 120 kHz, frequency range 150 kHz to 1 GHz)

- Electrical discharging time constant
  - 500 ms (6 dB bandwidth 200 Hz, frequency range 10 to 150 kHz)
  - 160 ms (6 dB bandwidth 9 kHz, frequency range 150 kHz to 30 MHz)
  - 550 ms (6 dB bandwidth 120 kHz, frequency range 30 MHz to 1 GHz)
- Mechanical time constant
  - 160 ms (6 dB band width 200 Hz, 9 kHz, frequency range 10 to 30 MHz)
  - 100 ms (6 dB bandwidth 120 kHz, frequency range 30 MHz to 1 GHz)

■ RF input

- Impedance
  - VSWR ≦1.5 (50 Ω, ATT ≧10 dB, frequency ≧30 kHz)
- Maximum input
  - +25 dBm (ATT ≧10 dB), 50 Vdc

■ RF input attenuator

- Attenuation
  - 0 to 50 dB, 10 dB steps
- Switching accuracy
  - ±1 dB (100 kHz to 1.5 GHz),
  - ±2.0 dB (1.5 to 2 GHz)

<Sweep>

■ Time

50 ms to 100 s variable
Variable in 1, 1.5, 2, 3, 5, 7 second step sequence

■ Trigger

FREE RUN, LINE, VIDEO, SINGLE, EXT TRIGGER

■ Sweep range

Normal: Entire range swept

Zone marker sweep: Range indicated by zone marker swept

<CRT display>

■ CRT

6 inch, magnetic deflection (amber)

■ Display items

Scale (grid), waveform data, setting conditions, menu, functions

■ Display method

Digital storage, 2 channels (A and B)

Horizontal axis 501 points

■ Direct plotting

Data on CRT screen hard-copied onto plotter or printer via GP-IB

■ Calibration

. ALL CAL

LEVEL CAL1, LEVEL CAL2, FREQ CAL calibrations

. LEVEL CAL1

Total level, LOG scale linearity error calibrations

. LEVEL CAL2

Resolution bandwidth switching deviation, reference level deviation calibrations

. FREQ CAL

LO frequency error, resolution bandwidth center frequency error calibrations

- Function memory

  Internal memory: 6 setting conditions

  PMC (32 kbytes): 12 setting conditions, measured waveform

<External control>

- GP-IB functions

  All functions except power switch, INTENSITY, PMC management, direct plotting, and GP-IB address controllable

  Interface: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0

<External output>

- TG output
  - FIRST LOCAL

    Frequency: 2.5214 to 4.7214 GHz

  - SECOND LOCAL

    Frequency: 2.5 GHz

- X-Y-Z axes

  X-axis output: Left end 0 V to right end approx. 10 V

  Y-axis output: Bottom 0 V to top approx. 1 V

  Z-axis output: TTL level

- Check output signal

. Frequency	50 MHz
. Output level	-2 dBm
. Output impedance	50 Ω

■ IF OUTPUT

. Frequency	3.6 MHz
. Output level 0 dBm (at reference level line on screen)	
. Output impedance	50 Ω

■ Video output

Composite, separate

■ Probe power supply

Power supply : +5, +15, -15 V

<Dc operation>

■ Dc power supply

Dedicated battery pack MZ144A or Dc-Dc converter MZ145B)

<External memory>

■ PMC*

. Memory card	SRAM** card BS32C1-A-30
. Dimensions	85.6H x 54W x 3.5D mm
. Storage capacity	32 kbytes
. Power supply	Built-in back-up battery

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* PMC: Plug-in-Memory Card

** SRAM: Static Random Access Memory

<General specifications>

- Operating temperature range 0° to 50°C
- Power requirement **V +10% or -15%, 50/60 Hz
- Power consumption ≦145 VA
- Dimensions and weight
  177H x 284W x 451D mm, ≦18.5 kg

<Option 01 (or 04)>

- PTA
  - Software
    PTL high level language software: ROM base
  - Keyboard 1 (Option 01 only)

<Option 02>

- RS-232C interface
  - Baud rate 1200 baud

SECTION 2

PREPARATION

This section explains the preparatory work before using the MS2601A Spectrum Analyzer and precautions relating to: (1) installation, (2) power supply, (3) storage, (4) re-packing and transportation. For the GP-IB cable connections, address setting, etc. see Section 8.

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2.1 Installation Precautions

This paragraph describes the MS2601A Spectrum Analyzer General installation precautions and mechanical assembly when mounting it in a rack.

2.1.1 Installation site environmental conditions

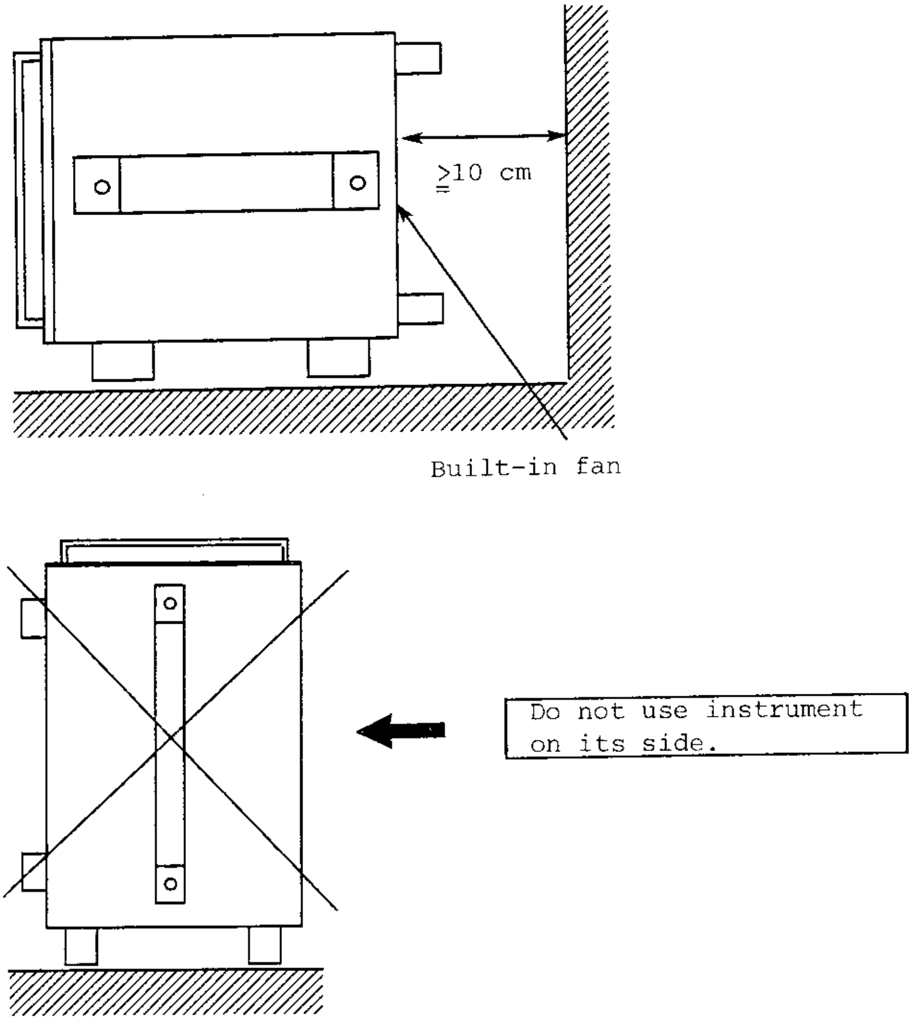
The MS2601A operates normally at ambient temperatures of 0° to 50°C. However, for best performance, do not use or store it where:

- It may be subjected to strong vibrations
- It may be exposed to damp or dust
- It may be exposed to direct sunlight
- It may be exposed to active gases

To maintain stable for a long time, in addition to meeting the conditions listed above, the MS2601A should be used at stable room temperatures and where ac line voltage fluctuations are small.

CAUTION

If the MS2601A is used at room temperature after being used or stored at a low temperature for a long time, condensation may occur inside the instrument and may cause short circuits. Always ensure that the MS2601A is thoroughly dry before turning on the power.



Do not use instrument on its side.

Fig. 2-1 Fan Clearance

(1) Fan clearance

To suppress any temperature increase inside the MS2601A, a cooling fan is mounted on the rear panel as shown in Fig. 2-1. Leave a space of at least 10 cm between the rear panel and walls, peripheral devices, obstructions, etc. so that the air flow is not obstructed.

2.1.2 Rack mounting

When mounting the MS2601A in a rack, the optional rack mounting kit is necessary. Order the rack mounting kit by using the order number given in Table 1-3.

The mounting instructions are supplied with the kit.

2.2 Power Supply Safety Measures

The MS2601A operates normally on a **Vac +10%/-15%, 50/60 Hz power supply.

However, supply ac power only after taking precautions against the following hazards.

- Electric shock
- Damage due to the abnormal voltage
- Earth current

Therefore, observe the following safety measures before supplying ac power.

2.2.1 Power cord polarity

Since the 3-pole (ground-type 2-pole) power cord is connected to the live line (L), neutral line (N), and ground line, the MS2601A is designed so that the power supply polarity is always matched when the plug is inserted into a 3-pole (ground-type 2-pole) supply outlet.

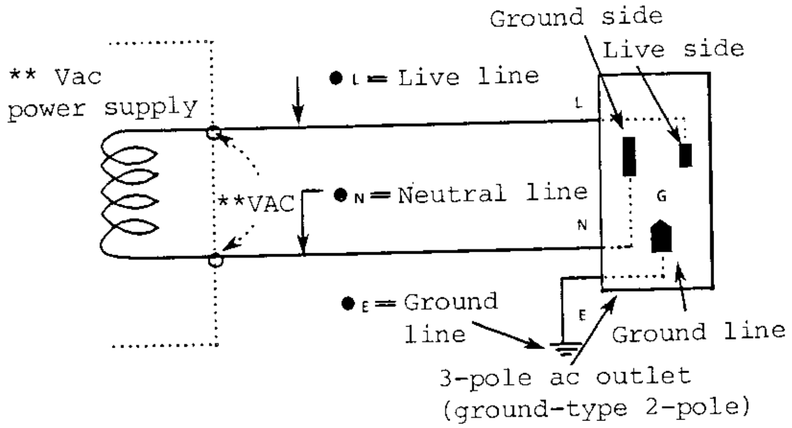


Fig. 2-2 Three-Pole Power Cord Plug and Outlet

2.2.2 Grounding

(1) Grounding frame ground (FG) terminal

When a 3-pole ac outlet (Fig. 2-2) is not available, ground the FG terminal (Fig. 2-3) directly to earth potential.

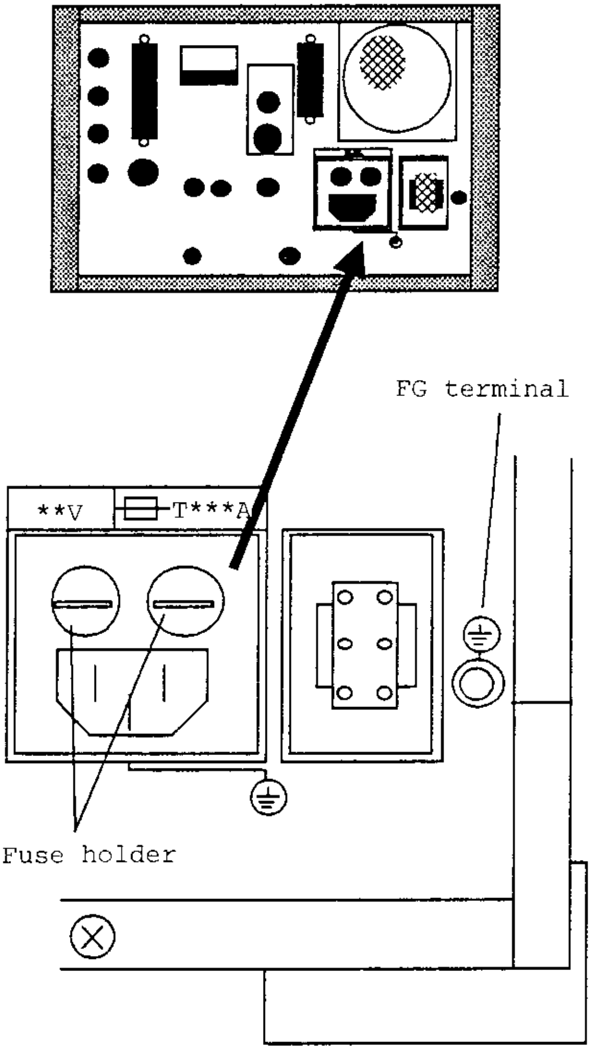


Fig. 2-3 Grounding (FG) Terminal

(2) Grounding by 3-pole ac outlet

If a 3-pole (ground type 2-pole) ac outlet is available, the MS2601A frame is connected to earth potential when the power cord is plugged into ac outlet and the FG terminal does not have to be grounded.

2.2.3 Fuse replacement

The standard system is supplied with the fuses shown in Table 1-1. The two fuses shown in Fig. 2-3 are rated at ***A.

When a fuse blows, locate and correct the cause of the trouble before changing the fuse.

WARNING

1. Before replacing a fuse, turn off the power switch and unplug the power cord from the ac outlet.

   There is an electric shock hazard if a fuse is replaced while the power on.

2. Before turning on the power after replacing a fuse, check the protective grounding described in paragraph 2.2.2 and check that the ac supply voltage is suitable. There is an electric shock hazard if the power is turned on without the protective grounding.

   If the ac supply voltage is unsuitable, the equipment may be damaged.

The fuse replacement procedure (Fig. 2-3) based on the above safety measures, is described below.

Step	Procedure
1	Set the POWER switch on the front panel to OFF and unplug the power cord from the ac outlet.
2	Turn the fuse holder counterclockwise and remove the cap, together with the fuse.
3	Remove the blown fuse from the cap and replace it with the spare fuse.
4	Refit the cap and turn it clockwise until it will turn no further.

CAUTION

If the fuse blows again after replacing it, check that the replacement is of the same type, rated voltage and current, as the original.

If the fuse is not the same type, it may not fit the holder, contact may be poor, or the fusing time may be too long.

If the rated voltage and current of the replacement fuse are too high and trouble reoccurs, the new fuse may not blow and the instrument may catch fire.

Set the power to ON after step 4 above.

For the power supply connection procedure, see SECTION 3.

2.3 Storage Precautions

This paragraph describes the precautions to take when storing the MS2601A for a long time.

2.3.1 Precautions before storage

1. Wipe any dust and fingermarks off the cabinet.
2. Check the performance as described in SECTION 4 and check that the MS2601A operates normally.
3. The maximum and minimum storage temperature range is 60° to -20°C. The maximum humidity is 90%.

2.3.2 Recommended storage conditions

In addition to meeting the conditions listed in paragraph 2.3.1, the MS2601A should preferably be stored where:

1. Temperature is 0° to 30°C
2. Humidity is 40% to 80%
3. Temperature and humidity are stable

Before using the MS2601A after storage, check the performance as described in SECTION 4.

2.4 Repacking and Transportation

When transporting the MS2601A over long distances, observe the precautions described below.

2.4.1 Repacking

Use the original packing materials. If the original packing materials were thrown away or destroyed, repack the MS2601A as follows:

1. Install the protective covers (sold separately, order No. B0025) over the front and rear panels.
2. Wrap the MS2601A in plastic or similar material.
3. Obtain a cardboard, wood, or aluminum box 10 to 15 cm larger than the MS2601A on all sides.
4. Put the MS2601A in the center of the box and fill the surrounding space with shock absorbent material.
5. Secure the box with twine, tape, or bands.

Note:

It is easy to repack the MS2601A if the original packing materials are saved.

2.4.2 Transportation

Transport the MS2601A under the storage conditions recommended in paragraph 2.3.2.

SECTION 3

STARTING OPERATION AND SIMPLE PERFORMANCE CHECKS

This section describes the handling and simple performance checks at the start of operation of the MS2601A Spectrum Analyzer.

The starting description is centered about turning the power on, and the CRT display. The purpose of the simple performance checks is to quickly and easily check the basic operation and performance of the MS2601A so that only the minimum number of items are checked. When more detailed checking is necessary, test the performance as described in SECTION 4.

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3.1 Power On and CRT Display

3.1.1 POWER ON/OFF

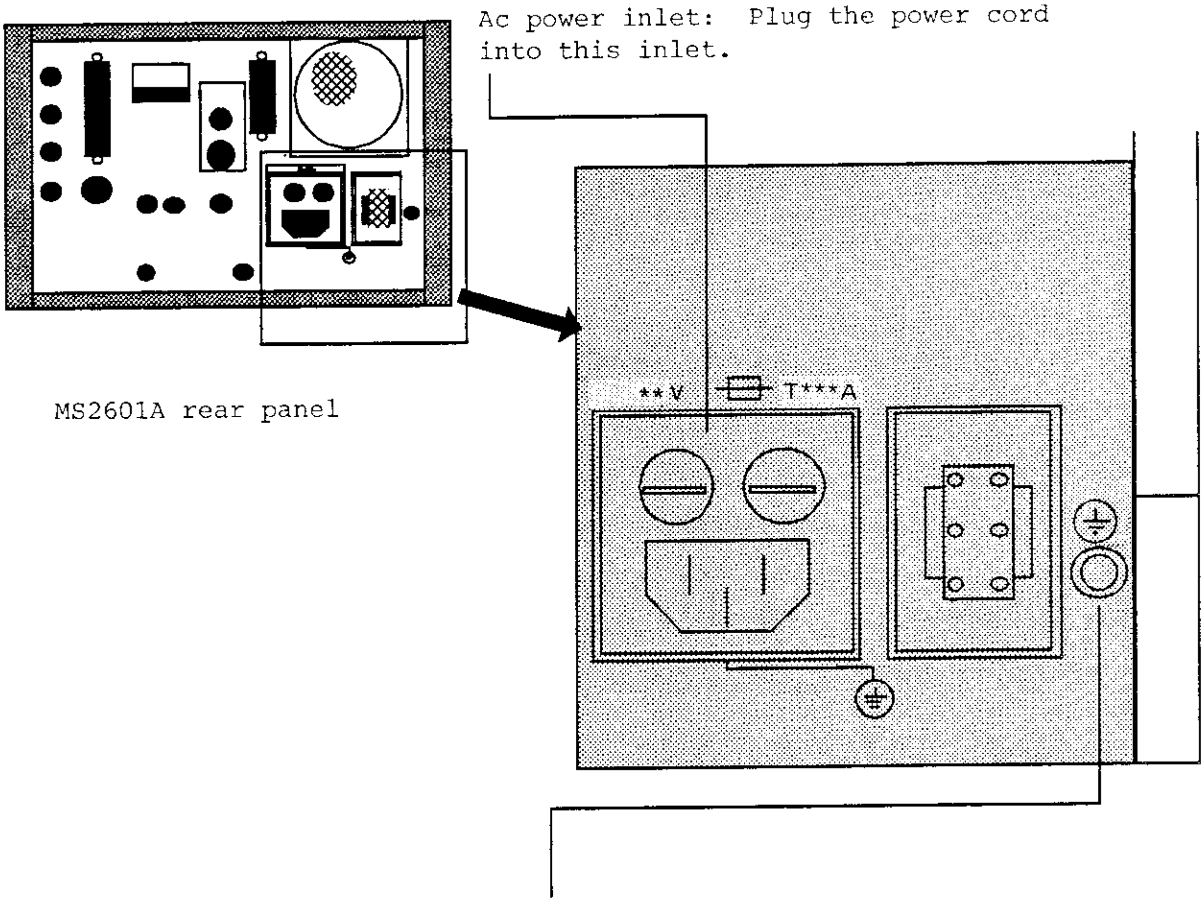
Before turning on the power, ground the MS2601A as described in paragraph 2.2, then plug the power cord into the ac power inlet.

WARNING

If the power is turned on without grounding the instrument, there is a danger of electric shock.

When a 3-pin (2-pin ground type) ac outlet is not available, before supplying power to the MS2601A, always connect the rear panel frame ground (FG) terminal or the ground terminal of the accessory power cord to earth potential.

Ac power inlet: Plug the power cord into this inlet.

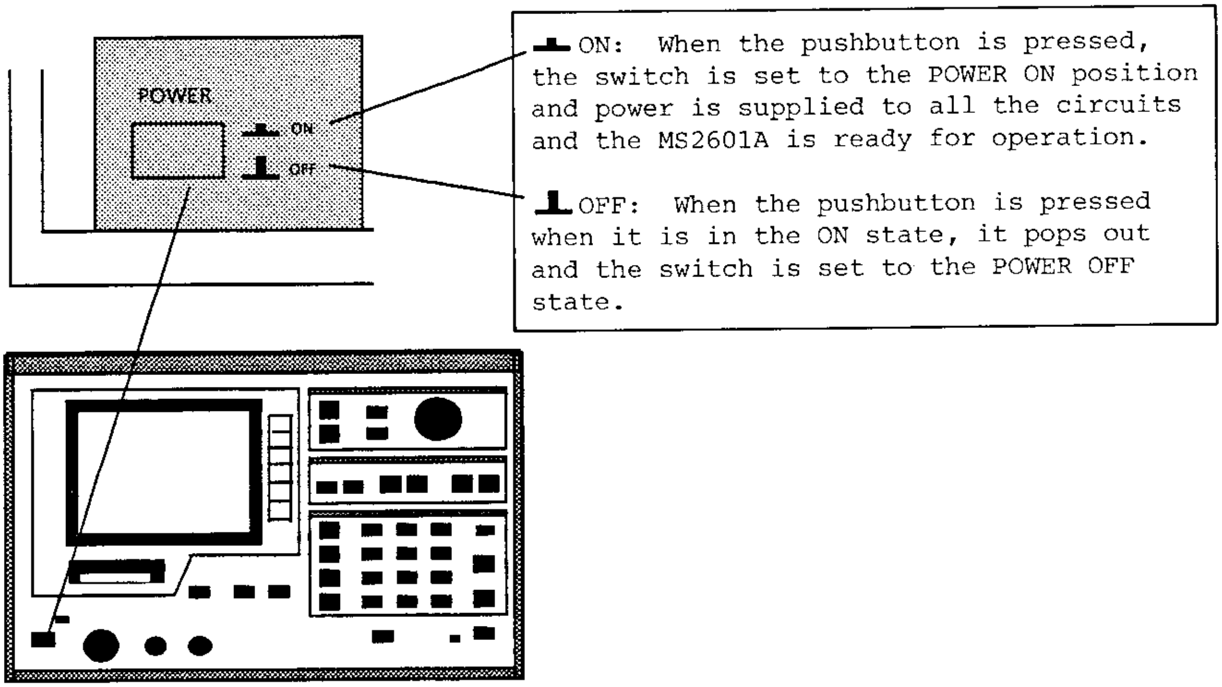


Frame ground terminal: To prevent electric shock, connect this terminal to earth potential.

Fig. 3-1 Rear Panel Power System Layout

CAUTION

If the ac line voltage is incorrect, the instrument may be damaged. Before turning on the power, check that the ac line voltage is within the specified value (** V $^{+10\%}_{-15\%}$).



⊥ ON: When the pushbutton is pressed, the switch is set to the POWER ON position and power is supplied to all the circuits and the MS2601A is ready for operation.

⊥ OFF: When the pushbutton is pressed when it is in the ON state, it pops out and the switch is set to the POWER OFF state.

Fig. 3-2 Front Panel POWER Pushbutton Switch

The correct procedure for connecting power to the MS2601A is described below.

Power connection procedure

Step	Procedure
1	Before connecting the power cord to the ac outlet, check that the ac outlet voltage is correct.
2	After checking that the front panel POWER switch is set to the OFF position, connect the power cord to the ac inlet.
3	Set the front panel POWER switch to the ON position.

3.1.2 CRT display setting parameters

When the power is turned on, the MS2601A automatically resets the function setting parameters set when the power was turned off previously whether or not the PMC* is installed. Consequently, if the power-off settings were the MS2601A initial display setting, they will be reset when the power is turned on again.

Otherwise, the initial display set parameters are only set when:

1. The power is turned on when the backup to the built-in RAM** is faulty.
2. [INITIAL] key (Fig. 3-3) is pressed after the power has been turned on.
3. The power is turned on and the keys [RECALL][0] are pressed in order after the initial setting has been changed to new set parameters.

When the MS2601A power is turned on, if the parameters set when the power was previously turned off is not needed, press the [INITIAL] key, then set the objective function parameters after the MS2601A has been initialized.

The CRT initial display setting is shown in Fig. 3-4.

Note:

When the power is turned on, the parameters set when the power was previously turned off are displayed at the top and bottom of the CRT scale as shown in Fig. 3-4. For example, the functions for which data can be entered from the data knob or numeric/unit keys are displayed in highlighted characters, such as MKR. The setting parameters or measurement data are displayed to the right of the highlighted characters and colon (:). However, since only MARKER(1) is always displayed at the menu display when the power is turned on, MKR is highlighted although the marker entry mode was not set when the power was previously turned off.

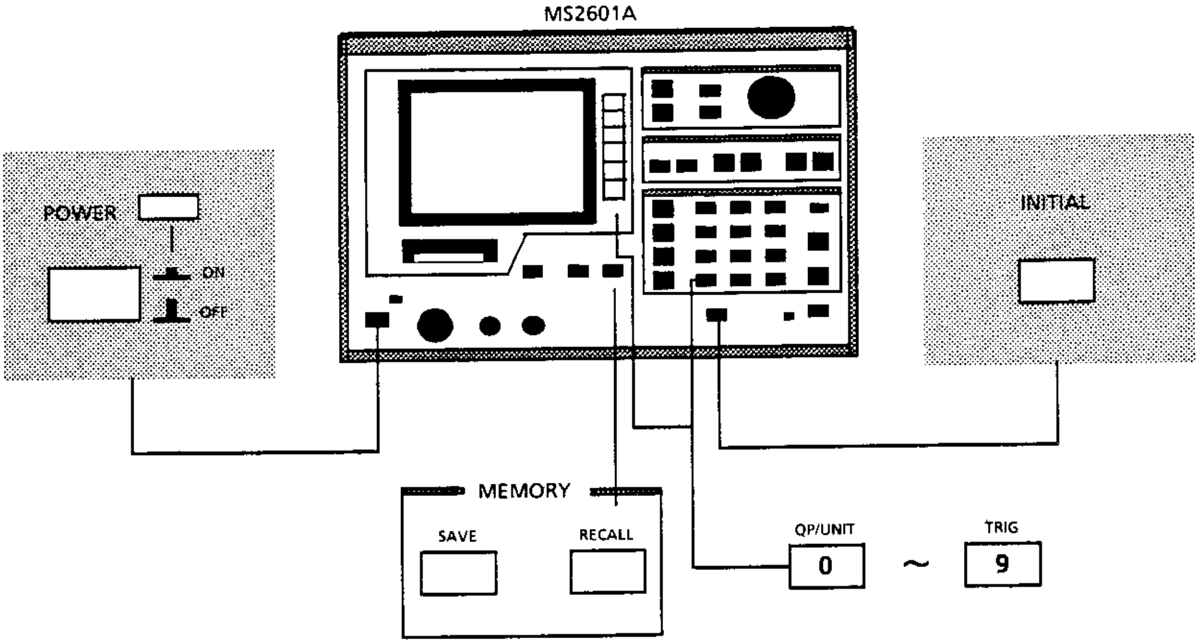


Fig. 3-3 Keys for Reproducing the Setting Parameters

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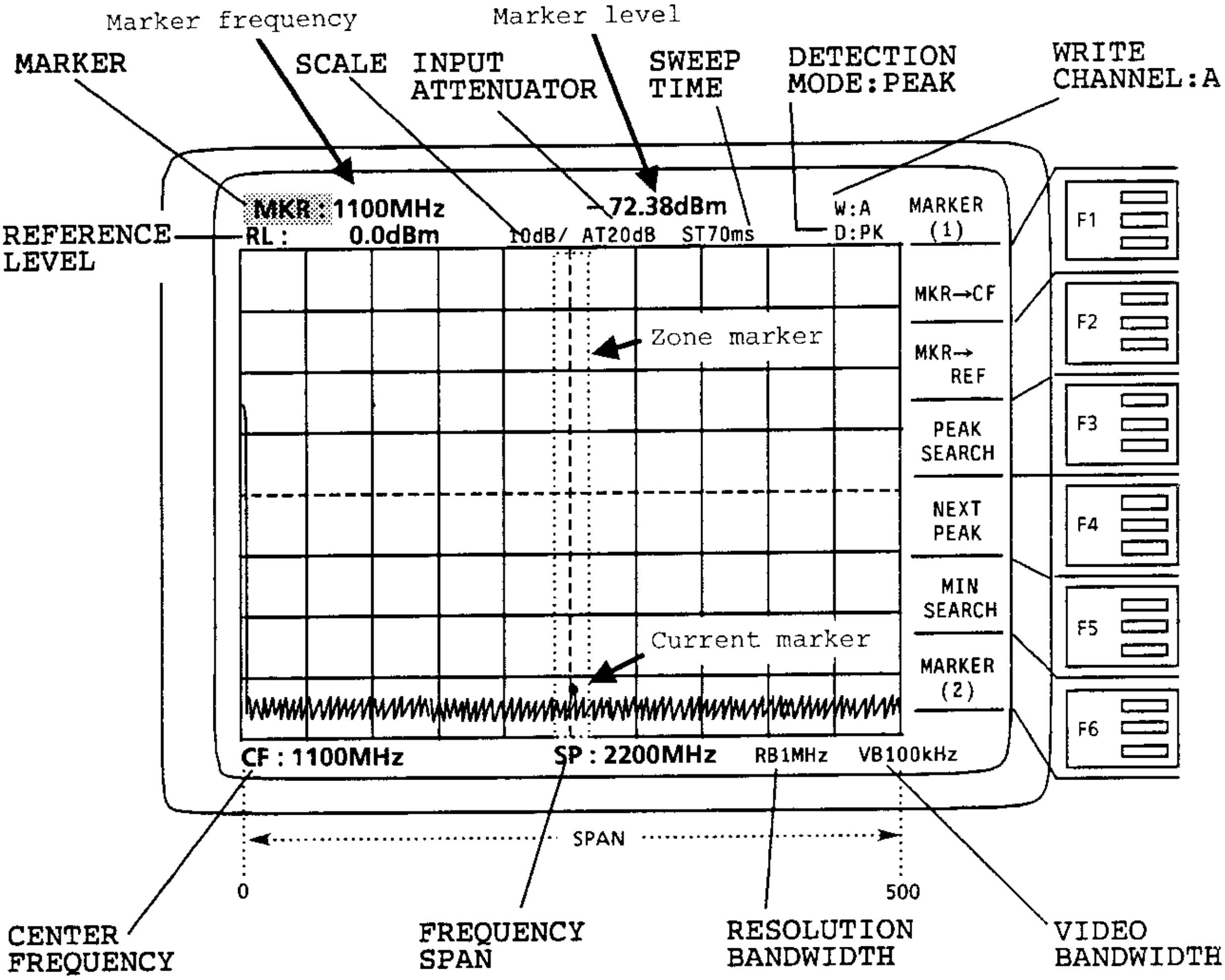
*PMC: Plug-in Memory Card **RAM: Random Access Memory



CENTER FREQ	1100 MHz
SPAN	2200 MHz
REF LEVEL	0 dBm
INPUT ATTEN	AUTO (10 dB)
RESOLN BW	AUTO (1 MHz)
VIDEO BW	AUTO (100 kHz)
SWEEP TIME	AUTO (50 ms)
SCALE	LOG 10 dB/div
TRIG	FREE
TRACE	A ch WRITE ON, NORMAL MODE, READOUT ON (B ch WRITE OFF, READOUT OFF)
MARKER	NORMAL, CENTER, WIDTH NAR
CORR D	ON
RSPS D	ON

*GPIB ADDRESS	01
*UNIT	dBm
*ANTENNA	DIP

Items indicated by the asterisk (*) are not changed by [INITIAL] key.

Fig. 3-4 CRT Display in Initial State (Initial Setting)

When the [INITIAL] key is pressed, the MS2601A setting parameters are initialized (Fig. 3-4). However, GP-IB ADDRESS, UNIT (level units) , and ANTENNA do not change. The MARKER (1) menu is displayed and the MS2601A enters the marker entry mode.

- The characters MKR at the top left corner of the CRT (Fig. 3-4) are highlighted. Since this highlighted display indicates that marker function entry is possible (equivalent to pressing [MARKER] key), the zone marker* can be moved by using the data knob.
- Each time data is entered from the numeric/unit keys or the data knob during data entry, the value of that data is displayed on the CRT. For example, when the [REF LEVEL] key is pressed, RL; is highlighted and the data entered at the right of RL: is displayed as it is entered.

The CRT display parameters listed around the edge of the screen in Fig. 3-4 are described in Table 3-1.

Table 3-1 CRT Display Setting Parameters

Setting display on CRT		Description
Initial/other setting	Range/setting mode	
RL: 0.0 dBm When [REF LEVEL] key pressed: RL:	-100.0 dBm to +20.0 dBm (0.1 dB steps)	. RL: 0.0 dBm display at initial setting indicates Reference Level: 0 dBm. . The top line of the CRT scale is the RL line. <Entry order> REF LEVEL Numeric/unit keys or data knob

Table 3-1 CRT Display Setting Parameters (Cont.)

Setting display on CRT		Description
Initial/other setting	Range/setting mode	
MKR: 1100 MHz After [MARKER] key pressed: . Normal marker selection MKR: . Δ marker selection ΔMKR: . COUNT ON (normal marker) selection FREQ: . COUNT ON (Δ marker) selection ΔFRQ:		■ NORMAL (normal marker mode) The current marker is moved to the largest trace within the zone marker* of the currently-written channel and the frequency and absolute level at the marker position are digitally displayed on the CRT. In Fig. 3-4, since nothing is connected to the input connectors, only the internal noise of the MS2601A is measured. Because the maximum point within the zone may not be at the center of the CRT, the marker frequency is moved up and down 1100 MHz by shifting the noise peak. ■ Δ marker mode When the [F2] key is pressed when the MARKER (2) menu is opened and NORMAL marker is selected, the current marker position becomes the reference marker and the frequency and level differences become 0. Then, current marker is moved by the data knob and the difference between two points (frequency difference or level difference) is found. ■ Frequency count mode When the [SHIFT] [COUNT] keys are pressed in order, the frequency of the signal at the marker position is counted at a 1 Hz, 10 Hz, or 100 Hz resolution. If the marker is the normal marker, the counted frequency is displayed as the marker frequency. If the marker is the Δ marker, the difference between the counted frequency and the reference marker frequency is displayed.

* The zone marker is a dotted frame displayed on the CRT. At initialization, it is positioned at the center of the CRT. The current market is placed at the largest point within this zone. In Fig. 3-4, the frequency and level of the current marker within the zone are 1100 MHz and -72.38 dBm.

Table 3-1 CRT Display Setting Parameters (Cont.)

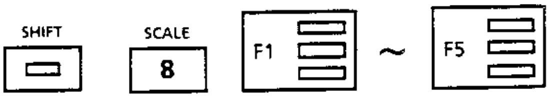
Setting display on CRT		Description
Initial/other setting	Range/setting mode	
10dB ... [F1] key 5dB ... [F2] key 2dB ... [F3] key 1dB ... [F4] key LIN ... [F5] key	. LOG scale mode 10 dB/5 dB/2 dB/ 1 dB . LIN scale mode . The LOG 10 dB/div vertical axis scale has 8 divisions; all the other scale settings have 10 divisions.	. The 10 dB display at initialization shows that the CRT vertical scale is 10 dB/div LOG scale. . The dB/div value shown at the left is set by using the [F1] to [F4] keys. . The LINEAR scale is set by using the [F5] key. <Entry order> 
AT10dB AT0dB AT20dB AT30dB AUTO mode AT0dB AT10dB AT20dB AT30dB AT40dB AT50dB MANUAL mode	. AUTO mode 0 dB/10 dB/20 dB/ 30 dB Set with [F1] the key. . MANUAL mode 0 dB/10 dB/20 dB/ 30 dB/40 dB/50 dB Raise or lower in 10 dB steps with the [F5] key or [F6] key.	. The AT20dB display at initialization shows that the INPUT ATTENUATOR (abbreviated ATTEN or AT) is set to 20 dB in the AUTO mode. . When ATTEN is set in the MANUAL mode, the line under the characters [AT] on the CRT shows that the ATTEN setting is in the MANUAL mode. <Entry order> 

Table 3-1 CRT Display Setting Parameters (Cont.)

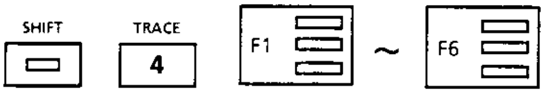
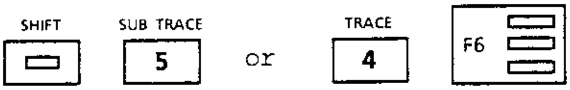
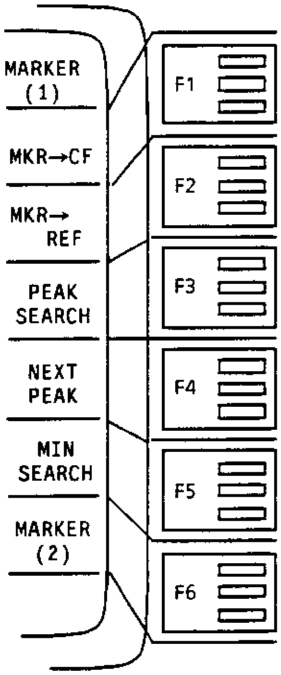
Setting display on CRT			Description
Initial/other setting		Range/setting mode	
ST50ms ~ ST100s AUTO mode	ST50ms ~ ST100s MANUAL mode	. AUTO mode 50 ms to 100 s Set with the [F1] key. . MANUAL mode 50 ms to 100 s Set in the 1-1.5-2-3-5-7 time sequence with the [F5] key or in reverse order with the [F6] key.	. The ST70ms display at initialization shows that the SWEEP TIME (ST) is set to 70 ms in the AUTO mode. . When ST is set in the MANUAL mode, the line under the characters [ST] on the CRT shows that the ST setting is in the MANUAL mode. <Entry order> 
W:A .... [F1] key W:B .... [F5] key		Digital storage memory channel: . Channel A . Channel B	. W:A display at initialization shows that the WRITE (W) destination memory of the input waveform currently being swept is channel A (A). . WRITE (W) destination memory: For channel B (B), after the [SHIFT][TRACE] keys are pressed in order, B-WRITE ON is selected by using the [F5] key. <Entry order> 

Table 3-1 CRT Display Setting Parameters (Cont.)

	Setting display on CRT		Description
	Initial/other setting	Range/setting mode	
SUB TRACE	D:PK D:SMP D:DIP	■ Trace detection mode . PK (Positive Peak) . SMP (Sample) . DIP (Negative Peak)	. D:PK display at initialization shows that the trace detection mode is Positive Peak Detection (PK). . Positive peak detection ... PK is selected with the [F3] key. . Negative peak detection ... DIP is selected with the [F3] key. . Sampled value detection ... SMP is selected with the [F3] key. . MAX HOLD ... MAX is selected. . AVG .... AVR is selected. <Entry order>
TRACE	D:MAX D:AVR	■ Write mode . MAX . AVR	





In the MS2601A, when the FUNCTION section [MARKER] key, the MENU selection keys, [LIST], [SAVE], or [RECALL] key is pressed, a menu is displayed on the right side of the CRT.

To execute one of the measurement functions indicated by the menu items, select the function soft [F1] to [F6] key corresponding to the item.

The MARKER (1) is always displayed at the menu display when power is turned on as shown in Fig. 3-4, which are equivalent to pressing the [MARKER] key.

MKR is highlighted at the top left corner of the CRT to indicate that the marker function entry is ready. When the data knob is turned so that the zone marker is positioned at the required measurement zone, the maximum level and frequency within the zone can be measured (see soft key functions table in Appendix P of this manual).

Table 3-1 CRT Display Setting Parameters (Cont.)

Setting display on CRT			Description
	Initial/other setting	Range/setting mode	
A U T O	VB100kHz VB100Hz VB1kHz VB10kHz	Video bandwidth setting values . AUTO mode 100 Hz 1 kHz 10 kHz 100 kHz . MANUAL mode 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz - OFF -	. The VB 100 kHz display at initialization shows that the video bandwidth (VB) is set to 100 kHz in the AUTO mode. . The AUTO mode is set with the [F1] key. . When the video bandwidth is set in the MANUAL mode, the line under the characters [VB] on the CRT shows that the VB setting is in the MANUAL mode. . In the MANUAL mode, the set value is increased and decreased by using the [F5] and [F6] keys. <Entry order> SHIFT ▭ VID BW 7 F1 ~ F3
M A N U A L	VB1Hz VB10Hz VB100Hz VB1kHz VB10kHz VB100kHz - OFF -		
A U T O	RB1MHz RB30Hz RB100Hz RB300Hz RB1kHz RB3kHz RB10kHz RB30kHz RB100kHz RB300kHz	Resolution bandwidth setting values . AUTO/MANUAL modes 30 Hz 100 Hz 300 Hz 1 kHz 3 kHz 10 kHz 30 kHz 100 kHz 300 kHz 1 MHz In the MNUAL mode, the RB is set in the 1-3 frequency sequence shown in the left.	. The RB1MHz display at initialization shows that the resolution bandwidth (RB) is set to 1 MHz in the AUTO mode. . The AUTO mode is set by using the [F1] key. . When the resolution bandwidth is set in the MANUAL mode, the line is under the characters [RB] on the CRT shows that the RB setting is in the MANUAL mode. . In the MANUAL mode, the set value is increased and decreased by using the [F5] and [F6] keys. <Entry order> RESOLN BW ▨ F1 ~ F5
M A N U A L	RB30Hz RB100Hz RB300Hz RB1kHz RB3kHz RB10kHz RB30kHz RB100kHz RB300kHz RB1Mz		

Table 3-1 CRT Display Setting Parameters (Cont.)

Setting display on CRT		Description
Initial/other setting	Range/setting mode	
SP: 2200MHz When [SPAN] key pressed: SP:	. 1 kHz to 2200 MHz . Span can varied from 1 kHz to 2000 MHz in the 1-2-5 frequency sequence with the step keys. . Zero span setting is used as fixed frequency tuning. . One scale division (frequency/div) is 1/10 of displayed value.	. The SP:2000MHz diplay at initialization shows that the frequency span is 2200 MHz. . Fig. 3-4 shows the CF/SPAN mode. The sweep center frequency (CF) is 1100 MHz and the sweep width from the left to the right of the CRT is 2200 MHz. . There are 501 measurement points on the horizontal axis. The sweep start point (left end of CRT) is point 0, the sweep center point is point 250, and the sweep end point (right end of CRT) is point 500. <Entry order> SPAN ☐ Numeric/unit keys, data knob, step keys Note: The SPAN step key can be operated separately from the [SPAN] key.

Table 3-1 CRT Display Setting Parameters (Cont.)

Setting display on CRT		Description
Initial/other setting	Range/setting mode	
CF:1100MHz After the [SHIFT] [FREQ MODE] keys are pressed in order:	. CF 0 Hz to 2210 MHz	. CF:1100MHz displayed at initialization shows that the center frequency is 1100 MHz.
. CENTER selected with [F1] key CF: . START selected with [F2] key SF: . STEP SIZE selected with [F3] key SS:	. SF: 0 Hz to 2210 MHz . SS: 0 to 2210 MHz (Minimum step 20 Hz) . Setting resolution: 20 Hz	. Fig. 3-4 shows the CF/SPAN mode. The sweep width from the left to the right of the CRT is 2200 MHz and the sweep center frequency (CF) is 1100 MHz. <Entry order> FREQ Numeric/unit keys or data knob CF.SF.SS selection and SS entry SHIFT FREQ MODE 2 F1 ~ F3

In addition to the CRT display described above, when the [F2] key (ALLCAL) is pressed after the [CAL] key, the message CALIBRATING is displayed. In the MANUAL mode, if the SWEEP TIME is very fast, the message UNCAL is displayed. When the MS2601A enters an inadequate state, a message such as UNCAL is displayed at the top of the CRT. These messages are described in paragraph 3.2 and following paragraphs.

Fig. 3-5 summarizes the CRT display setting parameter range at initialization and other settings described in Fig. 3-4 and Table 3-1.

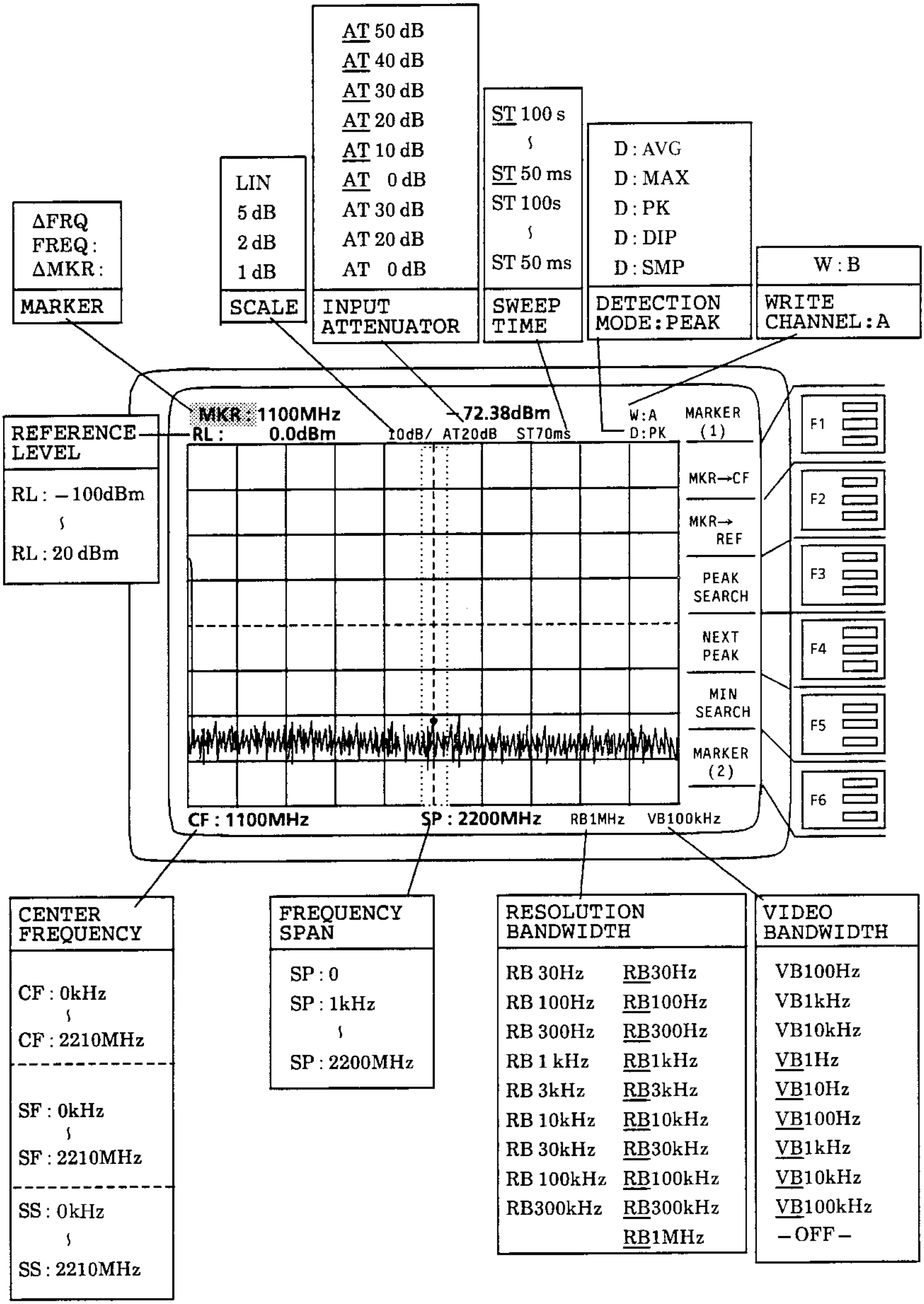


Fig. 3-5 CRT Display Setting Parameters Range

3.1.3 Panel and display abbreviations

The abbreviations displayed on the panels and CRT are listed below in alphabetical order.

ABBREVIATION	MEANING
A	A ch (Trace-storage Location)
ADRS	Address
AT	Input Attenuator
ATTEN	Input Attenuator
AVER	Average
AVG	Average
AVG RT	Average Rate
B	B ch (Trace-storage Location)
BOT	Bottom
BS	Back Space
BW	Bandwidth
CAL	Calibration
CAP	Capital
CF	Center Frequency (Linear Sweep)
CHAR	Character
COPY	Direct Plotting
CORR D	Correction Data
CUR	Current
CURS	Cursor
D	Detector
DET	Detector
DIP	Negative Peak Detector
DIP	Dipole Antenna
DSPL	Display A ch or B ch
EXT	External Trigger
FREQ	Frequency (Measured value)
LIN	Linear Scale
LN	Line
LOG	Logarithmic Scale

(Cont.)

ABBREVIATION	MEANING
LOG	Log-Periodic Antenna
MAX	Max Hold
MDL	Middle
MIN	Minimum
MKR	Marker
NAR	Narrow
NUM	Number
PEAK	Positive Peak Detection
PK	Positive Peak Detection
PMC	Plug-in Memory Card
PRTCT	Protect
PTA	Personal Test Automation
QP	Quasi-Peak Detection
RB	Resolution Bandwidth
REF	Reference Level
REG	Register
RESOLN	Resolution Bandwidth
RL	Reference Level
RSPS D	Frequency Response Data
SF	Start Frequency
SML	Small
SMP	Sampling Detector
SP	Frequency Span (Linear Sweep)
SS	Step Size
ST	Sweep Time
SWP	Sweep
TR	Trace by A ch or B ch
TRIG	Trigger

(Cont.)

ABBREVIATION	MEANING
VB	Video Bandwidth
VID	Video Bandwidth
W	Write
WRIT	Write
Z	ZONE
Z WDTH	Zone Width

3.2 Simple Performance Checks

This paragraph describes simple performance checks to be made when the MS2601A Spectrum Analyzer is delivered. Before the MS2601A is shipped, Anritsu confirms that the catalog specifications are satisfied over a 0° to 50°C ambient temperature range.

If the MS2601A passes the simple checks described below, it can be used immediately.

The following checks are mode:

- Initial setting display check
- REF LEVEL check
- SAVE/RECALL check

(1) Simple performance checks adapter

. 50 Ω coaxial cable (1)... Length approx. 1 m (BNC-P.RG-55/U.NP)

(2) Set-up

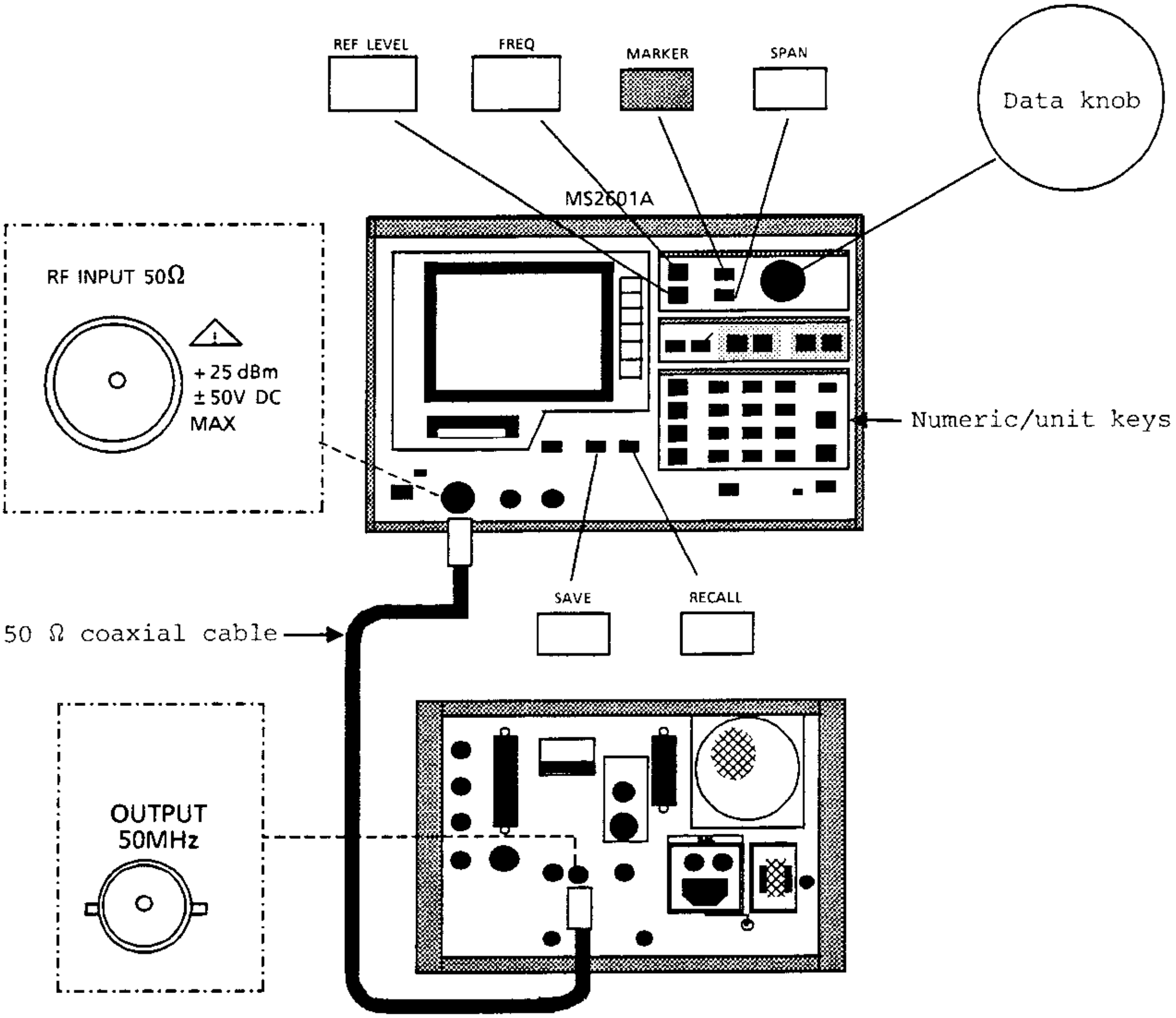
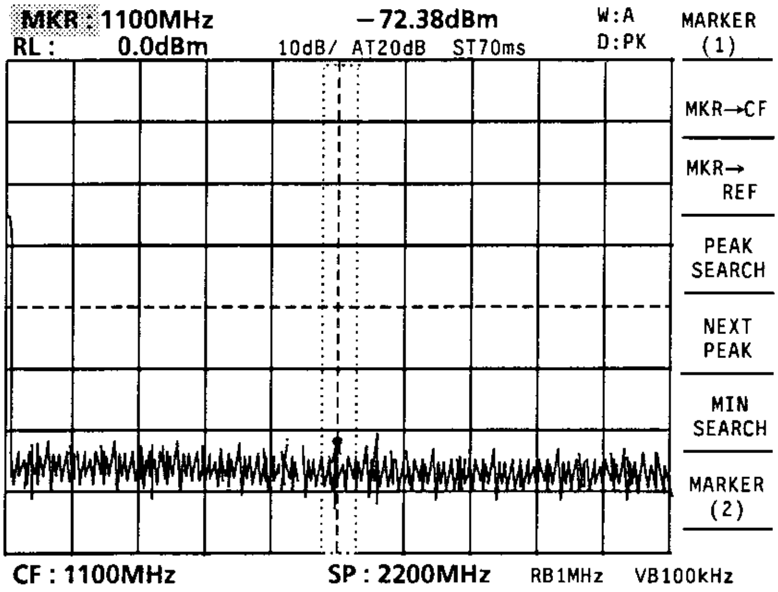


Fig. 3-6 Main Keys and 50 MHz Signal Connection at Simple Performance Checks



REF LEVEL	0 dBm
SCALE	LOG 10 dB/div
INPUT ATTEN ..	AUTO (10 dB)
SWEEP TIME ...	AUTO (50 ms)
VIDEO BW ...	AUTO (100 kHz)
RESOLN BW	AUTO (1 MHz)
SPAN	2200 MHz
CENTER FREQ	1100 MHz
MARKER	CENTER
MARKER	NORMAL
MARKER	WIDTH NAR
TRACE	A ch WRITE ON
TRACE	NORMAL MODE
TRIG	FREE
TRIG	FREE
CORR D	ON
RSPS D	ON
GPIB ADDRESS	01
UNIT	dBm
ANTENNA	DIP

Initial Setting Display Check

3.2.1 Initial setting display check

Check the range list shown above at the initial CRT display (Fig. 3-4). After turning on the power without the 50 MHz signal connected as shown in Fig. 3-6, press the [INITIAL] key.

This sets the MS2601A to the initial state irrespective of the previous settings. The initial checks are:

(1) Setting parameters check

Check that the REF LEVEL to CENTER FREQ values of the function parameters listed at the right side of the figure above are displayed at the respective parameters around the outside of the CRT scale shown at the left.

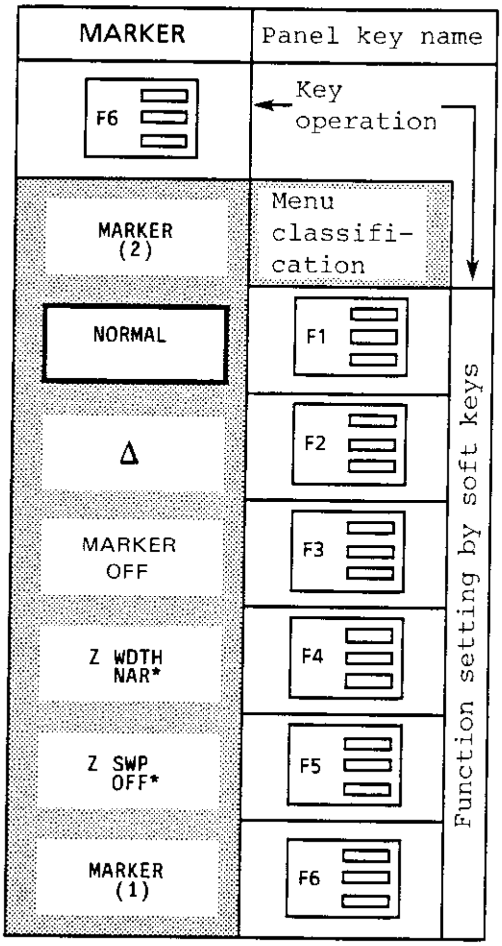
(2) Marker entry mode check

Check that MKR: characters at the top right side of the figure on the previous page are highlighted. This shows that zone marker control data can be entered.

The procedure is described below.

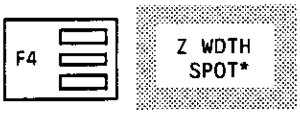
Step	Procedure
	Marker non-entry mode
1	Press the [REF LEVEL], [FREQ], or [SPAN] key so that characters other than MKR are highlighted.
2	Check that the marker zone cannot be moved with the data knob, although the marker frequency and level are displayed on the CRT display.
	Marker entry mode
3	Press the [MARKER] key. Check that MKR: characters at the top left of the CRT are highlighted.
4	Check that the marker zone moves from left to right when the data knob is turned clockwise and from right to left when the data knob is turned counterclockwise.

(3) MARKER (NORMAL, CENTER, WIDTH NAR) check

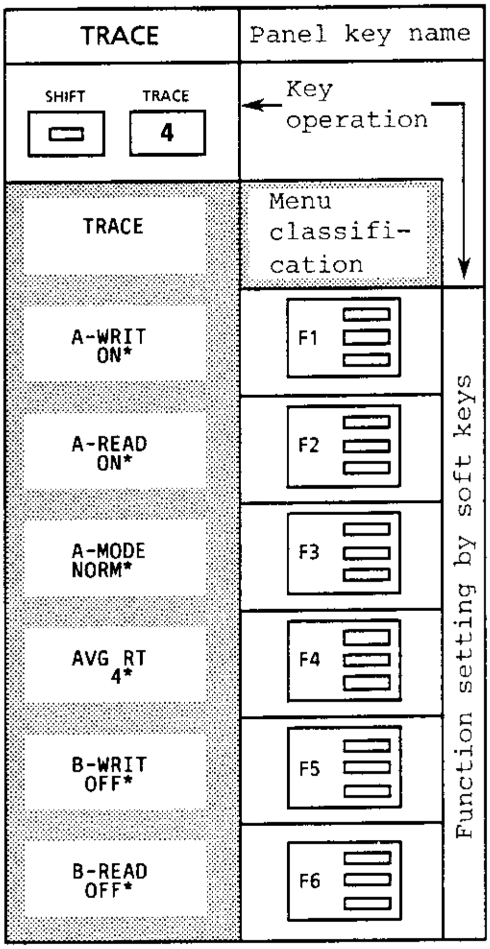


Step	Procedure
	<u>NORMAL check</u>
1	Press the [F6] key to display the menu shown above.
2	Check that the current marker is the normal marker (NORMAL enclosed by bold line shown above).
3	Check that the bright spot in the zone marker indicates the normal marker, and that the current marker is always at the maximum level of the trace within the marker zone.

(Cont.)

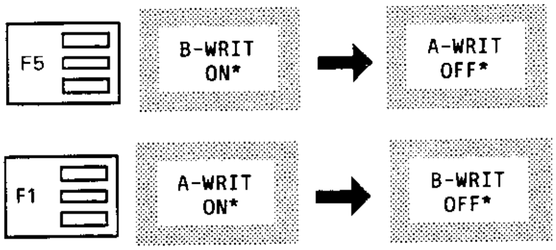
Step	Procedure
	CENTER/WIDTH NAR check
4	Press the [F4] key until SPOT is selected. 
5	Check that the current marker and a single line indicating the zero zone marker are at the center of the CRT.
6	Set Z WDTH to SPOT or WIDE and move the zone marker away from the center of the CRT by using the data knob, then press the [INITIAL] key and check that the Z WDTH NAR marker zone is positioned at the center of the CRT. The part corresponding to the center line of the NAR marker zone matches the CENTER point.

(4) TRACE (A ch WRITE ON, NORMAL MODE) check



Note:

If setting is not performed by [F3] key within the menu shown above after initialization, the trace waveform on the CRT is not processed and rewriting to memory at each sweep is displayed. This is called the NORMAL mode. Since the peak value of the input signal at this time is detected, D:PK is displayed at the top right of the CRT. At B-WRIT ON* (W:B), the A-MODE function is changed to the B-MODE function.

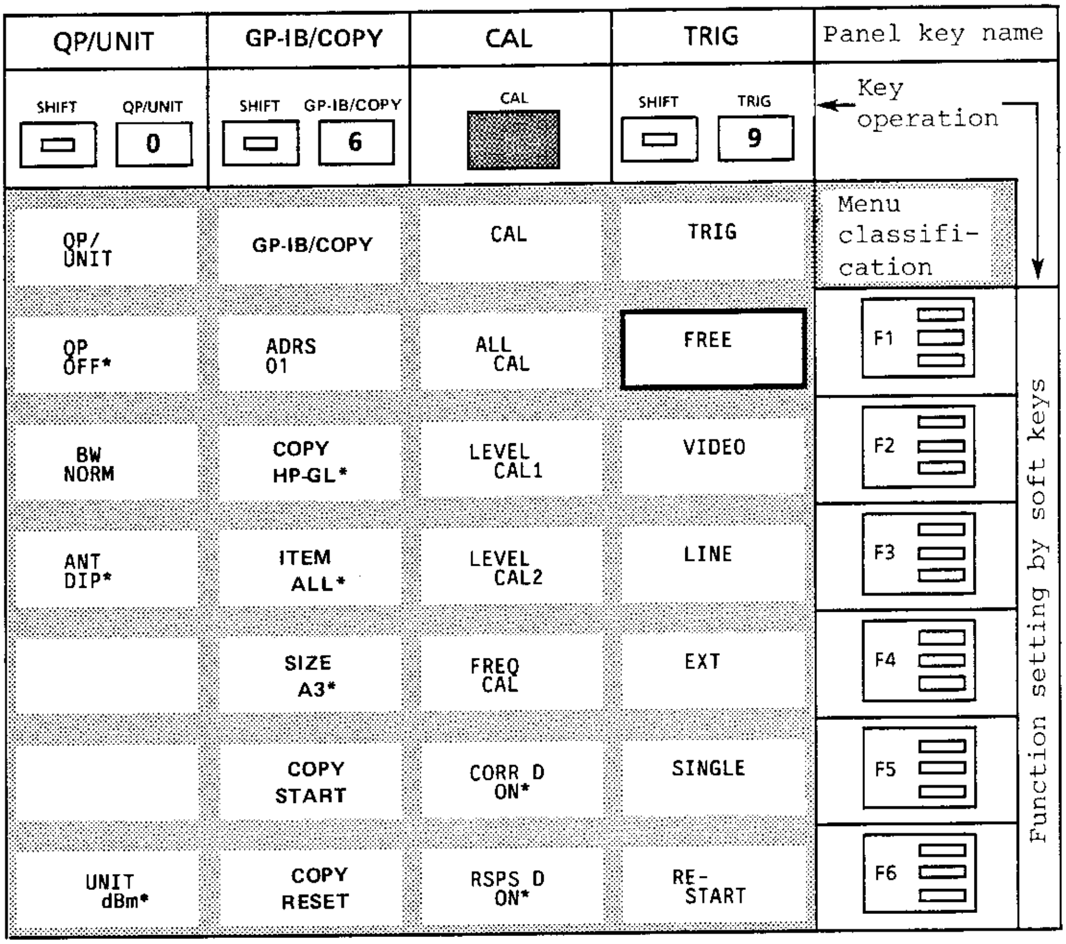
Step	Procedure
1	Press the keys ⌈SHIFT⌉⌈TRACE⌉ to display the menu shown at the left.
	Channel A WRITE ON check
2	Check that the menu corresponding to the ⌈F1⌉ key is A-WRIT ON*; that is, W:A.
3	Check that the menu alternates between A-WRIT ON* (W:A) and A-WRIT OFF* (W:) each time the ⌈F1⌉ key is pressed.
4	Check that when the ⌈F4⌉ key is pressed to select B-WRIT ON* (W:B), A-WRIT OFF* is selected, and when the ⌈F1⌉ key is pressed to select A-WRIT ON* (W:A), B-WRIT OFF* is selected. 
	NORMAL MODE check
5	Check that the menu corresponding to the [F3] key is A-MODE NORM* (D:PK displayed at top right of CRT).
6	Check that when the ⌈F3⌉ key is pressed repeatedly, the menu changes to A-MODE NORM* the third time the key is pressed.

(Cont.)

Step	Procedure
7	Check that the other modes and the display at the top right of the CRT correspond as follows:  

(5) TRIG to ANTENNA checks

Check TRIG to ANTENNA with the menus corresponding to soft keys [F1] to [F6] after the panel keys are operated as shown below.



QP/UNIT	GP-IB/COPY	CAL	TRIG	Panel key name
SHIFT QP/UNIT ▭ 0	SHIFT GP-IB/COPY ▭ 6	CAL ▩	SHIFT TRIG ▭ 9	Key operation
QP/ UNIT	GP-IB/COPY	CAL	TRIG	Menu classification
QP OFF*	ADRS 01	ALL CAL	**FREE**	F1
BW NORM	COPY HP-GL*	LEVEL CAL1	VIDEO	F2
ANT DIP*	ITEM ALL*	LEVEL CAL2	LINE	F3
	SIZE A3*	FREQ CAL	EXT	F4
	COPY START	CORR D ON*	SINGLE	F5
UNIT dBm*	COPY RESET	RSPS D ON*	RE- START	F6

Function setting by soft keys

Initial setting		Corresponding key	Remarks
TRIG	FREE	F1	Check solid line framing.
CORR D	ON	F5	Check ON*.
RSPS D	ON	F6	ALL CAL can be performed by pressing the [F1] key.
GP-IB ADDRESS ...	01	F1	These six items are not changed by [INITIAL] key. The values set at POWER OFF are held even after the power is turned on again.
COPY	HP-GL	F2	
ITEM	ALL	F3	
SIZE	A3	F4	
UNIT	dBm	F6	
ANTENNA	DIP	F3	

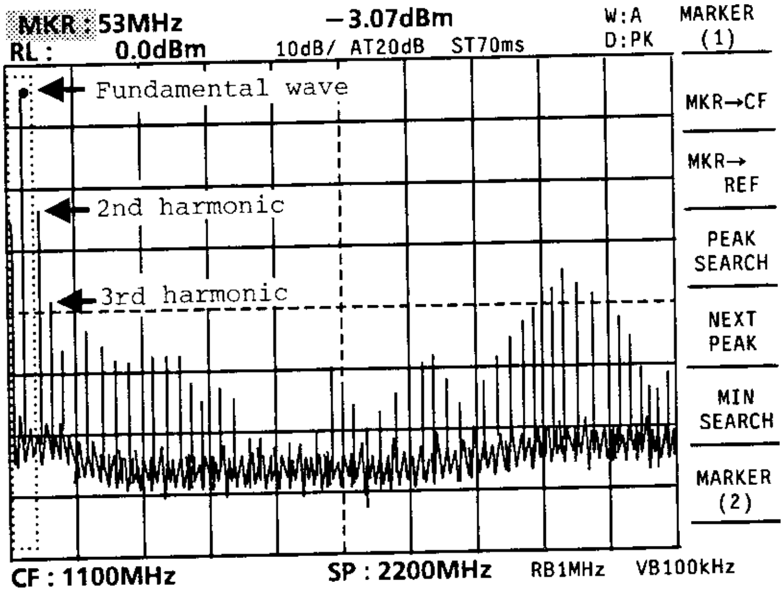
Note:

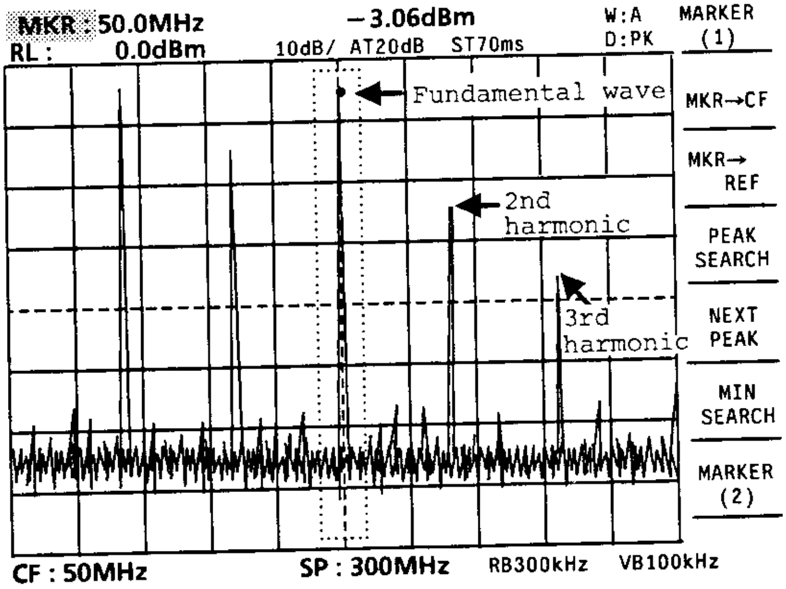
In the QP/UNIT menu, BW NORM* corresponding to the [F2] key shows that the RESOLN BW (RB) 1 MHz bandwidth is the 3 dB bandwidth. When the [F2] key is pressed repeatedly, 200 Hz, 9 kHz, and 120 kHz are displayed as the 6 dB bandwidth. This is used at QP (Quasi-Peak) ON (corresponds to [F1] key).

3.2.2 REF LEVEL function check

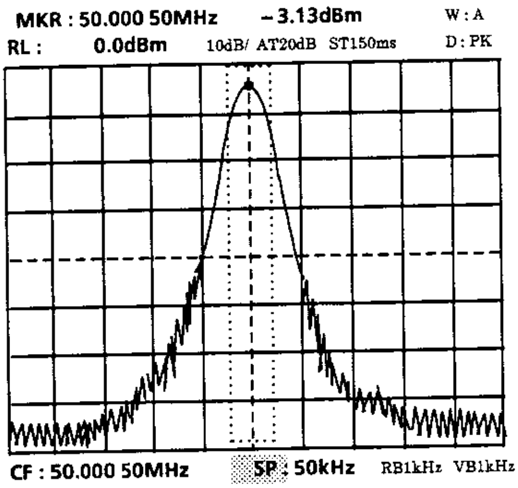
If the signal level is read at the reference line (REF LEVEL), the scale nonlinearity error is not included and measurements can be made at the highest accuracy.

The REF LEVEL function when the level of the fundamental wave to the third harmonic is not measured at the reference level and when that is measured at the reference level, is checked below.

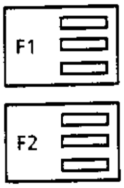


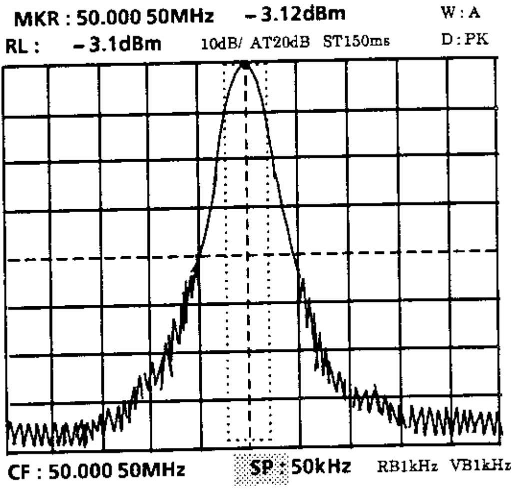


Step	Procedure
1	Press the INITIAL key.
2	Turn the data knob so that the fundamental wave, 2nd harmonic, or 3rd harmonic is within the zone marker, and read the marker position data, respectively. For example: . Fundamental wave: 53 MHz, -3.08 dBm . 2nd harmonic : 106 MHz, -21.43 dBm . 3rd harmonic : 154 MHz, -38.52 dBm
3	Press the FREQ, SUB TRACE 5, QP/UNIT 0, MHz keys.
4	Press the MARKER key.
5	Repeat step 2. For example: . Fundamental wave: 50.0 MHz, -3.06 dBm . 2nd harmonic : 99.8 MHz, -21.52 dBm . 3rd harmonic : 149.6 MHz, -38.45 dBm
6	Press the SPAN, SUB TRACE 5, QP/UNIT 0, kHz keys.
7	Measure the levels by setting those markers at the reference level as shown below. In those measurements, measure the reference level by pressing the [F1][F2] keys. F1 MKR→CF F2 MKR→REF

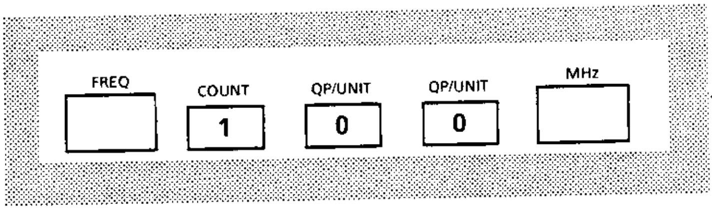


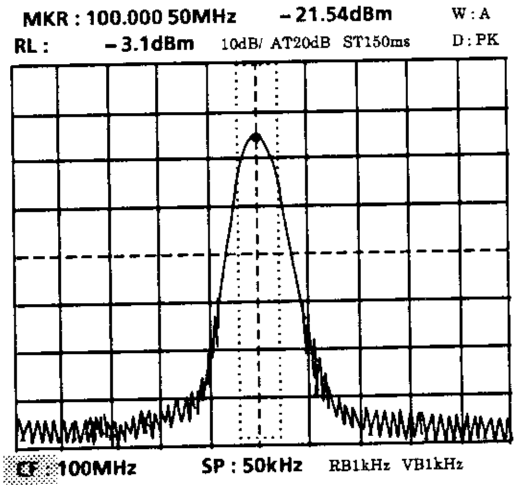
MKR : 50.000 50MHz -3.13dBm W : A
RL : 0.0dBm 10dB/ AT20dB ST150ms D : PK
CF : 50.000 50MHz SP : 50kHz RB1kHz VB1kHz



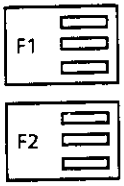


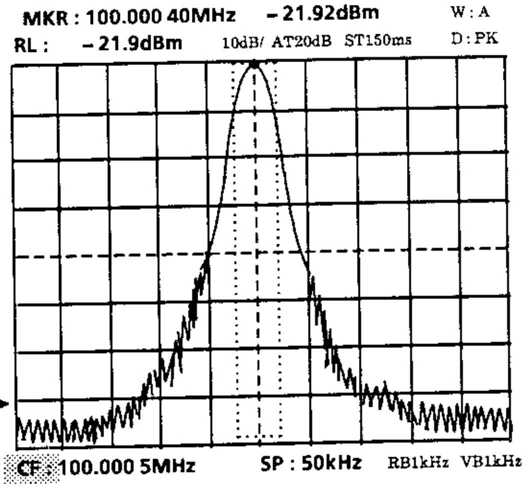
MKR : 50.000 50MHz -3.12dBm W : A
RL : -3.1dBm 10dB/ AT20dB ST150ms D : PK
CF : 50.000 50MHz SP : 50kHz RB1kHz VB1kHz



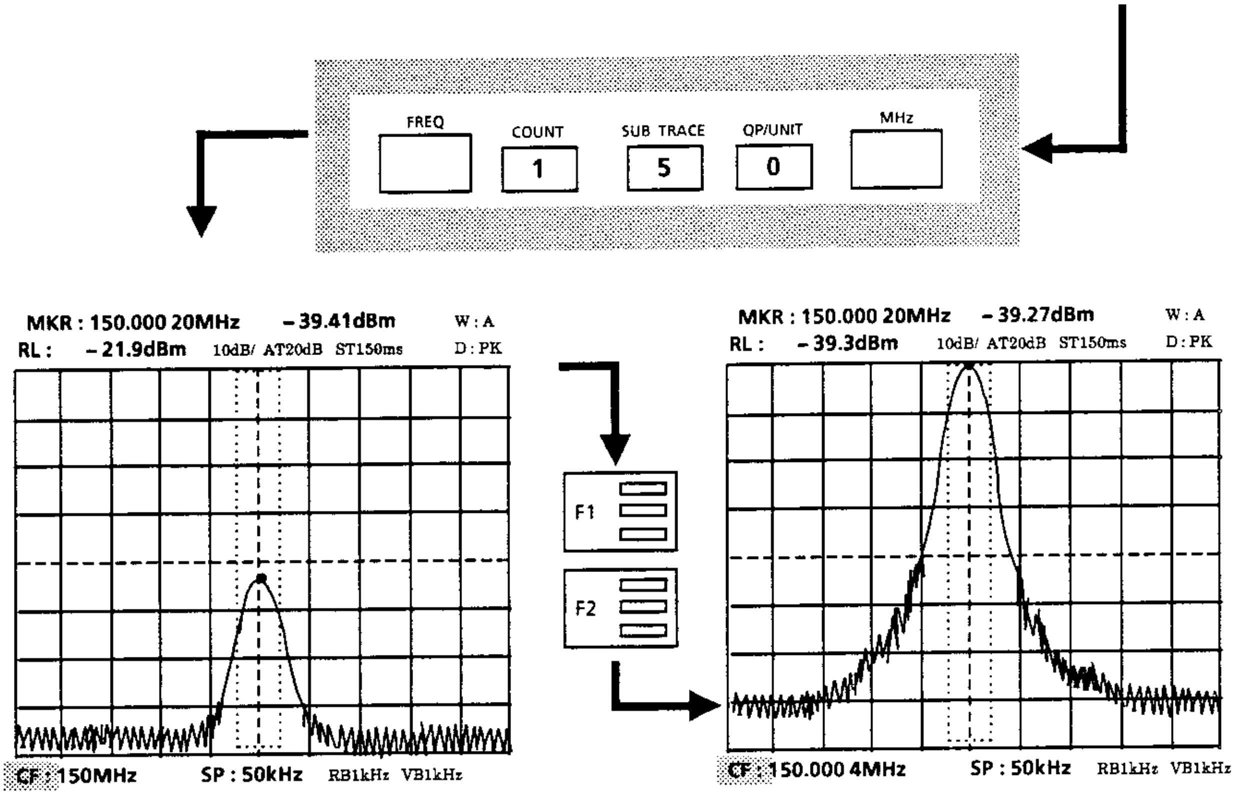


MKR : 100.000 50MHz -21.54dBm W : A
RL : -3.1dBm 10dB/ AT20dB ST150ms D : PK
CF : 100MHz SP : 50kHz RB1kHz VB1kHz





MKR : 100.000 40MHz -21.92dBm W : A
RL : -21.9dBm 10dB/ AT20dB ST150ms D : PK
CF : 100.000 5MHz SP : 50kHz RB1kHz VB1kHz


FREQ
COUNT
1
SUB TRACE
5
QP/UNIT
0
MHz
MKR : 150.000 20MHz -39.41dBm W : A
RL : -21.9dBm 10dB/ AT20dB ST150ms D : PK
CF : 150MHz SP : 50kHz RB1kHz VB1kHz
F1
F2
MKR : 150.000 20MHz -39.27dBm W : A
RL : -39.3dBm 10dB/ AT20dB ST150ms D : PK
CF : 150.000 4MHz SP : 50kHz RB1kHz VB1kHz

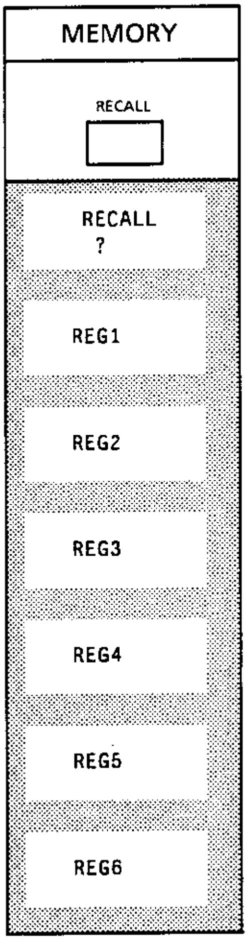
3.2.3 SAVE/RECALL function check

This check is divided in two: 1. when PMC not installed, and 2. when PMC installed.

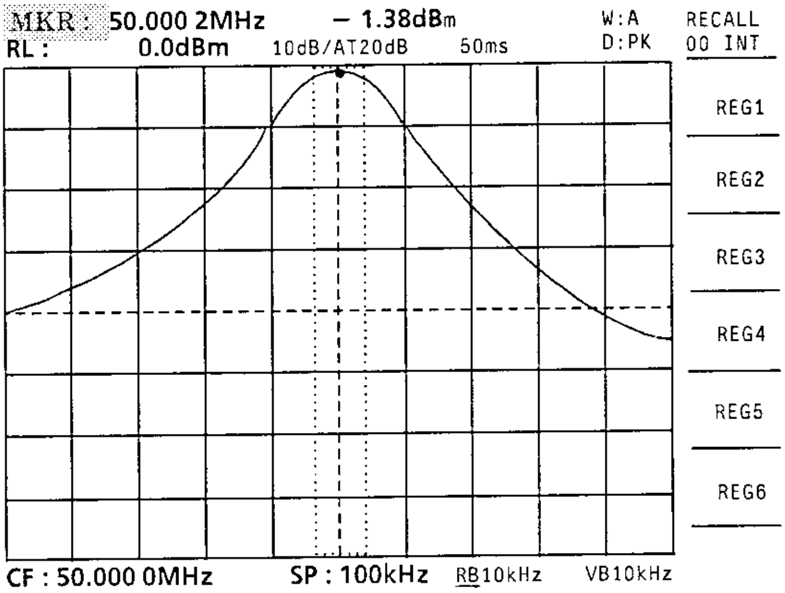
A formatted 32 kbytes PMC is used.

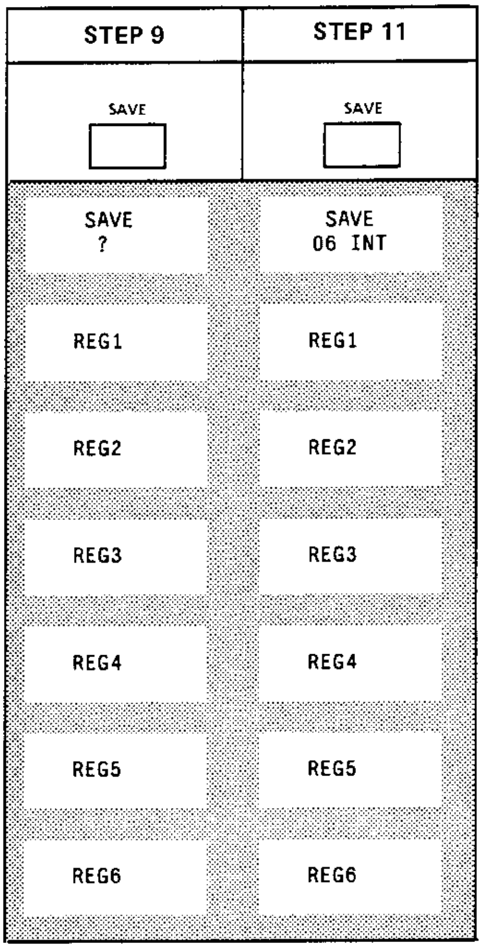
Step	Procedure
1	Turn on the power, and input a signal to the RF INPUT. Select a panel function and set the parameters. (For example, select RL, SCALE, INPUT ATTEN, ST, VB, RB, SP, or CF, and set data to observe the waveform.)
2	Remember these parameters.
3	Change the set parameters.
4	Remember these new parameters. (The parameters set in steps 1 and 3 must not be the same).
5	Turn the power off.
6	Turn the power on and check that the MARKER (1) menu is displayed and that the settings of step 3, and the marker entry mode, are reset. (If the same signal in step 3 is applied to the RF INPUT, the same waveform is reproduced.)

(Cont.)

Step	Procedure
7	Check that when the [RECALL] key is pressed, the RECALL? menu is displayed as shown below. 

(Cont.)

Step	Procedure
8	Since ? requests the REG No., enter 0 by pressing the ⌈0⌉⌈ENTER⌉ keys. If the settings in step 1 were for measurement of a 50 MHz signal, for example, RL: 0 dBm, SCAL: 10 dB/div, INPUT ATTEN: 20 dB, ST: 50 ms, W:A, D:PK, VB: 10 kHz, RB: 10 kHz, SP: 100 kHz, CF: 50 MHZ, when the same signal is applied, the following screen is displayed:  MKR : 50.000 2MHz − 1.38dBm W:A RL : 0.0dBm 10dB/AT20dB 50ms D:PK CF : 50.000 0MHz SP : 100kHz RB10kHz VB10kHz



(Cont.)

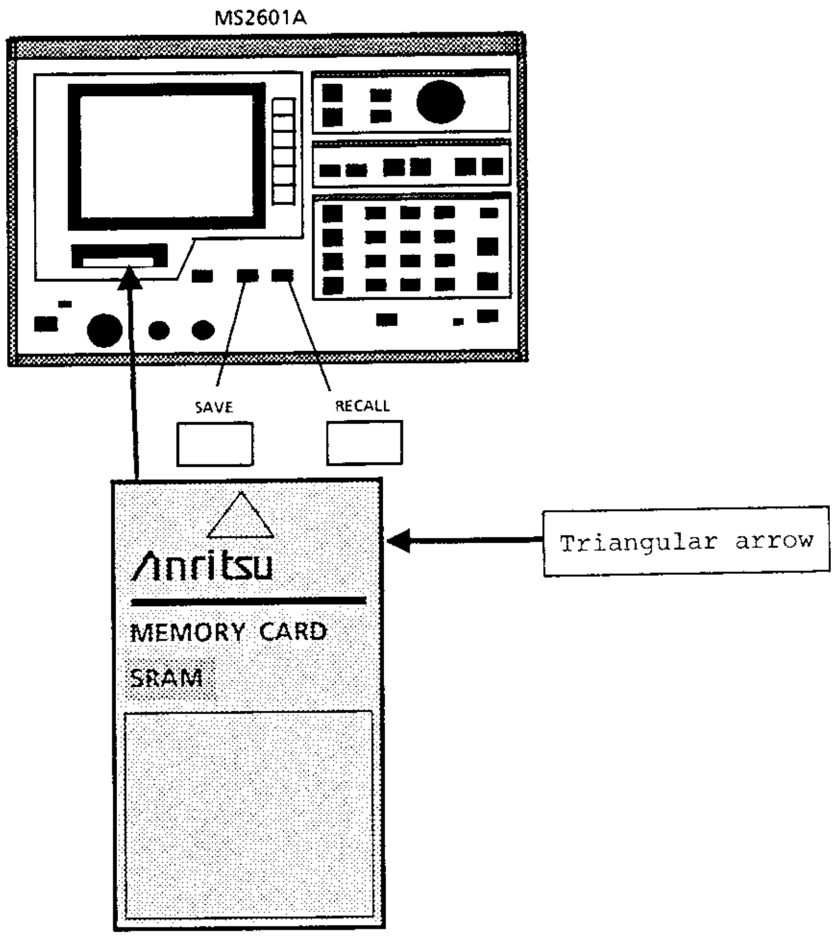
Step	Procedure
	<u>PMC not installed</u>
9	Check that when the [SAVE] key is pressed, SAVE? is displayed on the CRT to prompt REG No. entry.
10	Try to input 0 by pressing the [SAVE][0][ENTER] keys and check that it is not accepted.
11	Press one of the soft keys [F1] to [F6] and one of the numeric keys [1] to [6], then press the [ENTER] key. If the number is 6, SAVE 06 INT should be displayed.
12	Turn the power off and back on.

(Cont.)

Step	Procedure
13	Check that when the [RECALL] key is pressed, RECALL? is displayed on the CRT to prompt REG. No. entry.
14	Press the [F6] key of the same number or press the [6] key as in step 11, then press the [ENTER] key.
15	Check that RECALL 06 INT and the step 11 setting parameters are displayed on the CRT.
	PMC installed
16	Insert the PMC into the MS2601A after noting the precautions described below.
17	Check the SAVE/RECALL functions in the same way as when the PMC is not installed. Since up to 12 REG Nos. can be used, also check the SAVE/RECALL functions for numeric keys [7] to [12]. At RECALL, RECALL PMC should be displayed on the CRT.

Note:

- Always discharge static electricity from the PMC before inserting it by discharging it to ground.
- If the PMC is forced into the slot, the pins may be damaged. Insert it as shown in the figure below.



Triangular arrow

SECTION 4

CALIBRATION AND PERFORMANCE TESTS

This section explains the periodical calibration and performance test for the MS2601A Spectrum Analyzer.

TABLE OF CONTENTS

4.1 Regular Care and Preventive Maintenance

The primary purpose of the calibration and performance tests is preventive maintenance and to prevent deterioration of the MS2601A.

Therefore, the MS2601A must be used correctly under the recommended conditions. Periodic calibration and performance test should be done regularly in addition to the regular care and maintenance.

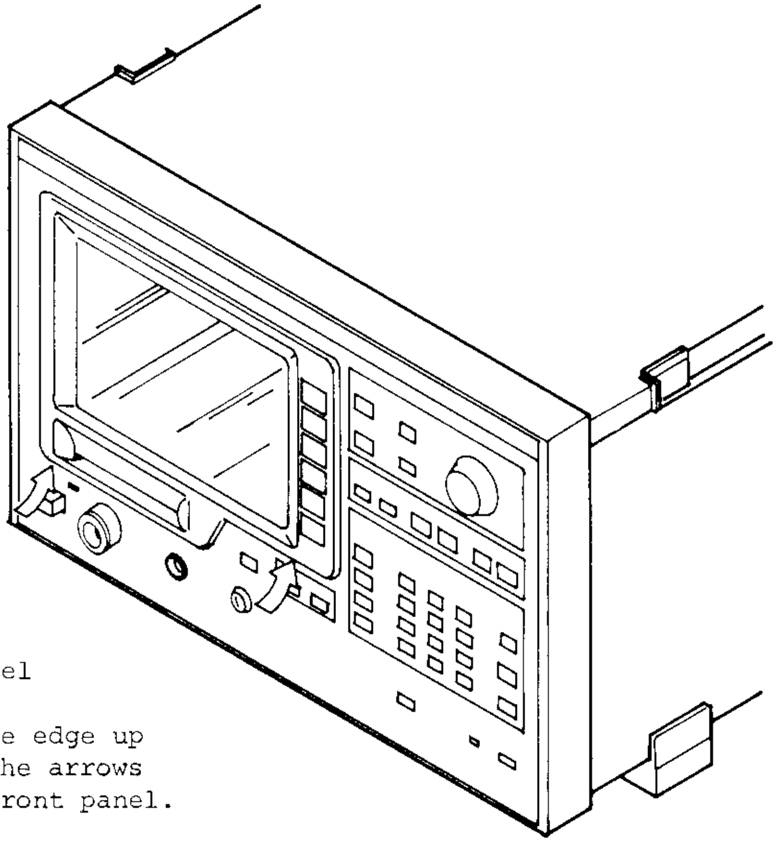
Table 4-1 lists the regular care and when it should be done.

Table 4-1 Regular Care and Maintenance

	Period	Care and maintenance
Soiling	. Before long-term storage . When dust has entered housing	Wipe off dust with soapy water or cleaning solvent*
Dust and dirt	. When noticeable dust and dirt have accumulated inside cabinet	Open housing and blow out dust with compressed air
CRT display	. When noticeable dirt inside CRT filter	Remove bezel of CRT filter as shown the following figure (a) and (b) and wipe off dust with wet cloth.
Lubrication	Not necessary	
Loose screws	When found	Retighten using recommended tool

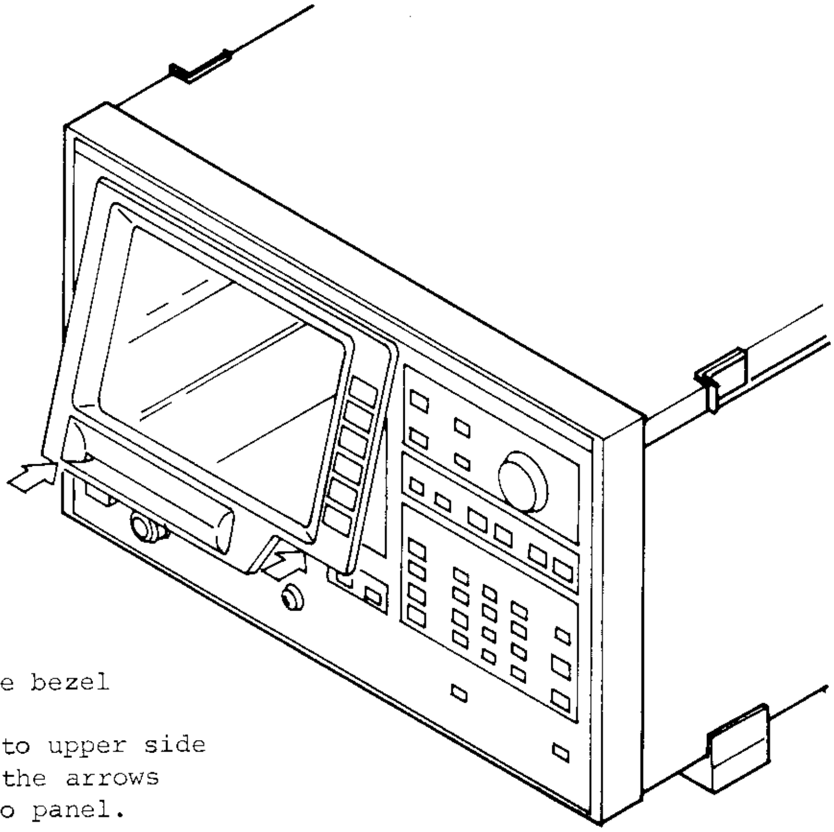
* Do not use thinner or benzene; they will damage the coating.

If you suspend use of this equipment or store it for a long time, see paragraph 2.3



(a) How to remove the bezel

Pull while pushing the edge up in the direction of the arrows and remove from the front panel.



(b) How to install the bezel

Insert the bezel to upper side edge and pushing the arrows position, fixed to panel.

4.2 Measuring Instruments Required for Calibration and Performance Test

Table 4-2 lists the measuring instruments required for calibraton and performance tests.

Table 4-2 Measuring Instruments Required for Calibration and Performance Tests, and Test Items

Test item	Measuring instrument	Main performance	Recommended equipment (Anritsu)	Reference paragraph
Reference oscillator frequency accuracy	Oscilloscope	50 MHz measurable (external trigger)		4.3.1
	Frequency standard	Accuracy $\leqq$ x 10^{-9}		
Reference oscillator frequency stability	Frequency counter	External STD 10 MHz	MF57A	4.4.1
	Frequency standard	Stability $\leqq$ x 10^{-9}/day	MF57A Opt 3	
Center frequency readout accuracy	Synthesized signal generator	10 MHz EXT REF input	MG655A	4.4.2
	Frequency standard	Accuracy $\leqq 1 \times 10^{-9}$		
Frequency span readout accuracy	Synthesized signal generator	10 MHz EXT REF input	MG655A	4.4.3
Resolution bandwidth selectivity	(None)	(None)		4.4.4
Sideband noise	Synthesized signal generator	SSB phase noise: $\leqq$-120 dBc/Hz (10 kHz offset)	MG655A	4.4.5
Frequency measuring accuracy	(None)	(None)		4.4.6
CRT display scale linearity	Synthesized signal generator	Frequency: 100 MHz	MG655A	4.4.7
	Attenuator	Frequency: 100 MHz Minimum step: 0.1 dB (with calibration data)	MN510C	
Frequency response	Tracking generator	TG for MS2601A	MH680A	4.4.8
	Power meter	-10 dBm Frequency: 100 kHz to 2 GHz	ML4803A	
	Power sensor		MA4601A	
Reference level accuracy	Synthesized signal generator	Frequency: 50 MHz	MG655A	4.4.9
	Attenuator	Frequency: 50 MHz Minimum step: 0.1 dB (with calibration data)	MN510C	
	Power meter	0 dBm Frequency: 50 MHz	ML4803A	
	Power sensor		MA4601A	
Average noise level	50 Ω termination	VSWR $\leqq$1.15 (DC to 8 GHz)	MP752A	4.4.10
Second and third harmonic distortion	Synthesized signal generator	Second and third harmonic distortion: $\leqq$-30 dB	MG655A	4.4.11
	Low-pass filter	Cutoff frequency: 6.4 and 820 MHz Attenuation: $\geqq$50 dB (at 10 to 15 MHz, 1.4 to 2.1 GHz)		

4.3 Calibration

Calibrate the frequency of the built-in 10 MHz reference oscillator semi-annually.

If adjustment or repair is necessary because some items do not satisfy the specifications, contact Anritsu's service section.

4.3.1 Reference oscillator frequency accuracy

If the calibration accuracy is low, even if a high-stability reference oscillator is installed, the measurement results will not exceed the calibration accuracy.

Since the MS2601A 10 MHz reference oscillator stability is $\pm 2 \times 10^{-8}$/day, use a standard signal generator as a frequency standard that receives a standard wave or color TV broadcast subcarrier (locked to the rubidium atomic standard) and generates a signal locked to it.

(1) Calibration specification

- ■ Reference oscillator
  - Accuracy $\pm 2 \times 10^{-8}$/day
    After calibration after 24 hour warm up,
    25°±5°C
  - Frequency 10 MHz

(2) Calibration instruments

- Oscilloscope: 50 MHz measurable, external trigger
- Frequency standard: Accuracy: $\leqq 1 \times 10^{-9}$

(3) Setup

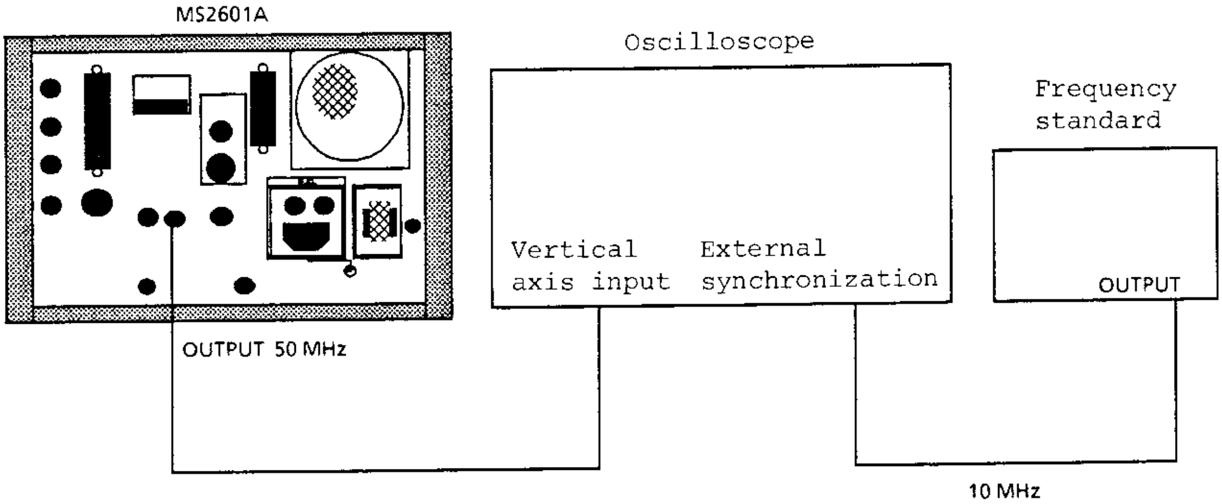


Fig. 4-1 Reference Oscillator Calibration

(4) Calibration procedure

Step	Procedure
1	Set up the equipment as shown in Fig. 4-1 at a room temperature of 25°±5°C. Remove the MS2601A top panel. (Figure 4-2 shows the MS2601A viewed from above after removing the top panel.)
2	Turn on the power switch and leave the MS2601A for 24 hours to warm-up the reference oscillator.
3	Input the reference frequency of the frequency standard to the external synchronizing input of the oscilloscope. Also, input the 50 MHz output signal from the OUTPUT 50 MHz on the rear of the MS2601A to the vertical axis of the oscilloscope.

(Continued)

Step	Procedure
4	Adjust the oscilloscope so that the input waveform can be observed. When the input waveform on the oscilloscope moves to the right or left and is not synchronous, the frequency of the MS2601A reference oscillator does not match the (reference frequency of the frequency standard)/5. (This 50 MHz signal is 5 times as large as the 10 MHz reference oscillator frequency.)
5	There is a hole for calibration access to the reference oscillator in the top panel of the MS2601A (Fig. 4-2). Insert a screwdriver and turn the potentiometer to adjust the input waveform so that the waveform on the oscilloscope does not move right or left.

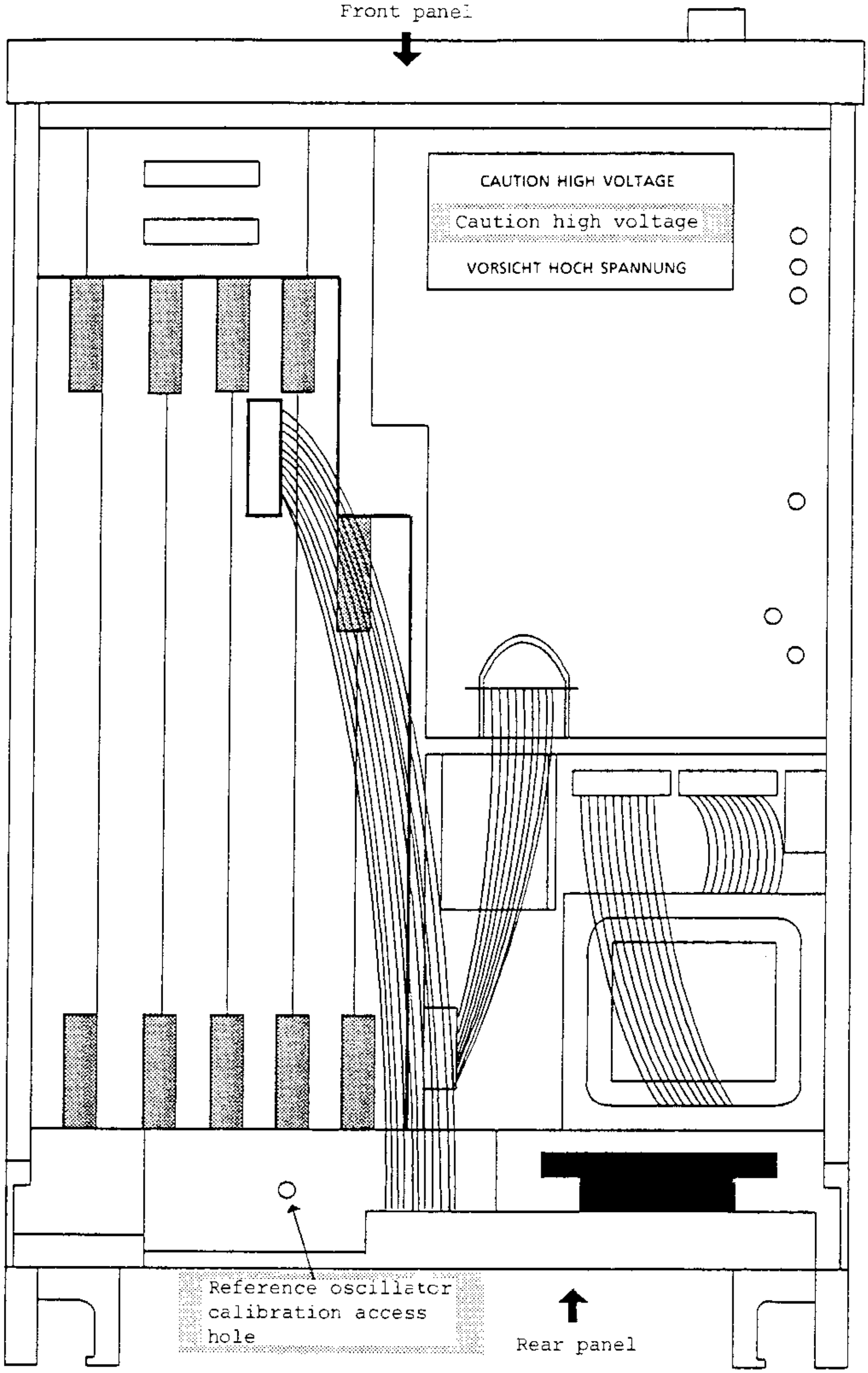


Fig. 4-2 Position of Reference Oscillator Calibration Access Hole

4.4 Performance Tests

If the MS2601A performance must be checked at acceptance inspection, periodic inspection, or repair, test the performance according to the description in paragraphs 4.4.1 to 4.4.11. Test the performance periodically as preventive maintenance for items considered to be important.

Note:

The warm-up time depends on the test item. For test items other than oscillator frequency, warm up the equipment for at least for thirty minutes and test the performance after the MS2601A stabilizes completely. Also, begin measurement after taking the warm-up time of the calibration instrument into full consideration. In addition, the test must be conducted at room temperature; there must be little ac power supply voltage fluctuation, and no noise, vibration, dust, humidity, etc.

4.4.1 Reference oscillator frequency stability

The frequency stability of the 10 MHz crystal oscillator used as the reference oscillator is tested. Measure the frequency change after 24 hours and 48 hours after power-on (aging rate) at ambient temperatures of both 0° and 50°C (temperature characteristic).

(1) Specifications

■ Reference oscillator

. Frequency	10 MHz
. Aging rate	$\leqq \pm 2 \times 10^{-8}$/day After 24 hour warm-up at 25°±5°C

- Temperature characteristic $\leqq \pm 5 \times 10^{-8}$ at 0° and 50°C referred to frequency at 25°C

(2) Test instruments

- Frequency counter: MF57A
- Frequency standard: with stability of $\leqq \pm 1 \times 10^{-9}$/day

(3) Setup

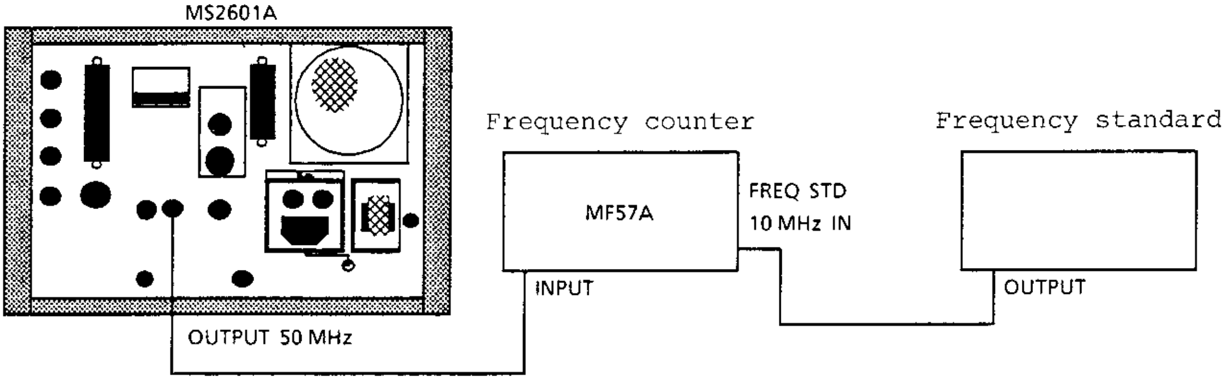


Fig. 4-3 Reference Oscillator Frequency Stability Test

(4) Procedure

Aging rate: Test this at the ambient temperature ±2°C in a vibration-free place.

Step	Procedure
1	Set the changeover switch (FREQ STD: INT/EXT) on the MF57A counter rear panel to EXT.
2	Set the power switch on the MS2601A front panel to ON.

(Continued)

Step	Procedure
3	Measure the frequency using the counter with 0.1 Hz resolution after 24 hours have passed after turning the power on.
4	Measure the frequency using the counter after 24 more hours have passed from the step 3 measurement.
5	Calculate the stability by using the following equation. $\text{Frequency stability} = \frac{\text{(counter reading in step 4)} - \text{(counter reading in step 3)}}{\text{(counter reading in step 3)}}$

Temperature characteristic: Test this performance in a vibration-free constant temperature room.

Step	Procedure
1	Set up the MS2601A in a constant temperature room at 25°C as shown in Fig. 4-3.
2	Set the power switch on the MS2601A front panel to ON and wait until the MS2601A internal temperature stabilizes (approx. 1.5 hours after room temperature stabilizes).
3	When the internal temperature stabilizes, measure the frequency by using the counter with 0.1 Hz resolution.
4	Change the room temperature to 50°C.
5	When the room temperature and the MS2601A internal temperature re-stabilize, measure the frequency by using the counter.

(Continued)

Step	Procedure
6	Calculate the stability by using the following equation. $\text{Frequency stability} = \frac{\text{(counter reading in step 5) - (counter reading in step 3)}}{\text{(counter reading in step 3)}}$
7	Change the room temperature to 0°C and repeat steps 5 and 6.

4.4.2 Center frequency readout accuracy

Add the known frequency which serves as the center frequency reference to the MS2601A as shown in Fig. 4-4 and set CF (same value as the known reference frequency) and SPAN. At this time, check that the difference between the reading of the marker readout frequency (thick arrow in Fig. 4-4) of the center frequency peak point, and the CF set value is $\leqq \pm$(100 Hz + 2% of frequency span + tuning frequency x reference frequency accuracy).

The MG655A Synthesized Signal Generator is phase-locked with the same accuracy as the 10 MHz reference oscillator (Fig. 4-4) and its 100 MHz and 1000 MHz signals are used as a reference center frequency.

(1) Specifications

Center frequency accuracy after automatic calibration (when frequency span is 10 kHz or more)
±(100 Hz + 2% of frequency span + tuning frequency x reference frequency accuracy)

(2) Test instruments

- Synthesized signal generator:
  Lockable to external reference oscillator mode
- Frequency standard: Accuracy: $\leqq 1 \times 10^{-9}$

(3) Setup

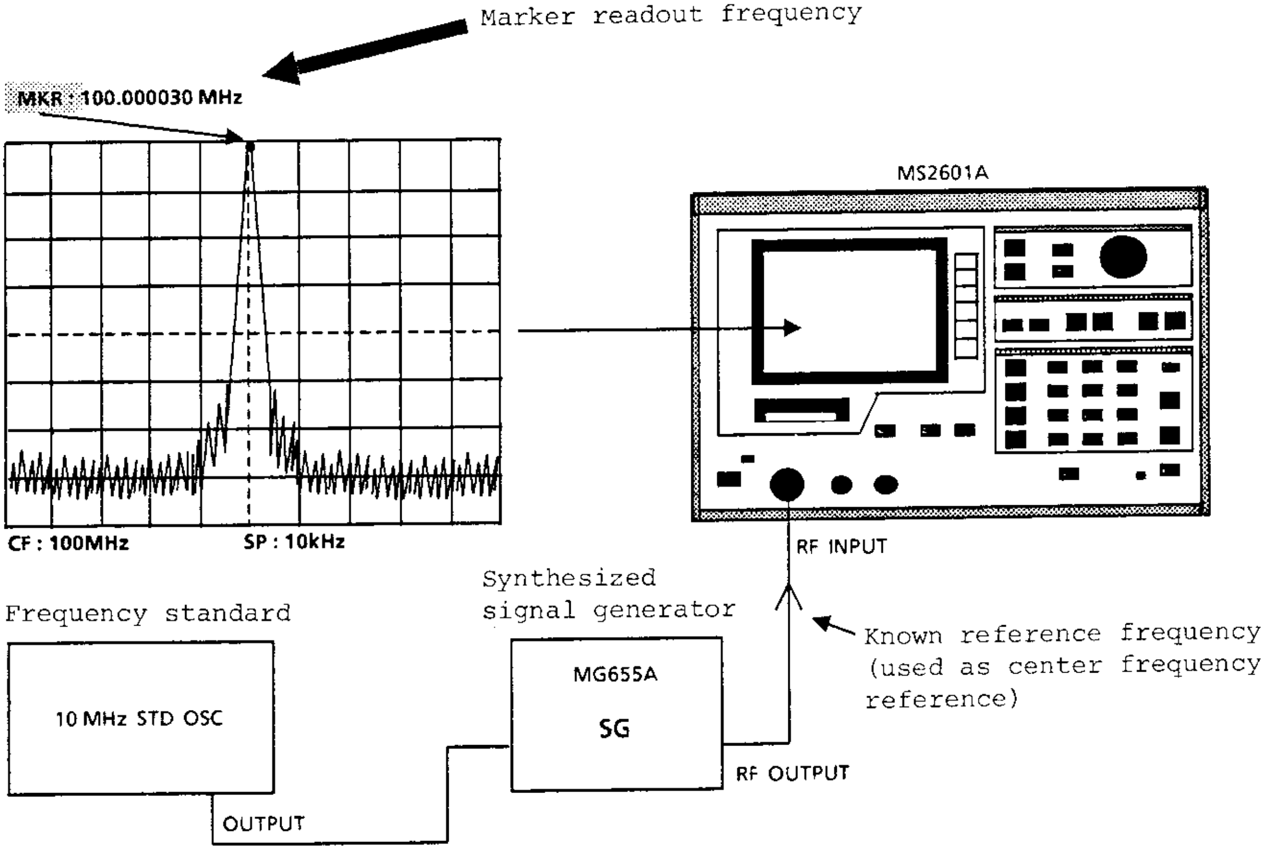
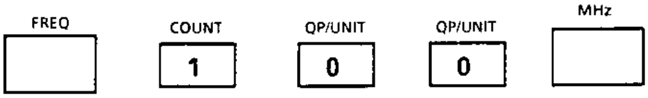
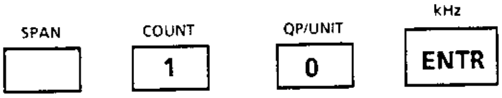
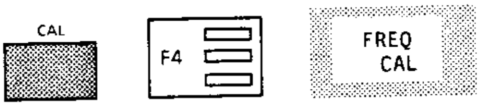


Fig. 4-4 Center Frequency Readout Accuracy Test

(4) Procedure

Step	Procedure
1	Press the [INITIAL] key; the frequency entry enters the CENTER FREQ mode. Also, the NORMAL marker is positioned at the center of the CRT.
2	Set the signal generator output frequency equal to the center frequency (100 MHz in Table 4-3). After pressing the [FREQ] key in the FUNCTION section, set the center frequency to 100 MHz by using the numeric/unit keys in the MENU section. 
3	After pressing the [SPAN] key in the FUNCTION section, set the span (10 kHz) that corresponds to the center frequency (100 MHz) in Table 4-3 by using the numeric/unit keys. 
4.	Press the following keys to perform frequency calibration. 
5	Wait until the message CALIBRATING, which is displayed on the CRT, is cleared.
6	Read the marker frequency (indicated by thick arrow in Fig. 4-4) and check that the value is within the range between the maximum and minimum values shown in Table 4-3.

(Continued)

Step	Procedure
7	Repeat steps 2 to 6 for frequencies other than the center frequency 100 MHz and span 10 kHz according to the combinations of center frequency and span shown in Table 4-3.

Table 4-3 Center Frequency Readout Accuracy Test

SG output frequency	Center frequency	Frequency span	Center frequency reading		
			Minimum	Marker value	Maximum
100 MHz	100 MHz	10 kHz	99.99970 MHz	————	100.00030 MHz
100 MHz	100 MHz	100 kHz	99.9979 MHz	————	100.0021 MHz
100 MHz	100 MHz	1 MHz	99.980 MHz	————	100.020 MHz
100 MHz	100 MHz	10 MHz	99.80 MHz	————	100.20 MHz
100 MHz	100 MHz	100 MHz	98.0 MHz	————	102.0 MHz
1000 MHz	1000 MHz	10 kHz	999.99970 MHz	————	1000.00030 MHz
1000 MHz	1000 MHz	100 kHz	999.9979 MHz	————	1000.0021 MHz
1000 MHz	1000 MHz	1 MHz	999.980 MHz	————	1000.020 MHz
1000 MHz	1000 MHz	10 MHz	999.80 MHz	————	1000.20 MHz
1000 MHz	1000 MHz	100 MHz	998.0 MHz	————	1002.0 MHz

(5) Precautions

Set the signal generator output level to approx. 0 to -10 dBm.

4.4.3 Frequency span readout accuracy

Using the setup shown in Fig. 4-5, set the start frequency (left side of CRT) and stop frequency (right side of CRT) with the SG so that the frequency difference between the peak levels at the left and right sides of the CRT becomes the frequency span value. At this time, check that the value obtained by reading the frequency difference between start and stop is within 2% of the set span value.

(1) Specifications

Frequency span accuracy ±2%

(2) Test instruments

- Synthesized signal generator: 1 Hz resolution

(3) Setup

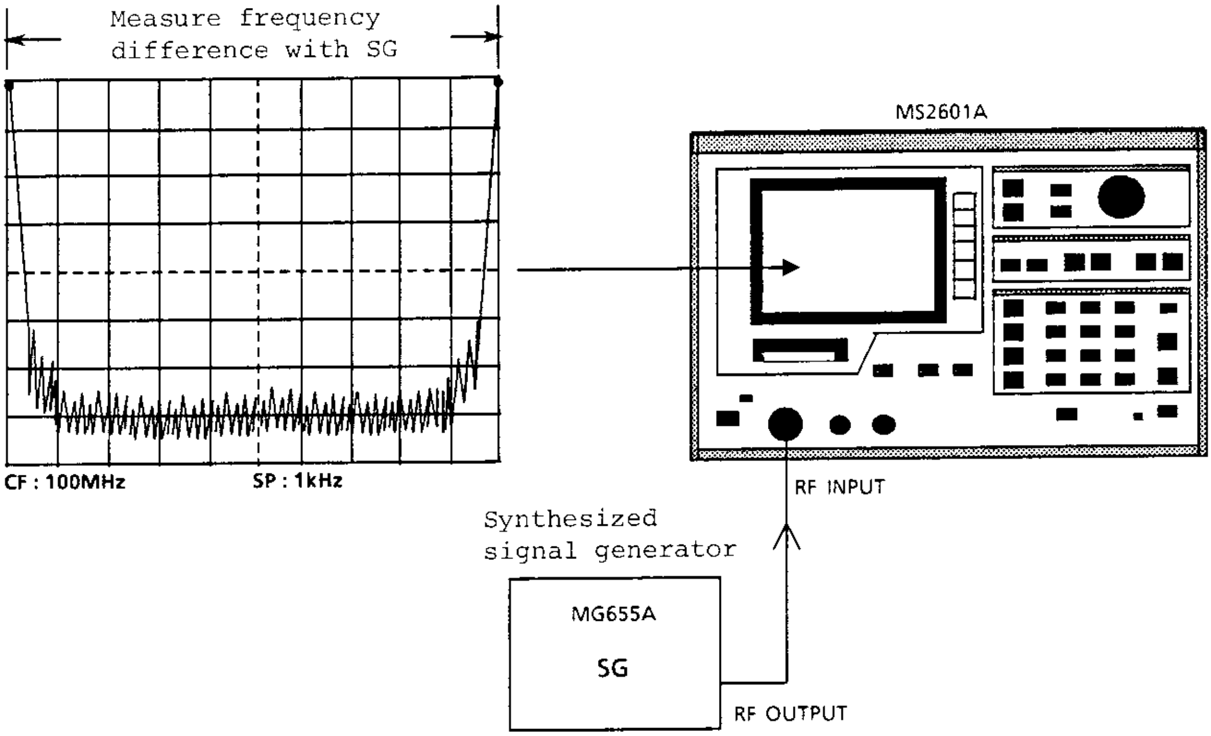


Fig. 4-5 Frequency Span Readout Accuracy Test

(4) Procedure

Step	Procedure
1	Press the [INITIAL] key.
2	Press the following keys to perform frequency calibration. CAL F4 FREQ CAL
3	Wait until the message CALIBRATING, which is displayed on the CRT, is cleared.
4	Set the MS2601A functions as shown below: SPAN............. 1 kHz *1 CENTER FREQ...... 100 MHz *2
5	Set the SG output frequency to the start frequency (99.9995 MHz) shown in Table 4-4.
6	Adjust the SG output frequency to set the spectrum peak at the left end of the CRT. Remember the frequency as f1.
7	After setting the SG output frequency to the stop frequency (100.0005 MHz), adjust it to set the spectrum peak at the right end of the CRT. Remeber the frequency as f2.
8	Calculate (f2 - f1) and check that the value is within the specified range (minimum to maximum values) shown in Table 4-4.
9	Repeat steps 4 to 8 for frequencies other than the span 1 kHz and the center frequency 100 MHz according to the combinations of frequency span and center frequency shown in Table 4-4.

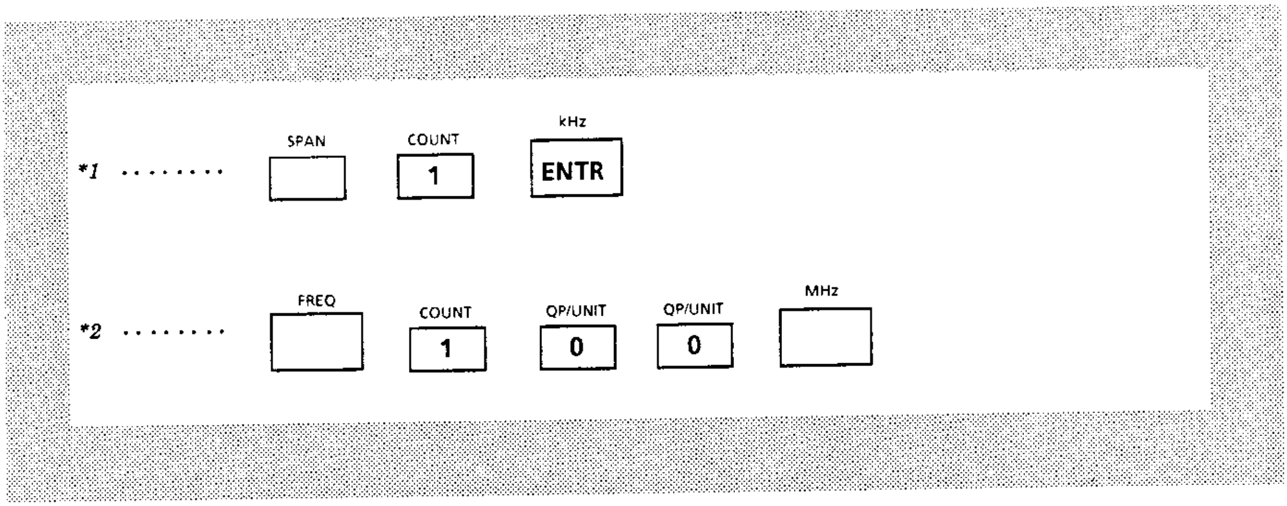


Table 4-4 Frequency Span Readout Accuracy Test

Frequency span	Center frequency	Signal generator setting		Span		
		Start frequency	Stop frequency	Minimum	f2-f1	Maximum
1 kHz	100 MHz	99.9995 MHz	100.0005 MHz	980 Hz	———	1020 Hz
10 kHz	100 MHz	99.995 MHz	100.005 MHz	9.8 kHz	———	10.2 kHz
100 kHz	100 MHz	99.95 MHz	100.05 MHz	98 kHz	———	102 kHz
1 MHz	100 MHz	99.5 MHz	100.50 MHz	0.98 MHz	———	1.02 MHz
10 MHz	100 MHz	95 MHz	105 MHz	9.8 MHz	———	10.2 MHz
100 MHz	100 MHz	50.0 MHz	150.0 MHz	98 MHz	———	102 MHz
1000 MHz	600 MHz	100.0 MHz	1100.0 MHz	980 MHz	———	1020 MHz

(5) Precautions

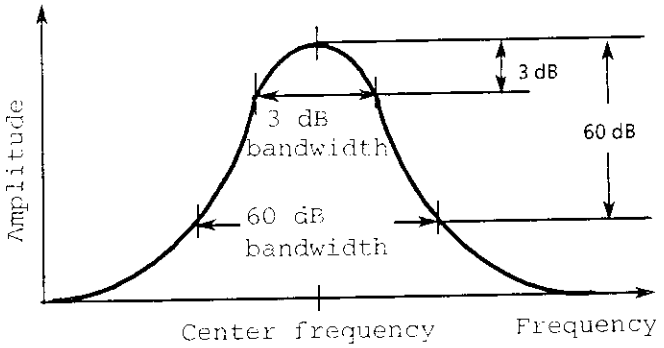
Set the signal generator output level to approx. 0 to -10 dBm.

4.4.4 Resolution bandwidth and selectivity

If there are two input signals with the frequency difference corresponding to 3 dB bandwidth (of IF final stage), these signals can be resolved as two spectrum waveforms. This is called the resolution bandwidth.

However, the selectivity is improved for the narrower 60 dB bandwidth. Therefore, measure the 3 dB and 60 dB bandwidths at the points located 3 dB and 60 dB respectively below the peak of the center frequency as shown in the figure below. Then, calculate the selectivity from the following equation.

$$\text{Selectivity} = \frac{\text{60 dB bandwidth (Hz)}}{\text{3 dB bandwidth (Hz)}}$$



For the test procedure, first measure the resolution bandwidth and 60 dB bandwidth, and then calculate the selectivity (60 dB bandwidth [Hz]/3 dB bandwidth [Hz]).

(1) Specifications

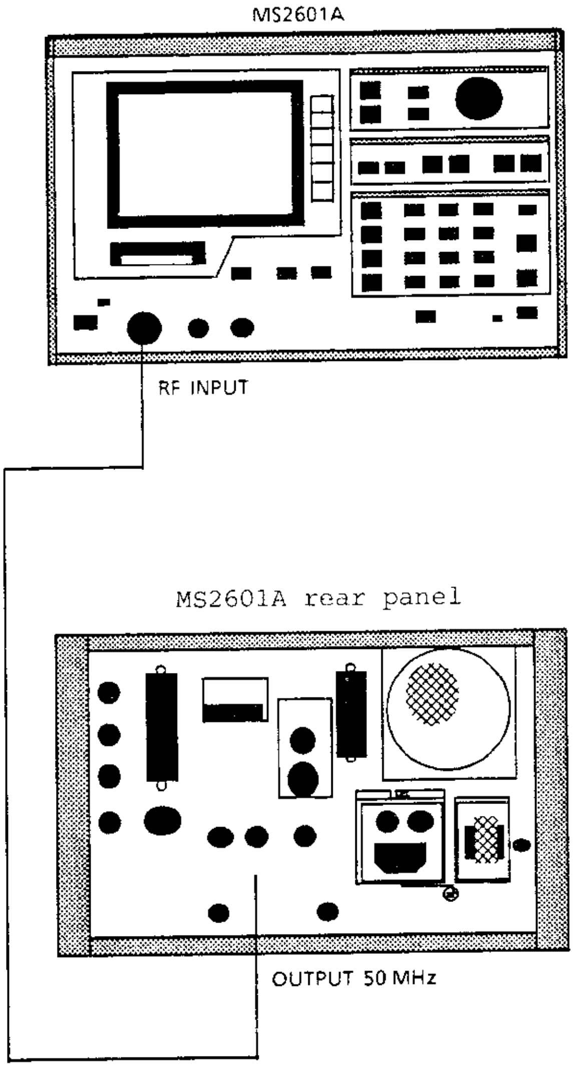
Resolution bandwidth accuracy: ±20%

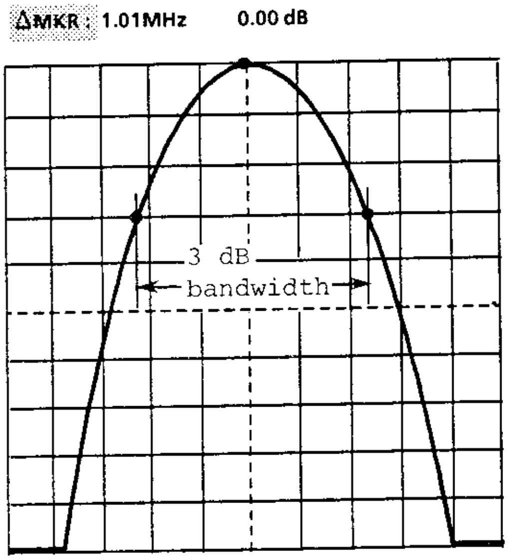
Selectivity: $\leq$15:1 (60 dB/3 dB bandwidth ratio)

(2) Test instruments

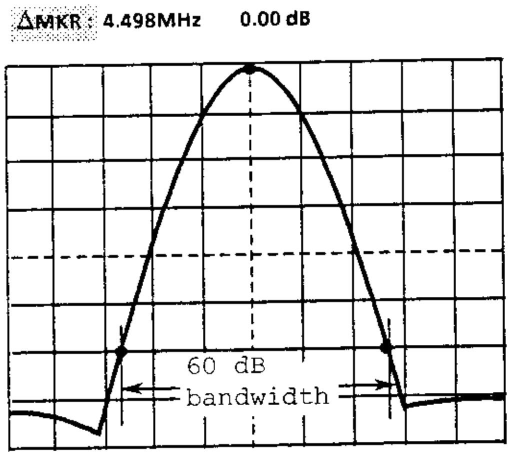
The 0 dBm and 50 MHz signal at the OUTPUT 50 MHz connector on the rear of the MS2601A must be used as the signal source for this test. This signal is from an extremely stable signal-source which is phase-locked to the 10 MHz reference signal (crystal controlled).

(3) Setup





(a) Resolution Bandwidth

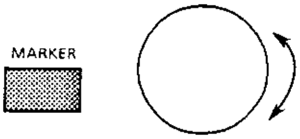


(b) 60 dB Bandwidth

Fig. 4-6 Resolution Bandwidth Selectivity Test

(4) Procedure

(a) Resolution bandwidth accuracy

Step	Procedure
1	Press the [INITIAL] key.
2	Press the following keys to perform all calibration. 
3	Wait until the message CALIBRATING, which is displayed on the CRT, is cleared.
4	Set the MS2601A functions as shown below: CENTER FREQ: 50 MHz *1 SPAN: 5 MHz *2 RESOLN BW (MANUAL): 1 MHz SCALE: LOG 1 DB/*3 MARKER: NORMAL Z WIDTH: NAR TRACE: A-WRITE ON
5	Press the [PEAK → REF] key and match the peak of the signal trace to the top line (REF LEVEL) on the CRT.
6	After pressing the [MARKER] key, turn the data knob so that the peak of the signal trace is included in the zone marker (Fig. 4-7). 

(Continued)

Step Procedure

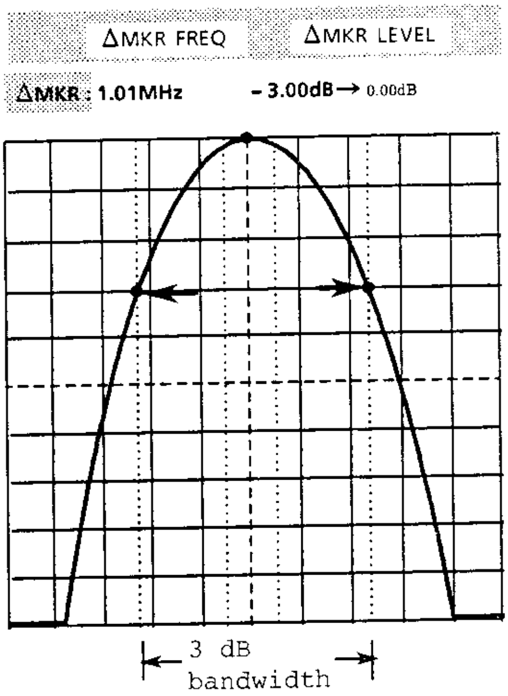
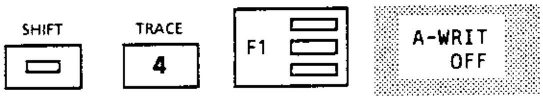


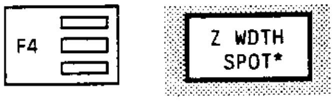
Fig. 4-7 3 dB Bandwidth Measurement

7 After pressing the [SHIFT] and [TRACE] keys sequentially, confirm the sweep completion and then press the [F1] key to select the menu [A-WRIT OFF].



8 After pressing the [MARKER] key, press the [F2] key to select the menu [Δ].

Press the [F4] key to select the spot marker.



(Continued)

Step	Procedure
9	Move the current marker in the direction of the ← point (Fig. 4-7) by using the data knob so that the Δ marker level comes closest to -3 dB.
10	Press the [F2] key to select the menu [Δ] again. (The current marker at the ← point (Fig. 4-7) becomes the reference marker and the reference marker previously located at the peak of the trace waveform disappears.)
11	Move the current marker in the direction of the → point (Fig. 4-7) by using the data knob so that the Δ marker level comes closest to 0 dB.
12	The frequency reading of the Δ marker shows the 3 dB resolution bandwidth. Write this value in Table 4-5.
13	Repeat steps 4 to 12 for the frequencies other than the resolution bandwidth 1 MHz and the frequency span 5 MHz according to the combinations of resolution bandwidth and frequency span shown in Table 4-5.

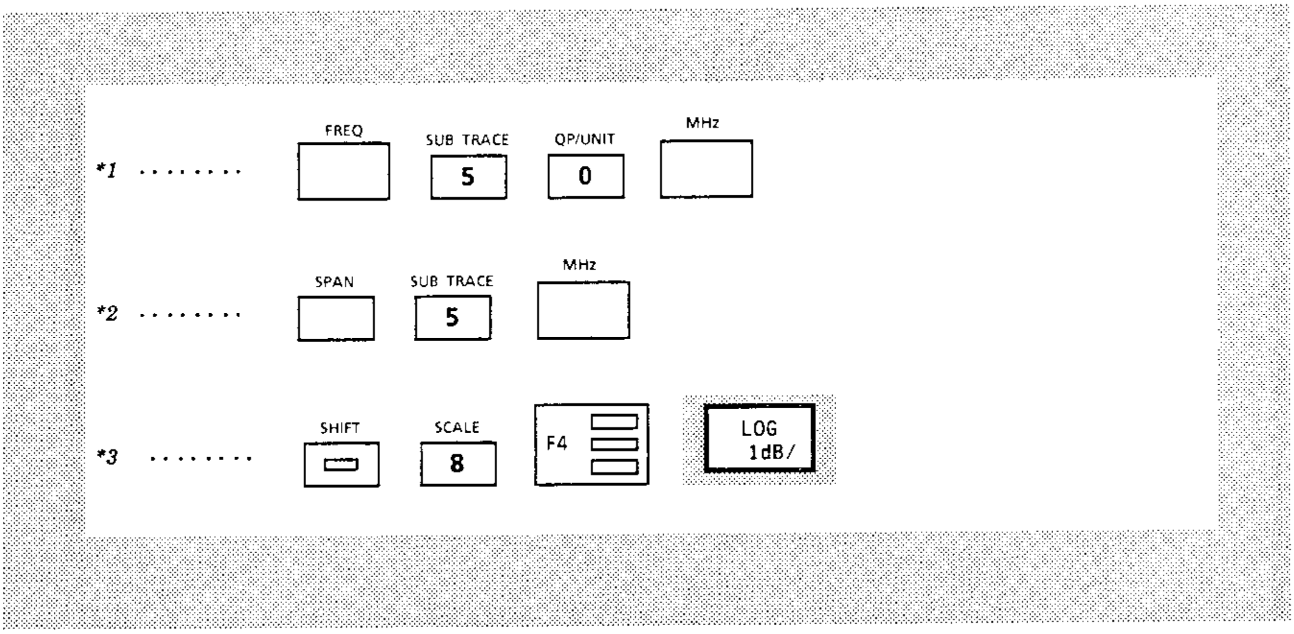


Table 4-5 Resolution Bandwidth (3 dB)

Resolution bandwidth	Frequency span	Δ marker frequency reading		
		Minimum	(3 dB bandwidth)	Maximum
1 MHz	5 MHz	0.8 MHz	—	1.2 MHz
300 kHz	500 kHz	240 kHz	—	360 kHz
100 kHz	200 kHz	80 kHz	—	120 kHz
30 kHz	50 kHz	24 kHz	—	36 kHz
10 kHz	20 kHz	8 kHz	—	12 kHz
3 kHz	5 kHz	2.4 kHz	—	3.6 kHz
1 kHz	2 kHz	0.8 kHz	—	1.2 kHz
300 Hz	1 kHz	0.24 kHz	—	0.36 kHz
100 Hz	1 kHz	0.08 kHz	—	0.12 kHz
30 Hz	1 kHz	0.024 kHz	—	0.036 kHz

(b) Resolution bandwidth selectivity

Step	Procedure
1	Set the MS2601A functions as shown below: CENTER FREQ: 50 MHz *1 SPAN: 10 MHz *2 RESOLN BW (MANUAL): 1 MHz SCALE: LOG 10 dB VID BW: 100 Hz *3 MARKER: NORMAL Z WIDTH: NAR TRACE: A-WRITE ON
2	Press the [PEAK → REF] key to match the peak of the signal trace to the top line (REF LEVEL) on the CRT.

(Continued)

Step Procedure

3 After pressing the [MARKER] key, turn the data knob so that the peak of the signal trace is included in the zone marker (Fig. 4-8).

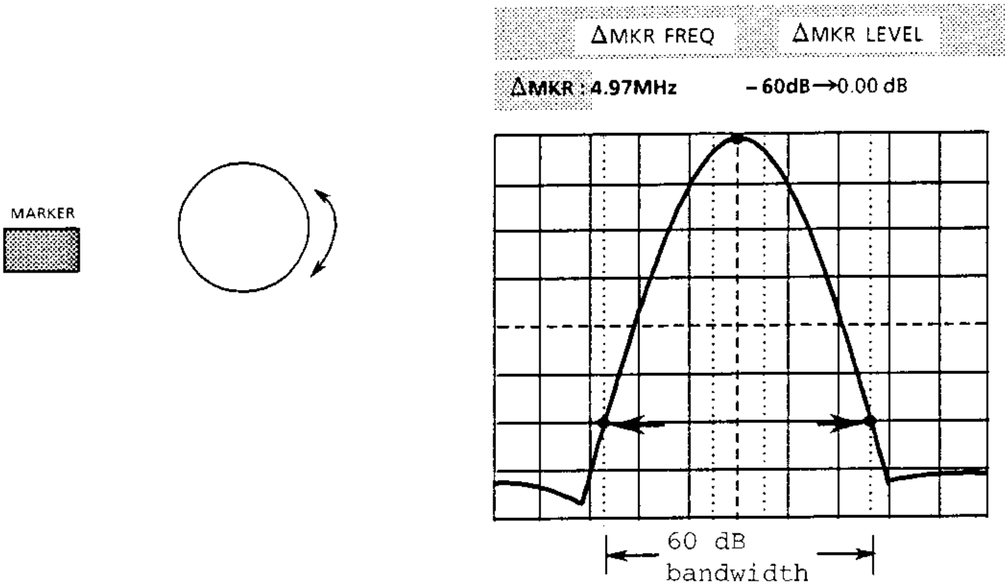
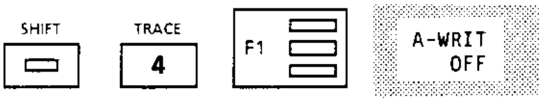


Fig. 4-8 60 dB Bandwidth Measurement

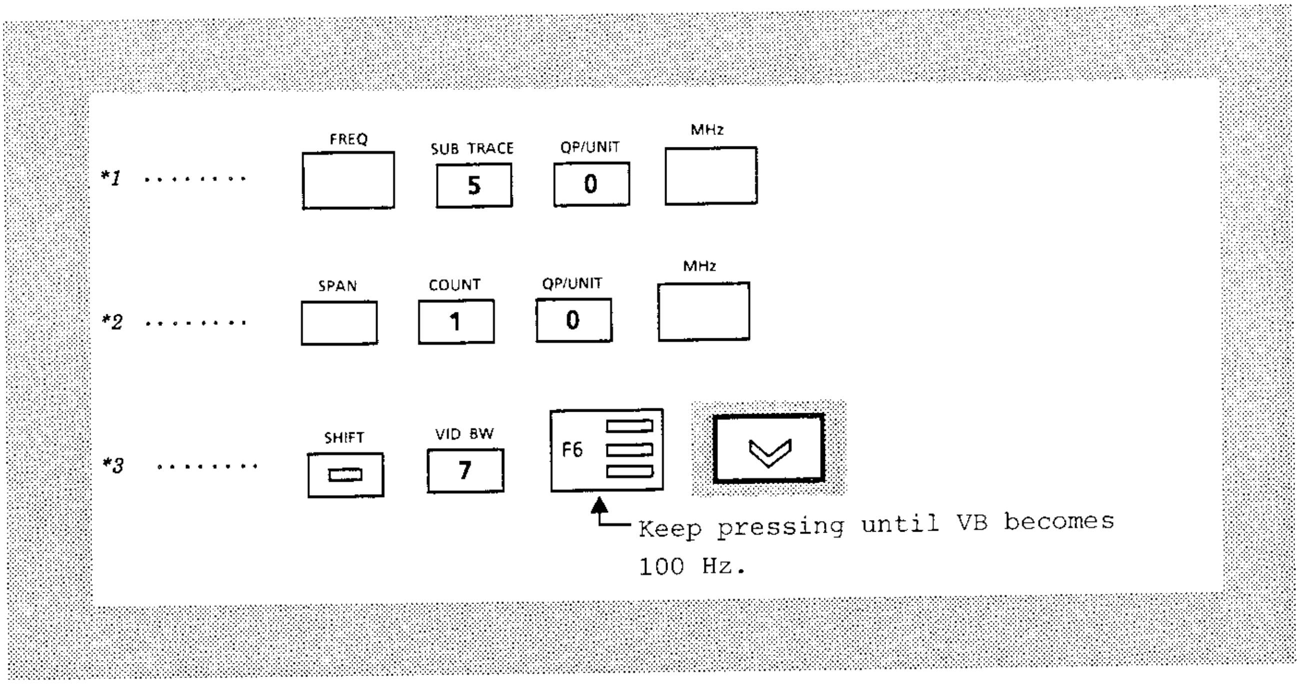
4 After pressing the [SHIFT] and [TRACE] keys sequentially, confirm the sweep completion and then press the [F1] key to select the menu [A-WRIT OFF].



5 After pressing the [MARKER] key, press the [F2] key to select the menu [Δ].

(Continued)

Step	Procedure
6	Press the [F4] key to select the spot marker. F4 Z WDTH SPOT*
7	Move the current marker in the direction of the ← point (Fig. 4-8) by using the data knob so that the Δ marker level comes closest to -60 dB.
8	Press the [F2] key to select the menu [Δ] again. (The current marker at the ← point (Fig. 4-8) becomes the reference marker and the reference marker previously located at the peak of the trace waveform disappears.)
9	Move the current marker in the direction of the → point (Fig. 4-8) by using the data knob so that the Δ marker level comes closest to 0 dB.
10	The frequency reading of the Δ marker shows the 60 dB bandwidth. Write this value in Table 4-6.
11	Repeat steps 4 to 12 for the frequencies other than the resolution bandwidth 1 MHz and the frequency span 30 MHz according to the combinations of resolution bandwidth and frequency span shown in Table 4-6.
12	Write the value, recorded in Table 4-5, in Table 4-6 for the 3 dB bandwidth.
13	When the value calculated from (60 dB BW/3 dB BW) is ≤15 for each resolution bandwidth in Table 4-6, the selectivity is within specification.



Keep pressing until VB becomes 100 Hz.

Table 4-6 Selectivity Test (60 dB/3 dB Bandwidth Ratio)

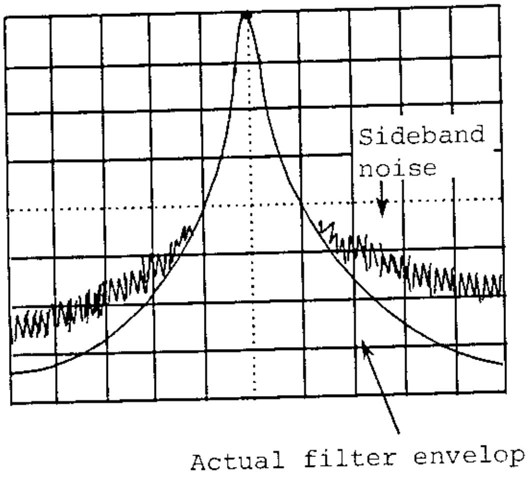
Resolution bandwidth	Frequency span	Video bandwidth	60 dB bandwidth	30 dB bandwidth	Selectivity (60 dB BW/3 dB BW)
1 MHz	10 MHz	100 Hz	________	________	____________
300 kHz	5 MHz	100 Hz	________	________	____________
100 kHz	2 MHz	100 Hz	________	________	____________
30 kHz	500 kHz	100 Hz	________	________	____________
10 kHz	200 kHz	100 Hz	________	________	____________
3 kHz	50 kHz	100 Hz	________	________	____________
1 kHz	20 kHz	10 Hz	________	________	____________
300 Hz	5 kHz	1 Hz	________	________	____________
100 Hz	2 kHz	1 Hz	________	________	____________
30 Hz	1 kHz	1 Hz	________	________	____________

4.4.5 Sideband noise

When the resolution bandwidth is set to a fixed value and a signal that has far less sideband noise level than the equipment to be tested is input, test how many dB the noise level that is a certain frequency away from the peak of the spectrum waveform, is down from the peak.

Since the average value is measured for the noise level, insert a video filter for measurement.

This sideband noise is a spectrum response which is modulated by the internal noise of the spectrum analyzer. If this response is large, the actual filter envelope is masked by the noise as shown, which makes measurement impossible.



(1) Specifications

Sideband noise: $\leqq$-80 dBc (resolution bandwidth 100 Hz, video bandwidth 1 Hz, 10 kHz away from signal)

(2) Test instruments

Signal generator: MG655A Synthesized Signal Generator

(3) Setup

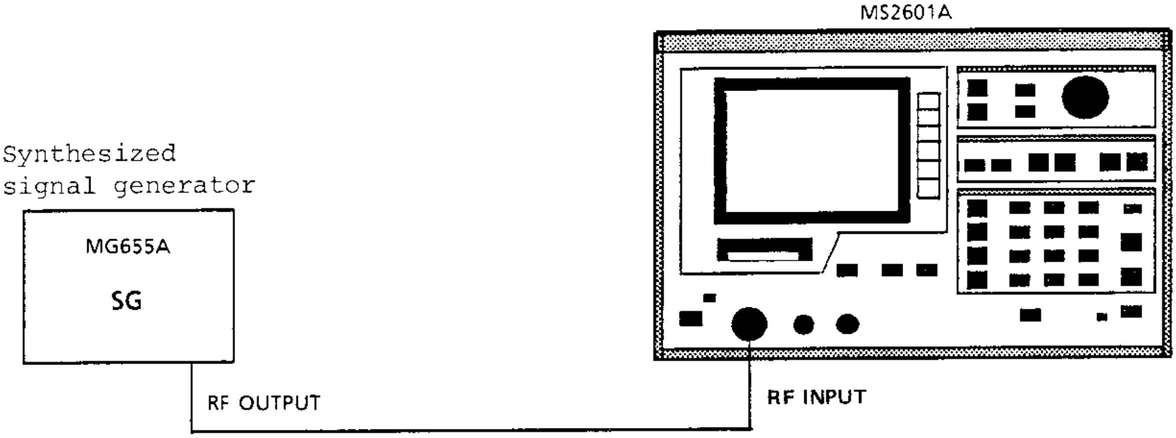


Fig. 4-9 Sideband Noise Test

(4) Procedure

Step	Procedure
1	Press the [INITIAL] key.
2	Press the following keys to perform all calibration. CAL F1 ALL CAL
3	Wait until the message CALIBRATING, which is displayed on the CRT, is cleared.
4	Set the SG output to 1100 MHz and 0 dBm.
5	Set the MS2601A functions as shown below: CENTER FREQ: 1100 MHz RESOLN BW: 100 Hz *1 SPAN: 5 kHz *2
6	Press the [PEAK → REF] key to match the peak of the signal trace to the top line (REF LEVEL) on the CRT.

(Continued)

Step Procedure

7 After pressing the [MARKER] key, turn the data knob so that the peak of the signal trace is included in the zone marker.

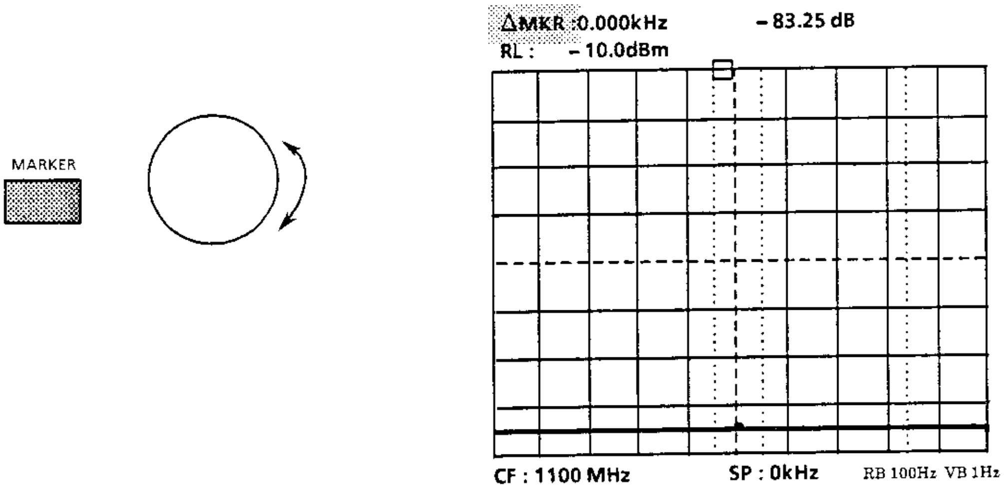
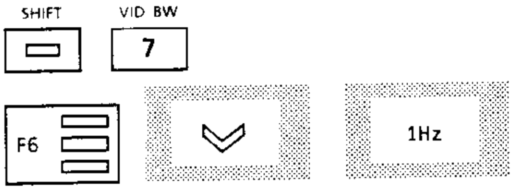
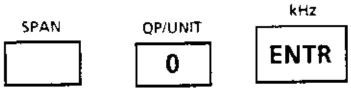


Fig. 4-10 Sideband Noise Measurement

8 Set VID BW to 1 Hz.



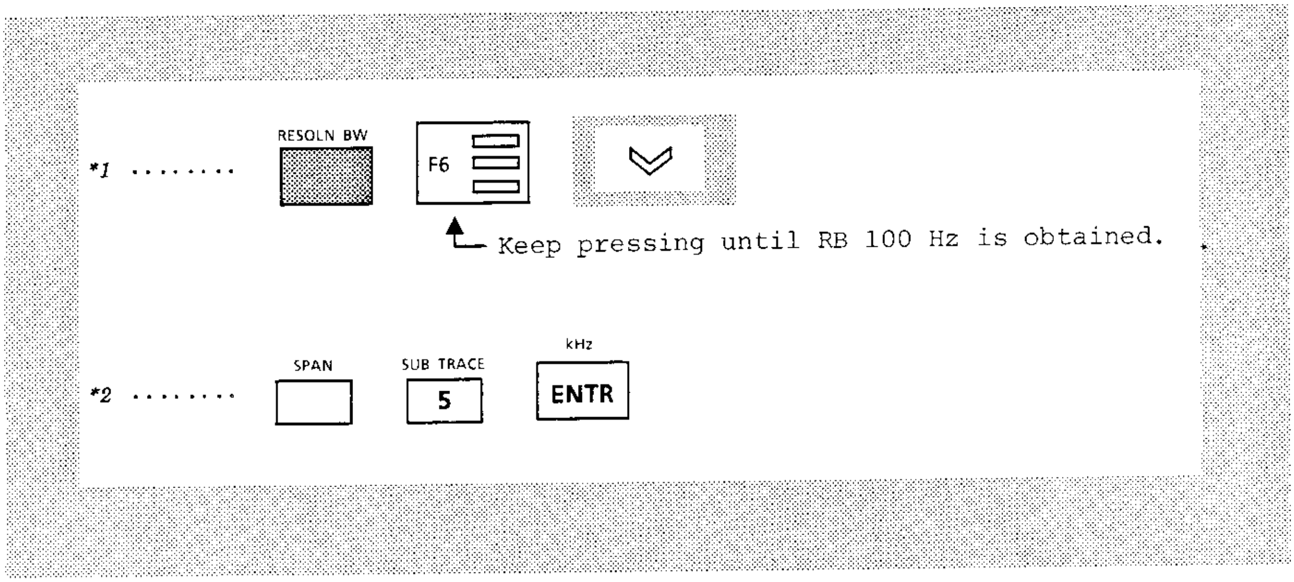
9 Set the SPAN to 0 kHz and adjust the SG output frequency to make the level maximum.



10 Set the marker to Δ marker and lower the REF LEVEL by 10 dB.

(Continued)

Step	Procedure
11	Confirm that the Δ marker level is ≦-80 dB when the SG output frequency is current value + 10 kHz or more. (Fig. 4-10)
12	Confirm that the Δ marker level is also ≦-80 dB when the SG output frequency is current value - 10 kHz or less.



Keep pressing until RB 100 Hz is obtained.

4.4.6 Frequency measurement accuracy

Set the marker point to the position at least 20 dB higher than the undesired signal, such as noise and adjacent interference signal, and test the frequency measurement accuracy in COUNT ON mode when the built-in counter is operated by a signal with good S/N.

(1) Specifications

- Accuracy: $\leqq$(Readout frequency x reference oscillator accuracy ± (20 Hz or 2 count))
- Resolution: 1 Hz, 10 Hz, 100 Hz

(2) Test instruments

Input the test signal from the OUTPUT 50 MHz connector on the rear of the MS2601A to the RF INPUT.

This signal is phase-locked to the 10 MHz reference signal.

Since the built-in counter gate signal is generated from the 10 MHz reference signal, the reference oscillator accuracy component in the specifications is negligible compared to the (20 Hz or 2 count) component.

(3) Setup

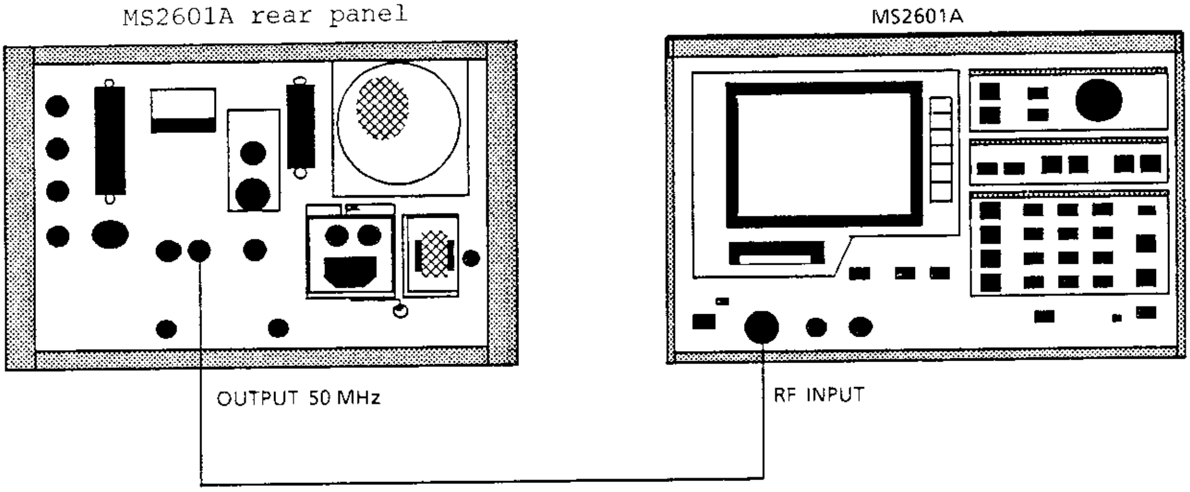
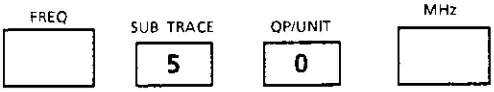
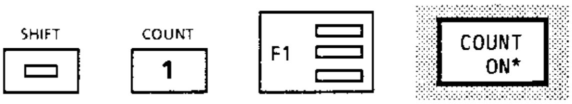


Fig. 4-11 Frequency Measurement Accuracy Test

(4) Procedure

Step	Procedure
1	Press the [INITIAL] key.
2	Press the following keys to perform frequency calibration. 
3	Wait until the message CALIBRATING,which is dislayed on the CRT, is cleared.
4	Set the CENTER FREQ to 50 MHz. 
5	Set the frequency measurement mode to COUNT ON and the resolution to 1 Hz. 
6	Confirm that the FREQ reading at the upper left of the CRT is the RF INPUT frequency 50 MHz ±20 Hz or less.
7	Confirm that the measured frequency value is constant even when the span is varied in a 1-2-5 sequence over 1 kHz to 2000 MHz.  Press several times toward the lower limit or  Press several times toward the upper limit

(Continued)

Step Procedure

8 Confirm that the measured value is constant even when the marker position is varied along the slope 20 dB or more higher than the noise (Fig. 4-12).

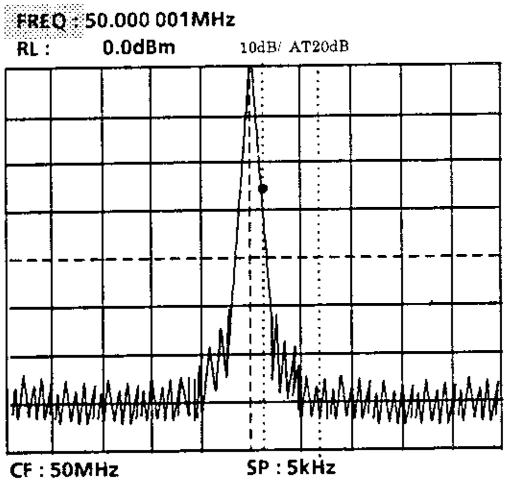


Fig. 4-12 Frequency Measurement

9 Change the counter resolution to 10 Hz and confirm that the FREQ reading is 50 MHz ±20 Hz or less.

10 Change the counter resolution to 100 Hz and confirm that the FREQ reading is 50 MHz ±200 Hz or less.

4.4.7 CRT display amplitude scale linearity

Test the error per CRT vertical graduation for the LOG display. For the LOG display linearity, test that the graduation is equal to the logarithm (dB) of the input signal level.

Input the correct level signal to the RF INPUT via an external attenuator and calculate the error from the attenuation of the attenuator and the Δ marker reading at the trace waveform peak.

(1) Specifications

CRT display amplitude scale linearity

After automatic calibration
(when resolution bandwidth is 100 Hz to 1 MHz)

LOG: ±1 dB for 0 to -70 dB (10 dB/div)
±0.5 dB for 0 to -50 dB (5 dB/div)
±0.3 dB for 0 to -20 dB (2 dB/div)
±0.2 dB for 0 to -10 dB (1 dB/div)

(2) Test instruments

- Signal generator: MG655A
- Attenuator: MN510C

(3) Setup

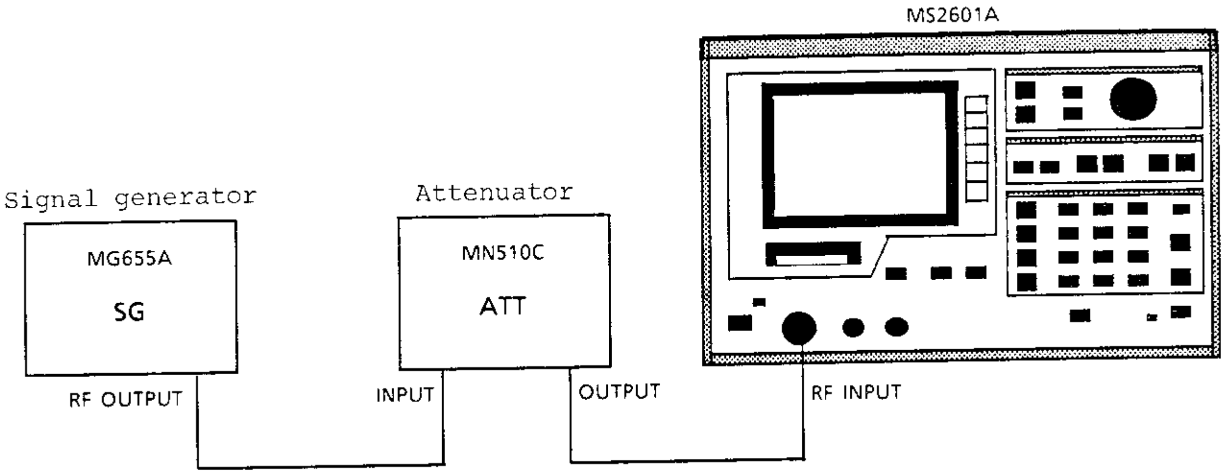


Fig. 4-13 CRT Display Amplitude Scale Linearity Test

(4) Procedure

LOG display linearity

Step	Procedure
1	Press the [INITIAL] key.
2	Press the following keys to perform all calibration. CAL F1 ALL CAL
3	Wait until the message CALIBRATING, which is displayed on the CRT, is cleared.
4	Set the SG to 100 MHz and 0 dBm.
5	Set the ATT to 0 dB.

(Continued)

Step Procedure

6 Set the MS2601A functions as shown below:

CENTER FREQ: 100 MHz *1
SPAN: 5 kHz *2
RESOLN BW: 1 kHz *3
VID BW: 10 Hz *4

7 Set the spectrum waveform peak to the center of the CRT.

PEAK→CF ☐

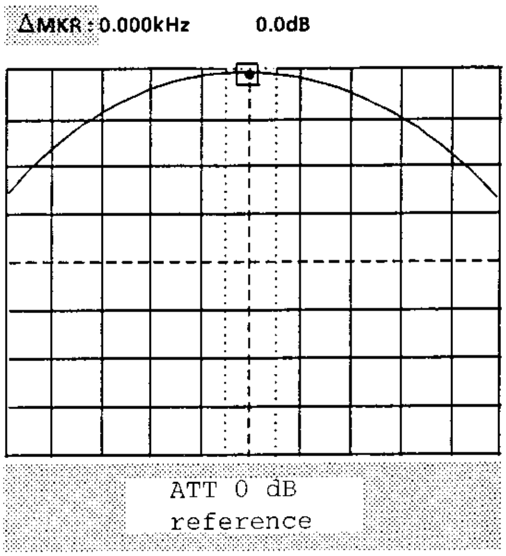
8 Adjust the SG output level so that the marker level reading is 0.0 dBm.

9 Set the marker to Δ marker after the sweep is completed (Fig. 4-14 (a)).

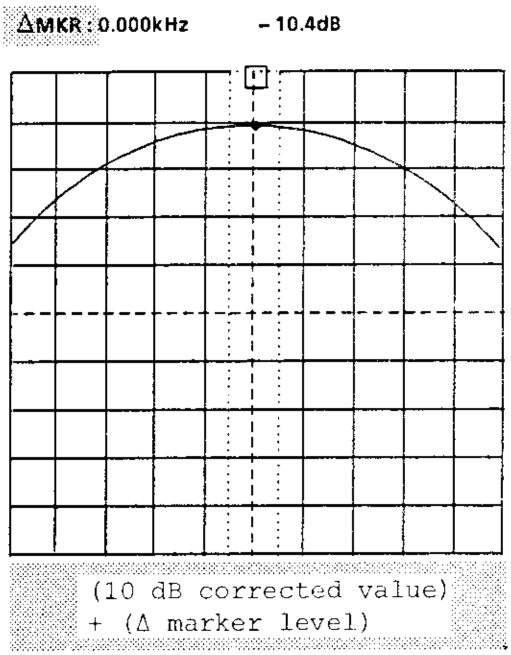
MARKER ▨ F6 MARKER (2) F2 Δ

10 Read the current marker level when ATT is set to 10 dB (Fig. 4-14 (b)). Find the error by adding the ATT 10 dB corrected value to Δ marker level (Table 4-7).

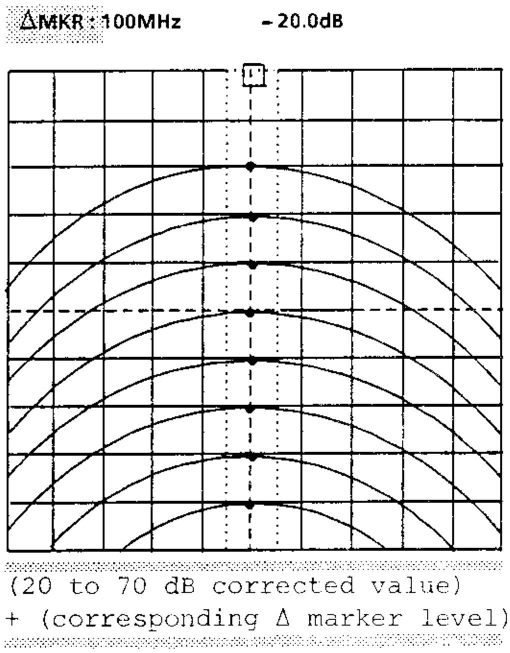
11 Find the error by adding the Δ marker level to the corresponding ATT corrected value when ATT is set to 20 to 70 dB (10 dB steps) as shown in Fig. 4-14 (c) (Table 4-7).



(a) Reference Point Setting



(b) Δ Marker Level When ATT is 10 dB



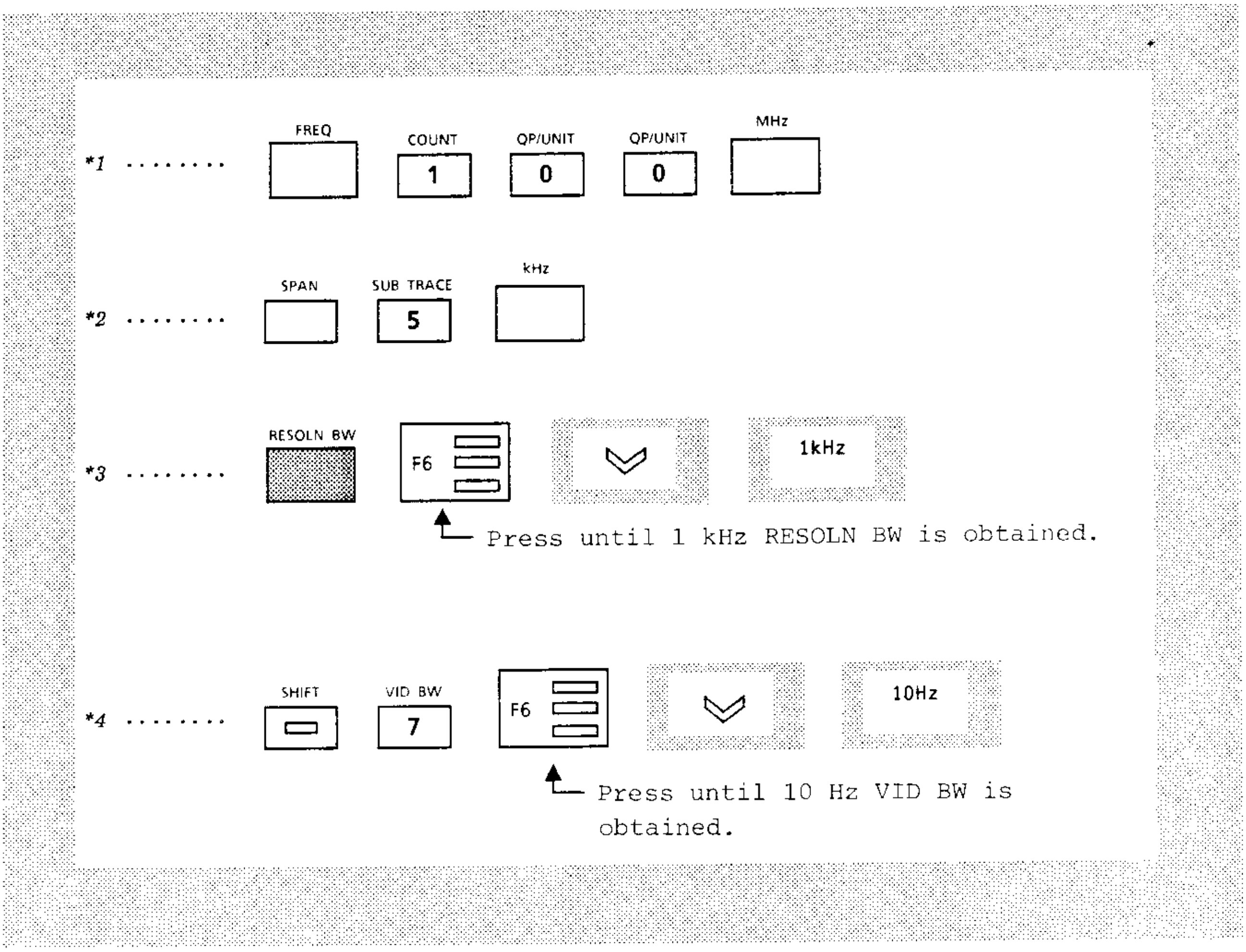
(c) Δ Marker Level When ATT is 20 to 70 dB

Fig. 4-14 CRT Display Linearity (LOG)

(Continued)

Step	Procedure
12	Repeat steps 5 to 11 for the LOG scale other than 10 dB/div. However, change the settings corresponding to the following points.

	SHIFT ▭ SCALE 8	ATT setting	Corresponding table
5 dB/div	LOG 5dB/	0 to 50 dB (5 dB steps)	Table 4-8
2 dB/div	LOG 2dB/	0 to 20 dB (2 dB steps)	Table 4-9
1 dB/div	LOG 1dB/	0 to 10 dB (1 dB steps)	Table 4-10



Press until 1 kHz RESOLN BW is obtained.

Press until 10 Hz VID BW is obtained.

Table 4-7 LOG Display Linearity (10 dB/div)

ATT setting	A	B	Error (dB) = A + B (±1 dB)
	ATT corrected value (dB)	Δ marker level (dB)	
0	0 (Reference)	0 (Reference)	0 (Reference)
10			
20			
30			
40			
50			
60			
70			

Table 4-8 LOG Display Linearity (5 dB/div)

ATT setting	A	B	Error (dB) = A + B (±0.5 dB)
	ATT corrected value (dB)	Δ marker level (dB)	
0	0 (Reference)	0 (Reference)	0 (Reference)
5			
10			
15			
20			
25			
30			
35			
40			
45			
50			

Table 4-9 LOG Display Linearity (2 dB/div)

ATT setting	A ATT corrected value (dB)	B Δ marker level (dB)	Error (dB) = A + B (±0.3 dB)
0	0 (Reference)	0 (Reference)	0 (Reference)
2			
4			
6			
8			
10			
12			
14			
16			
18			
20			

Table 4-10 LOG Display Linearity (1 dB/div)

ATT setting	A ATT corrected value (dB)	B Δ marker level (dB)	Error (dB) = A + B (±0.2 dB)
0	0 (Reference)	0 (Reference)	0 (Reference)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

4.4.8 Frequency response

Generally, when one or more signals with a different frequency but the same amplitude are input, the spectrum analyzer displays the same amplitude for each spectrum on the CRT.

To find the frequency response, measure the amplitude deviation of other frequencies when the amplitude of a specific frequency is set as the reference.

For the MS2601A Specifications, test the amplitude deviation between 100 kHz to 2.0 GHz, making 50 MHz as the reference.

(1) Specification

Frequency response: ±0.5 dB (Temperature 20° to 30°C at 100 kHz to 2.0 GHz and input ATT 20 dB)

(2) Test instruments

- Tracking generator: MH680A
- Power meter: ML4803A
- Power sensor: MA4601A

(3) Setup

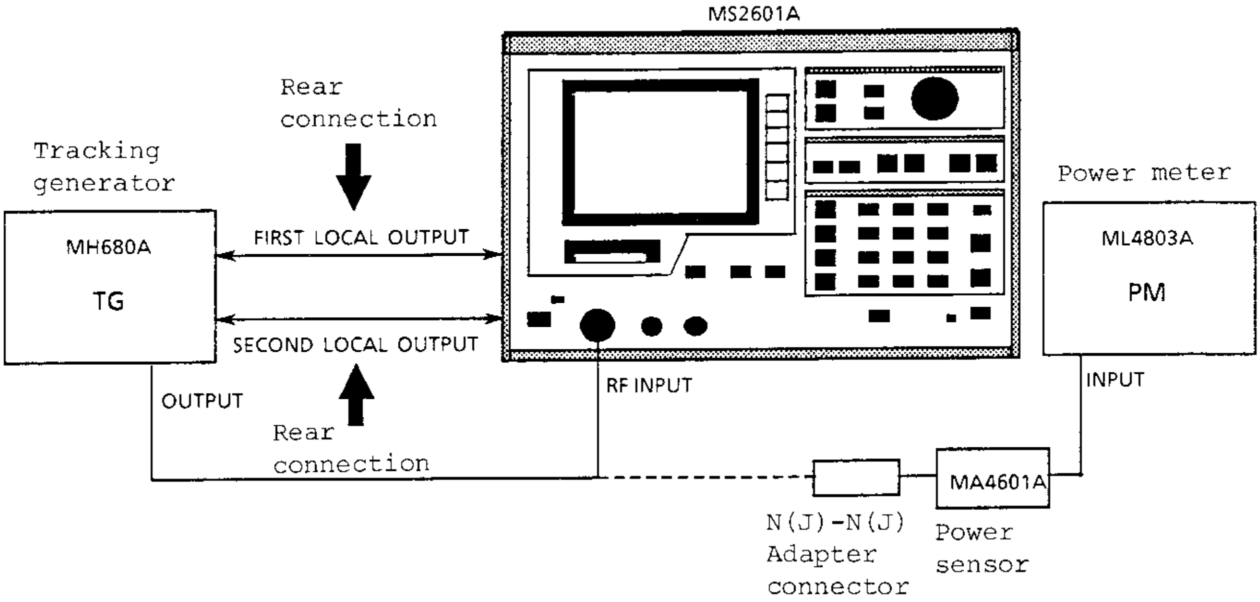


Fig. 4-15 Frequency Response Test

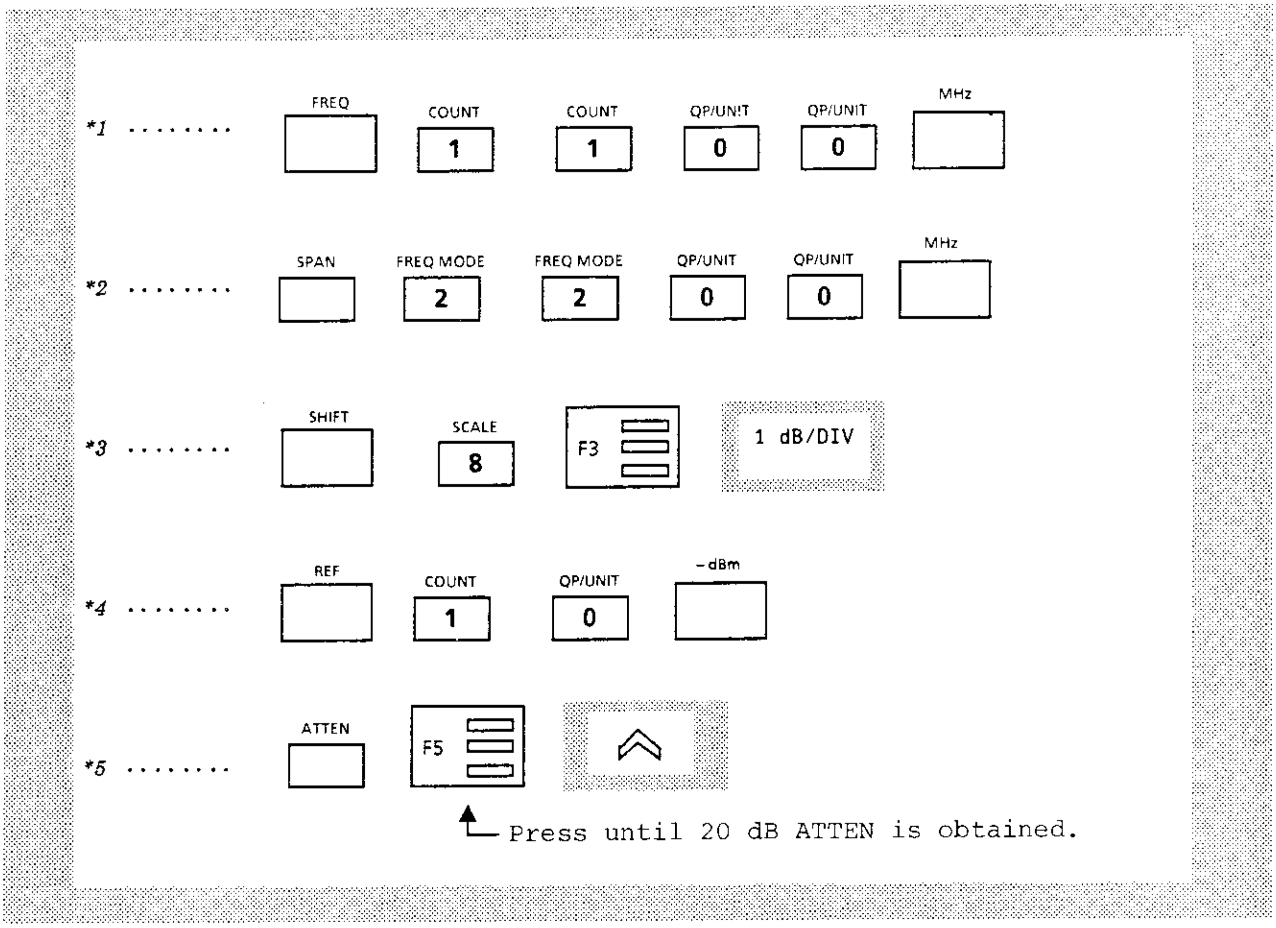
(4) Procedure

(a) Confirmation of entire frequency response picture

Step	Procedure
1	Press the [INITIAL] key.
2	Press the following keys to perform all calibration. CAL F1 ALL CAL
3	Wait until the message CALIBRATING, which is displayed on the CRT, is cleared.
4	Connect OUTPUT of the tracking generator (TG) to RF INPUT of the MS2601A with a coaxial cable.
5	Set the TG output level to -10 dBm.

(Continued)

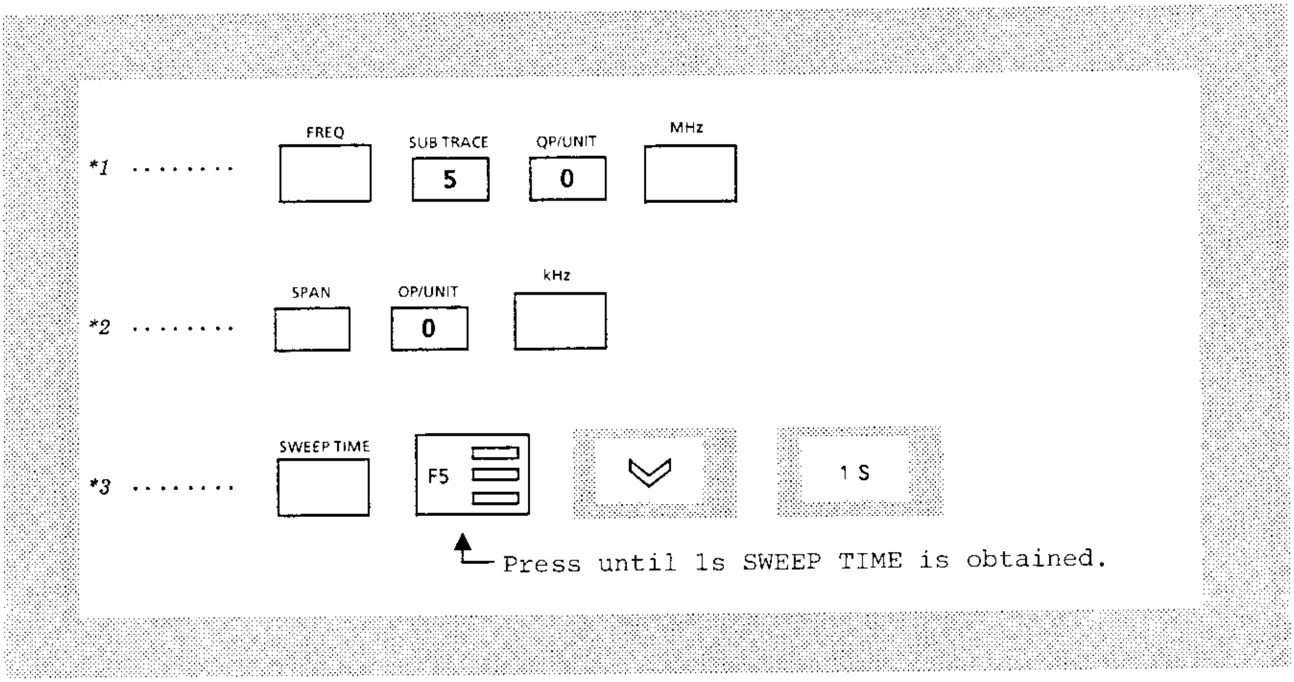
Step	Procedure
6	Set the MS2601A functions as shown below: CENTER FREQ: 1100 MHz *1 SPAN: 2200 MHz *2 SCALE: LOG 1 dB *3 REF LEVEL: -10 dBm *4 ATTEN: 20 dB *5
7	Confirm that the MS2601A display trace is continuous.



Press until 20 dB ATTEN is obtained.

(b) Calibration of MH680A TG output level

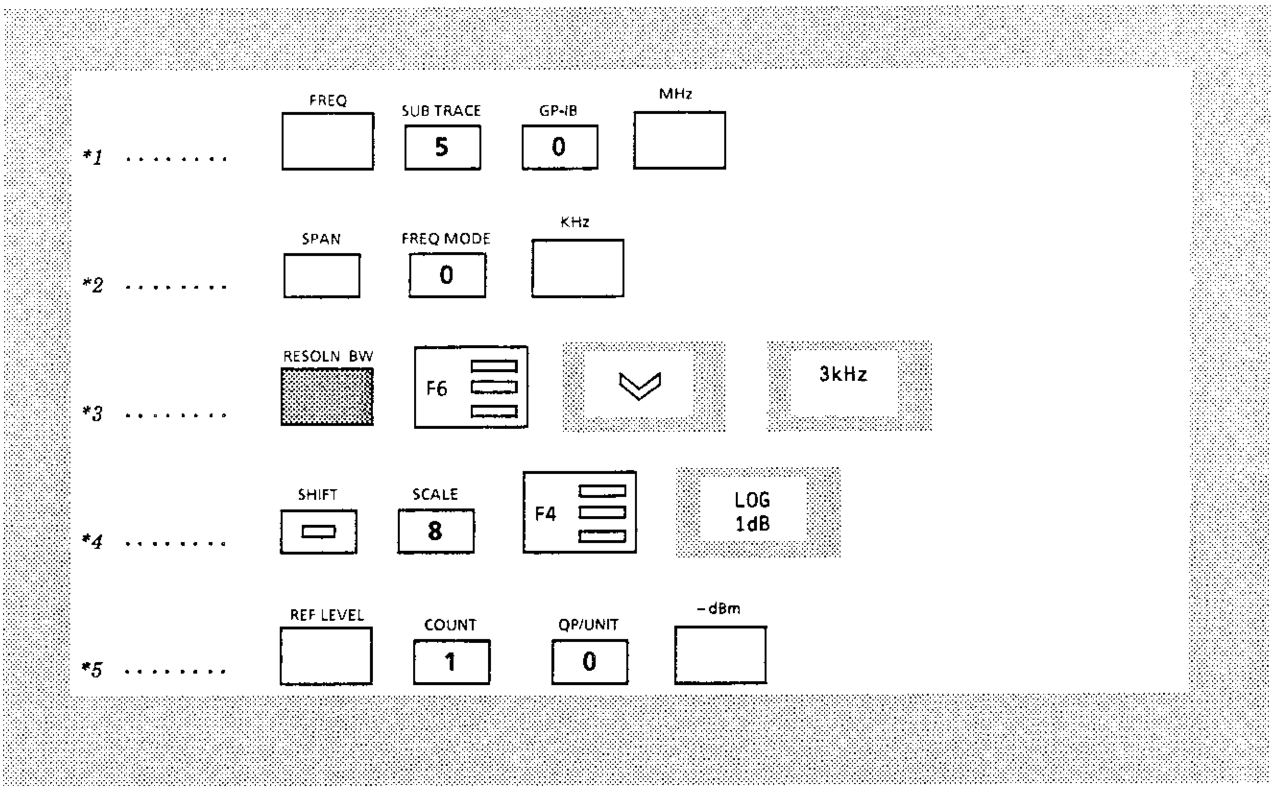
Step	Procedure
1	Set the TG output level to -10 dBm.
2	Set the MS2601A functions as shown below: CENTER FREQ: 50 MHz *1 SPAN: 0 kHz *2 SWEEP TIME: 1 s * 3
3	Connect the TG output to the power sensor input with a coaxial cable.
4	Read the power meter display. (Calibrated value of 50 MHz reference signal)
5	Change the MS2601A CENTER FREQ as shown in Table 4-11 and read the power meter display. This data is the calibration data.



Press until 1s SWEEP TIME is obtained.

(c) Read-out of measured amplitude deviation (frequency response)

Step	Procedure
1	Connect TG OUTPUT to MS2601A RF INPUT with a coaxial cable.
2	Set the MS2601A functions as shown below: CENTER FREQ: 50 MHz *1 SPAN: 0 kHz *2 RBW: 3 kHz *3 SCALE: 1 dB *4 REF LEVEL: -10 dBm *5 ATTEN: 20 dB
3	Set the marker to Δ marker in the 50 MHz frequency reception. 
4	Change the MS2601A CENTER FREQ as shown in Table 4-11 and read the Δ marker level data.
5	Find the measured amplitude deviation from the following expression. Deviation = Δ marker level reading - calibrated level value at measured frequency


*1 ....
FREQ
SUB TRACE
5
GP-IB
0
MHz
*2 ....
SPAN
FREQ MODE
0
KHz
*3 ....
RESOLN BW
F6
3kHz
*4 ....
SHIFT
SCALE
8
F4
LOG
1dB
*5 ....
REF LEVEL
COUNT
1
QP/UNIT
0
-dBm

(5) Precautions

1. Operate at ambient temperature of 20° to 30°C.
2. The warm-up time must be 60 minutes or more.

Table 4-11 Frequency Response Error

Frequency	Calibrated value	Marker level	Error
100 kHz	__________	__________	__________
100 MHz	__________	__________	__________
200 MHz	__________	__________	__________
300 MHz	__________	__________	__________
400 MHz	__________	__________	__________
500 MHz	__________	__________	__________
600 MHz	__________	__________	__________
700 MHz	__________	__________	__________
800 MHz	__________	__________	__________
900 MHz	__________	__________	__________
1000 MHz	__________	__________	__________
1100 MHz	__________	__________	__________
1200 MHz	__________	__________	__________
1300 MHz	__________	__________	__________
1400 MHz	__________	__________	__________
1500 MHz	__________	__________	__________
1600 MHz	__________	__________	__________
1700 MHz	__________	__________	__________
1800 MHz	__________	__________	__________
1900 MHz	__________	__________	__________
2000 MHz	__________	__________	__________

4.4.9 Reference level accuracy

In the above-mentioned frequency response, the relative value of 100 kHz to 2000 MHz with 50 MHz as the reference is tested. Here the absolute amplitude level at only 50 MHz is tested. Confirm the level accuracy after inputting an SG output calibrated by a standard power meter to the MS2601A.

(1) Specification

Reference level accuracy

At 50 MHz frequency after automatic calibration (Resolution bandwidth, video bandwidth and sweep time set to AUTO)

≦±0.3 dB (0 to -50 dBm)
≦±0.75 dB (+20 to -70 dBm)

(2) Test instruments

- Signal generator: MG655A
- Attenuator: MN510C
- Power sensor: MA4601A
- Power meter: ML4803A

(3) Setup

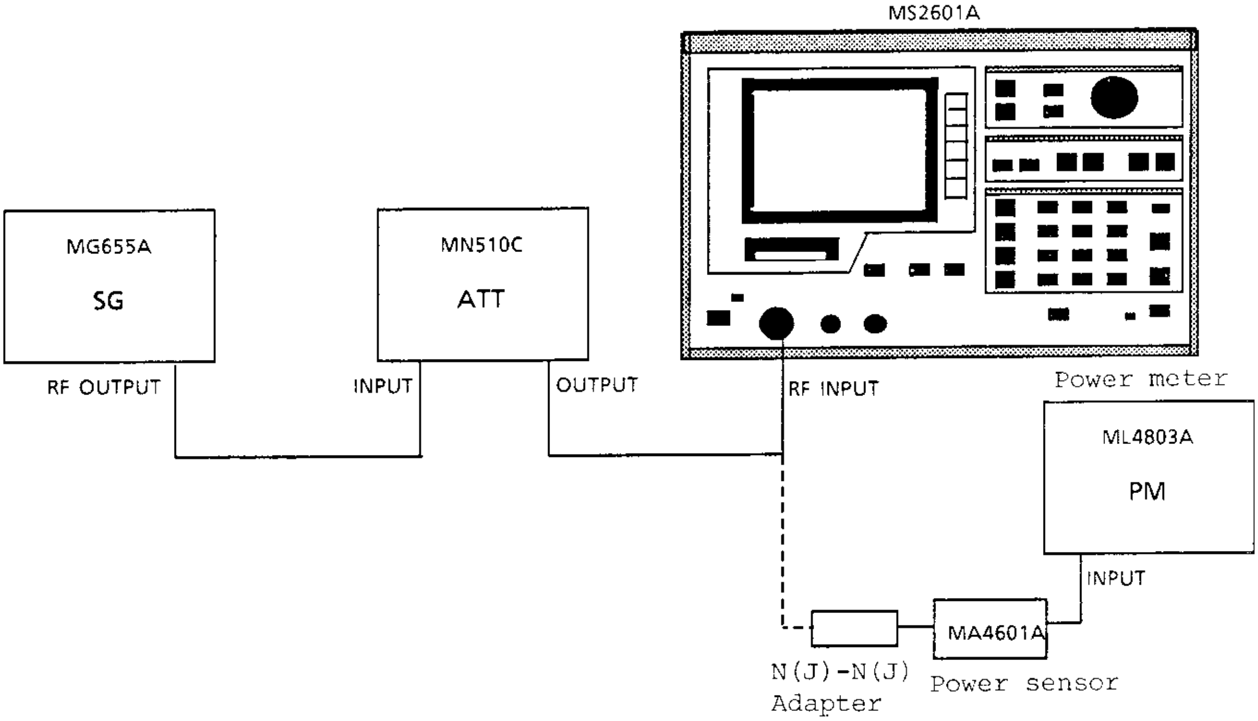


Fig. 4-16 Reference Level Accuracy Test

(4) Procedure

Step	Procedure
1	Press the [INITIAL] key.
2	Press the following keys to perform all calibration. CAL F1 ALL CAL
3	Wait until the message CALIBRATING, which is displayed on the CRT, is cleared.
4	Connect the attenuator OUTPUT to the power sensor input.
5	Set the SG frequency to 50 MHz and adjust the SG level so that the power meter indication is 0 dBm. At this time, set the attenuator to 0 dB.

(Continued)

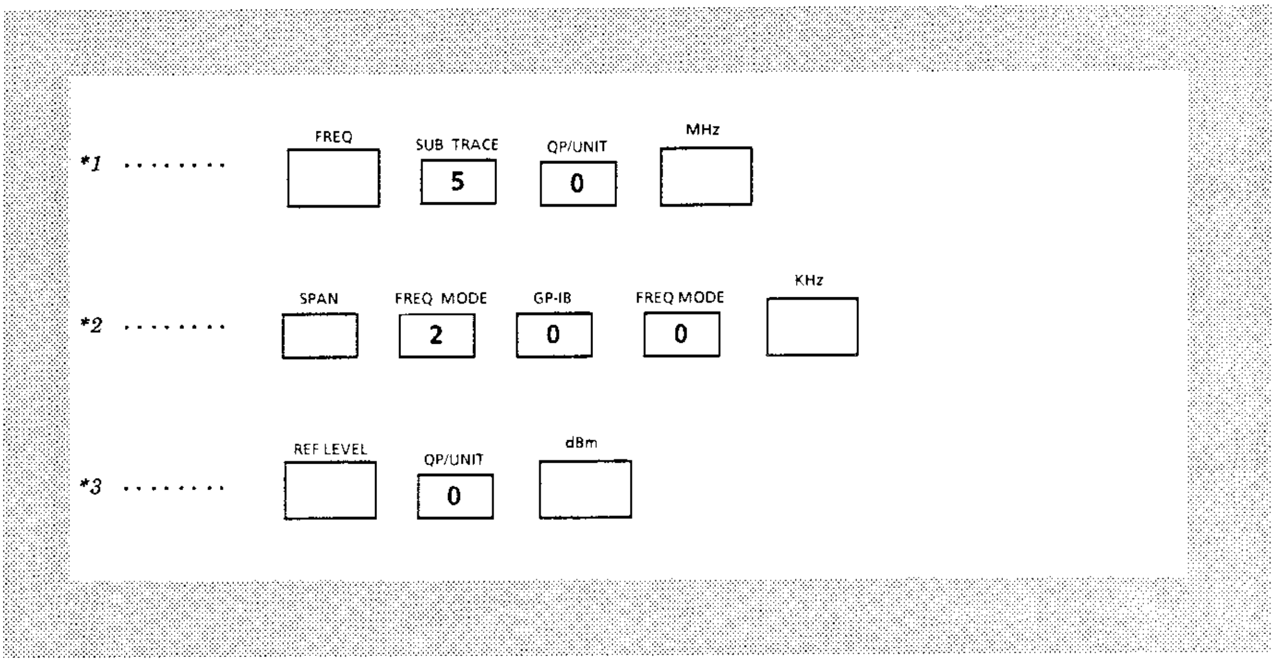
Step	Procedure
6	Connect the attenuator OUTPUT to the MS2601A RF INPUT connector.
7	Set the MS2601A functions as shown below: CENTER FREQ: 50 MHz *1 SPAN: 200 kHz *2 REF LEVEL: 0 dBm *3
8	Press the [PEAK → CF] key so that the input signal moves to the center of the CRT.
9	Read the marker level.
10	When the attenuator is set in 10 dB steps, set the reference level as shown in Table 4-12 and read the marker level each time.

Table 4-12

Reference level setting	Marker level value	Calibrated attenuation value	Error
0 dBm			
-10			
-20			
-30			
-40			
-50			
-60			
-70			

(Continued)

Step	Procedure
11	Find the error from the following equation. Error = marker level value - reference level set value - calibrated attenuation value



(5) Precautions

1. Set the resolution bandwidth, video filter and sweep time to AUTO.
2. The warm-up time must be 60 minutes or more.

4.4.10 Average noise level

The internal noise distributed evenly in proportion to the resolution bandwidth over the whole measurement frequency band is called the average noise level. The MS2601A measures the average noise level at the 300 Hz resolution bandwidth and 1 Hz video filter.

(1) Specification

Average noise level

≦-120 dBm (resolution bandwidth 300 Hz, video filter 1 Hz, frequency 1 MHz frequency to 2 GHz)

(2) Test instruments

50 Ω terminator: MP752A

(3) Setup

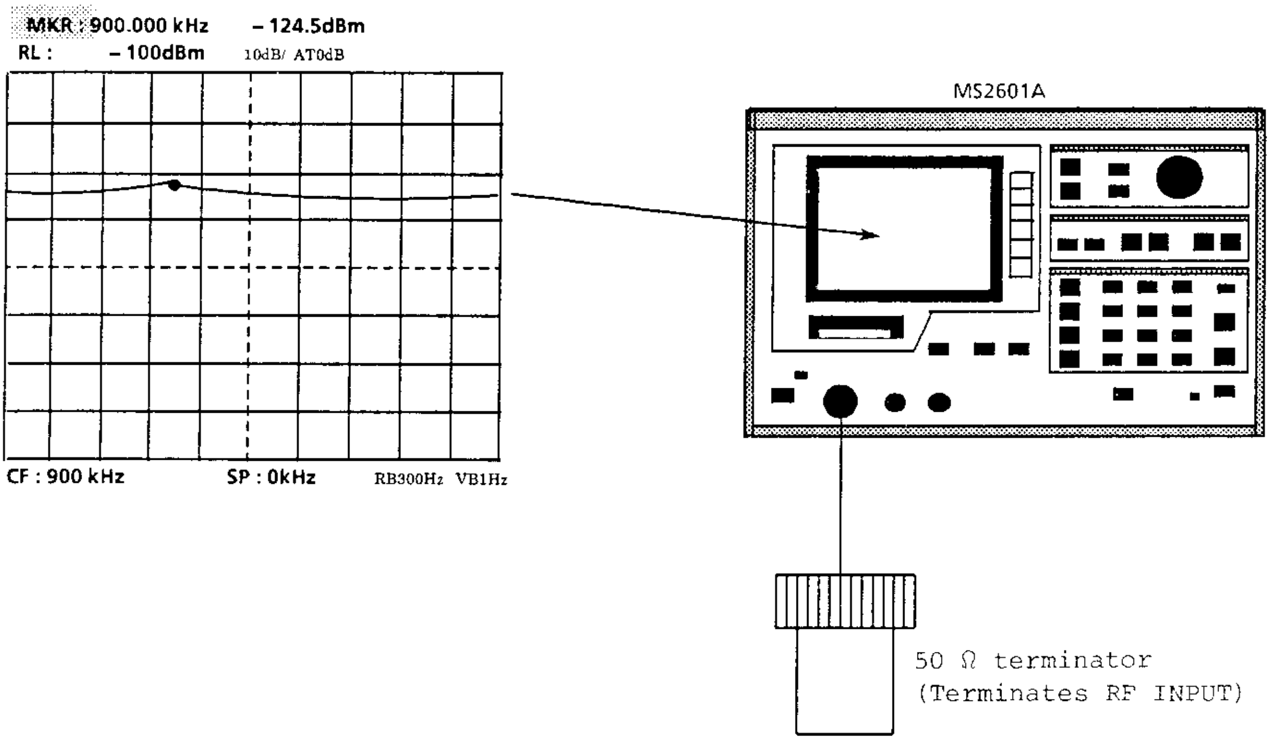
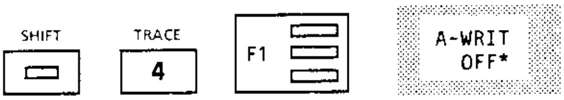
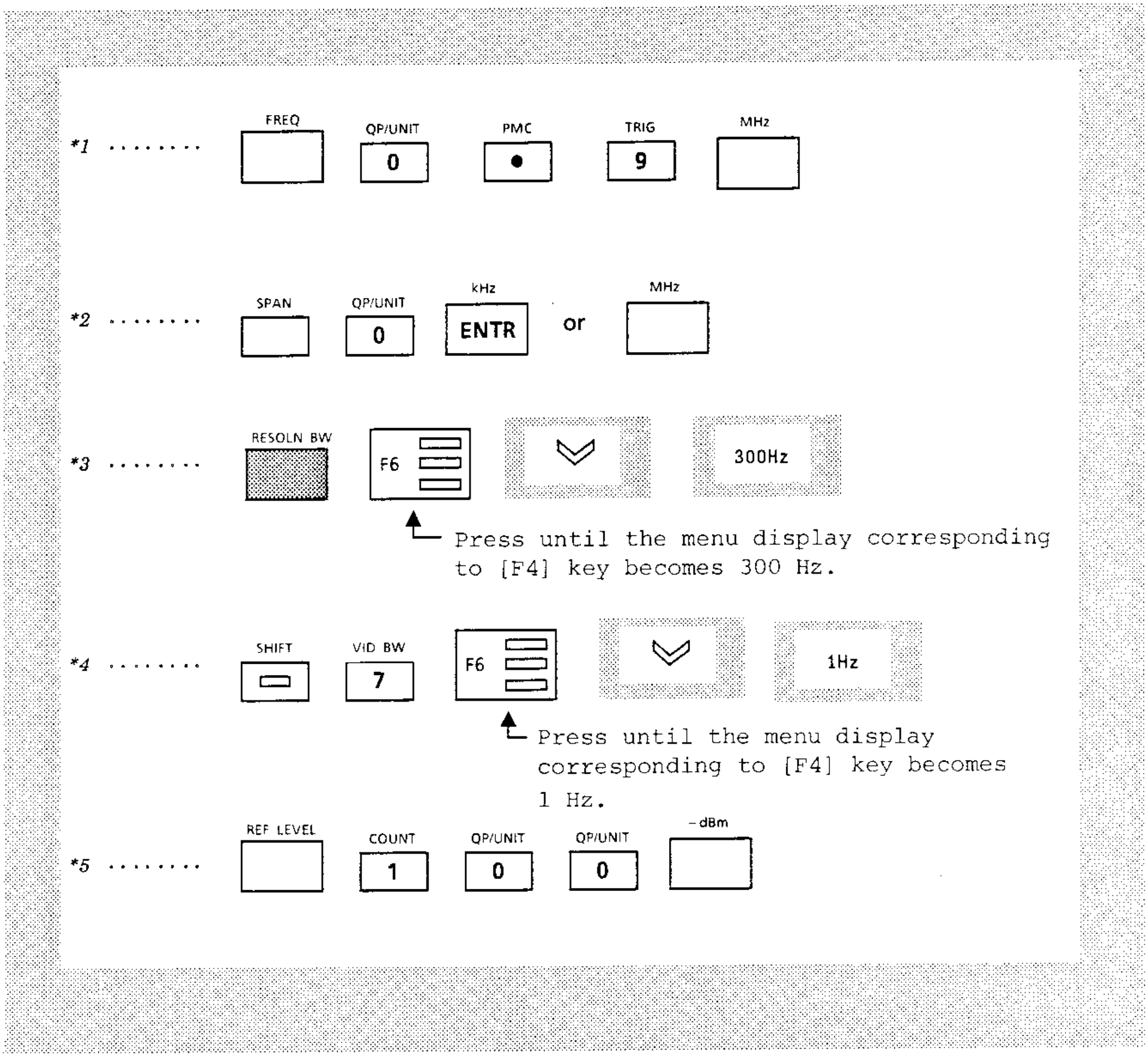


Fig. 4-17 Average Noise Level Test

(4) procedure

Step	Procedure
1	Press the [INITIAL] key.
2	Press the following keys to perform all calibration. 
3	Wait until the message CALIBRATING, which is displayed on the CRT, is cleared.
4	Terminate the RF INPUT with the 50 Ω terminator.
5	Set the MS2601A functions as shown below: CENTER FREQ: 0.9 MHz *1 SPAN: 0 kHz *2 RESOLN BW: 300 Hz *3 VID BW: 1 Hz *4 REF LEVEL: -100 dBm *5
6	When the sweep is completed, turn off the A ch write mode and make the trace waveform stationary. 
7	Since the marker level indicates the average noise level, find the maximum value in the trace waveform by using peak search mode. 
8	Find each average noise level by repeating steps 6 to 7 when the center frequency is set to 1000.1 MHz and 2000.1 MHz.



Press until the menu display corresponding to [F4] key becomes 300 Hz.

Press until the menu display corresponding to [F4] key becomes 1 Hz.

4.4.11 Second and third harmonics distortion

Even if a signal without harmonic distortion is input to the spectrum analyzer, generally, the higher harmonic is generated by the analyzer input mixer non-linearity and is displayed on the CRT.

The second and third harmonic levels are the highest harmonics displayed on the MS2601A. The main point of the test is to apply a signal with a distortion that is lower than the MS2601A internal highly harmonic distortion (at least 20 dB) to the MS2601A and to measure the level difference between the fundamental wave and the second/third harmonics. If a low-distortion signal source cannot be obtained, apply a low-distortion signal to the MS2601A after passing the signal through an LPF.

(1) Specifications

Second and third harmonic distortion

≦-75 dB
At -30 dBm input level with 0 dB input attenuator
(input frequency of 5 to 800 MHz)

(2) Test instruments

- Signal generator: MG655A
- LPF: With attenuation of 50 dB or more at twice and three times the fundamental frequencies

(3) Setup

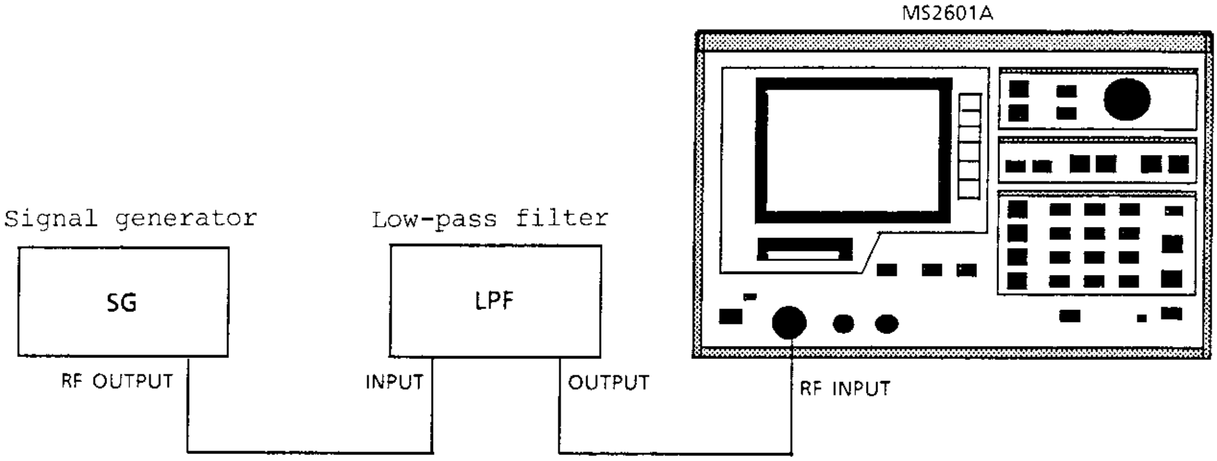


Fig. 4-18 Second and Third Harmonics Distortion Test

(4) Procedure

Step	Procedure
1	Press the [INITIAL] key.
2	Press the following keys to perform all calibration. CAL F1 ALL CAL
3	Wait until the message CALIBRATING, which is dispayed on the CRT, is cleared.
4	Set the LPF cut-off frequency to approx. 6.4 MHz.
5	Set the SG output frequency to 5 MHz and the output level to -30 dBm.

(Continued)

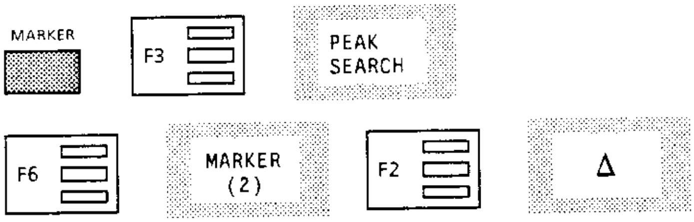
Step Procedure

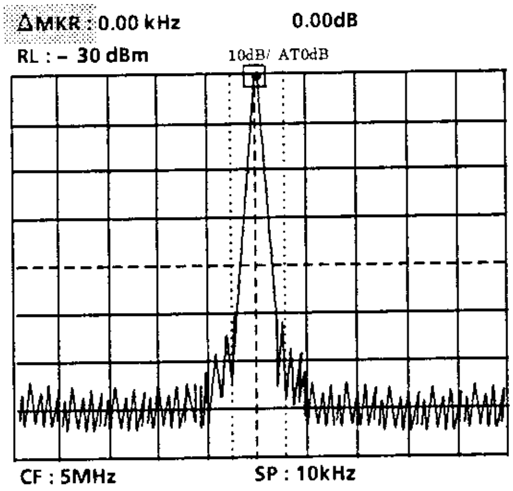
6 Set the MS2601A functions as shown below:

CENTER FREQ:	5 MHz *1
SPAN:	10 kHz *2
REF LEVEL:	-30 dBm *3
ATTEN:	0 dB *4

7 Adjust the SG output level so that peak of the spectrum waveform is at the REF LEVEL (the top horizontal line of the CRT).

8 Move the marker to the peak of the spectrum waveform and make the marker the Δ marker.





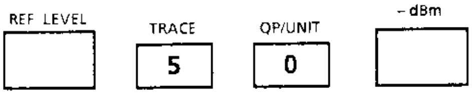
(Continued)

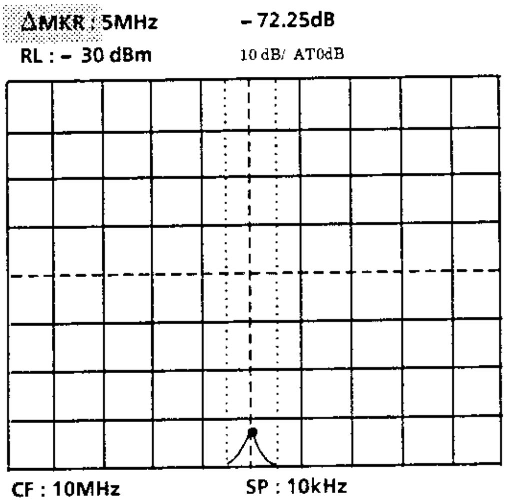
Step Procedure

9 Set the center frequency to twice the fundamental wave frequency to display the second harmonic on the CRT.

The Δ marker reading indicates the level difference between the fundamental wave and the second harmonic.

If the level difference is 80 dB or more, set the REF LEVEL to -50 dBm. Confirm that the ATTEN set value is 0 dB.





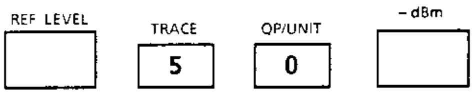
10 Set the center frequency to three times the fundamental wave frequency to display the third harmonic on the CRT.

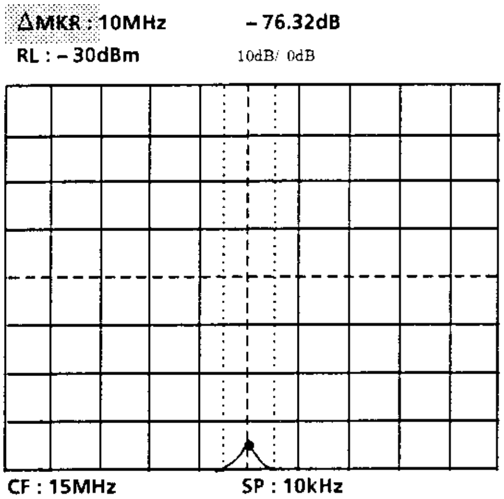
The Δ marker reading indicates the level difference between the fundamental wave and the third harmonic.

If the level difference is 80 dB or more, set the REF LEVEL to -50 dBm. Confirm that the set ATTEN value is 0 dB.

(Continued)

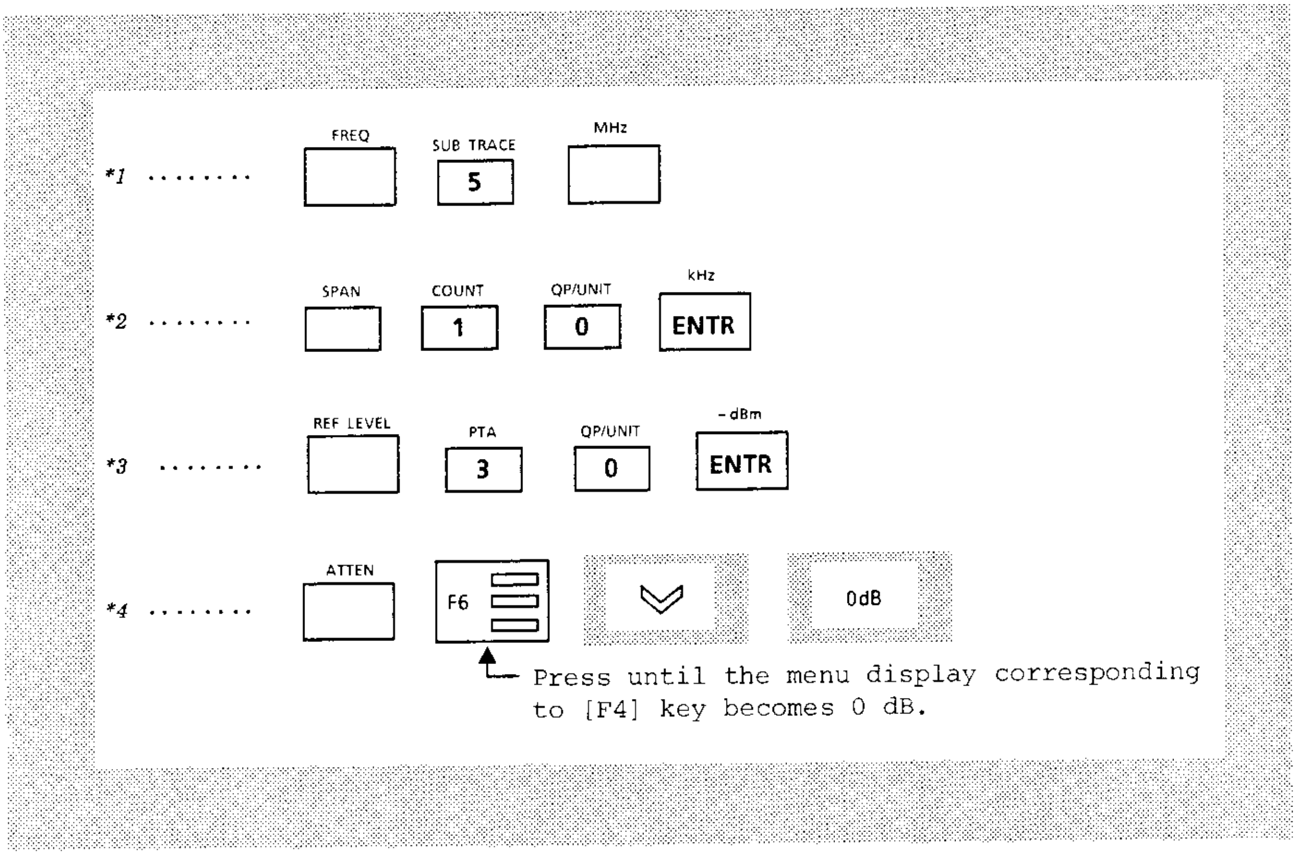
Step	Procedure





11 After setting as shown below, repeat steps 7 to 10.

SG OUTPUT FREQ: 700 MHz
LPF CUT OFF: 820 MHz
MS2601A CENTER FREQ: 700 MHz



Press until the menu display corresponding to [F4] key becomes 0 dB.

4.5 Service

If the MS2601A is damaged or does not operate as specified, contact your nearest Anritsu dealer or business office for requesting repair. When you request repair, provide the following information.

(1) Equipment name and machine number on rear panel

(2) Fault description

(3) Name of a person-in-charge and address for contact when fault confirmed or at completion of repair

SECTION 5

DETAILED OPERATING INSTRUCTIONS

The MS2601A can be operated manually from the front panel keys (local operation) or by remote control.

Remote control via GP-IB can be used to set the functions corresponding to local operation, except the power switch and INTENSITY knob. Remote control is described from SECTION 8. Local operation is described in this section. Read this section while referring to the MS2601A front and rear panels shown in APPENDIX P.

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5.1 Measurement Parameters Setting (FUNCTION)

This paragraph describes frequency (FREQ), reference level (REF LEVEL), span (SPAN), and marker data setting using the FUNCTION section.

To set the frequency, reference level, span, and marker, first, press the appropriate function header key ([FREQ], [REF LEVEL], [SPAN], [MARKER]), then enter the data.

Since the data may not be settable by numeric/unit keys or data knob, depending on the kind of header key, these methods are summarized below.

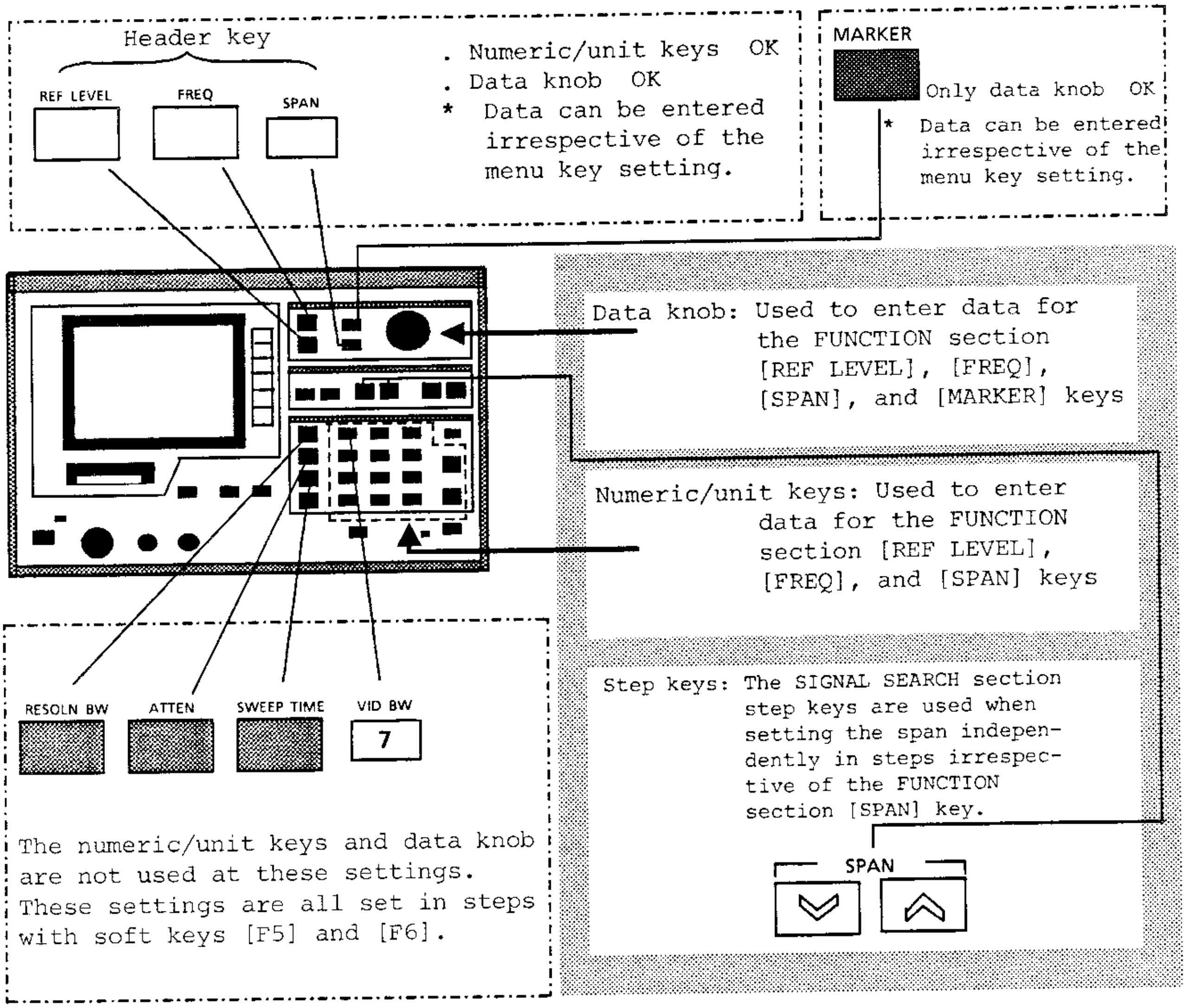
There are two data entry methods:

1. Numeric/unit keys... Value entered directly
2. Data knob... Set value continuously changeable

When one of the four FUNCTION section keys is pressed, the current function data entry mode is continued until one of the other three function keys is pressed. The setting parameters header characters displayed on the CRT are highlighted (reverse-displayed). Therefore, the next data can be entered after the last data entry.

Note:

When the FUNCTION section [FREQ], [REF LEVEL], [MARKER], or [SPAN] key is pressed, the MS2601A enters the function entry mode indicated by the key. This mode is independent of the menu key and is not cleared by menu key operation. Function data can be entered independently from the menu key even when the menu setting is changed.



. Numeric/unit keys OK
. Data knob OK
* Data can be entered irrespective of the menu key setting.

Only data knob OK
* Data can be entered irrespective of the menu key setting.

Data knob: Used to enter data for the FUNCTION section [REF LEVEL], [FREQ], [SPAN], and [MARKER] keys

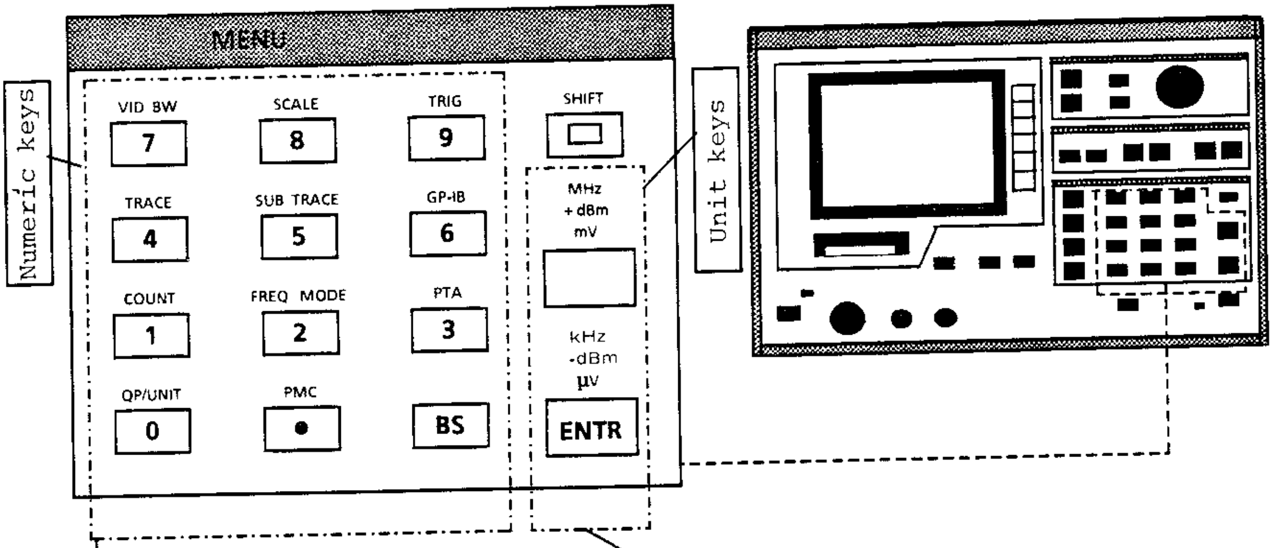
Numeric/unit keys: Used to enter data for the FUNCTION section [REF LEVEL], [FREQ], and [SPAN] keys

Step keys: The SIGNAL SEARCH section step keys are used when setting the span independently in steps irrespective of the FUNCTION section [SPAN] key.

The numeric/unit keys and data knob are not used at these settings. These settings are all set in steps with soft keys [F5] and [F6].

5.1.1 Data entry by numeric/unit keys

Data is entered in the order of header key (HEADER), numeric keys (DATA), and unit keys (UNIT). The numeric/unit keys are located in the front panel MENU section (Fig. 5-1).



■ Numeric data is entered by using the numeric/unit keys. There are 12 numeric keys: [0] to [9], [.], and a data correction (back space) key [BS]. Press the [0] to [9] keys and decimal point key [.] without pressing the [SHIFT] key. Then set the unit by using the unit keys. The [BS] key erases the last entry each time it is pressed. Fractions may be entered without the leading zero. For example, 0.5 can be entered by pressing either the [0][.][5] keys or [.][5] keys.

■ The unit keys are the two keys at the right of the MENU section. They set the frequency, reference level, and span units. The usable units are determined by the header key setting. Pressing the unit key completes data entry. When the header is [SAVE] or [RECALL], data entry is completed by pressing the [ENTR] key.

Fig. 5-1 Data Entry by Numeric/Unit Keys

Setting example	Key operation		
Center frequency CF 12.4 MHz (FREQ MODE: CENTER)*	FREQ ☐	COUNT 1, FREQ MODE 2, PMC •, TRACE 4	MHz +dBm mV ☐
Start frequency SF 1 MHz (FREQ MODE: START)**	FREQ ☐	COUNT 1	MHz +dBm mV ☐
Frequency span SP 50 kHz	SPAN ☐	SUB TRACE 5, QP/UNIT 0	kHz -dBm µV ENTR
Reference level RL -7 dBm (UNIT MODE: dBm)	REF LEVEL ☐	VID BW 7	kHz -dBm µV ENTR
Saves data to PMC REG No. 12	SAVE ☐	COUNT 1, FREQ MODE 2	kHz -dBm µV ENTR
	Header key (HEADER)	Numeric keys (DATA)	Unit keys (UNIT)

* SHIFT ☐ FREQ MODE 2 F1 ☰ CENTER ← Press key [F1] to select CENTER.

** SHIFT ☐ FREQ MODE 2 F2 ☰ START ← Press key [F2] to select START.

. Up to frequency 10 digits can be entered before pressing unit key. However, when the unit key is pressed, the set number of significant digits is limited by the function of the set header key and the remaining digits are truncated.

- If a mistake is made during data entry, characters can be erased one at a time from the last entry by pressing the [BS] key.

<Example>

100.25 entered instead of 100.36

COUNT	QP/UNIT	QP/UNIT	PMC	FREQ MODE	SUB TRACE			PTA	GP-IB
1	0	0	•	2	5	BS	BS	3	6

100.36 reset

5.1.2 Data entry by data knob

- When the data knob is turned clockwise, the set value is increased; when it is turned counterclockwise, the set value decreases.
- The data knob is convenient for changing the set value in small steps. When the knob is turned slowly, the set value is changed by the smallest step; when it is turned rapidly, the step change becomes larger. For instance, when setting the marker to the objective signal, if the knob is turned rapidly, the marker also moves rapidly; if the knob is turned slowly, the marker moves slowly.

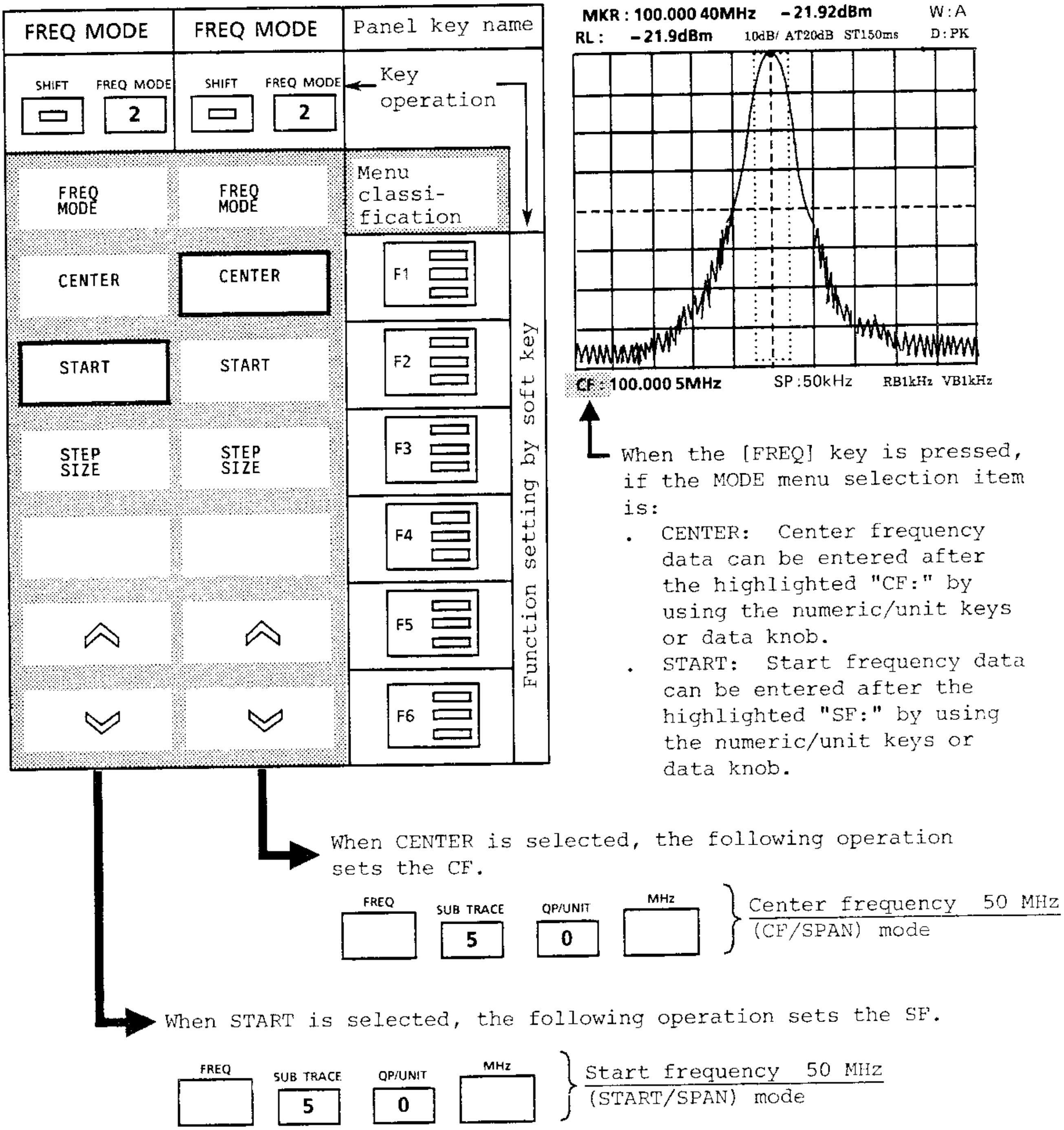
The step operation is limited to the SPAN STEP keys ([∨] and [∧]) and soft keys ([F5] and [F6]) in several menus. On the other hand, the numeric/unit keys and data knob setting values and setting ranges differ with the FUNCTION section header key.

Therefore, the numeric/unit keys and data knob are described in relation to the descriptions of the FUNCTION and MENU section keys.

5.1.3 Frequency setting (FREQ)

When the front panel FUNCTION section [FREQ] key is pressed, the MS2601A enters the FREQ entry mode. This mode is independent of the menu keys and is not cleared by menu key operation. FREQ entry is performed with the numeric/unit keys and data knob.

- When CENTER is selected at the FREQ MODE menu (paragraph 5.4.12), the CENTER FREQ can be set.
- When START is selected at the FREQ MODE menu, the START FREQ can be set.



When the [FREQ] key is pressed, if the MODE menu selection item is:

- CENTER: Center frequency data can be entered after the highlighted "CF:" by using the numeric/unit keys or data knob.
- START: Start frequency data can be entered after the highlighted "SF:" by using the numeric/unit keys or data knob.

When CENTER is selected, the following operation sets the CF.

Center frequency 50 MHz (CF/SPAN) mode

When START is selected, the following operation sets the SF.

Start frequency 50 MHz (START/SPAN) mode

Fig. 5-2 Frequency Setting and FREQ MODE

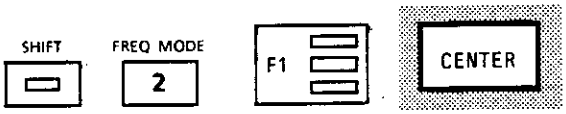
(1) CENTER FREQ entry mode setting

When the FUNCTION section [FREQ] key is pressed, if any following FREQ MODE menu condition is satisfied, the CENTER FREQ entry mode is set:

- CENTER already selected at FREQ MODE menu

  When the MS2601A is set to the initial state by pressing the [INITIAL] key, CENTER is selected.

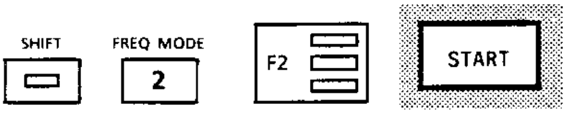
- CENTER selecting at FREQ MODE menu operation performed



(2) START FREQ entry mode setting

When the FUNCTION section [FREQ] key is pressed, if any following FREQ MODE menu condition is satisfied, the START FREQ entry mode is set:

- START already selected at FREQ MODE menu
- START selecting at FREQ MODE menu operation performed



(3) Numeric/unit keys and data knob setting range

- ■ Data setting range... 0 to 2210 MHz (20 Hz steps)
  - When the 10 Hz digit is less than a 20 Hz step, it is rounded up to the next 20 Hz step value.
  - 1 Hz digits are truncated.

<Example>

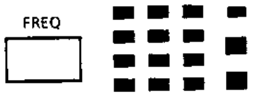
10.00 kHz → 10 kHz
10.01 kHz → 10.02 kHz
(When less than 20 Hz step, rounded up to 20 Hz of the next 20 Hz step value)
10.02 kHz → 10.02 kHz
10.03 kHz → 10.04 kHz
(When less than 20 Hz step, rounded up to 40 Hz of the next 20 Hz step value)
10.04 kHz → 10.04 kHz
10.009 kHz → 10 kHz
(Since 9 Hz is 1 Hz digit, it is truncated.)

Note:

When the set value exceeds the setting range, a buzzer sounds and the limit value is set.
The SPAN value is changed automatically so that the CF and SPAN, or START and SPAN relationships are correct and a buzzer sounds. (See the table on the next page.)

■ Usage features

Numeric/unit keys



CENTER FREQ and START FREQ can be set at a resolution of 20 Hz.
However, since the marker frequency resolution is 0.2% of the frequency span, the narrower the span, the higher the number of digits that can be read.

Data knob

The center frequency and start frequency change width is:

- Knob turned slowly: Approx. 1/10 of frequency span (horizontal axis 1 div) per one rotation
- Knob turned rapidly: Approx. 2 to 3 times the speed of when knob turned slowly

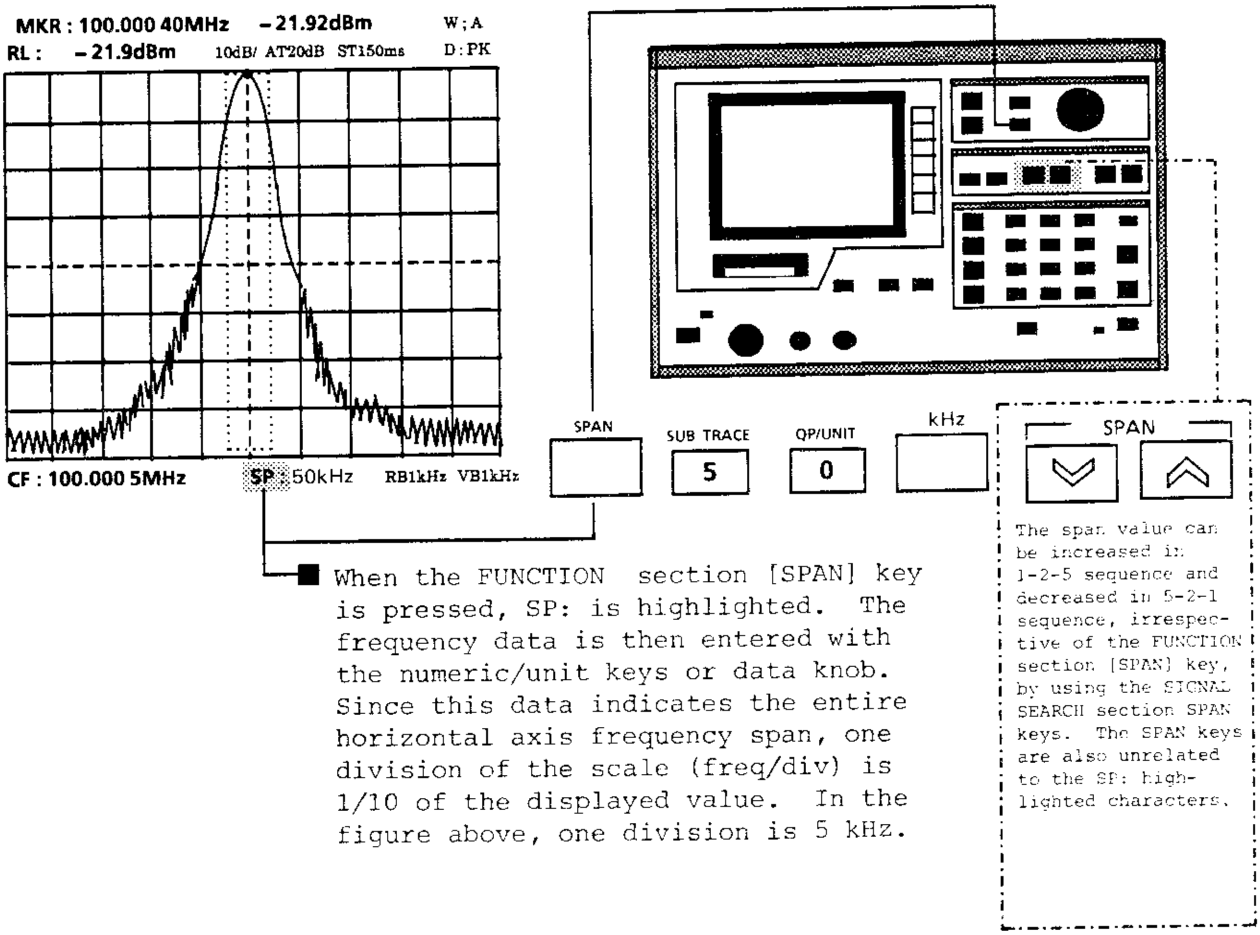
Relationship with span

For example, in the CF/SPAN mode, if the relationship between CF and SPAN is correct, SPAN will not change even if CF is changed.
However, if CF is set so that (CF-SPAN/2) is less than -100 MHz, or (CF + SPAN/2) is greater than 2300 MHz, since the SPAN value is unsuitable, a buzzer sounds and the SPAN value is automatically changed so that the relationship with CF is correct. For instance, when CF 50 MHz is entered from the CF 1100 MHz and SPAN 2200 MHz state, SPAN is automatically set to 300 MHz.

5.1.4 Frequency span setting (SPAN)

When the FUNCTION section [SPAN] key is pressed, the MS2601A enters the SPAN entry mode. This mode is independent of the menu keys and is not cleared by menu key operation.

SPAN is entered with the numeric/unit keys and data knob. SPAN can be changed with the SIGNAL SEARCH section SPAN step keys.



■ When the FUNCTION section [SPAN] key is pressed, SP: is highlighted. The frequency data is then entered with the numeric/unit keys or data knob. Since this data indicates the entire horizontal axis frequency span, one division of the scale (freq/div) is 1/10 of the displayed value. In the figure above, one division is 5 kHz.

The span value can be increased in 1-2-5 sequence and decreased in 5-2-1 sequence, irrespective of the FUNCTION section [SPAN] key, by using the SIGNAL SEARCH section SPAN keys. The SPAN keys are also unrelated to the SP: highlighted characters.

Fig. 5-3 Frequency Span Setting

(1) Numeric/unit keys and data knob setting range

■ Data setting range .... 0 and 1 kHz to 2200 MHz

- If setting of a number larger than two digits is attempted, only two high-order digits are set. Zero is substituted for the low-order digits.
- For significant digits in the ≧50 and ≦10 ranges and for 5 kHz or less, the lower of the two high-order digits is set to the lower even number if it is an odd number.
- When a number between ≧10 and ≦50 and one significant digit number is entered, the entered value is set.

<Example 1> Even number setting

≧50	≦10	≦5 kHz
576 MHz → 560 MHz	9.99 kHz → 9.8 kHz	1.5 kHz → 1.4 kHz
569 MHz → 560 MHz	9.99 MHz → 9.8 MHz	1.2 kHz → 1.2 kHz
835 MHz → 820 MHz	9.88 MHz → 9.8 MHz	1.3 kHz → 1.2 kHz
820 MHz → 820 MHz	5.3 MHz → 5.2 MHz	1.76 kHz → 1.6 kHz
	6.29 MHz → 6.2 MHz	(1.76 MHz → 1.7 MHz)

Last digit of high-order 2 digits

Parenthesized values are >5 kHz at significant digits over 10.

<Example 2>

Entry of significant digits between 10 and 50 and one significant digit

1256 MHz → 1200 MHz
1346 MHz → 1300 MHz
49 MHz → 49 MHz
48.49 MHz → 48 MHz
47.6 MHz → 47 Mhz
11.5 MHz → 11 MHz
10.7 MHz → 10 MHz

1.98 MHz → 1.9 MHz
700 MHz → 700 MHz (significant digits 1)
770 MHz → 760 MHz (significant digits >50)
470 MHz → 470 MHz
905 MHz → 900 MHz (significant digits 1)
995 kHz → 980 kHz (significant digits >50)

Note:

When the set value exceeds the setting range, a buzzer sounds and the limit value is set. If the relationship between SPAN and CF is incorrect, the SPAN value is automatically changed so that the relationship is correct. (See the table below.)

■ Usage features

Relationship with CF

For example, in the CF/SPAN mode, if the relationship between CF and SPAN is correct, the SPAN value can be set wider or narrower than the current SPAN value, based on a constant CF.
However, if the current SPAN value satisfies the condition (CF-SPAN/2) = -100 MHz or (CF+SPAN/2) = 2300 MHz, if an attempt is made to set SPAN to a value wider than the current SPAN value without changing CF, a buzzer will sound and SPAN will return to the current SPAN value (limit value). For instance, if an attempt is made to set SPAN to 410 MHz when the CF = 100 MHz and SPAN = 400 MHz state, a buzzer will sound and the SPAN value will be automatically reset to 400 MHz.

■ Usage features (Cont.)

Relationship with RB, VB, and ST

If the resolution bandwidth (RB), video bandwidth (VB), and sweep time (ST) are set in AUTO mode, when the SPAN value is changed,

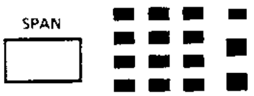
- RB is automatically set to the optimum value corresponding to the SPAN value.
- VB is automatically set to the optimum value according to the RB value.
- ST is automatically set to the optimum value according to the SPAN, RB, and VB values.

so that frequency and level measurement errors are not generated.

Span width

Since the span readout accuracy is 2%, the absolute error can be reduced and the signal waveform zoom (magnification) effect and marker reading resolution can be increased by narrowing the span width.

Numeric/unit keys

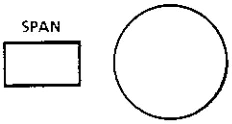


Up to 7 digits can be entered, but setting is 2 significant digits and is based on the limits described in the data setting range section.

- Even if kHz is specified as the unit, frequencies over 1000 kHz are displayed in MHz unit.
  <Example> 1000 kHz → 1 MHz, 999 kHz → 980 kHz
- Even if MHz is specified as the unit, frequencies below 1000 kHz are displayed in kHz unit.
  <Example> 0.999 MHz → 980 kHz
- The unit when SPAN 0 is entered can be either kHz or MHz.

■ Usage features (Cont.)

Data knob



The span value can be varied continuously or in even-number steps at two significant digits as shown below, based on the limits described in the data setting range.

kHz	Even number	1, 1.2, 1.4, 1.6 to 2, 2.2, 2.4 to 9.8, 10
	Continuous	10, 11, 12 to 20, 21, 22 to 30, 31, 32 to 49, 50
	Even number	50, 52 to 58, 60, 62, 64 to 96, 98, 100
	Continuous	100, 110, 120 to 470, 480, 490, 500
	Even number	500, 520 to 580, 600, 620, 640 to 940, 980
MHz	Continuous	1, 1.1, 1.2 to 2, 2.1, 2.2, to 3, 3.1, 3.2 to 4.9, 5
	Even number	5, 5.2 to 5.8, 6, 6.2, 6.4 to 9.6, 9.8, 10
	Continuous	10, 11, 12 to 20, 21, 22 to 30, 31, 32 to 49, 50
	Even number	50, 52 to 58, 60, 62, 64 to 96, 98, 100
	Continuous	100, 110, 120 to 470, 480, 490, 500
	Even number	500, 520 to 580, 600, 620, 640 to 960, 980, 1000
	Continuous	1000, 1100, 1200 to 2000, 2100, 2200

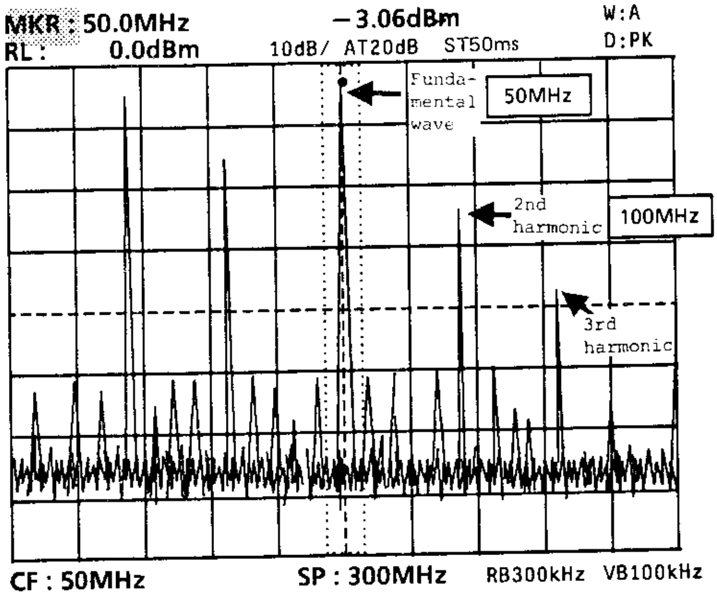
(2) Zero span

When the frequency span is set to 0, the MS2601A operates as a fixed tuned receiver with the variable bandwidth tuned to the center frequency (CF).

- The CRT horizontal axis is a time-domain display (input signal shown as a function of time).
- When an input signal equal to the set CF is applied to the RF INPUT connector, its detected output is displayed on the CRT as a change of amplitude with time.

<Example>

Receive 50 and 100 MHz signals shown below in time domain.



After pressing the

SPAN	QP/UNIT	KHz
	0	

keys in order,

(1) To receive the 50 MHz signal,

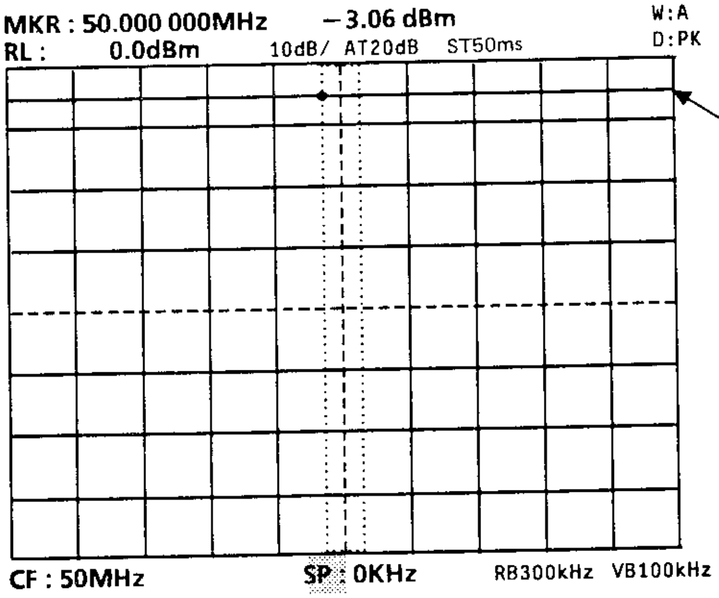
Press

FREQ	SUB TRACE	QP/UNIT	MHz
	5	0	

(2) To receive the 100 MHz signal,

Press

FREQ	COUNT	QP/UNIT	QP/UNIT	MHz
	1	0	0	



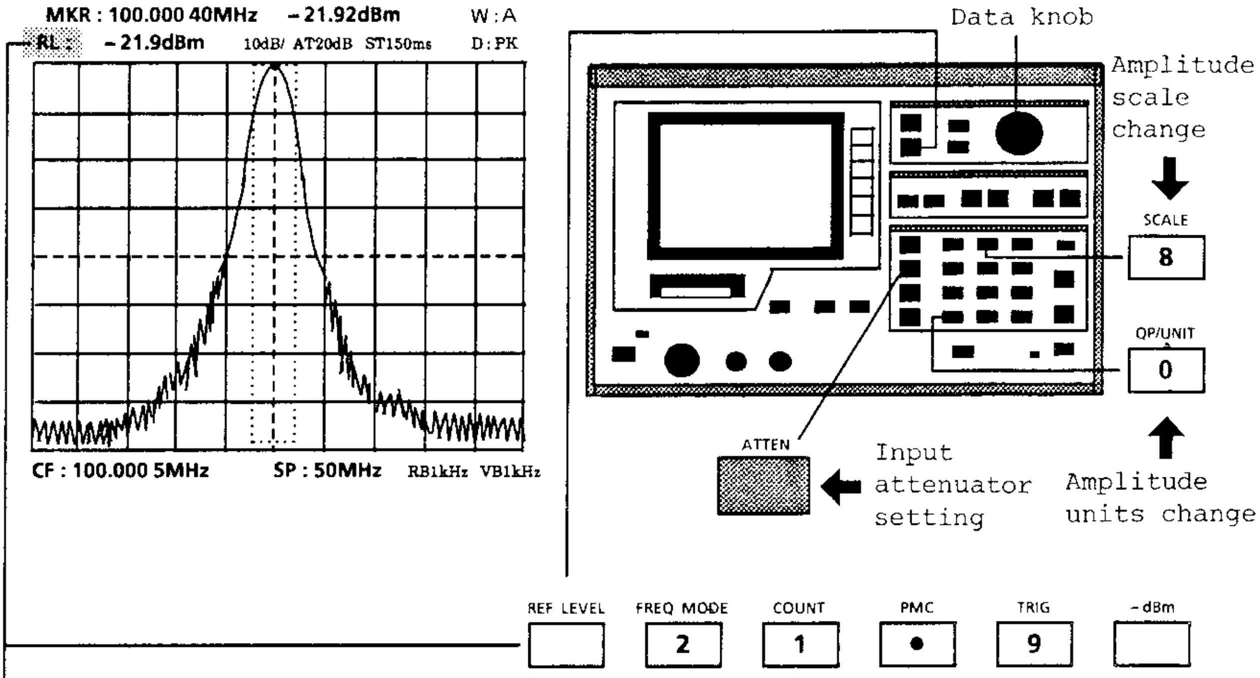
The CRT when the 50 MHz signal is received is shown at the left.

50 MHz reception level -3.06 dBm

When the signal level on the CRT does not change with time, a constant amplitude is measured.

5.1.5 Reference level setting (REF LEVEL)

When the front panel FUNCTION section [REF LEVEL] key is pressed, the MS2601A is set to the REF LEVEL entry mode. This mode is independent of the menu keys and is not cleared by menu key operation. REF LEVEL is entered by using the numeric/unit keys and data knob..



- When the FUNCTION section [REF LEVEL] key is pressed, RL: is highlighted. The reference level data is then entered with the numeric/units keys or data knob.
  The absolute amplitude level of the horizontal line at the top of the CRT scale (reference level line) can be changed by this operation.

- When the polarity of the reference level is negative, enter the positive value, then press the [-dBm] unit key.

Fig. 5-4 Reference Level and Associated Data Setting

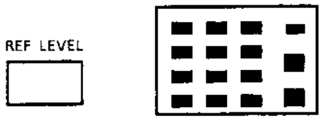
(1) Numeric/unit keys and data knob setting range

■ REF LEVEL setting range: -100.0 to +20.0 dBm
(0.1 dB steps)

- When the unit is not dBm, the converted value from the corresponding dBm value is set.
- dBμV........ +7.0 to +127.0 dBμV
- dBmV........ -53.0 to +67.0 dBmV
- dBμV(emf)... +13.0 to +133.0 dBμV(emf)
- V........... 2.2 μV to 2240 mV
  (For LIN, 70.8 μV to 2240 mV)

■ Usage features

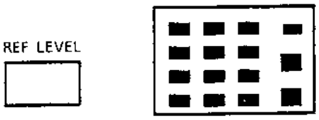
Numeric/unit keys



- When dBμV or dBmV is selected at the QP/UNIT menu, the dBm unit key is used for dBμV or dBmV unit.
- When V is selected at the QP/UNIT menu, use the μV or mV unit key.
- The setting resolution is 0.1 dB. Therefore, data entered after the 0.1 dB digit is truncated.
- When the unit is V (μV, mV), up to 3 significant digits can be entered. However, since the internal setting format is a 0.1 dB unit, the data is reset so that conversion to 0.1 dB unit is possible as shown below.

■ Usage features (Cont.)

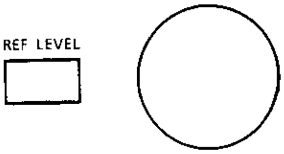
Numeric/unit keys



dBm	V converted value	Entry		Setting
0.0	224 mV	224 mV	→	224 mV
0.1	226 mV	225 mV	→	224 mV
0.2	229 mV	228 mV	→	226 mV
0.3	232 mV	231 mV	→	229 mV
0.4	234 mV	235 mV	→	234 mV
0.5	237 mV	236 mV	→	234 mV
0.6	240 mV	240 mV	→	240 mV
0.7	243 mV	244 mV	→	243 mV
0.8	245 mV	245 mV	→	245 mV
0.9	248 mV	248 mV	→	248 mV
1.0	251 mV	250 mV	→	248 mV

- Since the data corresponding to the value converted to a 0.1 dB unit is entered, the underlined data are set as entered.
- Since the other data is between 0.1 dB converted data, it is rounded to the corresponding value converted to the 0.1 dB unit data smaller than the entered data and set and displayed.

Numeric/unit keys



- For log scale, the data is changed in 0.1 dB steps.
- For V unit, the data is changed in steps corresponding to 0.1 dB.

(2) Amplitude scale modification

The SCALE menu can be opened and the CRT vertical amplitude scale can be selected from 10 dB/div, 5 dB/div, 2 dB/div, 1 dB/div, and LIN, by pressing the [SHIFT][SCALE] keys.

In the initial state, LOG 10 dB/div is already selected. 10 dB/ of "10 dB/ AT20 dB" in Fig. 5-4 shows this. For 10 dB/div, the vertical axis of the CRT scale is 8 divisions. For the other four amplitude scales, the vertical axis is 10 divisions.

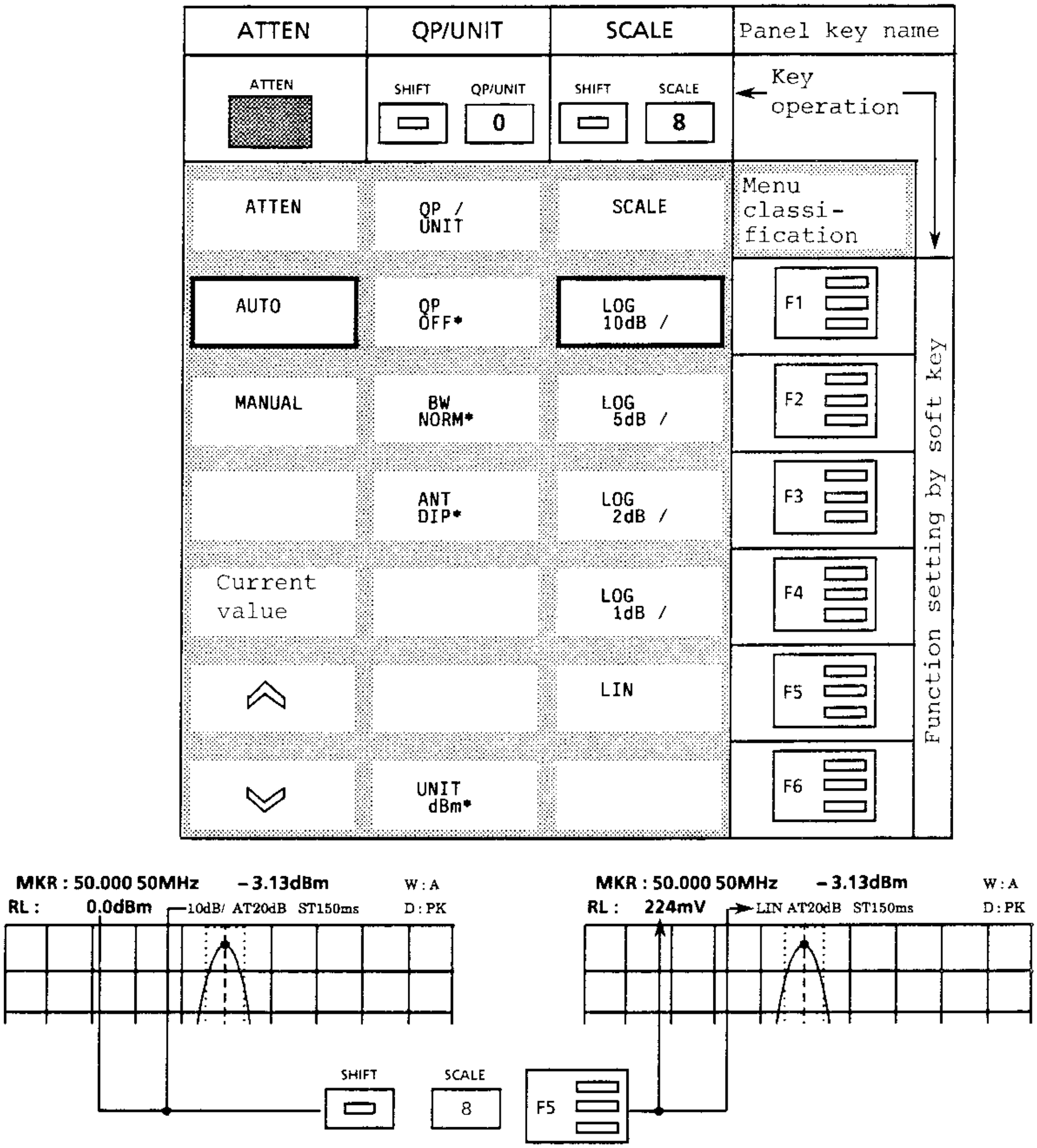


Fig. 5-5 Reference Level Menu

To set LIN, press the [F5] key as shown above. RL (REF LEVEL) becomes a V (volt) display and the vertical amplitude scale is displayed as LIN. In the figure above, the display is changed from 0.0 dBm to 224 mV, and from 10 dB/div to LIN.

The linear scale is an amplitude scale which is proportional to the input voltage. The top line on the CRT is the REF LEVEL value and the bottom line is 0.0 mV.

Note:

The LOG and LIN amplitude display linearity error per vertical division on the CRT is shown below. In addition, when the peak of the signal is under the reference level line, if the peak is moved to the top line of the CRT by using the data knob or [PEAK→REF] key, and the level on the top (reference level) line is read, the scale linearity is not included and measurement can be made at the highest accuracy. (When LIN is set, PEAK → REF is not performed)

LOG: ±1 dB at 0 to -70 dB (10 dB/div) display
±0.5 dB at 0 to -50 dB (5 dB/div) display
±0.3 dB at 0 to -20 dB (2 dB/div) display
±0.2 dB at 0 to -10 dB (1 dB/div) display
LIN: ±3% of reference level (full scale)

(3) Amplitude units modification

The QP/UNIT menu is opened by pressing the [SHIFT] [QP/UNIT] keys shown in Fig. 5-4 or Fig. 5-5 and the amplitude unit is selected with soft key [F6].

When the menu is first opened, the UNIT display corresponding to the [F6] key is displayed with an asterisk and the unit with the asterisk is already set even if the [F6] key is not pressed.

For example, if dBm is already used as the amplitude unit, the menu display is as follows:

UNIT
dBm*

The units shown below can be selected serially by pressing the [F6] key repeatedly. (The unit key which was pressed last is selected.)

UNIT dBm* | UNIT dBμV* | UNIT dBmV* | UNIT V* | UNIT dBμe* | UNIT dB/m*

Note:

When UNIT is dBm, etc. (except V) when SCALE is LOG, if the scale is changed to LIN, UNIT changes to V. When SCALE is returned to LOG, the previous log UNIT is recalled. Therefore, when the [INITIAL] key is pressed in the LIN scale, SCALE becomes LOG, but the previous log UNIT is recalled. When dB/m (= dBμV/m field strength measurement) is selected as UNIT, only the marker level unit becomes dBμV/m. The REF LEVEL unit becomes dBμV.

(4) REF LEVEL setting and input attenuator (ATTEN)

When REF LEVEL is set when AUTO is selected at the ATTEN menu (Fig. 5-5), INPUT ATTEN is set automatically in accordance with Table 5-1 so the dynamic range is extended according to the REF LEVEL so that gain compression does not occur.

Table 5-1 AUTO Mode

REF·LEVEL(dBm)	ATTEN(dB)
-100.0 ~ -20.0	0
-19.9 ~ -10.0	10
-9.9 ~ 0.0	20
0.1 ~ 10.0	30
10.1 ~ 20.0	40

Table 5-2 ATTEN

REF·LEVEL(dBm)	Settable ATTEN (dB)
-100.0 ~ -62.0	0
-61.9 ~ -52.0	0, 10
-51.9 ~ -42.0	0, 10, 20
-41.9 ~ -32.0	0, 10, 20, 30
-31.9 ~ -22.0	0, 10, 20, 30, 40
-21.9 ~ -10.0	0, 10, 20, 30, 40, 50
-9.9 ~ 0.0	10, 20, 30, 40, 50
0.1 ~ 10.0	20, 30, 40, 50
10.1 ~ 20.0	30, 40, 50

INPUT ATTEN in AUTO mode is set at initial setting or when the [ATTEN][F1] keys are pressed in order.

The INPUT ATTEN in AUTO mode value is set so that when a signal of the same level as the REF LEVEL is input, gain compression has no effect and level measurement is performed accurately and the noise level is lowered. However, if INPUT ATTEN is left in the AUTO mode, to increase the sensitivity and measure low-level signals when measuring non-harmonic spurious response, signal adjacent spurious response, etc., the ATTEN value may be too high and measurement at the required sensitivity may be impossible. In this case, set INPUT ATTEN in the MANUAL mode in accordance with Table 5-2. The INPUT ATTEN value can be set to a low value within the range over which mixer level [(input level equal to reference level) - (INPUT ATTEN value)] is ≦-10 dBm.

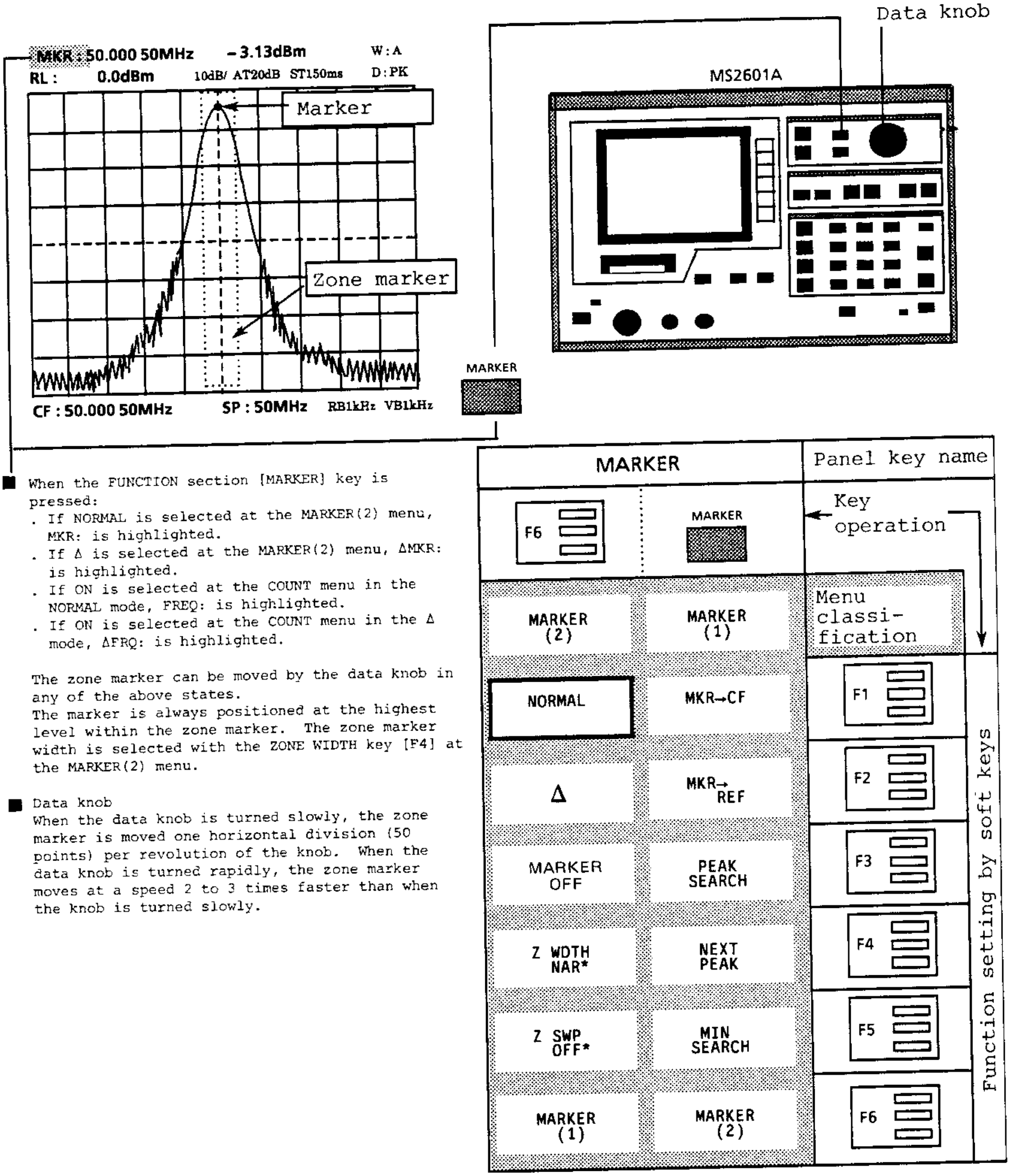
When measuring 2nd and 3rd harmonic spurious response, the affect of internal distortion must be eliminated by lowering the mixer input level. Since the specified internal distortion is ≦-75 dB for a -30 dBm mixer input level, to measure harmonic spurious response down to -75 dB, the mixer input must be made ≦-30 dBm. In this case, if the ATTEN setting remains AUTO, since the ATTEN value is too small, set the ATTEN value in the MANUAL mode. To set the MANUAL mode, open the ATTEN menu by pressing the [ATTEN] key and set the ATTEN value with the [F5] or [F6] key.

5.2 Marker Function Details

When the front panel FUNCTION section [MARKER] key is pressed, the MARKER(1) or MARKER(2) menu is displayed in accordance with the display selected previously. When MKR: is highlighted by pressing the [MARKER] key, the zone marker can be moved with the data knob (numeric/unit keys cannot be used).

Note:

- When the FUNCTION section [FREQ], [REF LEVEL], or [SPAN] key is pressed when a MARKER menu is displayed, the highlighted characters at the top left of the CRT are cleared and the highlighted characters of the selected FUNCTION are displayed even if the MARKER menu remains displayed. At this time:
  - The zone marker and spot marker cannot be moved with the data knob.
  - The measured value (frequency and level) can be read from the marker.
  - The MARKER menu function can be selected and executed with soft keys [F1] to [F6].
- When the [INITIAL] key is pressed or at POWER ON, the MARKER(1) menu is displayed.
  However, for the MARKER(2) menu:
  - When the [INITIAL] key is pressed, menu items NORMAL, Z WIDTH NAR*, and Z SWP OFF are set, the MARKER(2) menu is not displayed on the CRT.



MARKER		Panel key name
F6	MARKER	Key operation
MARKER (2)	MARKER (1)	Menu classi-fication
NORMAL	MKR→CF	F1
Δ	MKR→REF	F2
MARKER OFF	PEAK SEARCH	F3
Z WDTH NAR*	NEXT PEAK	F4
Z SWP OFF*	MIN SEARCH	F5
MARKER (1)	MARKER (2)	F6

■ When the FUNCTION section [MARKER] key is pressed:

- If NORMAL is selected at the MARKER(2) menu, MKR: is highlighted.
- If Δ is selected at the MARKER(2) menu, ΔMKR: is highlighted.
- If ON is selected at the COUNT menu in the NORMAL mode, FREQ: is highlighted.
- If ON is selected at the COUNT menu in the Δ mode, ΔFRQ: is highlighted.

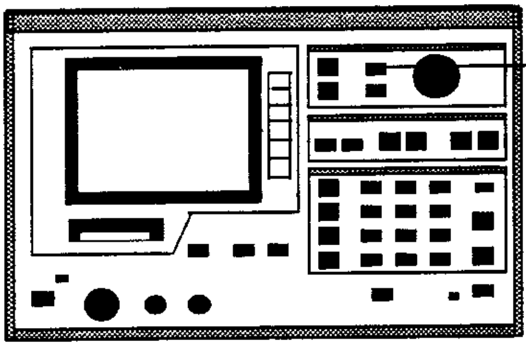
The zone marker can be moved by the data knob in any of the above states. The marker is always positioned at the highest level within the zone marker. The zone marker width is selected with the ZONE WIDTH key [F4] at the MARKER(2) menu.

■ Data knob
When the data knob is turned slowly, the zone marker is moved one horizontal division (50 points) per revolution of the knob. When the data knob is turned rapidly, the zone marker moves at a speed 2 to 3 times faster than when the knob is turned slowly.

Fig. 5-6 CRT Display when MARKER Key Pressed

5.2.1 MARKER(1) and (2) menus

When the front panel FUNCTION section [MARKER] key is pressed, the MARKER(1) or MARKER(2) menu shown below is displayed and the MS2601A enters the MARKER entry mode. The MARKER menu (1) or (2) that was previously displayed is reproduced. However, at POWER ON, or when the [INITIAL] key is pressed, the MARKER(1) menu is displayed. The required function is selected by pressing the corresponding soft keys [F1] to [F6].

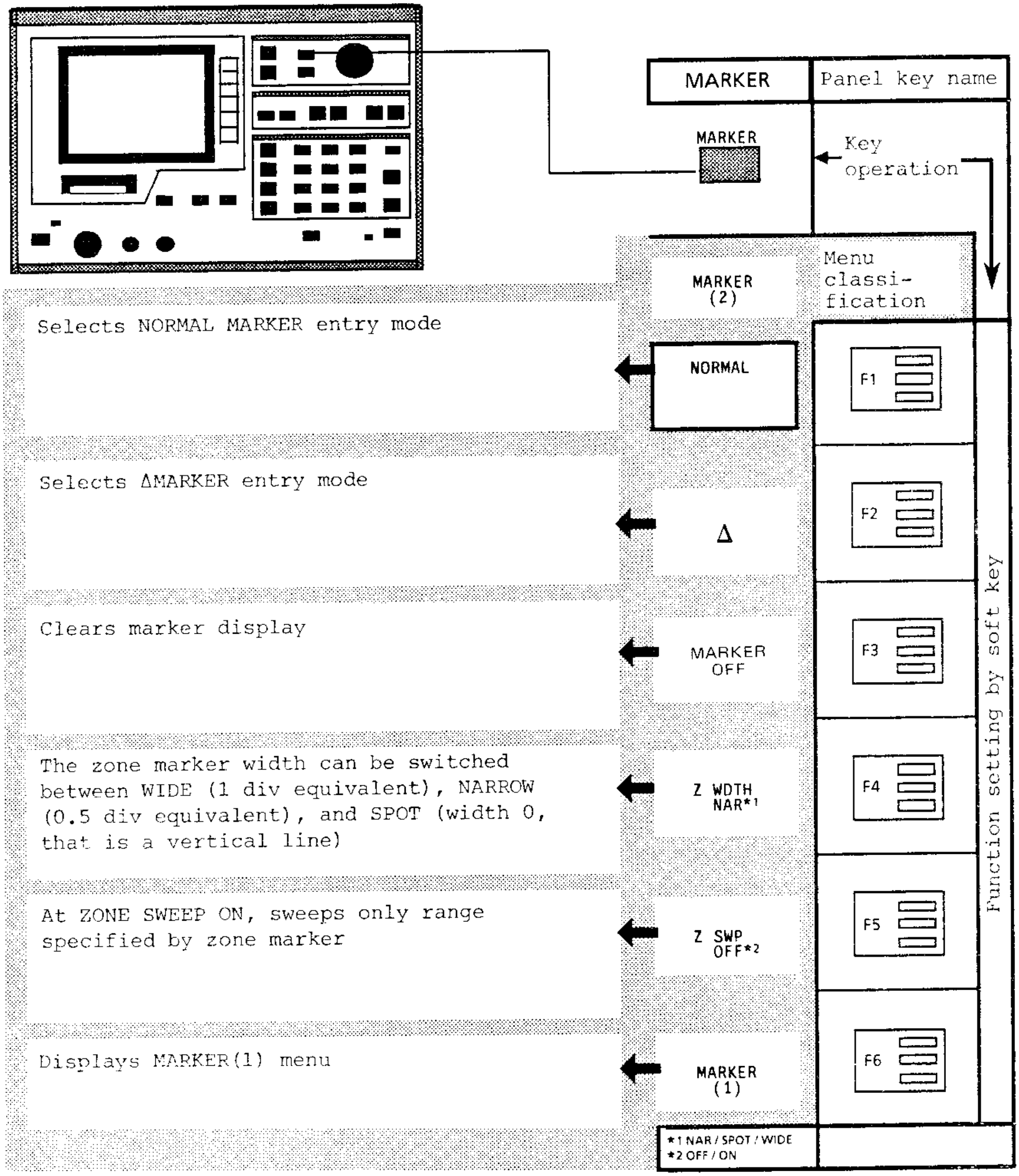


MARKER	Panel key name
MARKER	Key operation
MARKER (1)	Menu classification

Function setting by soft key

Makes marker frequency CENTER FREQ Ineffective when SCALE is LIN or at both A and B-WRITE OFF	MKR→CF	F1
Makes marker level REF LEVEL Ineffective when SCALE is LIN or at both A and B-WRITE OFF	MKR→REF	F2
Moves marker to highest level on CRT and makes that point center of zone marker	PEAK SEARCH	F3
Moves marker to next lower peak from current marker level This function is effective only when ZONE WIDTH is SPOT.	NEXT PEAK	F4
Moves marker to lowest level on CRT This function is effective only when ZONE WIDTH is SPOT.	MIN SEARCH	F5
Displays MARKER(2) menu	MARKER (2)	F6

When the [F6] key is pressed when the MARKER(1) menu is displayed when the front panel FUNCTION section [MARKER] key is pressed, the MARKER(2) menu shown below is displayed on the CRT and the required function is selected by pressing the soft key [F1] to [F6] corresponding to that function.



Selects NORMAL MARKER entry mode	NORMAL	F1
Selects ΔMARKER entry mode	Δ	F2
Clears marker display	MARKER OFF	F3
The zone marker width can be switched between WIDE (1 div equivalent), NARROW (0.5 div equivalent), and SPOT (width 0, that is a vertical line)	Z WDTH NAR*1	F4
At ZONE SWEEP ON, sweeps only range specified by zone marker	Z SWP OFF*2	F5
Displays MARKER(1) menu	MARKER (1)	F6

*1 NAR / SPOT / WIDE
*2 OFF / ON

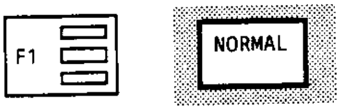
(1) MARKER(1) menu function selection

The MARKER(1) menu MKR→CF to MARKER(2) functions are selected by pressing the corresponding keys [F1] to [F6].

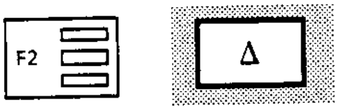
(2) MARKER(2) menu function selection

For MARKER(2) menu NORMAL to MARKER(1) functions:

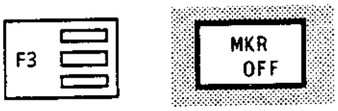
- When keys [F1] to [F3] that correspond to NORMAL, Δ, and MKR OFF are pressed once, the selected function is enclosed in a square frame which is held until another function is selected.



..... Function held until [F2] or [F3] key pressed



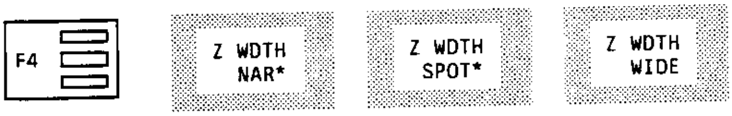
..... Function held until [F1] or [F3] key pressed

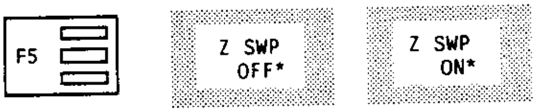


..... Function held until [F1] or [F2] key pressed

- Function selected with asterisk... Displayed function set.

. [F4] or [F5] key... Menus shown below serially switched by pressing [F4] or [F5] key repeatedly.





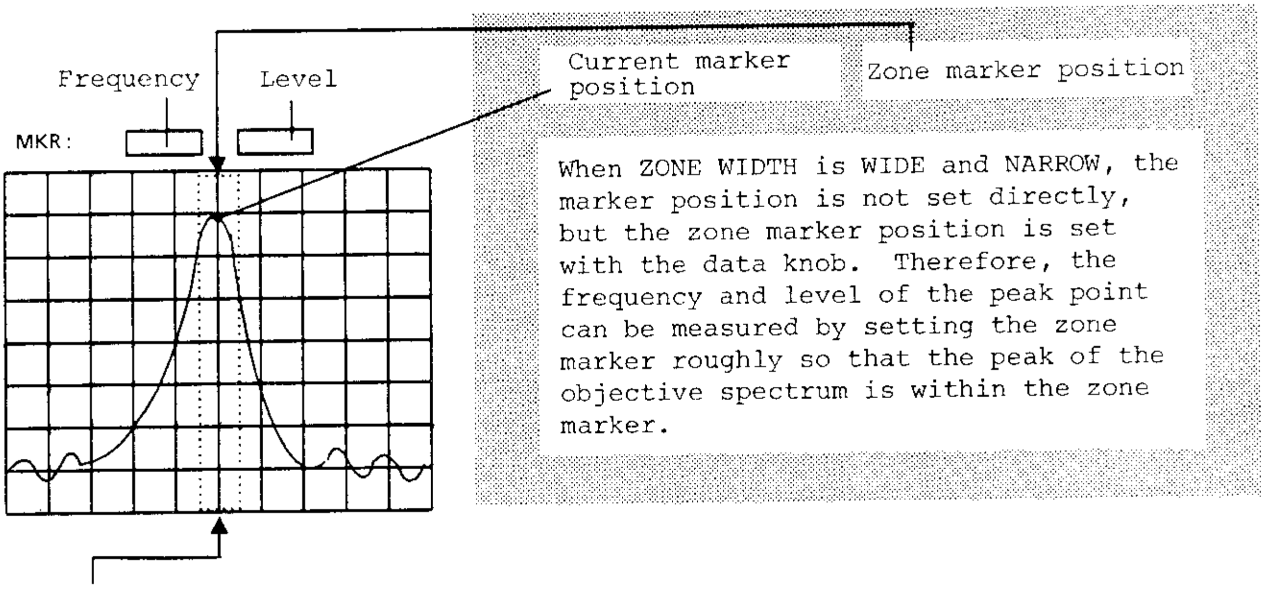
. [F6] key.... MARKER(1) menu displayed when pressing [F6] key.

5.2.2 NORMAL marker and zone marker selection

When the [MARKER] key is pressed, if any following condition is satisfied, the NORMAL marker and zone marker NAR are selected.

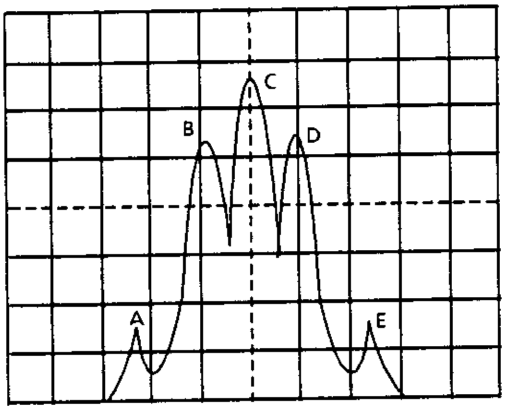
- NORMAL and Z WDTH NAR* already selected at MARKER(2) menu
- NORMAL and WDTH NAR* selected with [F1] and [F4] keys at MARKER(2) menu
- [INITIAL] key pressed

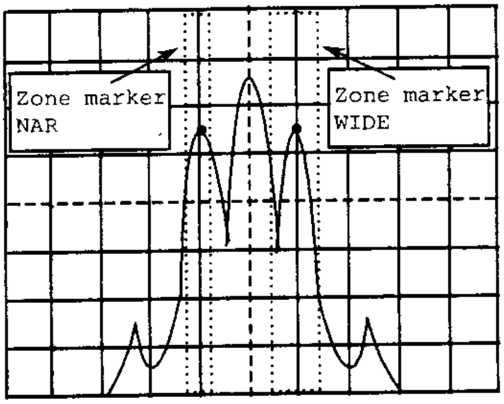
The NORMAL marker sets the zone marker (displayed by dotted frame on CRT) at the channel currently written (READ ON channel when a channel is not written, or the last channel set to READ ON when channels A and B are set to READ ON at the same time) and displays the marker point (current marker) at the highest point within the zone marker. The marker frequency and level are then displayed digitally.



When ZONE WIDTH is WIDE and NARROW, the marker position is not set directly, but the zone marker position is set with the data knob. Therefore, the frequency and level of the peak point can be measured by setting the zone marker roughly so that the peak of the objective spectrum is within the zone marker.

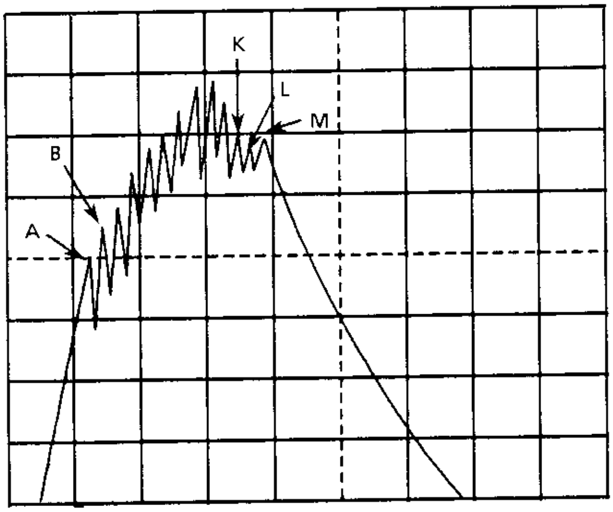
1. The dotted line frame is moved as one marker, that is, the zone marker, with the data knob.
2. The marker is moved to the highest level within the frequency range indicated by the zone marker.
3. The current marker frequency and level are displayed digitally at the top of the figure.
4. Because the zone width is 0 when ZONE WIDTH is SPOT, the position of the marker point itself can be set with the data knob.

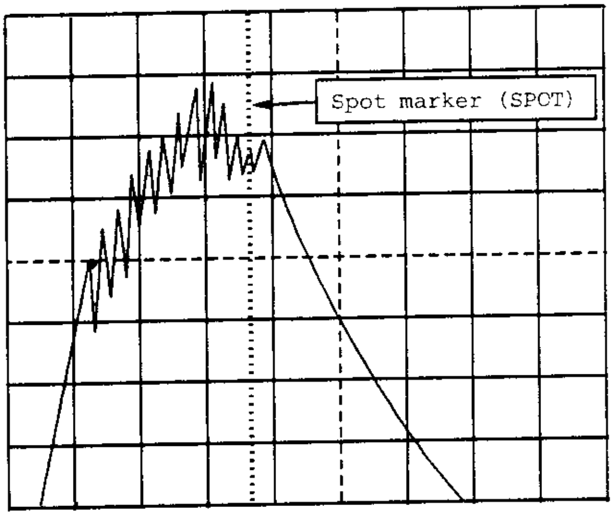




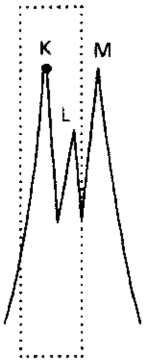
The current marker point is positioned to peaks A, B, C, D, or E of the trace waveform shown above by setting the zone marker to NAR or WIDE and turning the data knob so that one of the peaks (A, B, C, D, E) is within the zone marker. The operation after opening of the MARKER(2) menu is shown below.

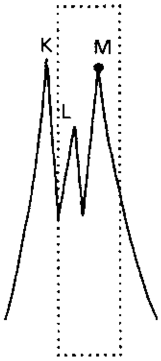
Step	Procedure
1	F1 NORMAL ← NORMAL marker selection
2	Press the F4 key to display Z WDTH NAR* or Z WDTH WIDE*.
3	Move the zone marker to the measurement zone with the data knob.



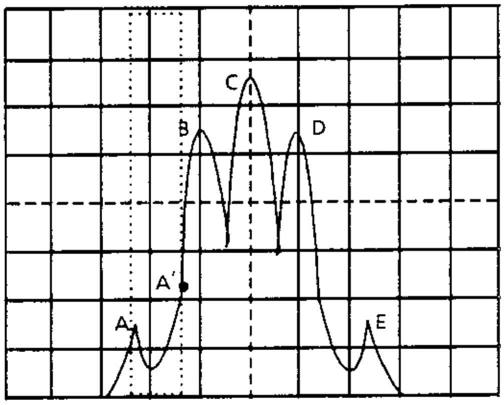


When the peaks of the waveforms are grouped close together as shown above, the zone marker is set to NAR or SPOT with the [F4] key. Of peaks A, B, ...K, L, and M, all but L can be handled by the NAR zone marker. For peak L, the zone marker is set to SPOT because when the zone marker is set to NAR, peak K or M, which has a higher level than peak L, is within the zone marker and the marker cannot be positioned to peak L.





When the space between peaks is narrow, the SPOT zone marker is more suitable than the NAR zone marker.



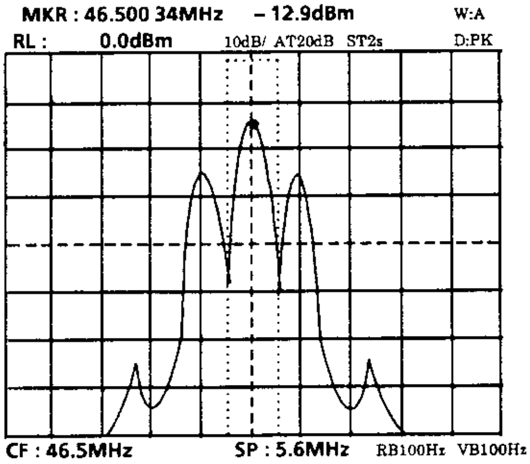
Note:

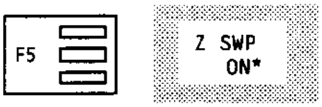
When the left slope of peak B is within the zone marker when the zone marker is moved to position the marker at peak A in the figure above, move the zone marker so that the height of that position A' is lower than A, that is A>A'.

Since A<A' in the figure above, the marker cannot be displayed at peak A.

5.2.3 Zone marker sweep

To sweep only the bottom-peak - bottom of waveform C of the spectrum waveforms shown above of the Note above and increase the waveform C adjustment speed, only the frequency range of the part displayed by the zone marker can be swept repeatedly. The operation after opening of the MARKER(2) menu is shown below.



Step	Procedure
1	Set the zone marker to WIDE or NAR by using the [F4] key.
2	Move the zone marker to the waveform C measurement range by using the data knob.
3	Adjust the span so that the measurement range is within the zone marker.
4	Set ZONE SWEEP to ON with the [F5] key. 

- ■ Sweep speed

Since the sweep speed at ZONE SWEEP is the same as normal sweep, the sweep time of ZONE SWEEP is:

. WIDE.... 1 div (1/10) of full sweep

. NAR..... 0.5 div (1/20) of full sweep

The example above shows that the sweep time that normally requires 2 s at full sweep can be performed in 1/10 the time, or 200 ms.

Notes:

1. When ZONE SWEEP is on, the zone marker can be moved with the data knob, but the PEAK→CF, PEAK→REF, SCROLL <,>, MKR→CF, MKR→REF, PEAK SEARCH, NEXT PEAK, MIN SEARCH, and ZONE WIDTH functions cannot be executed (buzzer sounds). To execute these functions, turn off ZONE SWEEP.

2. ZONE SWEEP is not turned on when ZONE WIDTH is SPOT (buzzer sounds).

3. Steps 3 and 4 in the operating procedure previously described cannot be interchanged. Changing the full sweep width during partial sweep cannot be performed.

4. When ZONE SWEEP is on, the TRIG mode cannot be set to VIDEO, LINE, or EXT. When TRIG mode is set to VIDEO, LINE, or EXT, ZONE SWEEP cannot be turned on.

5.2.4 Δ marker

When the [F2] key is pressed when the MARKER(2) menu is opened and NORMAL marker is selected, the position of the current marker ● becomes the reference marker ☐ and the frequency and level differences become 0.

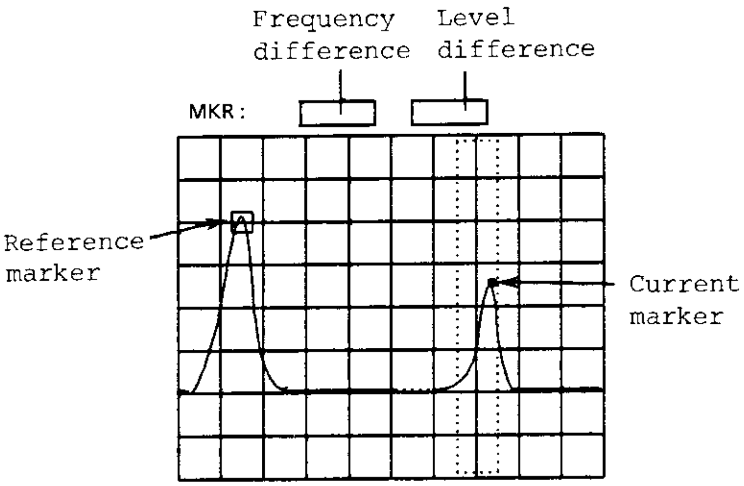
Thereafter, the current marker ● is moved with the data knob and the differences (frequency and level) between two points is found. That is, the Δ marker is used as follows:

1. To display ☐ over the current marker ● as the reference marker.

2. To store the current frequency and level of the [●] point as the reference marker frequency and level in LOG scale. (In LIN scale, the reference marker level is stored as a position on the vertical axis on the CRT, and not as a level value.)

3. To display the frequency and level differences between the reference marker ☐ and current marker ● digitally as 0.000 kHz and 0.00 dBm.

4. When the current marker ● is moved with the data knob thereafter, to display the frequency difference between the current marker ● and the reference marker and the level difference between the current marker and the reference marker, digitally.



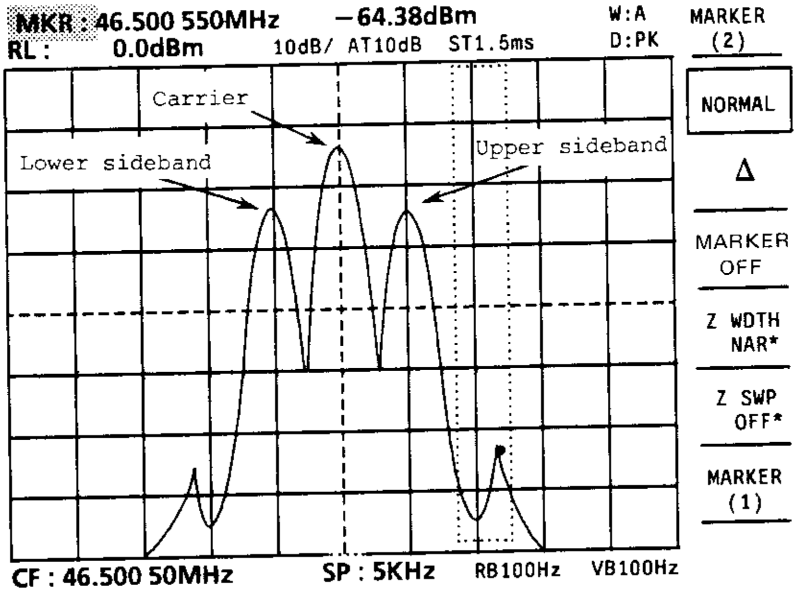
For LOG scale, the level difference is represented by dB. For LIN scale, the level difference is represented by multiplier (x).

For a description of Δ marker measurement at the LIN scale, see paragraphs 5.4.6 (2) and 6.5.2(2).

Notes:

1. Since the Δ marker reference marker frequency and level do not change with changes of the spectrum waveform, the reference marker may not be on the waveform and be moved off the CRT by frequency setting, then it is displayed at the end of the scale line.

2. When the [F2] key Δ is pressed when the reference marker □ and current marker ● are displayed at separate positions on the trace in the Δ marker mode, the reference marker □, which was at the reference point up to here, is cleared and moved to the current marker ●, where it becomes the new reference point.



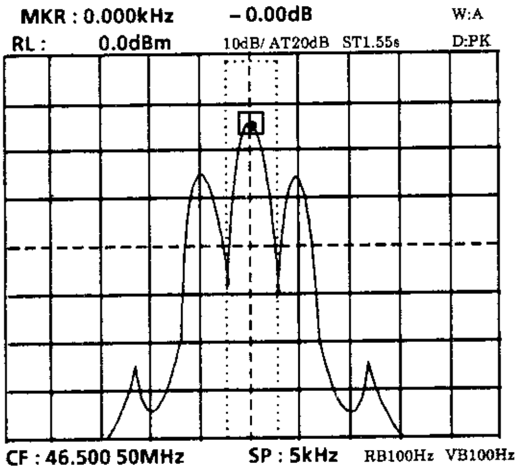
<Example>

The sideband spectrum of an AM wave at the MARKER(2) menu selection is shown in the figure above (500 Hz modulation frequency, 30% modulation depth).

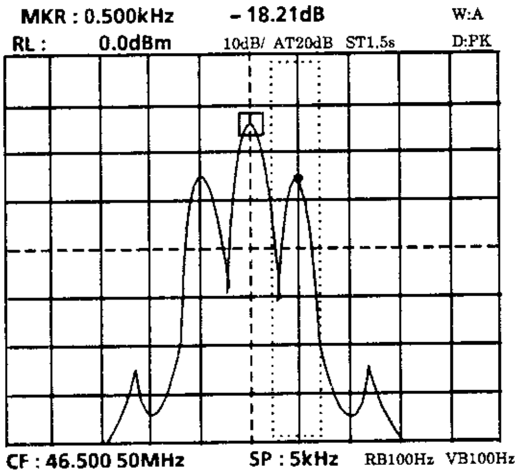
The detailed procedures to:

1. Find level and frequency differences between carrier and upper and lower sidebands.
2. Find frequency and level differences between upper and lower sidebands.

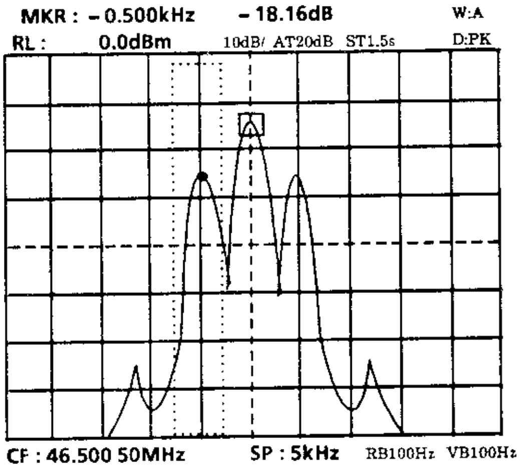
are described below.



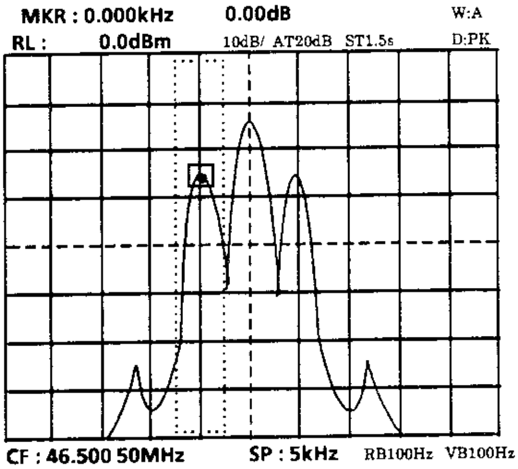
(Step 2)



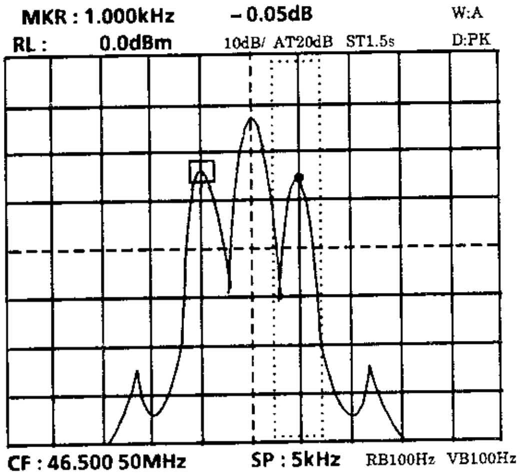
(Step 3)



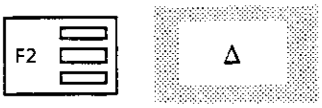
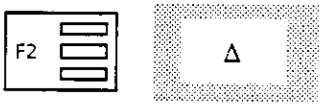
(Step 5)



(Step 7)



(Step 10)

Step	Procedure
	Frequency and level differences between carrier and sidebands
1	Move the zone marker to the center of the CRT (Carrier position) by using the data knob.
2	Set the Δ marker with the [F2] key. 
3	Move the zone marker to the position where it encompasses the peak of the upper sideband by using the data knob.
4	Read the frequency difference 0.500 kHz and level difference -18.21 dB from the CRT.
5	Move the zone marker to the position where it encompasses the peak of the lower sideband by using the data knob.
6	Read the frequency difference -0.500 kHz and level difference -18.16 dB from the CRT.
	Frequency and level differences between sidebands
7	Make the current marker the reference marker (lower sideband position). 
8	Check that the reference marker □ moves to the current marker position.
9	Check that the marker reading is 0.000 kHz, 0.00 dB.

(Cont.)

Step	Procedure
10	Move the zone marker to the position where it encompasses the peak of the upper sideband by using the data knob.
11	Check that the frequency difference is 1.000 kHz and the level difference is -0.05 dB.

Notes:

1. The level of the reference marker at LOG scale is ineffective when scale is switched from LOG to LIN. To use the Δ marker with the LIN scale, reset the reference marker by pressing the Δ key again. This also applies when scale is switched from LIN to LOG.
2. At LOG scale, the Δ marker reference level does not change even if REF LEVEL is changed. Therefore, when REF LEVEL is changed, the reference marker position on the CRT changes.
   However, at LIN scale, the position on the CRT does not change even if REF LEVEL is changed. Therefore, the level changes.
   In addition, at LIN scale, measure with a fixed REF LEVEL.

5.2.5 PEAK, NEXT PEAK, MIN points search

The PEAK, NEXT, and MIN points search using the spectrum of built-in 50 MHz signal is described below.

Initialize the MS2601A and supply the 50 MHz signal from the rear panel OUTPUT 50 MHz connector to the RF INPUT connector.

The CRT display at this time is shown below.

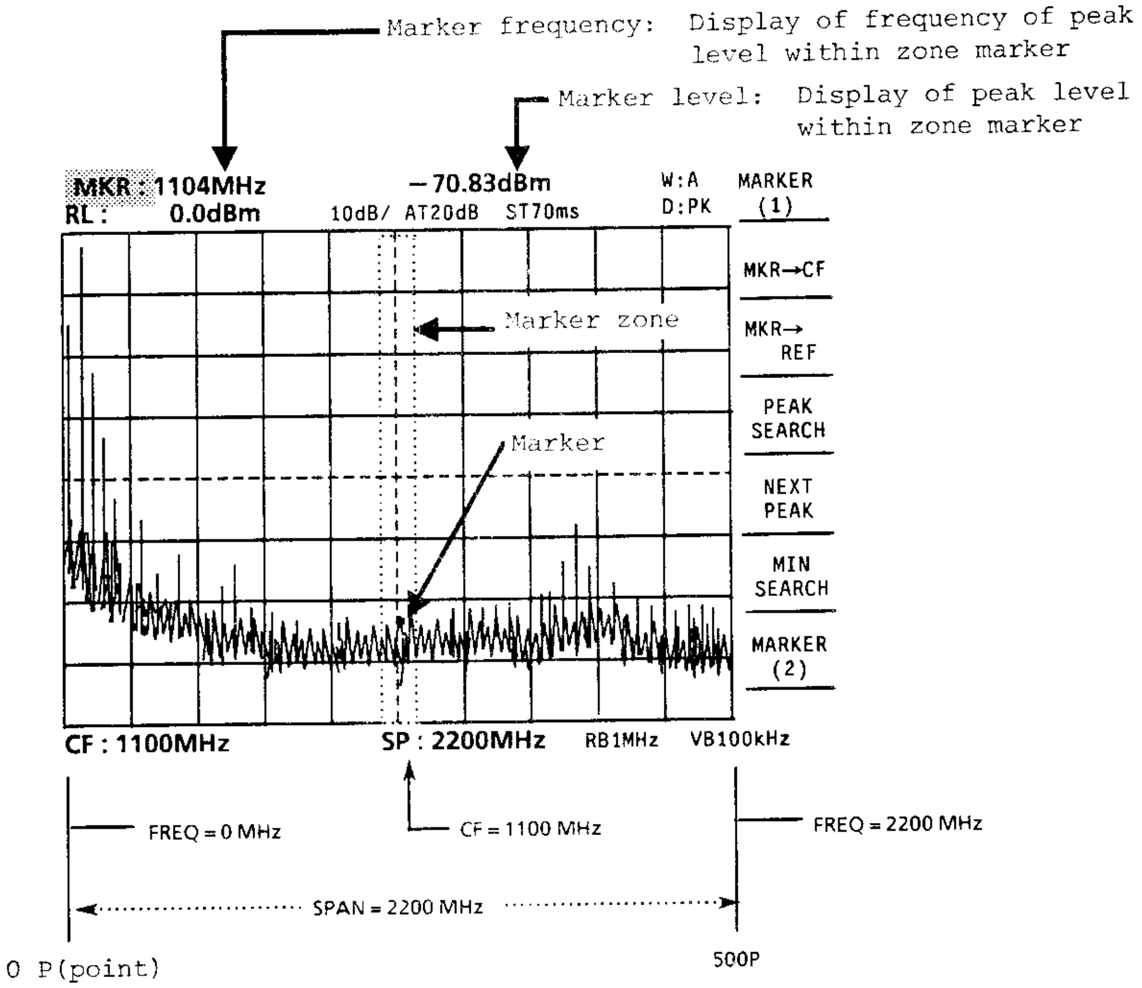
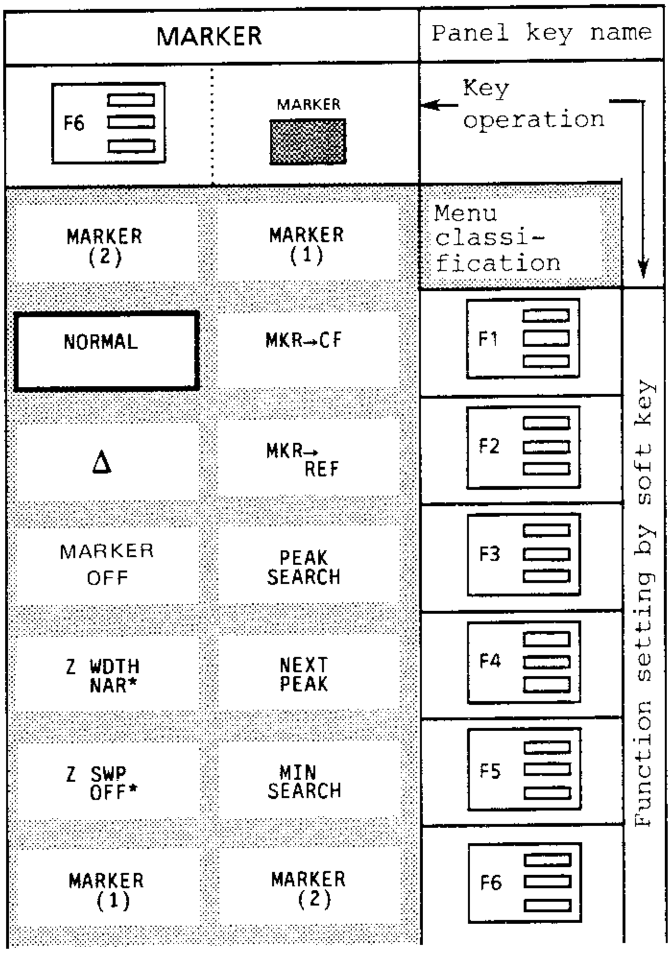
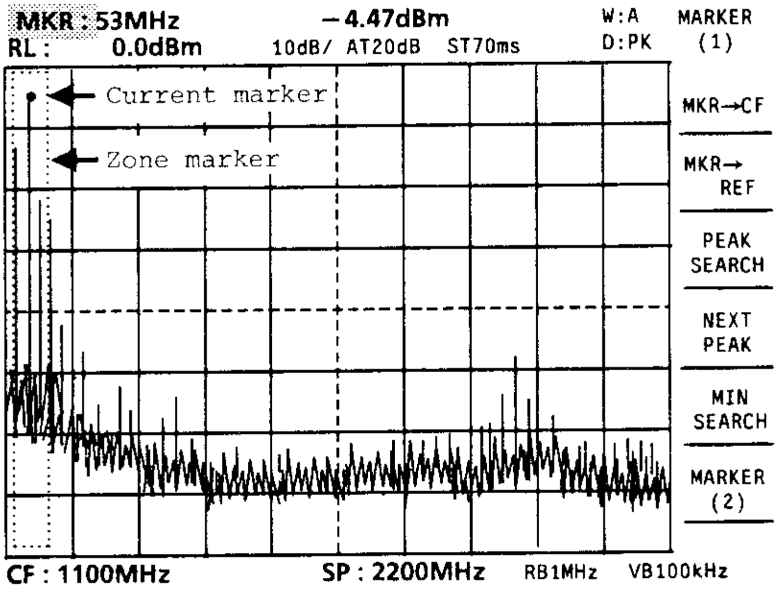


Fig. 5-7 Rear Panel 50 MHz Signal Spectrum (After Full Span Initialization)


MARKER
Panel key name
F6
MARKER
Key operation
MARKER (2)
MARKER (1)
Menu classi-fication
NORMAL
MKR→CF
F1
Δ
MKR→ REF
F2
MARKER OFF
PEAK SEARCH
F3
Z WDTH NAR*
NEXT PEAK
F4
Z SWP OFF*
MIN SEARCH
F5
MARKER (1)
MARKER (2)
F6
Function setting by soft key


MKR : 53MHz
−4.47dBm
W:A
D:PK
RL : 0.0dBm
10dB/ AT20dB ST70ms
MARKER (1)
Current marker
Zone marker
MKR→CF
MKR→ REF
PEAK SEARCH
NEXT PEAK
MIN SEARCH
MARKER (2)
CF : 1100MHz
SP : 2200MHz
RB1MHz
VB100kHz

Step Procedure

PEAK SEARCH

1 Press the SHIFT ⇨ TRIG 9 F5 SINGLE keys; the sweep stops.

2 Press the MARKER F3 PEAK SEARCH keys and check that the zone marker moves to the zone where it encompasses the highest level fundamental wave of the 50 MHz signal. (When the zero beat is large, the zone marker moves to it.)

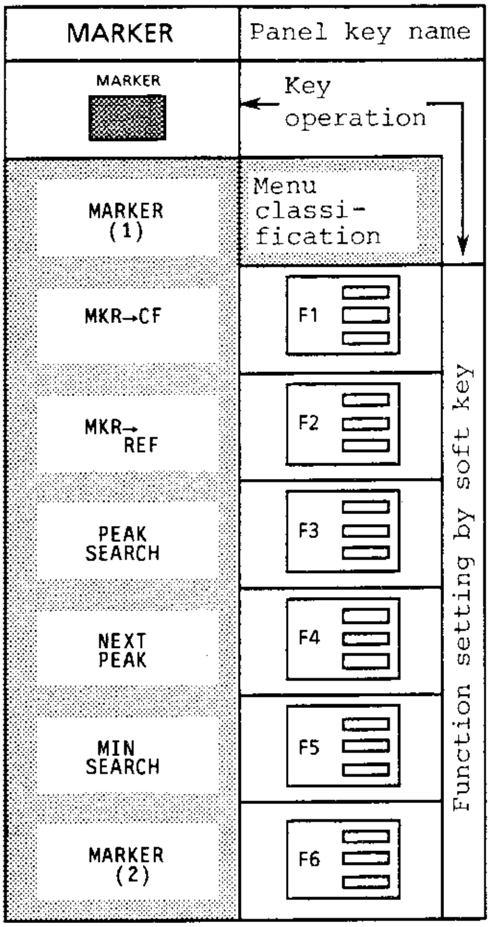
3 Check that the current marker is at the peak level within the zone marker. (See figure on the previous page.)

NEXT PEAK

4 Press the F6 MARKER (2) keys; the MARKER(2) menu is displayed.

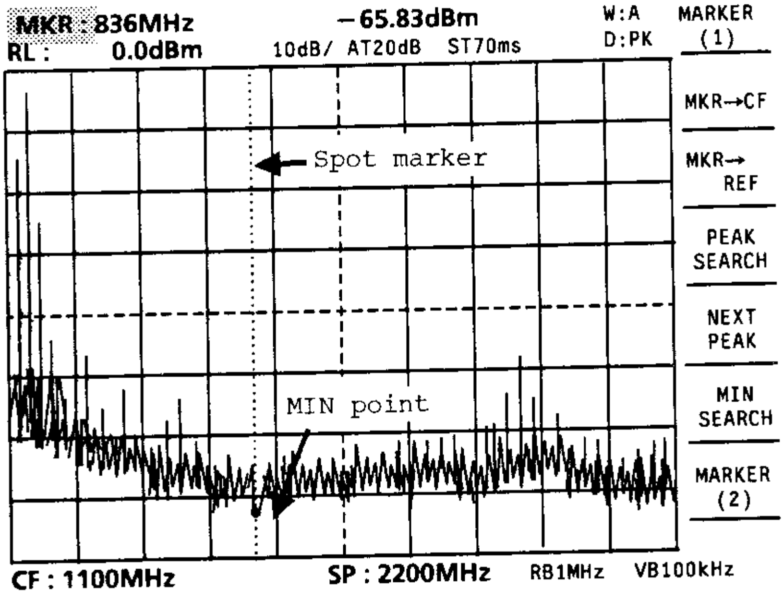
5 Change Z WDTH (Zone width) from NAR to SPOT.

6 Press the F4 Z WDTH SPOT* keys and check that the zone marker is cleared and one vertical line is superimposed on the marker brightspot.



(Cont.)

Step	Procedure
7	Press the F6 MARKER (1) keys; the MARKER(1) menu is redisplayed.
8	Check that each time the [F4] key is pressed, the marker is set to the next highest peak of the level.
	MIN SEARCH
9	Press the F5 MARKER (2) keys.
10	Check that the marker is set to the lowest peak of the spectrum trace displayed on the CRT at a 2200 MHz span.



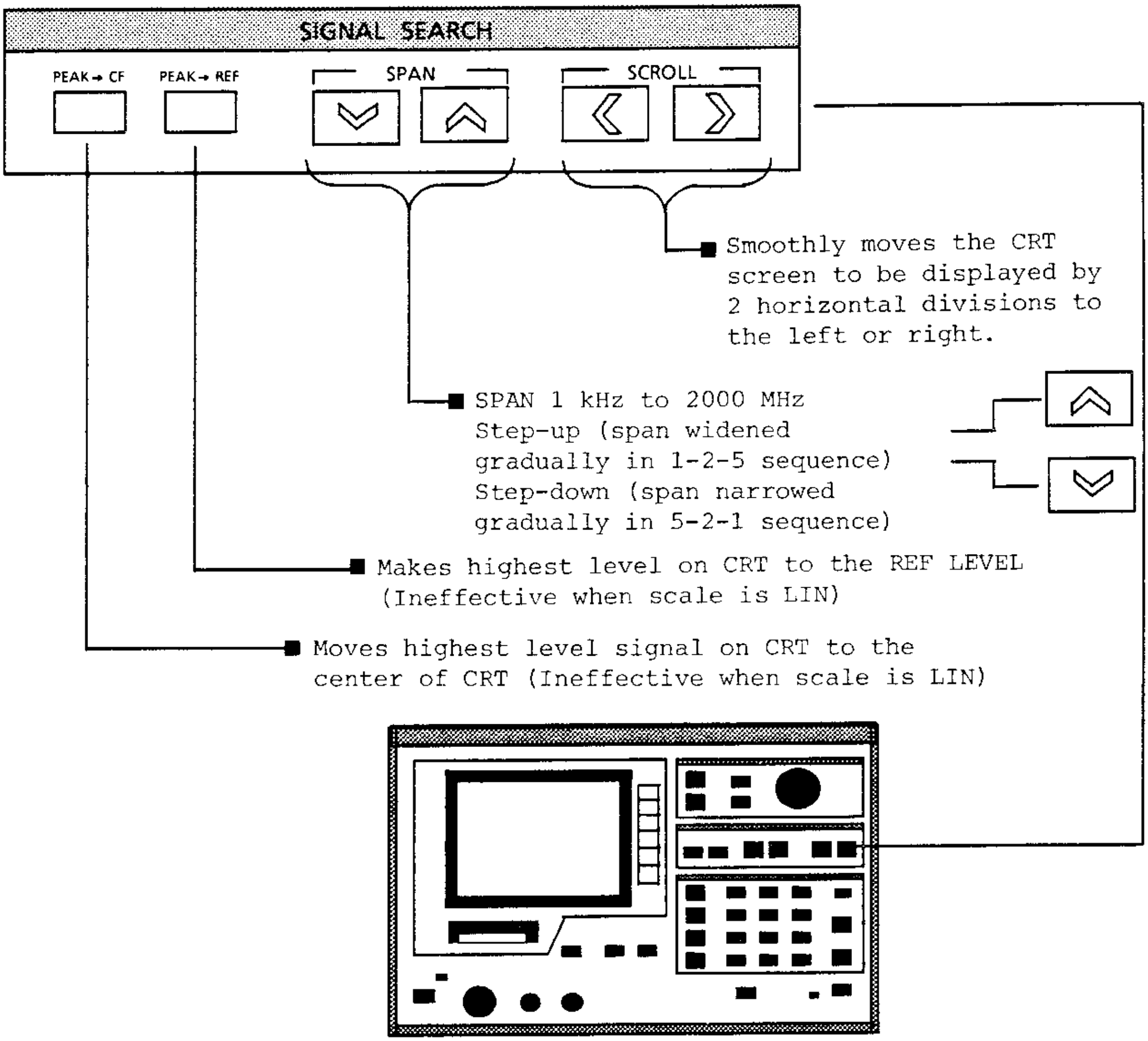
MKR : 836MHz −65.83dBm
RL : 0.0dBm 10dB/ AT20dB ST70ms
W:A
D:PK
CF : 1100MHz SP : 2200MHz RB1MHz VB100kHz

Note:

The NEXT PEAK and MIN SEARCH functions are executed only when ZONE WIDTH is SPOT. If NEXT or MIN SEARCH is executed at a ZONE WIDTH other than SPOT, a buzzer sounds to indicate an operation error. The PEAK SEARCH function is executed at any ZONE WIDTH. When NEXT PEAK and MIN SEARCH are executed when repetitive sweep is performed, the trace may change, the marker may move, and the previous point may not be the NEXT point and MIN point at the next sweep. In actual measurement, NEXT PEAK and MIN SEARCH must be executed after stopping sweep.

5.3 Signal Search

This function quickly sets the signal under investigation to the required position on the CRT.



■ Smoothly moves the CRT screen to be displayed by 2 horizontal divisions to the left or right.

■ SPAN 1 kHz to 2000 MHz
Step-up (span widened gradually in 1-2-5 sequence)
Step-down (span narrowed gradually in 5-2-1 sequence)

■ Makes highest level on CRT to the REF LEVEL (Ineffective when scale is LIN)

■ Moves highest level signal on CRT to the center of CRT (Ineffective when scale is LIN)

Fig. 5-8 Signal Search Function

5.3.1 Peak level signal to center frequency (PEAK → CF)

When the ⌈PEAK→CF⌉ key is pressed, the highest peak of the spectrum waveform of the channel currently being written on the CRT is displayed at the center of the CRT. (The frequency of the peak is made the CENTER FREQ and the zone marker is displayed at the center of the CRT.)

Notes:

1. When the highest peak on the CRT is a minus frequency, CENTER FREQ is made 0 kHz.
2. If there are multiple highest peaks of the same level on the CRT, the peak of the lowest frequency is moved to the center of the CRT.
3. When ZONE SWEEP is ON or scale is LIN or at both the A- and B-WRITE OFF, the PEAK→CF function is not executed.

5.3.2 Peak level to reference level (PEAK → REF)

When the ⌈PEAK→REF⌉ key is pressed, the waveform is displayed so that the level of the highest peak of the spectrum waveform of the channel currently being written on the CRT coincides with the top horizontal line (REF LEVEL) of the scale. (The level of the peak is made the REF LEVEL.)

The zone marker is moved so that its center coincides with the peak.

Note:

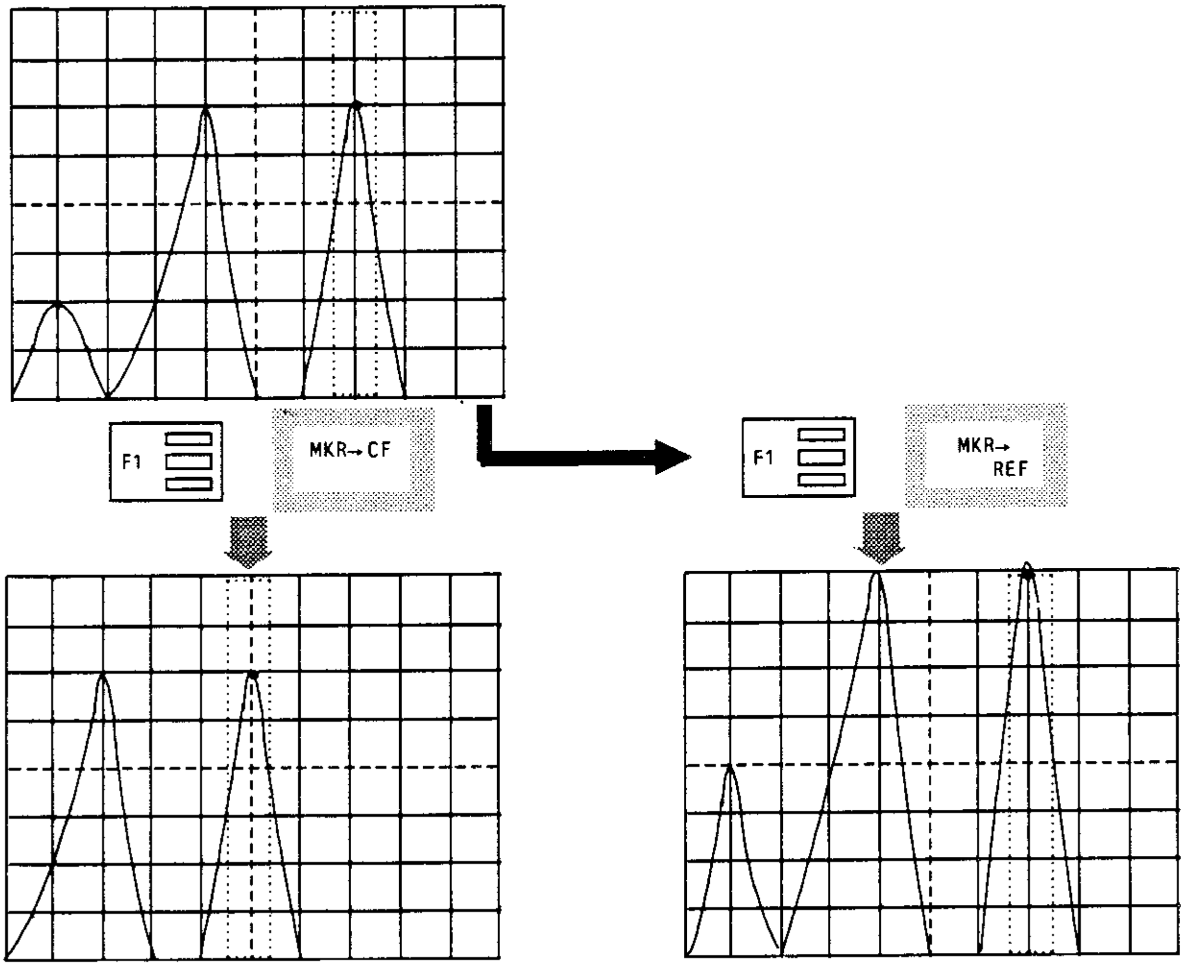
When ZONE SWEEP is ON or scale is LIN or at both A- and B-WRITE OFF, the PEAK→REF function is not executed.

<Example>

Check the difference of MKR→CF, MKR→REF, PEAK→CF, and PEAK→REF functions with the two same peak level waveforms.

(1) MKR→CF, MKR→REF

Check that the zone marker is on the objective signal before frequency and level movements.

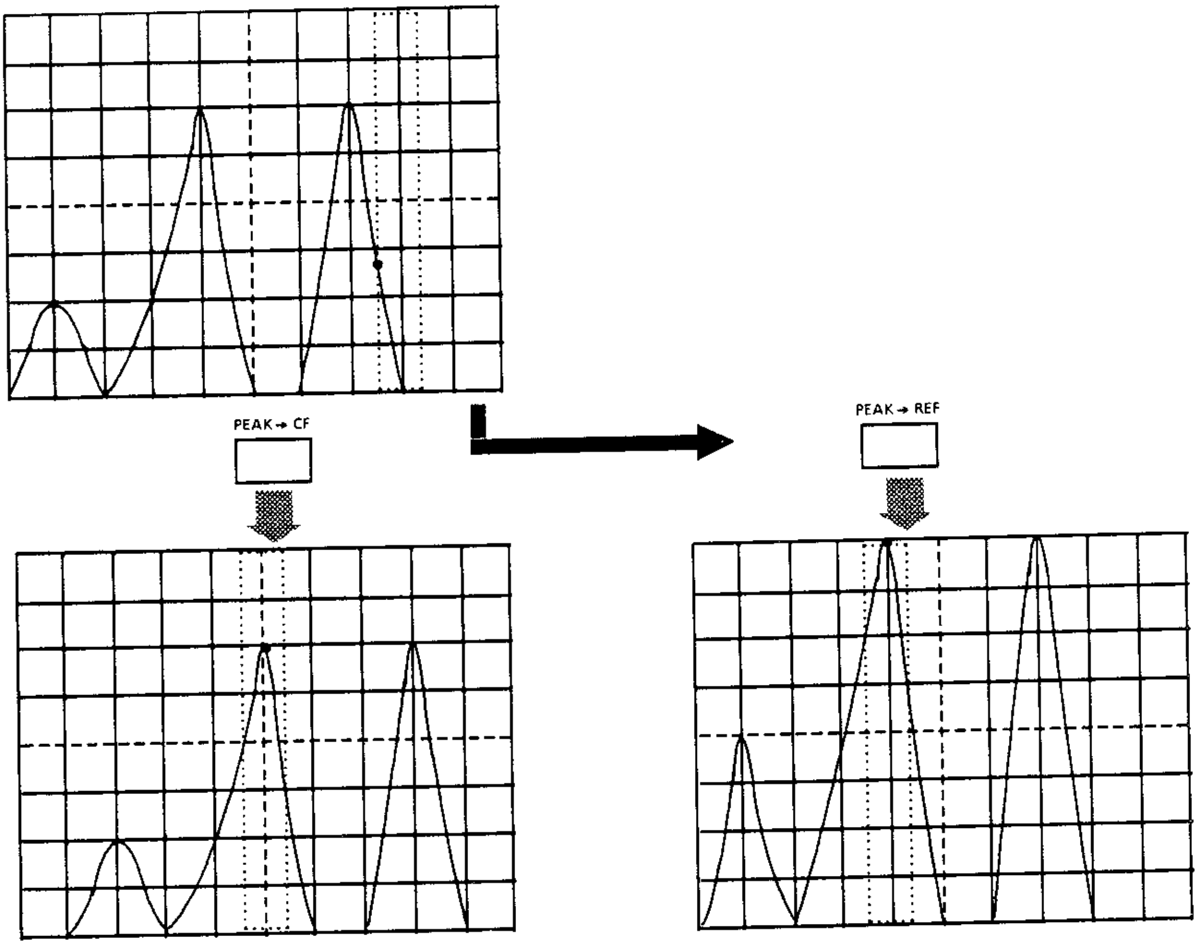


(2) PEAK→CF, PEAK→REF

Attention focussed on peaks only

If there are multiple waveforms of the same level, check the high and low frequencies.

The zone marker position does not have to be checked before frequency and level movements.



5.3.3 Span (SPAN)

The operational feature of the SIGNAL SEARCH section SPAN keys is that the span can be set both irrespective of the FUNCTION section [SPAN] key and the other keys. Tuning can be performed rapidly by using these keys with the [PEAK→CF] key.

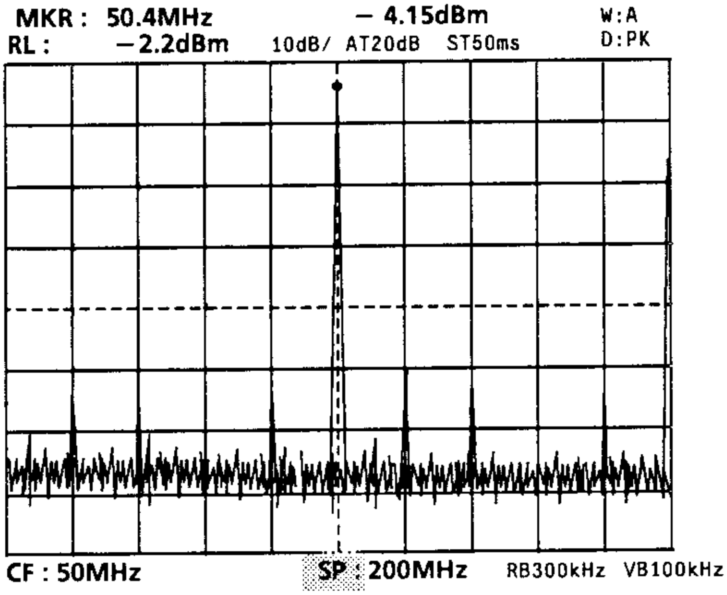
When the [SPAN ∨] key is pressed, SPAN is stepped-down 1 step (span width becomes narrower).

When the [SPAN ∧] key is pressed, SPAN is stepped-up 1 step (span width becomes wider).

Span setting (minimum 1 kHz, maximum 2000 MHz) with these step keys is in 1-2-5 sequence (step-up direction) and 5-2-1 sequence (step-down direction).

Note:

When the SPAN value is limited by the CENTER or START FREQ value, a buzzer sounds and the SPAN is set to the limit value (see example below).



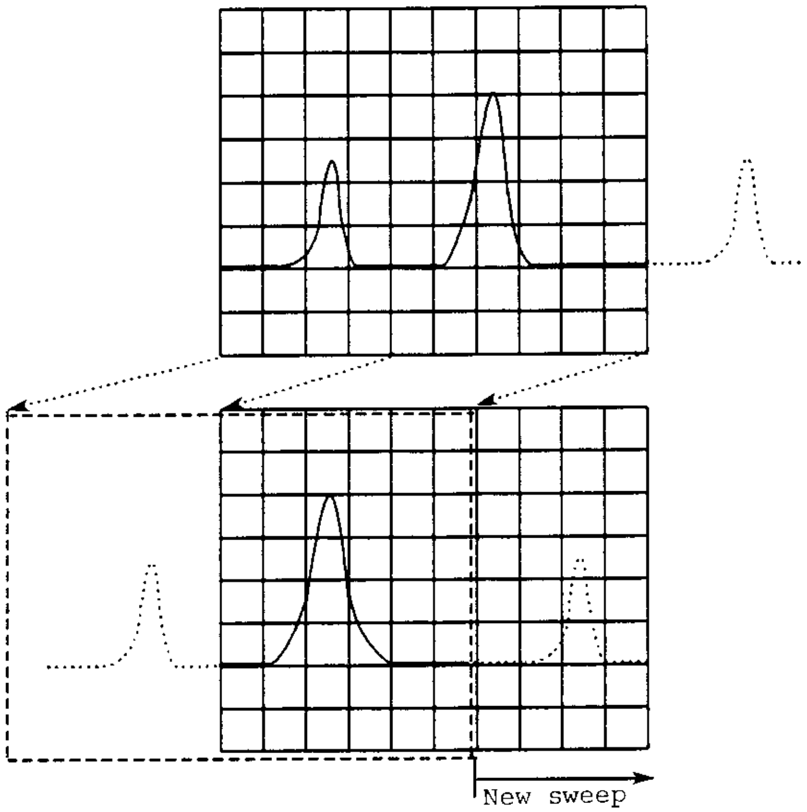
SPAN can be set within the range at which the relations (CF-SPAN/2)≧-100 MHz and (CF+SPAN/2)≦2300 MHz are satisfied. In the figure above, if CF =50 MHz constant, SPAN keys [∨] and [∧] can set the SPAN between 1 kHz and 200 MHz in steps. Because SPAN=200 MHz in the figure above, if stepping the span up to SPAN=500 MHz with the [∧] key is attempted, the buzzer will sound and the limit value will be set to SPAN=300 MHz. This is because (CF-SPAN/2) = (50-300/2) = -100 MHz.

5.3.4 Signal waveform scrolling to horizontal direction (SCROLL)

(1) Left scroll

When the [SCROLL <] key is pressed once, the spectrum waveform is scrolled 2 divisions to the left. Then, new sweeping begins two divisions to the right and displayed on the CRT. The key can be pressed consecutively up to five times (total 10 divisions).

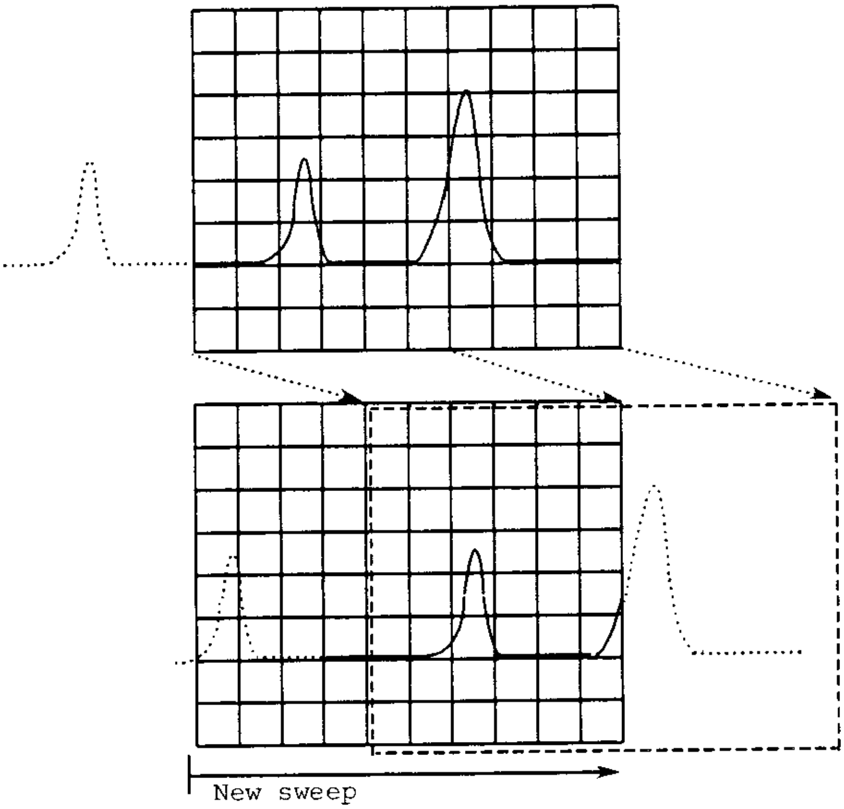
The figure below shows the result of pressing the [<] key twice.



(2) Right scroll

When the [SCROLL >] key is pressed once, the spectrum waveform is moved 2 divisions to the right. Then a new sweeping begins from the left end. The key can be pressed consecutively up to five times (total 10 divisions).

The figure below shows the result of pressing the [>] key twice.



(3) SCROLL precautions

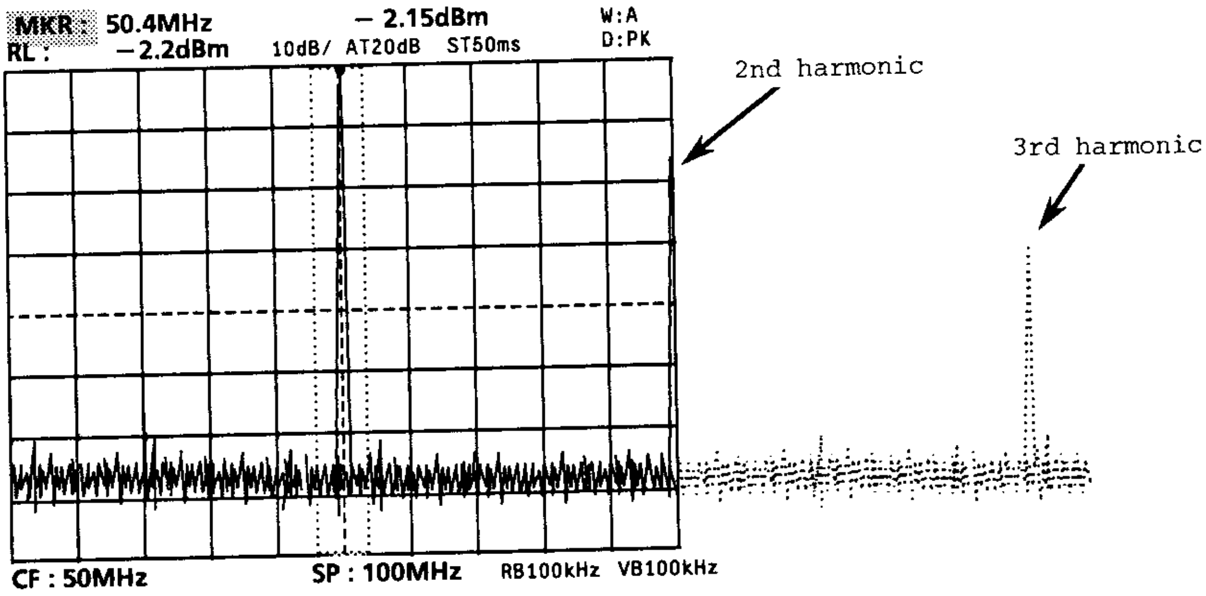
Note the precautions below.

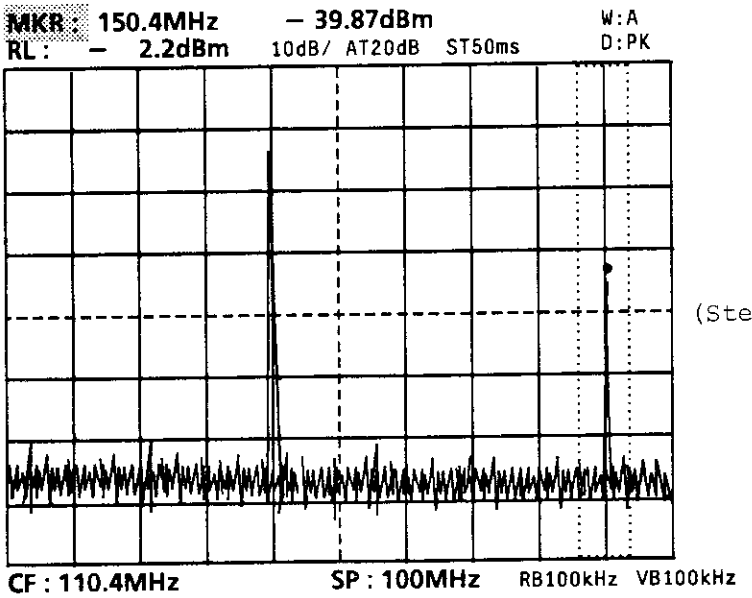
1. The SCROLL function is not executed during COUNT mode (buzzer sounds).
2. The SCROLL function is not executed when the TRIG mode is set to VIDEO, LINE, or EXT (buzzer sounds).
3. The SCROLL function is not executed when right SCROLL causes CENTER FREQ to drop below 0 Hz or START FREQ to drop below -100 MHz or when left SCROLL causes CENTER FREQ to exceed 2210 MHz or the frequency of the right end of the CRT (stop frequency) to exceed 2300 MHz (buzzer sounds).
4. When PEAK→CF, PEAK→REF, MKR→CF, or MKR→REF is executed when sweep is stopped at TRIG SINGLE mode, the CF or REF LEVEL changes but the waveform does not change and the relationship between the setting parameters and waveform is incorrect. If SCROLL is performed in this state, the waveform is scrolled with the incorrect setting parameters and waveform relationship. The correct waveform can be obtained and SCROLL can be performed correctly by restarting the sweep.

(4) <Example>

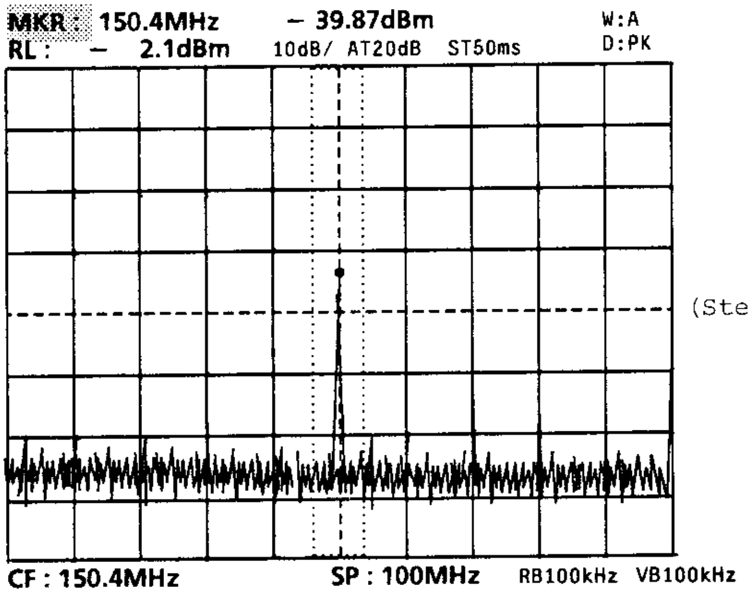
Measure 3rd harmonic level when 50 MHz fundamental wave is at center of CRT with 100 MHz span.

The 3rd harmonic is 50 MHz to the right of the 2nd harmonic as shown in the figure below. Since this is off the right side of the CRT, it is not displayed on the CRT. Therefore, the SCROLL key [<] is pressed and the 3rd harmonic is displayed on the CRT and its level is measured as follows.

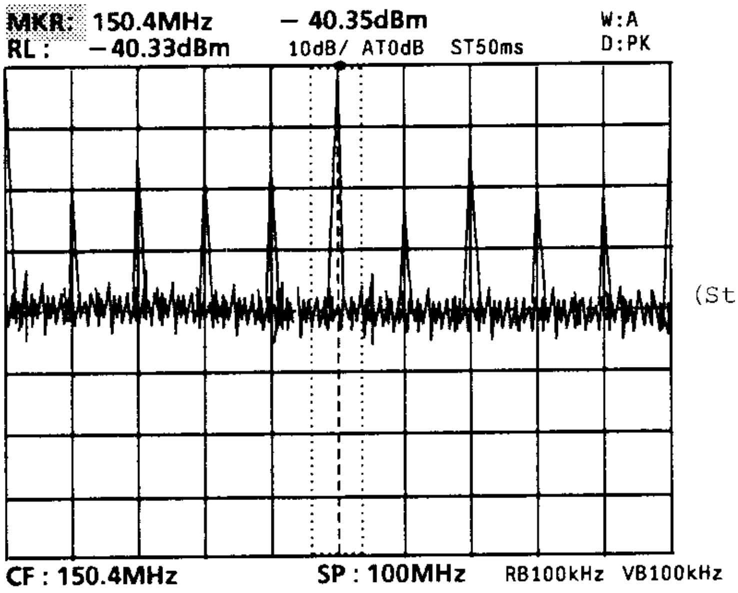




(Step 2)



(Step 3)



(Step 4)

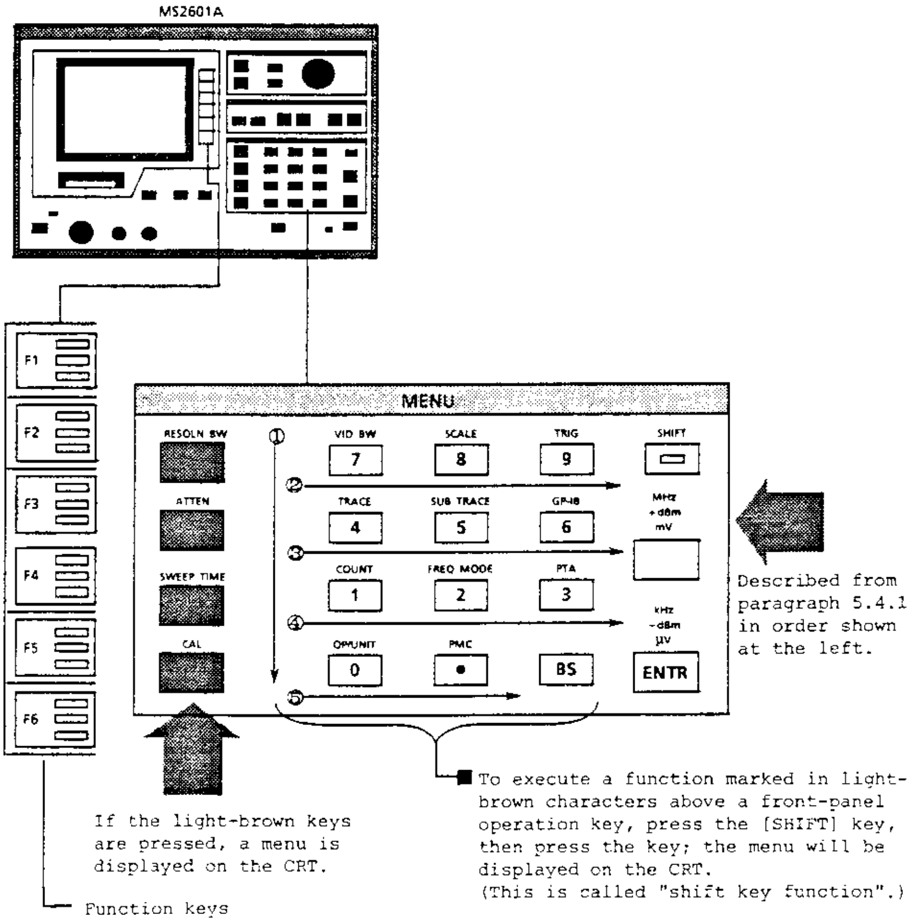
Step	Procedure
1	When the [<] key is pressed once, the spectrum waveform is scrolled two divisions to the left. So, display the 3rd harmonic on the CRT by pressing the [<] key three times. 《 《 《
2	Move the marker zone by using the data knob so that the marker moves to the peak of the 3rd harmonic as shown in the figure at the top on the previous page.
3	Press the F2 MKR→CF keys. The 3rd harmonic is moved to the center of the CRT as shown in the figure at the center on the previous page.
4	Press the F1 MKR→ REF keys.
5	Check that the peak level of the 150 MHz 3rd harmonic is at the REF line and is -40.35 dBm for example as shown in the figure at the bottom on the previous page.

5.4 Selection of Measurement Function by Menu Key (MENU section)

From the description up to here, the frequency, reference level, span, and marker functions are performed by the FUNCTION section and the desired signal is quickly caught by the SIGNAL SEARCH section. These two sections comprise the basic analyzer functions.

The MENU section can display a menu for many functions besides the previously-described basic functions. The required measurement function can be selected and displayed from among these functions by using function keys [F1] to [F6].

The following description is based on the menu at initialization.



Described from paragraph 5.4.1 in order shown at the left.

If the light-brown keys are pressed, a menu is displayed on the CRT.

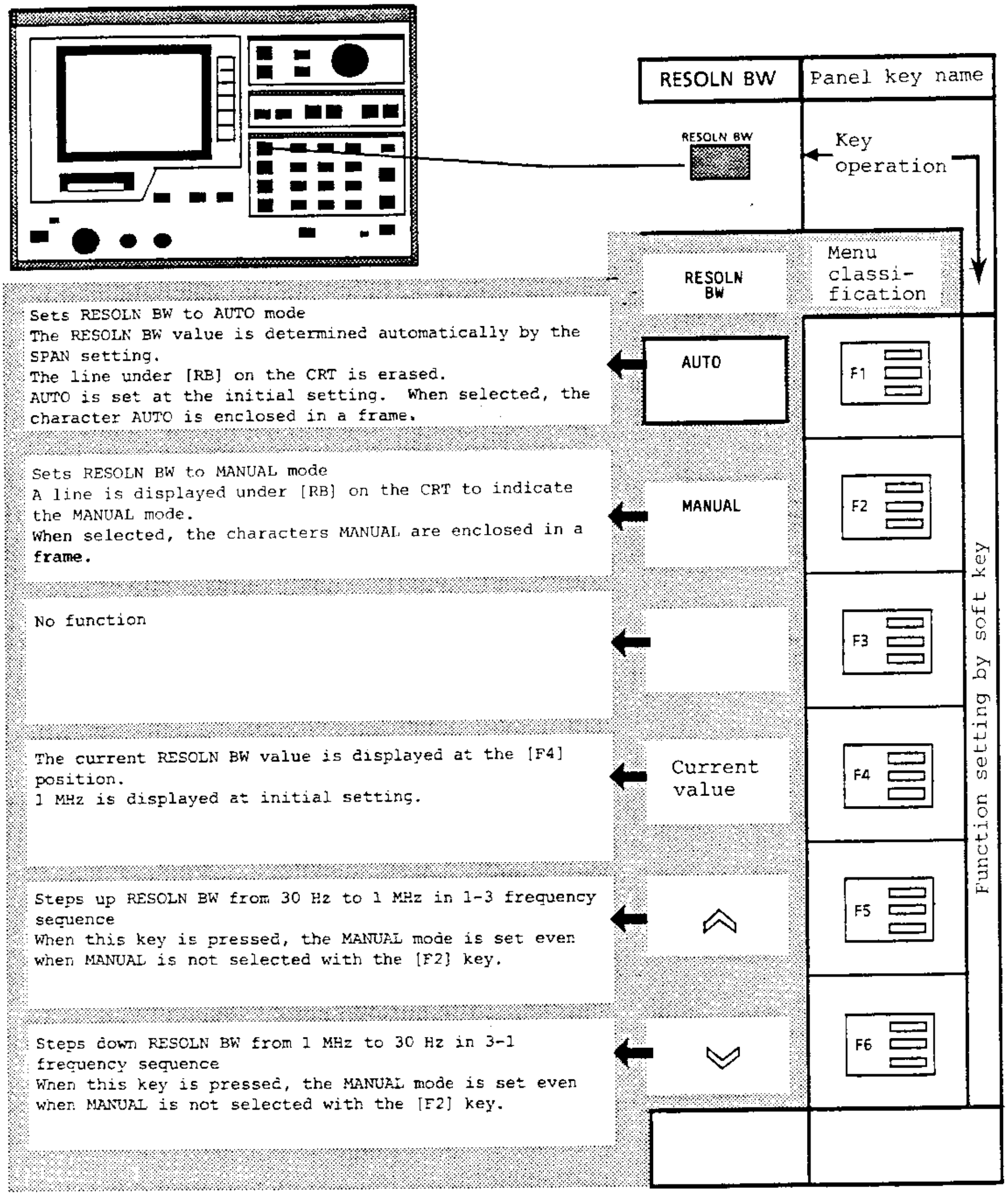
■ To execute a function marked in light-brown characters above a front-panel operation key, press the [SHIFT] key, then press the key; the menu will be displayed on the CRT.
(This is called "shift key function".)

Fig. 5-9 Measurement Function Selection by Menu Key

5.4.1 Resolution bandwidth setting (RESOLN BW)

When the front panel MENU section [RESOLN BW] key is pressed, the RESOLN BW menu shown below is displayed on the CRT. Select the required function by pressing the soft key [F1] to [F6] corresponding to the function.

RESOLN BW cannot be set with the data knob or numeric/unit keys.

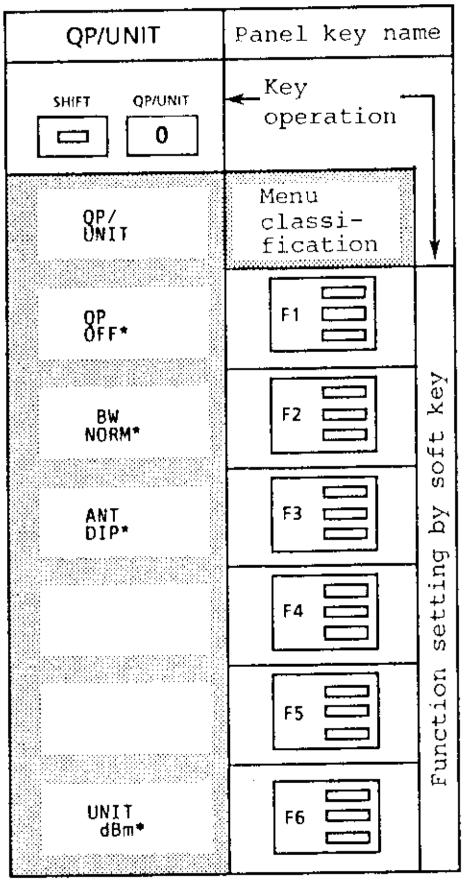


Sets RESOLN BW to AUTO mode The RESOLN BW value is determined automatically by the SPAN setting. The line under [RB] on the CRT is erased. AUTO is set at the initial setting. When selected, the character AUTO is enclosed in a frame.	AUTO	F1
Sets RESOLN BW to MANUAL mode A line is displayed under [RB] on the CRT to indicate the MANUAL mode. When selected, the characters MANUAL are enclosed in a frame.	MANUAL	F2
No function		F3
The current RESOLN BW value is displayed at the [F4] position. 1 MHz is displayed at initial setting.	Current value	F4
Steps up RESOLN BW from 30 Hz to 1 MHz in 1-3 frequency sequence When this key is pressed, the MANUAL mode is set even when MANUAL is not selected with the [F2] key.	⋀	F5
Steps down RESOLN BW from 1 MHz to 30 Hz in 3-1 frequency sequence When this key is pressed, the MANUAL mode is set even when MANUAL is not selected with the [F2] key.	⋁	F6

(1) 3 dB bandwidth and 6 dB bandwidth

The MS2601A has two IF filters: 3 dB bandwidth filter and 6 dB bandwidth filter. At initial setting, the 3 dB bandwidth IF filter is selected.

- The resolution bandwidth (RESOLN BW) sets the 3 dB bandwidth of the IF filter.
- If BW corresponding to the [F2] key of the QP/UNIT menu shown at the right is NORM*, the 3 dB bandwidth IF filter is selected.
- When the above BW display is 200, 9k, and 120k, it indicates that 200 Hz, 9 kHz, and 120 kHz frequencies are available at the IF filter as the 6 dB bandwidth.
  These bandwidthes are used in electromagnetic interference (EMI) quasi-peak detection.



(2) AUTO mode

At initialization, RESOLN BW (resolution bandwidth), SWEEP TIME (sweep time), and VIDEO BW (video bandwidth) in the MENU section are set to AUTO.

This automatically sets them to the optimum state so that frequency and level measurement errors do not occur even when SPAN is changed. The SPAN, RESOLN BW, VIDEO BW, and SWEEP TIME in AUTO set states are listed in Table 5-3.

Table 5-3 AUTO Mode (SP, RB, VB, ST)

SPAN	RES.BW	VIDEO BW	SWEEP TIME
0	AUTO set value held	AUTO set value held	AUTO set value held
1 kHz	30 Hz	100 Hz	3 s
∿ 10 kHz	100 Hz	100 Hz	500 ms to 3 s
∿ 20 kHz	300 Hz	1 kHz	200 ms to 700 ms
∿ 100 kHz	1 kHz	1 kHz	50 ms to 300 ms
∿ 200 kHz	3 kHz	10 kHz	50 ms to 70 ms
∿ 2 MHz	10 kHz	10 kHz	50 ms to 70 ms
∿ 20 MHz	30 kHz	100 kHz	50 ms to 70 ms
∿ 100 MHz	100 kHz	100 kHz	50 ms
∿ 1000 MHz	300 kHz	100 kHz	50 ms to 100 ms
∿ 2200 MHz	1 MHz	100 kHz	50 ms to 70 ms

- When RESOLN BW is AUTO, the RESOLN BW value corresponding to SPAN is set.
- When VIDEO BW is AUTO, the VIDEO BW value is set in accordance with RESOLN BW.
- When SWEEP TIME is AUTO, the SWEEP TIME value corresponding to SPAN, RESOLN BW, and VIDEO BW is set.

(3) MANUAL setting

Normally, if RESOLN BW, VIDEO BW, and SWEEP TIME are set to the AUTO mode, measurements can be made without considering their set values.

However, set RESOLN BW in the MANUAL mode in the following cases:

1. General measurement

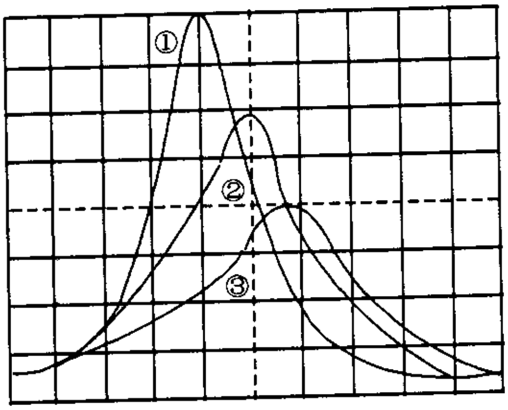
   When observing two adjacent signals, etc. the frequency resolution can be increased and the noise can be reduced (approx. 10 dB at RB/10) by narrowing the bandwidth.

   However, if the bandwidth is too narrow, the spectrum will become too sharp, the response characteristic will be degraded, and the sweep will become slow. Select the bandwidth for a practical sweep speed.

2. Intermodulation distortion observation

   To make measurements at a comparatively wide frequency span and low noise level when measuring two signal intermodulation distortion, set RESOLN BW to MANUAL and make it narrower than the AUTO value. However, the sweep time will increase in inverse proportion to the square of the RESOLN BW.

Note:

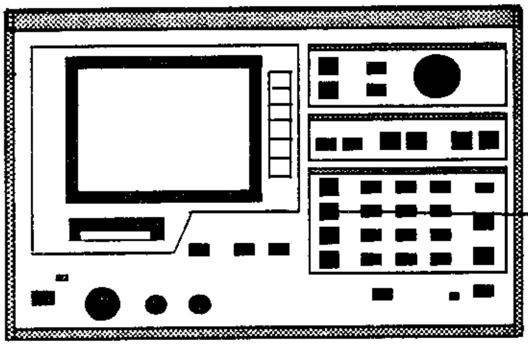


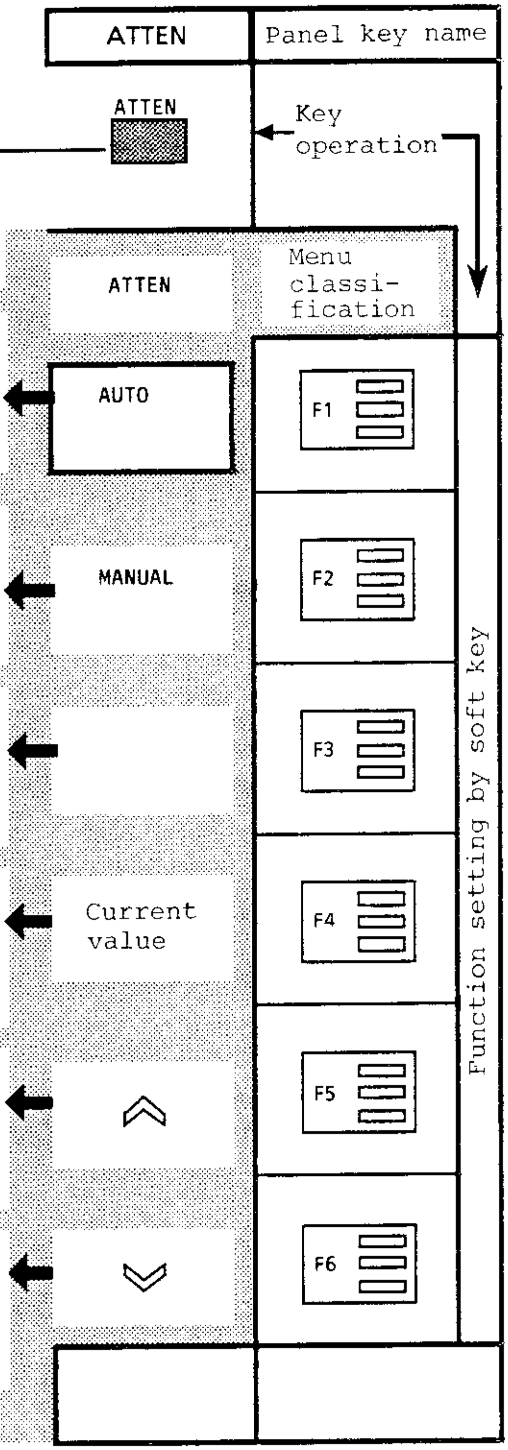
The spectrum on the CRT differs with the sweep speed as shown in the figure above. When the sweep speed is appropriate, waveform ① is displayed on the CRT. When the sweep speed is increased, waveforms ② and ③ are displayed. When the sweep is too fast, the amplitude on the CRT decreases, the apparent bandwidth becomes wider, and the frequency deviates. When waveform ① cannot be maintained, UNCAL is displayed at the top right of the CRT.

5.4.2 Input attenuator setting (ATTEN)

When the front panel MENU section [ATTEN] switch is pressed, the ATTEN menu shown on the next page is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F6].

The ATTEN value can be set from 0 to 50 dB (10 dB steps). ATTEN cannot be set with the data knob and numeric/unit keys.





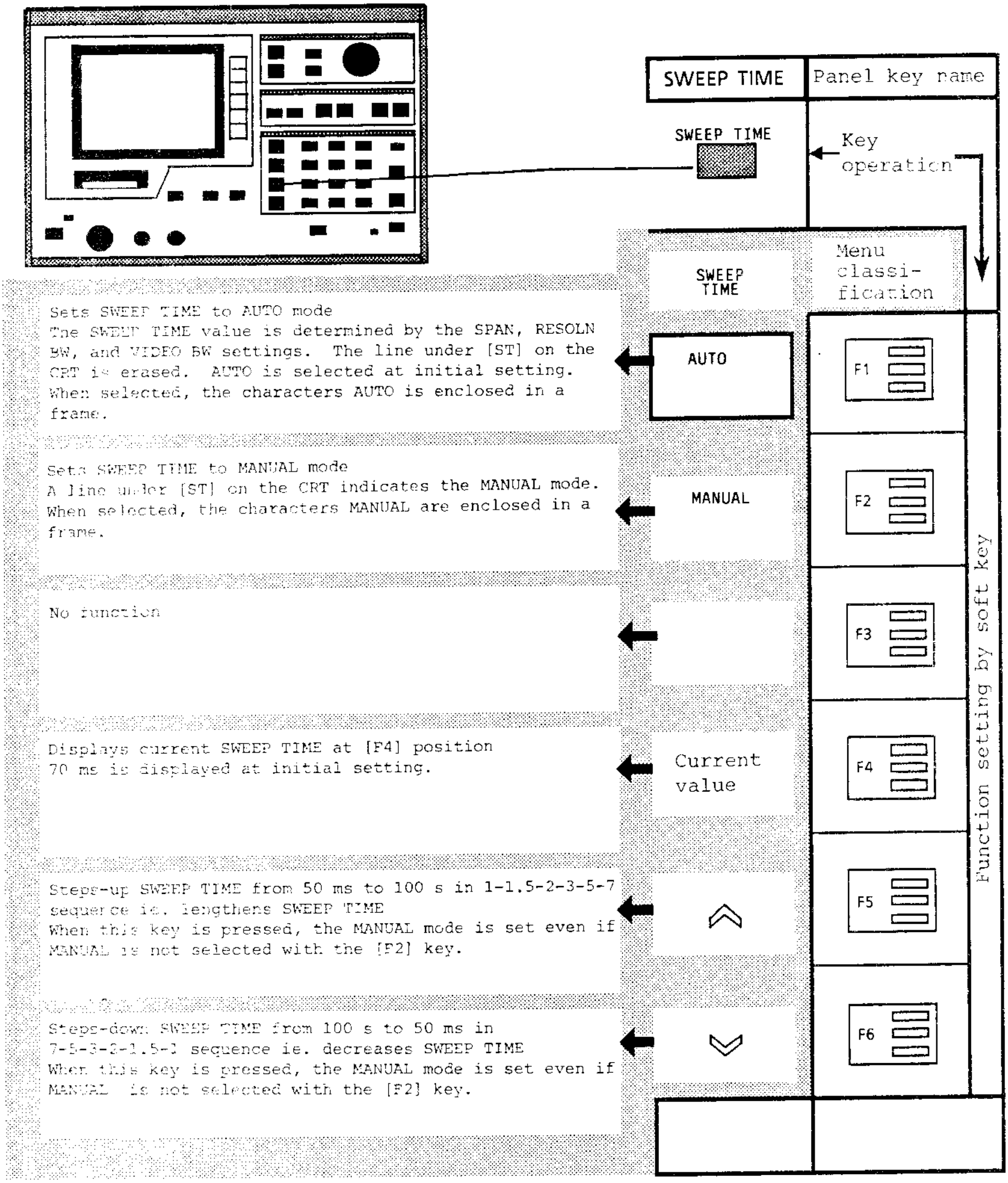
AUTO	Sets ATTEN to AUTO mode The ATTEN value is determined by the REF LEVEL setting. The line under [AT] on the CRT is erased. AUTO is selected at the initial setting. When selected, the character AUTO is enclosed in a frame.
MANUAL	Sets ATTEN to MANUAL mode A line under [AT] on the CRT indicates the MANUAL mode. When selected, the characters MANUAL is enclosed in a frame.
	No function
Current value	The current ATTEN value is displayed at the [F4] position. 20 dB is displayed at initial setting.
︿	Steps up ATTEN from 0 to 50 dB in 10 dB steps When the [F5] key is pressed, the MANUAL mode is set even if MANUAL is not selected with the [F2] key.
﹀	Steps down ATTEN from 50 to 0 dB in 10 dB steps When the [F6] key is pressed, the MANUAL mode is set even if MANUAL is not selected with the [F2] key.

The values that can be set are determined by the REF LEVEL setting. For more information, see paragraph 5.1.5 Tables 5-1 and 5-2.

5.4.3 Sweep time setting (SWEEP TIME)

When the front panel MENU section [SWEEP TIME] key is pressed, the SWEEP TIME menu shown on the next page is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F6].

SWEEP TIME cannot be set with the numeric/unit keys and data knob.



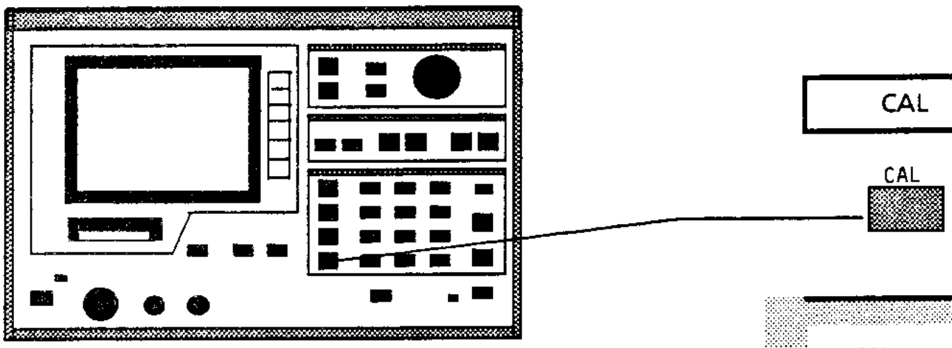
SWEEP TIME	Menu classification	
AUTO	F1	Sets SWEEP TIME to AUTO mode The SWEEP TIME value is determined by the SPAN, RESOLN BW, and VIDEO BW settings. The line under [ST] on the CRT is erased. AUTO is selected at initial setting. When selected, the characters AUTO is enclosed in a frame.
MANUAL	F2	Sets SWEEP TIME to MANUAL mode A line under [ST] on the CRT indicates the MANUAL mode. When selected, the characters MANUAL are enclosed in a frame.
	F3	No function
Current value	F4	Displays current SWEEP TIME at [F4] position 70 ms is displayed at initial setting.
⌃	F5	Steps-up SWEEP TIME from 50 ms to 100 s in 1-1.5-2-3-5-7 sequence ie. lengthens SWEEP TIME When this key is pressed, the MANUAL mode is set even if MANUAL is not selected with the [F2] key.
⌄	F6	Steps-down SWEEP TIME from 100 s to 50 ms in 7-5-3-2-1.5-1 sequence ie. decreases SWEEP TIME When this key is pressed, the MANUAL mode is set even if MANUAL is not selected with the [F2] key.

For a description of AUTO and MANUAL modes, see paragraphs 5.4.1(2) and (3).

5.4.4 Calibration (CAL)

When the front panel MENU section [CAL] key is pressed, the CAL menu shown on the next page is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F6].

When the menu is opened, the items indicated by the asterisk are already selected. When the relevant soft key is pressed at this time, the function of the currently-displayed item is selected.



CAL	Panel key name
CAL	Key operation
CAL	Manu classification

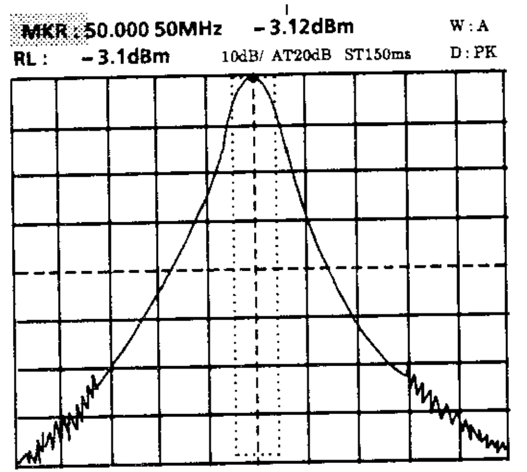
Function setting by soft key

F1	ALL CAL	Executes all CAL routines (This is the same as executing all the CAL routines with the [F2], [F3], and [F4] keys.) Time required: Approx. 90 s
F2	LEVEL CAL1	Executes CAL routine for LOG linearity and overall gain deviation items The RESOLN BW at this time is 3 kHz fixed. Time required: Approx. 30 s
F3	LEVEL CAL2	Executes CAL routine for GAIN switching deviation and RESOLN BW switching level deviation items Time required: Approx. 45 s
F4	FREQ CAL	Executes CAL routine for VCO frequency deviation and RESOLN BW center frequency deviation items Time required: Approx. 7 s
F5	CORR D ON*	When this key is ON, the level correction data (CORRECTION DATA) obtained as a result of the CAL routines is used. At initial setting, it is set to ON. When OFF, it is not used (correction not performed). The OFF setting is only used in maintenance. When measuring, always set this key to ON.
F6	RSPS D ON*	When this key is ON, frequency response (RESPONSE) correction data is used. At initial setting, it is set to ON. When it is OFF, correction is not performed. The OFF setting is only used in maintenance. When measuring, always set this key to ON.
* OFF/ON	*	

To calibrate all the level and frequency errors, press the [F1] key.

To calibrate only part of the errors, press either the [F2], [F3], or [F4] key. During the CAL operation, a [*] symbol string is displayed to show how the operation is progressing. The [*] symbols are erased one-by-one according to progress. Calibration is complete when the all the [*] symbols have disappeared.

Use of the [F1], [F2], and [F3] keys is illustrated on the next page.

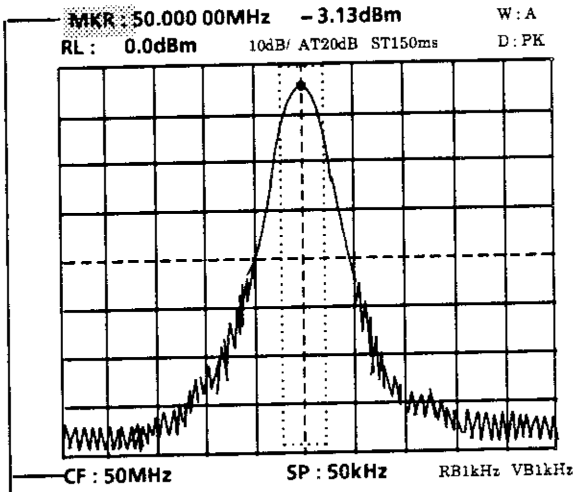


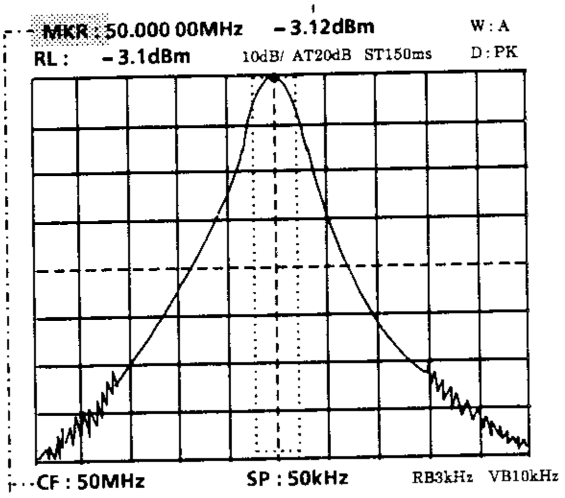
F1: Calibration of all errors
- Frequency and level error

F2: LOG display accuracy
- LOG scale linearity
- Overall gain

F3: REF LEVEL accuracy
- Gain switching error
- Level error at RESOLN BW switching

F4: Frequency readout accuracy
- VCO frequency deviation
- RESOLN BW center frequency deviation





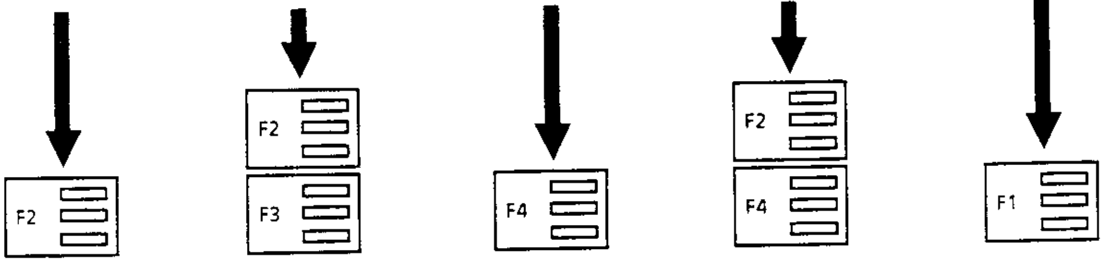
Measures relative level of spectrum on CRT

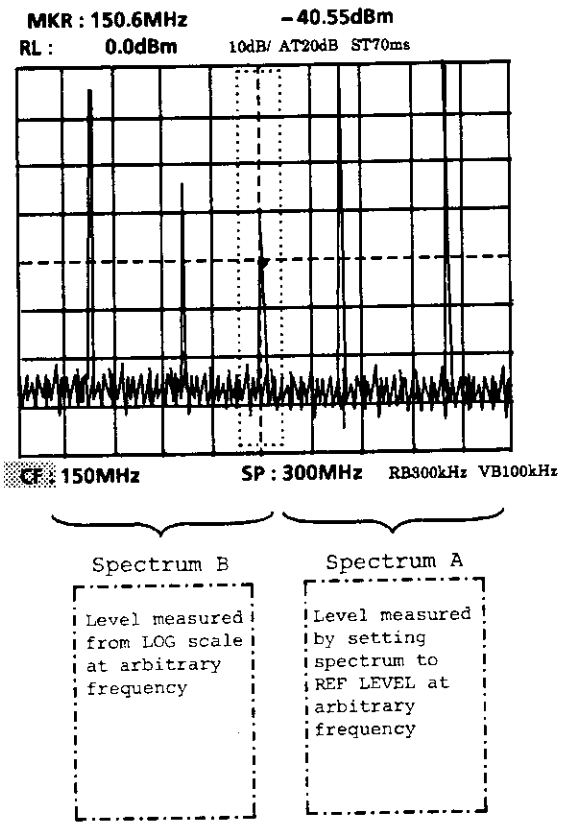
Measures absolute level of spectrum on CRT

Raises frequency readout accuracy

Raises frequency readout accuracy and measures relative level of spectrum

Raises frequency readout accuracy and measures absolute level of spectrum





Spectrum B

Level measured from LOG scale at arbitrary frequency

Spectrum A

Level measured by setting spectrum to REF LEVEL at arbitrary frequency

Notes:

For the measurement shown above:

1. For measurement by setting the spectrum to REF LEVEL (example: spectrum A), if RSPS D corresponding to the [F6] key is ON, since the frequency characteristic is corrected automatically, the level accuracy is calibrated. However, for the frequency accuracy, the span error is added.

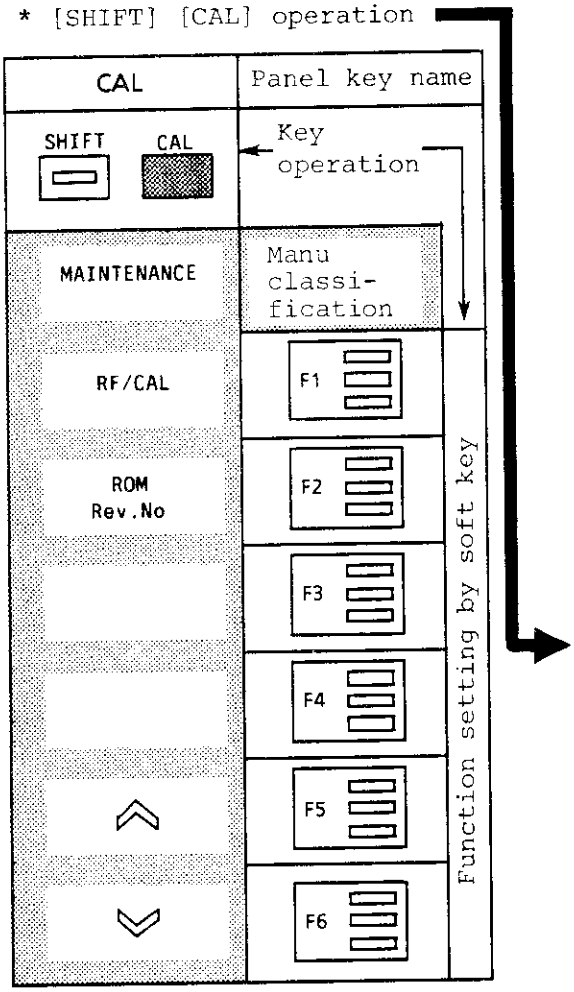
2. Level measurement accuracy from the LOG scale (example: spectrum B) is calibrated by LEVEL CAL1 (F2) and LEVEL CAL2 (F3). However, level measurement at the REF LEVEL line has the advantage that it does not include the LOG scale linearity error and high-accuracy measurements can be made.

3. When calibrating with an external signal applied to the RF INPUT, the correct calibration value cannot be obtained. Calibrate without a signal applied to the RF INPUT.

4. Note that when CALIBRATION is executed, the ch A spectrum data changes.

5. At LIN scale, the correction data obtained by CALIBRATION is not used whether CORR D is ON or OFF. (Correction is not performed.)

* [SHIFT] [CAL] operation

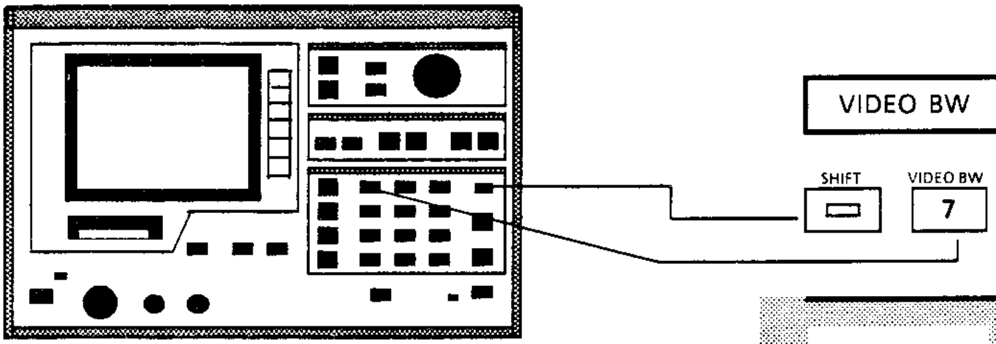


When the [SHIFT][CAL] keys are pressed in order, the MAINTENANCE menu is displayed as shown at the left. This menu is only used at maintenance. It is not used in normal measurements. For more information, refer to the service manual. If this menu is displayed by mistake, the MS2601A can be returned to the normal state by pressing the [INITIAL] key.

5.4.5 Video bandwidth setting (VIDEO BW)

When the front panel MENU section [SHIFT][VIDEO BW] keys are pressed, the VIDEO BW menu shown on the next page is displayed on the CRT. Select the required function by pressing the corresponding soft keys [F1] to [F6]. VIDEO BW cannot be set with the numeric/unit keys and data knob. VIDEO BW determines the bandwidth after detection. When VIDEO BW is narrow, the noise is averaged.

VIDEO BW	Panel key name



Key operation

	VIDEO BW	Menu classification
Sets VIDEO BW to AUTO mode The VIDEO BW value is determined by the RESOLN BW value. The line under [VB] on the CRT is erased. AUTO is selected at initial setting.	**AUTO**	F1
Sets VIDEO BW to MANUAL mode A line under [VB] on the CRT indicates the MANUAL mode.	**MANUAL**	F2
No function		F3
Displays current VIDEO BW value at [F4] position 100 kHz is displayed at initial setting.	Current value	F4
Steps-up VIDEO BW 1 Hz, 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, and -OFF- When pressed, the MANUAL mode is selected even if MANUAL is not selected with the [F2] key.	⌃	F5
Steps-down VIDEO BW -OFF-, 100 kHz, 10 kHz, 1 kHz, 100 Hz, 10 Hz, and 1 Hz The MANUAL mode is set.	⌄	F6

Function setting by soft key

(1) AUTO mode

See paragraph 5.4.1 (2).

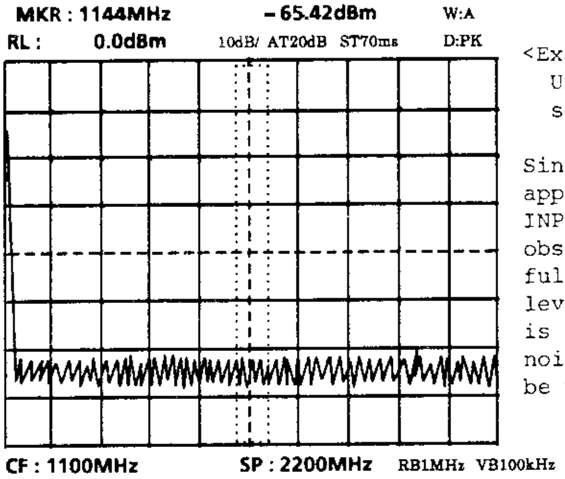
(2) MANUAL setting

When the input signal level is the same as, or less than, the average noise level, the noise is averaged and signal measurement is made easy by narrowing VIDEO BW.

However, as the VIDEO BW is narrowed, the sweep time increases in inverse proportion to the VIDEO BW.

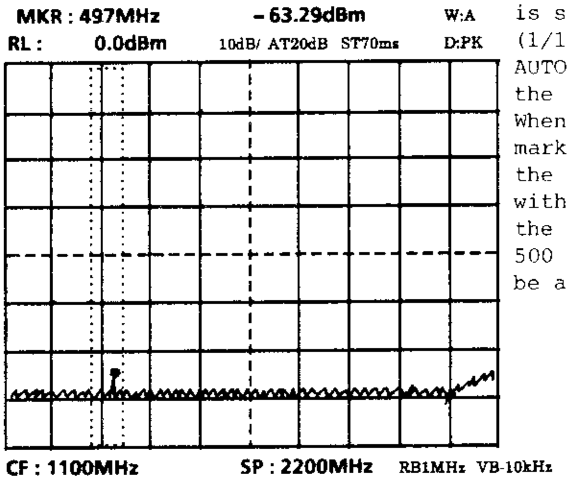
- In the AUTO mode, VIDEO BW is set so that noise is not averaged, but sweep time is fast.
- Averaging is also done by performing AVERAGING without narrowing VIDEO BW (sweep time sped-up). This is performed by setting the A-MODE (or B-MODE) to AVG corresponding to the [F3] key which is shown on the next page. In this case, the averaging rate (4, 8, 16, 32) is specified by using the [F4] key.

  Because the noise is averaged gradually at each sweep, AVERAGING can be ended by WRITE OFF when the sweep has been averaged sufficiently to grasp the entire image.

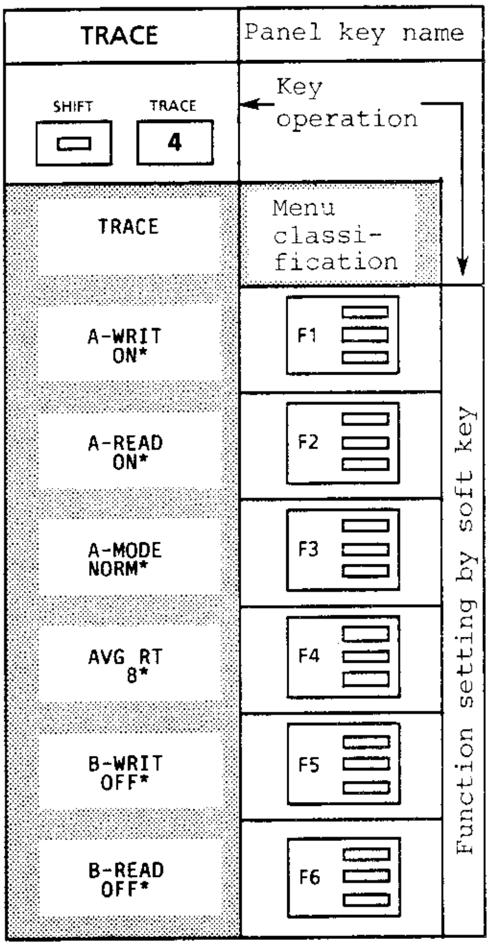


<Example>
Unknown signal search

Since the signal applied to the RF INPUT connector is observed over the full span but its level is low, it is obscrured by noise and cannot be measured.

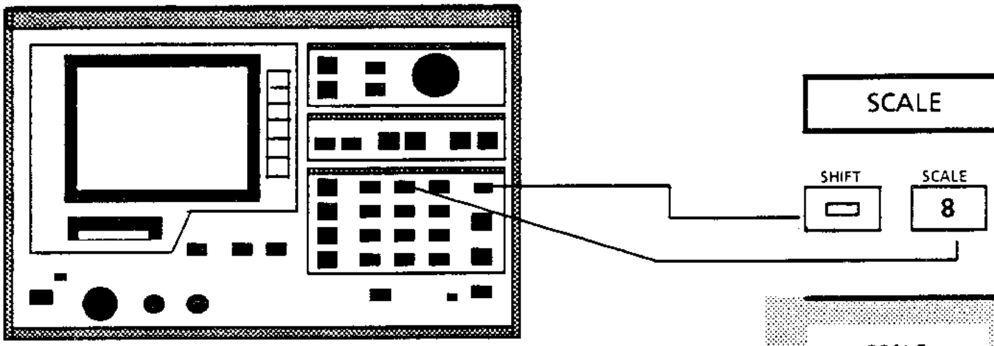


When the VIDEO BW is set to 10 kHz (1/10 of that in AUTO) manually, the signal appears.. When the zone marker is moved to the signal position with the data knob, the level at approx. 500 MHz is seen to be approx. -63 dBm.



5.4.6 CRT vertical scale setting (SCALE)

When the front panel MENU section [SHIFT][SCALE] keys are pressed, the SCALE menu shown on the next page is displayed. Select the required function by pressing the corresponding soft key [F1] to [F5].



SCALE	Panel key name
SHIFT, SCALE 8	Key operation
SCALE	Menu classification

Function setting by soft key

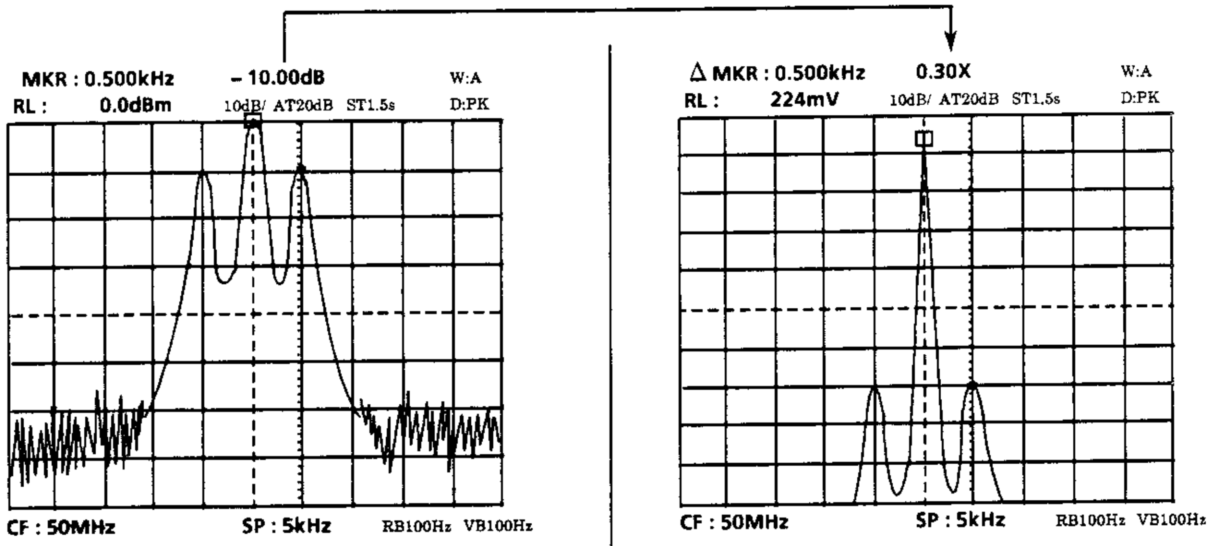
Sets SCALE to LOG 10 dB/div and the vertical scale axis on the CRT becomes 8 divisions LOG 10 dB/div is selected at initial setting. When selected, the characters LOG 10 dB/ are enclosed in a frame.	LOG 10dB/	F1
Sets SCALE to LOG 5dB/div and the vertical scale axis on the CRT becomes 10 divisions When selected, the characters LOG 5 dB/ are enclosed in a frame.	LOG 5dB/	F2
Sets SCALE to LOG 2 dB/div The vertical scale axis on the CRT becomes 10 divisions. When selected, the characters LOG 2 dB/ are enclosed in a frame.	LOG 2dB/	F3
Sets SCALE to LOG 1 dB/div The vertical scale axis on the CRT becomes 10 divisions. When selected, the characters LOG 1 dB/ are enclosed in a frame.	LOG 1dB/	F4
Sets SCALE to LINEAR and the vertical scale axis on the CRT becomes 10 divisions When selected, the characters LIN are enlosed in a frame.	LIN	F5
No function		F6

For a description of SCALE, see paragraphs 5.1.5 (1), (2) and (3) and paragraph 5.4.6.

(1) CRT display range

Scale	The line at the top of the CRT scale is the reference level. At 10 dB/div, the vertical axis has 8 divisions. At other dB/div or LIN settings, the vertical axis has 10 divisions.	. The LOG display 10 dB/div is -70 dB for an 8-division vertical scale to match the -70 dB linearity guarantee range. If the linearity allowance is >±1 dB, use up to -80 dB is possible.
LOG display	10 dB/div: -70 dB relative to reference level 5 dB/div: -50 dB relative to reference level 2 dB/div: -20 dB relative to reference level 1 dB/div: -10 dB relative to reference level	. The LIN scale volt/div is determined by the reference level value. For example, to set 5 mV/div, set the reference level to 50 mV.
LIN display	10%/div of reference level (full scale) (unit V)	. When SCALE is LIN, the PEAK→CF, PEAK→REF, MKR→CF, and MKR→REF functions are not performed.
Linearity	After automatic calibration LOG: ±1 dB at 0 to -70 dB (10 dB/div) display ±0.5 dB at 0 to -50 dB (5 dB/div) display ±0.3 dB at 0 to -20 dB (2 dB/div) display ±0.2 dB at 0 to -10 dB (1 dB/div) display LIN: ±0.3% of reference level (full scale)	

(2) LOG.LIN comparison at Δ marker (level difference measurement)

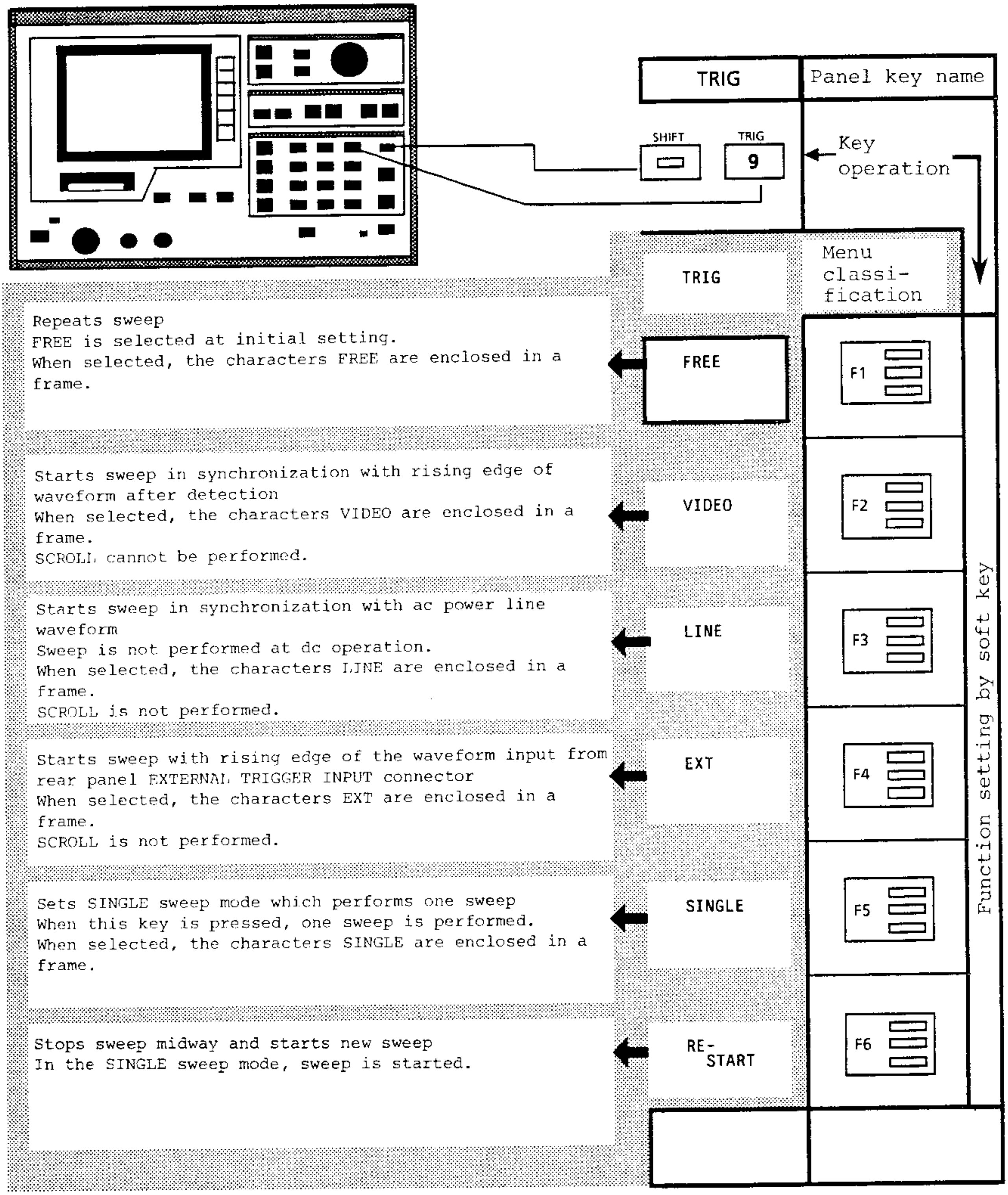


The level difference between the highest level in the figure and the peak to its right is measured as -10 dB.

When the measurement at the left is measured in the LIN mode, the reference marker level is made 1.00X and the other levels are measured as multiplication ratio X (multiplication ratio = 3-digit relative value with 1.00X as reference).

5.4.7 Sweep start selection (TRIG)

When the front panel MENU section [SHIFT][TRIG] keys are pressed, the TRIG menu shown below is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F6].



Repeats sweep FREE is selected at initial setting. When selected, the characters FREE are enclosed in a frame.	FREE	F1
Starts sweep in synchronization with rising edge of waveform after detection When selected, the characters VIDEO are enclosed in a frame. SCROLL cannot be performed.	VIDEO	F2
Starts sweep in synchronization with ac power line waveform Sweep is not performed at dc operation. When selected, the characters LINE are enclosed in a frame. SCROLL is not performed.	LINE	F3
Starts sweep with rising edge of the waveform input from rear panel EXTERNAL TRIGGER INPUT connector When selected, the characters EXT are enclosed in a frame. SCROLL is not performed.	EXT	F4
Sets SINGLE sweep mode which performs one sweep When this key is pressed, one sweep is performed. When selected, the characters SINGLE are enclosed in a frame.	SINGLE	F5
Stops sweep midway and starts new sweep In the SINGLE sweep mode, sweep is started.	RE-START	F6

Notes:

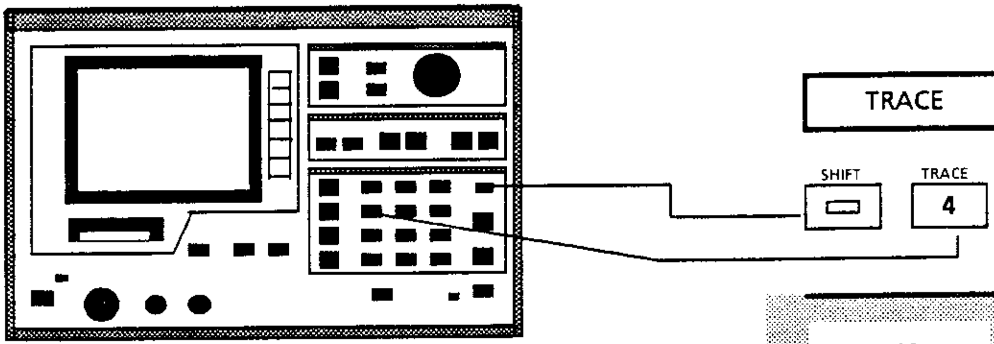
1. When ZONE SWEEP is ON, TRIG mode cannot be set to VIDEO, LINE, or EXT. When TRIG mode is set to VIDEO, LINE, or EXT, ZONE SWEEP cannot be turned on.
2. When PEAK→CF, PEAK→REF, MKR→CF, or MKR→REF is executed when sweep is stopped in the TRIG SINGLE mode, CF or REF LEVEL changes, but the waveform remains the same and the relationship between the setting parameters and waveform is incorrect. If SCROLL is performed in this state, the waveform moves with the setting parameters and the waveform relationship remains incorrect.

5.4.8 Signal waveform write and read (TRACE)

When the front panel MENU section [SHIFT][TRACE] keys are pressed, the TRACE menu shown on the next page is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F6].

Channels A and B can be written and read.

When the menu is opened, the items with the asterisk (*) are selected already. When the relevant soft key is pressed at this time, the function of the currently-displayed item is selected.



TRACE	Panel key name	
SHIFT ▭ TRACE 4	Key operation	
	TRACE	Menu classification
Turns A ch WRITE mode on and off . When A-WRITE ON, A-READOUT ON and B-WRITE OFF . When A-WRITE OFF, Others not changed A-WRITE ON is set at initial setting.	**A-WRIT ON*1**	F1
Turn A ch READOUT mode on and off . When A-READOUT OFF, A-WRITE OFF . When A-READOUT ON, Others not changed A-READOUT ON is set at initial setting.	**A-READ ON*1**	F2
At A-WRITE ON, displays [A-MODE]; at B-WRITE ON, displays [B-MODE] Each channel mode is switched to NORMAL, MAX HOLD, or AVERAGE. A-MODE is displayed at initial setting.	**A-MODE NORM*2**	F3
Switches AVERAGE RATE	**AVG RT 8*3**	F4
Turns B ch WRITE mode on and off . When B-WRITE ON, A-WRITE OFF and B-READOUT ON . When B-WRITE OFF, Others not changed B-WRITE OFF is set at initial setting.	**B-WRIT OFF*4**	F5
Turns B ch READOUT mode on and off . When B-READOUT OFF, B-WRITE OFF . When B-READOUT ON, Others not changed B-READOUT OFF is set at initial setting.	**B-READ OFF*4**	F6

Function setting by soft key

*1 ON/OFF
*2 NORM/MAX/AVG
*3 8/16/32/4
*4 OFF/ON

Note:

At both A-WRITE OFF and B-WRITE OFF, the PEAK→CF, PEAK→REF, MKR→CF, and MKR→REF functions are not performed.

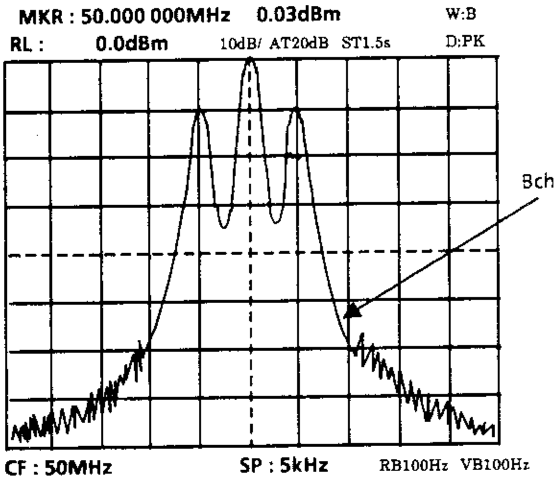
(1) A ch and B ch simultaneous display

Because A ch WRITE ON is related to B ch WRITE OFF and B ch WRITE ON is related to A ch WRITE OFF, A ch and B ch WRITE cannot be turned on simultaneously.

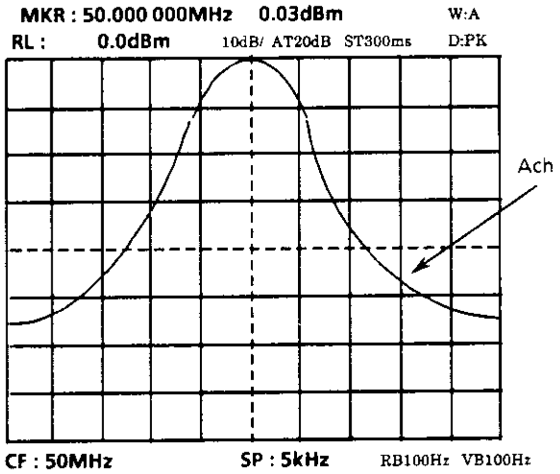
However, because the other modes do not change, even when A-READ and B-READ are turned on simultaneously, A ch and B ch can be displayed simultaneously by setting A ch or B ch to WRITE ON and setting the other WRITE OFF channel (B ch or A ch) to READ ON.

<Example>

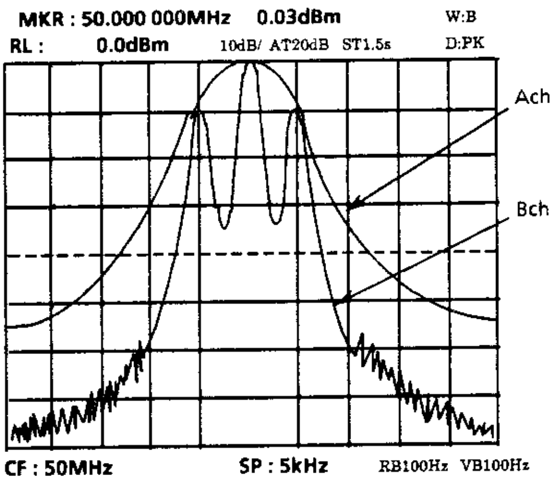
Monitor B ch during A ch sweep after data stored at B ch.



(Step 2)



(Step 4)



(Step 5)

Step	Procedure
1	Set A ch to WRITE/READ OFF. F1 A-READ OFF* A-WRIT OFF*
2	Set B ch to WRITE/READ ON. F5 B-WRIT ON* B-READ ON*
3	After data storage, set B ch to WRITE/READ OFF. F6 B-READ OFF* B-WRIT OFF*
4	Set A ch to WRITE/READ ON. F1 A-WRIT ON* A-READ ON*
5	Display B ch waveform during A ch sweep. F6 B-READ ON* Because the other modes are not changed at B-READ ON, the B ch waveform can be displayed during A ch sweep by turning the [F6] key on and off.

(2) A and B WRITE MODE

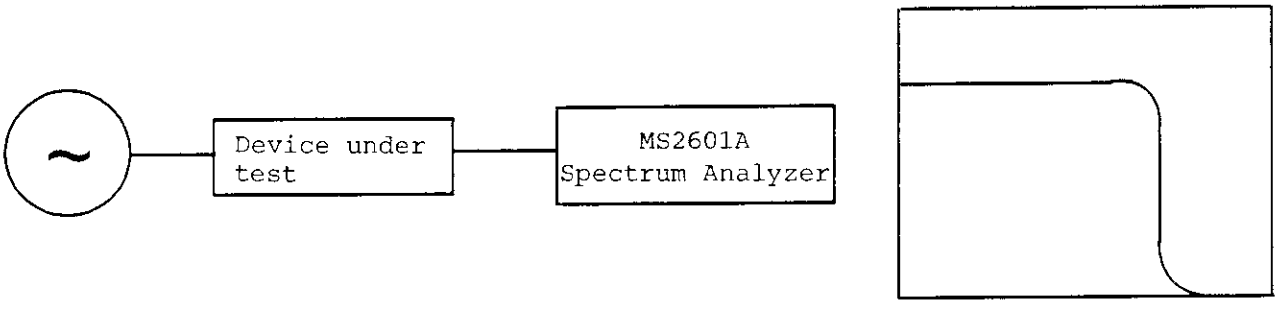
The [F3] key enables the following three A or B WRITE modes.

■ NORMAL

This mode rewrites and displays the memory in accordance with the input waveform at each sweep without any processing. When the sweep is repeated, the data is rewritten.

■ MAX HOLD

This mode rewrites the memory contents at each sweep. At this time, the old data are compared to new data at each point of the X axis and the larger data is written in the memory. The figure below is an application example of amplitude-frequency characteristic measurement combined with a sweep oscillator.



MAX HOLD function used

■ AVERAGE (digital video averaging)

Averaging is performed at each point at each sweep. The averaging rate (32, 16, 8, 4) can be set by pressing the [F4] key. Averaging starts from the next sweep after setting the averaging rate.

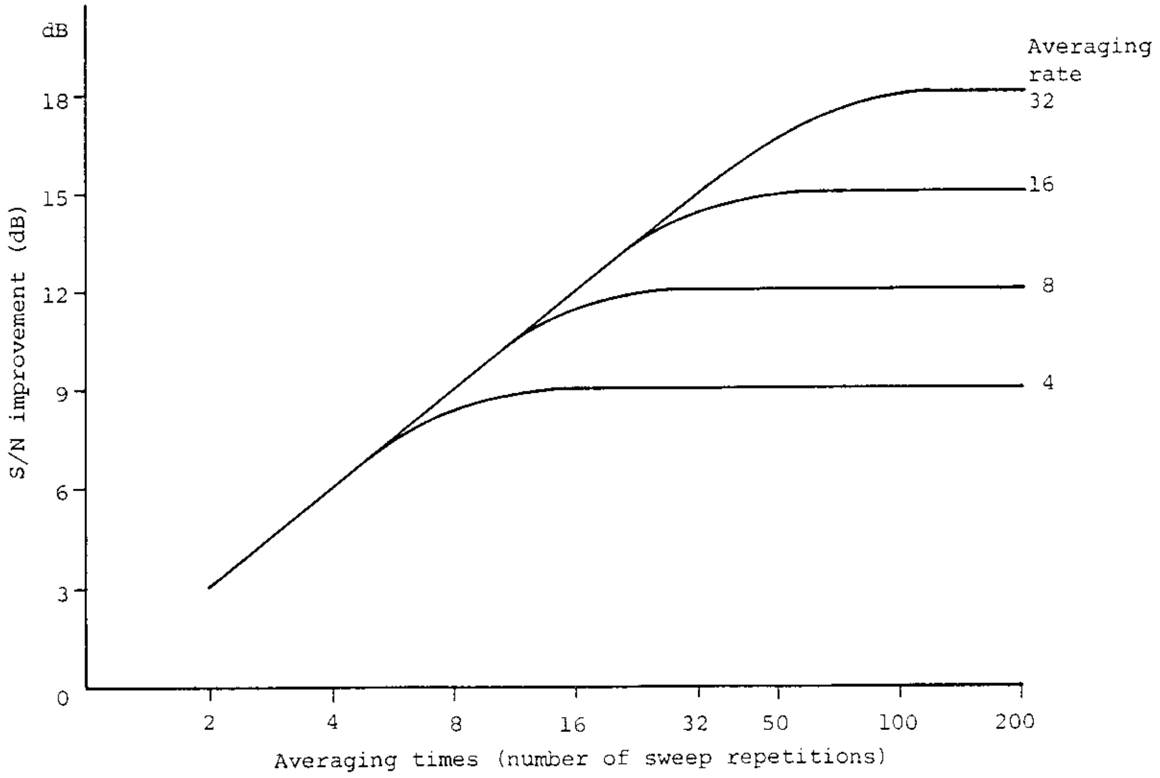


Fig. 5-10 S/N Improvement by Digital Video Averaging

The disadvantage of averaging by the video filter described in paragraph 5.4.5 (2) is that when the video bandwidth is narrowed to increase the averaging effect, the sweep time becomes longer.

The digital video process averages the trace display by averaging the data after A/D conversion at each sweep without narrowing the video bandwidth. Since the VIDEO BW is comparatively wide and the time for one sweep can be shortened, the entire spectrum image can be determined and repetitive sweeping can be stopped after the necessary averaging. With video filter averaging, one sweep is long and it takes time to determine the entire spectrum image.

Since the averaging rate is 8 at initial setting, Fig. 5-10 shows improvement of the S/N by 9 dB with 8 sweeps.

Note:

Usually, when measuring the frequency and level of a spectrum waveform, peak detection is selected as the analyzer detection mode. At peak detection, since the peak value during sampling interval is held, the instantaneous value immediately after A/D conversion is not used at the trace signal. On the other hand, at noise measurement, the instantaneous value immediately after A/D conversion is necessary. Therefore, the SMP (sample) detection mode in the SUB TRACE menu (paragraph 5.4.9) must be selected by using the [F3] key for noise measurement.

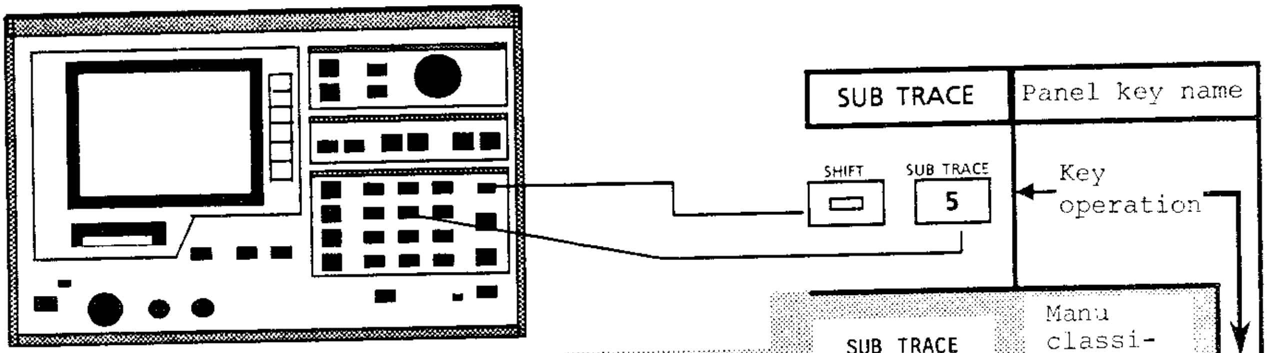
(3) A ch and B ch spectrum data at initial state

. At POWER ON	At POWER ON, the A ch and B ch spectrum waveform data are cleared (-200 dBm written as initial value).
. When [INITIAL] key pressed	Only the A ch spectrum data is cleared. The B ch spectrum data remains.
. GP-IB "INI" or device clear execution	

5.4.9 Signal waveform processing (SUB TRACE)

When the front panel MENU section [SHIFT][SUB TRACE] keys are pressed, the SUB TRACE menu shown on the next page is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F5].

When the menu is opened, the items with the asterisk (*) are selected already. When the relevant soft key is pressed at this time, the function of the item currently-displayed item is selected.



	SUB TRACE	
Transfers contents of A ch to B ch The original B ch data is lost. The A ch contents not changed.	A→B	F1
Turns A-B operation on and off When A-B operation is turned on, the B ch contents are subtracted from the A ch contents and the difference is stored to A ch. The original A ch data is lost. The sweep is started from the left end and the B ch value is subtracted from the spectrum data input value for each measurement point and the difference is stored to A ch.	A-B OFF*1	F2
Switches DETECTION MODE PEAK: Positive peak detector SMP: Sampling detector DIP: Negative peak detector	DET PEAK*2	F3
No function		F4
At A-B operation, the REF LINE position on the CRT is switched to the TOP, MIDDLE (MDL), or BOTTOM (BOT).	REF LN TOP*3	F5
No function		F6

Function setting by soft key

*1 OFF/ON
*2 PEAK/SMP/DIP
*3 MDL/BOT/TOP

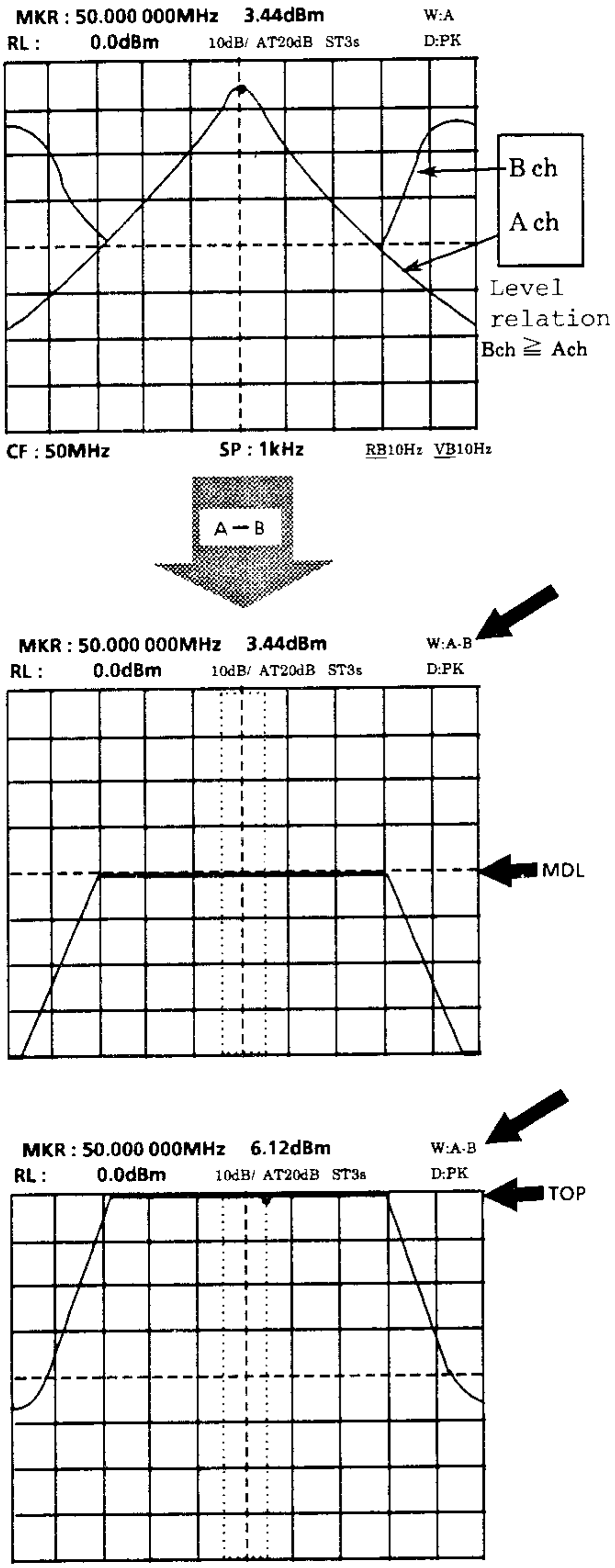
Note:

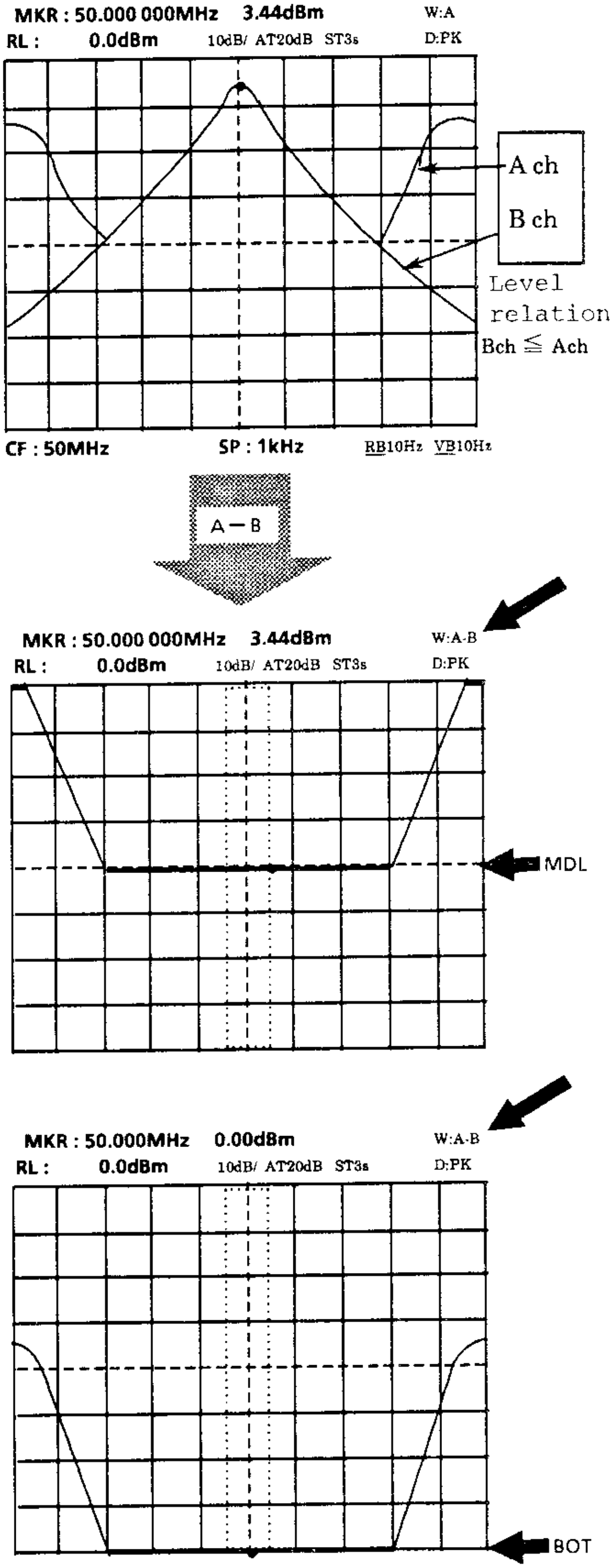
When A-B operation is turned on, B-WRITE is turned off. Therefore, when A-B operation is on, B-WRITE cannot be turned on.

(1) A-B and REF LN

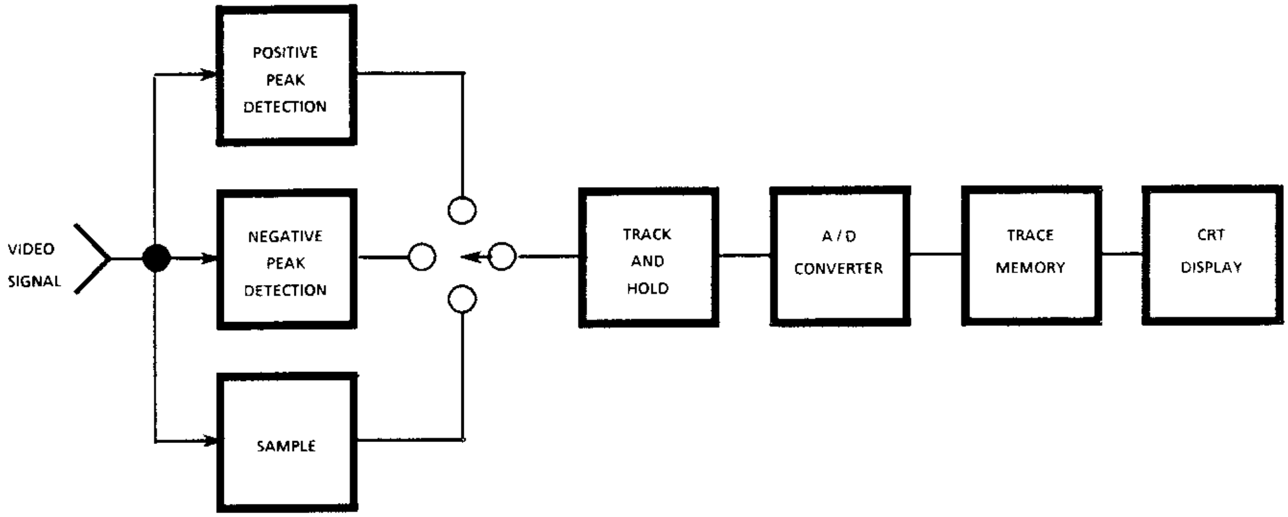
When the [F2] key (A-B→A) is pressed, the B ch contents are subtracted from the A ch contents and the difference is stored to A ch. The reference level of the difference is switched to TOP, MIDDLE (MDL), or BOTTOM (BOT) by using the [F5] key (REF LN).

For example, the result of the operation between two waveforms with the same center peak and different falling parts at both sides is shown on the next page.


MKR : 50.000 000MHz 3.44dBm
W:A
RL : 0.0dBm 10dB/ AT20dB ST3s
D:PK
B ch
A ch
Level relation
Bch ≧ Ach
CF : 50MHz
SP : 1kHz
RB10Hz VB10Hz
A − B
MKR : 50.000 000MHz 3.44dBm
W:A-B
RL : 0.0dBm 10dB/ AT20dB ST3s
D:PK
MDL
MKR : 50.000 000MHz 6.12dBm
W:A-B
RL : 0.0dBm 10dB/ AT20dB ST3s
D:PK
TOP


MKR : 50.000 000MHz 3.44dBm
W:A
RL : 0.0dBm 10dB/ AT20dB ST3s
D:PK
A ch
B ch
Level relation
Bch ≦ Ach
CF : 50MHz
SP : 1kHz
RB10Hz VB10Hz
A − B
MKR : 50.000 000MHz 3.44dBm
W:A-B
RL : 0.0dBm 10dB/ AT20dB ST3s
D:PK
MDL
MKR : 50.000MHz 0.00dBm
W:A-B
RL : 0.0dBm 10dB/ AT20dB ST3s
D:PK
BOT

(2) PEAK, SMP, and DIP DETECTION



The route of the video signal that finally becomes the trace signal on the CRT is selected from the following three routes with the [F3] key before the signal is A/D-converted.

1. Positive peak detection route.. Menu display PEAK
2. Negative peak detection route... Menu display DIP
3. Sample route................... Menu display SMP

PEAK/DIP

The MS2601A has 501 horizontal axis measurement points corresponding to 501 trace memories. When PEAK or DIP is selected by using the [F3] key, the detected peak value is held so that it can be displayed when the sweep reaches the measurement sample point. In positive (negative) peak detection, the maximum (minimum) value during the hold time remains in the memory.

If the level of the memorized digital data are traced, it becomes the spectrum waveform displayed on the CRT.

- PEAK is used in most normal measurements.
- DIP is used when measuring the lower envelop of a modulated waveform.

SMP

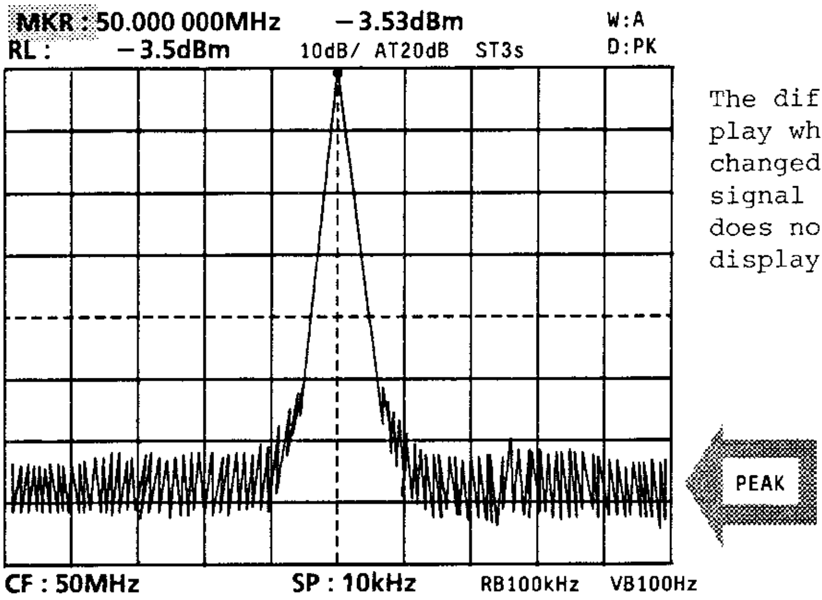
In the sample mode, the current video signal at each sample point is A/D-converted, memorized, and displayed on the CRT.

- Sample mode is used in noise measurement (digital level averaging), zero span, etc.

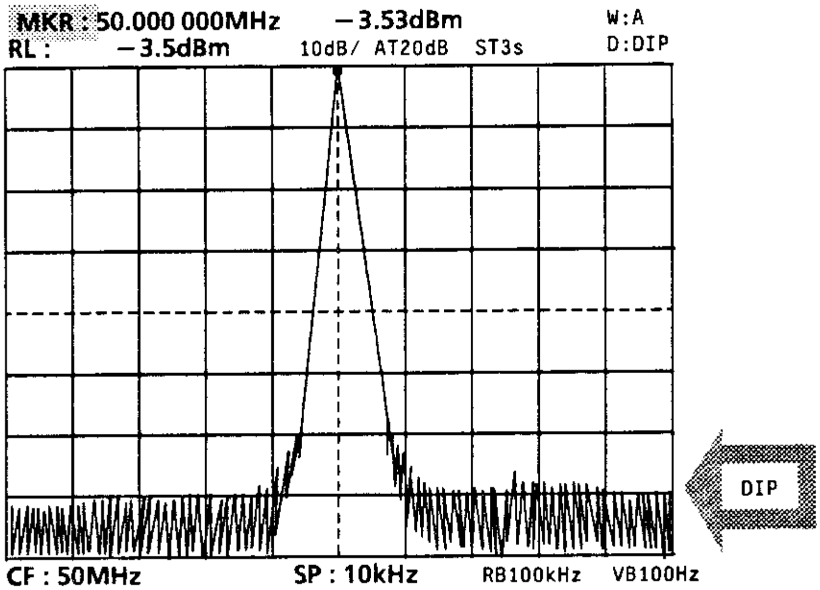
Note:

The value of spectrum peak level is not correctly displayed in the SMP or DIP detection mode if the SPAN and RESOLN BW parameters are set so that the spectrum is displayed as discrete vertical lines.

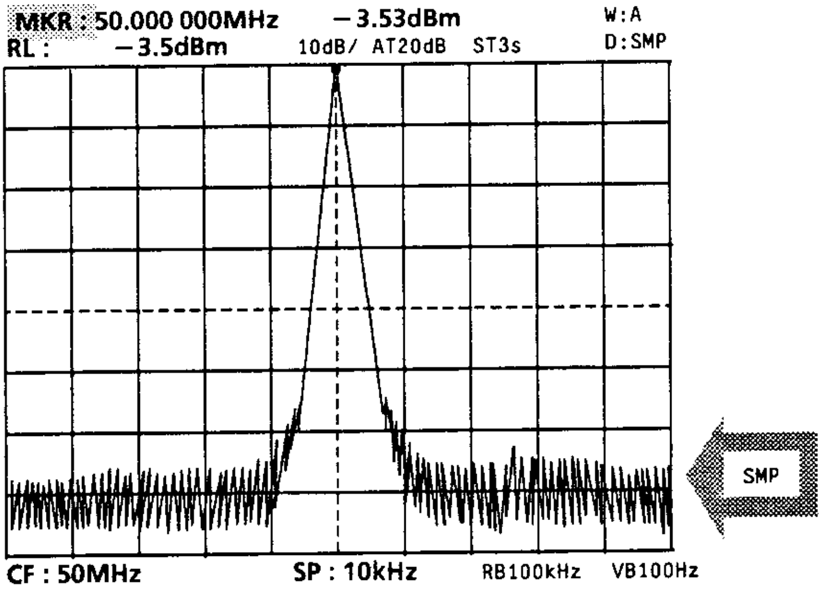
The difference in the trace display when the detection mode is changed is shown below. The signal at the center of the CRT does not change, but the noise display is different.



(Positive Peak Detection)



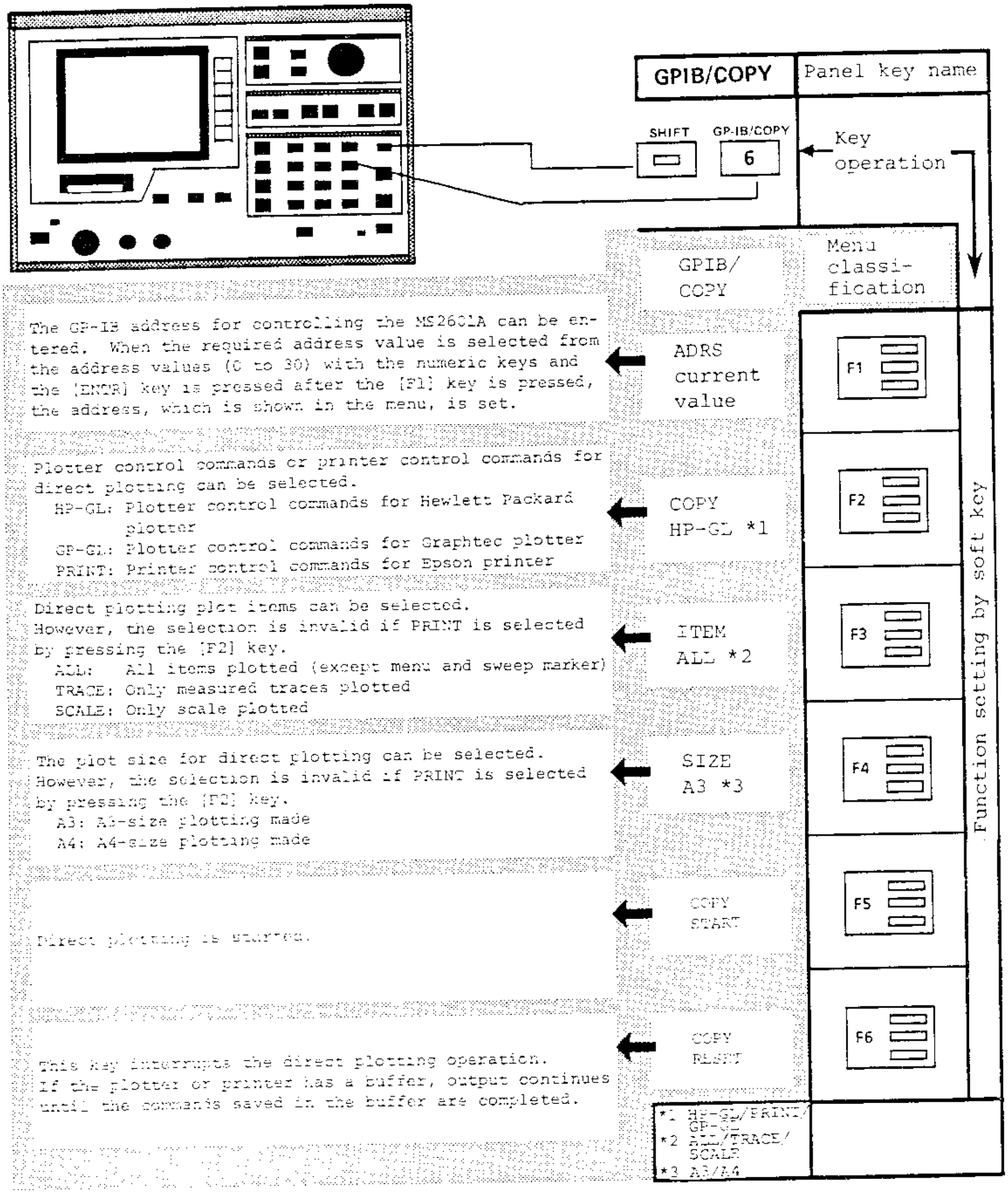
(Negative Peak Detection)



(Sample)

5.4.10 GP-IB/direct plotting setting (GP-IB/COPY)

When the front panel MENU section [SHIFT][GP-IB/COPY] keys are pressed, the GP-IB/COPY menu shown below is displayed. Select the required function by pressing the corresponding soft key [F1] to [F6]. (For an example of [F1] key use, see paragraph 9.2.3.)



The GP-IB address for controlling the MS2601A can be entered. When the required address value is selected from the address values (0 to 30) with the numeric keys and the [ENTR] key is pressed after the [F1] key is pressed, the address, which is shown in the menu, is set.

Plotter control commands or printer control commands for direct plotting can be selected.

HP-GL: Plotter control commands for Hewlett Packard plotter
GP-GL: Plotter control commands for Graphtec plotter
PRINT: Printer control commands for Epson printer

Direct plotting plot items can be selected. However, the selection is invalid if PRINT is selected by pressing the [F2] key.

ALL: All items plotted (except menu and sweep marker)
TRACE: Only measured traces plotted
SCALE: Only scale plotted

The plot size for direct plotting can be selected. However, the selection is invalid if PRINT is selected by pressing the [F2] key.

A3: A3-size plotting made
A4: A4-size plotting made

Direct plotting is started.

This key interrupts the direct plotting operation. If the plotter or printer has a buffer, output continues until the commands saved in the buffer are completed.

Example of Machines available for direct plotting:

(1) GP-GL: GD9411 (Graphtec), FP5301 (Graphtec), VP6804A (Matsushita)
(2) HP-GL: 7475A (HP), 7550A (HP), 7470A (HP), 7440A (HP)
(3) PRINT: VP-800 (Epson), DPR7713B (ANRITSU)

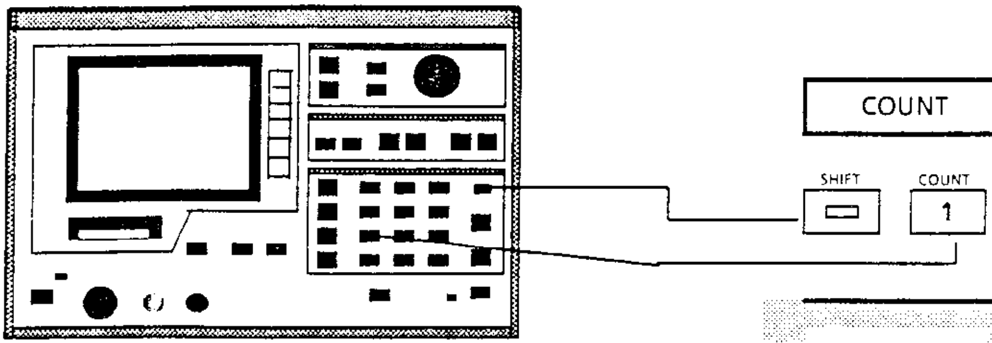
Note: Before pressing the [COPY START] key, confirm that the plotter or printer is in the listen only mode and remote status.

5.4.11 Frequency count (COUNT)

When the front panel MENU section [SHIFT][COUNT] keys are pressed, the COUNT menu shown on the next page is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F2].

When the menu is opened, the items with the asterisk (*) are selected already. If the relevant soft key is pressed at this time, the currently-displayed item is selected.

COUNT	Panel key name

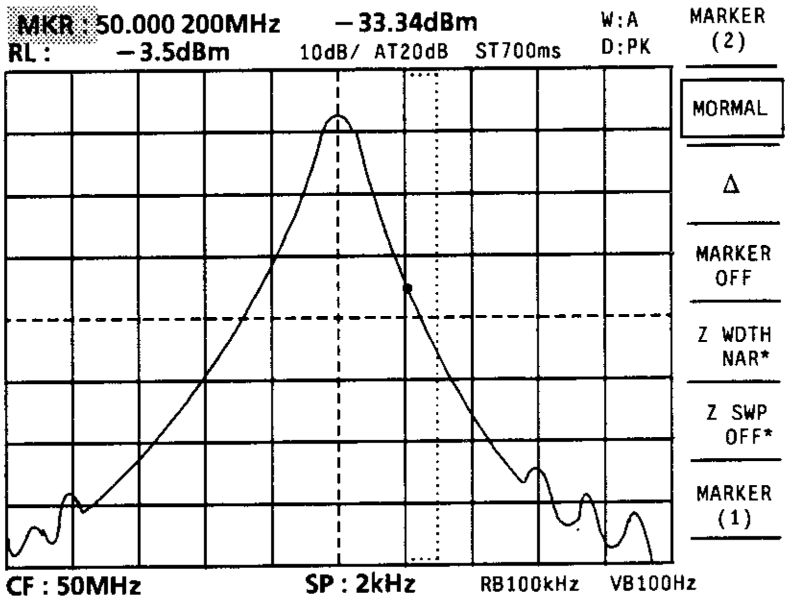


Key operation

	COUNT	Menu classification
This key, when ON, counts and displays the peak frequency at the marker position. For NORMAL marker, [FREQ:] is displayed instead of [MKR:]. For Δ marker, the difference between the reference marker frequency and counter frequency is displayed. The characters [ΔFRQ] are displayed instead of [ΔMKR].	COUNT OFF*1	F1
Switches counting resolution to 1 Hz, 10 Hz, or 100 Hz	RESOLN 10Hz*2	F2
No function		F3
No function		F4
No function		F5
No function		F6

Function setting by soft key

*1 OFF/ON
*2 10Hz/100Hz/1Hz



The above figure shows a 50 MHz signal measured in the NORMAL marker mode.

	NORMAL marker mode	Δ marker mode
COUNT OFF	Marker frequency: 50.000 200 MHz	Frequency difference between reference marker frequency and current marker frequency when waveform peak is made reference: 0.200 kHz
	Characters displayed at top left of CRT: MKR:	Characters displayed at top left of CRT: ΔMKR:
COUNT ON	Frequency of spectrum peak at marker position: 50.000 000 MHz	Frequency difference between reference marker frequency and current marker frequency when waveform peak is made reference: 0.00 kHz
	Characters displayed at top left of CRT: FREQ:	Characters displayed at top left of CRT: ΔFRQ:
Comment	At COUNT OFF, to measure the signal frequency, the marker is positioned at the spectrum peak. At COUNT ON, the displayed frequency matches the frequency of the spectrum peak even if the marker is not set to the spectrum peak.	

At NORMAL MARKER, the counted frequency is displayed as the marker frequency ([FREQ:] is displayed instead of [MKR:]).

At ΔMARKER, the difference between the counted frequency and reference marker frequency is displayed ([ΔFRQ:] is displayed).

Notes:

1. At the end of each sweep, counting is performed in the sweep-stopped state. During counting, key input processing waits. (When the sweep time is long, the waiting time may be long.) The first key input is stored, but the buzzer sounds and input is not accepted at the second input. Therefore, COUNT cannot be turned off if the counting operation has not ended.

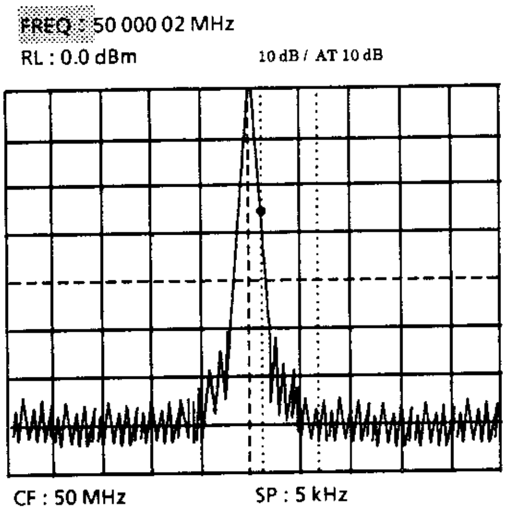
2. When MARKER OFF is set, COUNT can not be on.

3. At COUNT ON, SCROLL is not performed. (When the SCROLL key is pressed, a buzzer sounds.)

4. When SPAN is 500 kHz or higher, or RESOLN BW is too small compared to SPAN, since tuning is automatic and the frequency is counted, counting may take more time.

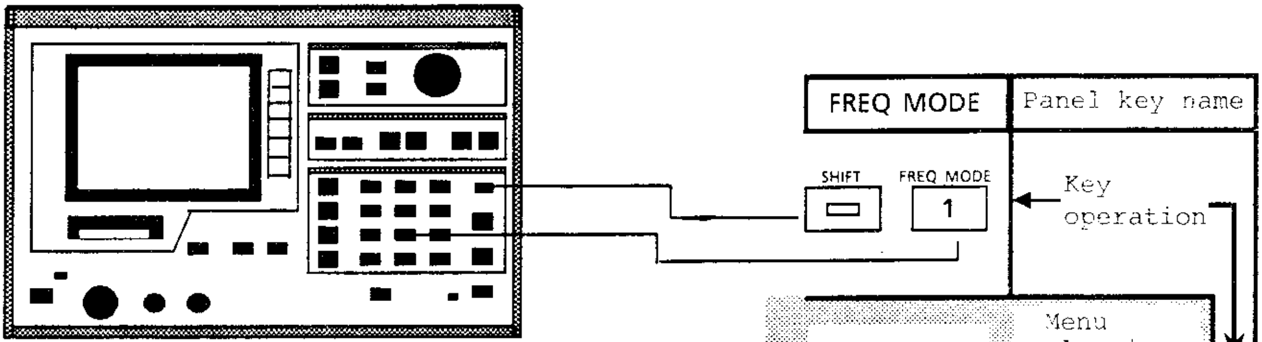
5. To measure at the specified accuracy, since the accuracy is affected by noise, adjacent interference, and other undesired waves, set the marker to within -30 dB of the REF LEVEL. Count at 20 dBm or more above the noise level.

If the marker is -40 dB or less from the REF LEVEL, a counting error may occur.



5.4.12 Center and start frequencies setting (FREQ MODE)

When the front panel MENU section [SHIFT][FREQ MODE] keys are pressed, the FREQ MODE menu shown below is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F6].



	FREQ MODE	Menu classification	Function setting by soft key
Sets CENTER FREQ entry mode The parameter display on the CRT is [CF:]. CENTER is selected at initial setting. When selected, the characters CENTER are enclosed in a frame.	CENTER	F1	
Sets CENTER FREQ entry mode The parameter display on the CRT is [SF:]. When selected, the characters START are enclosed in a frame.	START	F2	
The step size when CENTER or START FREQ is stepped-up/down by using the [F5] and [F6] keys can be entered. The parameter display on the CRT is [SS:]. When selected, the characters STEP SIZE are enclosed in a frame.	STEP SIZE	F3	
No function		F4	
Steps-up FREQ (CENTER or START frequency)	⌃	F5	
Steps-down FREQ (CENTER or START frequency)	⌄	F6	

(1) CF entry... (See paragraph 5.1.3.)

(2) SF entry .. (See paragraph 5.1.3.)

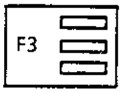
(3) STEP SIZE entry

- To register the CF (CENTER FREQUENCY) step size, when the FREQ MODE menu is opened;
  1. Select CENTER.
  2. If center is not selected, press the [F1] key to select CENTER.
  3. Then press the [F3] key to enter step size.
- To register the SF (START FREQUENCY) step size, when the FREQ MODE menu is opened;
  1. Select START.
  2. If START is not selected, press the [F2] key to select START.
  3. Then press the [F3] key to enter step size.

Note:

When STEP SIZE is selected by key [F3], the previously-set entry mode is held. At the end of STEP SIZE entry, the entry mode returns to the previous mode.

The registration procedure after pressing [F3] key is shown below. (Assuming that CF is 50 MHz and the CF step size is 100 MHz in the following procedure.)

Step	Action	Verification
1		 Enclosed in a frame when [F3] key pressed.  CENTER frame erased. Parameter displayed at bottom left of CRT SS (STEP SIZE) CF: 50 MHz → SS: 0 kHz
2	COUNT 1 QP/UNIT 0 QP/UNIT 0	Parameter displayed at bottom left of CRT SS: 100
3	MHz	When a unit key is pressed, each display returns to the CF mode display.  Returns to original CENTER display  STEP SIZE frame erased Parameter display at bottom left of CRT SF: 50 MHz

(Cont.)

Step	Action	Verification
4	F5 ☰ ∧	Parameter display at bottom left of CRT CF: 150 MHz
5	F6 ☰ ∨	Parameter display at bottom left of CRT CF: 50 MHz

5.4.13 PTA ON/OFF (PTA)

PTA is optional. When the [SHIFT][PTA] keys are pressed, PTA is started.

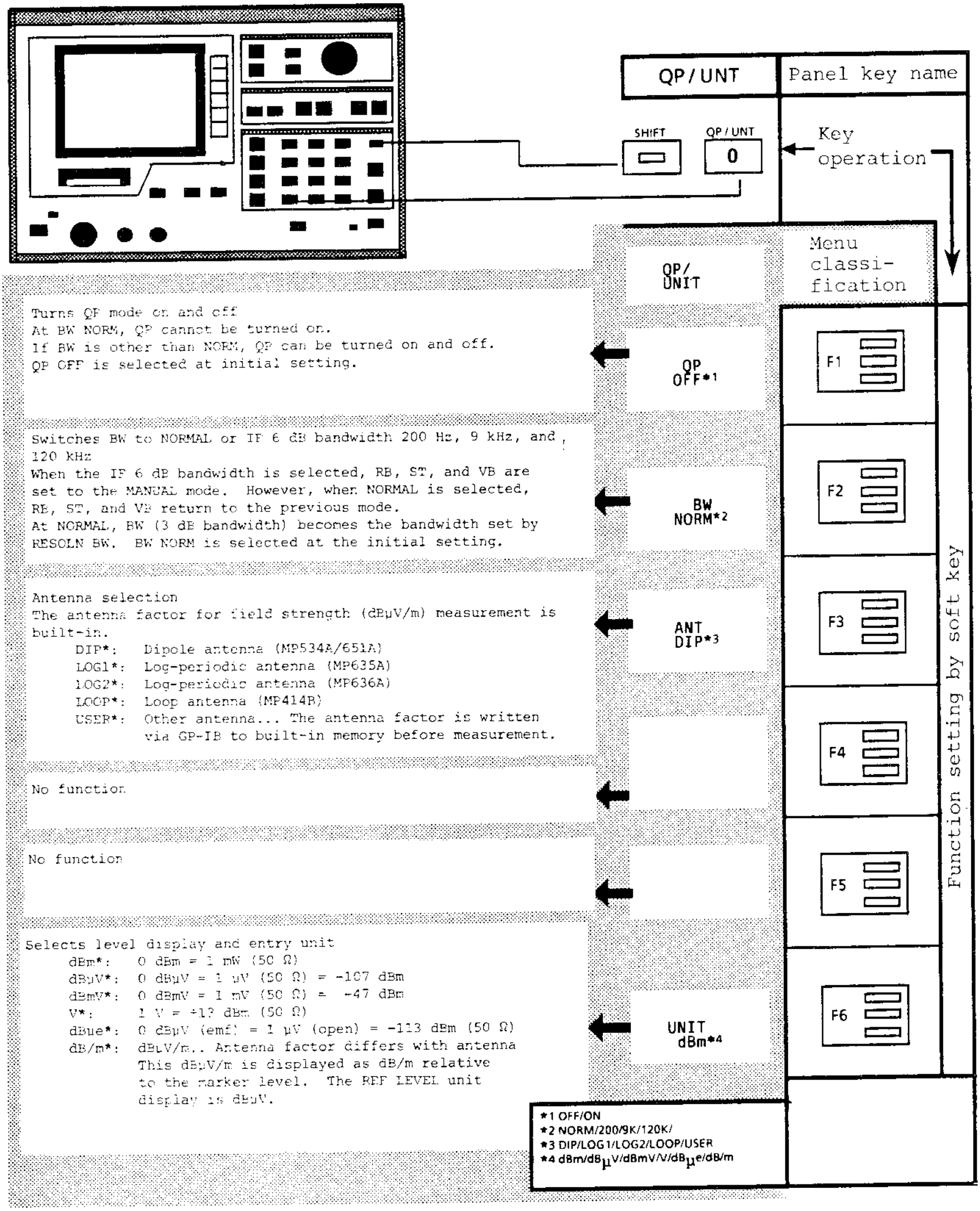
If the PTA option is not installed, the buzzer sounds and nothing happens. (The menu is also not displayed.)

For a description of the PTA, refer to the PTA manual.

5.4.14 Level unit setting and field strength measurement (QP/UNIT)

When the front panel MENU section [SHIFT][QP/UNIT] keys are pressed, the QP/UNIT menu shown below is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F6].

When the menu is opened, the items with the asterisk (*) are selected already. When the relevant key is pressed at this time, the function of the currently-displayed item is set.



Turns QP mode on and off
At BW NORM, QP cannot be turned on.
If BW is other than NORM, QP can be turned on and off.
QP OFF is selected at initial setting.

Switches BW to NORMAL or IF 6 dB bandwidth 200 Hz, 9 kHz, and 120 kHz
When the IF 6 dB bandwidth is selected, RB, ST, and VB are set to the MANUAL mode. However, when NORMAL is selected, RB, ST, and VB return to the previous mode.
At NORMAL, BW (3 dB bandwidth) becomes the bandwidth set by RESOLN BW. BW NORM is selected at the initial setting.

Antenna selection
The antenna factor for field strength (dBµV/m) measurement is built-in.

DIP*:	Dipole antenna (MP534A/651A)
LOG1*:	Log-periodic antenna (MP635A)
LOG2*:	Log-periodic antenna (MP636A)
LOOP*:	Loop antenna (MP414B)
USER*:	Other antenna... The antenna factor is written via GP-IB to built-in memory before measurement.

No function

No function

Selects level display and entry unit

dBm*:	0 dBm = 1 mW (50 Ω)
dBµV*:	0 dBµV = 1 µV (50 Ω) = -107 dBm
dBmV*:	0 dBmV = 1 mV (50 Ω) = -47 dBm
V*:	1 V = +13 dBm (50 Ω)
dBµe*:	0 dBµV (emf) = 1 µV (open) = -113 dBm (50 Ω)
dB/m*:	dBµV/m.. Antenna factor differs with antenna This dBµV/m is displayed as dB/m relative to the marker level. The REF LEVEL unit display is dBµV.

*1 OFF/ON
*2 NORM/200/9K/120K/
*3 DIP/LOG1/LOG2/LOOP/USER
*4 dBm/dBµV/dBmV/V/dBµe/dB/m

For a description of BW, see paragraph 5.4.1(1).

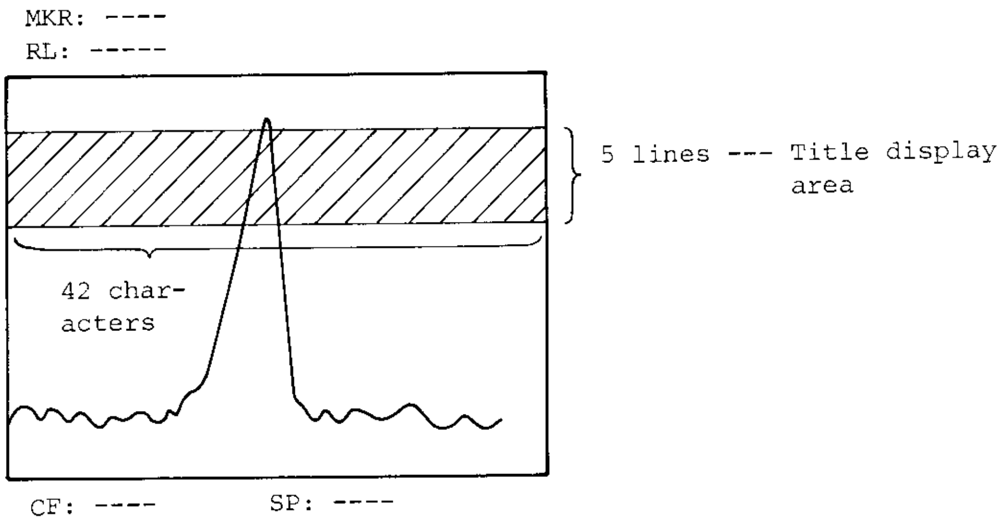
Note:

When outside the frequency range of the selected antenna, when UNIT is dBμV/m, "*******" is displayed at the marker level item to indicate out-of-range.

5.4.15 Title display (TITLE)

A title with up to 42 characters x 5 lines can be displayed.

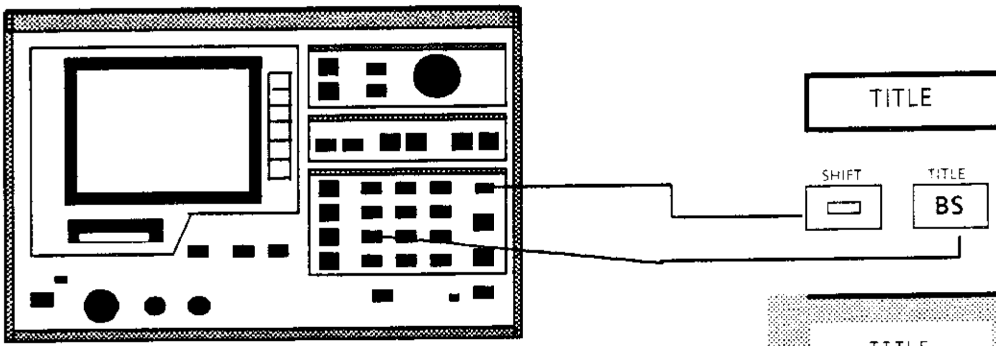
Characters are selected by turning the data knob, and are set by pressing the [ENTR] key.



When the [SHIFT] and [TITLE] (BS) keys are pressed in this order on the front panel MENU screen, the following title menu is displayed on the CRT.

Select the required function by pressing the corresponding soft key [F1] to [F6]

TITLE	Panel key name



Key operation

		Menu classification
	TITLE	
Enables cursor to be moved up and down by turning the data knob (5 lines)	CURS ↑↓	F1
Enables cursor to be moved left and right by turning the data knob (42 characters)	CURS ← →	F2
Enables characters to be selected by turning the data knob Pressing the [ENTR] key then inputs the selected characters. Also, pressing this key enables three types of characters to be selected: Numeric/symbol (NUM); Alphabetic upper case (CAP); Alphabetic lower case (SML)	CHAR NUM*1	F3
Turns the TITLE display ON and OFF Even if the title display is turned off, the title can be redisplayed when this key is pressed again because the data is memorized.	DISPLAY ON*2	F4
Clears the title display and memory storage	CLEAR	F5
Erases the cursor and releases the title entry	CURSOR OFF	F6

Function setting by soft key

*1 NUM/CAP/SML
*2 ON/OFF

Notes:

1. Pressing the ⌈F5⌉ key clears the complete title.

   If the title is to be erased character-by-character, set NUM mode by using the ⌈F3⌉ key; select a space by turning the data knob and press the ⌈ENTR⌉ key.

2. The title on the screen can be saved/recalled together at the same time as the setting parameter. (Both internal memory and PMC can be used.)

3. The first line of the title can be displayed by using the CUR and REG keys of the LIST function.

4. When the PTA is ON, if the ⌈F4⌉ DISPLAY is set to OFF or if the ⌈F5⌉ CLEAR key is pressed, both the 5 character lines of the title and the characters displayed by PTA are cleared at the same time. (If the PTA cursor is scrolled down to the bottom and the ⌈⏎⌉ key is pressed, the screen is scrolled and the cleared characters reset. This is because the PTA characters and title characters are displayed on the same screen.)

5.5 SAVE-RECALL Function (MEMORY, PMC)

The MS2601A has two memory systems for saving measurement conditions and measured results to memory and recalling and reusing them later: RAM and PMC (Plug-in Memory card)

Mainframe RAM (PMC not installed)

- Mainframe RAM (with battery backup)
- REG No. 0 to 6

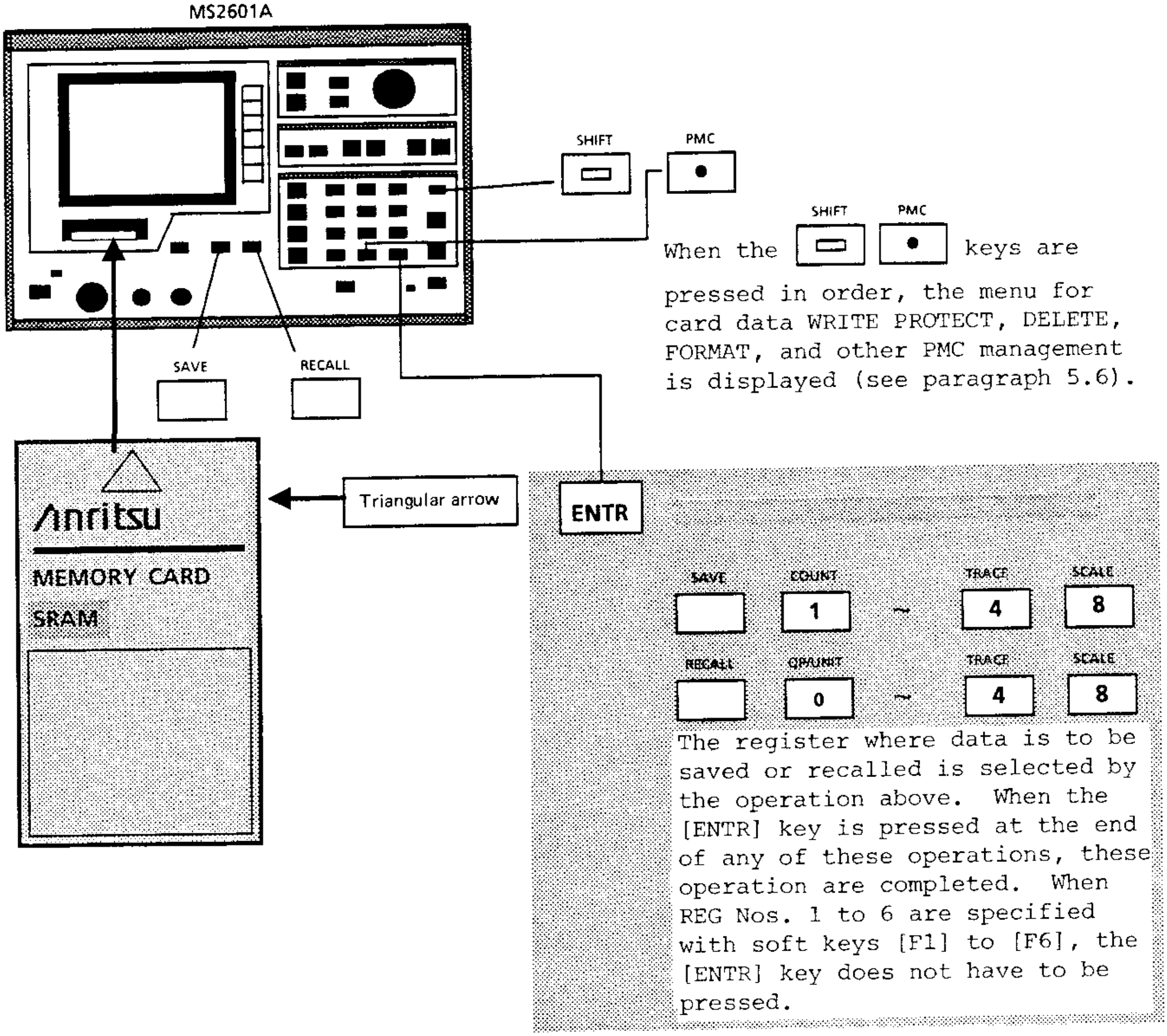
- Only the setting parameters (not waveform) can be saved and recalled.
  Therefore, when the same signal as was previously input is applied to the RF INPUT connector, when the data is recalled, the same waveform is reproduced.

PMC installed

- Mainframe RAM other than REG No. 0 is not used.
- The REG No. that can be used varies according to the PMC capacity.
  PMC capacity 32 kbytes.. REG No. 1 to 12
  PMC capacity 128 kbytes.. REG No. 1 to 48
- The setting parameters, and A ch and B ch waveforms can be saved and recalled.

Note:

Check visually whether or not the PMC is installed when the REG No. is actually specified.



When the SHIFT PMC keys are pressed in order, the menu for card data WRITE PROTECT, DELETE, FORMAT, and other PMC management is displayed (see paragraph 5.6).

The register where data is to be saved or recalled is selected by the operation above. When the [ENTR] key is pressed at the end of any of these operations, these operation are completed. When REG Nos. 1 to 6 are specified with soft keys [F1] to [F6], the [ENTR] key does not have to be pressed.

Fig. 5-11 SAVE/RECALL by PMC

CAUTION

1. If the PMC has a static electric charge on it when it is plugged in, the noise, etc. generated when the charge is discharged may damage the internal CPU. Therefore, prevent build up of a static electric charge by observing the precautions described below.
    a. When the PMC is not used, put it into the anti-static cover.
    b. When handling the PMC, discharge any static electric charge on the PMC or your body to ground before plugging it in.
2. IF the PMC is forced into the slot, the socket electrodes may be damaged. Insert the PMC so that the triangular arrow (Δ) is uppermost and facing the slot.

5.5.1 SAVE

When the [SAVE] key is pressed, [SAVE?] is displayed on the CRT to prompt REG No. entry. When the REG No. is specified as shown below, the current setting parameters (waveforms A ch and B ch also when PMC installed) can be saved.

REG No. specification

1. Press the [F1] to [F6] keys... Corresponds to REG No. 1 to 6
2. Enter 1 to 12 with the numeric keys, then press the [ENTR] key... Corresponds to REG No. 1 to 12

    [SAVE PMC] (or INT) is displayed.

Notes:

1. The REG No. 0 is in the mainframe RAM. When the setting parameters are changed, the immediately preceding state is automatically saved to this register and the current setting parameters cannot be saved to it by using [SAVE] key. The REG No. 0 can change the current state to the immediately preceding state by pressing the [RECALL] key.
2. Once the REG No. is entered by pressing the numeric keys + [ENTR] key, since the menu display does not change, REG No. 1 to 6 can be set consecutively by using the [F1] to [F6] keys. However, to re-enter the REG No. with the numeric keys, press the [SAVE] key again, then enter the REG No.
3. To observe the waveform data again by using the RECALL operation after saving a waveform data into a PMC, set the writing mode to the WRITE OFF state before saving to prevent the waveform data from being written. Do not set the WRITE ON state because in the WRITE ON state, the waveform data read out from the PMC is rewritten immediately for the sweep after RECALL if the data is saved into the PMC.

5.5.2 RECALL

When the [RECALL] key is pressed, "RECALL?" is displayed on the CRT to prompt REG No. entry.

When the REG No. is specified as shown below, the saved setting parameters (waveforms A ch and B ch also when PMC installed) can be recalled.

REG NO. specification

1. Press the [F1] to [F6] keys.. Corresponds to REG No. 1 to 6

2. Enter 0 to 12 with the numeric keys, then press the [ENTR] key... Corresponds to REG No. 0 to 12

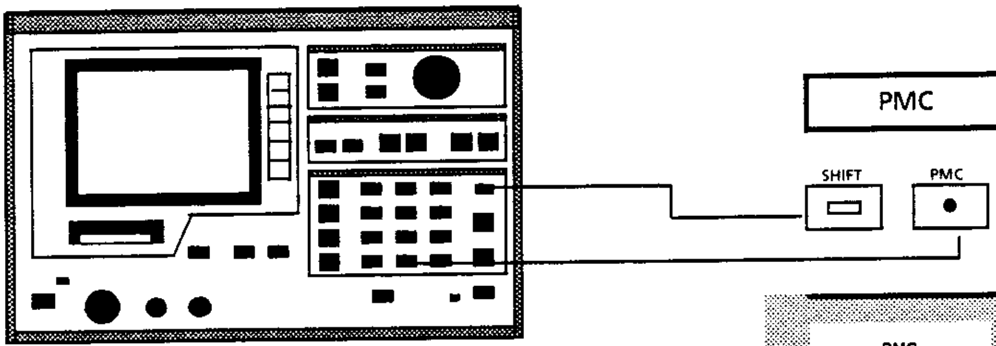
"RECALL PMC" (or INT) is displayed.

Note:

The REG No. 0 is used to change the current state to the immediately preceding state and can be used whether or not the PMC is installed.

5.5.3 PMC management (PMC)

When the front panel MENU section [SHIFT][PMC] keys are pressed, the PMC menu shown on the next page is displayed on the CRT. Select the required function by pressing the corresponding soft keys [F1] to [F6].



PMC	Panel key name
SHIFT PMC	Key operation

	PMC	Menu classification
Deletes contents of register (PMC file) of specified number After the [F1] key is pressed, [?] is displayed under DELETE. Enter the register number from the numeric keys, then press the [ENTR] key. When selected, the characters DELETE are enclosed in a frame.	DELETE	F1
Sets PMC WRITE PROTECT After selecting ON?/OFF? by pressing the [F2] key, press the [ENTR] key. When selected, the characters PRTCT are enclosed in a frame.	PRTCT*	F2
Formats PMC for MS2601A use After pressing the [F3] key and checking FORMAT?, press the [ENTR] key. When the PMC is formatted, its contents are all cleared. When selected, the characters FORMAT are enclosed in a frame.	FORMAT	F3
Checks PMC format If the format is the MS2601A format, displays "FMT OK; PRTCT OFF (or ON)" on the CRT and indicates the state of WRITE PROTECT	FORMAT CHECK	F4
Transfers PMC REG No. 1 to 6 setting parameters to REG No. 1 to 6 of mainframe RAM	LOAD REG1-6	F5
Transfers mainframe RAM REG No. 1 to 6 setting parameters to PMC REG No. 1 to 6	STORE REG1-6	F6

Function setting by soft key

(1) PMC

There are two types of PMC (Plug-in Memory Card):

1. SRAM type with built-in battery
2. EPROM type

(a) SRAM type

This PMC type saves the setting parameters and waveform data. The capacity is either 32 or 128 kbytes. (No battery is installed in the 128 kbyte type when it is shipped; install the supplied battery before starting operation.)

Both the setting parameters and waveform data (A ch and B ch) are saved or recalled simultaneously as one set.

The 32 kbyte PMC can save 12 sets (REG No. 1 to 12) and the 128 kbyte PMC can save 48 sets (REG No. 1 to 48).

(b) EPROM type

This PMC type can be used only as a soft pack when the PTA (option) is installed.

Note:

Each item (functions corresponding to F1 to F6 keys) of the MENU cannot be controlled by GP-IB. However, PMC SAVE and RECALL can be controlled by GP-IB.

(2) Error messages

When the PMC function is executed, if the PMC is normal, "PMC Pass" is displayed on the CRT. If the PMC is abnormal, the error messages shown below are displayed on the CRT.

Error message	Meaning
no PMC	PMC not connected
no FORMAT	PMC not formatted
different FORMAT	Incorrect format type
write protect	PMC write-protected
bad PMC	PMC faulty
memory over	Memory overflow
not find file	Unregistered file (REG No.) read Or unusable REG No. written
different PMC type	Incorrect PMC type

Note:

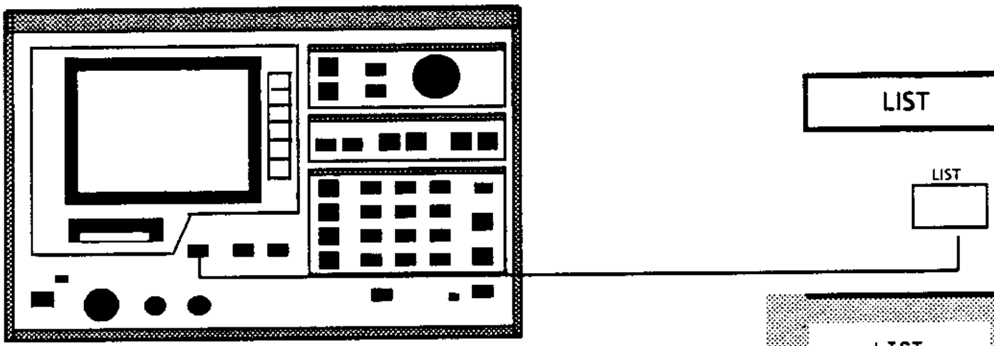
When SAVE is executed with the PMC installed and the setting parameters and waveform data cannot be saved to the PMC because the PMC is write-protected or because of another error, a PMC error message is displayed on the CRT in accordance with the table above.

(3) FORMAT

- ■ FORMAT CHECK
  - . If WRITE PROTECT ON at FORMAT OK, "FMT OK: PRTCT ON" is displayed.
  - . If WRITE PROTECT OFF at FORMAT OK, "FMT OK: PRTCT OFF" is displayed.
- ■ PROTECT ON/OFF
  - . When the PMC was formatted by another model type and WRITE PROTECT is ON, it cannot be formatted with the MS2601A.
  - . When the PMC is write-protected, [F1] DELETE, [F3] FORMAT , and [F6] STORE cannot be executed.
  - . When WRITE PROTECT is OFF, the PMC can be formatted by the MS2601A even if it has already been formatted by another model type.

5.6 Current Setting Parameters and Memory Contents List Display (LIST)

When the front panel MENU section [LIST] key is pressed, the spectrum display is cleared and the LIST menu shown on the next page is displayed on the CRT. Select the required function by pressing the corresponding soft key [F1] to [F6].

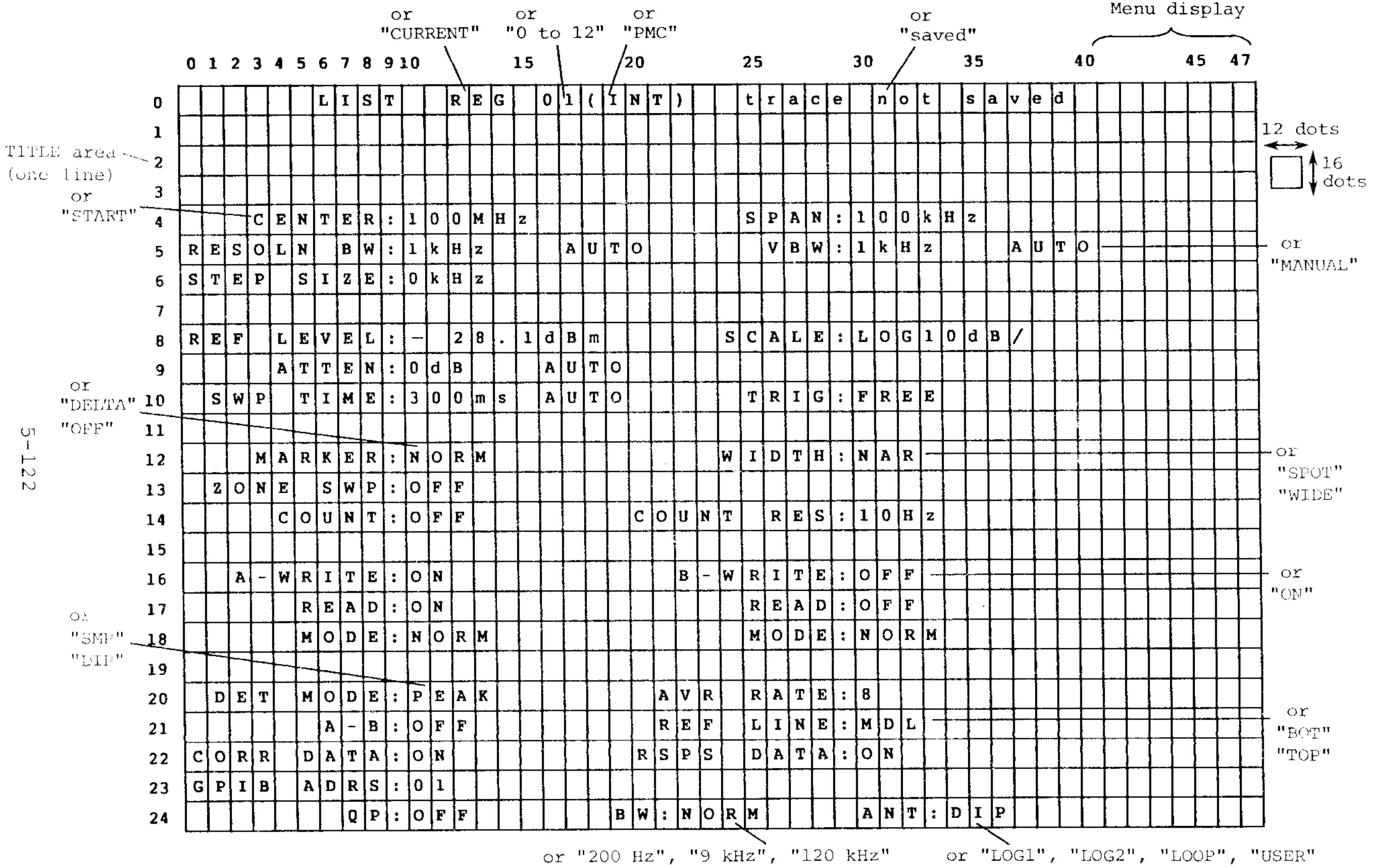


LIST	Panel key name
LIST	Key operation
LIST	Menu classification

Function setting by soft key

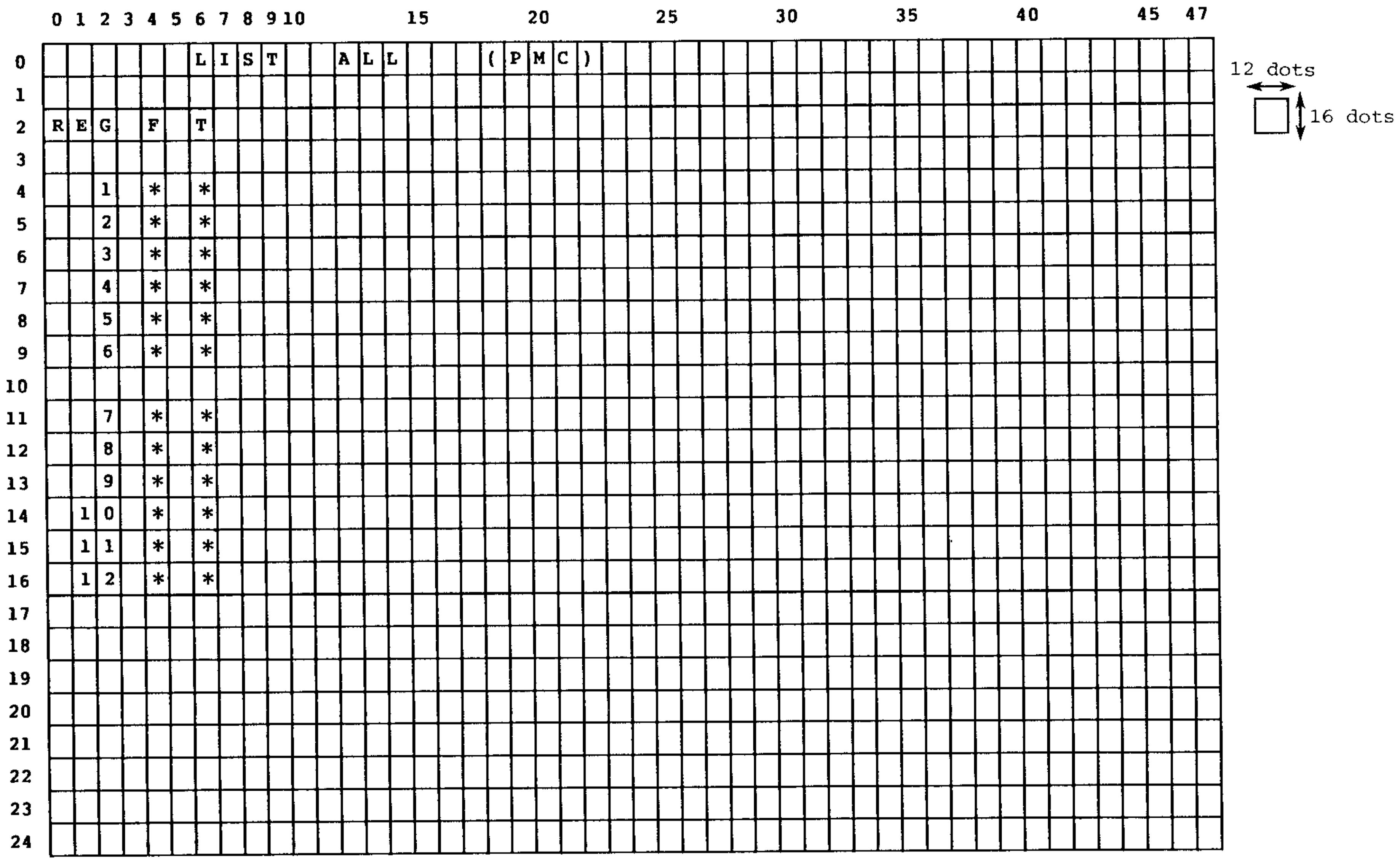
Displays list of current setting parameters	CUR	F1
When the [F2] key is pressed, [?] is displayed. When the REG No. is entered from the numeric keys and [ENTR] is pressed, a list of the setting parameters of the specified register is displayed.	REG	F2
Displays list of usage state of all registers	ALL	F3
No function		F4
No function		F5
Returns to normal spectrum display	RETURN	F6

(1) LIST (CUR, REG) display example



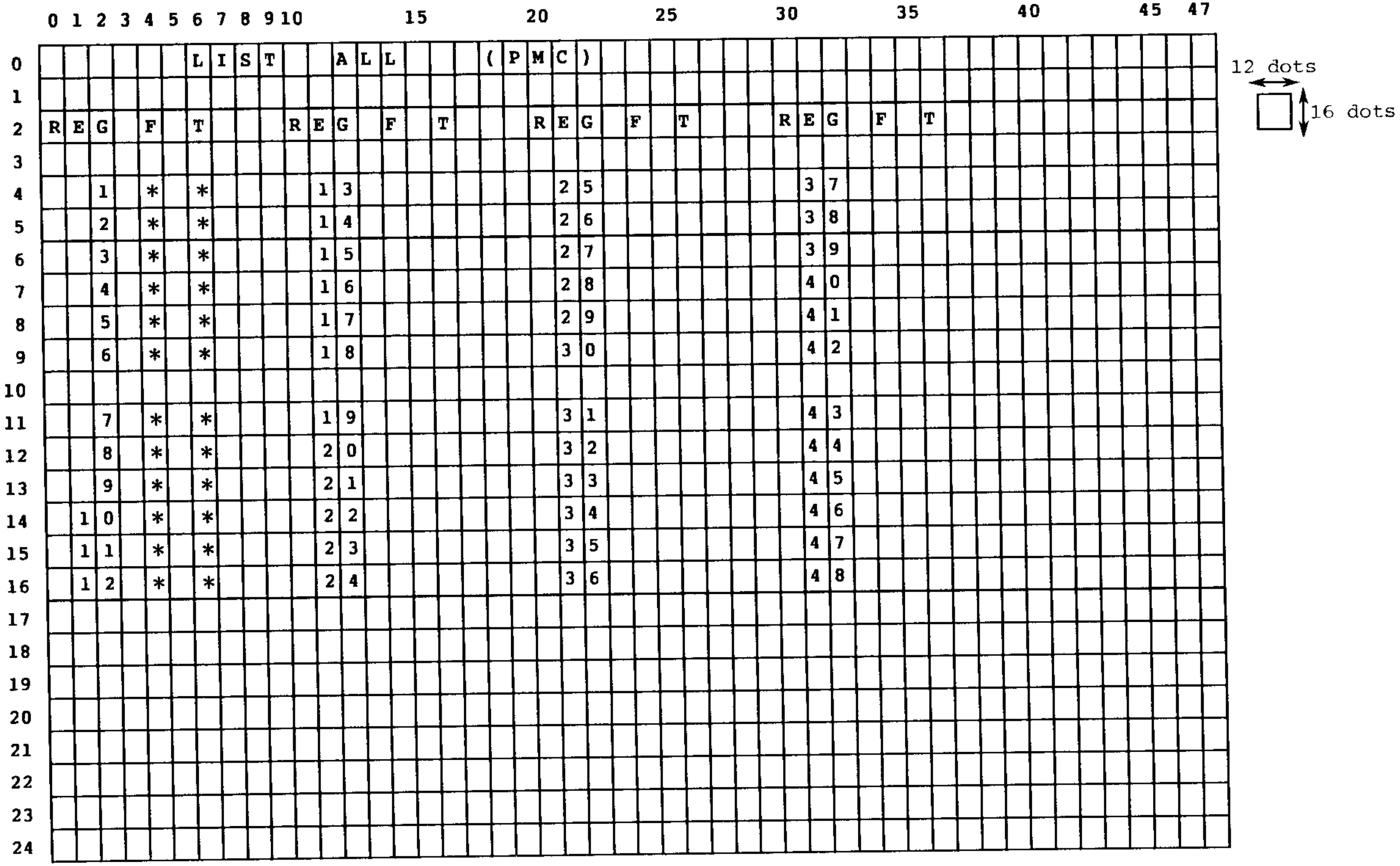
```
      LIST  REG 01(INT)  trace not saved



   CENTER:100MHz         SPAN:100kHz
RESOLN BW:1kHz   AUTO     VBW:1kHz   AUTO
STEP SIZE:0kHz

REF LEVEL:-28.1dBm      SCALE:LOG10dB/
    ATTEN:0dB   AUTO
 SWP TIME:300ms AUTO     TRIG:FREE

   MARKER:NORM          WIDTH:NAR
 ZONE SWP:OFF
    COUNT:OFF       COUNT RES:10Hz

  A-WRITE:ON          B-WRITE:OFF
     READ:ON             READ:OFF
     MODE:NORM           MODE:NORM

 DET MODE:PEAK        AVR RATE:8
      A-B:OFF         REF LINE:MDL
CORR DATA:ON        RSPS DATA:ON
GPIB ADRS:01
       QP:OFF       BW:NORM    ANT:DIP
```

(2) LIST (ALL) display example (32 kbyte PMC)



F : FUNCTION
T : TRACE

(3) LIST (ALL) display example (128 kbyte PMC)



```
      LIST  ALL   (PMC)

REG F T   REG F T   REG F T   REG F T

  1 * *    13        25        37
  2 * *    14        26        38
  3 * *    15        27        39
  4 * *    16        28        40
  5 * *    17        29        41
  6 * *    18        30        42

  7 * *    19        31        43
  8 * *    20        32        44
  9 * *    21        33        45
 10 * *    22        34        46
 11 * *    23        35        47
 12 * *    24        36        48
```

F : FUNCTION
T : TRACE

SECTION 6

MEASUREMENT

The following three basic functions, which are explained in SECTION 5, are used during measurement by the MS2601A. The menu functions can also be combined if necessary.

- ■ Measurement of object signal frequency and level
  - . Zone marker
  - . Count mode
- ■ Measurement of frequency and level deferences between signal and reference
  - . Δ marker
  - . Count mode
- ■ Searching for required signal in zone and measuring required signal frequency and level
  - . Peak search
  - . Various search functions

This section describes how to use the above-mentioned functions.

For automatic measurement, see GP-IB (after SECTION 8), PTA (Option 01), and RS-232C (Option 02).

TABLE OF CONTENTS

6.1 General Notes on Measurement

This paragraph explains preparations for measurement. For descriptions of the power supply, see paragraphs 2.2 and 3.1.1.

6.1.1 Input signal level range

Table 6-1 shows the relationship between the maximum input signal level (REF LEVEL) and AUTO and MANUAL modes of the ATTEN menu.

Table 6-1 REF LEVEL and Input Attenuator (ATTEN)

REF LEVEL (dBm)	AUTO ATTEN (dB)	Settable MANUAL ATTEN (dB)
-100.0 to -62.0	0	0
-61.9 to -52.0	0	0, 10
-51.9 to -42.0	0	0, 10, 20
-41.9 to -32.0	0	0, 10, 20, 30
-31.9 to -22.0	0	0, 10, 20, 30, 40
-21.9 to -20.0	0	0, 10, 20, 30, 40, 50
-19.9 to -10.0	10	0, 10, 20, 30, 40, 50
-9.9 to -0.0	20	10, 20, 30, 40, 50
0.1 to 10.0	30	20, 30, 40, 50
10.1 to 20.0	40	30, 40, 50

The input signal level range applicable to the MS2601A RF INPUT connector is explained below.

(1) -100 to +20 dBm input signal level

When the input level is in this range, REF LEVEL can be set according to Table 6-1 and the measurement can be performed with a reference level accuracy of ±0.3 dB (after calibration).

- ATTEN (AUTO)...

  When REF LEVEL is set as shown in Table 6-1, the ATTEN value of 0 to 40 dB is automatically set so that there is no gain compression.

- ATTEN (MANUAL)...

  - When ATTEN is set to that the mixer input level is -30 dBm, the maximum dynamic range can be obtained (see paragraph 6.1.2).
    The mixer input level is obtained from the equation ([REF LEVEL] - [ATTEN value]).
    Where, REF LEVEL = input signal level

    When a very low level is measured, the ATTEN value can be set lower than that in AUTO in the range where the mixer input level is -10 dBm or less.

(2) +20.1 to +25 dBm input signal level

Although a signal level in this range can be applied, REF LEVEL cannot be set. At the data entry, the REF LEVEL set value returns automatically to +20 dBm when the unit key is pressed.

In both AUTO and MANUAL, the MS2601A optimum mixer input level of -30 dBm cannot be obtained. When the input signal level is increased, the analyzer gain is compressed and harmonic distortion is generated due to the non-linear operation of the input mixer which causes an error in the measured value. This will make it difficult to read the input signal level correctly from the CRT. Also internal circuits will be damaged by an input of more than +25 dBm.

(3) Maximum input level

CAUTION

- Never apply a signal exceeding +25 dBm or ±50 Vdc because this equipment does not have an over-input protection circuit and the input circuit (input attenuator or mixer diode, etc.) may be damaged.
- If a +20.1 to +25 dBm signal is applied with through attenuation (0dB), the input mixer may be damaged. Therefore, always set ATTEN to 10 to 50 dB for this level range.

6.1.2 Dynamic range

Table 6-2 shows the dynamic range specifications of the MS2601A.

Table 6-2 MS2601A Dynamic Range

1	Average noise level	≤-120 dBm (Resolution bandwidth 300 Hz, video filter 1 Hz, frequency 1 MHz to 2 GHz)
2	Residual spurious	≤-100 dBm (Frequency ≥100 kHz, input attenuator 0 dB, input 50 Ω terminated)
3	Second and third harmonic distortion	-75 dB (Input level -30 dBm, input attenuator 0 dB, frequency 5 to 800 MHz)

Generally, even when a signal is not input to the spectrum analyzer, the following two factors are always present as the proper internal response in the spectrum analyzer.

1. Average noise level

   This noise is generated in the RF section and is evenly distributed on all the frequency bands.

2. Residual spurious

   Harmonics from various oscillation sources in the analyzer, and various signals, are complicatedly mixed with each other, converted to the IF signal, and displayed on the CRT.

When a signal is input to the analyzer, another response called harmonic distortion is displayed on the CRT due to non-linear operation of the input mixer.

3. Harmonic distortion

   When the input level is too high, the signal enters the mixer non-linear region. Therefore, a spurious frequency corresponding to the harmonic of the input signal is generated.

The dynamic range is the difference between the upper limit level of the input signal and the maximum level of the above-mentioned factors 1, 2 and 3. It is represented in dB and is the range in which the measurement can be performed without taking the effect of 1, 2 and 3 into consideration. The MS2601A has a dynamic range of $\geqq$70 dB as shown in Table 6-2.

6.1.3 Maximum dynamic range

The maximum dynamic range is obtained on the basis of the following three procedures.

1	Set the maximum input signal level to obtain the optimum mixer input level using the formula	Mixer input level = (input signal level) - (ATTEN value). The optimum input signal level is obtained when the mixer input level is -30 dBm. In the specifications, this optimum input level is set when ATTEN = 0 dB. Therefore, the input signal level = mixer input level = optimum input level = -30 dBm (see Note below). [illegible] 77 [illegible]
2	Set the input signal level to REF LEVEL	After the maximum input signal level is determined so that the optimum input level can be obtained, set REF LEVEL to the same level as the maximum input level and position the input signal peak at the top of the CRT.
3	Lower the noise level	Decrease RBW so that the lower limit input signal level is not obscured by the noise.

Note:

The MS2601A has a dynamic range of 70 dB or more at an input signal level of -30 dBm. Therefore, the levels mentioned in 1, 2, and 3 of paragraph 6.1.2 will be as follows when the input signal level is -30 dBm.

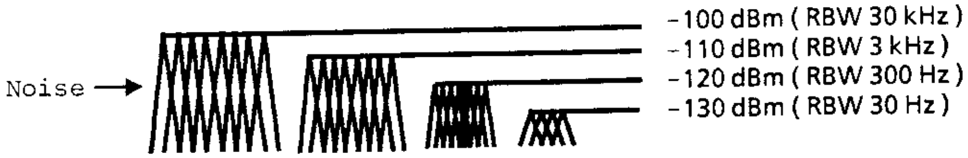
1. Average noise level: ≦-120 dBm
2. Residual spurious: ≦-100 dBm
3. Harmonic distortion: ≦-75 dB (≦-105 dBm)

All levels described to Note above must be -(x + y) dBm or less to obtain a dynamic range of y dB at an input level of -x dBm. Namely, according to item 2 (-100 dBm), dynamic range will be ≧70 dB (-30 dBm - [-100 dBm]).

(1) Average noise level

Noise level adjustment is required for very low level measurement.

The noise level is proportional to the resolution bandwidth (RBW). Generally, when the bandwidth is decreased to 1/10, the noise level is decreased by 10 dB and the sensitivity is improved by 10 dB.



When RBW is narrowed, the noise level is decreased. However, the sweep speed must be slowed. For measurement by partial observation, the ZONE SWEEP method can be used to narrow the sweep span even when the sweep speed is slow. However, setting the RBW for an easy-to-observe sweep requires consideration of the measurement efficiency.

(2) Descriminating spurious by ATTEN menu with MANUAL control

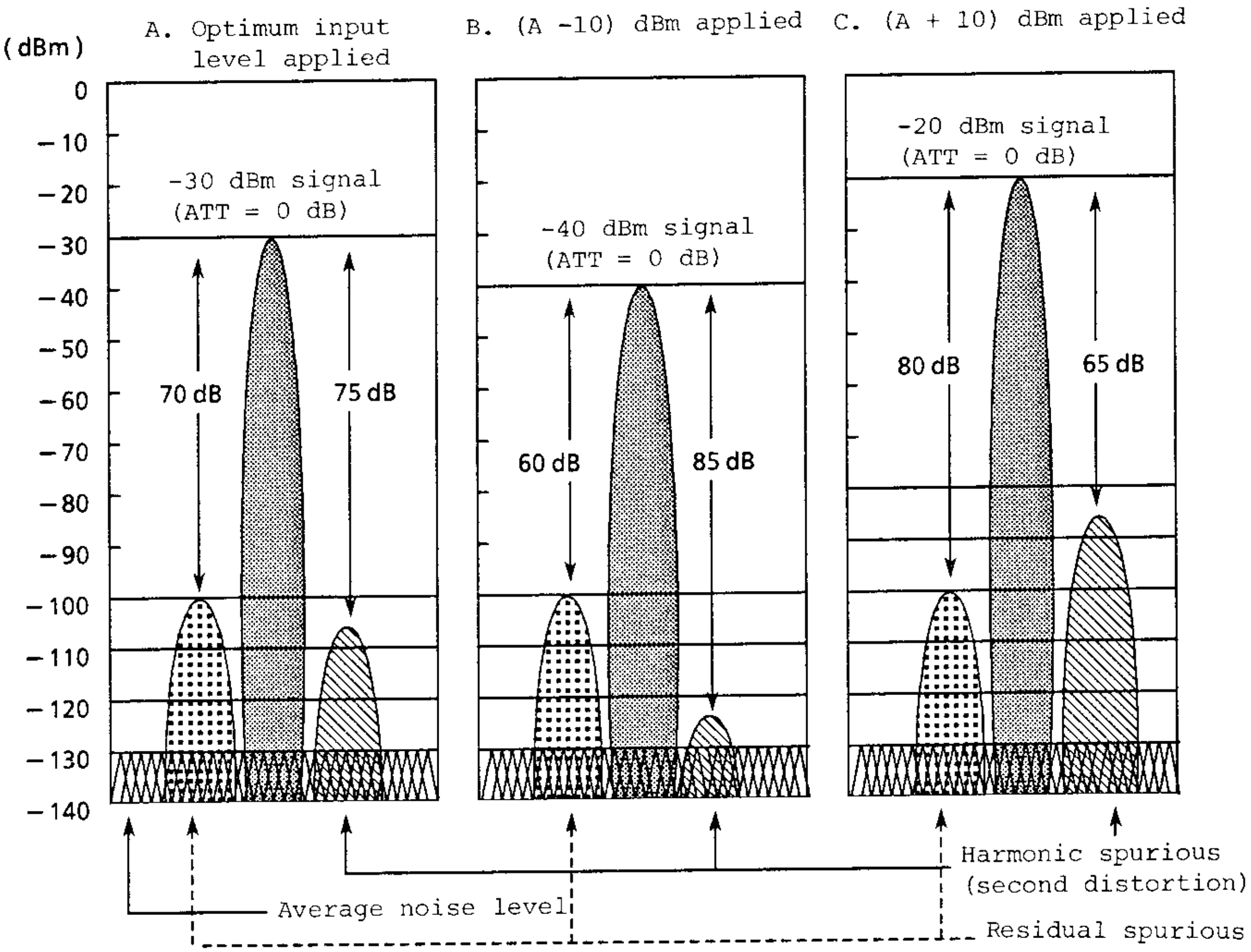
To discriminate whether the spectrum displayed on the CRT is an input signal spectrum or spurious or noise generated by the MS2601A, use the MANUAL setting of the ATTEN menu as follows.

The input signal displayed on the CRT when the attenuation of the input attenuator is changed, increases and decreases by the same degree of attenuation change.

However, the displayed residual spurious or noise generated by the MS2601A changes very little. Also, for the internal spurious due to the second or third harmonic distortion, changes by twice or three times as much as the input attenuator (dB) change, respectively.

(3) Dynamic range comparison between optimum input level and optimum input level ±10 dB

Table 6-1 explains the dynamic range relationship between the input signal, harmonic distortion, residual spurious and average noise levels whose lower limit level areas are exaggerated.



When the input signal is at the -30 dBm optimum level, the 70 dB dynamic range is obtained for the harmonic spurious and residual spurious. Note that in the Figs. (b) and (c) at the right side the dynamic range is narrowed by the same amount as the input signal difference from the optimum level.

When the input signal level is lowered by 10 dB, the second harmonic distortion is lowered by 20 dB. Therefore, a dynamic range of 85 dB is obtained for the second harmonic. However, a dynamic range of only 60 dB is obtained for the residual spurious.

When the input signal level is raised by 10 dB, the second harmonic distortion is raised by 20 dB. Therefore, a dynamic range of 65 dB is obtained for the second harmonic distortion. Also, the residual spurious dynamic range is 10 dB higher than that at the optimum input level.

Fig. 6-1 Dynamic Range Comparison Between Optimum Input Level and Optimum Input Level ±10 dB

6.1.4 Brightness control

If the CRT is too bright, the back raster will be seen and observation becomes hard.

6.1.5 CAL (calibration)

You should calibrate the MS2601A before measurement data does not meet the specifications.

1. After POWER ON, perform all calibration after approx. 30 minutes warmup.
2. Perform frequency calibration every 30 minutes during frequency measurement.

Moreover, unless calibration is too time-consuming, the measurement error can be minimized by calibrating at every opportunity.

6.2 Typical Measurement Example

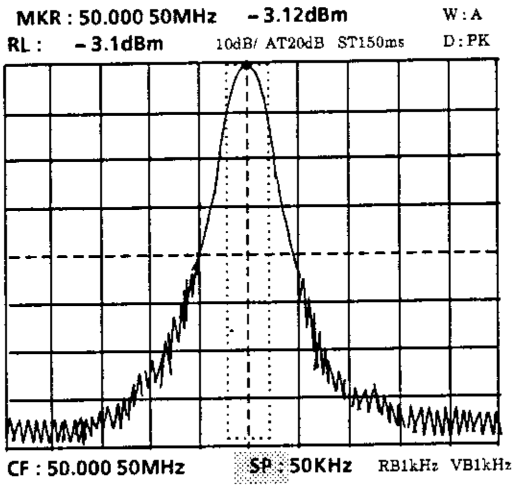
Apply the 50 MHz signal from the OUTPUT 50 MHz connector on the rear panel to the RF INPUT and measure the 50 MHz fundamental wave for the following two items.

1. CRT display of desired signal

   Display the desired signal at the reference level at the CRT center as shown in the figure in the next page (CF/SPAN mode).

2. Measured result record

   After reading the frequency and level of the signal from the CRT, output the data to the video plotter as shown in the figure in the next page.



Note:

The rear panel 50 MHz OUTPUT signal is phase-locked to the 10 MHz reference signal. The nominal output level is -2 dBm. The measurement results in these examples are for reference only.

6.2.1 Procedure from power-on to input (RF INPUT) of signal to be measured

Generally, follow the procedures below from power-on to input of the signal to be measured.

1. Set power-on.
2. Warm-up for 30 to 60 minutes.
3. Calibrate (CAL).
4. Select pre-set measurement parameter.
5. Input the signal to be measured.

Table 6-2 shows the setup for using the 50 MHz signal output from the OUTPUT connector as the signal to be measured.

The explanation refers to Fig. 6-2 and procedures 1 to 5 above.

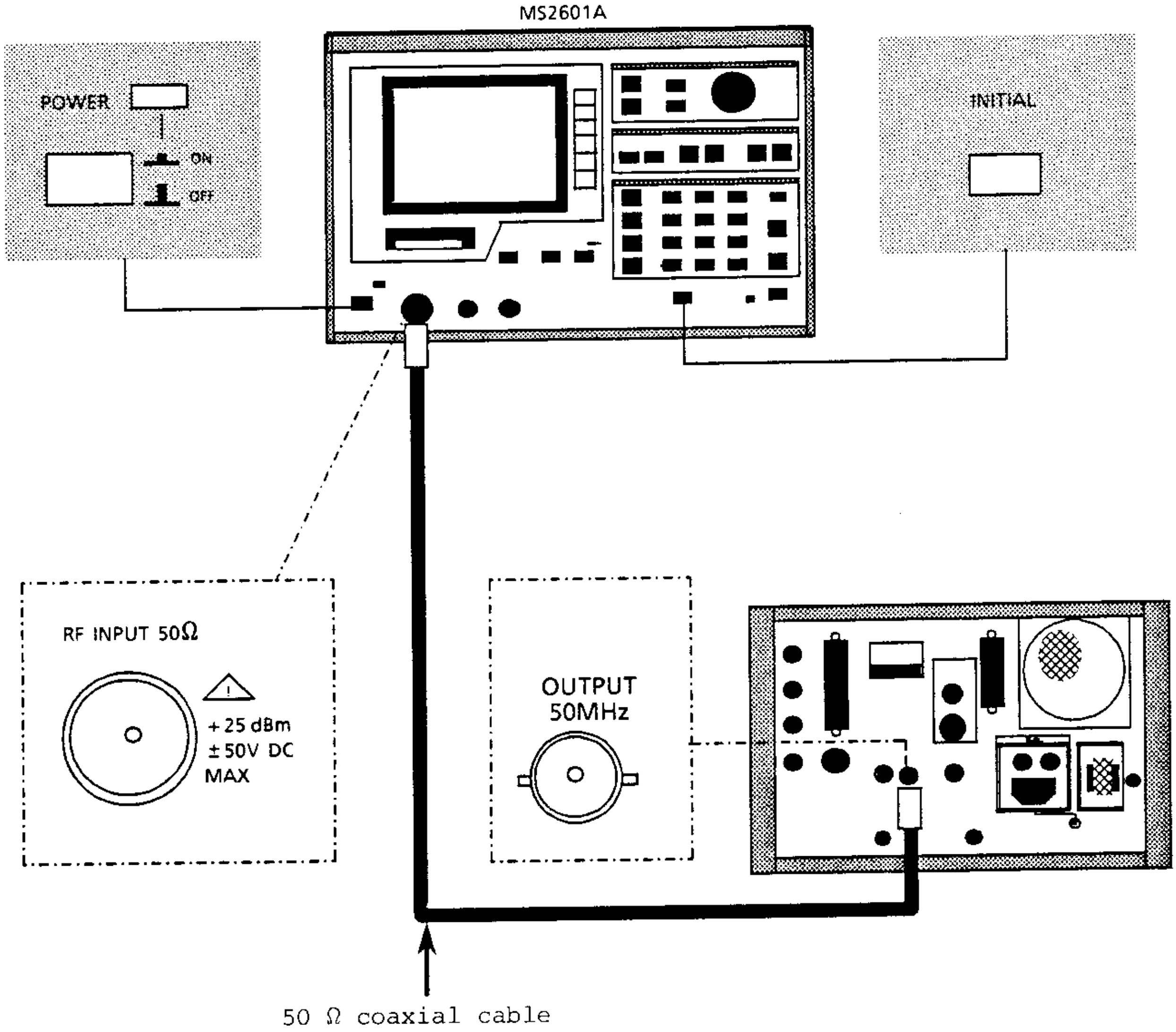


Fig. 6-2 Power-on and Input of Signal to be Measured

For power-on details and parameter and initial settings after power-on, see paragraphs 3.1.1 and 3.1.2. Here, important points in the measurement procedure are explained.

(1) Power-on

When the POWER switch (Fig. 6-2) is set to ON, the MS2601A status can be assessed from the CRT display.

- Menu...

  MARKER (1) displayed regardless of preceding power-off status setting

- Entry mode...

  The marker entry mode set regardless of preceding power-off status setting

- Set parameters...

  Set function parameters value at preceding power-off except that described above reset

- Zone marker...

  Zone marker position at preceding power-off reset

Note:

The trace waveform at the preceding power-off cannot be reproduced at power-on. However, since the set parameters and zone marker are reproduced, the same waveform can be reproduced if the same signal is applied to RF INPUT.

When the waveform data must be reproduced without the signal applied, the SAVE/RECALL function must be used with the PMC. For details, see paragraph 6.2.1 (4) or 5.5.

When the entry mode is the start frequency and the menu is FREQ MODE, Fig. 6-3 shows the CRT display at power-on after power-off. The display changes as seen in the entry mode (start frequency to marker), menu (FREQ MODE to MARKER) and waveform (presence to absence).

However, all the other set parameters at power-off are reproduced at power-on.

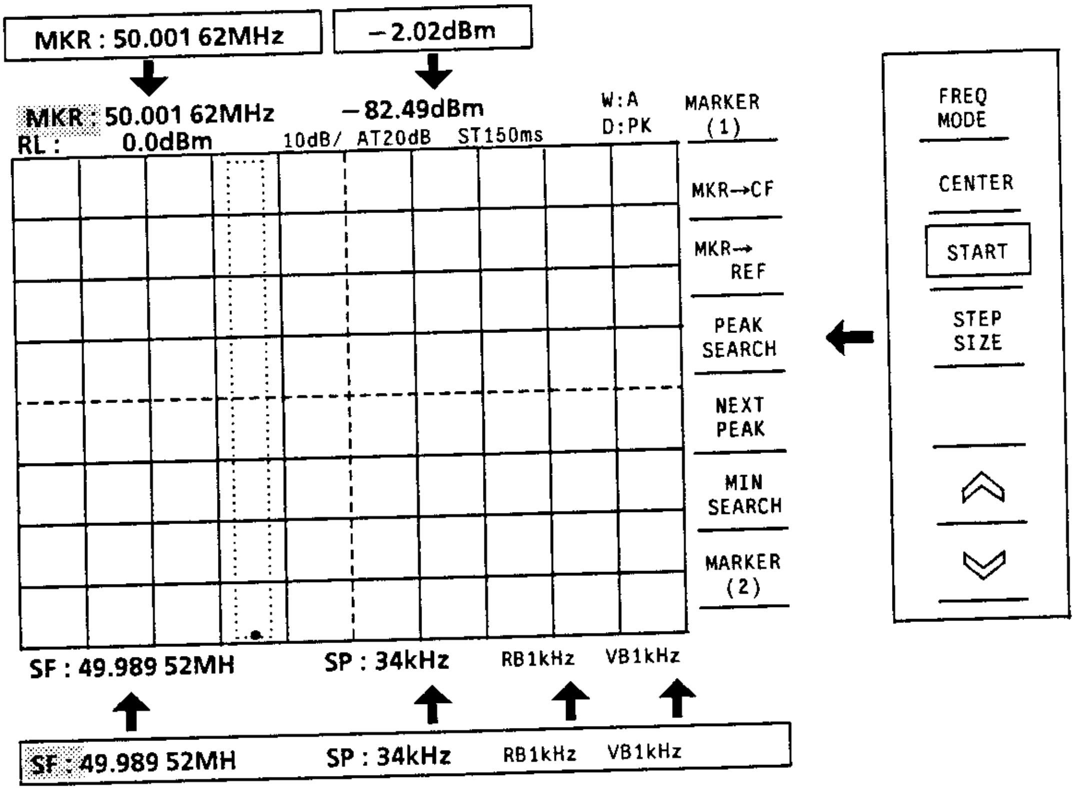


Fig. 6-3 CRT Display at Power-on

(2) Warmup

The MS2601A can be used just after power-on but a warmup of at least 30 minutes is necessary for stable and high-accuracy measurement at the specifications.

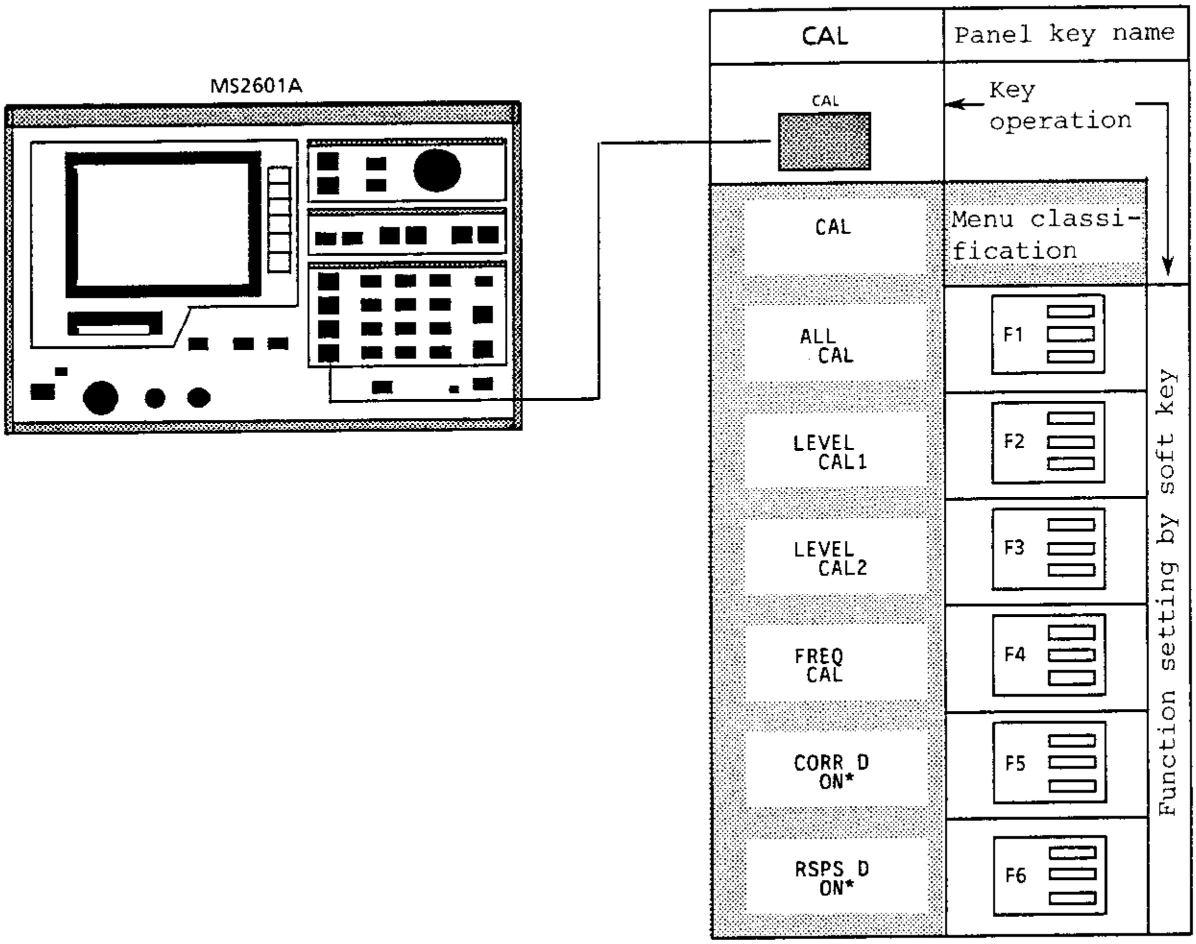
Thirty minutes warmup is required so that the frequency of the built-in crystal oscillator reaches the specification and the circuit temperature stabilizes.

In ordinary measurement, 30 minutes warmup is sufficient. However, to perform high-accuracy measurement and test the performance of the MS2601A, the warmup times of the other test measuring instruments must be considered.

Sixty minutes warmup is sufficient for the MS2601A and the other measuring instruments.

(3) CAL (calibration)

Calibrate according to the operations shown in the next page to minimize any error related to amplitude and frequency.



Step	Procedure
1	INITIAL
2	CAL F1 ALL CAL
3	Confirm that during calibration, the message CALIBRATING is displayed in the middle of the upper CRT scale along with asterisks (*) which indicate the operation progress. The asterisks disappear one-by-one as calibration progresses.

(Cont.)

Step	Procedure
4	Confirm that the calibration is completed in about 90 seconds. When the calibration is completed, the asterisks and the message CALIBRATING should have disappeared.

Note:

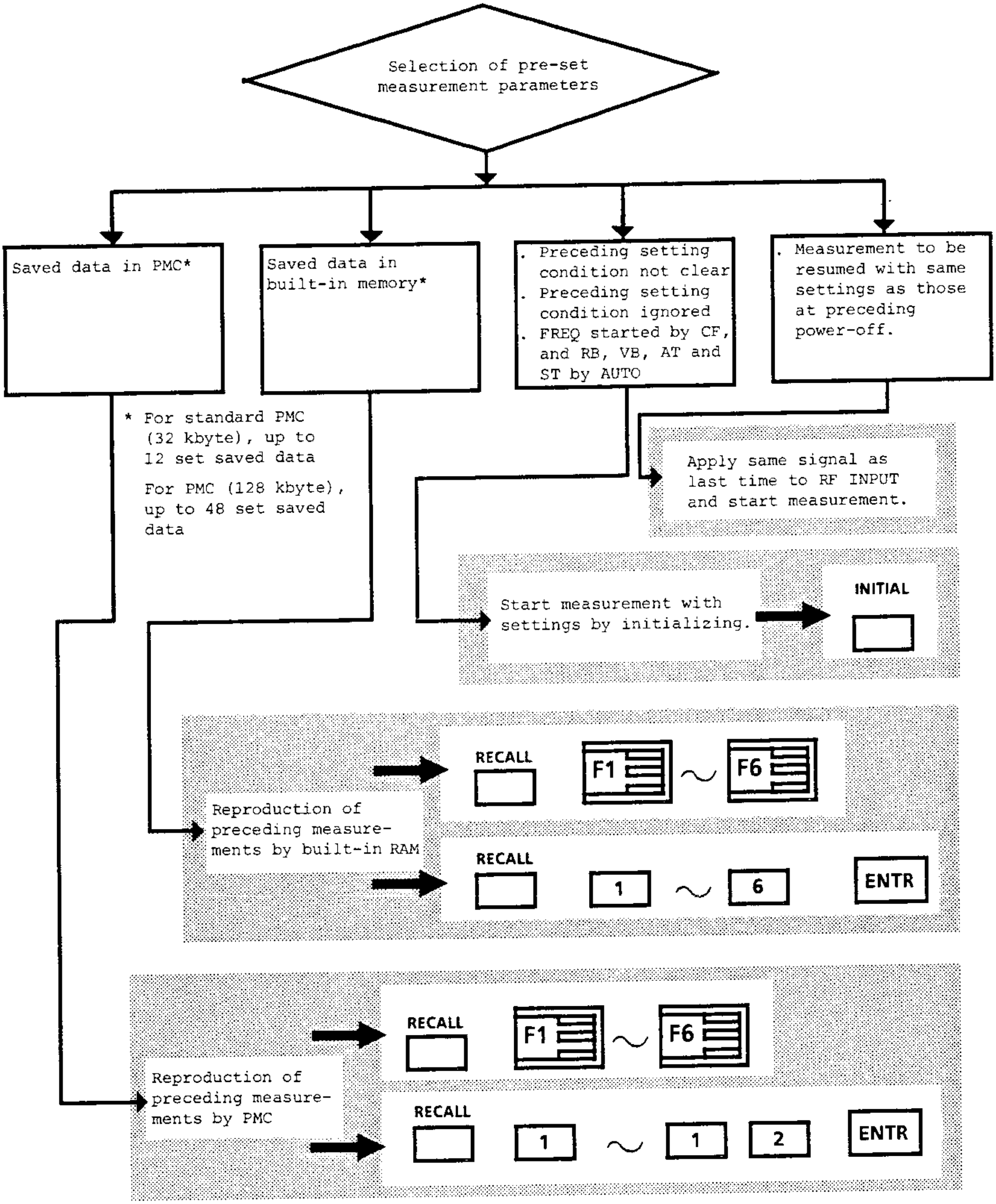
Calibrate without a signal applied to the RF INPUT. When calibrating with an external signal applied to the RF INPUT, the correct calibration value cannot be obtained.

(4) Selection of pre-set measurement parameters

Pre-set measurement parameters can be selected before measurement as shown in the following figure; the route at the right end is continued from paragraphs 6.2.1 (1) to (3) above.

When measurement is to be resumed from the setting condition before the preceding power-off setting, press the [RECALL], [0] and [ENTR] keys in this order.

The description in this paragraph starts measurement from the initial condition (setting when [INITIAL] key pressed) irrespective of the preceding setting.



Selection of pre-set measurement parameters

Saved data in PMC*

Saved data in built-in memory*

- Preceding setting condition not clear
- Preceding setting condition ignored
- FREQ started by CF, and RB, VB, AT and ST by AUTO

- Measurement to be resumed with same settings as those at preceding power-off.

* For standard PMC (32 kbyte), up to 12 set saved data

For PMC (128 kbyte), up to 48 set saved data

Apply same signal as last time to RF INPUT and start measurement.

Start measurement with settings by initializing.

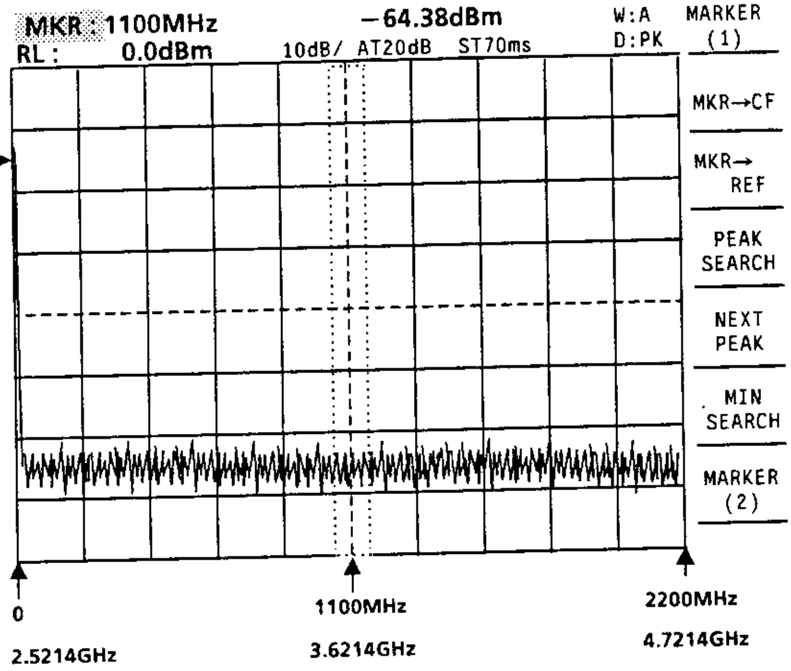
Reproduction of preceding measurements by built-in RAM

Reproduction of preceding measurements by PMC

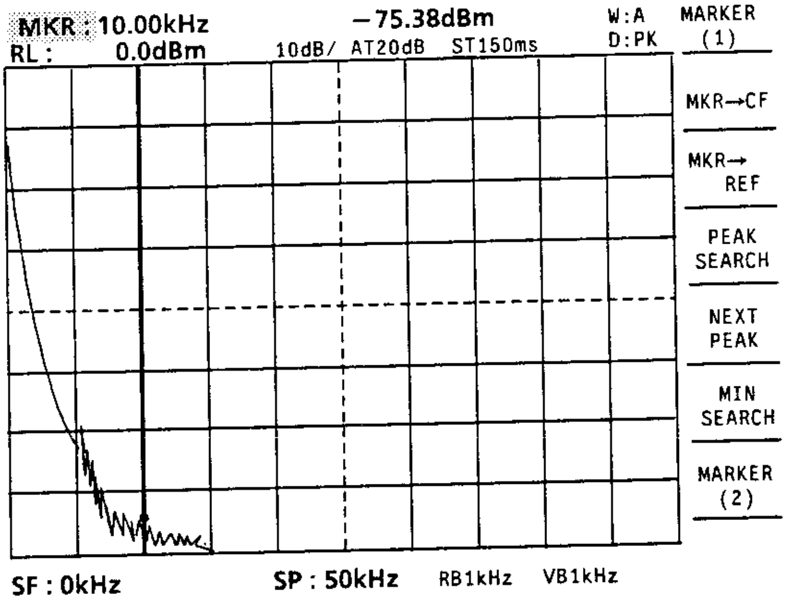
When the [INITIAL] key is pressed, the full bandwidth sweep of 0 to 2.2 GHz is set and the CRT display is shown in the figure in the next page. Since the CRT display setting parameters at initialization have been already explained in paragraph 3.1.2, the zero beat signal is explained here. This signal always appears at the left of the CRT at initialization.

■ **Zero beat signal**

The relationship between the input signal frequency at a full bandwidth sweep of 0 to 2.2 GHz and the 1st LOCAL frequency is shown on the horizontal axis in the figure on the right. When the input frequency of 0, the 1st LOCAL sweep start frequency is equal to the IF frequency. At this time, the LOCAL signal is not mixed with the input signal. Therefore, its leakage (carrier leak) passes via the IF and is finally displayed at the left end of the horizontal axis as shown in the figure on the right.



From the above-mentioned relationship, this carrier leak is called a zero beat signal and is handled as a signal indicating the sweep starting point frequency of the horizontal axis. When SPAN is narrowed to 50 kHz, as shown in the figure on the right, and the zero beat signal sideband noise is observed, it is known that the sideband noise affects the sensitivity at 10 kHz of the lower limit measurement frequency of the MS2601A. For example, if the 10 kHz signal level is -75 dBm or less, that part is masked by the zero beat sideband noise and measurement is impossible, as shown in the figure.

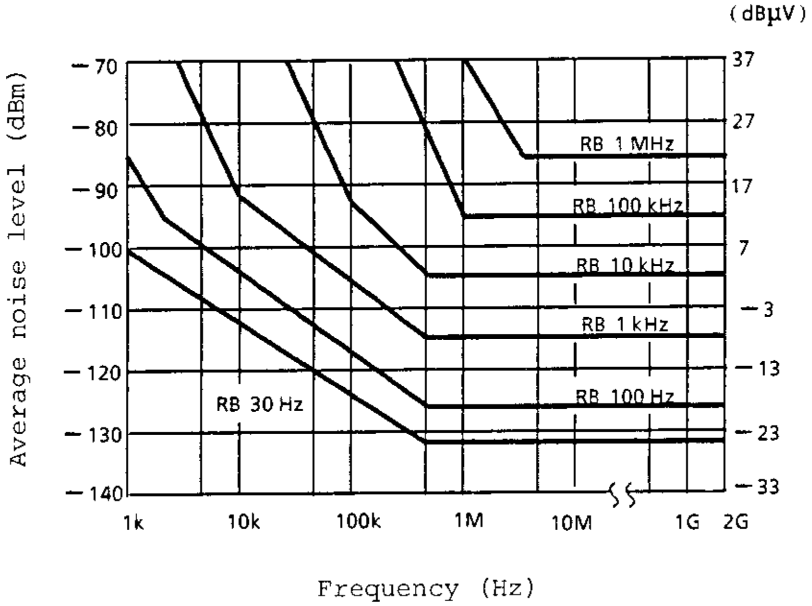


* When the full bandwidth sweep of 0 to 2.2 GHz is set, the relationship between the input signal frequencies of 0, 1100 MHz and 2200 MHz, and the 1st LOCAL frequencies is shown below.

- At left of CRT (input signal frequency 0 MHz)... 1st LOCAL frequency 2.5214 GHz = 2.5214 GHz + 0
- At middle of CRT (input signal frequency 1100 MHz)... 1st LOCAL frequency 3.6214 GHz = 2.5214 MHz + 1100 MHz
- At right of CRT (input signal frequency 2200 MHz)... 1st LOCAL frequency 4.7214 GHz = 2.5214 GHz + 2200 MHz

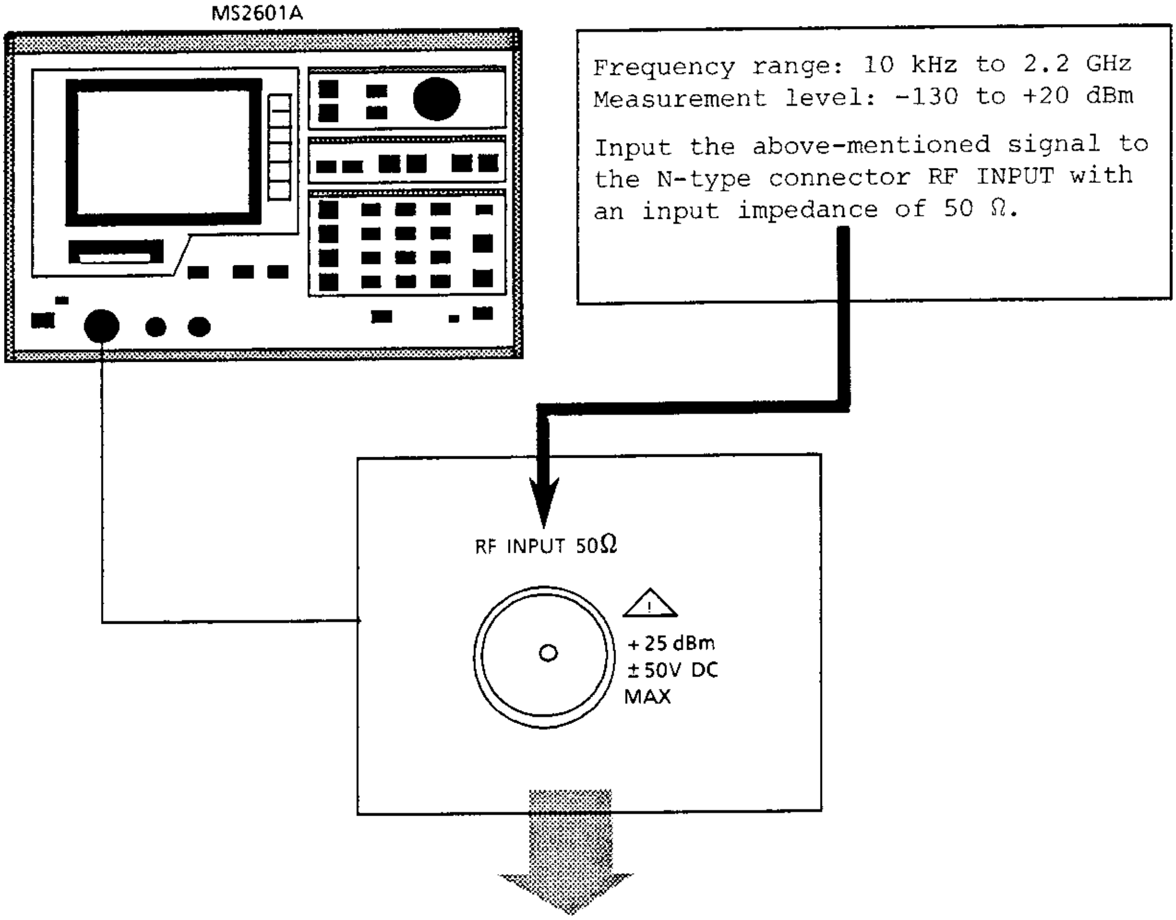
Namely, 1st IF = 2.5214 GHz = 1st LOCAL frequency - input signal frequency = (2.5214 GHz + input signal frequency) - input signal frequency.

The right-hand figure shows the frequency characteristic of the average noise level of the MS2601A. This characteristic shows that the resolution bandwidth (RB) 1 kHz or less must be selected for the IF bandwidth (RB) when an input frequency of more than 10 kHz is to be measured at a sensitivity of -80 dBm. As mentioned above, when the MS2601A is used near the lowest limit frequency, pay attention to the IF bandwidth (resolution bandwidth RB) where the desired sensitivity can be obtained.



(5) Input of signal to be measured

This paragraph explains precautions when inputting the 50 MHz signal from the rear OUTPUT connector to the RF INPUT connector as well as when inputting any other signal to the MS2601A.



Frequency range: 10 kHz to 2.2 GHz
Measurement level: -130 to +20 dBm

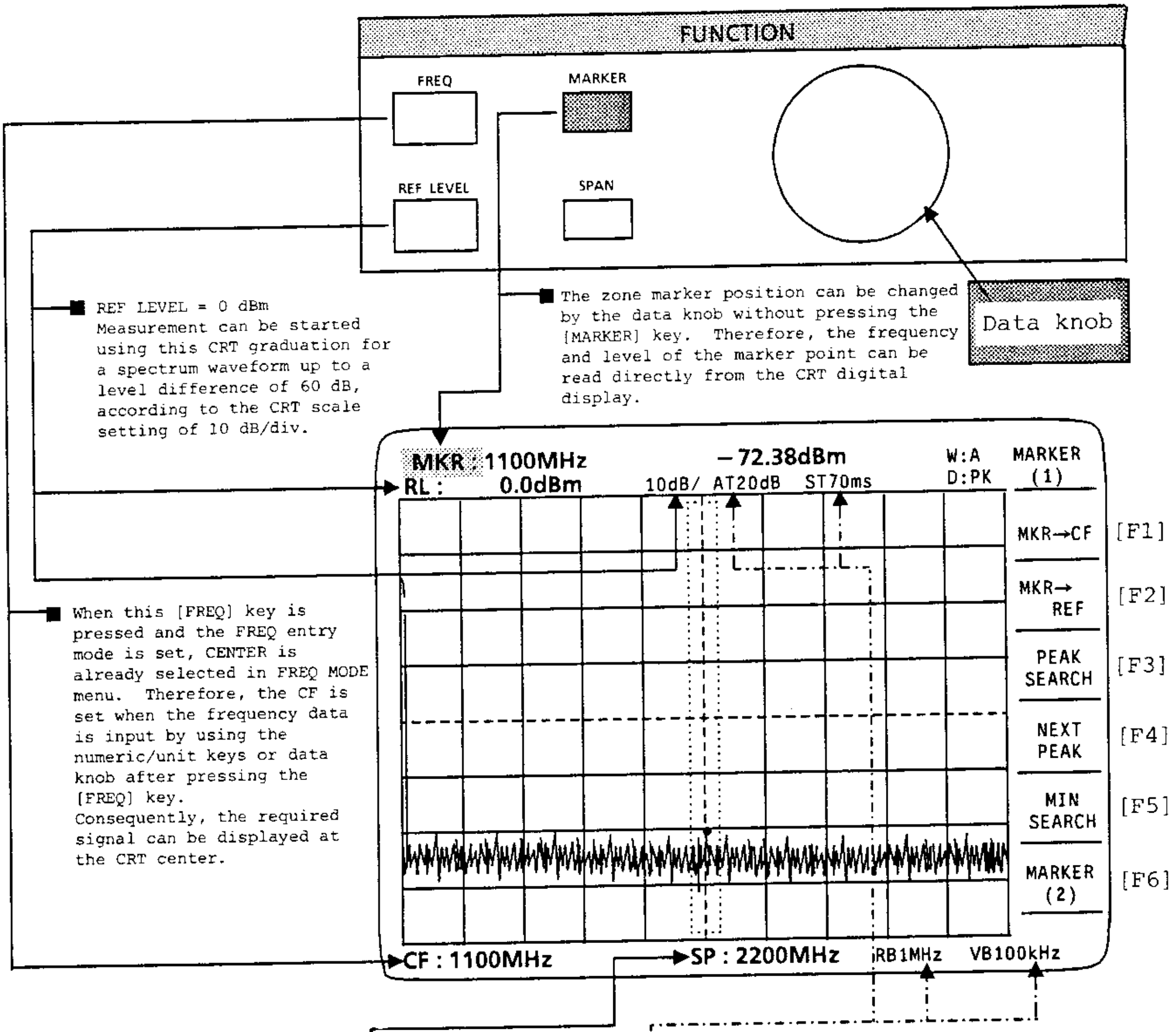
Input the above-mentioned signal to the N-type connector RF INPUT with an input impedance of 50 Ω.

CAUTION

The input circuit is not overinput-protected, and the input attenuator or input mixer may be damaged if a signal exceeding +25 dBm or ±50 Vdc is applied.
The symbol ⚠ warns against excessive input.

6.2.2 Initialization (INITIAL) at measurement start

Figure 3-4 describes the setting, and Appendix P describes the menu, when the [INITIAL] key is pressed. Here the initialization setting is explained in the figure in the next page.



■ REF LEVEL = 0 dBm
Measurement can be started using this CRT graduation for a spectrum waveform up to a level difference of 60 dB, according to the CRT scale setting of 10 dB/div.

■ The zone marker position can be changed by the data knob without pressing the [MARKER] key. Therefore, the frequency and level of the marker point can be read directly from the CRT digital display.

■ When this [FREQ] key is pressed and the FREQ entry mode is set, CENTER is already selected in FREQ MODE menu. Therefore, the CF is set when the frequency data is input by using the numeric/unit keys or data knob after pressing the [FREQ] key.
Consequently, the required signal can be displayed at the CRT center.

☆ MARKER (1) menu
Press the [F1], [F2], or [F3] key to move the marker point to CF, REF or PEAK point, respectively. Furthermore, when the [F6] key is pressed, the zone sweep or Δ marker can be specified (for details see paragraph 5.2.1).

■ Sets FULL SPAN or full bandwidth sweep of 0 to 2.2 GHz

If the signal frequency is unknown, the location of the signal frequency in the band can be easily found using this function.

■ Input attenuator (AT), Sweep time (ST), resolution bandwidth (RB), Video bandwidth (VB)

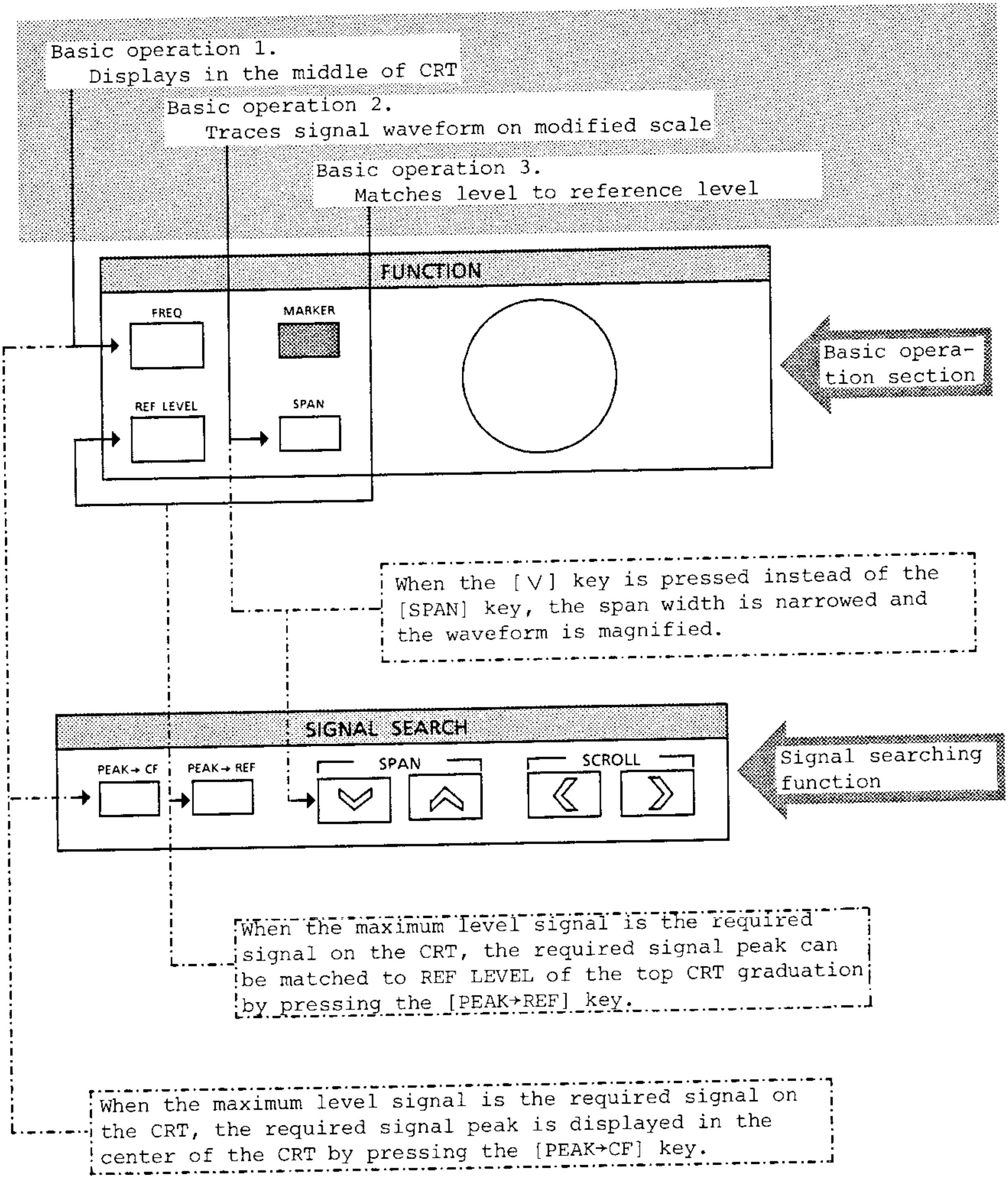
Even if SPAN or REF LEVEL are changed, each setting is automatically optimized so that frequency and level measurement error does not occur. At initialization, the values AT = 20 dB, ST = 70 ms, RB = 1 MHz, and VB = 100 kHz that are displayed on the CRT are the current values set in AUTO. If the current setting is MANUAL, AT, ST, RB, and VB are underlined.
For example, if RB 100 kHz is set in MANUAL, the display is RB100 kHz.
Therefore, because all letters are not underlined at initialization, all four are set in AUTO mode.

☆ W:A... Indicates that only A of A and B is used as the writing (W) channel (for details see paragraph 5.4.8).
☆ D:PK... Indicates that detection (D) is peak detection mode (PK) (for details see paragraph 5.4.9).

6.2.3 Displaying required signal in reference level at CRT center (FREQ, SPAN, REF LEVEL)

Measurement described in this paragraph pays attention to the following three basic operations to improve the resolution of the signal waveform. The object here is to understand these three basic operations which start by pressing the FUNCTION section operation keys (shown in figure below).

SIGNAL SEARCH section has convenient functions for signal search to help the basic operation.



Basic operation 1.
Displays in the middle of CRT

Basic operation 2.
Traces signal waveform on modified scale

Basic operation 3.
Matches level to reference level

Basic operation section

When the [V] key is pressed instead of the [SPAN] key, the span width is narrowed and the waveform is magnified.

Signal searching function

When the maximum level signal is the required signal on the CRT, the required signal peak can be matched to REF LEVEL of the top CRT graduation by pressing the [PEAK→REF] key.

When the maximum level signal is the required signal on the CRT, the required signal peak is displayed in the center of the CRT by pressing the [PEAK→CF] key.

Note:

Before performing the three basic operations, the MS2601A is assumed to have been initialized, or set to the same setting as at initialization.

For example,

. FREQ MODE...

CENTER (CF) is already selected. So, pressing the keys [SHIFT],[FREQ MODE], [F1] in this order is not required.

. AUTO is selected for each of sweep time (ST), input attenuator (AT), resolution bandwidth (RB) and video bandwidth (VB).

First, follow the procedure of (1) → (2) → (3) → (4) → (5) explained in the Fig. 6-2 setup and paragraph 6.2.1. The CRT shown below is displayed when the [INITIAL] key is pressed and the 50 MHz signal from the rear panel is input.

The basic three operations for displaying only the trace waveform of the 50 MHz fundamental wave at a reference level in the center of the CRT are shown below.

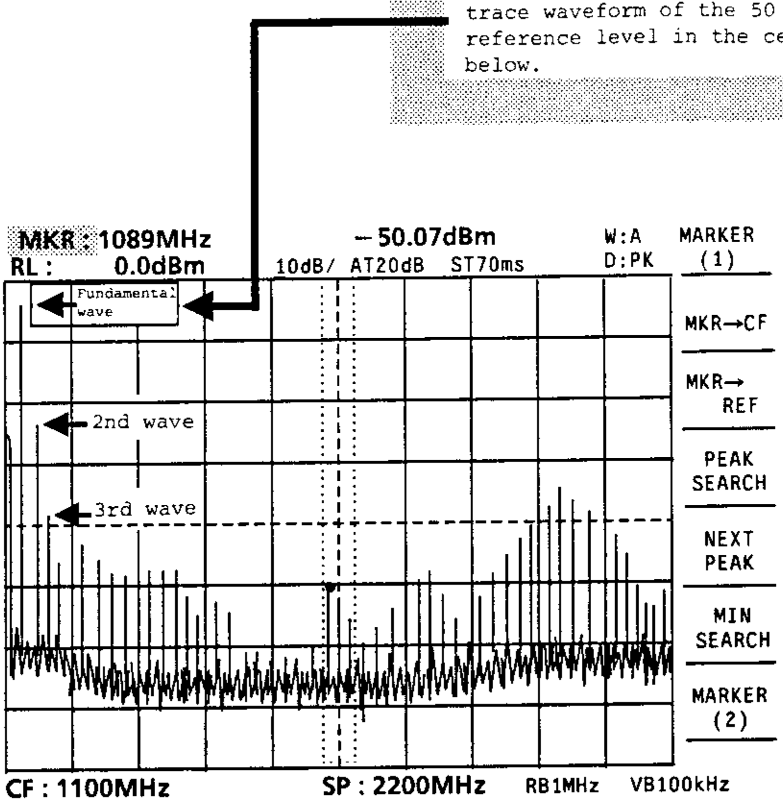
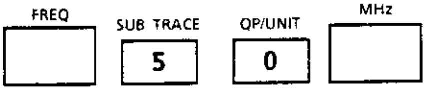


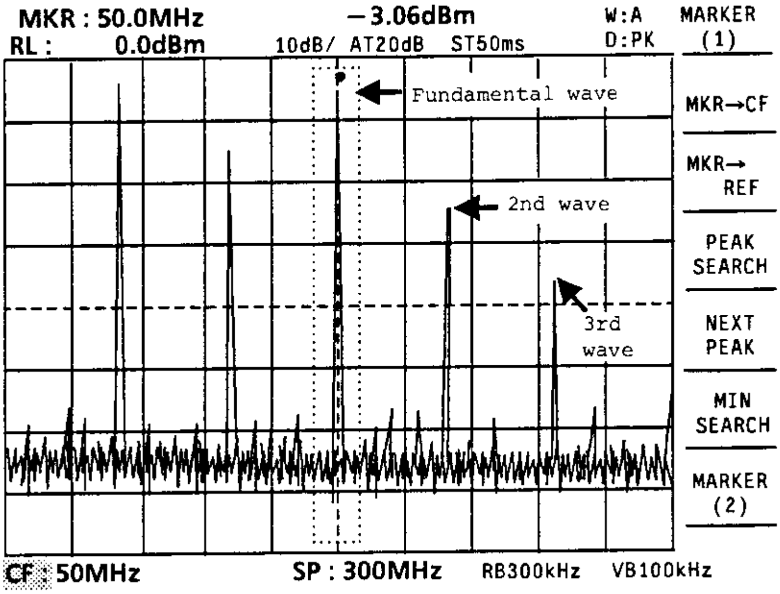
Fig. 6-4 50 MHz OUTPUT Signal Spectrum (After Full Span Initialization)

Basic operation 1.



Since CENTER is already selected in the FREQ MODE menu when the [FREQ] key is pressed, CF: is highlighted at the lower left of the CRT. Therefore, input the 50 MHz data by using the numeric/unit keys.

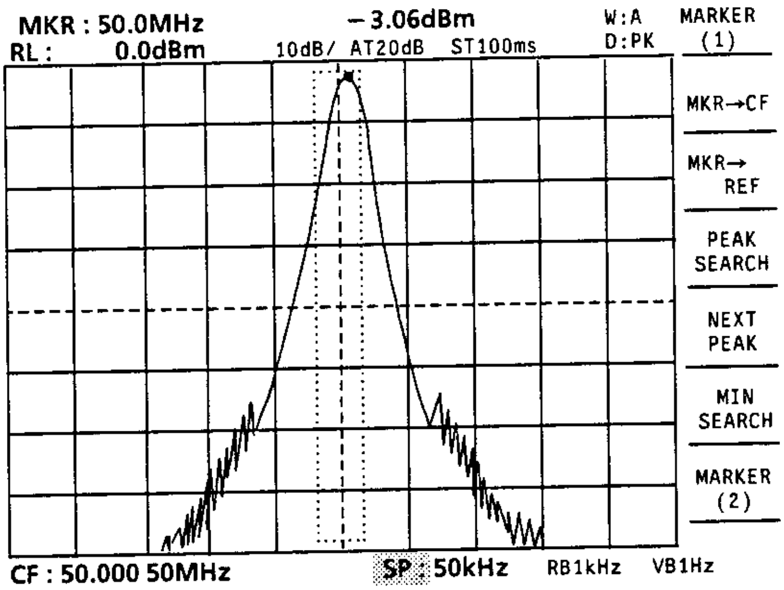
The frequency data can be finely adjusted by using the data knob after setting 50 MHz as described in the above operation.



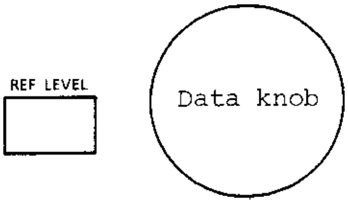
Basic operation 2. SPAN SUB TRACE 5 QP/UNIT 0 kHz

This operation highlights SP: The optimum value is automatically set for RB, VB, and ST in connection with the set value of SPAN.

In the methods other than that mentioned above, set SPAN 50 kHz by pressing the [⩔] key sequentially. In this case, the highlighted characters remain CF:.



Basic operation 3.

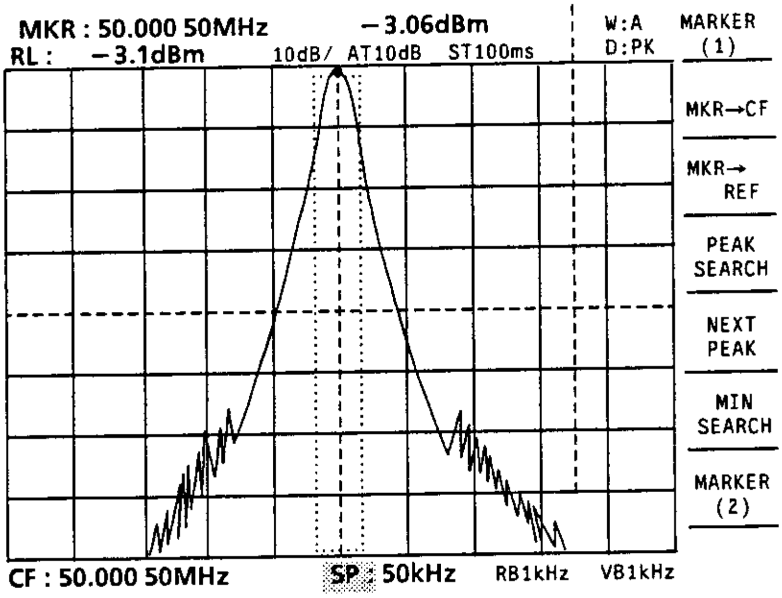


Match the peak of the displayed signal to the horizontal line at the top of the CRT by using the data knob.

Since the top of the waveform is in the zone marker, the marker is on the waveform peak.

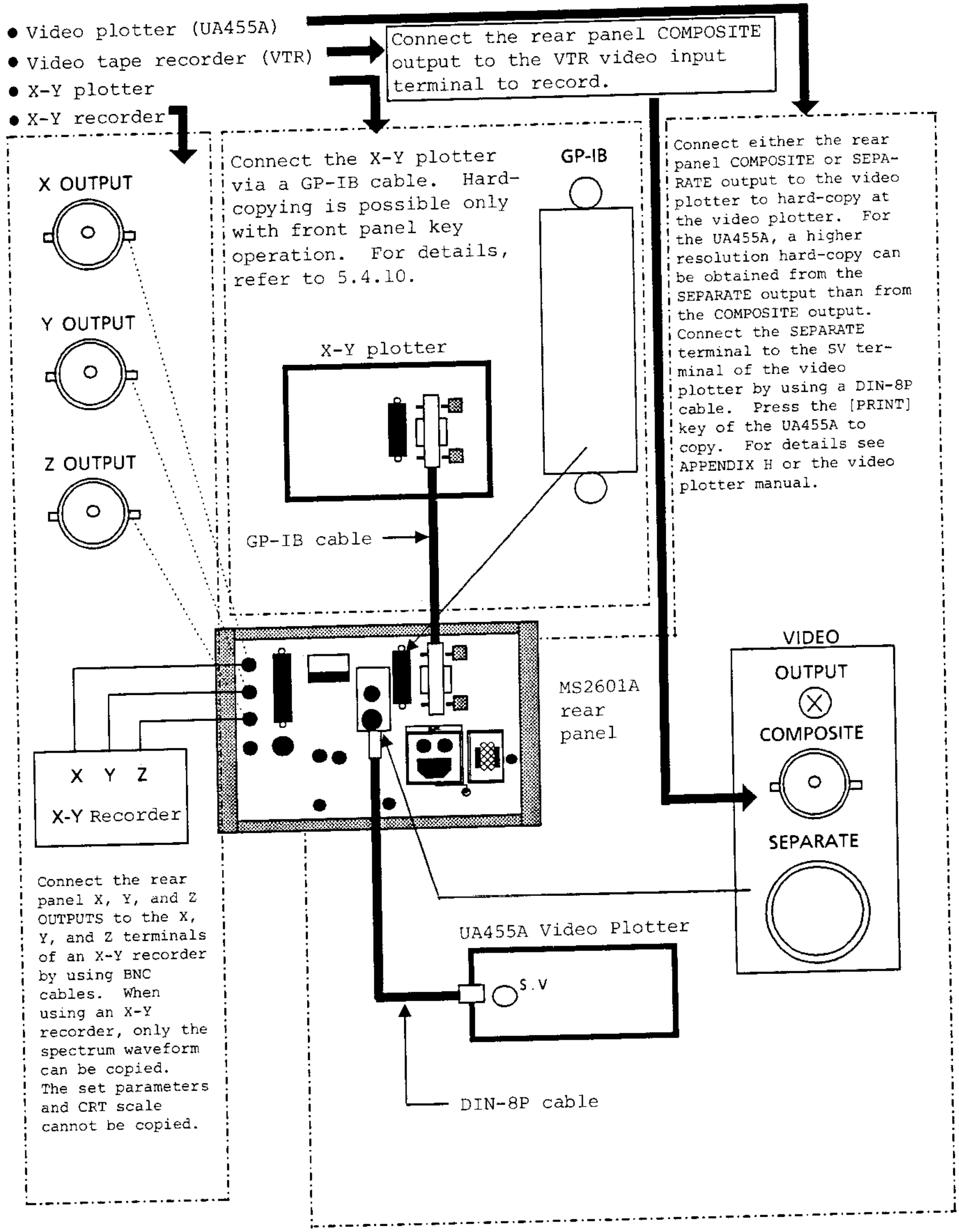
In methods other than that mentioned above;

- Press the [F1] or [PEAK→CF] key to move the waveform peak to the center of the CRT.
- Press the [F2] or [PEAK→REF] key to move the waveform peak to REF LEVEL.



6.2.4 Record of measured results

Measured results can be output to the following four types of equipment for hard-copying the setting and waveform data from the CRT.



Connect the rear panel COMPOSITE output to the VTR video input terminal to record.

Connect the X-Y plotter via a GP-IB cable. Hard-copying is possible only with front panel key operation. For details, refer to 5.4.10.

Connect either the rear panel COMPOSITE or SEPARATE output to the video plotter to hard-copy at the video plotter. For the UA455A, a higher resolution hard-copy can be obtained from the SEPARATE output than from the COMPOSITE output. Connect the SEPARATE terminal to the SV terminal of the video plotter by using a DIN-8P cable. Press the [PRINT] key of the UA455A to copy. For details see APPENDIX H or the video plotter manual.

Connect the rear panel X, Y, and Z OUTPUTS to the X, Y, and Z terminals of an X-Y recorder by using BNC cables. When using an X-Y recorder, only the spectrum waveform can be copied. The set parameters and CRT scale cannot be copied.

6.3 Measurement Using PEAK/NEXT PEAK/MIN Functions

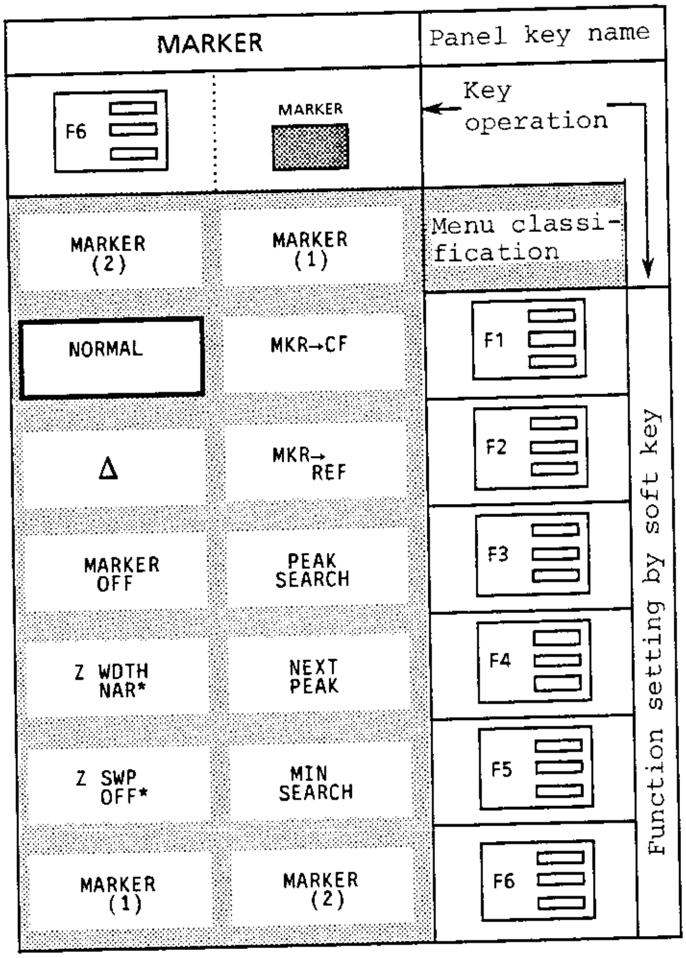
The spectrum PEAK level, NEXT PEAK level and MIN level measurement using the built-in 50 MHz signal is explained in this paragraph.

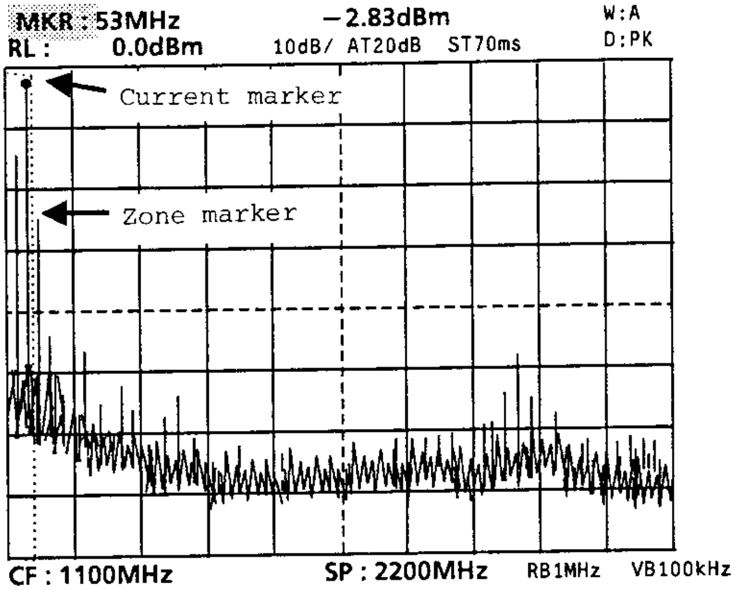
Initialize the MS2601A and input the 50 MHz signal from the rear panel OUTPUT 50 MHz connector to the RF INPUT 50 Ω connector.

Step	Procedure
	PEAK SEARCH
1	F3
2	Confirm that the zone marker is in the area of the 50 MHz signal fundamental wave of the maximum level.
3	Confirm that the current marker is at the peak level in the zone marker (lower figure).
	NEXT SEARCH
4	F6 MARKER (2) The menu becomes MARKER (2).
5	Change the Z WDTH (Zone width) from NAR to SPOT. F4 Z WDTH SPOT*
6	Confirm that the marker zone has disappeared and that a line overlaps the marker bright spot.

Note:

In steps 2 and 3, if the zero beat signal is higher than the 50 MHz fundamental wave level, the zone marker moves to the area including the zero beat signal. The current marker is positioned at the peak of the zero beat signal.



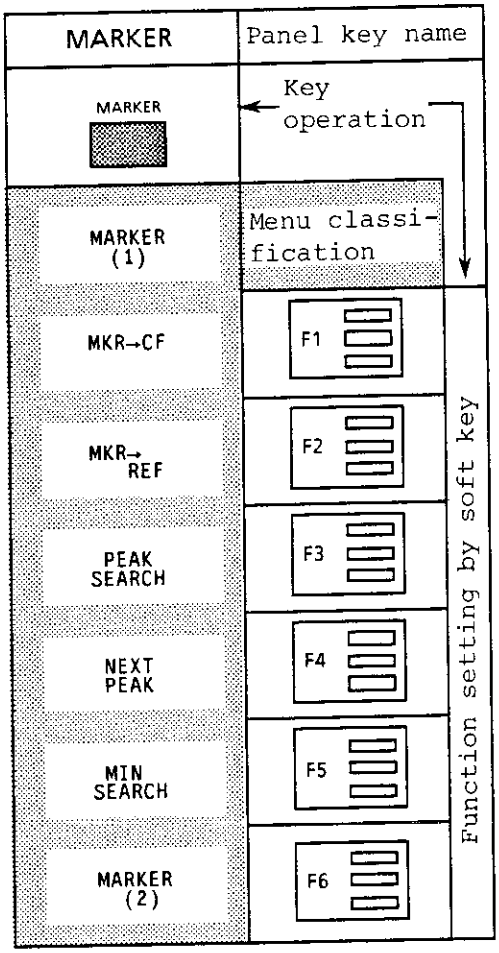


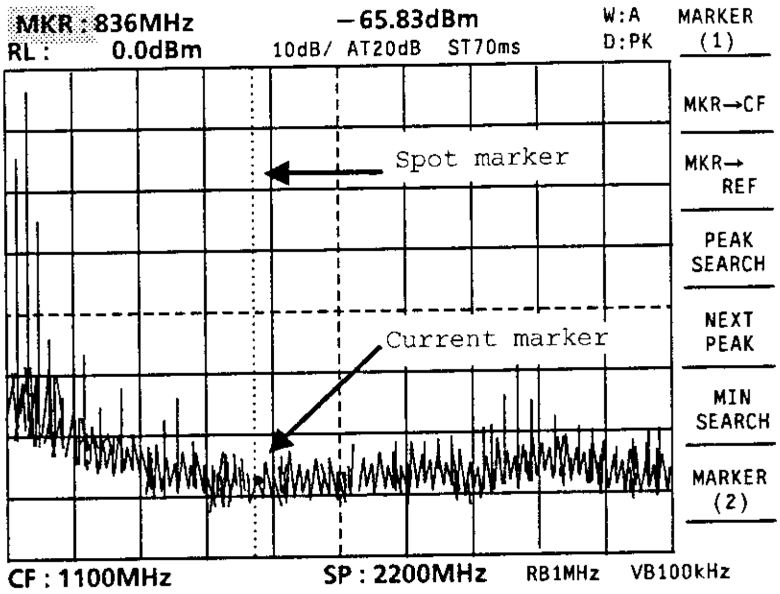
(Cont.)

Step	Procedure
7	Display the MARKER (1) menu again. F6 MAPKER (1)
8	Confirm that every time the [F4] key is pressed, the marker is moved and set to the peak with the next highest level.
	MIN SEARCH
9	F6 MIN SEARCH
10	Confirm that the marker is moved and set at the position of the lowest level among the spectrum traces displayed on the CRT.

Note:

NEXT SEARCH and MIN SEARCH functions work only when the zone width is SPOT. If NEXT SEARCH or MIN SEARCH is tried in a zone width other than SPOT, an operation error (notified by the buzzer) occurs. PEAK SEARCH works in any zone width.





6.4 Harmonic Distortion Measurement

This paragraph explains the harmonic distortion measurement procedure using the built-in 50 MHz signal.

The rear panel OUTPUT 50 MHz signal is used as the signal source to measure the fundamental and harmonic wave under various conditions.

6.4.1 Frequency and level measurement of fundamental wave and second harmonic

Move the fundamental wave of the 50 MHz signal to the center of the CRT and the second harmonic to the right end of the CRT. Measure the frequency, absolute level, frequency difference and level difference between the fundamental wave and the second harmonic as described in the next page. Measure the frequency at 10 Hz resolution.

Step Procedure

1

INITIAL
☐

2

FREQ	SUB TRACE	QP/UNIT	MHz
☐	5	0	☐

Confirm that the SPAN value narrows when the warning sounds. (This means that CF and SPAN have established the new correct relation.)

3

SPAN
☐

4 Confirm that the highlighted characters on the CRT change from MKR to SP.

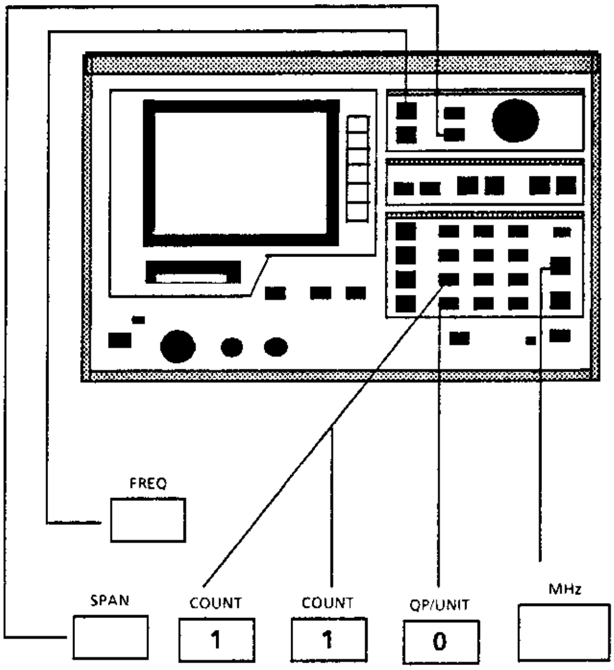
5 Enter the 110 MHz span data.

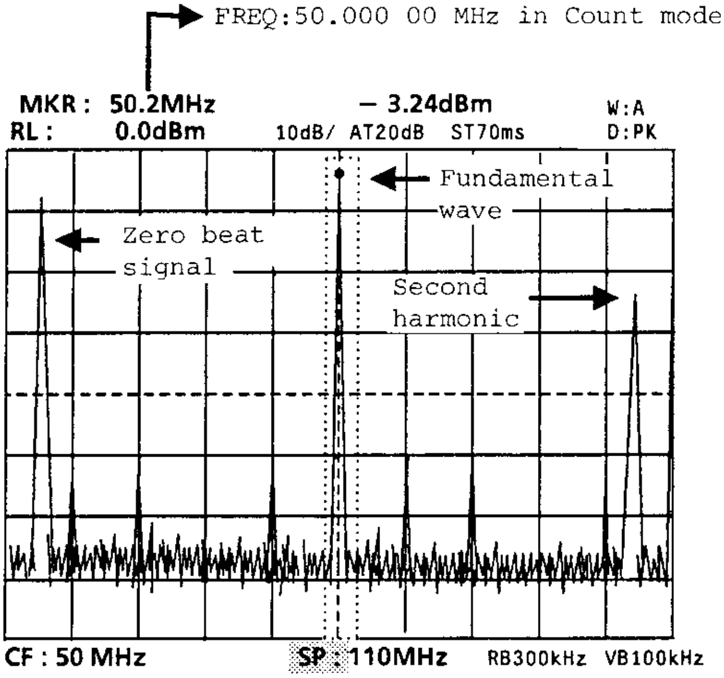
COUNT	COUNT	QP/UNIT	MHz
1	1	0	☐

The data is displayed at the right of the highlighted characters SPAN: after entry.

6 When the unit key [MHz] entry is completed, confirm that SPAN 110 MHz is set and 110 MHz is displayed at the right of the highlighted characters SPAN:.

7 Read the level and frequency of the fundamental wave peak.


FREQ
SPAN
COUNT
1
COUNT
1
QP/UNIT
0
MHz

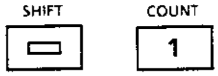

FREQ:50.000 00 MHz in Count mode
MKR : 50.2MHz
– 3.24dBm
W:A
RL : 0.0dBm
10dB/ AT20dB ST70ms
D:PK
Fundamental wave
Zero beat signal
Second harmonic
CF : 50 MHz
SP : 110MHz
RB300kHz VB100kHz

(Cont.)

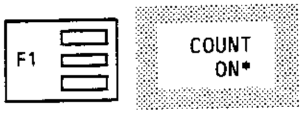
Step Procedure

Frequency measurement

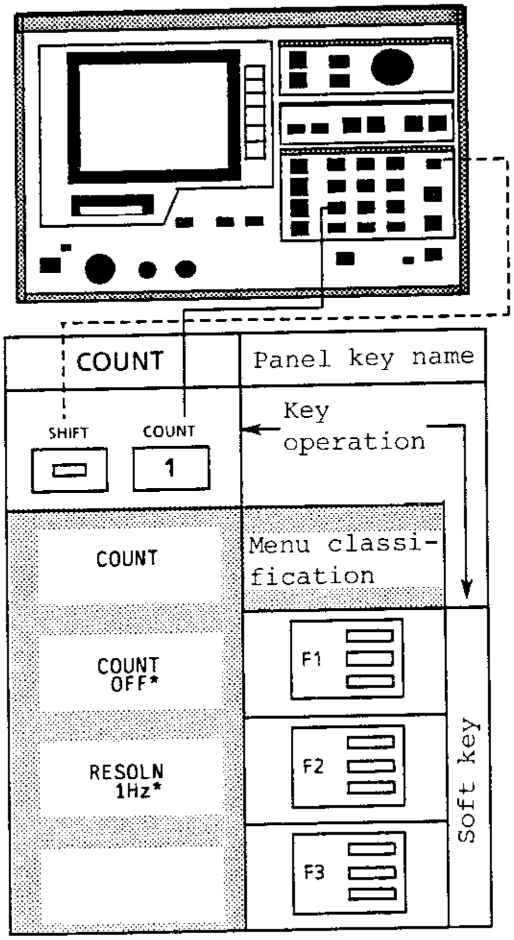
8



9

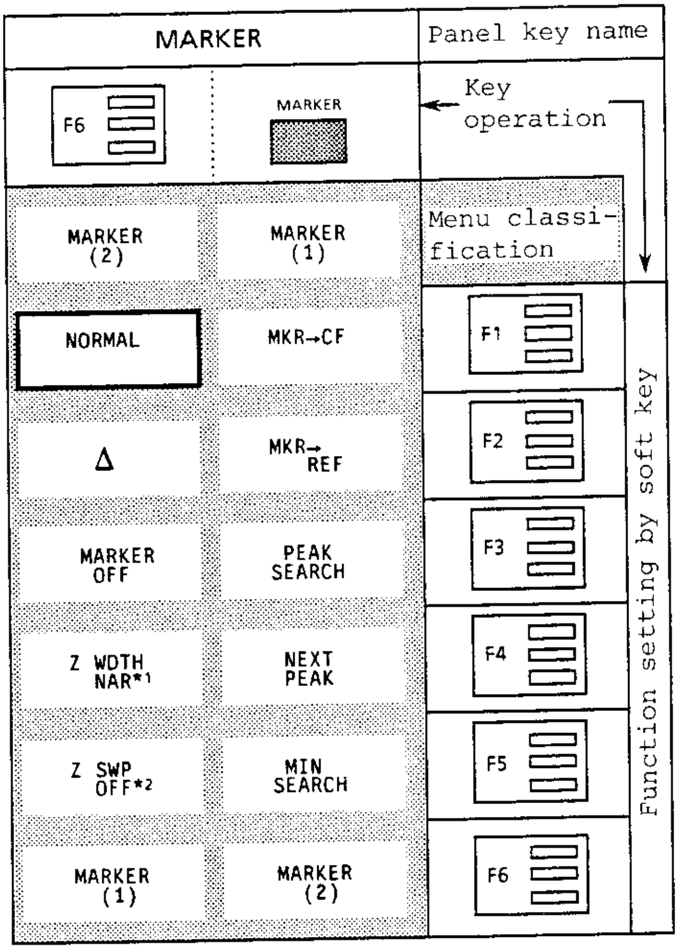


10 Confirm that the highlighted characters MKR: are erased and changed to FREQ: and that the frequency of the measured fundamental wave is 50.000 00 MHz with 10 Hz resolution.



(Cont.)

Step	Procedure
	<u>Second harmonic level measurement</u>
11	MARKER
12	Check that the FREQ: characters change to highlighted FREQ:. Confirm that the frequency of the marker point is measured in the marker mode.
13	F6 MARKER (2)
14	F4 Z WPTH SPOT*
15	F6 MARKER (1)
16	F4 NEXT PEAK If the marker moves to the zero beat signal, repeat this step again to move the marker to the second harmonic.
17	Read the frequency and level of the second harmonic peak.



MARKER		Panel key name
F6	MARKER	Key operation
MARKER (2)	MARKER (1)	Menu classification
NORMAL	MKR→CF	F1
Δ	MKR→ REF	F2
MARKER OFF	PEAK SEARCH	F3
Z WDTH NAR*1	NEXT PEAK	F4
Z SWP OFF*2	MIN SEARCH	F5
MARKER (1)	MARKER (2)	F6

Function setting by soft key

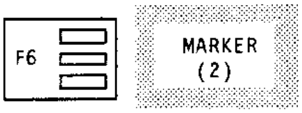
(Cont.)

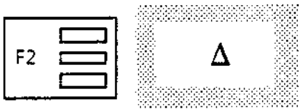
Step Procedure

Frequency and level difference measurement

18

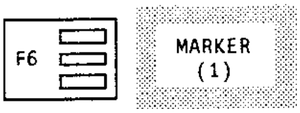

If the level of the zero beat signal is higher than that of the fundamental wave, move the spot marker to the fundamental wave by pressing NEXT PEAK ⌈F4⌋ key.

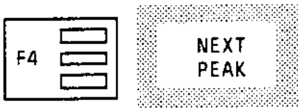
19


20


21 Confirm the following two points.

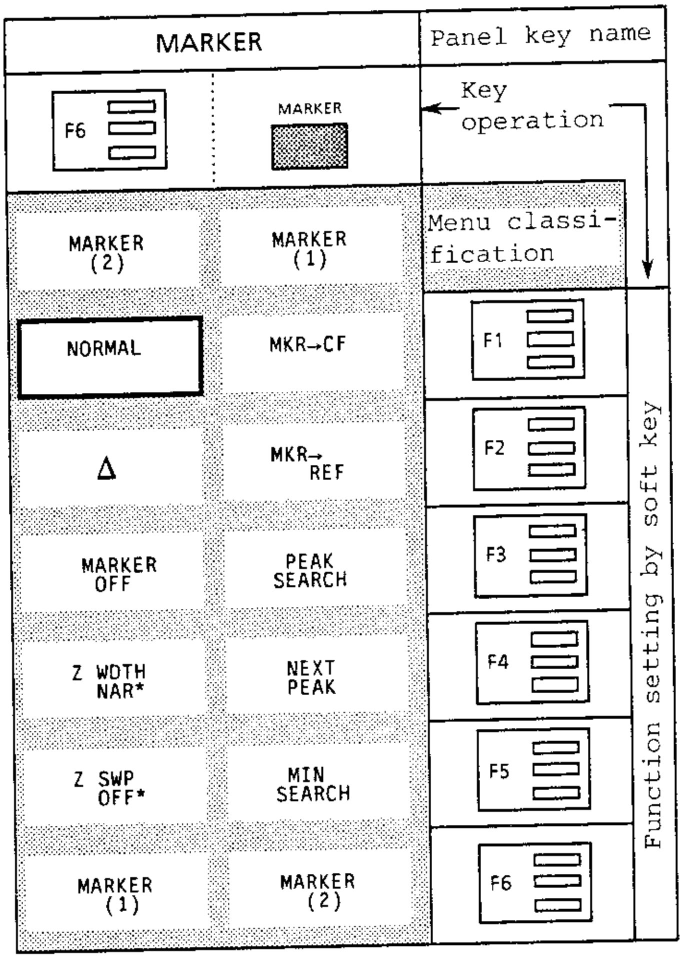
- ☐ is set to the marker point.
- The highlighted characters change from FREQ: to ΔFRQ:.

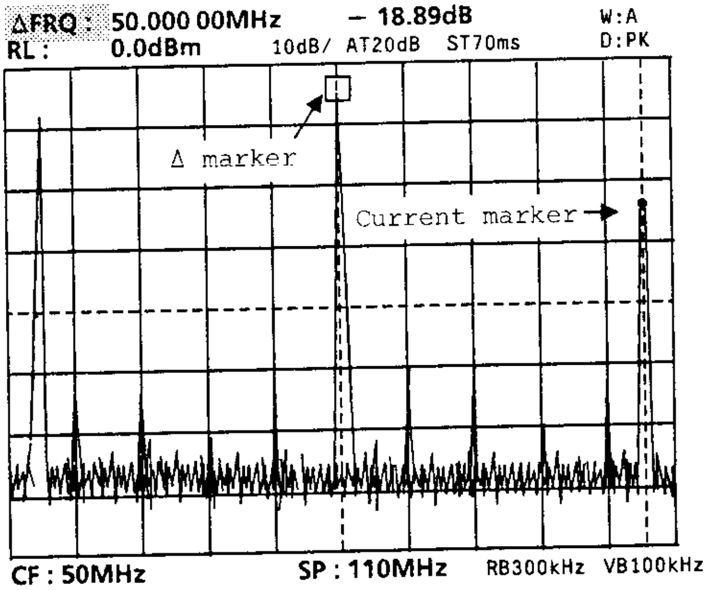
22


23


24 Confirm that the current marker is set at the peak of the second harmonic.

25 Confirm that the frequency and level differences between the fundamental wave and the second harmonic are 50.000 00 MHz and -18.89 dB.


MARKER
Panel key name
F6
MARKER
Key operation
Menu classification
MARKER (2)
MARKER (1)
NORMAL
MKR→CF
Δ
MKR→ REF
MARKER OFF
PEAK SEARCH
Z WDTH NAR*
NEXT PEAK
Z SWP OFF*
MIN SEARCH
MARKER (1)
MARKER (2)
F1
F2
F3
F4
F5
F6
Function setting by soft key


ΔFRQ : 50.000 00MHz
– 18.89dB
W:A
RL : 0.0dBm
10dB/ AT20dB ST70ms
D:PK
Δ marker
Current marker
CF : 50MHz
SP : 110MHz
RB300kHz VB100kHz

6.4.2 Measurement up to fifth harmonic on same screen

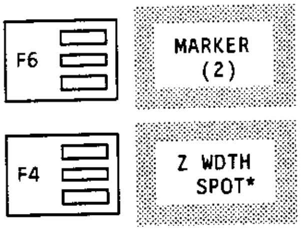
The level differences to the fundamental wave are measured on the same screen up to the fifth harmonic with the fundamental wave as START FREQ.

Step	Procedure
1	INITIAL FREQ
2	SHIFT FREQ MODE 2 CENTER
3	F2 START Lower right screen display switching CF: 1100 MHz → SF: 0 kHz
4	SUB TRACE 5 QP/UNIT 0 MHz Lower-right screen display switching SF: 0 kHz → SF: 50 MHz
5	SPAN FREQ MODE 2 SUB TRACE 5 QP/UNIT 0 MHz
6	MARKER F3 PEAK SEARCH

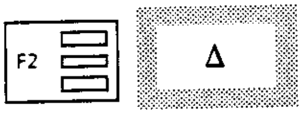
(Cont.)

Step Procedure

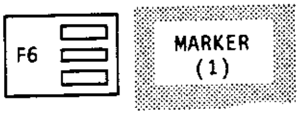
7



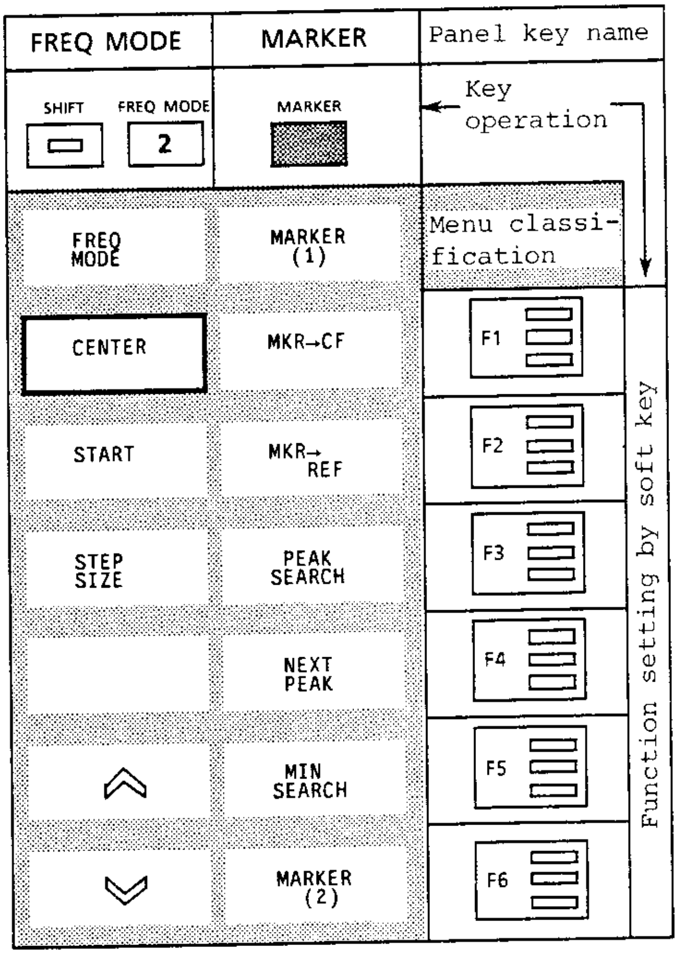
8

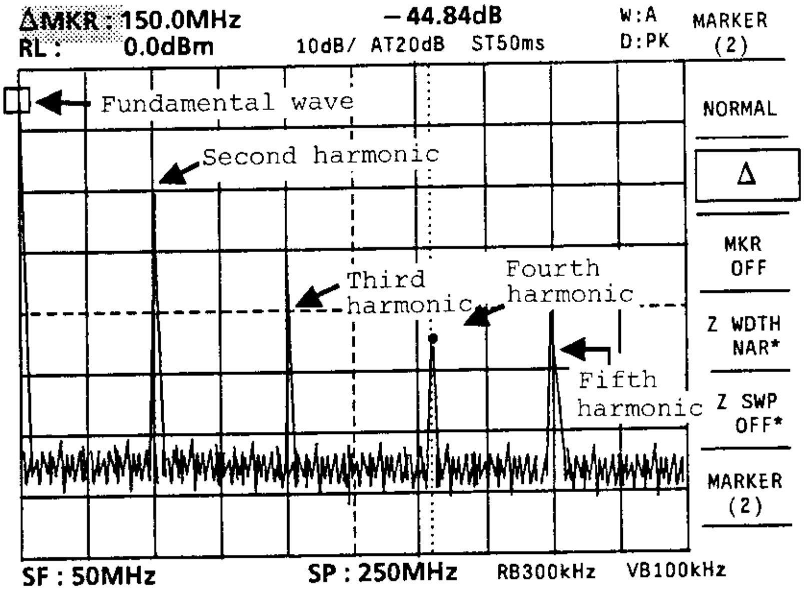


9



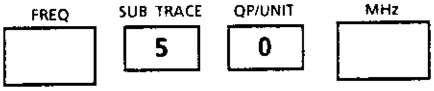
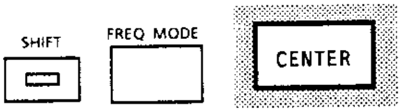
10 Perform the NEXT PEAK operation for the second to fifth harmonics and measure the level differences between them and the fundamental wave.


FREQ MODE
MARKER
Panel key name
SHIFT
FREQ MODE
2
MARKER
Key operation
FREQ MODE
MARKER (1)
Menu classification
CENTER
MKR→CF
F1
START
MKR→ REF
F2
STEP SIZE
PEAK SEARCH
F3
NEXT PEAK
F4
MIN SEARCH
F5
MARKER (2)
F6
Function setting by soft key

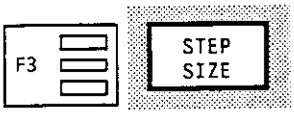
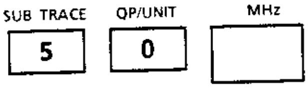
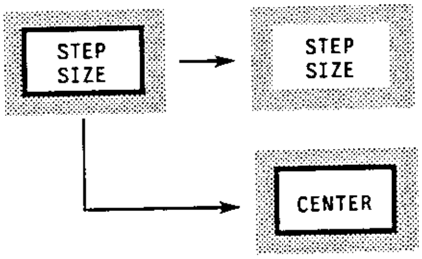

ΔMKR : 150.0MHz
−44.84dB
W:A
MARKER (2)
RL : 0.0dBm
10dB/ AT20dB ST50ms
D:PK
Fundamental wave
Second harmonic
Third harmonic
Fourth harmonic
Fifth harmonic
NORMAL
Δ
MKR OFF
Z WDTH NAR*
Z SWP OFF*
MARKER (2)
SF : 50MHz
SP : 250MHz
RB300kHz
VB100kHz

6.4.3 Measurement using step size

The absolute levels up to the sixth harmonic are measured in the step size equal to CF on the LOG scale in the center of the CRT.

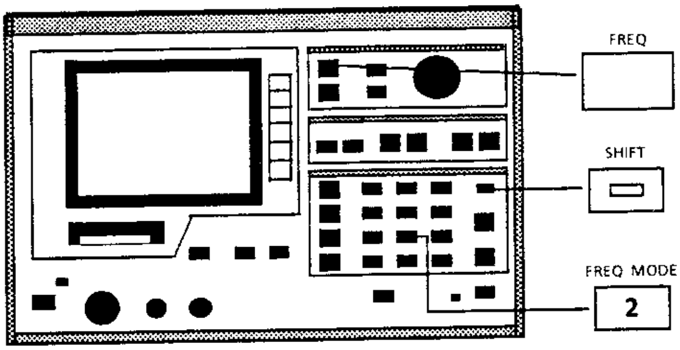
Step	Procedure
1	
2	
3	Confirm the following points. . The fundamental wave at the left of the screen in step 1 comes to the center position (CF). . The highlighted characters change from MKR: to CF:. . Each set parameter value is changed. (CF, MKR, SP, RB) . The frequency and level of the marker point
4	

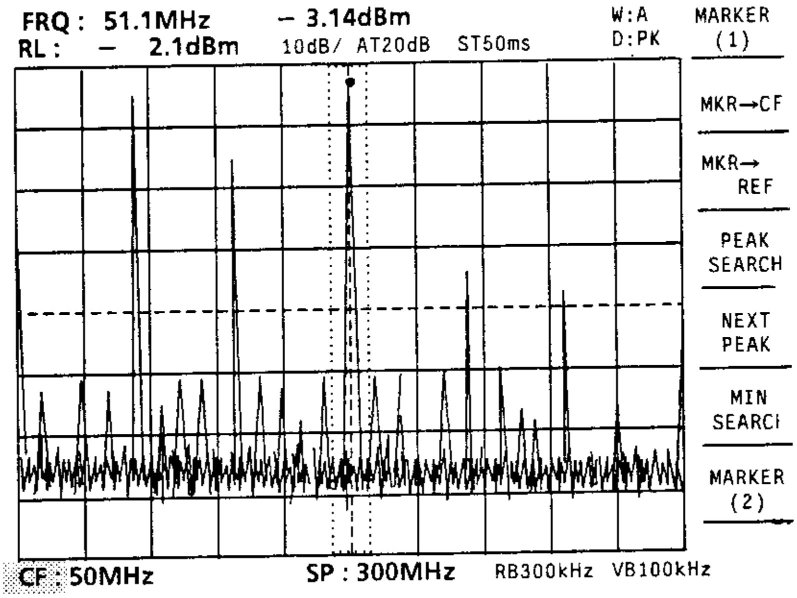
(Cont.)

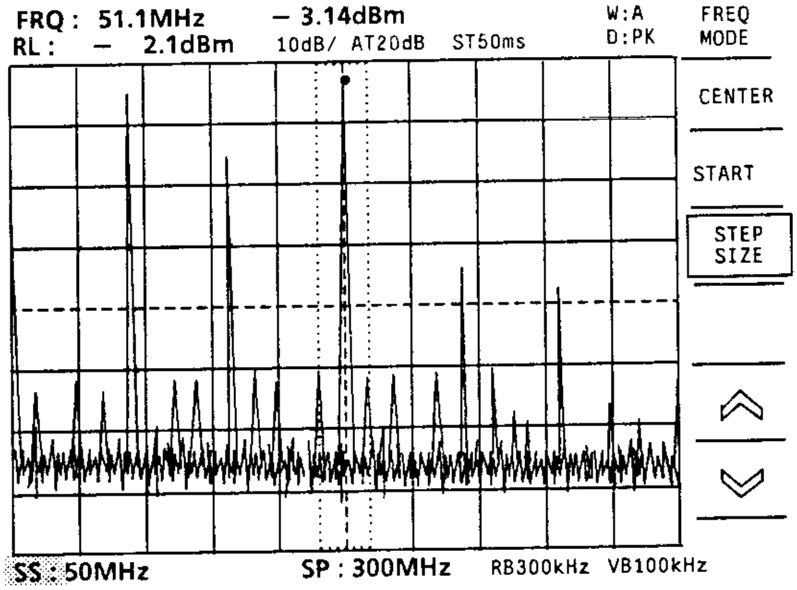
Step	Procedure
5	 Lower-left screen display switching CF: 50 MHz → SS: 0 kHz  Lower-left screen display switching SS: 50 MHz → CF: 50 MHz 

Note:

The span is so wide that the marker point frequency reading resolution in the center of the CRT is not good. Confirm the frequency in the Count mode which has the best resolution. But in this paragraph, the frequencies of the fundamental wave and harmonics are known, so the measurement continues as is.

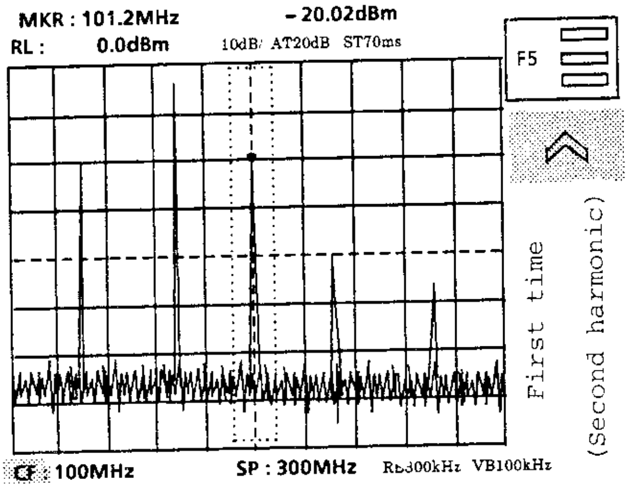



FRQ : 51.1MHz   − 3.14dBm   W:A
RL : − 2.1dBm   10dB/ AT20dB   ST50ms   D:PK
CF : 50MHz   SP : 300MHz   RB300kHz   VB100kHz

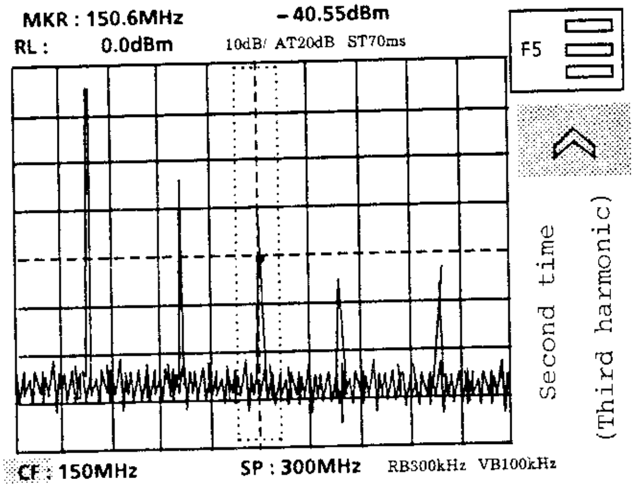

FRQ : 51.1MHz   − 3.14dBm   W:A
RL : − 2.1dBm   10dB/ AT20dB   ST50ms   D:PK
SS : 50MHz   SP : 300MHz   RB300kHz   VB100kHz

(Cont.)

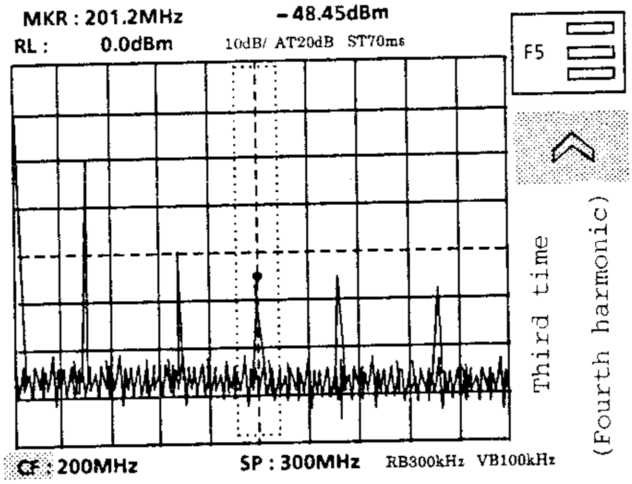
Step	Procedure
6	Confirm that the next harmonic is measured in the center of the CRT every time the [F5] key is pressed. Measurement from the second to sixth harmonics by pressing the [F5] key five times is shown below. (The spectrum other than the harmonics is excluded in the figure.)



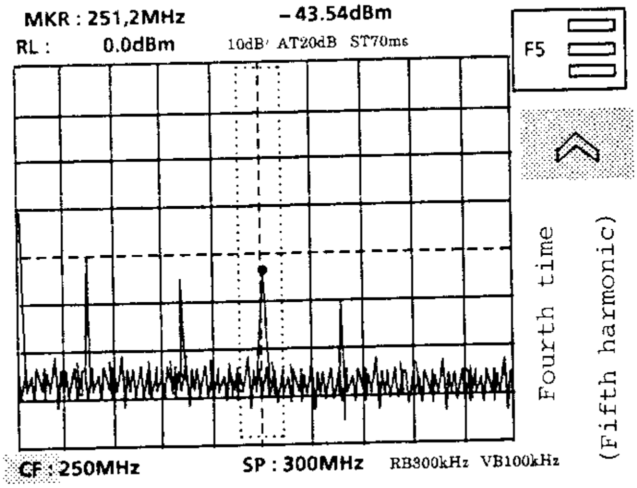
First time (Second harmonic)



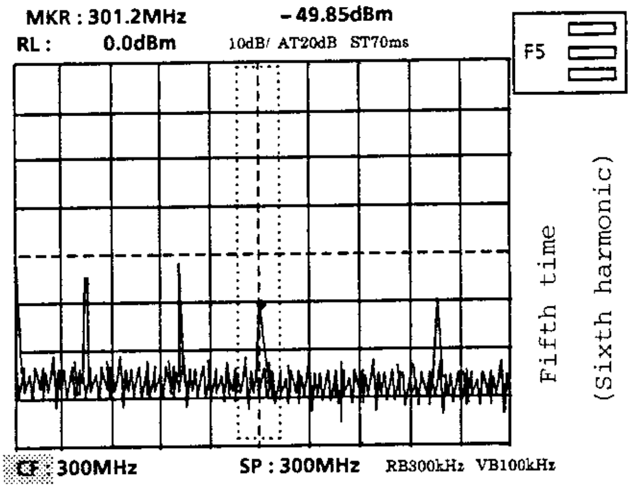
Second time (Third harmonic)



Third time (Fourth harmonic)



Fourth time (Fifth harmonic)



Note:

When [MKR→REF] key is pressed in the marker mode in the above-mentioned measurement, each harmonic level is measured in the reference level. In this case, the measured value does not include the LOG scale linearity error. Therefore, the measurement accuracy improves. For the measurement including this operation, see paragraph 3.2.2.

6.5 Modulated Wave Measurement

In modulated waves such as AM, FM and PAM waves (pulse amplitude modulated wave), the sideband wave spectrum is distributed at both the upper and lower sides of the carrier wave. Therefore, the measurement enlarges and displays the spectrum on the screen using almost the same procedure as that of harmonic distortion measurement.

6.5.1 General measurement procedure

The procedure described here summarizes the MS2601A general measurement procedure and is not limited to modulated wave measurement.

Step	Procedure
1	Press the [INITIAL] key or set the SPAN to 2200 MHz to perform a full sweep and receive a signal to be measured from among the wide frequency range.
2	If a spectrum does not appear on the CRT, press the [REF LEVEL] key and change the REF LEVEL value by using the data knob.
3	When signal reception is confirmed by watching the CRT, move the zone marker to a position including the peak level of the signal to be measured in the marker mode by using the data knob. If the maximum signal on the CRT is the signal to be measured, press the [F3] key and perform PEAK SEARCH. (If the [PEAK→CF] key is pressed, the next step 4 can be omitted.)

(Cont.)

Step	Procedure
4	Display the spectrum to be measured at the center of the CRT by using one of the following methods. . When the signal frequency to be measured is determined by using the zone marker, set CF and SPAN to display the signal at the center of the CRT. . Press the [F1] key in the marker mode to perform MKR → CF. . When the maximum signal on the CRT is the signal to be measured, press the [PEAK→CF] key.
5	When it is necessary to enlarge the spectrum, decrease SPAN. General SPAN setting is as follows: . If the required span value must be set, press the [SPAN] and numeric/unit keys. . If the objective signal must just be enlarged or reduced, press the [∨] or [∧] keys in the SIGNAL SEARCH section. . If a SPAN value other than that in the 1-2-5 sequence must be set, press the [SPAN] and numeric/unit keys.

(Cont.)

Step	Procedure
6	Move the spectrum peak to the required position on the CRT vertical scale by using one of the following methods. . Select LOG or LIN scale from the SCALE menu. . After pressing the [REF LEVEL] key, adjust the reference level by using the data knob. Use either one of the following methods to match the signal peak to the reference level. . If the maximum level on the CRT is the objective signal, press the [PEAK→REF] key. . Press the [F2] key in the marker mode to perform the MKR→REF operation.

6.5.2 AM modulation factor measurement

When an AM wave is measured in the LOG mode according to the procedure in paragraph 6.5.1 and is displayed as shown in Fig. 6-5, the carrier wave frequency fc, modulation frequency fm, and each level Pc, P1 and P2 (dBm or dBμ) are measured. The low-level spectrum (P2) separate from the carrier is caused by the second harmonic of the modulation signal and the second harmonic distortion of the modulation signal can be obtained as (P1 - P2) dB.

P1 is a signal component caused by the AM modulation. The lower the level of P2 is, the less the distortion of the modulation signal P1 becomes. The (P1 - P2) value is called the secondary modulation distortion. Figure 6-5 shows secondary modulation distortion = P1 - P2 = 20 dB. This can be easily measured in the Δ mode.

The third modulation distortion is obtained similarly from the level difference with P1.

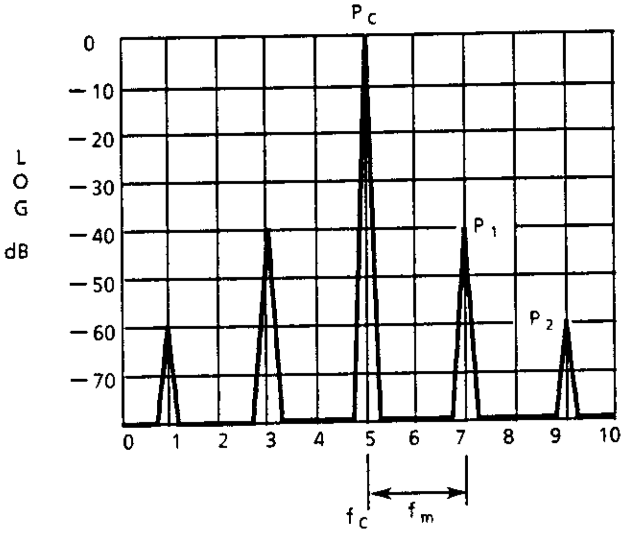


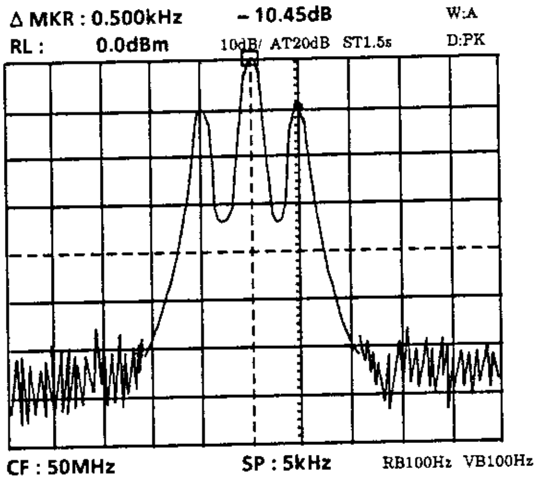
Fig. 6-5 AM Wave Spectrum Display

(1) Measurement of AM modulation factor m in LOG mode

The modulation factor m is calculated from the level difference (Pc - P1) dB using the following formula:

$$20 \log \frac{m}{2} = Pc - P1$$

Figure 6-6 shows this relationship. When SCALE 10 dB/div is used, the maximum 70 dB level difference can be read directly from the screen. Therefore, a modulation factor as low as 0.06% can be measured. The following figure shows that a 60% modulation factor is measured from the level difference measurement by the Δ marker.



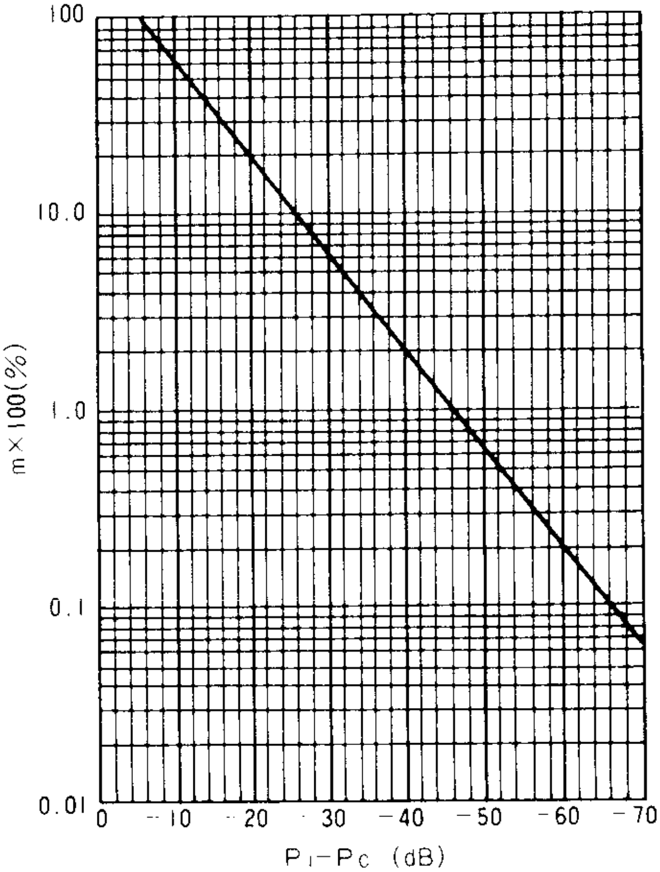


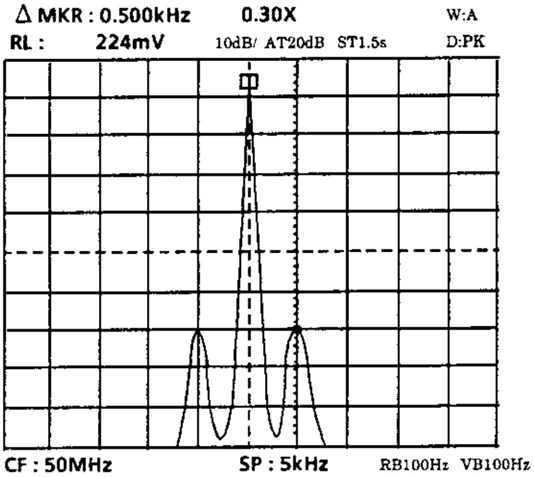
Fig. 6-6 AM Modulation Factor (m) and Sideband Wave Level (P1 dB)

(2) Measurement of AM modulation factor m in LIN mode

The modulation factor m is represented by the following formula from the amplitude ratio between the single sideband and carrier.

$$\frac{m}{2} = \frac{\text{single sideband amplitude}}{\text{carrier amplitude}}$$

Therefore, when the Δ marker is used in the LIN mode, the AM modulation factor m can be measured as described below.



In the above figure:

1. Move the Δ marker to the peak of the carrier wave spectrum.
2. Move the spot marker to the peak of the single sideband spectrum.
3. When the reference marker point (Δ marker) of the carrier wave is set to 1.00X as shown in the above figure, the ratio of the single sideband level to the carrier level can be read directly as 0.30X.

Therefore, the AM modulation factor m can be found from the following calculation.

AM modulation depth m (%) = 2 x (0.30) x 100

= 60%

(3) Measurement of AM modulation factor m at low modulation frequency

When the modulation frequency in AM modulation factor measurement described in paragraphs 6.5.2 (1) and (2) is so low that the modulation frequency resolution is impossible, set SPAN to zero and operate the MS2601A as a fixed-frequency receiver to display the demodulated waveform shown in Fig. 6-7. The modulation factor m can be obtained from Emax, Emin and Ec as shown in Fig. 6-7.

$$m = \frac{Emax - Ec}{Ec} = \frac{Ec - Emin}{Ec}$$

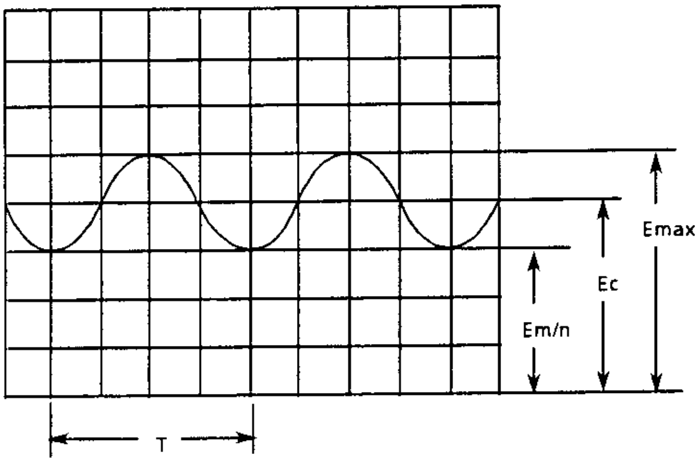


Fig. 6-7 Time Domain Display of AM Wave

For a positive and negative symmetrically modulated wave, the above formula is transformed to the following one to enable the measurement using PEAK SEARCH and MIN SEARCH operations.

$$\text{AM modulation factor m (\%)} = \left(\frac{E_{MAX} - Ec}{Ec}\right) \times 100$$

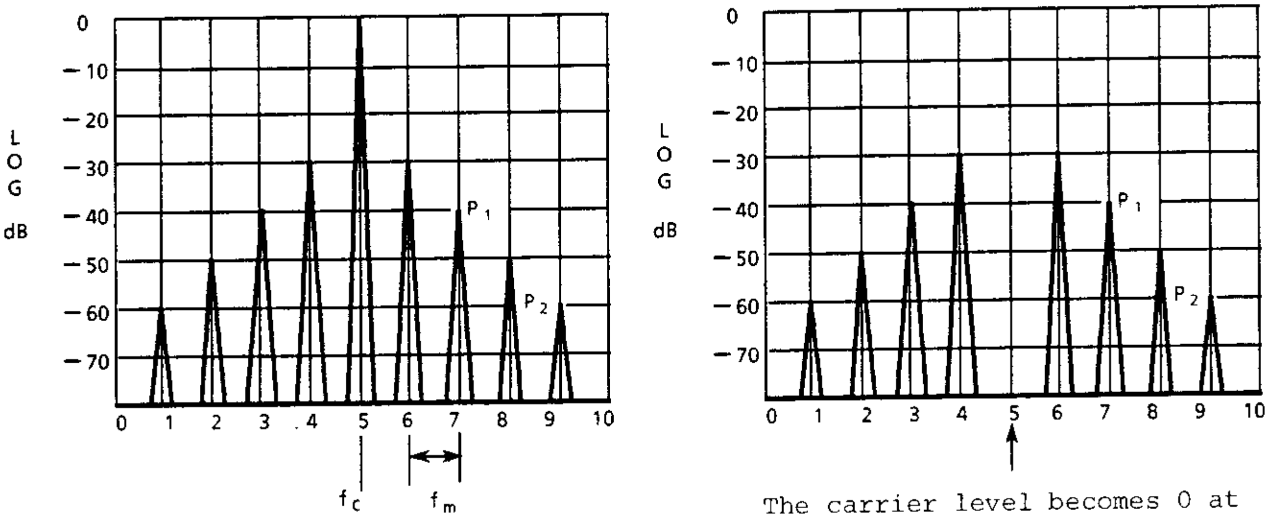
$$= \left(\frac{E_{MAX} - E_{MIN}}{E_{MAX} + E_{MIN}}\right) \times 100$$

The procedure for AM modulation factor measurement of a positive and negative symmetrically modulated wave is shown below.

Step	Procedure
1	Display the center of the spectrum to be measured in the center of the CRT with CF/SPAN mode.
2	Select LIN at the SCALE menu.
3	Set SPAN to 0.
4	Set REF LEVEL properly to display the demodulated waveform on the CRT.
5	Select VIDEO at the TRIG menu to obtain a stationary image (Fig. 6-7).
6	Set to marker mode, read E_{MAX} from PEAK SEARCH operation and E_{MIN} from MIN SEARCH operation, and calculate the % from the above-mentioned formula for the AM modulation factor m.

6.5.3 FM deviation measurement

When a display similar to that shown in Fig. 6-8(a) is obtained by using the measurement procedure in paragraph 6.5.1, the carrier frequency fc, modulation signal frequency fm, and each sideband spectrum level can be measured.



The carrier level becomes 0 at certain modulation factor.

(a) Spectrum Display (Spectrum Interval = fm)

(b) Setting deviation by carrier-zero-suppression

Fig. 6-8 FM Wave Spectrum Display

The levels of the carrier wave and sideband waves change depending on the modulation factor mf as shown in the Bessel function curve of Fig. 6-9. The j0(mf) = 0 and j1(mf) = 0 in the table in the next page shows the modulation factors in which the carrier wave level and the first sideband wave level are 0.

①	$J_0(m_f) = 0$	$J_1(m_f) = 0$
①′	$m_f = 2.40484$	
②		$m_f = 3.8317$
②′	$m_f = 5.5201$	
③		$m_f = 7.0156$
③′	$m_f = 8.6535$	
④		$m_f = 10.1735$
④′	$m_f = 11.7915$	
⑤		$m_f = 13.3237$
⑤′	$m_f = 14.931$	

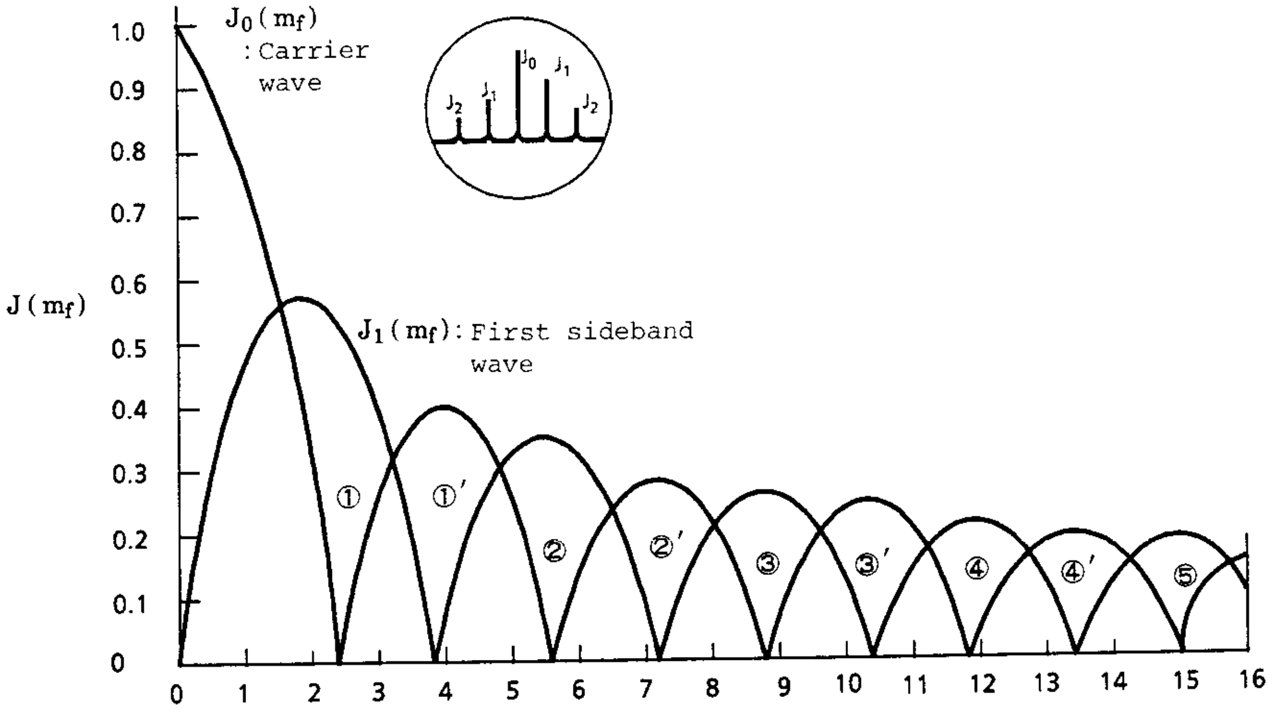


Fig. 6-9 Bessel Functions j0 (mf) and J1 (mf)

Measurement of the FM deviation by finding the modulation factor mf in which the carrier wave level becomes 0 is called "carrier-zero-suppression".

The modulation factor mf is changed by adjusting the modulation signal input level of the FM equipment.

The following relationship exists between the modulation frequency fm, modulation factor mf and deviation Δf.

$$\Delta f = mf \cdot fm$$

Figure 6-10 shows the setup to measure the frequency deviation of an FM transmitter. Monitor the modulation frequency fm with a counter and adjust the output level of an audio oscillator to vary mf.

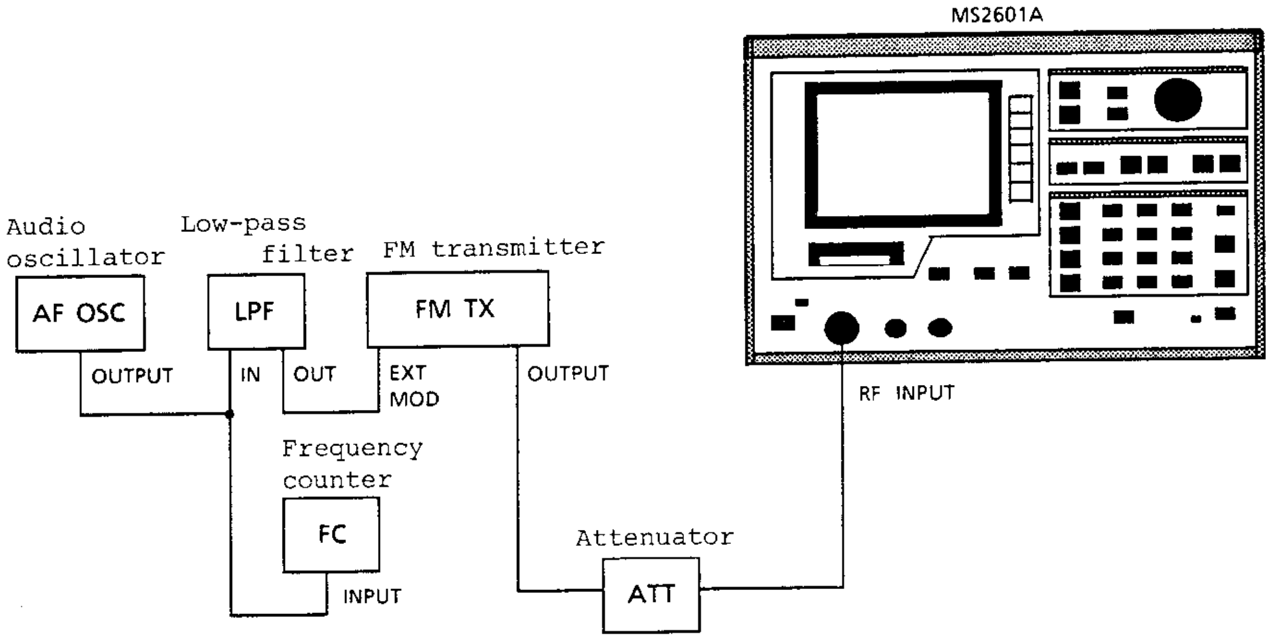


Fig. 6-10 Frequency Deviation Measurement Setup

Table 6-3 shows the relationship between the residual component of the carrier wave and the frequency deviation calibration accuracy in carrier-zero-suppression. At first time, the ±0.2% calibration accuracy can be obtained by increasing frequency deviation when the carrier wave level is attenuated down to -52 dB (value in brackets in table).

The frequency deviation of this point will be 2.40484 (1±0.002) x fm = 2.40484 fm ±4.80968 x 10^{-3} fm.

Table 6-3 Residual Component of Carrier Wave and Frequency Deviation Calibration Accuracy

	Calibration accuracy Condition	±0.2%	±0.5%	±1%
Residual component of carrier wave	CW** = 0 (First time) 2.40484 rad (mf)	0.00250* (-52 dB)	0.00663 (-43.6 dB)	0.0124 (-38.1 dB)
	CW = 0 (Second time) 5.52009 rad (mf)	0.00374 (-48.6 dB)	0.00937 (-40.6 dB)	0.0187 (-34.6 dB)
	CW = 0 (Third time) 8.6535 rad (mf)	0.00468 (-46.6 dB)	0.0117 (-38.6 dB)	0.0233 (-32.7 dB)
	CW = 0 (Fourth time) 11.7915 rad (mf)	0.00515 (-45.8 dB)	0.0138 (-37.2 dB)	0.0271 (-31.3 dB)
	CW = 0 (Fifth time) 14.9301 rad (mf)	0.00615 (-44.2 dB)	0.0154 (-36.3 dB)	0.0306 (-30.3 dB)

* 20 LOG 0.0025 = -52 dB
** CW: Carrier wave level

As an example, when FM transmitter output frequency deviations of 9 kHz, 3 kHz and 900 Hz are set by carrier-zero-suppression as shown in Fig. 6-10, use Table 6-4 which shows the value of the modulation frequency in which the carrier wave level is eliminated the first time, second time, third time, etc. according to Fig. 6-9.

Table 6-4 Modulation frequency vs. Frequency Deviation

	Frequency deviation (Δf) Condition		9 kHz	3 kHz	900 Hz
Modulation frequency (fm)	J0(mf) = 0 (CW = 0)	First time	3742.5 Hz	1247.5 Hz	374.3 Hz
		Second time	1630.4 Hz	543.5 Hz	163 Hz
		Third time	1040 Hz	346.7 Hz	104 Hz
		Fourth time	763.3 Hz	254.4 Hz	76.3 Hz
		Fifth time	602.8 Hz	201 Hz	60.3 Hz

The procedure to set an FM transmitter frequency deviation to 9 kHz is shown below based on Figs. 6-8 to 6-10 and Tables 6-3 and 6-4 with the setup in Fig. 6-10.

Step	Procedure
1	Set AF OSC (modulation frequency oscillator) output frequency to 3742.5 Hz while monitoring it with a counter.
2	Display the FM wave from the FM transmitter on the CRT according to the procedure in paragraph 6.5.1.
3	Increase the AF OSC output level, while checking that the frequency counter indication always reads 3742.5 Hz, so that the carrier wave level is attenuated at first to -52 dB or less in comparison to non-modulation. This completes FM setting of mf=2.4084 (1 ±0.002).
4	The frequency deviation Δf is calculated as shown below from Tables 6-3 and 6-4. $\Delta f = mf \cdot fm = 2.40484\ (1 \pm 0.002) \times 3742.5\ \text{Hz}$ $= 9\ \text{kHz} \pm 18\ \text{Hz}$

6.6 Measurement of Transmission Characteristic Combined with Tracking Generator

The transmission characteristic (amplitude-frequency characteristic) of an amplifier, filter, etc. can be measured in combination with a tracking generator (MH680A).

Generally, when the amplitude-frequency characteristic of the device (DUT) includes the amplitude-frequency characteristic of the measurement system, the measured results include a large error. However, since the MS2601A has A ch and B ch spectrum memories and an A-B→A operation function, the amplitude-frequency characteristic of the measurement system can be eliminated. This is done by storing the amplitude-frequency characteristic of the direct-coupled measurement system without the DUT in memory B. Afterwards, if the measured result includes the amplitude-frequency characteristic of the measurement system, the measurement system amplitude-frequency characteristic previously stored in memory B is subtracted from the measured result by the A-B→A operation function. Therefore, the amplitude-frequency characteristic of only the DUT is measured (see paragraph 6.6.2).

Here an example of the amplitude-frequency characteristic of a bandpass filter (BPF) with a 220 MHz center frequency is explained.

6.6.1 Setup and measurement

(1) Rear panel LOCAL output connection

Connect the FIRST LOCAL OUTPUT and SECOND LOCAL OUTPUT of the MS2601A to the corresponding FIRST LOCAL INPUT and SECOND LOCAL INPUT of the MH680A by using the coaxial cables attached to the tracking generator.

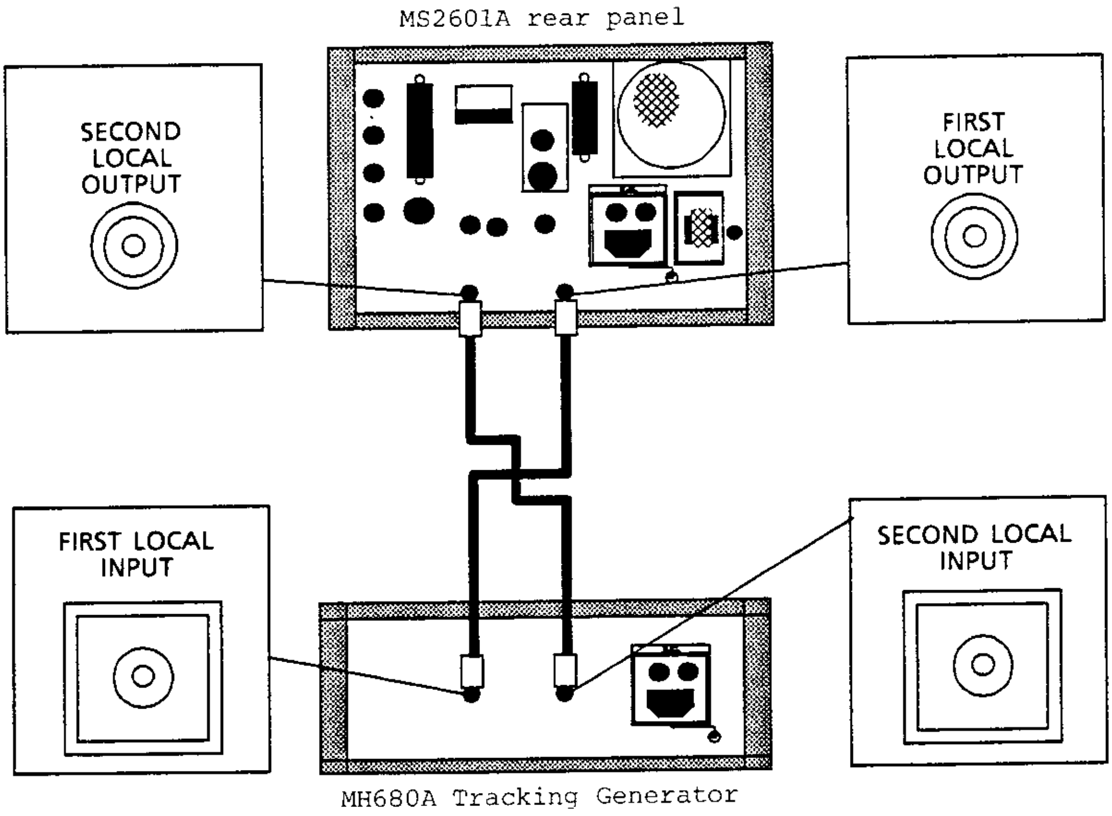
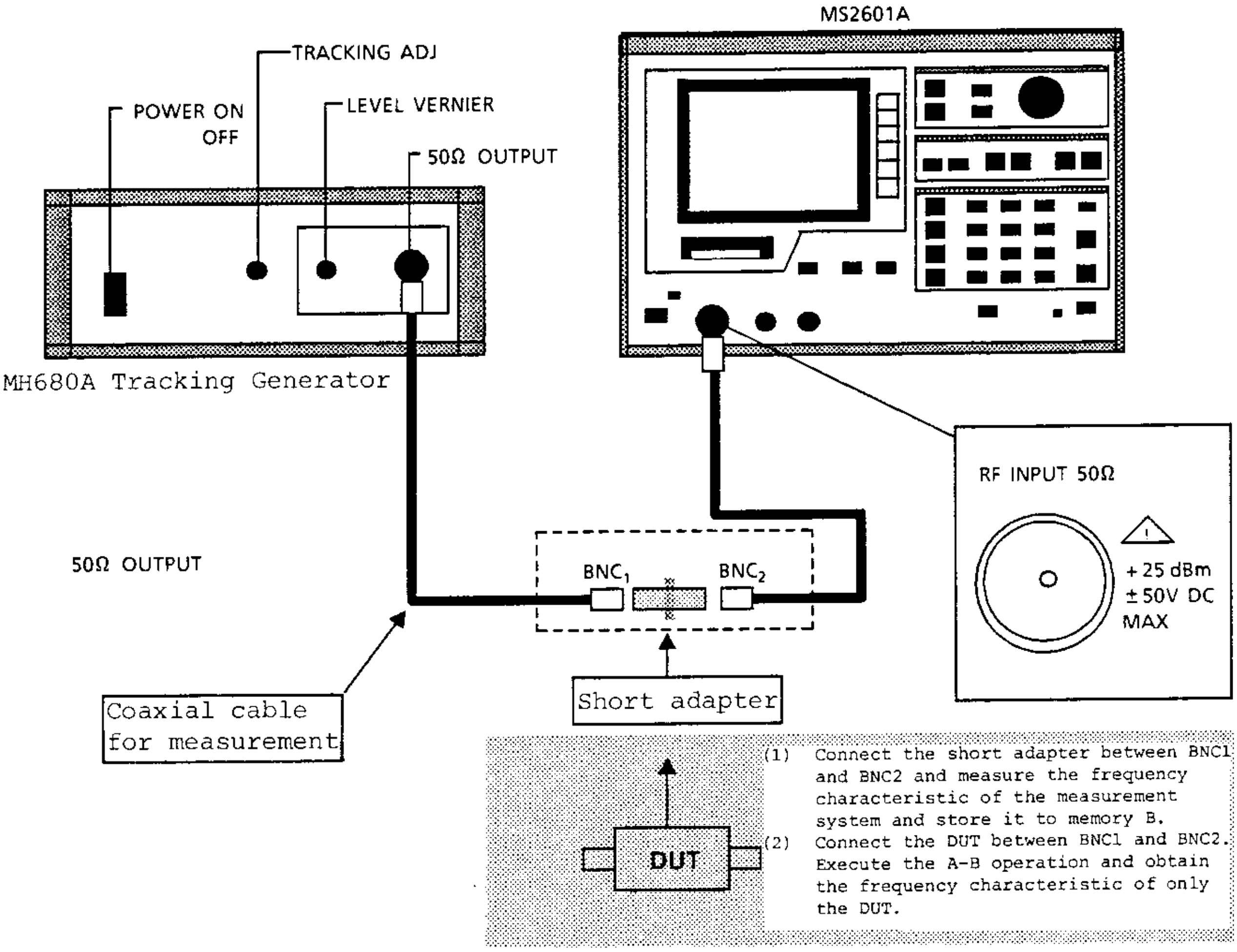


Fig. 6-11 Rear Panel LOCAL Output Connection to MH680A

(2) DUT connection



(1) Connect the short adapter between BNC1 and BNC2 and measure the frequency characteristic of the measurement system and store it to memory B.

(2) Connect the DUT between BNC1 and BNC2. Execute the A-B operation and obtain the frequency characteristic of only the DUT.

Fig. 6-12 Measurement System Calibration and Measurement

(3) Measurement procedure

Step	Procedure
1	Connect the rear panel LOCAL OUTPUT signals to the MH680A as shown in Fig. 6-11.
2	Connect the MH680A 50 Ω OUTPUT to the MS2601A RF INPUT as shown in Fig. 6-12. However, connect the short adapter between BNC1 and BNC2 instead of the DUT.

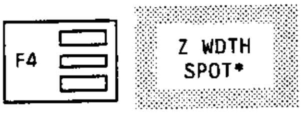
(Cont.)

Step Procedure

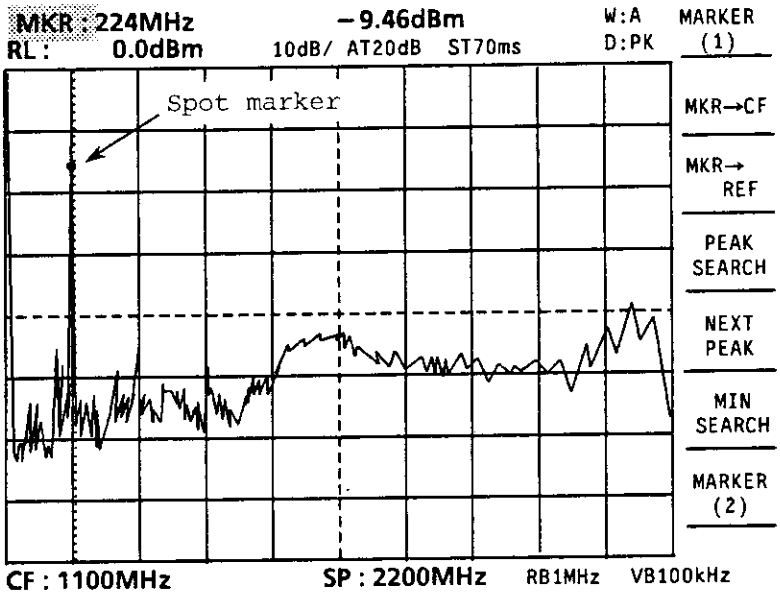
Signal reception

3 Press the [INITIAL] key to perform a full sweep and confirm the 220 MHz filter output signal.

Change the marker to SPOT to measure the frequency, level and level difference between two points in the amplitude-frequency characteristic measurement.

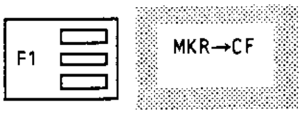


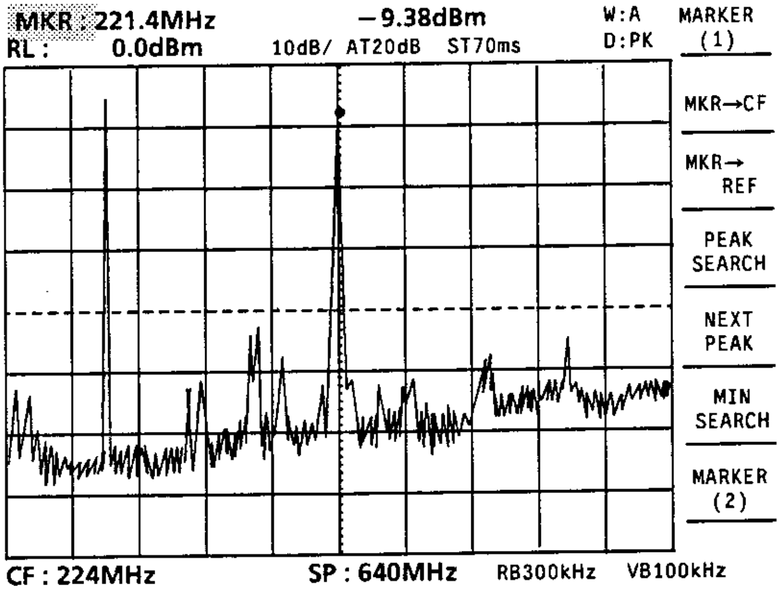
4 Move the zone marker to the peak position around 220 MHz by the data knob (See the figure below.)



(Cont.)

Step	Procedure
5	Display the signal to be measured at the center of the CRT.



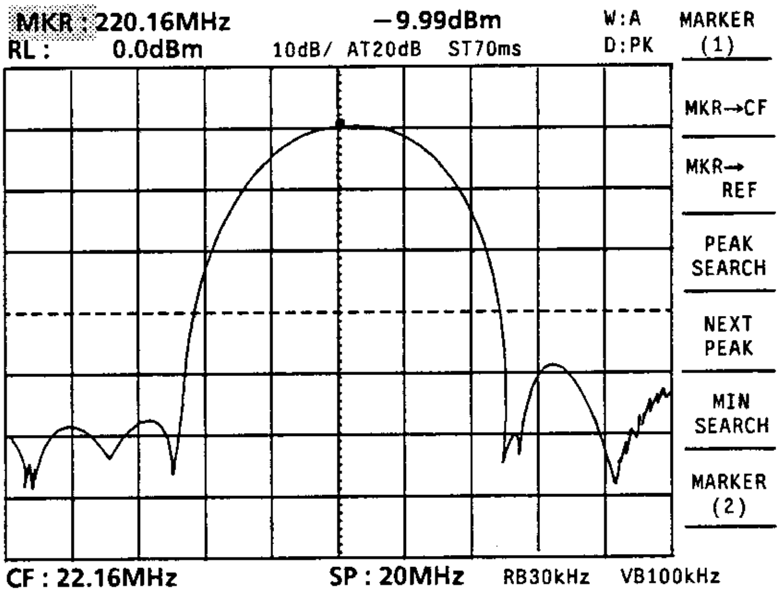


Step	Procedure
6	Magnify the signal to be measured up to an easy-to-observe waveform while pressing the span key [V]. (This includes the amplitude-frequency characteristic of the measurement system.)

(Cont.)

Step Procedure

7 Press the [PEAK→CF] key to move the maximum point of the amplitude-frequency characteristic to the center of the CRT.



8 Adjust the TRACKING ADJ volume of the tracking generator so that the maximum point in step 7 rises further.

9 Adjust the vertical position of the waveform with the tracking generator LEVEL VERNIER volume .

Measurement system calibration

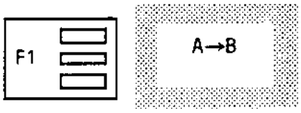
10 Remove the DUT and connect the short adapter between BNC1 and BNC2 (Fig. 6-12).

11 SHIFT [▭] SUB TRACE [5]

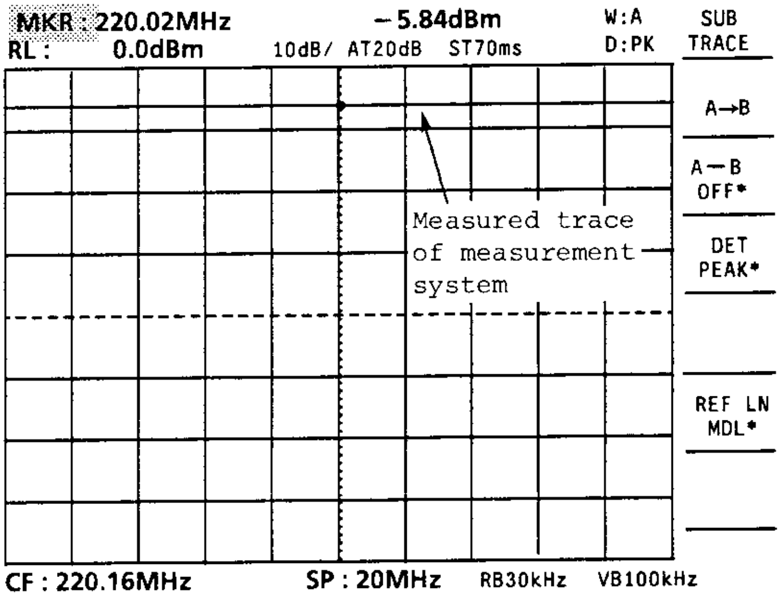
(Cont.)

Step Procedure

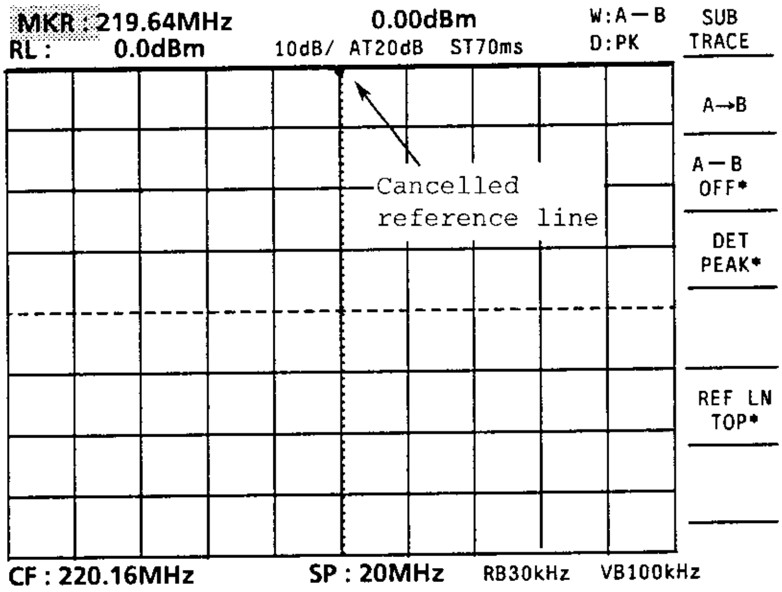
12 Store the A ch measurement system measured trace in B ch.



13 Press the [F2] key to cancel the measured trace of the measurement system so that A-B can be turned on.

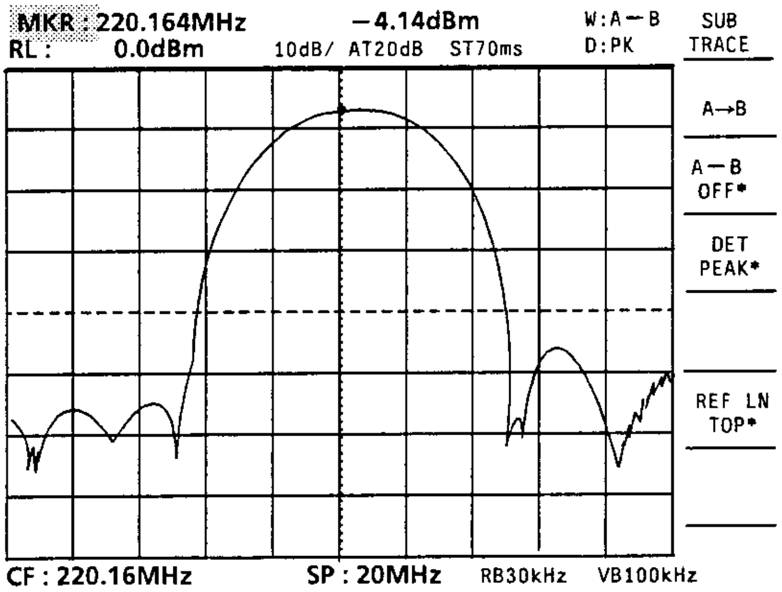


Step	Procedure
14	Press the [F5] key so that REF LN becomes TOP* to move the cancelled reference line to the top of the CRT.



(Cont.)

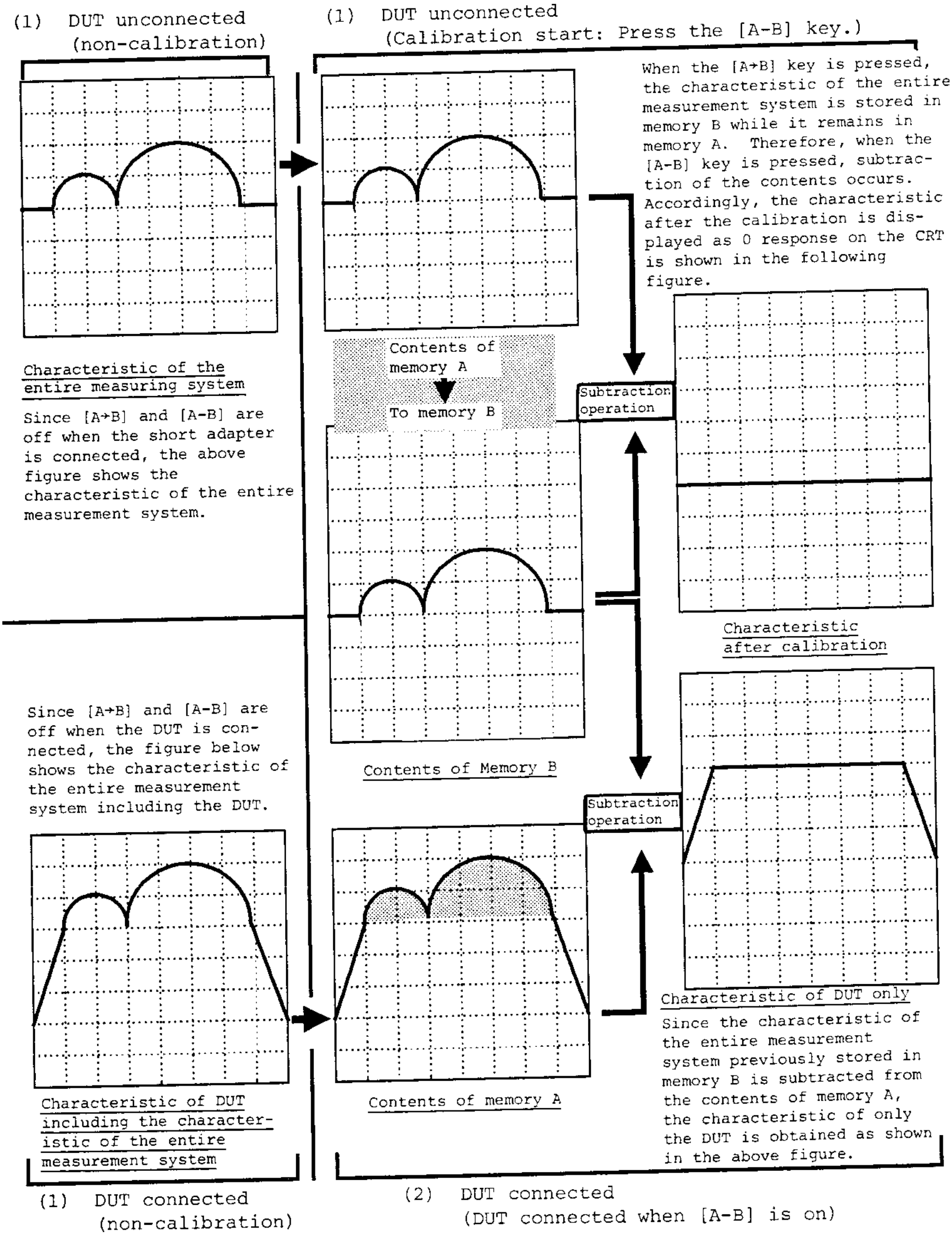
Step	Procedure
	DUT measurement start
15	Remove the short adapter and connect the DUT between BNC1 and BNC2 (Fig. 6-12).
16	Since the measurement system measured trace is already stored in B ch and A-B is turned on, the amplitude-frequency characteristic of only the DUT is read directly in A ch as shown in the figure below.



DUT amplitude-frequency characteristic excluding measurement system amplitude-frequency characteristic

6.6.2 Correction function by subtraction operation

In the figure below, the amplitude-frequency characteristic of the measurement system is exaggerated to make the measurement of the amplitude-frequency characteristic (transmission characteristic) by subtraction easy to understand. (1) shows non-calibration and (2) shows calibration.



Characteristic of the entire measuring system

Since [A→B] and [A-B] are off when the short adapter is connected, the above figure shows the characteristic of the entire measurement system.

When the [A→B] key is pressed, the characteristic of the entire measurement system is stored in memory B while it remains in memory A. Therefore, when the [A-B] key is pressed, subtraction of the contents occurs. Accordingly, the characteristic after the calibration is displayed as 0 response on the CRT is shown in the following figure.

Characteristic after calibration

Since [A→B] and [A-B] are off when the DUT is connected, the figure below shows the characteristic of the entire measurement system including the DUT.

Characteristic of DUT including the characteristic of the entire measurement system

Characteristic of DUT only

Since the characteristic of the entire measurement system previously stored in memory B is subtracted from the contents of memory A, the characteristic of only the DUT is obtained as shown in the above figure.

6.7 Field Strength Measurement

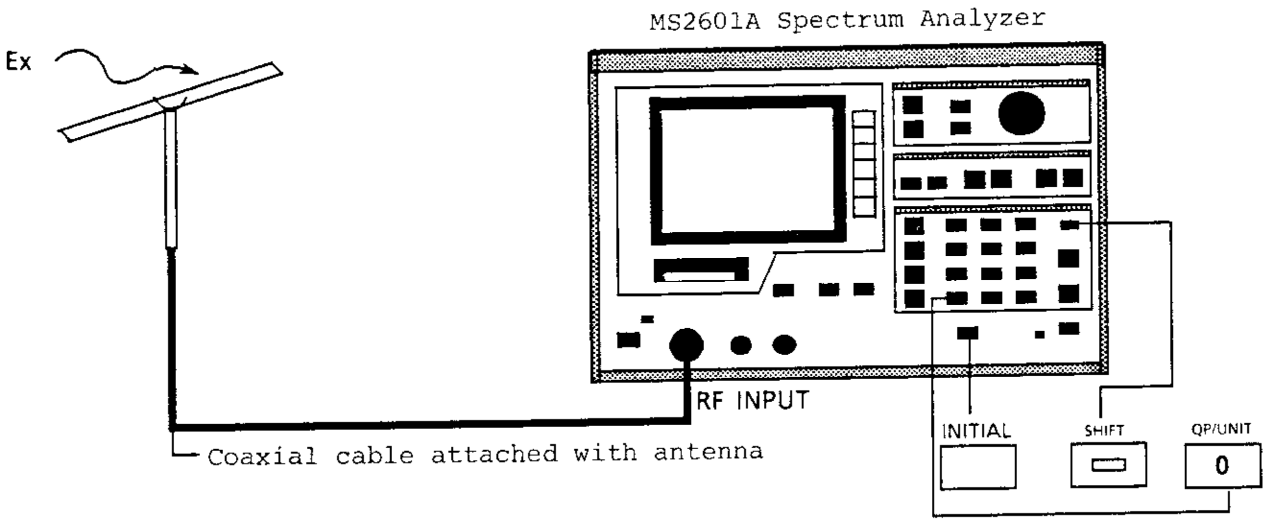


Fig. 6-13 Antenna and MS2601A Connection

To measure the field strength, connect the antenna of the peripheral equipment to the RF INPUT connector of the MS2601A by using a coaxial cable and receive the incoming wave. An undesignated antenna can be also used.

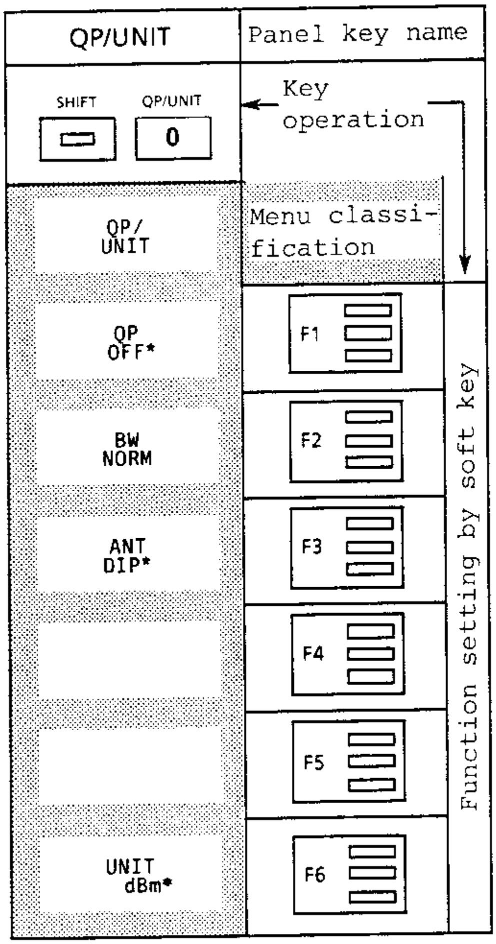
6.7.1 Direct reading of field strength using designated antenna

When the MS2601A is used with the designated antenna, it automatically changes the antenna factor and directly displays the field strength.

Step	Procedure
1	Press the [SHIFT] and [QP/UNIT] keys sequentially and open the QP/UNIT menu.
2	Select the required antenna from among the designated antennas DIP*, LOG1*, LOG2* and LOOP* by pressing the [F3] key. (For the type and item name of the antenna, see the menu corresponding to the [F3] key in the figure below)
3	Select UNIT dB/m by pressing the [F6] key. (dB/m represents dBμV/m as explained in the figure below.)
4	Currently, the received wave is accepted at full sweep. Read the frequency of the required received wave and display it at the center of the CRT by using the CF/SPAN operation.
5	Measure the field strength converted by the antenna factor at the displayed frequency from the marker level reading.

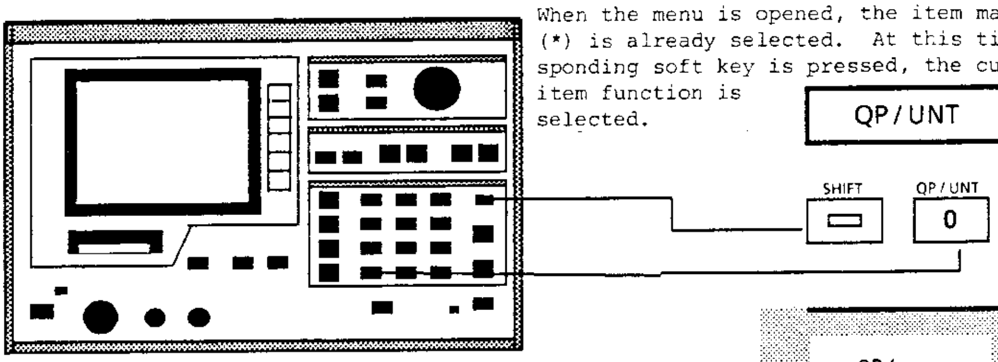
Note:

dB/m, the displayed marker level unit, represents dBμV/m. The REF LEVEL unit display is dBμV.


QP/UNIT
Panel key name
SHIFT
QP/UNIT
0
Key operation
Menu classification
QP/UNIT
QP OFF*
BW NORM
ANT DIP*
UNIT dBm*
F1
F2
F3
F4
F5
F6
Function setting by soft key

When the menu is opened, the item marked by an asterisk (*) is already selected. At this time, when the corresponding soft key is pressed, the currently-displayed item function is selected.

QP/UNT — Panel key name



Key operation

QP/ UNIT — Menu classification

Function setting by soft key

F1	QP OFF*1	Turn QP mode ON/OFF. QP cannot be turned on in BW NORM. Unless BW is NORM, QP can be turned on or off. QP OFF is selected at initialization.
F2	BW NORM*2	The NORMAL and IF 6 dB bandwidth of 200 Hz, 9 kHz, and 120 kHz can be switched. When the 6 dB bandwidth IF is selected, RB, ST, and VB become MANUAL, but when NORMAL is selected, they return to AUTO. BW (3 dB bandwidth) set by RESOLN BW is selected in NORMAL; BW NORM* is selected at initialization.
F3	ANT DIP*3	Selects antenna to be used The following antennas with antenna factors are provided to measure the field strength (dBμV/m). DIP*: Dipole antenna (MP534A/651A) LOG1*: Log-periodic antenna (MP635A) LOG2*: Log-periodic antenna (MP636A) LOOP*: Loop antenna (MP414B) USER*: User's antenna ... the antenna factor is written in the internal memory via GP-IB before measurement.
F4		No function
F5		No function
F6	UNIT dBm*4	Select the level display and entry data unit. dBm*: 0 dBm = 1 mW (50 Ω) dBμV*: 0 dBμV = 1 μV (50 Ω) = -107 dBm dBmV*: 0 dBmV = 1 mV (50 Ω) = -47 dBm V*: 1 V = +13 dBm (50 Ω) dBμe*: 0 dBμV(emf) = 1 μV (Open) = -113 dBm (50 Ω) dB/m*: dBμV/m ... The antenna factor differs with the antenna type. This dBμV/m is represented as dB/m for the marker level. The REF LEVEL unit display at this time is dBμV.

*1 OFF/ON
*2 NORM/200/9K/120K/
*3 DIP/LOG1/LOG2/LOOP/USER
*4 dBm/dBμV/dBmV/V/dBμe/dB/m

6.7.2 Measurement of field strength using undesignated antenna

There are two methods for finding the field strength: (1) calculation, and (2) direct measurement.

(1) Calculation

Generally, the field strength (EX = dBμV/m) is found from the following equation; measure it according to the a and b procedures.

$$Ex = Px + K0$$

Px: Measured value (dBμV)

K0: Antenna factor (dB)
Coefficient to convert measured voltage (dBμV) to display field strength (dBμV/m)

a. Select dBμV UNIT by pressing the [F6] key and measure the input signal in dBμV units.

b. Find K0 from the figure attached to the antenna and calculate the field strength from the above formula.

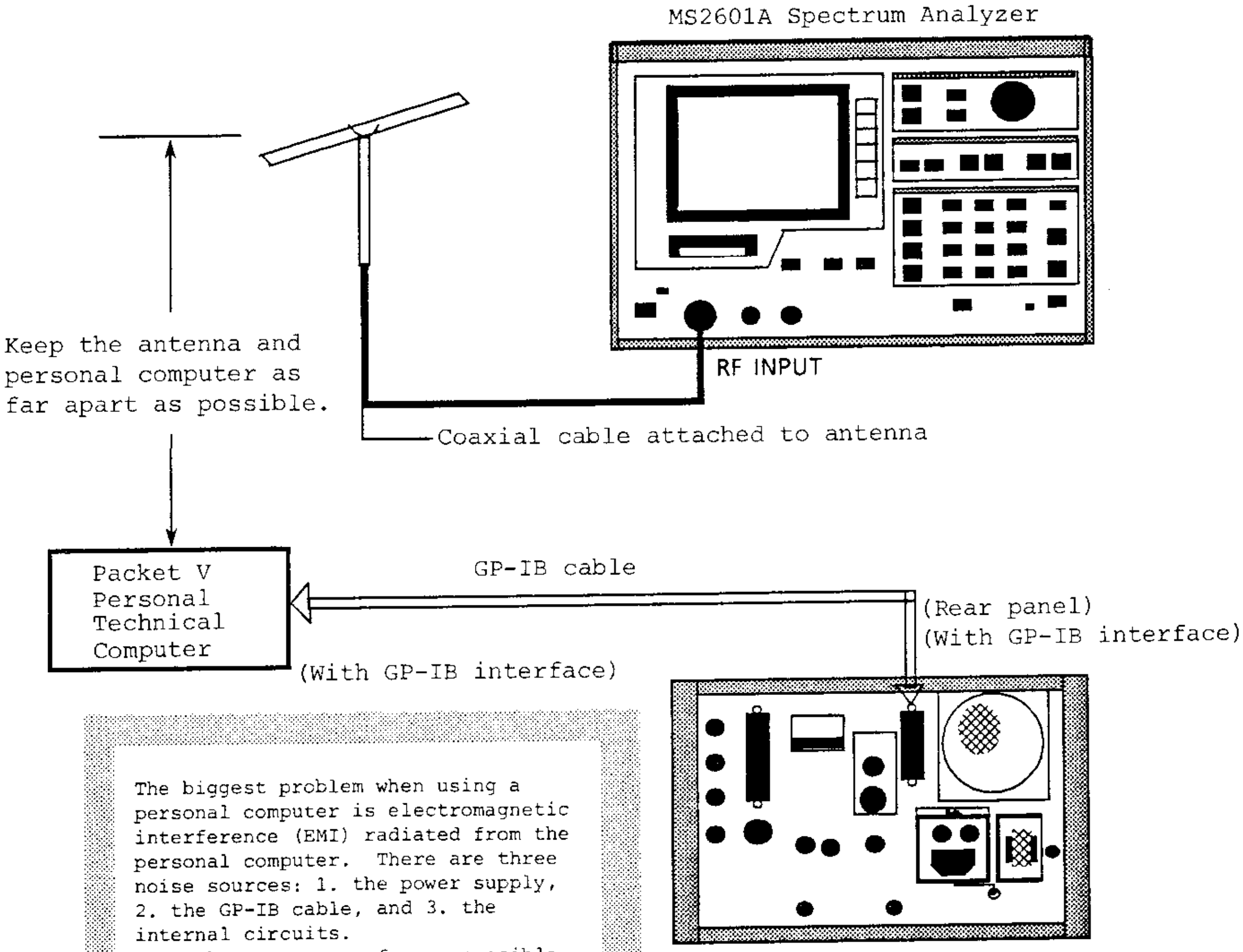
(2) Direct measurement

If the antenna factor of the user's antenna is previously written in the internal memory via GP-IB, direct measurement can be performed. Therefore, after inputting the antenna factor, unless USER* is selected by pressing the [F3] key as described in paragraph 6.7.1 step 2, measure the level of the received wave in dBμV/m units according to the procedure described in paragraph 6.7.1.

To write the antenna factor, see paragraph 11.11.

6.7.3 Note on automatic measurement of field strength

Automatic measurement of the field strength is performed under GP-IB control by a personal computer (Packet V Anritsu) used as the controller. Therefore, the precautions shown in Fig. 6-14 are necessary.



Keep the antenna and personal computer as far apart as possible.

The biggest problem when using a personal computer is electromagnetic interference (EMI) radiated from the personal computer. There are three noise sources: 1. the power supply, 2. the GP-IB cable, and 3. the internal circuits.
Keep the antenna as far as possible from the personal computer, GP-IB cable, ac power line, etc. to reduce the interference.
Also, use the antenna directivity or install the personal computer so that the effect of noise is minimized.

Fig. 6-14 Connection to Personal Computer for Automatic Field Strength Measurement

6.8 Measurement of Electromagnetic Interference (EMI)

TV video and FM audio etc. are often affected by electromagnetic noise from household vacuum cleaners or data processing equipment such as personal computers.

This noise may cause malfunctions in other equipment and can cause accidents.

It is called EMI (Electromagnetic Interference) and must be regulated.

The CISPR recommendation regulates EMI and many countries now enforce regulations based on this recommendation; the USA has the FCC standard and West Germany has the VDE standard.

The MS2601A has an electromagnetic interference measurement function conforming to the CISPR recommendation.

6.8.1 Interface wave to be measured

Electromagnetic interference is divided broadly into two categories according to the propagation route; 1. radiated interference and 2. conducted interference. Select the measured frequency range and IF bandwidth (RBW) as shown below and measure these two types of interference by using QP (Quasi-peak) detection.

Radiated interference	10 to 150 kHz (6 dB bandwidth 200 Hz) 150 kHz to 30 MHz (6 dB bandwidth 9 kHz) 30 to 1000 MHz (6 dB bandwidth 120 kHz)	This interference is transmitted through the air and interferes with the operation of other equipment.
Conducted interference	10 to 150 kHz (6 dB bandwidth 200 Hz) 150 kHz to 30 MHz (6 dB bandwidth 9 kHz)	This interference propagates through the power supply lines or connection cables and interferes with the operation of other equipment.

6.8.2 Basic specifications

The MS2601A has a quasi-peak (QP) detector conforming to the CISPR Pub 16 standard as an interference measurement function.

Also, the FCC standard Chapter 15 Section J Specification is very similar to that of CISPR Pub 16 and the MS2601A can also be used to measure EMI conforming to the FCC standard.

Table 6-5 shows the CISPR basic standard concerning QP value measurement of interference.

Table 6-5 QP Detection Standard

		CISPR standard		
Frequency range		10 to 150 kHz	150 kHz to 30 MHz	30 to 1000 MHz
6 dB bandwidth		200 Hz	9 kHz	120 kHz
Detector time constant	Charging	45 ms	1 ms	
	Discharging	500 ms	160 ms	550 ms
Mechanical (display) time constant		160 ms	160 ms	100 ms

6.8.3 Response characteristic of pulse repetition frequency

CISPR Pub 16 prescribes the response characteristic of the pulse repetition frequency. The MS2601A actual measured response characteristic of the pulse repetition frequency with preselector is shown in Fig. 6-15 (a), (b) and (c) and satisfies CISPR Pub 16.

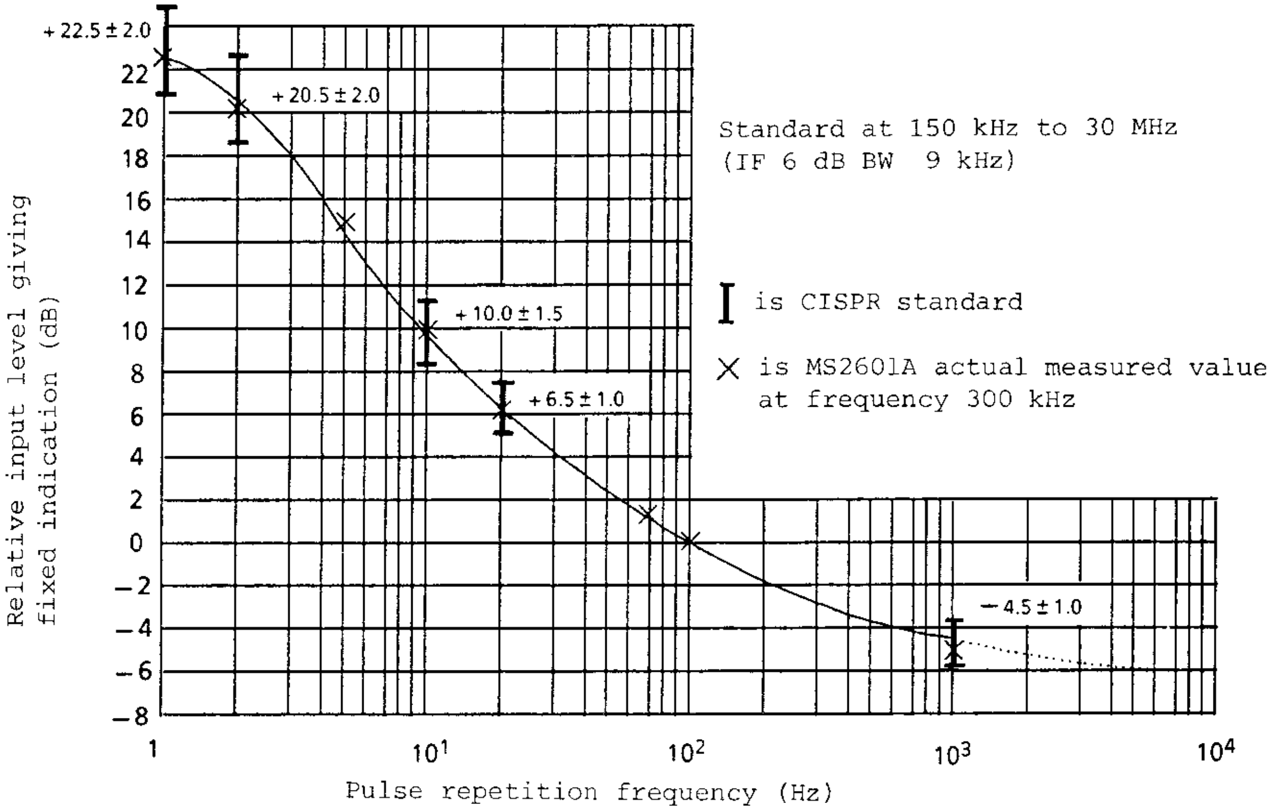


Fig. 6-15(a) Pulse Response Characteristics (150 kHz to 30 MHz Band)

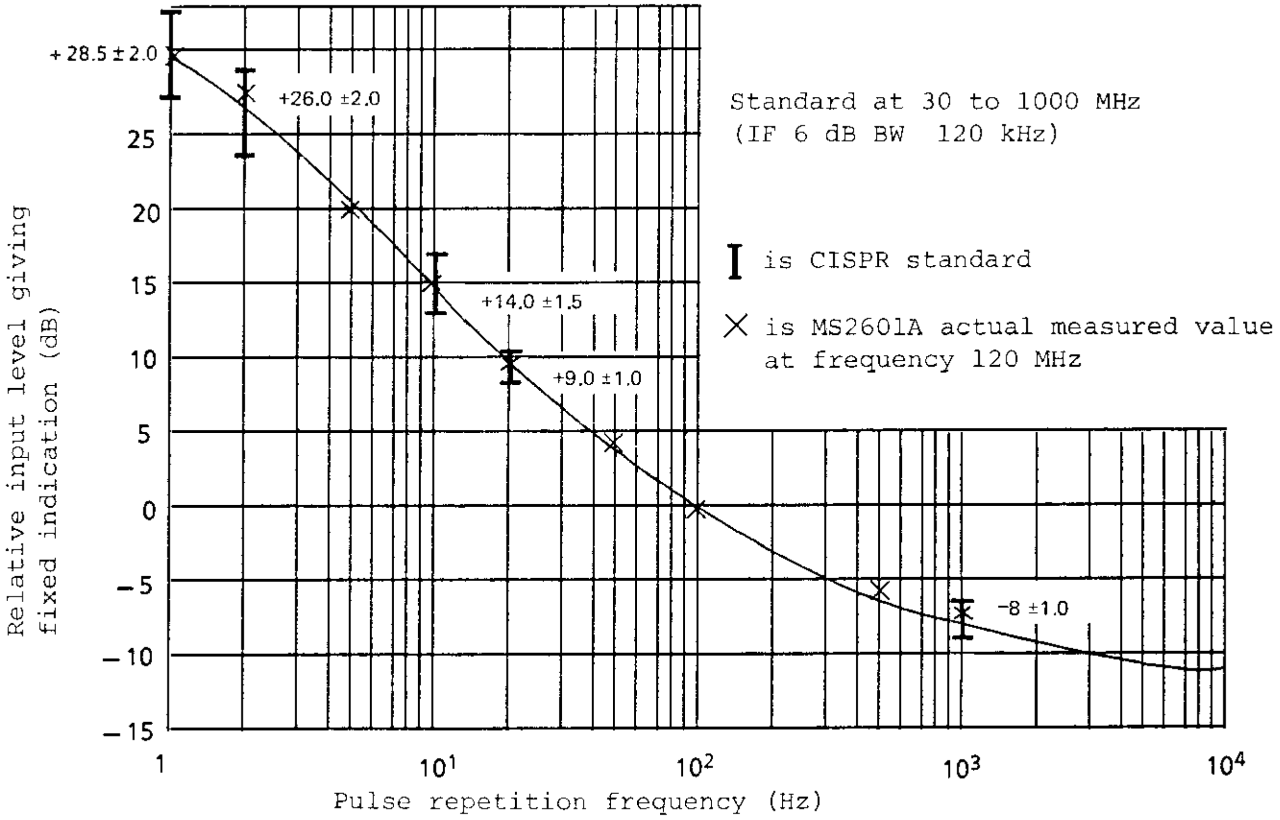


Fig. 6-15(b) Pulse Response Characteristics (30 to 1000 MHz Band)

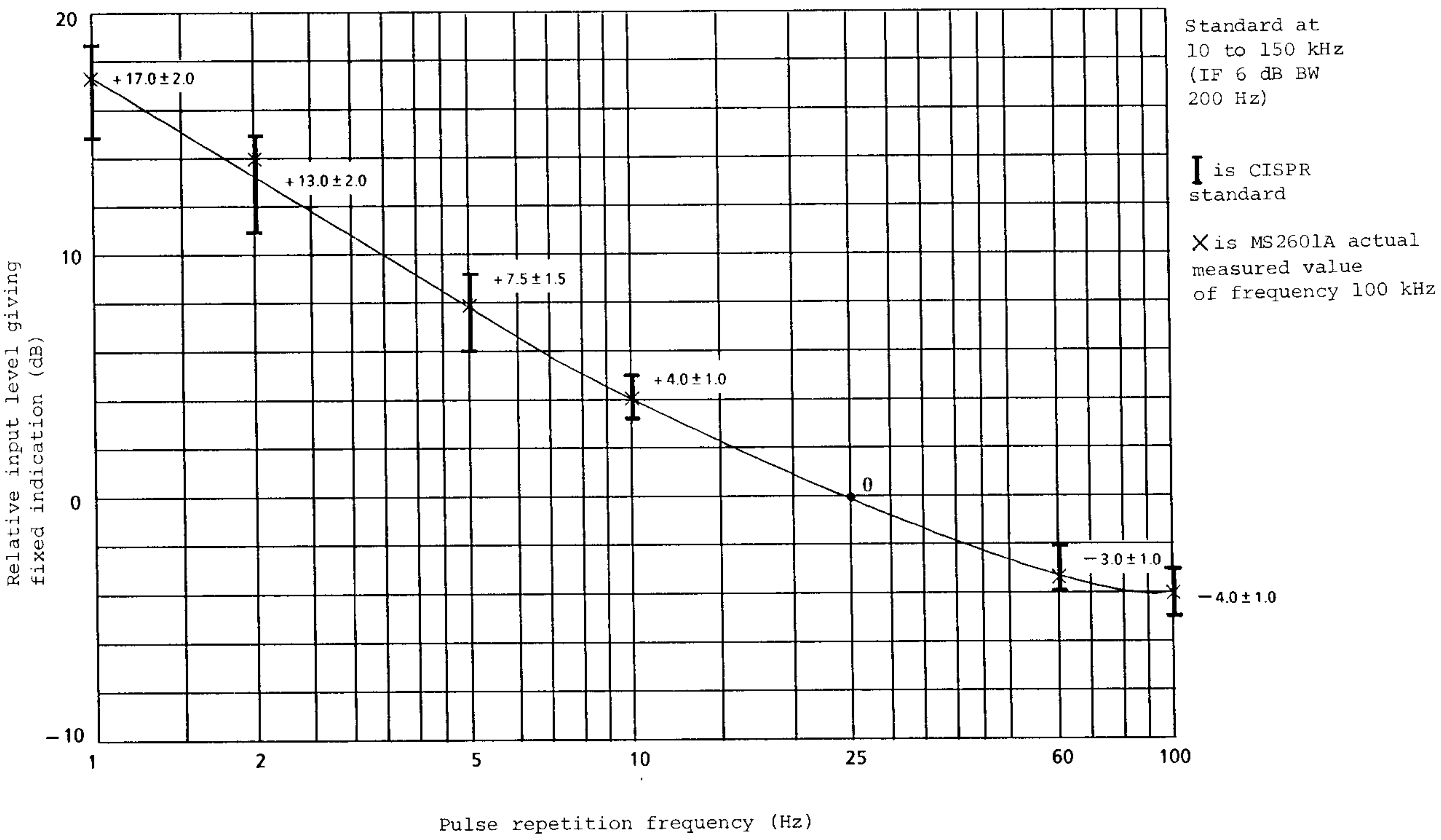


Fig. 6-15 (c) Pulse Response Curve (10 to 150 kHz Band)

6.8.4 Basics of EMI measurement

(1) Effective measurement using combination of LOG and QP (Quasi-Peak) modes

When the interference is measured, the LOG mode differs from the QP mode in the following points.

1. When the interference is measured, the QP mode measured value is smaller than the LOG mode measured value.
2. The charging and discharging time constants of the QP mode detector are large. If frequency sweep is performed, the measurement time in the QP mode is very long compared to that in the LOG mode.

For the above-mentioned reasons, for effective measurement you should measure EMI interference using the LOG mode in combination with QP mode as described in paragraph 6.8.4 (2) below.

(2) Basic measurement procedure

Step	Procedure
1	Receive the entire interference in LOG mode.
2	Receive the interference to be measured at zero span.
3	Switch to the QP mode and measure the interference.

(3) Measured value

For radiated interference, if a designated antenna is used, the interference field strength (dBμ/m) can be read directly as described in paragraph 6.8.4 (2) Step 3 above. If an undesignated antenna is used, the measured value is found as follows:

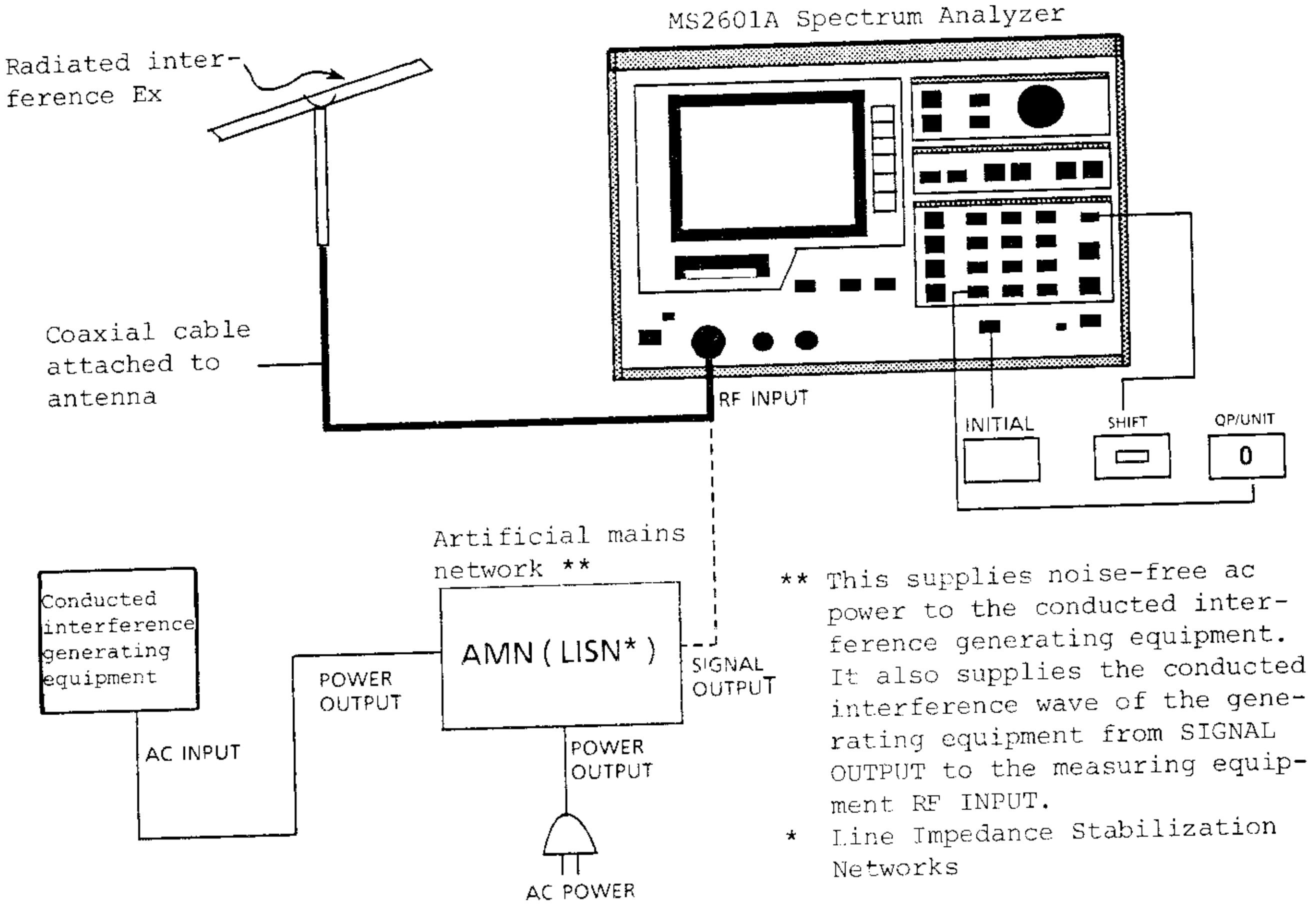
Measured value (dBμ/m) =
Value measured in paragraph 6.8.4 (2)
Step 3 - Antenna factor at measuring
frequency

If an undesignated antenna is used but the antenna factor has been previously written in the internal memory via GP-IB, direct measurement is possible.

For designated/undesignated antennas and field strength, see paragraph 6.7.

6.8.5 Interference measurement

(1) Connection to antenna or artificial mains network



** This supplies noise-free ac power to the conducted interference generating equipment. It also supplies the conducted interference wave of the generating equipment from SIGNAL OUTPUT to the measuring equipment RF INPUT.

* Line Impedance Stabilization Networks

Fig. 6-16 Connection to Antenna or Artificial Mains Network

As shown in Fig. 6-16, for radiated interference measurement, connect the antenna to the MS2601A RF INPUT. Also, for conducted interference measurement, apply the output from the Artificial Mains Network (AMN) SIGNAL OUTPUT to the RF INPUT.

(2) Measurement procedure

Measurement is performed according to the following steps.

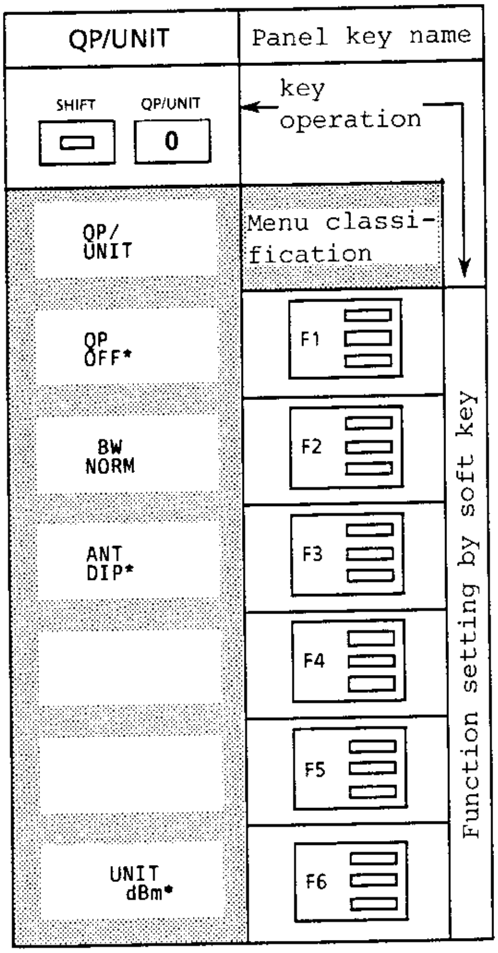
1. Interference wave reception
2. Confirmation of saturation level
3. Confirmation of input attenuator set value
4. Measures for change of input attenuator set value
5. Reading measured results

The measurement procedure for radiated interference is the same as that for conducted interference except for antenna selection and amplitude measurement unit (dBμV/m). Therefore, only the measurement procedure for conducted interference is explained.

For antenna selection and amplitude measurement unit (dBμV/m), see paragraph 6.7.

Note:

Unless the [F6] key selection is dB/m* in the QP/UNIT menu, the antenna selection corresponding to the [F3] key becomes invalid.



Step	Procedure
	Interference wave reception
1	Press the [INITIAL] key to obtain the LOG mode (SCALE 10 dB/div) and receive the entire interference wave at full sweep.
2	Press the [SHIFT] and [QP/UNIT] keys in sequence to open the QP/UNIT menu.

(Cont.)

Step	Procedure
3	Set the amplitude measurement unit to dBμV by pressing the [F6] key.

F6 dBμV*

Step	Procedure
4	Select the IF 6 dB bandwidth by pressing the [F2] key depending on the measuring frequency band.

Interference wave	Frequency band	F2		Key selection
Radiated or conducted	10 to 150 kHz	BW 200*	←	200 Hz
	150 kHz to 30 MHz	BW 9k*	←	9 kHz
Radiated	30 to 1000 MHz	BW 120*	←	120 kHz

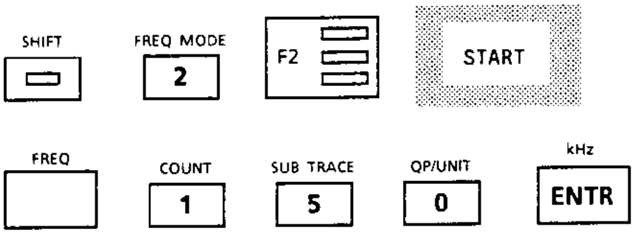
Step	Procedure
5	Press the keys [SHIFT], [SCALE], and [F2] in sequence to set SCALE to 5 dB/div (see Note at step 12).

(Cont.)

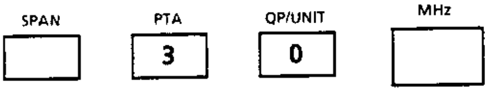
Step Procedure

6 Set the frequency band. For example, if BW is set to 9 kHz in step 4, set START to 150 kHz and SPAN to 30 MHz.

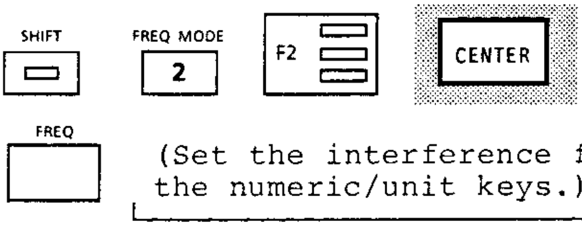
Setting START to 150 kHz



Setting SPAN to 30 MHz



7 Display the interference to be measured at the center of the CRT.



(Set the interference frequency by pressing the numeric/unit keys.)

8 Change the REF LEVEL to display the interference at the top of the CRT. In this case, one of the following three methods is used.

- After pressing the [MARKER] key, select MKR→REF by pressing the [F2] key.
- Press the [PEAK→REF] key in the SIGNAL SEARCH section.
- After pressing the [REF LEVEL] key, turn the data knob.

(Cont.)

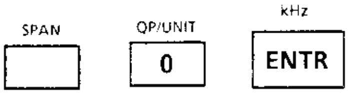
Step Procedure

Confirmation of saturation level

9 Press the [ATTEN] key and decrease the INPUT ATTEN setting by 10 dB by pressing the [F6] key.

(Example: Change 20 dB to 10 dB.) At this time, confirm that the interference gain compression at the CRT center is 1 dB or less. If there is a change of 1 dB or more, the MS2601A is causing the saturation. Remedy it by referring to paragraph 6.8.6 (1).

10 Set the frequency sweep to zero sweep (span).

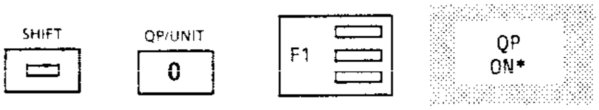


Confirmation of input attenuator set value

11 Confirm the ATTEN value displayed on the CRT.

Measurement by QP mode

12 Set QP to ON.



At QP mode ON

- The vertical scale becomes 5 dB/div.
- RESOLN BW, SWEEP TIME, and VIDEO BW are all set to MANUAL.
- VIDEO BW is turned OFF.

(Cont.)

Step	Procedure
	Note: Once the QP mode is set to ON, 5 dB/div scale is stored in a memory. When the BW is returned to NORM and set to a mode other than NORM again, 5 dB/div scale will reappear even when the QP mode is set to OFF.
13	After pressing the [REF LEVEL] key, change the REF level by turning the data knob so that the indication on the CRT is at the -40 dB line. (Adjustment to -40 dB line satisfies CISPR standard.) At this time, confirm that the input attenuator set value has not changed on the CRT.)
	When input attenuator set value changed
14	Change the input attenuator set value so that the set value is the same as that before the REF level is changed. The input level to the first-stage mixer will be the same and the mixer input level will be optimal. When the value set before changing the REF level is not obtained even if the input attenuator setting is changed, the S/N will deteriorate by a value equivalent to this difference. Pay attention to this point. The S/N must be 12 dB or more so that measurement error does not occur.
	Reading measured results
15	Read the marker point level which is the measured result.

6.8.6 Notes on EMI measurement

(1) Saturation level

If a high level external wave is measured, or the MS2601A level setting is incorrect, distortion or saturation in the MS2601A may cause measurement error.

Therefore, attention must be paid to the distortion and saturation level during interference measurement.

- ■ Use of pre-selector

  When interference is measured with a high level wave at an open site, distortion or saturation occur in the MS2601A due to excessive input even if the MS2601A level setting is correct. Since this will mask the objective signal or make identification very difficult, a measurement error will occur. At this time, a pre-selector or attenuator is required. If the pre-selector bandwidth is 6 MHz or less, the MS2601A is designed so that it will not cause saturation up to input powers of 100 mW. You should insert a pre-selector with a bandwidth of 6 MHz or less in the MS2601A input section for input powers up to 100 mW.

  For input powers of 100 mW or more, use an attenuator and decrease the input power to 100 mW or less.

- ■ Level setting

  If the input attenuator setting is inadequate, the input mixer generates distortion or saturation. Therefore, the input attenuator must be properly set.

The following methods are used to confirm the presence of saturation.

1. Change the input attenuator setting by only 10 dB in the LOG mode. If the interference level change from 10 dB is 1 dB or less at this time, there is no saturation.

   (When the MS2601A approaches the highest sensitivity [lowest level], this method cannot be used. At this time, use the following method.)

2. Insert a 1 dB step variable attenuator at the MS2601A input. A 40 dB maximum attenuation is sufficient.

   Examine the reception level when the attenuation is changed in 1 dB steps. A 1 dB compression level is the lower limit of the saturation level range.

   The MS2601A can measure correctly up to this level.

(2) Measurement of very-low level waves

The MS2601A sensitivity determines the measurement limit.

If the sensitivity is not sufficient for the CISPR standard, etc., use a pre-amplifier. In this case, note that the MS2601A saturation level decreases by an amount equivalent to the pre-amplifier gain. An S/N of 12 dB or more does not generate a measurement error.

(3) Frequency sweep and sweep time

Measurement at zero span is the best way to measure interference in the QP mode. However, measurement at repeated sweep is also possible. At this time, prolong the sweep time to measure correctly. If the sweep time is too short, a level error of several dB or more will occur. The error factors are as follows:

1. Error occurs due to an overshoot or ringing caused by the filter, etc. that determines the resolution bandwidth.
2. Since the charging and discharging time constants and the mechanical (display section) time constant of the quasi-peak (QP) detector are large, obtaining the true value requires a lot of time.
3. If the pulse repetition frequency is as low as 1 to 2 Hz, the probability of catching the pulse in the IF filter will be low. It is necessary to receive several pulses to obtain a measured value close to the true value.

Therefore, if the intensity of the interference is measured by sweeping the frequency, take the above-mentioned factors into consideration and use a long sweep time.

6.8.7 Applicable equipment (Artificial Mains Network)

Conducted EMI is measured by using an artificial mains network in the frequency band of 30 MHz or less. Anritsu has various artificial mains networks as shown below.

	MN423B*	MN424B	MN425B
Frequency range	150 kHz to 30 MHz	450 kHz to 30 MHz	10 kHz to 30 MHz
Impedance	75 Ω	50 Ω	50 Ω
Conformation	CISPR Publ	FCC Part 15	VDE 876

* A 75 Ω/50 Ω Impedance Transformer is required when the MN423B is used. The 6 dB conversion loss is suitable for measurement.

SECTION 7

PRINCIPLES OF OPERATION

This section briefly explains the principles of operation for the MS2601A Spectrum Analyzer by using block diagrams.

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7.1 Introduction

The MS2601A is a superheterodyne scanning-type spectrum analyzer.

Figure 7-1 shows a block diagram of the MS2601A.

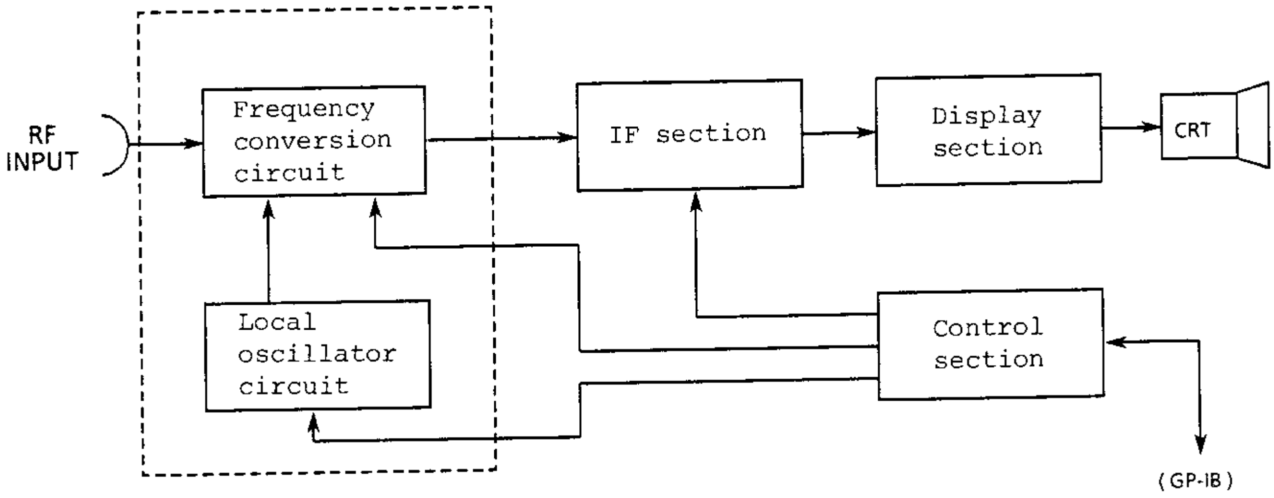

Fig. 7-1 MS2601A Block Diagram

The frequency conversion circuit mixer in the RF section converts the RF input frequency into an IF frequency. The signal detected via the IF section is transferred to the digital-storage display section. The CRT displays the signal in the frequency domain with the frequency on the horizontal axis and level on the vertical axis.

Each section is controlled by the microcomputer-based control section.

7.2 RF Section

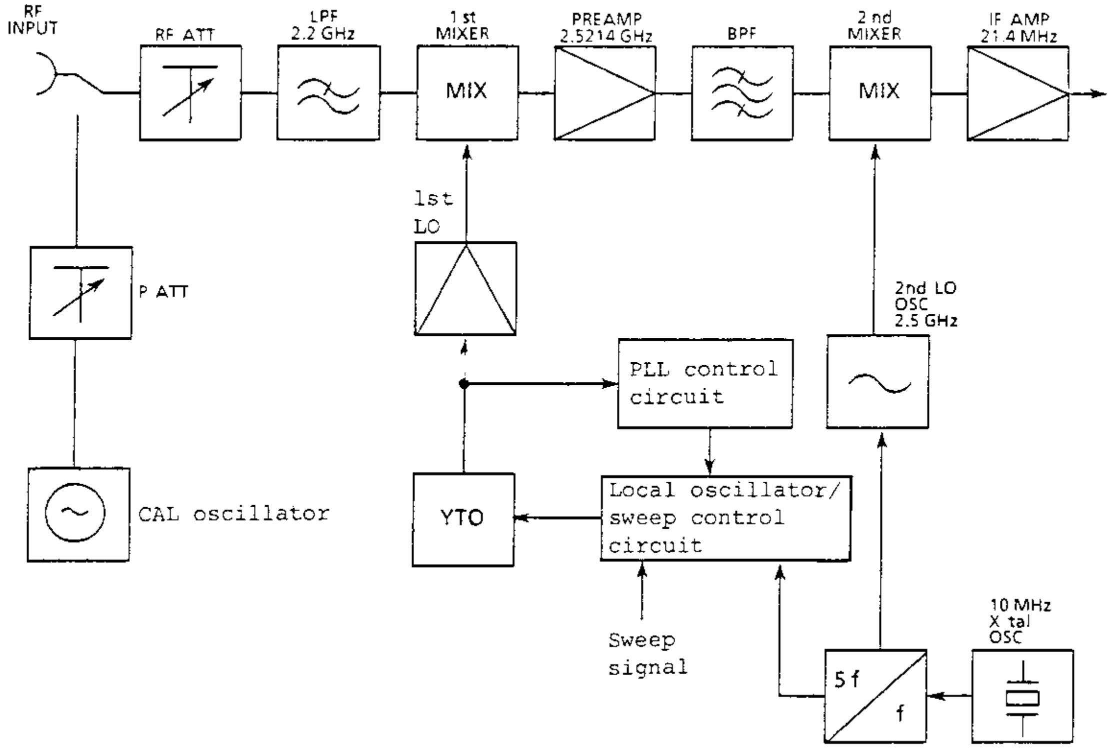

Fig. 7-2 RF Section Block Diagram

The input signal passes through the first mixer via the RF attenuator and 2 GHz low-pass filter. The first mixer mixes this signal with the first local signal (2.5314 to 4.5214 GHz) for conversion into the first IF signal of 2.5214 GHz.

The first IF signal passes through the preamplifier and band-pass filter, and is then mixed with the second local signal of 2.5 GHz by the second mixer to generate the second IF signal of 21.4 MHz.

The RF section also contains a control circuit to set or sweep the first local frequency, a Phase Locked Loop (PLL) control circuit to stabilize the first local frequency, and an amplifier and distribution circuit for the first local signal.

7.3 IF Section

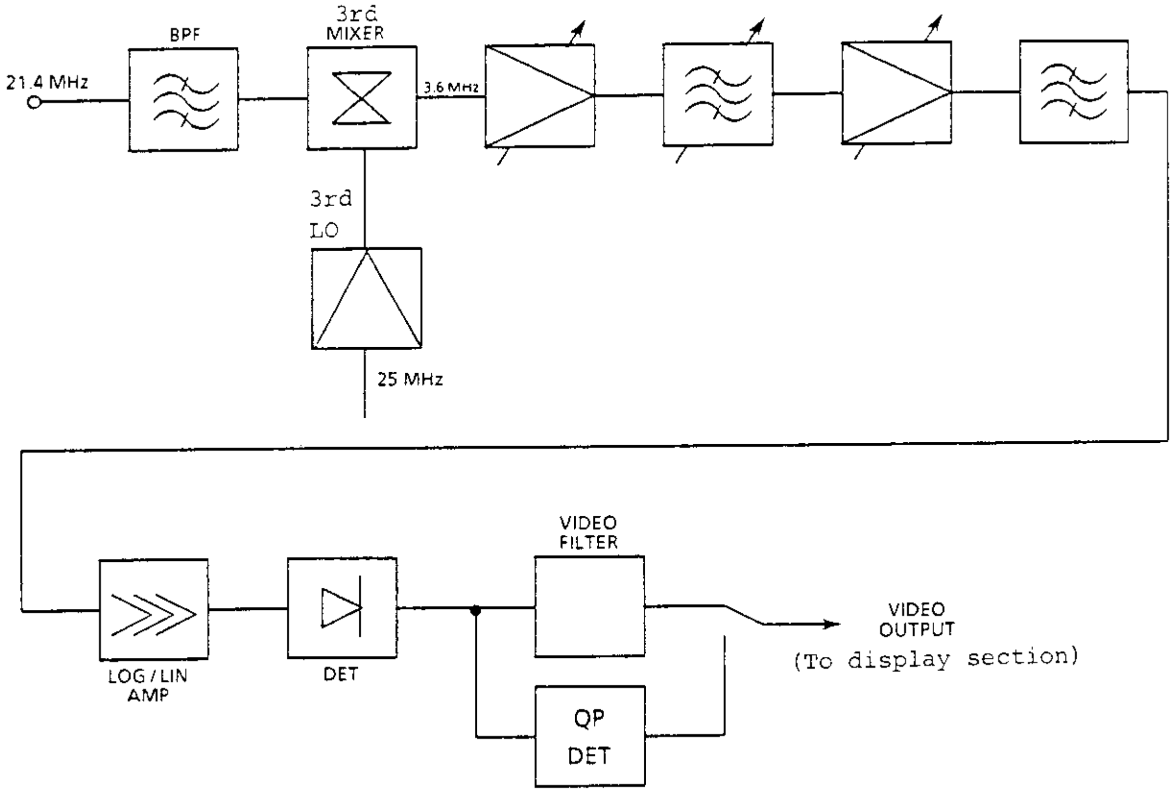

Fig. 7-3 IF Section Block Diagram

The 21.4 MHz 2nd IF signal passes through the 21.4 MHz band-pass filter and is converted into the final 3rd IF signal of 3.6 MHz by the third mixer. The 3.6 MHz 3rd IF signal passes through a four crystal and LC variable bandwidth filters, and three IF gain variable amplifiers (where the bandwidth and IF gain are determined).

The output signal passes through the log/lin amplifier and is detected.

After being detected, the signal is sent to the display section through the video amplifier or QP detector (selected in QP detection mode).

7.4 Display and Control Sections

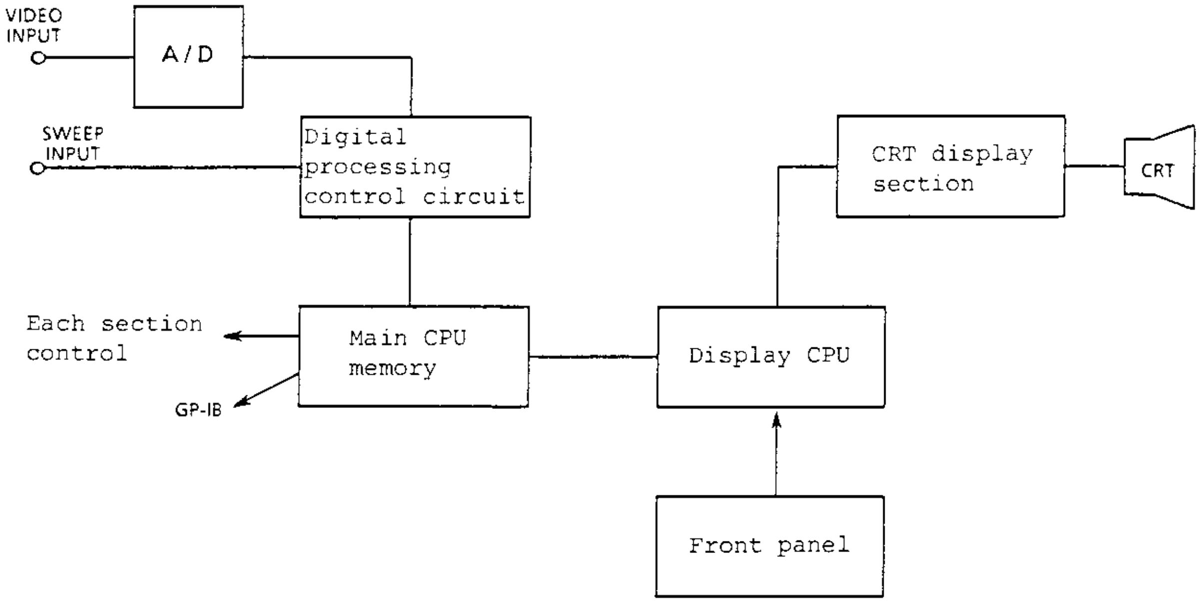

Fig. 7-4 Display and Control Section Block Diagram

The video signal sent from the IF circuit is converted from an analog into a digital signal when it enters the digital storage processing circuit. The CRT display is controlled by the CRT control IC according to determinations made by the display CPU.

The hardware of each section and the digital processing circuit are set under front panel control through the main CPU.

SECTION 8

GP-IB GENERAL

This section outlines the GP-IB functions of the MS2601A Spectrum Analyzer, and describes the related specifications (interface functions and device messages).

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8.1 Introduction

The MS2601A Spectrum Analyzer has a GP-IB interface. The GP-IB (General-Purpose Interface Bus) is a standard interface used for instruments that conform to IEEE-488 (Institute of Electrical and Electronic Engineers) and IEC-625 (International Electrotechnical Commission).

By using the GP-IB, operational functions of the front panel, except for the POWER switch, INTENSITY knob, PMC management, and the GP-IB address setting, can be controlled.

In addition, the marker point frequency and level, spectrum memory contents, and set values can be read.

When the Personal Test Automation (PTA) option is added, the CRT can be used as a personal computer terminal for character and graphics display.

Note that a flexible system can be constructed without using a personal computer.

This operation manual explains sample programs that run on the ANRITSU Packet-series Personal Technical Computers (IIe/III/IIIs/V).

Request "GP-IB Basic Guide" from Anritsu Corp. for fundamentals on the GP-IB.

8.2 GP-IB Specifications

8.2.1 GP-IB interface functions

Table 8-1 lists the GP-IB interface functions of the MS2601A.

Table 8-1 MS2601A GP-IB Interface Functions

Symbol	Interface function	Remarks
SH1	All source handshake functions provided	The data can be sent.
AH1	All accept handshake functions provided	The data can be received.
T6	Basic talker function provided Serial poll function provided Talk-only function not provided MLA talker release function provided	The talker function can be used.
L4	Basic listener function provided Listen-only function not provided MTA listener release function provided	The listener function can be used.
TE0	Address extension talker function not provided	Neither talker nor listener can be extended to a secondary address.
LE0	Address extension listener function not provided	
SR1	All service request functions provided	Service requests can be sent.
RL1	All remote/local functions provided	The local lockout function can be used.
PP0	Parallel poll function not provided	————
DC1	Device clear function provided	All functions are initialized as if the [INITIAL] key had been pressed.

Table 8-1 MS2601A GP-IB Interface Functions (Cont.)

Symbol	Interface function	Remarks
DT1	Device trigger function provided	The start of sweeping can be controlled.
C0	Control function not provided	The controller function cannot be used.

- The standard composition does not have a controller function. However, the optional 01 PTA function can be added to provide the system controller function.

  Refer to the PTA operation manual for details.

8.2.2 Device message list

Table 8-2 Device Message List

Parameter			Device message		
	Item	Control item	Control	Data request	Sent from talker
FUNCTION	FREQUENCY	CENTER (CF)	CNF△f	CNF?	CNF△f
		START	STF△f f= 0 Hz to 2210 MHz	STF?	STF△f
		SPAN	SPF△f f= 0 Hz, 10 kHz to 2200 MHz <Ex.> CF=1 MHz can be set in any of the following. (1)CNF 1MZ (2)CNF 1000KZ (3)CNF 1000000HZ (4)CNF 1000000	SPF?	SPF△f
		STEP SIZE	FSS△f	FSS?	FSS△f f: Ten-character fixed format <Data example> For CF = 1 MHz, CNF 0001000000
		STEP UP	FUP	—	
		STEP DOWN	FDN	—	
	MARKER	NORMAL	MKR△0	MKR?	MKR△0
		ΔMKR	MKR△1	MKR?	MKR△1
		MKR OFF	MKR△2	MKR?	MKR△2
		MKR→CF	MKR△3	—	—
		MKR→REF	MKR△4	—	—
	MARKER SEARCH FUNCTION	PEAK	MKS△0	—	—
		NEXT PEAK	MKS△1	—	—
		MINIMUM	MKS△2	—	—
		LEFT PEAK	MKS△3	—	—
		CENTER PEAK	MKS△4	—	—
		RIGHT PEAK	MKS△5	—	—
		LEFT MIN	MKS△6	—	—
		CENTER MIN	MKS△7	—	—
		RIGHT MIN	MKS△8	—	—
	MARKER POSITION	ZONE	MKZ△P	MKZ?	MKZ△P
		REFERENCE	—	RMK?	RMK△P
		CURRENT	— P: 0 to 500	CMK?	CMK△P P: 0 to 500

Notes:
1. △ in this table indicates a space. (This also applies to subsequent sections.)
   Do not confuse this symbol with delta (Δ).
2. The frequency units are abbreviated as HZ for Hz, KZ for kHz, and MZ for MHz. Hz is assumed if no unit is specified.
3. Ø in this table indicates zero.

Table 8-2 Device Message List (Cont.)

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
FUNCTION	ZONE WIDTH	NAR SPOT WIDE	MKW△0 MKW△1 MKW△2	MKW? MKW? MKW?	MKW△0 MKW△1 MKW△2 P:0 to 500
	ZONE SWEEP	ZONE SWEEP OFF ON	PSW△0 PSW△1	PSW? PSW?	PSW△0 PSW△1
	REF LEVEL	REF LEVEL	RLV△ℓ ℓ= -100.0 to +20.0 (dBm) The unit follows the UNIT setting (μV for V).	RLV?	RLV△ℓ The unit follows the UNIT setting (μV for V).
	UNIT	dBm dBμV dBmV V dBμV(emf) dBμV/m	UNT△0 UNT△1 UNT△2 UNT△3 UNT△4 UNT△5	UNT? UNT? UNT? UNT? UNT? UNT?	UNT△0 UNT△1 UNT△2 UNT△3 UNT△4 UNT△5
SIGNAL SEARCH	PEAK	PEAK→CF PEAK→REF	PCF PRL		
	SPAN	SPAN UP SPAN DOWN	SPU SPD		
	SCROLL	LEFT RIGHT	SCR△0 SCR△1	— —	— —

Table 8-2 Device Message List (Cont.)

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
MENU	**RESOLUTION BANDWIDTH**	RES BW (MANUAL)	ARB△0	ARB?	ARB△0
		RES BW (AUTO)	ARB△1	ARB?	ARB△1
		RESOLN BW			
		30 Hz	RBW△0	RBW?	RBW△0
		100 Hz	RBW△1	RBW?	RBW△1
		300 Hz	RBW△2	RBW?	RBW△2
		1 kHz	RBW△3	RBW?	RBW△3
		3 kHz	RBW△4	RBW?	RBW△4
		10 kHz	RBW△5	RBW?	RBW△5
		30 kHz	RBW△6	RBW?	RBW△6
		100 kHz	RBW△7	RBW?	RBW△7
		300 kHz	RBW△8	RBW?	RBW△8
		1 MHz	RBW△9	RBW?	RBW△9
		200 Hz	RBW△10	RBW?	RBW△10
		9 kHz	RBW△11	RBW?	RBW△11
		120 kHz	RBW△12	RBW?	RBW△12
	ATTENUA-TION	ATTEN (MANUAL)	AAT△0	AAT?	AAT△0
		ATTEN (AUTO)	AAT△1	AAT?	AAT△1
		ATTEN			
		0 dB	ATT△0	ATT?	ATT△0
		10 dB	ATT△1	ATT?	ATT△1
		20 dB	ATT△2	ATT?	ATT△2
		30 dB	ATT△3	ATT?	ATT△3
		40 dB	ATT△4	ATT?	ATT△4
		50 dB	ATT△5	ATT?	ATT△5
	SWEEP TIME	SWP TIME (MANUAL)	AST△0	AST?	AST△0
		SWP TIME (AUTO)	AST△1	AST?	AST△1
		SWEEP TIME	SWT△t t = 50 to 100000 (ms)	SWT?	SWT△t t in ms units
	CALIBRA-TION	CAL			
		ALL	CAL△0	—	—
		FREQ	CAL△1	—	—
		LEVEL 1	CAL△2	—	—
		LEVEL 2	CAL△3	—	—
	CORREC-TION DATA	OFF	CDT△0	CDT?	CDT△0
		ON	CDT△1	CDT?	CDT△1

Table 8-2 Device Message List (Cont.)

	Parameter		Device message		
	Item	Control item	Control	Data request	Sent from talker
MENU	RESPONSE DATA	OFF	CRE△0	CRE?	CRE△0
		ON	CRE△1	CRE?	CRE△1
	VIDEO BANDWIDTH	VID BW (MANUAL)	AVB△0	AVB?	AVB△0
		VID BW (AUTO)	AVB△1	AVB?	AVB△1
		VIDEO BW			
		1 Hz	VBW△0	VBW?	VBW△0
		10 Hz	VBW△1	VBW?	VBW△1
		100 Hz	VBW△2	VBW?	VBW△2
		1 kHz	VBW△3	VBW?	VBW△3
		100 kHz	VBW△4	VBW?	VBW△4
		100 kHz	VBW△5	VBW?	VBW△5
		OFF	VBW△6	VBW?	VBW△6
	SCALE	SCALE			
		1 dB/div	SCL△0	SCL?	SCL△0
		2 dB/div	SCL△1	SCL?	SCL△1
		5 dB/div	SCL△2	SCL?	SCL△2
		10 dB/div	SCL△3	SCL?	SCL△3
		LIN	SCL△4	SCL?	SCL△4
	TRIGGER	TRIG			
		FREE	TRG△0	TRG?	TRG△0
		VIDEO	TRG△1	TRG?	TRG△1
		LINE	TRG△2	TRG?	TRG△2
		EXT	TRG△3	TRG?	TRG△3
		SINGLE	TRG△4	TRG?	TRG△4
		START	TRG△5	TRG?	TRG△5
	A ch WRITE/ READ	WRITE OFF	AWR△0	AWR?	AWR△0
		WRITE ON	AWR△1	AWR?	AWR△1
		WRITE MODE			
		NORMAL	AMD△0	AMD?	AMD△0
		MAX HOLD	AMD△1	AMD?	AMD△1
		AVER	AMD△2	AMD?	AMD△2
		READ OUT			
		OFF	ARD△0	ARD?	ARD△0
		ON	ARD△1	ARD?	ARD△1

Table 8-2 Device Message List (Cont.)

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
MENU	B ch WRITE/ READ	WRITE OFF WRITE ON	BWR△0 BWR△1	BWR? BWR?	BWR△0 BWR△1
		WRITE MODE NORMAL MAX HOLD AVER	BMD△0 BMD△1 BMD△2	BMD? BMD? BMD?	BMD△0 BMD△1 BMD△2
		READ OUT OFF ON	BRD△0 BRD△1	BRD? BRD?	BRD△0 BRD△1
	DET MODE	PEAK SAMPLE DIP	DET△0 DET△1 DET△2	DET? DET? DET?	DET△0 DET△1 DET△2
	AVERAGE RATE	AVER RATE 4 8 16 32	AVR△0 AVR△1 AVR△2 AVR△3	AVR? AVR? AVR? AVR?	AVR△0 AVR△1 AVR△2 AVR△3
	SUB TRACE	A→B	ATB	———	———
		A−B OFF ON	AMB△0 AMB△1	AMB? AMB?	AMB△0 AMB△1
		REF LINE TOP MDL BOT	RLN△0 RLN△1 RLN△2	RLN? RLN? RLN?	RLN△0 RLN△1 RLN△2
	COUNT	COUNT OFF COUNT ON RESOLUTION 1 Hz 10 Hz 100 Hz	MKC△0 MKC△1 CRS△0 CRS△1 CRS△2	MKC? MKC? CRS? CRS? CRS?	MKC△0 MKC△1 CRS△0 CRS△1 CRS△2
	QUASI PEAK	QP OFF QP ON	QPD△0 QPD△1	QPD? QPD?	QPD△0 QPD△1

Table 8-2 Device Message List (Cont.)

	Parameter		Device message		
	Item	Control item	Control	Data request	Sent from talker
MENU	ANTENNA	DIPOLE LOG-PERI(1) LOG-PERI(2) LOOP USER	ANT△0 ANT△1 ANT△2 ANT△3 ANT△4	ANT? ANT? ANT? ANT? ANT?	ANT△0 ANT△1 ANT△2 ANT△3 ANT△4
	FREQ MODE	FREQ MODE CF/SPAN START/SPAN	FRQ△0 FRQ△1	FRQ? FRQ?	FRQ△0 FRQ△1
	SINGLE SWEEP	Single sweep execution Sweep in progress Sweep terminated	SWP	SWP? SWP?	SWP△0 SWP△1
	UNCAL	UNCAL display OFF ON	UNC△0 UNC△1	UNC? UNC?	UNC△0 UNC△1
		UNCAL status NORMAL UNCAL	—— ——	UCL? UCL?	UCL△0 UCL△1
	TITLE	TITLE	**TEN∆X,Y,text** (X=0 to 41 Y= 0 to 4)	——	——
		TITLE DISPLAY OFF ON	TTL∆0 TTL∆1	TTL? TTL?	TTL∆0 TTL∆1
SAVE/RECALL	INITIAL	INITIAL	INI	——	——
	SAVE	SAVE	SVM△m (m = 1 to 48)	——	——
	RECALL	RECALL	RCM△m (m = 0 to 48) m = register number from 1 to 99 (m is limited by the PMC capacity and is 1 to 12 for 32 kbyte).	——	——
	LIST	LIST REG	LST△m (m = 0 to 48)	——	——
		LIST CURRENT	LST△97	——	——
		LIST ALL	LST△98	——	——
		RETERN	LST△99	——	——

Table 8-2 Device Message List (Cont.)

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
PMC	PMC ERROR	**NO ERROR (PMC Pass)**		PER?	0
		NO FORMAT		PER?	1
		DIFFERENT FORMAT		PER?	2
		WRITE PROTECT		PER?	3
		BAD PMC		PER?	4
		NO PMC		PER?	5
		MEMORY OVER		PER?	6
		NOT FIND FILE		PER?	7
		DIFFERENT TYPE		PER?	8
SPECTRUM DATA	A ch	Memory A	XMA△P	XMA?△P0,P1	b
	B ch	Memory B	XMB△P	XMB?△P0,P1	b
			P: Start address from 0 to 500 The next numeric send data is input from the start address.	P0: Send start address from 0 to 500 P1: Amount of send data from 1 to 501	b: Two-byte binary data or seven-character ASCII data <Ex.> -123.56
	ASCII/ BINARY *1	ASCII data	BIN△0	—	—
		BINARY data	BIN△1	—	—
MARKER DATA		FREQ	—	MKF?	b b: 11-character ASCII data (unit: Hz) <Ex.> +2200000000 Frequency difference when ΔMKR
		LEVEL	—	MKL?	b b: Seven-character (Ten-character for V [in units of nV]) ASCII data Level difference when ΔMKR
SRQ		SRQ OFF	SRQ△0	SRQ?	SRQ△0
		SRQ ON	SRQ△1	SRQ?	SRQ△1
TERMINATOR		LF	TRM△0	—	—
		CR	TRM△1	—	—
		CR/LF	TRM△2	—	—

Note: *1 Mode is set automatically to ASCII data mode when the message is executed.

Table 8-2 Device Message List (Cont.)

Parameter		Device message		
Item	Control item	Control	Data request	Sent from talker
USER ANTENNA	USER ANTENNA CORR DATA (FREQ)	CD6△P P: Start address from 0 to 149 Up to 150 frequency data items (ASCII code) are received next. Data: Positive integer in 1 kHz units Data 0 should be input to address 0, and 3000000 to address 149.	CD6?△P0,P1 P0: Start address from 0 to 149 P1: Amount of send data	b b: Four-byte binary data
	USER ANTENNA CORR DATA (FACTOR)	CD7△P P: Start address from 0 to 149 Up to 150 antenna factor data items (ASCII code) are received next. Data: Signed integer in 0.1 dB units	CD7?△P0,P1 P0: Start address from 0 to 149 P1: Amount of send data	b b: Two-byte binary data or ASCII code

Table 8-3 GP-IB Suffix Codes

	Suffix unit	Suffix code	Remarks
Frequency	MHz kHz Hz	MZ KZ HZ	The MS2601A suffix codes only indicate frequency units. Hz is assumed if no unit is specified.

Table 8-4 Status Message Line Allocation

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Line Value	DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1
1	X	Service requested	Error (abnormal status)	Sweep end	X	CAL error	PMC error	ILLEGAL COMMAND
0	X	Service not requested	Normal status	X	X	X	X	X
Weight	128	64	32	16	8	4	2	1
Sending	0	1/0	1/0	1/0	0	1/0	1/0	1/0

Note: "X" in this table indicates that the bit is not used.

When Bit 5 = 1 (error status), one of the following three statuses occurs:

ILLEGAL COMMAND: Bit 0 = 1
PMC error: Bit 1 = 1
CAL error: Bit 2 = 1

SECTION 9

PANEL CONTROL FOR GP-IB

This section explains how to connect a GP-IB cable to the rear panel, and how to operate the [LOCAL] key of the front panel and [GP-IB] key of the MENU section.

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9.1 Preparing for GP-IB Use

For GP-IB remote control, connect a GP-IB cable and set the GP-IB address.

Figure 9-1 shows the location of the GP-IB cable connector on the panel.

The GP-IB cable must only be connected before turning the power on for the reason explained below.

9.1.1 Connecting and disconnecting GP-IB cable

CAUTION

When connecting or disconnecting the GP-IB cable, set the POWER switch to OFF and unplug the power cable. This is because the signal common line may be accidently disconnected before the other lines are disconnected. If the power is on when this happens, ac leakage voltage may damage the IC and other interface unit components.

9.1.2 Address setting conditions

The set GP-IB address of the MS2601A is read immediately after turning the power on.

The front panel keys are used to set the GP-IB address under the following conditions.

1. Immediately after turning power on.
2. In local state (The local state is initially set at power-on.)

If the MS2601A is in the remote state (REMS), press the [LOCAL] key to switch it to local (Fig. 9-2).

If the MS2601A is in the remote with lockout state (RWLS), execute the program to switch it to local.

See paragraph 9.2.2 for details on how to make these settings.

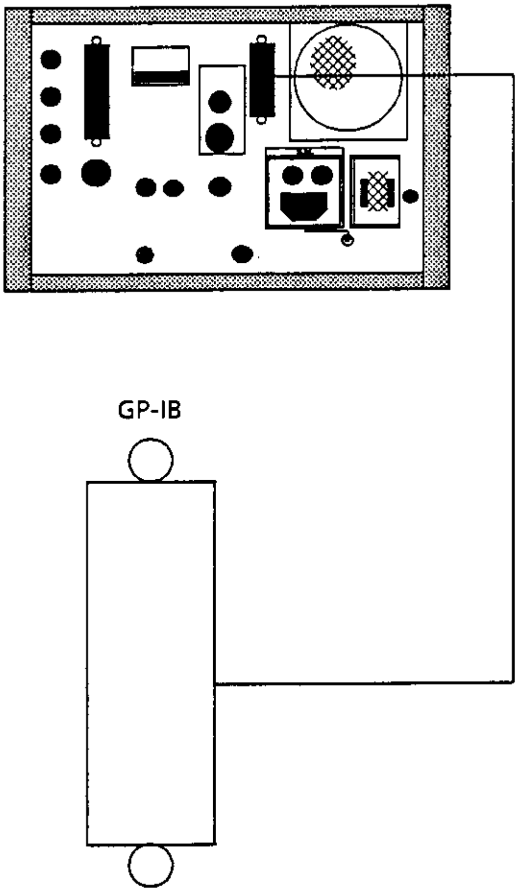


Fig. 9-1 GP-IB Cable Connector

9.2 [LOCAL] Key and [GP-IB] Key Operations

9.2.1 [LOCAL] key (LOCAL)

If the remote state is specified in the GP-IB control mode, the REMOTE lamp (left of the [LOCAL] key shown in Fig. 9-2) remains on for as long as the GP-IB of the MS2601A is being remotely controlled. The front panel keys cannot be used in this state. If the key functions must be used manually, press the [LOCAL] key to switch REMOTE to LOCAL, and to turn the REMOTE lamp off.

Note:

If the MS2601A is in the Remote With Lockout State (RWLS), the local state cannot be set by pressing the [LOCAL] key. Execute a program to release the lockout state, then press the [LOCAL] key to return to the local state.

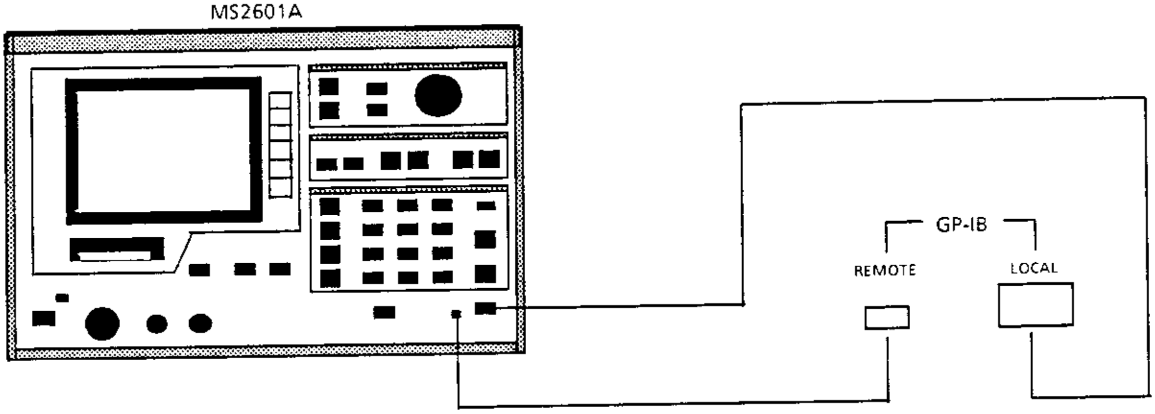
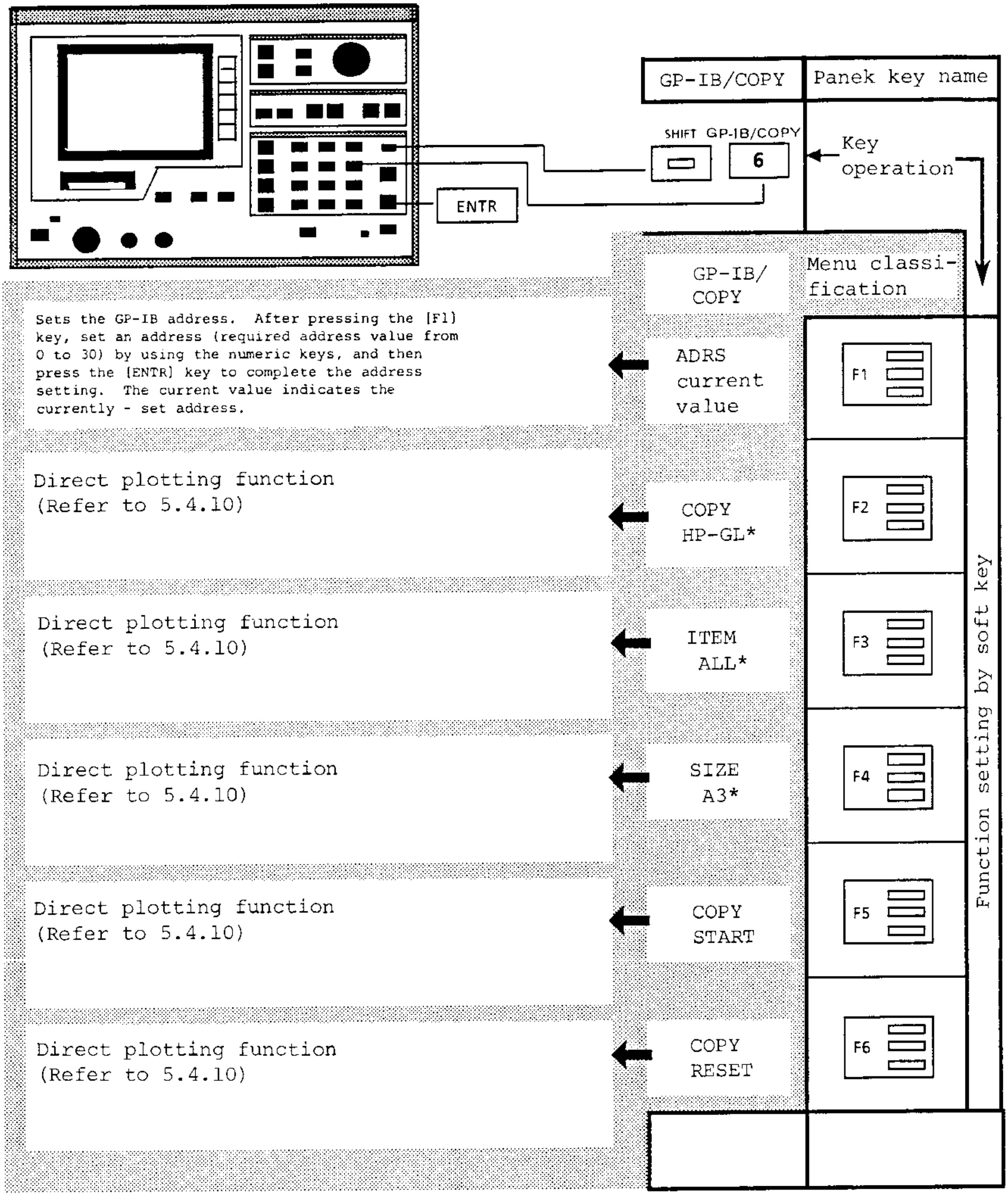


Fig. 9-2 [LOCAL] Key and REMOTE Lamp

9.2.2 [GP-IB] key (GP-IB/COPY)

When the [SHIFT] and [GP-IB/COPY] keys in the front panel MENU section are pressed in this order, the following GP-IB/COPY menu is displayed on the CRT. Set GP-IB address by pressing the soft key [F1].



Sets the GP-IB address. After pressing the [F1] key, set an address (required address value from 0 to 30) by using the numeric keys, and then press the [ENTR] key to complete the address setting. The current value indicates the currently - set address.

Direct plotting function (Refer to 5.4.10)

Direct plotting function (Refer to 5.4.10)

Direct plotting function (Refer to 5.4.10)

Direct plotting function (Refer to 5.4.10)

Direct plotting function (Refer to 5.4.10)

Fig. 9-3 GP-IB Menu

9.2.3 Checking and changing address (ADRS)

Only the [SHIFT] and [GP-IB/COPY] keys can be used to check the address.

To set a new address, press the [F1] key.

Notes:

1. The address cannot be changed in the remote state.
2. The [GP-IB/COPY] key is excluded from GP-IB remote control.

<Example>

Check current address 1 in the local state (LOCS) and change it to 26.

Step Procedure

Checking address

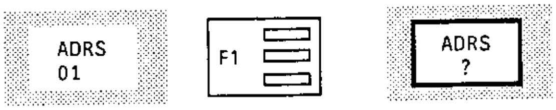
1. Press the front panel [LOCAL] key and confirm that the REMOTE lamp (to the left) goes off.

2. Press the [SHIFT] and [GP-IB/COPY] keys in this order.

3. The CRT message corresponding to the [F1] key indicates the address.

Changing address

4. Press the [F1] key, and ? prompts address selection.



5. To change the address to 26, press the following keys.

Note:

The address setting range is from 0 to 30.

The set address is always displayed as two digits, although 0 to 9 can be input as either one or two digits. For example, address 9 can be set by pressing the [9] and [ENTR] keys, or by pressing the [0], [9], and [ENTR] keys.

SECTION 10

GENERAL FORMAT OF GP-IB DEVICE MESSAGES

This section explains the device messages related to device functions.

See the MS2601A device data described on Table 8-2 when reading this section. The GP-IB Basic Guide (available from Anritsu) explains the interface functions that conform to IEEE Std. 488-1908.

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10.1 Introduction to Device Messages

A GP-IB system cannot always be properly controlled even when it fully conforms to IEEE488 standards both mechanically and electrically.

This may happen if the device message syntax is violated even when the interface messages conform to the IEEE488 standards.

Interface messages are generally applicable to all devices. Note that device messages are device-dependent messages used to control their corresponding devices only when they are programmed according to the unique specifications of each device.

Therefore, the codes and formats of device messages are regulated to some extent so as to not impair their general applicability.

In 1980, IEC issued the first standards (publication 625-2). Then in 1982, IEEE issued IEEE Std. 728-1982. Anritsu is also promoting the standardization of data codes and formats to minimize user problems and to simplify applications in view of the above trends.

10.2 General Formats of Device Messages

To set the CF of the MS2601A to 1 MHz and its SPAN to 100 kHz by using the Packet Personal Technical Computer as a controller, use a WRITE@ statement as shown in Fig. 10-1. (The following explanations assume that the interface select code is 1 and the MS2601A address is also 1 unless otherwise specified.)

```
WRITE  @101: " CNF 1MZ; SPF 100KZ"
```

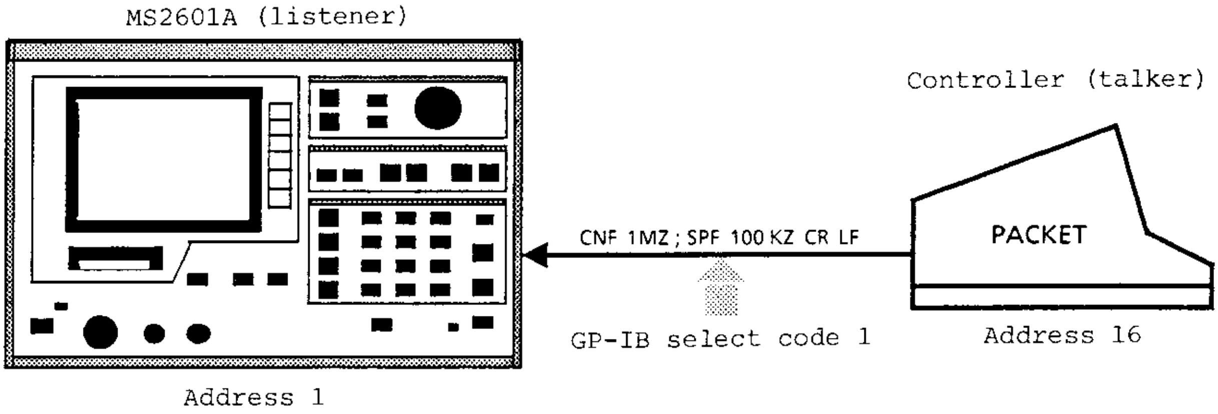


Fig. 10-1 Device Data Transfer

In Fig. 10-1, the right half of the WRITE@ statement (separated by a colon [:]) is the device message zone. The device message characteristics are as follows:

1. An upper-case alphabetic character string or combination of upper-case alphabetic characters and numeric data forms one message (data).
2. When several messages are consecutively transferred, they must be separated by a semicolon (;).
3. A single-line message is terminated by a CR LF code. (The CR LF at the end of the transferred data shown in Fig. 10-1 is automatically added by the WRITE@ statement.)

The four sections of a device message can be generalized as shown in Fig. 10-2.

The structure consists of four elements: header, separator, data, and separator. The separator inserted between the header and data is a space.

For the two messages in Fig. 10-1 (CNF 1MZ and SPF 100 KZ), the header of each message is an upper-case alphabetic character string that determines what is to be set. When numeric data follows this character string, it determines how the data is to be used.

The first alphabetic character string or the part before a space, within the combination of upper-case alphabetic characters and numeric characters, indicates the data type and contents. This is called the header (HR). The control data part is called numeric representation (NR), and the CR/LF part is called the separator (SR).

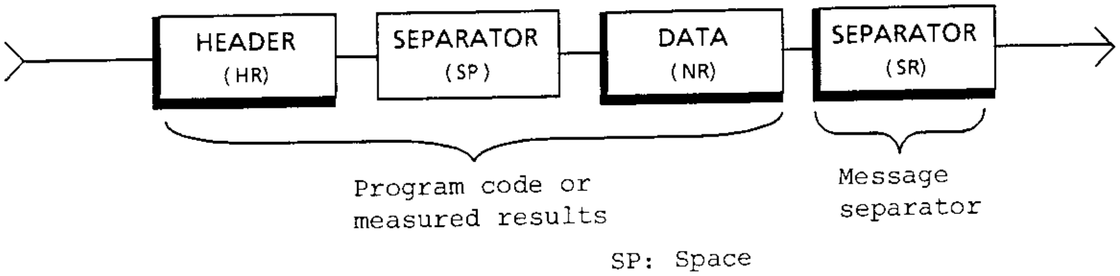
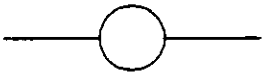


Fig. 10-2 General Format of Device Message

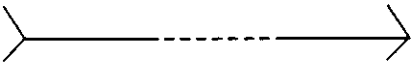
10.2.1 Device message syntax notation

A line extending right to left in the following message syntax notation indicates message element repetition. A line extending left to right under each message element indicates element omission. Figure 10-3 shows the symbols.

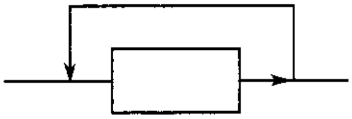
Message element clearly defined



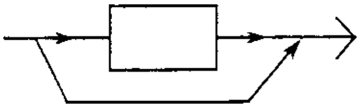
One ASCII character



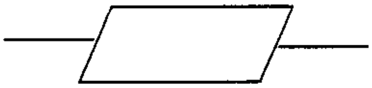
Line indicating message element connection



Line from right to left: Message element repeated twice or more



Line from left to right under message element: Message element omittable



END message to be sent with data byte (DAB)

Bold line: Recommended path

Fig. 10-3 Message Syntax Notation

10.2.2 Device message elements

Figure 10-4 shows the device message elements.

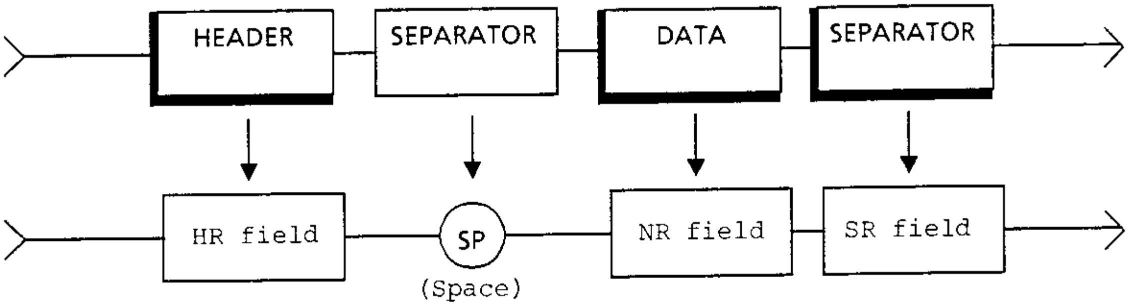


Fig. 10-4 Basic Syntax Diagram of Device Messages

(1) HR field

The HR field is located at the head of device messages. It generally indicates the use and function of the subsequent data.

If no data follows the header, it has a special use and function.

In general, the header consists of an abbreviated string of one to four upper-case alphabetic characters. Character strings registered as headers have unique meaning for the device.

The header description rules are as follows.

- The header can be a combination of upper-case alphabetic characters (A to Z) and spaces.
- The first character must be an upper-case alphabetic character, while following characters may be a combination of uppercase alphabetic characters and spaces.
- Generally, the header length is not limited, but is usually one to four characters long.

Note:

The header of a control message sent from the controller (talker) to the MS2601A (listener) is limited to three characters, and that of a data request message is limited of four characters (control message header + ?).

<Example>

- WRITE @101:"CNFΔ1MZ;SPFΔ100KZ"

  Span 100 kHz data

  Span setting header (three characters)

  Center frequency 1 MHz data

  Center frequency setting header

- WRITE @101:"CRS 1" .. Sets frequency measurement resolution to 100 Hz (control message)

  WRITE @101:"CRS?" ... Data request message (Four characters: control message + ?)

  READ @101:A$ .... Stores data sent from MS2601A as CRS1 This indicates that the MS2601A is currently in the frequency measurement state at a resolution of 100 Hz.

  Space SP .... Δ indicates a one-character space in a program description

A single space is usually used as a separator between HR and NR fields. However, if the first character of the NR field is a space, two or more spaces may be inserted between the HR and NR fields.

<Example>

One space and several spaces

```
WRITE @ 101 : "CNF△1MZ ; SPF△100KZ"
WRITE @ 101 : "CNF△△1MZ ; SPF△△△100KZ" ......... The contents are the
                                                  same as these of the
                                                  above example.
```

(2) NR field

The NR field contains control data (consisting of a numeric value or character string) used to execute the header function. Generally, for numeric values, a decimal numeric field and an integer, a real-number, or a floating-point (exponential) expression can be used but the MS2601A cannot use a floating-point (exponential) expression. A suffix can be added to the format.

Figure 10-5 shows the general format explained so far.

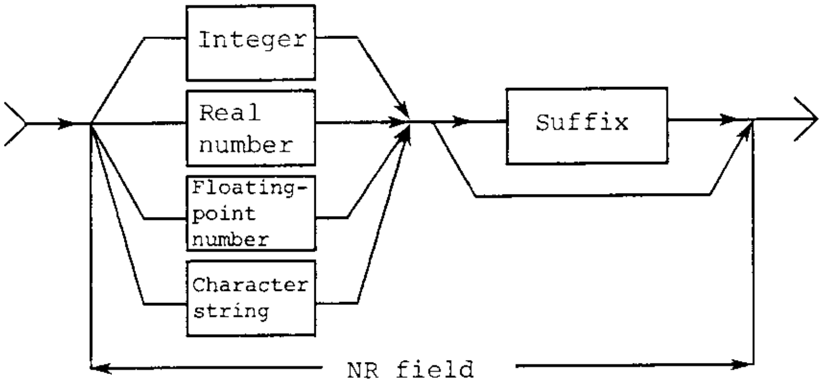


Fig. 10-5 General Format of NR Field

Table 10-1 lists the range of the NR field of the MS2601A.

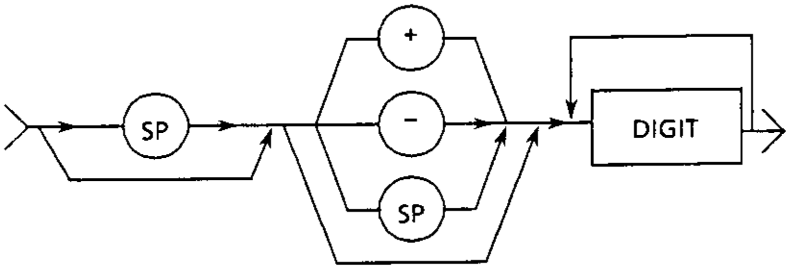
Table 10-1 Range of NR Field

Numeric value	Character string	Suffix
ASCII (integer, real number)		Frequency data unit
Binary (integer)	————	MHz → MZ kHz → KZ Hz → HZ

The numeric value (integer, real number) description rules are as follows.

■ Integer

- DIGIT: Number from 0 to 9
- A space may be inserted at the head.
- The + sign may be substituted by a space or may be omitted.
- Do not use a negative sign (-) for numeric value 0.

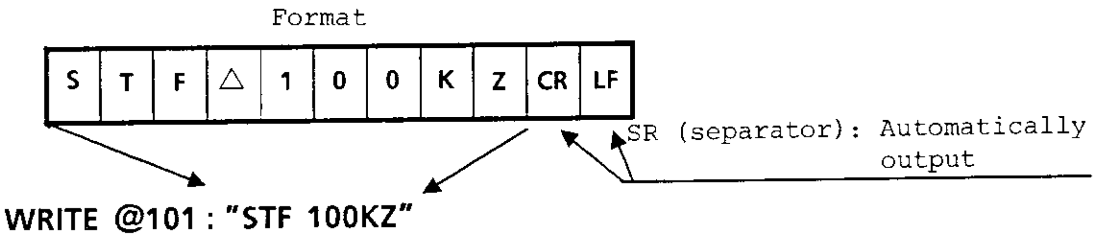


(SP: Space)

Fig. 10-6 Syntax Diagram of Integer Format

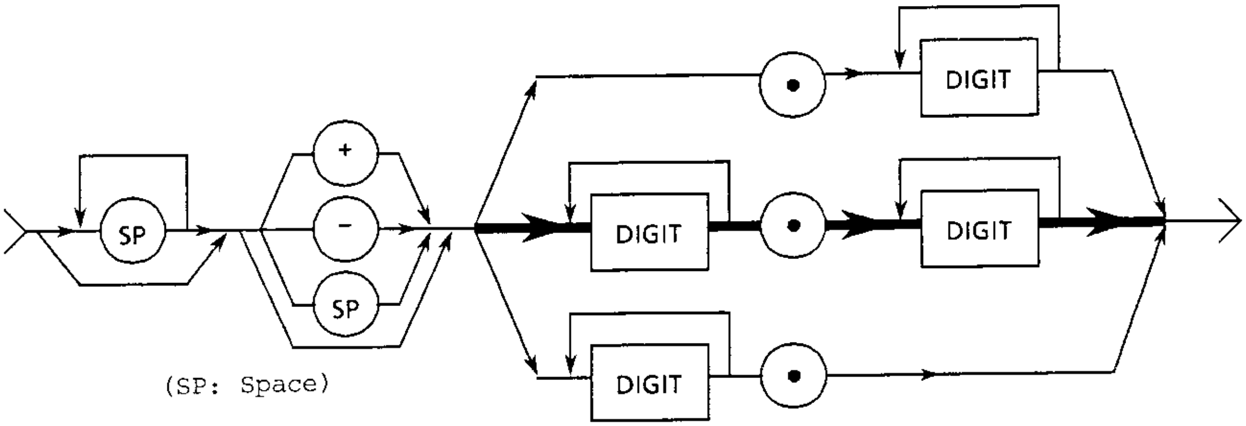
<Example>

Set MS2601A sweep start frequency to 100 kHz.



- ■ Real number

- A decimal point is always included.
- The part to the left of the decimal point is integer format.
- There is no space to the right of the decimal point.



(SP: Space)

Fig. 10-7 Syntax Diagram of Real Number Format

<Example>

Set sweep start frequency to 3.5 MHz and center frequency to 13.5 MHz.

Format	Program
① $\underbrace{\text{STF}}_{\text{HR}}\underbrace{\triangle\text{3.5MZ}}_{\text{NR}}\ \underbrace{\text{CR LF}}_{\text{SR}}$	WRITE @101:"STF 3.5MZ"
② $\underbrace{\text{CNF}}_{\text{HR}}\underbrace{\triangle\text{13.5MZ}}_{\text{NR}}\ \underbrace{\text{CR LF}}_{\text{SR}}$	WRITE @101:"CNF 13.5MZ"

(3) SR field

When there are several message elements (data) in one message (record), the SR (separator) field identifies them as separate data items. The field is also used to indicate the end of a message (record).

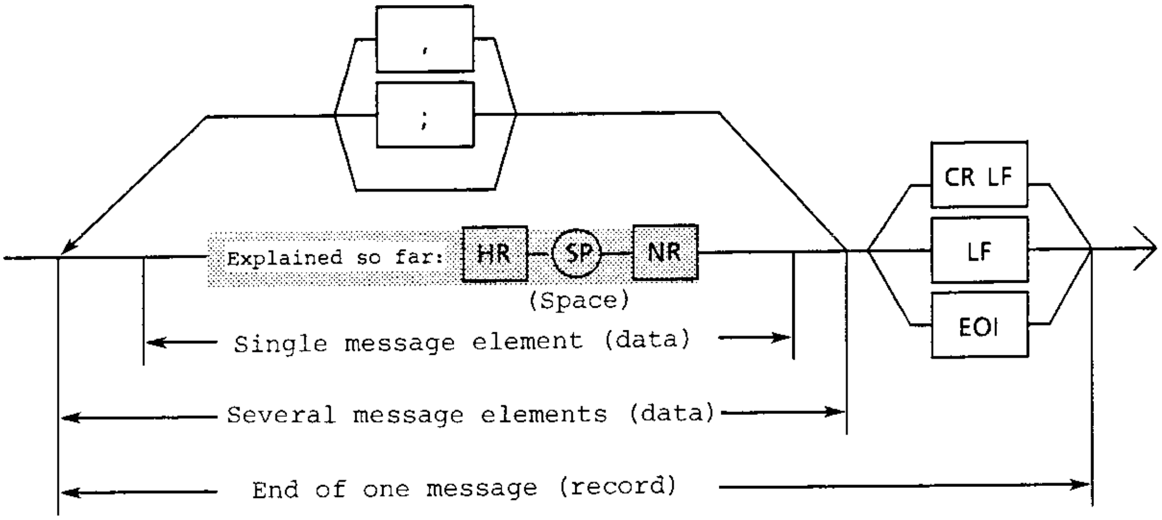


Fig. 10-8 SR Field Usage

Figure 10-8 and Table 10-2 show the usages of separators by the MS2601A.

Table 10-2 Separator Hierarchy

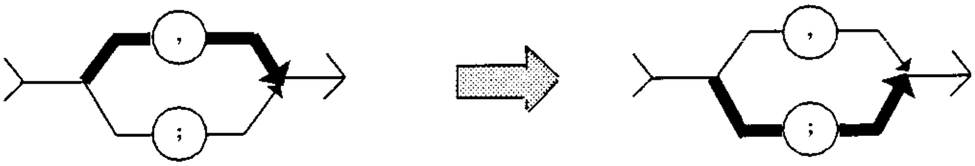
Level	ASCII code	Uni-line message	Meaning and usage	
1	, ;		. Data separation . Data separation in one record	
2	CR LF LF		Record termination	Sent immediately after final DAB
3		EOI		Sent concurrently with final DAB

■ Commas and semicolons

Commas and semicolons are generally used to delimit one or more message elements (data).

As shown in Fig. 10-9(a), commas (,) are usually recommended.

However, the MS2601A also uses semicolons (;) as shown in Fig. 10-9(b).



(a) (b)

Fig. 10-9 Commas and Semicolons

For MS2601A:

- Comma... Used to separate data when there are several data items in the NR field
- Semicolon... Used to separate messages that all include HR to NR

<Example>

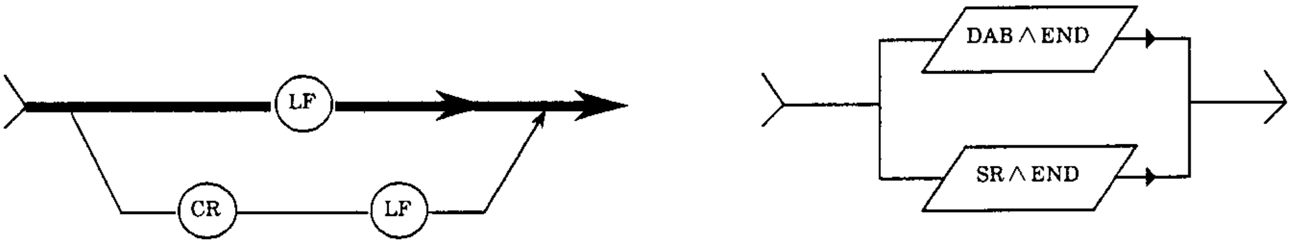
- WRITE@101: "CNFΔ1MZ;SPFΔ100KZ"
- Measurement point specification used to read data after a single sweep of channel A

  WRITE @101:"SWP;XMA?Δ0,501"

■ CR LF, LF, EOI

These codes indicate the end of a record (which is a message generally written on one line). Although use of the LF code is recommended, the CR code may also be used for to the following reasons.

1. Many commercially available products use the CR LF code (compatibility).
2. In general, listeners only recognize the last LF as a separator and ignore the CR code, but printers actually use the carriage return (CR) code..



(a) (b)

Fig. 10-10 CR LF, LF, and EOI

EOI is the highest-level delimiter. EOI is sent as an END message on an EOI line simultaneously with the final data byte (DAB).

EOI is also used to terminate binary data or to transfer several messages.

When DAB is sent from the MS2601A (talker) to a listener:

- LF, CR, or CR/LF is added to the end of the DAB as specified.
- EOI is sent simultaneously.

When the MS2601A (listener) receives DAB from the talker, both the line feed (LF) and EOI are accepted. (The CR before LF is ignored.)

10.2.3 Device message types

Table 10-3 classifies the device messages by usage. The control message controls panel settings and memory contents. To read the results, the controller (talker) must notify the listener of what is to be read. This is done by using a data request message.

See Table 10-3 for details.

Table 10-3 Device Message Types

Message	Talker	Listener	Explanation
Control	Controller	Device (MS2601A)	This message controls the device (MS2601A) panel settings and memory contents from the controller.
Data request	Controller	Device (MS2601A)	This message readies the device (MS2601A) to read its set values and data from the frequency and function memories. To read data from the device, a data request message must be sent from the controller immediately before reading the data.
Talker output	Device (MS2601A)	Controller	This message sends the data of a function specified by a data request message from the device (MS2601A as talker) to the controller in the specified format.

<Example>

Center frequency setting and readout.

```
10 WRITE @101:"CNF△1MZ"
20 WRITE @101:"CNF?"
30 READ  @101:A$
40 PRINT  A$
50 END
```

Line 10: Control message

Line 20: Data request message

Line 30: The controller (listener) reads data sent from the MS2601A (talker) into character string variable A$ by using a talker output message.

Line 40: 1 MHz frequency display on CRT

10.3 General Formats of MS2601A Device Messages

This paragraph explains the MS2601A messages according to the format described in paragraph 10.2.

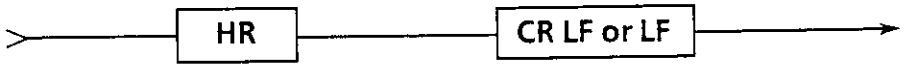
- General formats of control messages
- General formats of data request messages
- General formats of messages sent from talker (except status messages)

10.3.1 General formats of control messages

The MS2601A control messages use four formats. This paragraph explains these formats by using the commands for the Packet V Personal Technical Computer.

An SR (CR LF) is automatically output for the Packet V WRITE statement.

(1) Control message Format 1



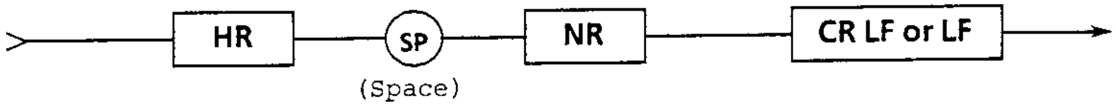
<Example>

Initialize MS2601A settings.

```
WRITE @1 01  :  "INI"
      |  |         |
      |  |         └──HR for initialization
      |  |
      |  └──MS2601A GP-IB address
      |
      └──Packet V interface select code
```

CR LF is automatically sent at the end of the above instruction.

(2) Control message Format 2



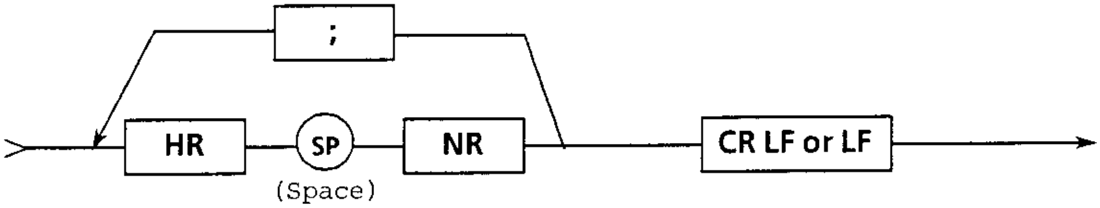
<Example>

Set center frequency to 10 MHz.

WRITE @101:"CNF△10MZ"

(3) Control message Format 3

Several control messages are sent in this format.



$\text{WRITE @101 : }\underbrace{\text{"CNF△10MZ;SPF△1MZ"}}_{\text{Center frequency: 10 MHz, span: 1 MHz}}$

Note:

If the initialization setting message INI is sent in Format 3, all settings after INI are cleared; INI should be sent in Format 1. Even if several messages are subsequently sent in Format 3, the subsequent settings are not cleared.

To set the center frequency to 10 MHz and the span to 1 MHz after initialization settings given in the above example, use the following program.

```
10  WRITE  @101: "INI "
20  WRITE  @101: "CNF△10MZ ; SPF△1MZ"
```

Note:
If INI; is written before CNF in a single WRITE statement, the settings after INI are also cleared.

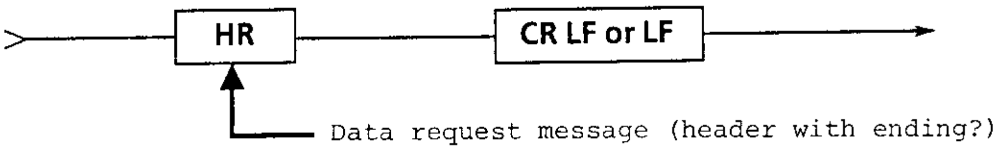
10.3.2 General formats of data request messages

The data request message is used to read the MS2601A set values (CF and SPAN) and data from the frequency and function memories.

To read data from the MS2601A, a data request message must be sent immediately before reading the data.

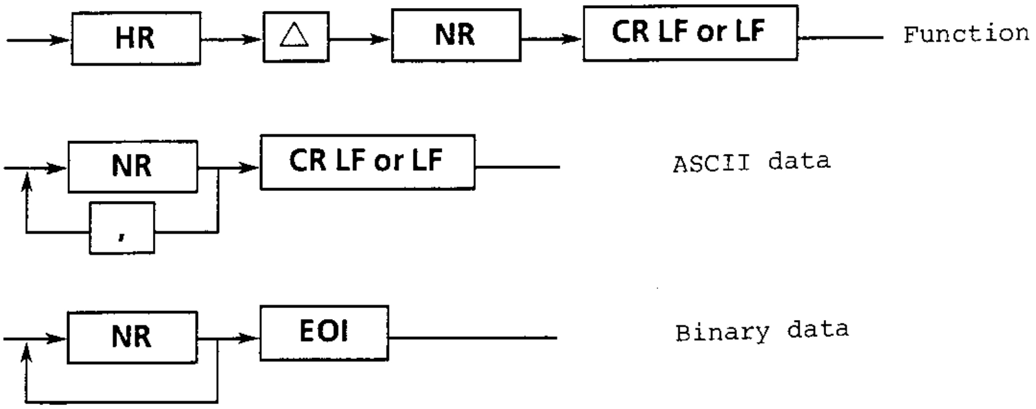
The MS2601A sends data, as well as the CR LF and END message (EOI) at the end of the data, when operating as a talker. (See paragraph 10.3.3.)

The data format uses the same format as a control message except that ? is added.



10.3.3 General formats of messages sent from talker

The data format sent from talker is as follows.



SECTION 11

DETAILS OF GP-IB DEVICE MESSAGES

This section explains the major device messages listed in Table 8-2 by using sample programs. See Section 12 for details on single sweep and SRQ messages.

TABLE OF CONTENTS

11.1 Initialization

Table 11-1 lists the program codes used for initialization.

Table 11-1 Program Codes for Initialization

Parameter		Device message		
Item	Control item	Control	Data request	Sent from talker
INITIAL	INITIAL	INT	——	——

<Example>

Initialize MS2601A.

```
 100  LET  ADR=101
● 110  WRITE  @ADR:"INI"
1000  END
```

The MS2601A is initialized by executing the above program as follows.

CENTER FREQ	1100 MHz
SPAN	2200 MHz
REF LEVEL	0 dBm
INPUT ATTEN	AUTO (20 dB)
RESOLN BW	AUTO (1 MHz)
VIDEO BW	AUTO (100 kHz)
SWEEP TIME	AUTO (70 ms)
SCALE	LOG 10 dB/div
TRIG	FREE
DISPLAY	A ch WRITE ON, NORMAL MODE, READ ON (B ch WRITE OFF, READ OFF)
MARKER	NORMAL, WIDTH NAR

The messages sent from the controller to initialize the MS2601A may use the GP-IB command SDC (Selected Device Clear) instead of INI.

The DCL@ device number can be used in a GP-IB control statement for this purpose. (See the GP-IB Basic Guide, available from Anritsu.)

The above example can be rewritten as follows.

```
 100  LET  ADR=101
● 110  DCL  @ADR
1000  END
```

Note:

If the following control messages are sent to change the initial center frequency from 1100 MHz to 300 MHz and the initial span from 2200 MHz to 1 kHz, the settings to the right of INI are all cleared. (See Note in paragraph 10.3.1(3).)

Bad example:

```
100  LET  ADR=101
110  WRITE  @ADR:"INI;CNF 300MZ;SPF 1KZ"
1000  END
```

For the initialization message INI, send only the INI first and send the other settings by separate message.

Good example:

```
100  WRITE  @ADR:"INI"
120  WRITE  @ADR:"CNF 300MZ;SPF 1KZ"
```

INI is generally used to set the MS2601A to the initial state (see the setting list on the previous page). The functions to be changed from this state are set with control messages. The following explanations assume that INI has already been set unless otherwise specified.

11.2 Setting Frequency

Table 11-2 lists the program codes used to set the frequency.

Table 11-2 Program Codes for Setting Frequency

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
ENTRY	FREQUENCY SET	CENTER START	CNF△f STF△f f= 0 Hz to 2209.99998 MHz	CNF? STF?	CNF△f STF△f
		SPAN	SPF△f f= 0 Hz, 10 kHz to 2200 MHz	SPF?	SPF△f
		STEP SIZE STEP UP STEP DOWN	FSS△f FUP FDN	FSS?	FSS△f f= Ten-character fixed format <Ex.> CF = 1 MHz, CNF 0001000000
MENU	FREQ MODE	FREQ MODE CF/SPAN START/SPAN	FRQ△0 FRQ△1	FRQ? FRQ?	FRQ△0 FRQ△1

11.2.1 Setting center frequency

<Example>

Set center frequency to 1 MHz.

Any of the following statements can set it.

```
WRITE  @101: "CNF 1MZ"
WRITE  @101: "CNF 1000kZ"
WRITE  @101: "CNF 1000000HZ"
WRITE  @101: "CNF 1000000"
```

Note:

The available units are Hz, kHz, and MHz, and their corresponding suffix codes are HZ, KZ, and MZ, respectively. If no unit is specified, Hz is assumed.

	Suffix unit	Suffix code
Frequency	Hz	HZ
	kHz	KZ
	MHz	MZ

11.2.2 Setting center/span and start/span (STF, SPF)

The center frequency (CF) or start frequency (SF) must be set with the frequency sweep width (SPAN).

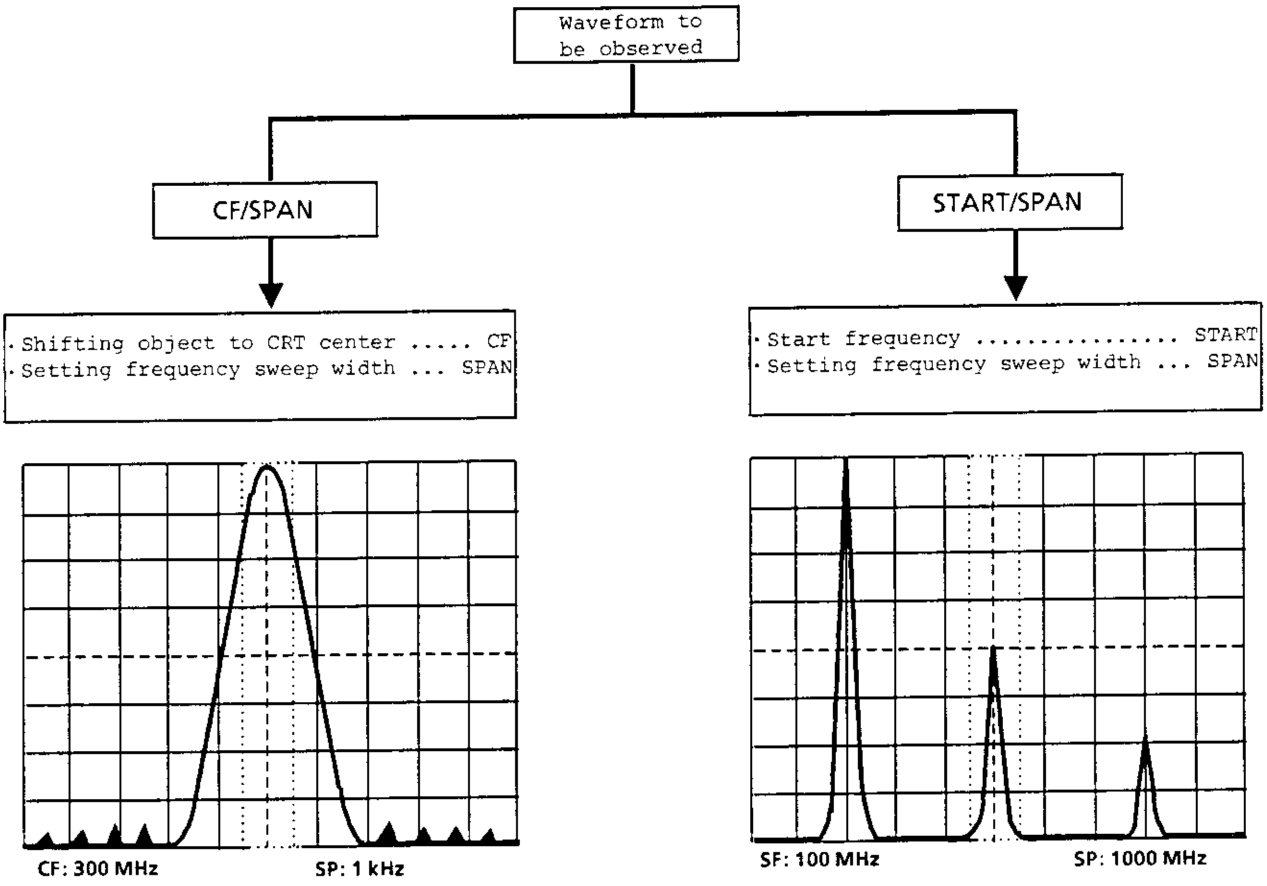


Fig. 11-1 CF/SPAN and START/SPAN

<Example 1>

Observe range of 300 MHz ±500 Hz.

Set CENTER to 300 MHz and SPAN to 1 kHz.

```
 100  LET   ADR = 101
 110  WRITE   @ADR : "CNF 300MZ ; SPF 1KZ"
1000  END
```

<Example 2> Set lower frequency limit to 100 MHz and upper limit to 1100 MHz for observation.

Set START to 100 MHz and SPAN to 1000 MHz.

```
 100  LET   ADR=101
 110  WRITE  @ADR:"STF 100MZ;SPF 1000MZ"
1000  END
```

11.2.3 Display in CF/SPAN and START/SPAN modes (FRQ)

(1) START/SPAN

When line 110 in the following program is executed,

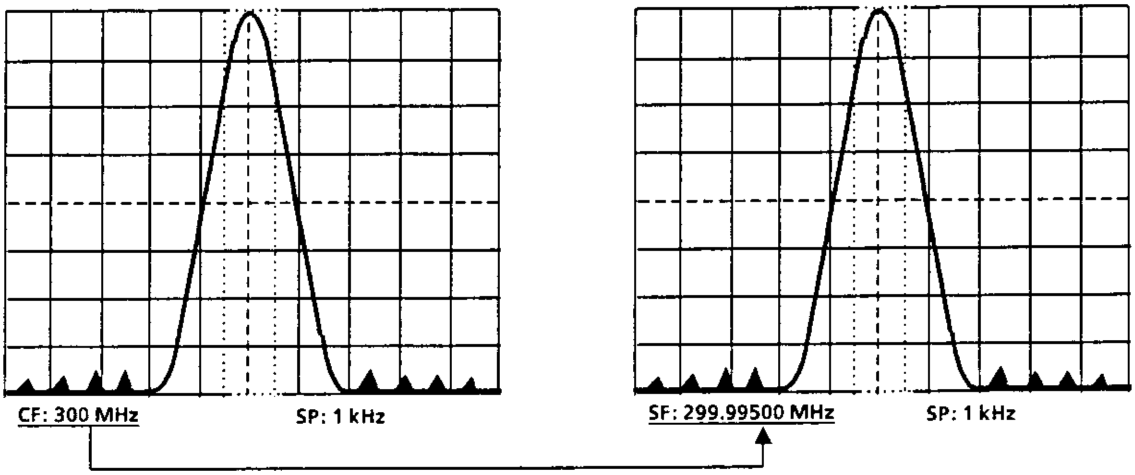
CF: 300 MHz and SP: 1 kHz are shown at the bottom of the CRT (following figure on the left).

To display the start frequency, send the FRQΔ1 control message to set the START/SPAN display mode.

```
110  WRITE  @ADR:"CNF 300MZ;SPF 1KZ"
120  WRITE  @ADR:"FRQ 1"
```

When line 120 is executed, the display changes to

SF: 299.99500 MHz and SP: 1 kHz as shown in the following figure on the right.



(2) CF/SPAN

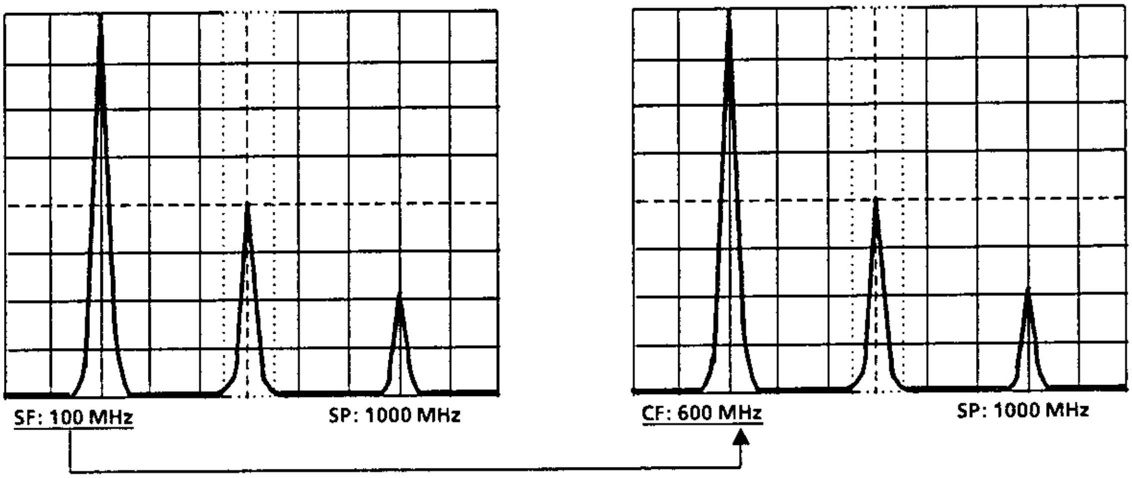
When line 110 in the following program is executed,

SF: 100 MHz and SP: 1000 MHz are shown at the bottom of the CRT (following figure on the left).

To display the center frequency (CF), send the FRQΔ0 control message to set the CF/SPAN display mode.

```
110  WRITE  @ADR:"STF 100MZ;SPF 1000MZ"
120  WRITE  @FRQ 0"
```

When line 120 is executed, the display changes to CF: 600 MHz and SP: 1000 MHz.



11.2.4 Frequency step-up/down (FSS, FUP, FDN)

Set the STEP SIZE with FSSΔf in advance. Then specify FUP for STEP UP or FDN for STEP DOWN.

<Example>

Set SPAN to 1 kHz and increase CF from 300 MHz to 900 MHz in STEP SIZE of 300 MHz. Record CNF value on controller CRT.

```
    90 DIM FREQ$*20
o  100 WRITE @101:"CNF 300MZ;SPF 1KZ;FSS 300MZ"
   110 FOR K=1 TO 3
   120   WRITE @101:"CNF?" ........ CF data request message
   130   READ @101:"FREQ$" ........ Storing CF data
   140   PRINT:FREQ$ .............. Printing stored CF results
o  150   WRITE @101:"FUP" ......... Step-up
   160 NEXT K
  1000 END
```

Printed results

```
CNF 0300000000
CNF 0600000000
CNF 0900000000
```

Ten-character fixed format

11.3 Specifying Marker and Reading Measured Value

Table 11-3 lists the program codes used to read data by specifying the marker.

Table 11-3 Marker-related Program Codes

Parameter			Device message		
	Item	Control item	Control	Data request	Sent from talker
FUNCTION (Marker specification)	MARKER	NORMAL	MKR△0	MKR?	MKR△0
		ΔMKR	MKR△1	MKR?	MKR△1
		MKR OFF	MKR△2	MKR?	MKR△2
		MKR→CF	MKR△3	—	—
		MKR→REF	MKR△4	—	—
	MARKER SEARCH FUNCTION	PEAK	MKS△0	—	—
		NEXT PEAK	MKS△1	—	—
		MINIMUM	MKS△2	—	—
		LEFT PEAK	MKS△3	—	—
		CENTER PEAK	MKS△4	—	—
		RIGHT PEAK	MKS△5	—	—
		LEFT MIN	MKS△6	—	—
		CENTER MIN	MKS△7	—	—
		RIGHT MIN	MKS△8	—	—
Data readout	MARKER POSITION	ZONE	MKZ△P	MKZ?	MKZ△P
		REFERENCE	—	RMK?	RMK△P
		CURRENT	— P:0 to 500	CMK?	CMK△P P:0 to 500
	ZONE WIDTH	NAR	MKW△0	MKW?	MKW△0
		SPOT	MKW△1	MKW?	MKW△1
		WIDE	MKW△2	MKW?	MKW△2
	MARKER DATA	FREQ		MKF?	b b: 11-character ASCII data (unit: Hz) <Ex.> +2200000000 Indicates the frequence in ΔMKR mode
		LEVEL		MKL?	b b: Seven-character (ten-character for V [in units of nV] ASCII data) Indicates the level difference in ΔMKR mode
	TERMINATOR	LF	TRM△0	—	—
		CR	TRM△1	—	—
		CR/LF	TRM△2	—	—

11.3.1 Specifying marker

Use the MARKER item message in the FUNCTION column (marker specification) of Table 11-3 to specify the marker function (such as NORMAL, ΔMKR, or MKR→CF).

Other messages are used to specify the measurement point where the specified markers should or will be placed.

(1) ZONE and MARKER ZONE WIDTH

If the MARKER ZONE WIDTH specification is not SPOT, a marker zone is created around the central specified marker point.

The marker point is moved automatically to the maximum level in the marker zone.

<Example 1>

Specify measurement point 250 in WIDE ZONE (Fig. 11-2(1)).

```
10  WRITE  @101:"MKR 0"!  NORMAL MARKER
20  WRITE  @101:"MKW 2"!  WIDE ZONE
30  WRITE  @101:"MKZ 250"!  ZONE POINT 250
40  END
```

<Example 2>

Specify measurement point 200 in WIDE ZONE.

```
30  WRITE  @101:"MKZ 200"
```

If the specification on program line 30 in the above example 1 is changed to 200, the marker point is moved automatically to the maximum level point 225 (Fig. 11-2(2)).

(2) Reading current marker point on Fig. 11-2(3) after executing NEXT PEAK.

```
10  WRITE  @101:"MKW 1"!  ZONE WIDTH SPOT
20  WRITE  @101:"MKS 0"!  PEAK
30  WRITE  @101:"MKR 1"!  DELTA MKR
40  WRITE  @101:"MKS 1"!  NEXT PEAK
50  WRITE  @101:"CMK ?"!  CURRENT MARKER
60  READ  @101:"C$
70  PRINT  C$
80  END
```

CMK250 is printed by line 70.

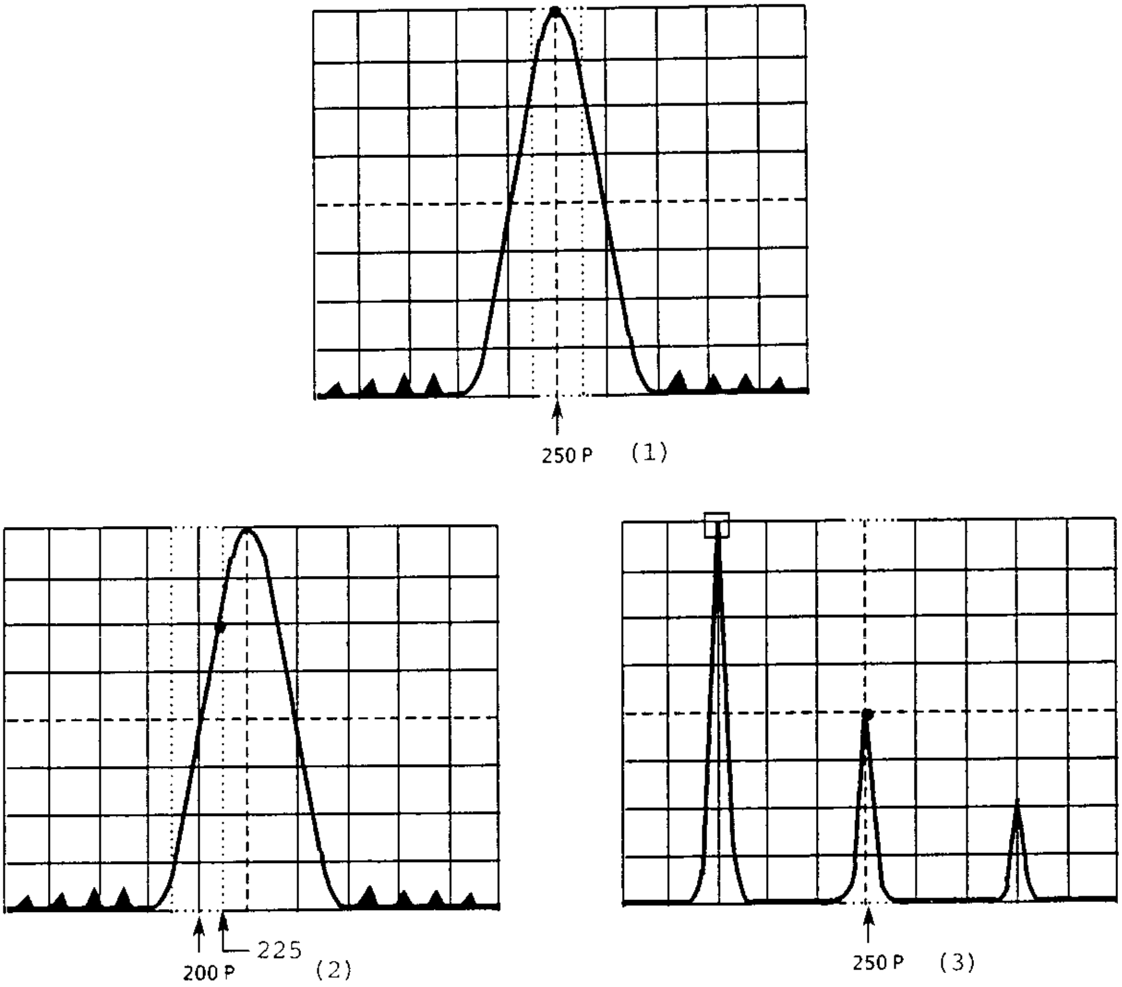


Fig. 11-2 Specifying Marker

11.3.2 Peak search and minimum search functions

As in Table 11-3, the marker search functions can be classified into five types of peak search function which are used to move the marker (current marker for Δ marker mode) to a peak on the trace (possible in WRITE OFF mode or after single sweep), and four types of minimum search function which are used to move the marker to a minimum point.

The peak search and minimum search functions listed in Table 11-3 are described below.

(1) PEAK SEARCH

Execution of WRITE@101: "MKSΔ0" moves the marker to the maximum level on the trace line. (If there is more than one point on the same level, the marker is moved to the left-most one.)

(2) NEXT PEAK SEARCH

Execution of WRITE@101: "MKSΔ1" moves the marker to the next highest peak. If MKSΔ1 is sent continuously, the marker keeps moving in the peak level order. This function is only effective when ZONE WIDTH is SPOT.

(3) LEFT PEAK SEARCH

Execution of WRITE@101: "MKSΔ3" moves the marker to the maximum level in three scale graticules from the left end of the trace line.

(4) CENTER PEAK SEARCH

Execution of WRITE@101: "MKSΔ4" moves the marker to the maximum level in four scale graticules about the center of the trace line.

(5) RIGHT PEAK SEARCH

Execution of WRITE@101: "MKSΔ5" moves the marker to the maximum level in three scale graticules from the right end of the trace line.

(6) MINIMUM SEARCH

Execution of WRITE@101: "MKSΔ2" moves the marker to the minimum level on the trace line.

(7) LEFT MINIMUM SEARCH

Execution of WRITE@101: "MKSΔ6" moves the marker to the minimum level in three scale graticules from the left end of the trace line.

(8) CENTER MINIMUM SEARCH

Execution of WRITE@101: "MKSΔ7" moves the marker to the minimum level in four scale graticules about the center of the trace line.

(9) RIGHT MINIMUM SEARCH

Execution of WRITE@101: "MKSΔ8" moves the marker to the minimum level in three scale graticules from right end of the trace line.

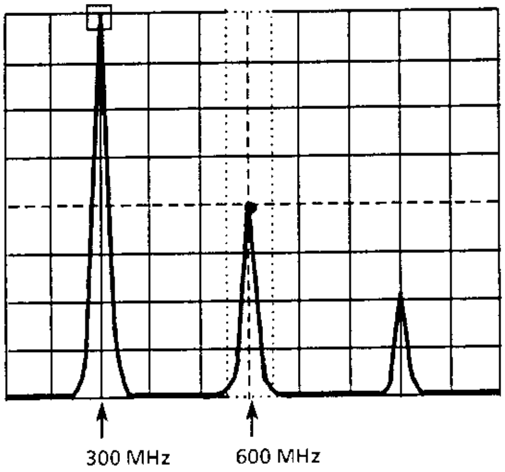
11.3.3 Reading (MKF, MKL) measured values (frequency and level)

To read the frequency at a marker point, changing the device message CMK? on program line 50 in paragraph 11.3.1 (2) to MKF? enables the marker point frequency to be read. Changing to MKL? enables the marker point level to be read.

<Example 1>

Read frequency and level differences between PEAK and NEXT PEAK in ASCII code in figure below.

```
 10  WRITE  @101 : "MKR 0"!  NORMAL MKR
 20  WRITE  @101 : "MKW 1"!  SPOT
 30  WRITE  @101 : "MKS 0"!  PEAK
 40  WRITE  @101 : "MKR 1"!  DELTA MKR
 50  WRITE  @101 : "MKS 1"!  NEXT PEAK
 60  !
 70  WRITE  @101 : "MKF?"!  FREQ DATA
 80  READ  @101 : FREQ$
 90  WRITE  @101 : "MKL?"!  LEVEL DATA
100  READ  @101 : LEVEL$
110  PRINT  "FREQ" ; FREQ$ ; "Hz"
120  PRINT  "LEVEL" ; LEVEL$ ; "dB"
130  END
```



The data request messages on lines 70 and 90 store the frequency difference data in character string variable FREQ$ on line 80, and the level difference data in character string variable LEVEL$ on line 100.

- Frequency difference data output

Execution of line 110 sets: FREQ $\underbrace{00300000000}_{\text{11-character ASCII}}$Hz

‖

$\underline{30}\ \underline{30}\ \underline{33}\ \underline{30}\ \underline{30}\ \underline{30}\ \underline{30}\ \underline{30}\ \underline{30}\ \underline{30}\ \underline{30}$

(See Appendix A for ASCII code.)

.... The leading blank digits in Hz units of the displayed value are padded with zeroes.

- Level difference data output

Execution of line 120 sets: LEVEL $\underbrace{-040.00}_{\text{7-character ASCII}}$ dB

‖

$\underline{2D}\ \underline{30}\ \underline{34}\ \underline{30}\ \underline{2E}\ \underline{30}\ \underline{30}$

.... The leading blank digits in the 0.1 dB unit of the displayed value are padded with zeroes.

Note:

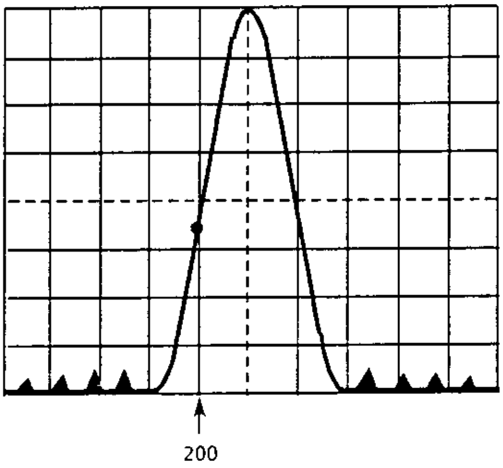
Binary data is generally stored in a numeric variable. A character-string variable is usually used to store ASCII data, although a numeric variable is acceptable if the data only consists of numeric information. However, a character-string variable must be used to check the character listing. The VAL (character-string variable) function is used to convert ASCII data consisting of a numeric character-string into a numeric value. If line 110 is changed to PRINT"FREQ";VAL(FREQ$)/1E6;"MHz", the frequency difference data is printed as FREQ 300 MHz.

11.3.4 Processing binary data (two-byte)

(1) ASCII and binary data reception

The following sample programs show the difference between ASCII and binary data when reading the level at measuring point 200 in the figure below.

For the binary data format, specify the WH format with USING in addition to BINΔ1, as shown below.

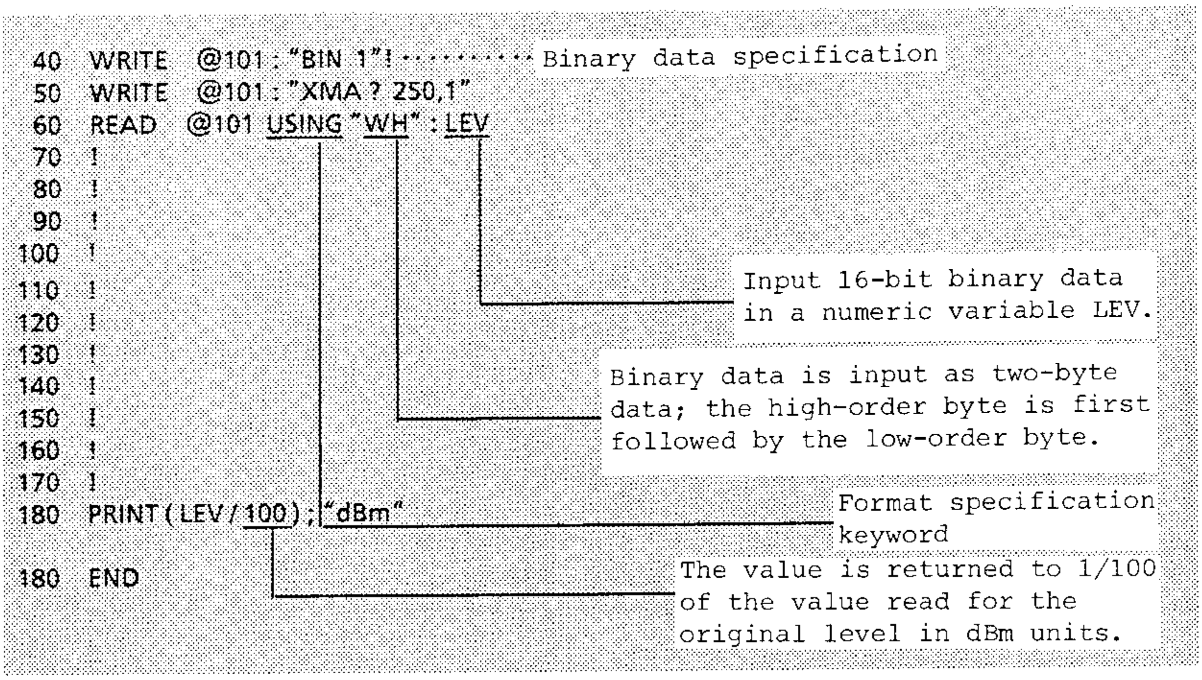


■ ASCII data

```
10  WRITE  @101 : "MKR 0"!  NORMAL
20  WRITE  @101 : "MKW 1"!  SPOT
30  WRITE  @101 : "MKZ 200"
40  WRITE  @101 : "BIN 0"!  ASCII DATA
50  WRITE  @101 : "MKL"
60  READ  @101 : LEV
70  PRINT LEV
80  END
If the level at point 200 is -45 dBm,
   LEV contents: -45 ... Unnecessary
                         zeroes are
                         deleted.
```

[] Two-byte binary data

- Level data is sent with 0.01 dBm as 1. Therefore, 1250 is sent for 12.5 dBm. (The actually sent data is 0000 0100 1110 0010 [1250D = 1024 + 128 + 64 + 32 + 2] in binary format, which is 04E2(H)* in hexadecimal format.)



```
 40  WRITE  @101:"BIN 1"! ·········· Binary data specification
 50  WRITE  @101:"XMA? 250,1"
 60  READ  @101 USING "WH":LEV
 70  !
 80  !
 90  !
100  !
110  !
120  !
130  !
140  !
150  !
160  !
170  !
180  PRINT(LEV/100);"dBm"

180  END
```

Input 16-bit binary data in a numeric variable LEV.

Binary data is input as two-byte data; the high-order byte is first followed by the low-order byte.

Format specification keyword

The value is returned to 1/100 of the value read for the original level in dBm units.

Note:

For ASCII data transfer, a terminator (LF, CR, or CR LF) can be selected; TRMΔ0 selects LF. In this case, define LF with SEPARATOR IS CHR$(10) before receiving the talker send data with the READ@ statement.

---

* H indicates a hexadecimal expression.

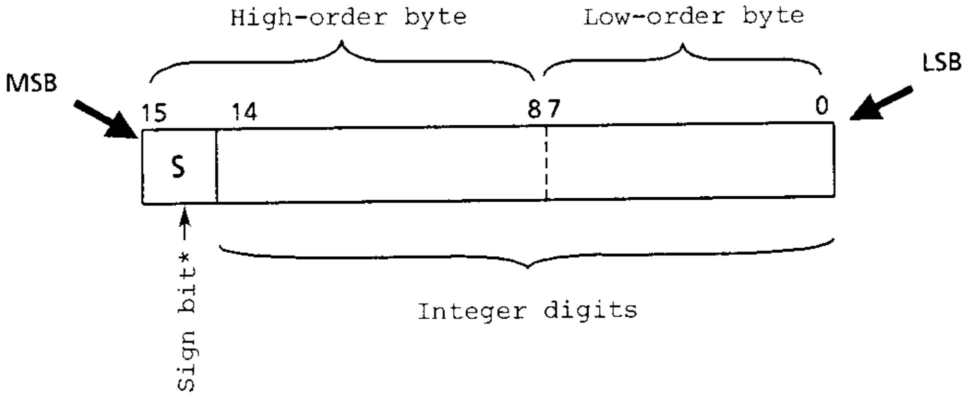
$$04E2H = -(0 \times 16^3 + 4 \times 16^2 + \underset{\substack{\uparrow \\ E}}{14} \times 16^1 + 2 \times 16^0) = 1250D$$

(2) Transferring two-byte binary data

For two-byte binary data, integers from -32,768 to 32,767 (total of 65,536) are divided and sent in order from the high-order byte to the low-order byte. To receive this data in this order, specify the format symbol WH. See paragraph 11.3.4 (1).

16-Bit Binary	With Sign	No Sign
1000000000000000	−32768	32768
1000000000000001	−32767	32769
1000000000000010	−32766	32770
1111111111111101	−3	65533
1111111111111110	−2	65534
1111111111111111	−1	65535
0000000000000000	0	0
0000000000000001	1	1
0000000000000010	2	2
0000000000000011	3	3
0111111111111101	32765	32765
0111111111111110	32766	32766
0111111111111111	32767	32767

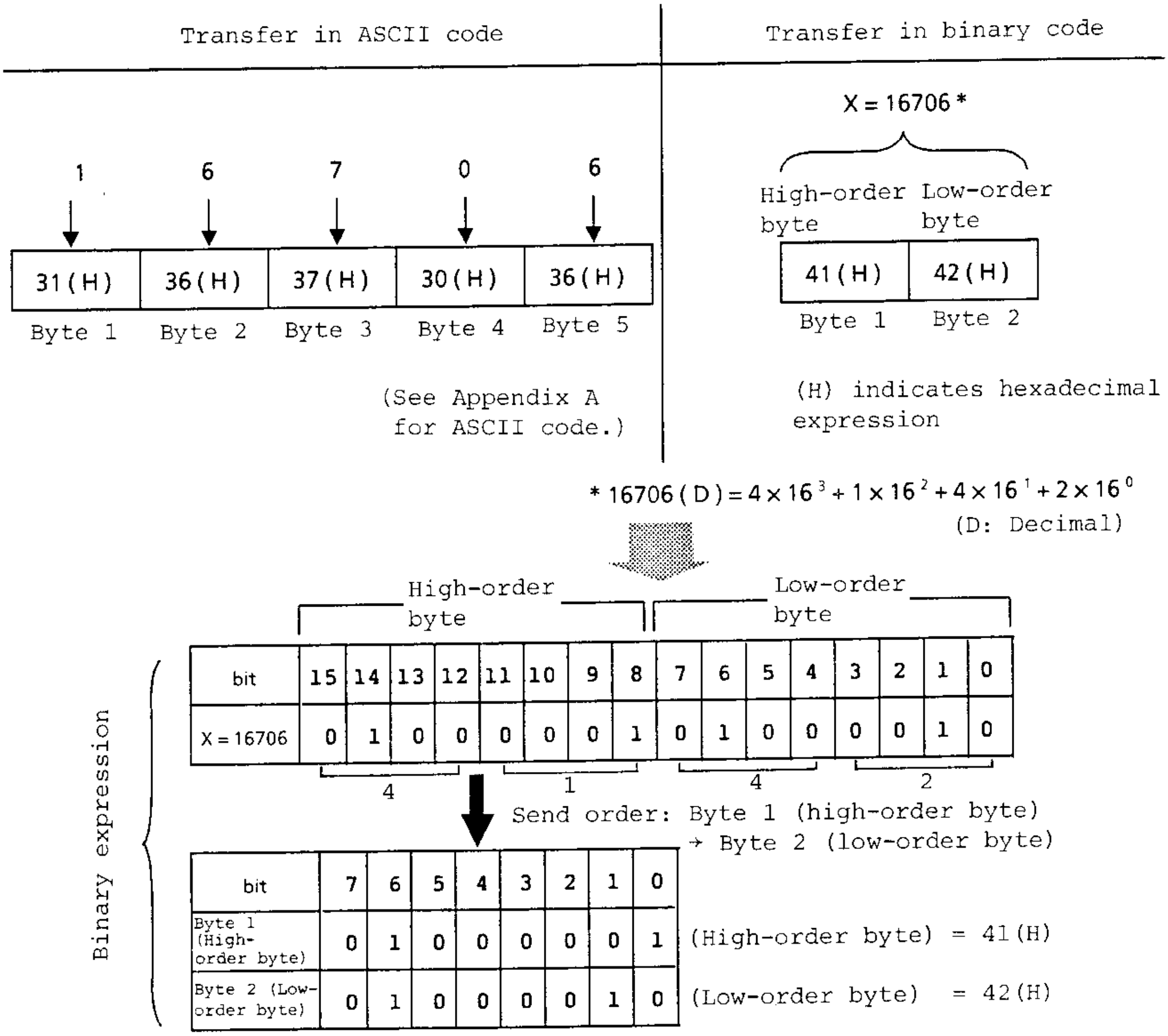
Sign bit: Bit 15 (MSB)
Integer digits: Bits 0 to 14
Sixteen bits (two bytes) are used.



Internal expression of two-byte binary data

* When a negative number is stored in a numeric variable, the sign bit is set in MSB to indicate a negative value.
A negative numeric value is stored as a two's complement.

Five bytes are required to transfer the integer 16706 in ASCII code. Note that the same data transfer in binary code only uses two bytes and does not require data format conversion. Therefore, the binary code method is often used for high-speed data transfer.



(See Appendix A for ASCII code.)

(H) indicates hexadecimal expression

$* \ 16706(D) = 4 \times 16^3 + 1 \times 16^2 + 4 \times 16^1 + 2 \times 16^0$

(D: Decimal)

bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
X = 16706	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1	0

Send order: Byte 1 (high-order byte)
→ Byte 2 (low-order byte)

bit	7	6	5	4	3	2	1	0	
Byte 1 (High-order byte)	0	1	0	0	0	0	0	1	(High-order byte) = 41(H)
Byte 2 (Low-order byte)	0	1	0	0	0	0	1	0	(Low-order byte) = 42(H)

- If a program is created by considering the following three points, the transfer is performed by DMA and enables high-speed I/O processing. (See paragraph 11.10 for details.)
  1. Format specification : I/O by WH format
  2. Use an integer array variable to store the data by using INT of the DIM statement.
  3. Use MAT WRITE@ for array output and MAT READ@ for array input. The stored data in the entire array can be input or output at once.

11.4 Frequency Count (MKC, CRS)

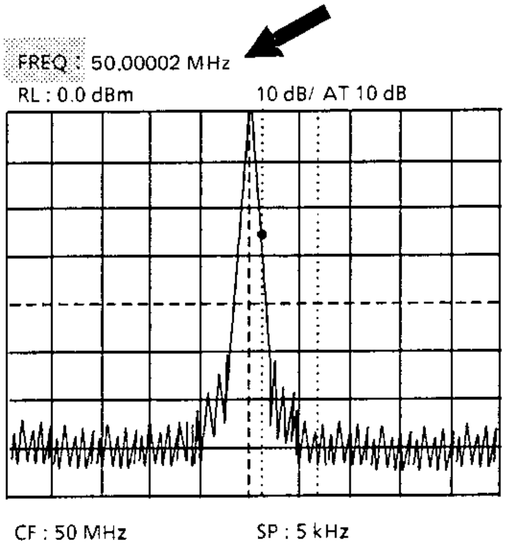
Specify the resolution and activate the COUNT ON mode according to Table 11-4 to measure the frequency of the received signal which has a marker.

Table 11-4 Frequency Count

Parameter		Device message		
Item	Control item	Control	Data request	Sent from talker
COUNT	COUNT OFF	MKC△0	MKC?	MKC△0
	COUNT ON	MKC△1	MKC?	MKC△1
	RESOLUTION			
	1 Hz	CRS△0	CRS?	CRS△0
	10 Hz	CRS△1	CRS?	CRS△1
	100 Hz	CRS△2	CRS?	CRS△2

When COUNT ON is specified, the frequency is displayed where indicated by the arrow in the figure below. (The marker display is changed to FREQ.)

To measure the frequency with the prescribed accuracy, set the marker point to at least 20 dB or more above the unnecessary waves (such as noise and adjacent interference).



<Example>

Set marker to maximum level of displayed trace line and measure frequency at 100 Hz resolution.

```
10  WRITE  @101 : "STF 10MHZ ; SWP" !
20  WRITE  @101 : "MKR 0"! NORMAL MARKER
30  WRITE  @101 : "MKS 0"! PEAK
40  WRITE  @101 : "CRS 2"! 100Hz RESOLUTION
50  WRITE  @101 : "MKC 1"! COUNT ON
60  WRITE  @101 : "SWP ; MKF ? "
70  READ  @101 : FREQ
80  PRINT FREQ
90  END
```

11.5 Setting Reference Level (RLV, UNT)

The reference level is set with the unit according to the UNIT setting.

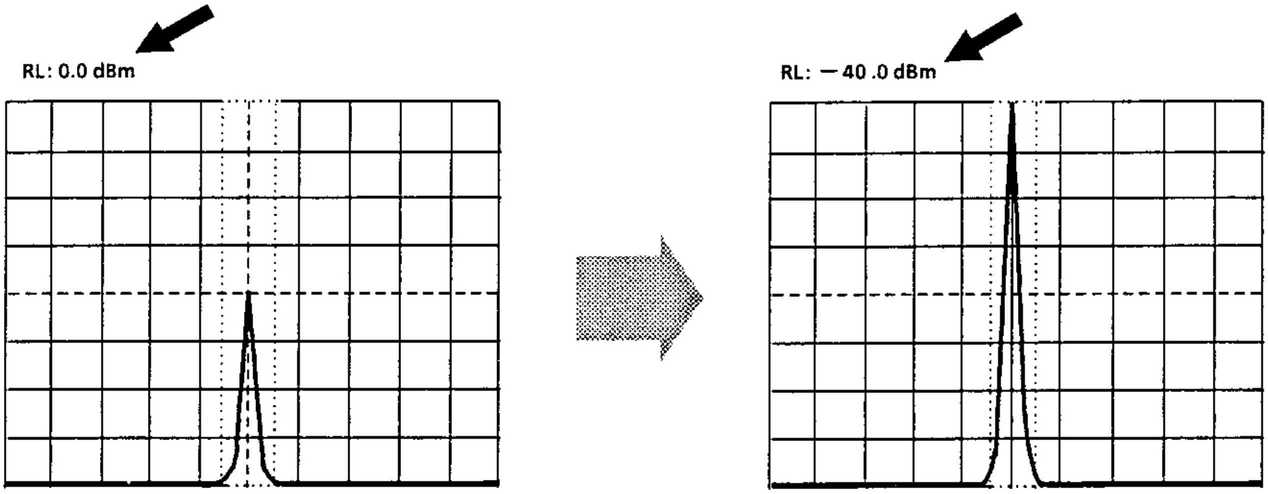
Table 11-5 Reference Level and Units

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
ENTRY	REF LEVEL	REF.LEVEL	RLV△ℓ ℓ=-100.0 to +20.0 (unit: dBm) The unit confirms the UNIT setting (in μV units for V)	RLV?	RLV△ℓ The unit confirms the UNIT setting (in μV units for V)
	UNIT	dBm	UNT△0	UNT?	UNT△0
		dBμV	UNT△1	UNT?	UNT△1
		dBmV	UNT△2	UNT?	UNT△2
		V	UNT△3	UNT?	UNT△3
		dBμV(emf)	UNT△4	UNT?	UNT△4
		dBμV/m	UNT△5	UNT?	UNT△5

(△: Space)

If line 20 in the following program is executed, the display (REF = 0 dBm) shown on the left figure below changes to that shown on the right (REF = -40 dBm).

```
10  WRITE  @101:"UNT 0"! dBm UNIT
20  WRITE  @101:"RLV -40.0"! REF.LEVEL
```



Note:

Line 10 is not required when the display is already set in the dBm mode and the mode need not be changed.

11.6 Signal Search

When the control messages listed in Table 11-6 are sent to the MS2601A, their corresponding control operations are executed.

For SPAN, the span is set in the sequence of 1-2-5 steps (up or down the frequency range of 1 kHz to 2 GHz) for each execution.

To confirm the current span value, send the data request message SPF? and check the value by receiving the message SPF△f sent from talker.

Table 11-6 Signal Search

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
SIGNAL SEARCH	PEAK	PEAK→CF PEAK→REF	PCF PRL		
	SPAN	SPAN UP SPAN DOWN	SPU SPD		
	SCROLL	LEFT RIGHT	SCR△0 SCR△1	SCR? SCR?	SCR△0 SCR△1

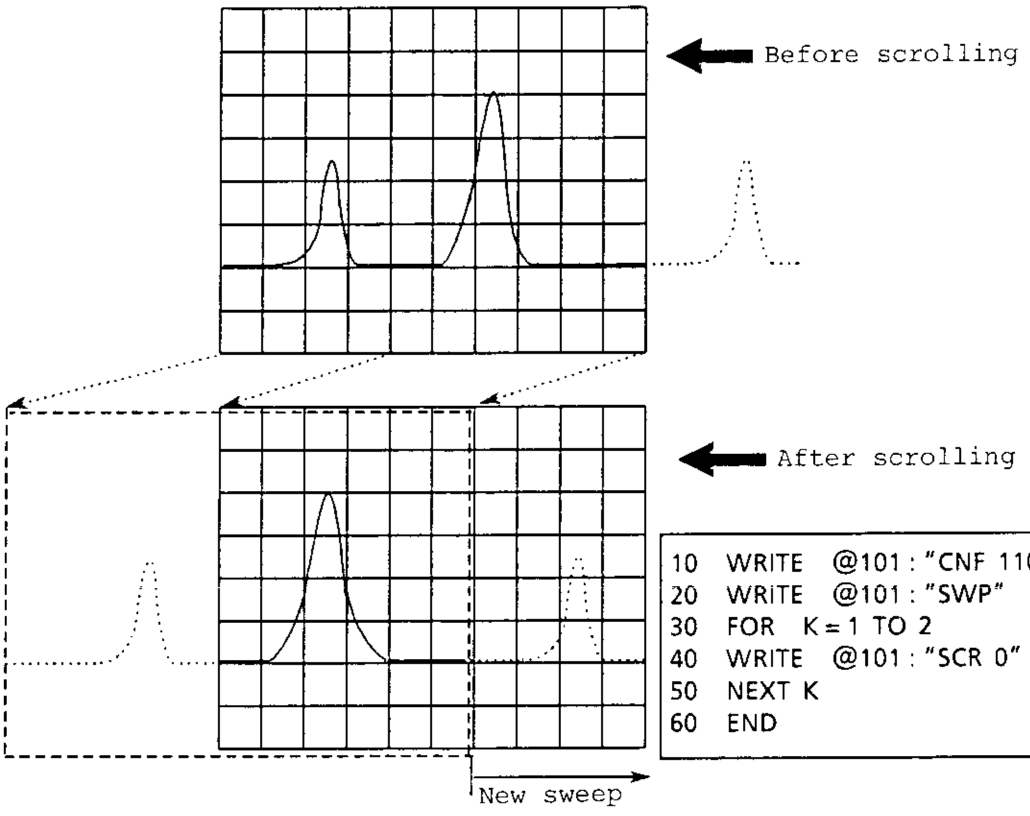
<Example 1>

Step-up the span four times and check the span value.

```
10  DIM SP$*20
20  FOR  K=1 TO 4
30    WRITE  @101:"SPD" ! SPAN STEP DOWN
40  NEXT  K
50  WRITE  @101:"SPF" ?
60  READ  @101:SP$
70  PRINT  SP$
80  END
```

<Example 2>

Scroll spectrum waveform to left by four divisions.



```
10  WRITE  @101:"CNF 1100MHZ;SPF 1MZ"
20  WRITE  @101:"SWP"
30  FOR  K=1 TO 2
40  WRITE  @101:"SCR 0"
50  NEXT K
60  END
```

One scroll execution shifts the waveform by two divisions. In the above example, SCRΔ0 is executed twice to scroll four divisions.

11.7 AUTO Mode (RESOLN BW, ATTEN, SWEEP TIME, VID BW)

The MS2601A can automatically select the most appropriate RESOLN BW, ATTEN, SWEEP TIME, and VID BW settings listed in Table 11-6 even when the REF LEVEL and SPAN settings are changed.

This is the function provided in the AUTO mode (ON). See Table 11-7 for details.

Table 11-7 AUTO Mode ON/OFF

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
MENU	AUTO mode	RES BW MANUAL RES BW AUTO	ARB△0 ARB△1	ARB? ARB?	ARB△0 ARB△1
		ATTEN MANUAL ATTEN AUTO	AAT△0 AAT△1	AAT? AAT?	AAT△0 AAT△1
		SWP TIME MANUAL SWP TIME AUTO	AST△0 AST△1	AST? AST?	AST△0 AST△1
		VID BW MANUAL VID BW AUTO	AVB△0 AVB△1	AVB? AVB?	AVB△0 AVB△1
		UNCAL display OFF ON	UNC△0 UNC△1	UNC? UNC?	UNC△0 UNC△1
		UNCAL status NORMAL UNCAL	——— ———	UCL? UCL?	UCL△0 UCL△1

- ■ The AUTO mode is set to ON in the initial state. For ordinary measurements, the mode need not be changed to MANUAL for RESOLN BW, ATTEN, SWEEP TIME, or VID BW.
- ■ Even when all the items listed in Table 11-7 are set in the AUTO mode, if one of the items listed in Table 11-8 is manually set, the corresponding control item listed in Table 11-7 is changed to MANUAL.

Table 11-8 Setting Bandwidth and Sweep Time

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
MENU	RESOLUTION BAND WIDTH	RESOLN BW			
		30 Hz	RBW△0	RBW?	RBW△0
		100 Hz	RBW△1	RBW?	RBW△1
		300 Hz	RBW△2	RBW?	RBW△2
		1 kHz	RBW△3	RBW?	RBW△3
		3 kHz	RBW△4	RBW?	RBW△4
		10 kHz	RBW△5	RBW?	RBW△5
		30 kHz	RBW△6	RBW?	RBW△6
		100 kHz	RBW△7	RBW?	RBW△7
		300 kHz	RBW△8	RBW?	RBW△8
		1 MHz	RBW△9	RBW?	RBW△9
		200 Hz	RBW△10	RBW?	RBW△10
		9 kHz	RBW△11	RBW?	RBW△11
		120 kHz	RBW△12	RBW?	RBW△12
	ATTENUATION	ATTEN			
		0 dB	ATT△0	ATT?	ATT△0
		10 dB	ATT△1	ATT?	ATT△1
		20 dB	ATT△2	ATT?	ATT△2
		30 dB	ATT△3	ATT?	ATT△3
		40 dB	ATT△4	ATT?	ATT△4
		50 dB	ATT△5	ATT?	ATT△5
	VIDEO BANDWIDTH	VIDEO BW			
		1 Hz	VBW△0	VBW?	VBW△0
		10 Hz	VBW△1	VBW?	VBW△1
		100 Hz	VBW△2	VBW?	VBW△2
		1 kHz	VBW△3	VBW?	VBW△3
		10 kHz	VBW△4	VBW?	VBW△4
		100 kHz	VBW△5	VBW?	VBW△5
		OFF	VBW△6	VBW?	VBW△6
	SWEEP TIME	SWEEP TIME	SWT△t t = 50 to 100000 (unit: ms)	SWT?	SWT△t t (unit: ms)

<Example>

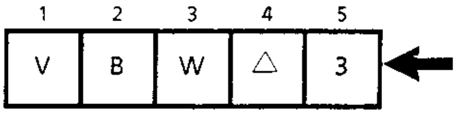
Measure with VID BW of 1/10 of bandwidth set in AUTO mode.

If UNCAL occurs, restore original bandwidth.

```
 10  WRITE @101:"VBW?" .............. VID BW data request
 20  READ @101:VB$  ................. Current VID BW
 30  LET NU=VAL(VB$(5:5)) ........... Conversion of last character into
 40  !                                numeric value
 50  IF NOT(NU>5 OR NU<1)THEN
 60    WRITE @101:"VBW"&STR$(NU-1)... Changing VID BW into VID BW/10
 70    WRITE @101:"UCL?" ............ UNCAL data request
 80    READ @101:UC$
 90    IF UC$="UCL 1"THEN ...........⎫ Restoring original bandwidth if
100      WRITE @101:"VBW"&STR$(NU) ..⎭ UNCAL
110    ELSE
120    END IF
130  ELSE
140  END IF
150  END
```

Line 30:

Assume that the message sent from the talker is VBW△3 (VID BW = 1 kHz).



VBW△3 is stored in the variable VB$ on line 30. Therefore, fetch 3 by using VB$ (5:5) and convert it into a numeric value by using VAL (VB$(5:5)). (See Note in paragraph 11.3.3 for VAL function.)

Line 50:

BW 1 Hz (VBW△0) and BW OFF (VBW△6) are ignored.

11.8 A-B and REFERENCE LINE

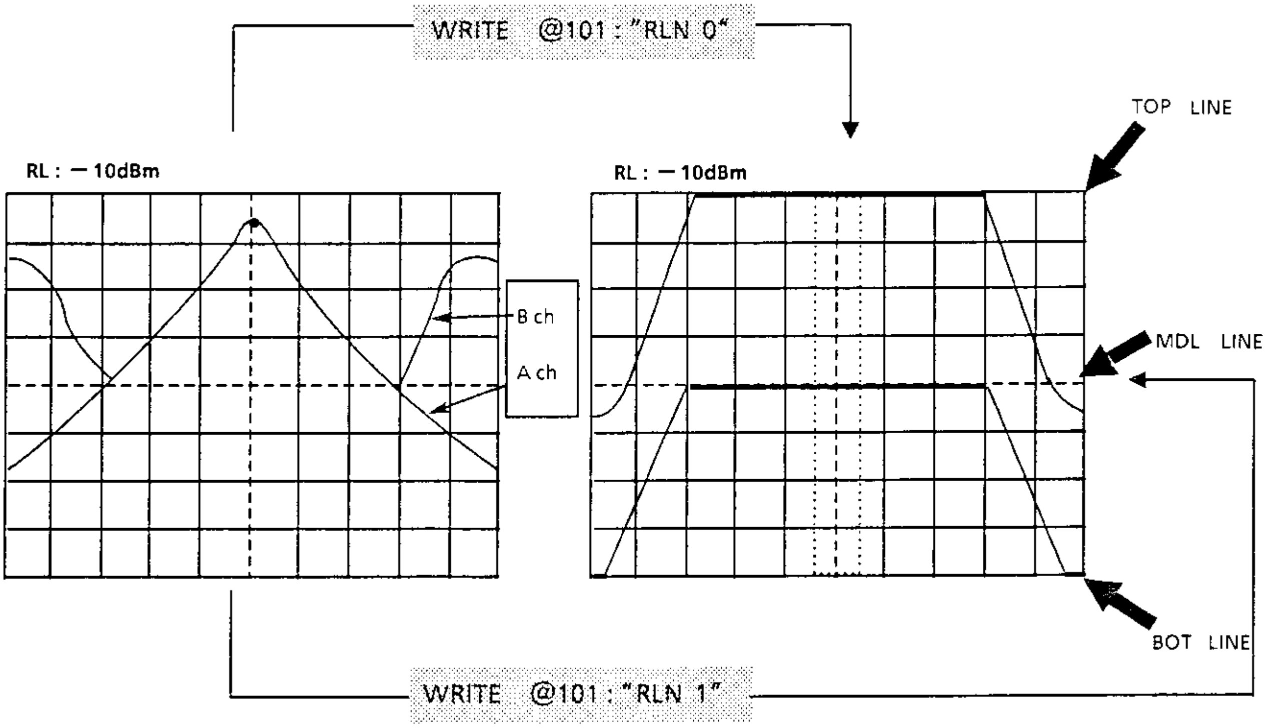
Three types of reference line (0 value position) are used for the results of the A-B function: TOP, MID (MDL), and BOTTOM (BOT) as listed in Table 11-9.

Table 11-9 Memories A and B and Reference Line

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
MENU	A,B MEMORY	A→B	ATB		
		A−B OFF ON	AMB△0 AMB△1	AMB? AMB?	AMB△0 AMB△1
	REFERENCE LINE	REF LINE TOP MDL BOT	RLN△0 RLN△1 RLN△2	RLN? RLN? RLN?	RLN△0 RLN△1 RLN△2

If the relationship between channels A and B is $A \leqq B$ at all points as shown in the figure on the left, the TOP REF LINE can be used because A-B is always negative.

Note that because MID is initially selected, the RLN message need not be sent when only using MID.



11.9 Sweep Control

The difference between the control item SINGLE (TRG△4) and the single sweep execution (SWP) listed in Table 11-10 is explained in this paragraph.

Table 11-10 Sweep Control

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
MENU	TRIGGER	TRIG			
		FREE	TRG△0	TRG?	TRG△0
		VIDEO	TRG△1	TRG?	TRG△1
		LINE	TRG△2	TRG?	TRG△2
		EXT	TRG△3	TRG?	TRG△3
		SINGLE	TRG△4	TRG?	TRG△4
		START	TRG△5	TRG?	TRG△5
	SINGLE SWEEP	Single sweep execution	SWP	—	—
		Sweep in progress	—	SWP?	SWP△0
		Sweep terminated	—	SWP?	SWP△1

The differences between TRG△4 and SWP are as follows:

TRG△4

The sweep termination status is checked using a status message.
Even if the sweep is not completed, other messages can be executed. This is primarily used for interrupt (parallel) processing using a status message.

SWP

Other messages cannot be executed until the sweep is completed. Therefore, SWP is more useful for executing subsequent processing after completing a single sweep.

See Section 12 for details on SINGLE SWEEP messages.

11.10 Reading and Writing Spectrum Data

Table 11-11 lists the spectrum data messages and A ch/B ch WRITE/READ messages.

(1) Reading spectrum data

To read 201 points of data from measurement points 150 to 350 as shown in the figure below, send the following data request message from the controller to the MS2601A.

- Send start address P0= 150
- Send data amount P1 = (350-150) + 1 = 201
- For channel A, the data request message XMA? 150,201 is sent from the controller to the MS2601A;
- For channel B, XMB? 150,201 is sent.

The talker send message sent from the MS2601A to the controller is stored in the built-in or external memory of the controller.

(2) Writing spectrum data

To rewrite the 201 points of the above data from start point 150 in channel A of the MS2601A, send the data (201 array elements) after defining 150 as the start address.

```
10  DIM  SP(200)
20  WRITE  @101:"AWR 0"
30  WRITE  @101:"XMA 150"
40  FOR  K=0 TO 200
50     WRITE  @101 USING "F8":SP(K)
60  NEXT  K
70  END
```

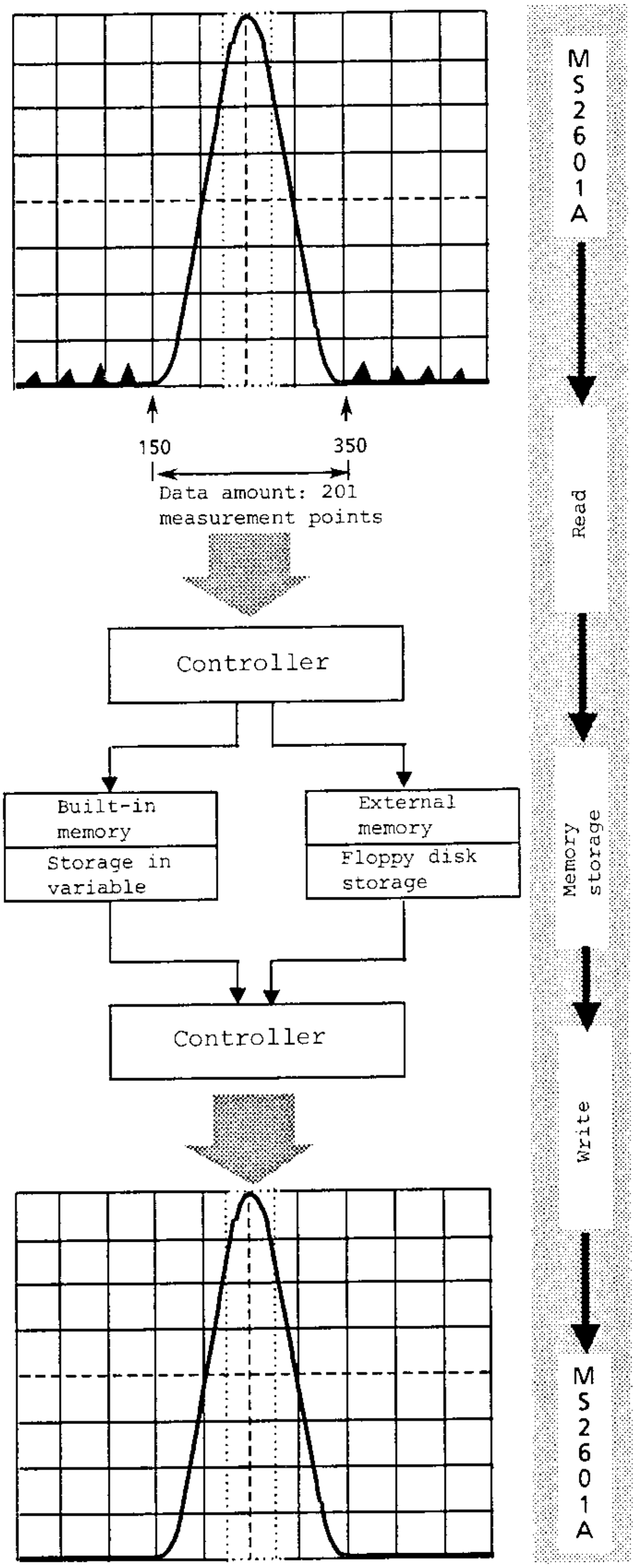


Fig. 11-3 Spectrum Data

Table 11-11 Spectrum Data in A ch/B ch

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
SPECTRUM DATA	A ch	Memory A	XMA△P	XMA?△P0,P1	b
	B ch	Memory B	XMB△P	XMB?△P0,P1	b
			p: Start address from 0 to 500 The subsequent numeric send data are input sequentially from the start address.	P0: Send start address from 0 to 500 P1: Send data amount from 1 to 501	b: Two-byte binary data or seven-character ASCII data <Ex.> -123.56
	ASCII/ BINARY	ASCII data	BIN△0	BIN?	BIN△0
		BINARY data	BIN△1	BIN?	BIN△1
MENU	A ch WRITE/ READ	WRITE OFF	AWR△0	AWR?	AWR△0
		WRITE ON	AWR△1	AWR?	AWR△1
		WRITE MODE			
		NORMAL	AMD△0	AMD?	AMD△0
		MAX HOLD	AMD△1	AMD?	AMD△1
		AVER	AMD△2	AMD?	AMD△2
		READ OUT			
		OFF	ARD△0	ARD?	ARD△0
		ON	ARD△1	ARD?	ARD△1
	B ch WRITE/ READ	WRITE OFF	BWR△0	BWR?	BWR△0
		WRITE ON	BWR△1	BWR?	BWR△1
		WRITE MODE			
		NORMAL	BMD△0	BMD?	BMD△0
		MAX HOLD	BMD△1	BMD?	BMD△1
		AVER	BMD△2	BMD?	BMD△2
		READ OUT			
		OFF	BRD△0	BRD?	BRD△0
		ON	BRD△1	BRD?	BRD△1
TERMINATOR		LF	TRM△0	—	—
		CR	TRM△1	—	—
		CR/LF	TRM△2	—	—

11.10.1 High-speed I/O of spectrum data

The high-speed I/O execution conditions are as follows:

1. Specify two-byte binary data with the control message BINΔ1.
2. Use a numeric array variable to store the send data in integer (INT) precision by using the DIM statement.
3. Use I/O statements MAT READ@ USING and MAT WRITE@ USING.
4. Specify WH for the I/O format (see paragraph 11.3.4).
5. Use EOI as terminator.

To input or output ASCII data at high speed, the following conditions must be satisfied.

1. Use a character-string array variable to store the send data.
2. Use I/O statements MAT READ@ and MAT WRITE@.
3. Use LF as the terminator.

The following sample programs apply to Fig. 11-3.

11.10.2 Sample program for reading spectrum data

<Example 1>

Read spectrum data from channel B in ASCII code.

(1) With FOR-NEXT loop

```
  10 DIM  SP$(200)
             └──────────── Array specification: 201 from SP$(0) to SP$(200)
  20 WRITE  @101:"BRD 1"! Bch READ ON
  30 WRITE  @101:"BIN 0"! ASCII DATA
● 40 WRITE  @101:"XMB? 150,201"! DATA REQUEST
  50 FOR K=0 TO 200
● 60   READ  @101:SP$(K)
  70   PRINT K,SP$(K)
  80 NEXT K
  90 END
```

(2) With MAT-READ

```
● 10 SEPARATOR IS CHR$(10)
                      └──── Specifies line feed (LF) as separator
  20 DIM  SP$(200)*30
  30 WRITE  @101:"BRD 1"! Bch READ ON
  40 WRITE  @101:"BIN 0"! ASCII DATA
● 50 WRITE  @101:"XMB? 150,201"! DATA REQUEST
● 60 MAT READ  @101:SP$
        └──────────────────── Reads data consecutively into specified
  70 !                        array variable
  80 !
  90 !
 100 FOR K=0 TO 200
 110   PRINT K,SP$(K)
 120 NEXT K
 130 END
```

<Example 2>

Read spectrum data from channel B in two-byte binary code.

(1) With FOR-NEXT loop

```
  10 DIM  INT SP(200)
  20 WRITE  @101:"BRD 1"! Bch READ ON
  30 WRITE  @101:"BIN 1"! BINARY DATA
● 40 WRITE  @101:"XMB? 150,201"! DATA REQUEST
  50 FOR K=0 TO 200
● 60   READ  @101 USING "WH":SP(K)
                     └──────────── Reads two bytes as single data
                                   (the high-order byte is read first)
  70   PRINT SP(K)/100
  80 NEXT K
  90 END
```

(2) With MAT READ

```
● 10 DIM  INT SP(200)!
  20 WRITE  @101:"BRD 1"! Bch READ ON
  30 WRITE  @101:"BIN 1"! BINARY DATA
  40 WRITE  @101:"XMB? 150,201"! DATA REQUEST
● 50 MAT READ  @101  USING "WH": SP
  60 FOR K=0 TO 200
  70   PRINT SP(K)/100
  80 NEXT K
  90 END
```

11.10.3 Sample program for writing spectrum data

The following example stores the spectrum data read from channel B into the DATA 1 file, and then reads it into channel A.

```
10 DIM  INT SP(200)

20 WRITE  @101:"BRD 1"! ········ Bch READ ON

30 WRITE  @101:"BIN 1"! ········ BINARY DATA

40 WRITE  @101:"XMB? 150,201"

50 MAT READ  @101 USING "WH":SP
```

Reads data from channel B into array variable SP

```
60 OPEN #1:"DATA 1",OUTPUT,STREAM

70 MAT  WRITE #1:SP

80 CLOSE #1
  :
  :
  :
```

Writes contents of array variable SP into DATA 1 file

```
110 OPEN #1:"DATA 1",STREAM

120 MAT  INPUT #1:SP

130 CLOSE #1
```

Reads data from DATA 1 file into array variable SP

```
140 WRITE  @101:"AWR 0;BRD 0" ! ·· Ach WRITE OFF

150 WRITE  @101:"XMA 150"

160 MAT  WRITE  @101 USING "F6,/,Z":SP
```

Writes data from array variable SP into channel A

F6: F indicates fixed-point format and 6 indicates number of integer digits

/: Indicates that terminator output for each element

Z: Indicates that terminator (CR or LF) of last data item not output twice

```
170 WRITE  @101:"ARD 1" ! ······ ACH READ ON

180 END
```

11.11 Writing Antenna Factor Data

The antenna frequency and factor data is written in the built-in memory EEPROM (Electrically Erasable Programmable Read Only Memory) of the MS2601A at program execution by the GP-IB controller.

Note:

The EEPROM retains the contents even when the power is turned off.
Rewriting automatically erases previously-stored data.
SAVE-RECALL is not applicable to the stored data.

(1) Control messages for writing data

Table 11-12 lists the control messages used for writing the antenna frequency data and the corresponding antenna factor data.

Table 11-12 Antenna Factor Control Messages

Parameter		Device message		
Item	Control item	Control	Data request	Sent from talker
USER ANTENNA	USER ANTENNA CORR DATA (FREQ)	CD6△P P: Start address from 0 to 149 Up to 150 frequency data items (ASCII code) are received next. Data: Positive integer in 1 kHz units Data 0 should be input to address 0, and data 3000000 should be input to address 149.	CD6?△P0,P1 P0: Start address from 0 to 149 P1: Send data amount	b b: Four-byte binary data
	USER ANTENNA CORR DATA (FACTOR)	CD7△P P: Start address from 0 to 149 Up to 150 antenna factor data items (ASCII code) are received next. Data: Signed integer in 0.1 dB units	CD7?△P0,P1 P0: Start address from 0 to 149 P1: Send data amount	b b: Two-byte binary data or ASCII code

<Supplement to Table 11-12>

Item	Frequency data	Factor data
Start address	P = 0 to 149 (usually 0)	P = 0 to 149 (usually 0)
First data**	Dummy data 0 at address 0	Dummy data at address 0*
Last data**	Dummy data 3000000 at address 149	Dummy data at address 149
Data unit	1 kHz	0.1 dB
Net data amount**	Max. of 148 If the data amount is less than 148, dummy data 0 is inserted before the data and dummy data 3000000 is inserted after the data.	Max. of 148 If the data amount is less than 148, dummy data* is inserted according to the frequency dummy data.

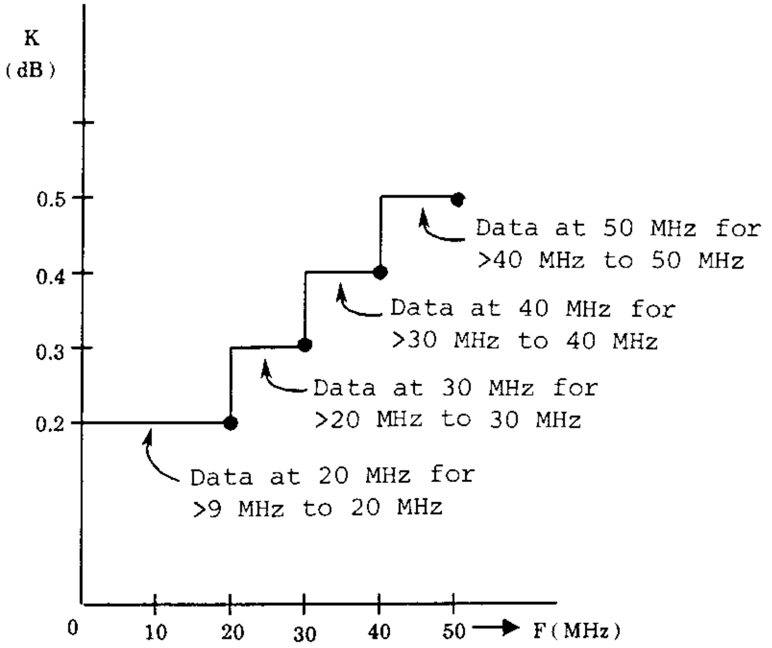
* All integers are acceptable.

** A total of 150 point data items must be input (including the first and last data items).

(2) Preparing for data input

For example, set the antenna frequency range from 10 MHz to 1480 MHz in steps of 10 MHz. The antenna factor corresponding to the frequency is increased from 10 MHz in steps of 0.1 dB to reach 14.8 dB at 1480 MHz. The following graph on the right shows how to set the antenna factor according to frequency range.

Frequency (F)	Antenna factor (k)
≦9 MHz	Out of range
10 M ~ 20 MHz	0.2 dB
30 MHz	0.3 dB
⋮	⋮
1000 MHz	10.0 dB
⋮	⋮
1480 MHz	14.8 dB
>1480	Out of range



The antenna factor and frequency input data are as follows

Measurement point	Frequency (unit: 1 kHz)	Antenna factor (unit: 0.1 dB)
1	0	0 (dummy)
2	9 000	2
3	20 000	3
4	30 000	4
	⋮	⋮
102	1 000 000	101
		⋮
148	1 470 000	148
149	1 480 000	149 (dummy)
150	3 000 000	150 (dummy)

Input antenna factor below frequency range and for the frequency range of 0 to ≤9000:0

Input antenna factor for frequency range of >9000 to ≤20000: 2

Input antenna factor for frequency range of >20000 to ≤30000: 3

Input antenna factor for frequency range of >30000 to ≤40000: 4

Input antenna factor for frequency range of >1000000 to <1010000: 101

Input antenna factor for frequency range of >1470000 to ≤1480000: 148

Input antenna factor for frequency range of >1480000 to ≤3000000: 149 (dummy)

Input antenna factor for frequency range >3000000: 150 (dummy)

(3) Creating programs and inputting data

■ Basic program

```
 10 !*****  USER ANTENNA USAGE  ************
 20 !
 30 LET  SPA = 101
 40 WRITE  @SPA : "INI"
 50 !
 60 !
 70 !
 80 !
 90 WRITE  @SPA : "ANT  4" ! .............................. USER ANTENNA FACTOR
100 WRITE  @SPA : "CD6  0" ! ............................................ FREQ.DATA
110 FOR  F = 0  TO  1480  STEP  10
120 LET  FDATA = F * 1000
130 WRITE  @SPA  USING "F10" : FDATA
140 NEXT  F
150 WRITE  @SPA  USING "F10" : 3000000
160 !
170 WRITE  @SPA : "CD7  0" ! ............................. ANTENNA FACTOR DATA
180 FOR  K = 1  TO  150  STEP  1
190 LET  ADATA = K
200 WRITE  @SPA  USING "F10" : ADATA
210 NEXT  K
220 END
```

11.2 Displaying TITLE

The following example displays "MS2601A" as a title from the fifth character at the first line in the title area on the CRT.

```
10 LET SPA=101
20 WRITE @SPA:"TEN 0,4,MS2601A"
30 WRITE @SPA:"TTL 1"
```

SECTION 12

GP-IB PROGRAMMING

This section explains programming using the sweep control messages that may or may not require a status message. The status message is a type of instruction used to interrupt the controller, and is very effective for parallel processing.

TABLE OF CONTENTS

12.1 Programming Using SWP Message

The SWP message is used when the processing after a single sweep is executed normally.

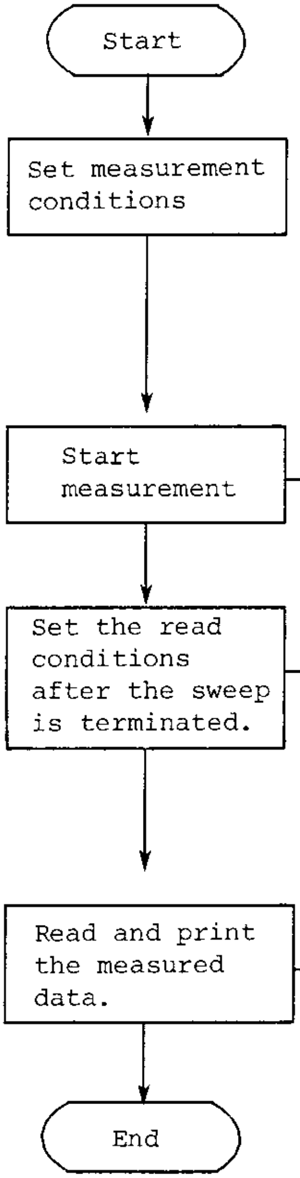
SWP disables the execution of other messages until the current sweep operation is terminated. (Messages cannot be sent to the MS2601A and other equipment connected to the GP-IB.)

12.1.1 Basic programming

An example of basic programming using status messages is explained as follows using the Packet personal technical computer as an example.

<Example 1>

Read and print (display) all trace point levels in ASCII code when the maximum point is set to the CRT center with CF = 300 MHz and SPAN = 1 kHz.



```
10 DIM MAG(500) ········· Registers variable area
20 LET SPA=101 !  ········· Defines MS2601A address in
                            variable SPA
30 IFC @1 ·········· Initializes interface functions
                     of all devices connected to GP-IB
40 DCL @1 ············ Initializes all devices connected to GP-IB
                       to their preset initial states
                       Use DCL @SPA or WRITE @SPA:"INI" to
                       initialize only the MS2601A.
50 WRITE @SPA:"CNF 300MZ; SPF 1kZ"  ······ Sets MS2601A to
                                           CF = 300 MHz and
                                           SPAN = 1 kHz
60 WRITE @SPA:"BIN 0"  ······· Sets read data in ASCII

70 WRITE @SPA:"SWP" !  ······· Starts single sweep to
                               obtain spectrum data

80 WRITE @SPA:"PCF" !  ······· Shifts peak to CF
90 WRITE @SPA:"SWP" !  ···· Sweeps to shift peak to CF

100 WRITE @SPA:"XMA? 0,501"  ······· Data request for
                                     measured results
110 FOR K=0 TO 500
120 READ @SPA:MAG(K)  ······ Reads measured results
130 PRINT K,MAG(K);"dBm"  ······ Prints measured data
140 NEXT K
150 END
```

Fig. 12-1 Basic Programming Using SWR Message

12.1.2 Sample programs

<Example 1>

Set center frequency to 100 MHz and frequency span to 100 kHz. Then read and print peak frequency and level of received signal.

```
 10 LET SPA = 101
 20 WRITE @SPA : "INI"
 30 WRITE @SPA : "SPF 100KZ ; CNF 100MZ"
 40 WRITE @SPA : "SWP ; MKS 0"  .................. Peak search after single sweep
 50 WRITE @SPA : "BIN 0"! ASCII DATA
 60 WRITE @SPA : "MKF?" ! ....................... Data request for peak frequency
 70 READ @SPA : FREQ
 80 WRITE @SPA : "MKL?" ! .......................... Data request for peak level
 90 READ @SPA : LEVEL
100 PRINT USING "FREQ = ####.#### MHz" : FREQ / 1000000
110 PRINT USING "LEVEL = ####.## dBm" : LEVEL
120 END
```

If the frequency of the peak is 100.02 MHz and the level is -20.5 dBm:

■ FREQ

```
Sent from → 00 100 020 000 → FREQ → 100 020 000 → Results of line 100:
talker                                              100.0200 MHz
            |←─────────────→|
       11-character ASCII code
       3030313030303230303030H
       ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑
       0 0 1 0 0 0 2 0 0 0 0
```

■ LEVEL

```
Sent from → -020.50 → LEVEL → -20.5 → Results of line 100: -20.5
talker
            |←───→|
      Seven-character ASCII code
        2D3032302E3530H*
        ↑ ↑ ↑ ↑ ↑ ↑ ↑
        - 0 2 0 . 5 0
```

(See Appendix A for ASCII code.)

---

*H indicates a hexadecimal expression.

** $-2050D = -(0 \times 16^3 + 8 \times 16^2 + 0 \times 16^1 + 2 \times 16^0) = -0802H$

<Example 2>

Harmonic spurious level measurement

Set the center frequency to 300 MHz and the span to 10 kHz to obtain a fundamental wave level of 300 MHz, and to measure up to the third-order harmonic level.

```
 10 ! *** HARMONIC SPURIOUS MEASUREMENT ***
 20 LET SPA = 101
 30 WRITE @SPA : "INI"
 40 WRITE @SPA : "SPF 10 KZ ; CNF 300MZ" !  ..........................  CF/SPAN SETUP
 50 WRITE @SPA : "SWP ; MKS 0" !  .........................  1 SWEEPING , PEAK SEARCH
 60 WRITE @SPA : "BIN 0 ; MKF?" !  ...................  ASCII CODE FREQ DATA REQUEST
 70 READ @SPA : FREQ
 80 WRITE @SPA : "FSS " , FREQ !  .....................................  FREQ STEP SIZE
 90 WRITE @SPA : "MKL ?"
100 READ @SPA : LEVEL
110 WRITE @SPA : "FUP ; SWP ; MKS 0" !  ..............  STEP UP , 1 SWEEP , PEAK SEARCH
120 WRITE @SPA : "MKL ?"!  ..................................  2 LEVEL DATA REQUEST
130 READ @SPA : LEVEL 2
140 WRITE @SPA : "FUP ; SWP ; MKS 0"!  ..............  STEP UP , 1 SWEEP , PEAK SEARCH
150 WRITE @SPA : "MKL ?"!  ..................................  3 LEVEL DATA REQUEST
160 READ @SPA : LEVEL 3
170 PRINT "*** HARMONIC SPURIOUS ***"
180 PRINT "Fundamental " ; FREQ / 1000000 ; "MHz  " ; LEVEL ; "dBm"
190 PRINT "Second Level  " ; LEVEL 2 ; "dBm"
200 PRINT "Third level  " ; LEVEL 3 ; "dBm"
210 END
```

<Example 3>

Using NEXT PEAK

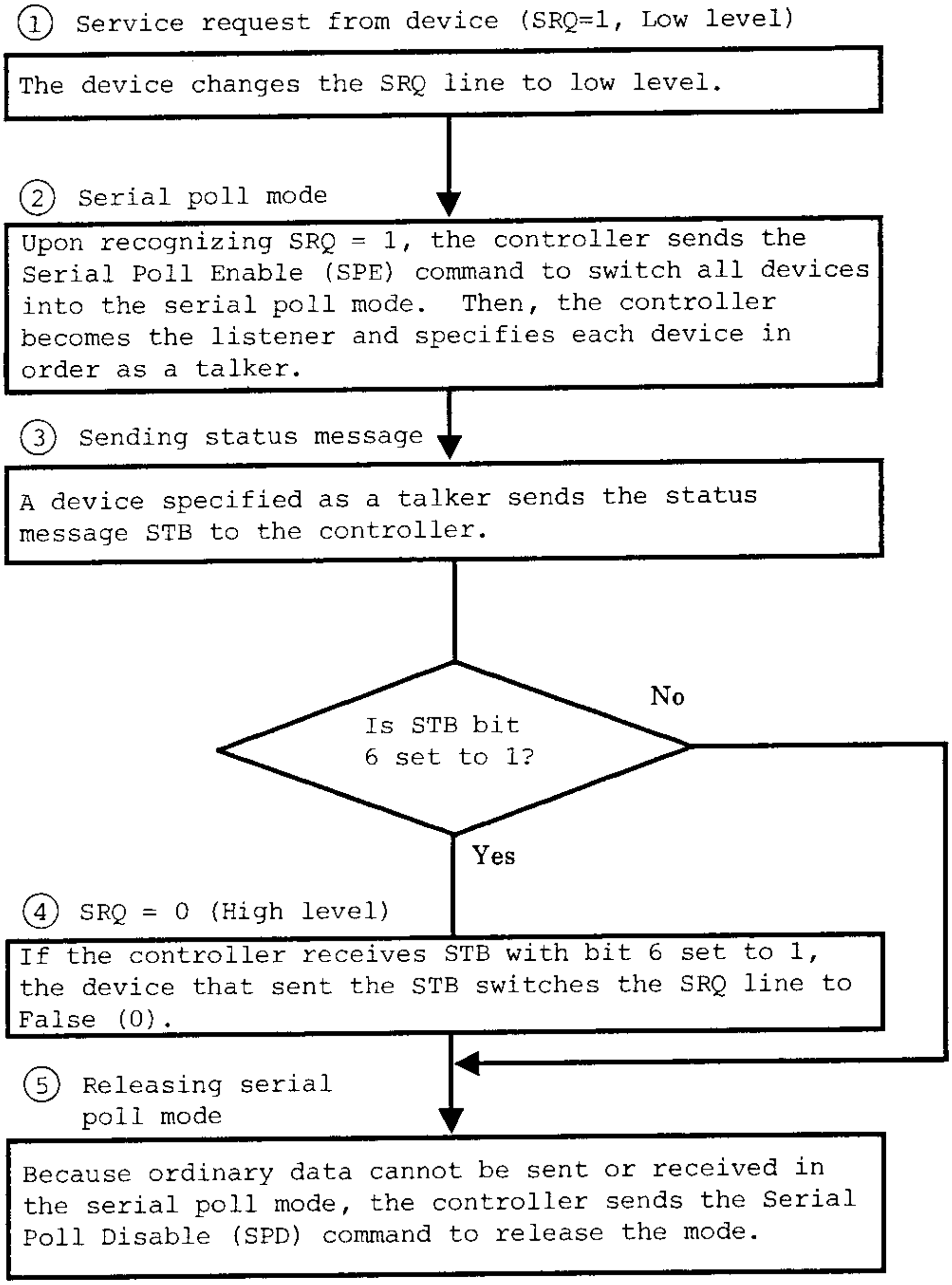
Search for peak points in descending order at FULL SPAN to measure each frequency and level.

```
 10 ! *** NEXT PEAK SEARCH ***
 20 LET N=1
 30 LET SPA=101
 40 WRITE @SPA:"INI"
 50 WRITE @SPA:" STF 10MZ"
 60 WRITE @SPA:"SWP" ............................................ 1 SWEEPING
 70 WRITE @SPA:"MKW 1;MKS 0"! ........................... SPOT,PEAK ENTRY
 80 GO SUB 130
 90 WRITE @SPA:"MKS 1"! ................................... NEXT PEAK ENTRY
100 GO SUB 130
110 IF N<11 THEN 90
120 STOP
130 *** Data read subroutine ***
140 WRITE @SPA:"BIN 0;MKF?"! ..................... ASCII CODE DATA REQUEST
150 READ @SPA:FREQ
160 WRITE @SPA:"MKL?"
170 READ @SPA:LEVEL
180 PRINT USING "## FREQ= ####.#### MHz   LEVEL=####,## dBm":N, FREQ/
    100000,LEVEL
190 LET N=N+1
200 RETURN
210 END
```

12.2 Programming Using Interruption by Status Message

The GP-IB enables a device to interrupt the controller. If the device issues an SRQ signal, the controller is interrupted. The controller checks which device has issued the interrupt. This is called polling.

There are two types of polling: serial and parallel. The MS2601A has a serial polling function. Figure 12-2 outlines the use of this function.



① Service request from device (SRQ=1, Low level)

The device changes the SRQ line to low level.

② Serial poll mode

Upon recognizing SRQ = 1, the controller sends the Serial Poll Enable (SPE) command to switch all devices into the serial poll mode. Then, the controller becomes the listener and specifies each device in order as a talker.

③ Sending status message

A device specified as a talker sends the status message STB to the controller.

Is STB bit 6 set to 1?

④ SRQ = 0 (High level)

If the controller receives STB with bit 6 set to 1, the device that sent the STB switches the SRQ line to False (0).

⑤ Releasing serial poll mode

Because ordinary data cannot be sent or received in the serial poll mode, the controller sends the Serial Poll Disable (SPD) command to release the mode.

Fig. 12-2 Serial Poll Mode

The following statement is used to execute the processing of the status data in Fig. 12-2 on the Packet V Personal Technical Computer.

```
STATUS @Device number: Numeric variable
```

For serial polling of the MS2601A at address 1, write the statement as follows.

```
STATUS @101 : S
```

S: Inputs status data content S (weights) to the controller

1: Specifies talker address 1 for MS2601A

@1: GP-IB interface select code

Each status data bit has meaning. Therefore, Table 8-4 is listed again as Table 12-1 below.

Table 12-1 Status Message Line Allocation

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Line Value	DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1
1	X	Service requested	Error (abnormal status)	Sweep end	X	CAL error	PMC error	ILLEGAL COMMAND
0	X	Service not requested	Normal status	X	X	X	X	X
Weight	128	64	32	16	8	4	2	1
Sending	0	1/1	1/1	1/1	0	1/1	1/1	1/1

In serial polling, the controller requests a status byte from each device and checks which device generated the SRQ from the status byte contents. The device that generated the SRQ sets bit 6 (SRQ message) of the status byte to 1. The other bits indicate the reason for issuing the SRQ.

The program uses the SRQ command to turn SRQ generation on or off before serial polling.

Parameter		Device message		
Item	Control item	Control	Data request	Sent from talker
SRQ control	SRQ OFF SRQ ON	SRQ△0 SRQ△1	SRQ? SRQ?	SRQ△0 SRQ△1

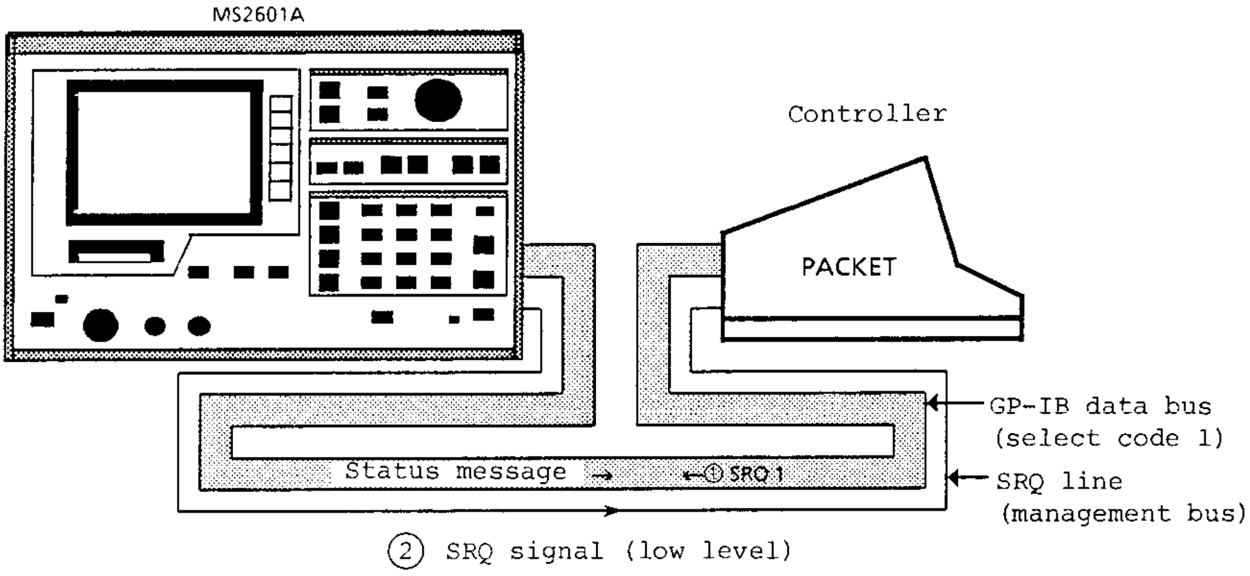


Fig. 12-3 Sending Status Messages

①: The controller executes WRITE @101:"SRQ 1" to turn on the MS2601A SRQ function. (←①SRQ 1 in Fig. 12-3)

②: When the MS2601A receives SRQΔ1, SRQ is issued to the controller with bit 6 set to 1 (low) at sweep termination or error (Table 12-1). In other words, a service request is issued if the following conditions occur. (② SRQ signal (low level) in Fig. 12-3)

1. Sweep termination.......... Bit 4 set to 1
2. Error or other abnormal statuses.. Bit 5 set to 1

The following explanation is based on the sweep termination status (with no error).

To execute a single sweep on the MS2601A, the SRQ function of the MS2601A must be turned on and the TRGΔ4 or TRGΔ5 control message (listed in the following table) must be sent from the controller to the MS2601A. The message enables a single sweep to be executed. TRGΔ4 is the single sweep mode setting command that executes one sweep. TRGΔ5 enables another single sweep to be executed when in the single sweep mode.

Parameter			Device message		
Item		Control item	Control	Data request	Sent from talker
MENU	TRIGGER	TRIG			
		FREE	TRG△0	TRG?	TRG△0
		VIDEO	TRG△1	TRG?	TRG△1
		LINE	TRG△2	TRG?	TRG△2
		EXT	TRG△3	TRG?	TRG△3
		SINGLE	TRG△4	TRG?	TRG△4
		START	TRG△5	TRG?	TRG△5

When a sweep is completed, a service request is issued to the controller with bit 6 set to 1 when bit 4 is set to 1 (sweep termination).

At that time, STATUS @101:S is executed. Because bits 6 and 4 of S are set to 1, the value of S is $2^6 + 2^4 = 80$.

The BIT (N,S) function is used to detect the value at binary bit position N of numeric variable S value ($\leqq$65535).

(Here, N: Bit position of numeric expression S)

Function	Function name	Example	Meaning
BIT(N,S)	Bit check	When HSTR$(16385,4)=4001 and 4001 = 0 1000 0000 0000 0001: BIT(15,16385)=0 BIT(0,16385)=1	Checks whether bit value is 0 or 1 at bit position N of numeric expression S

A service request for an interrupt can be issued from a device at any time, regardless of the current controller processing.

Note that some programs only enable the controller to use serial polling and check device status messages.

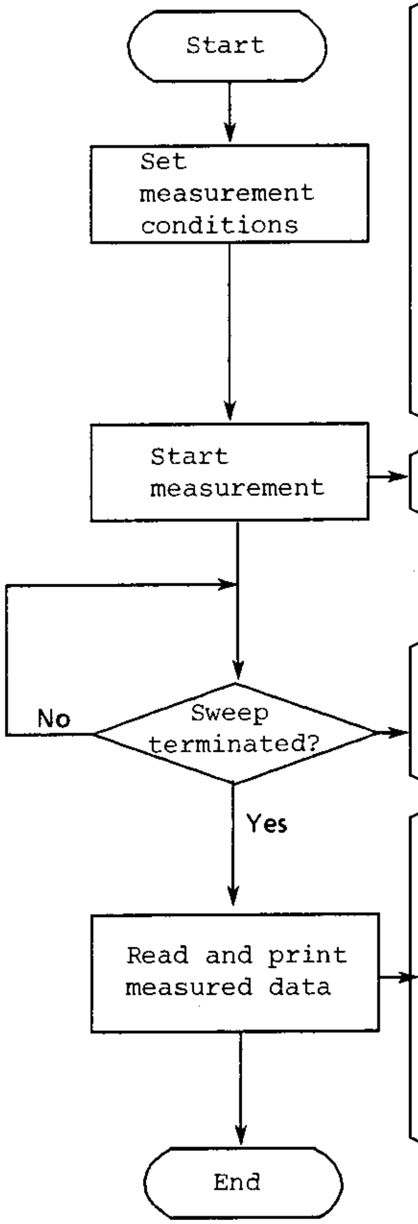
Paragraph 12.2.1 explains programming using serial polling and paragraph 12.2.2 explains programming using interrupt processing. Paragraph 12.2.3 explains programming using interrupt parallel processing.

12.2.1 Basic programming using serial polling

This program example executes serial polling from the controller.

<Example 1>

Read and print (display) all waveform point levels in two-byte binary format with CF = 300 MHz and SPAN = 1 kHz.



```
10 DIM MAG (500) ········· Registers variable area

20 LET SPA = 101 !  ········ SET MS2601A ADDRESS.
30 IFC @1 ! ·········· GP-IB INITIALIZE
40 DCL @1 ! ············ GP-IB DEVICE ALL INITIALIZING.
50 WRITE @SPA : "SPF 1KZ ; CNF 300MZ"
60 WRITE @SPA : "TRG 4" !  ······   TRIG = SINGLE
70 WRITE @SPA : "SRQ 1" !  ······   MS2601A SRQ ON

80 WRITE @SPA : "TRG 5" !  ·······    TRIG = RESTART

90 STATUS @SPA : S !  ···· SERIAL POLL
100 IF   NOT   (BIT (6,S) = 1 AND BIT(4,S) = 1)   THEN   90

110 WRITE @SPA : "BIN 1" !  ·······    BINARY READ
120 WRITE @SPA : "XMA? 0,501" !   ·······   RESULT REQUEST
130 MAT READ @SPA USING "WH" : MAG !  ···· RESULT
                                                READOUT
140 FOR K = 0 TO 500
150    PRINT USING"####.## dBm" : MAG ( K ) / 100
160 NEXT  K
170 END
```

Fig. 12-4 Basic Programming Using Serial Polling

```
100  IF  NOT  (BIT(6,S) = 1  AND  BIT(4,S) = 1)  THEN  90
```

The line 100 can be rewritten by evaluating with the weight S as follows:

```
100  IF  S><80  THEN  90  or  100  IF  S = 80  THEN  110  ELSE  90
```

12.2.2 Programming using interrupt processing

The program in paragraph 12.2.1 executes serial polling from the controller.

This paragraph explains how to create a program that suspends execution until the WAIT EVENT statement specified event occurs. When an interrupt is generated, the program restarts execution to read the measured values.

This event indicates SRQ. The program assigns it a name for processing purposes. An I/O interrupt received through an external I/O interface is generally called an external event.

- WAIT EVENT statement

The execution wait status continues until a PROCESS EVENT or SIGNAL statement declared event occurs.

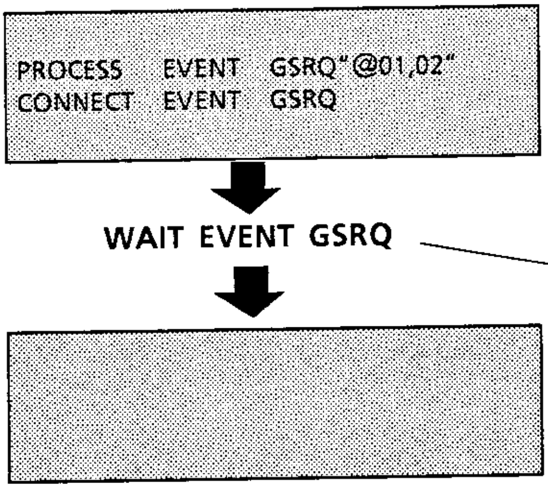
WAIT EVENT	Internal event flag name External event flag name	**TIMEOUT**	Numeric expression Character string expression

NOTE:

Internal event flag name External event flag name	Upper-case alphabetic characters, numbers, and underlines (_) can be used. The name must begin with an upper-case alphabetic character followed by any number of characters.

An internal event flag name is assigned to an event that can be freely defined in the program.

The external event flag name used in this paragraph is GSRQ because it is assigned to SRQ. (The name can be changed arbitrarily as mentioned in the above note on the format).



The name of an external event is declared in advance in the PROCESS EVENT statement. An external event cannot occur even when its name is declared. It must be validated by using the CONNECT EVENT statement.

Suspends execution until GSRQ event occurs

Describe the contents to be processed after the GSRQ event occurs (after suspended execution).

- PROCESS EVENT statement

The external event name to be generated by using the interface unit or function keys is declared as follows.

PROCESS EVENT	External event flag name	**"KEYkk"** **"@SS,nn"**

Note:

- External event flag name

  Upper-case alphabetic characters, numbers, and underlines (_) can be used. The name must begin with an uppercase alphabetic character followed by any number of characters.

- KEYkk

  This indicates an interrupt generated by using the function keys.

  kk: Two-digit number 00≦kk≦23

- @SS,nn

  This specifies the cause of an interrupt to be generated from the interface unit.

  SS: Select code of interface unit
  Two-digit number 00 ≦SS≦17

  nn: Bit number of interrupt cause
  Two-digit number 00 ≦nn≦15

"nn" is the number of the bit that indicates the cause of the interrupt from the I/O interface. To receive SRQ, specify 02. See Appendix B for details.

■ CONNECT EVENT statement

This statement enables the external event declared by the PROCESS EVENT statement to be generated.

CONNECT EVENT Event flag name [,Event flag name ...]

Note:

Event flag name

Upper-case alphabetic characters, numbers, and underlines (_) can be used. The name must begin with an upper-case alphabetic character followed by any number of characters.

<Example 1>

SRQ interrupt from GP-IB interface

```
● 10  PROCESS  EVENT  GSRQ"@01,02"
● 20  CONNECT  EVENT  GSRQ
  30  DO
● 40  WAIT  EVENT  GSRQ
          ∫
  45  EXIT  IF K = 5
          ∫
  50  PRINT"SRQ received";
  60  LOOP**
```

External event name

Because the GP-IB select code 1, specify @01. Specify 02 for the cause of interrupt to be generated from the GP-IB interface because bit 2 indicates SRQ reception.

** Loop processing is executed on the block between DO and LOOP. Control is released from this loop only when the conditional expression specified in the EXIT IF statement is satisfied.

EXIT IF conditional expression

Conditional expression = relational expression/
logical expression

Note:

The functions of the PROCESS EVENT and CONNECT EVENT statements for an SRQ interrupt only recognize the occurrence of an external event when the SRQ line (originally set to high level [false] status) is switched to low level (true). Therefore, the occurrence of an external event cannot be recognized if the SRQ line is true from the beginning and the SRQ line must be set to false before executing these statements. To do so, read the MS2601A status data and reset the previous service request status. See Fig. 12-2 ④ for details.

In the next example, the basic program in Fig. 12-4 is changed to an SRQ interrupt processing program with the PROCESS EVENT, CONNECT EVENT, and WAIT EVENT statements.

<Example 2>

Creating an SRQ interrupt processing program from the program of Example 1.

```
 10 DIM INT MAG(500)
 20 LET SPA = 101
 30 !
 40 !- - - - - - - - - - - - -Initialization- - - - - - - - - - - - -
 50 IFC  @1
 60 DCL  @1
 70 !- - - - - - - - - - - - -Device set- - - - - - - - - - - - - -
 80 WRITE  @SPA : "SPF 1KZ ; CNF 300MZ"
 90 WRITE  @SPA : "TRG 4"
100 !
110 ! - - - - - - - - - - - - -SRQ Event- - - - - - - - - - - - - -
120 STATUS  @SPA : S! ........................................... Dummy SRQ reset
130 PROCESS EVENT GSRQ "@01,02" ! ........................ GSRQ event declaration
140 CONNECT EVENT GSRQ ! ................................... Enables GSRQ event
150 !
160 !********************MEASUREMENT********************
170 WRITE  @SPA : "SRQ 1" ! ................................................ SRQ ON
180 WRITE  @SPA : "TRG 5" ! ...................................... SWEEP START
190 WAIT EVENT GSRQ ! ........................................... WAITS SWEEP END
200 !
210 !- - - - - - - - - - - - Reading and Printing- - - - - - - - - - -
220 !
230 WRITE  @SPA : "BIN 1"
240 WRITE  @SPA : "XMA ? 0 , 501"
250 MAT READ  @SPA USING "WH" : MAG
260 FOR K = 0 TO 500
270   PRINT USING "####.## dBm" : MAG (K) /100
280 NEXT K
290 END
```

Line 190 suspends execution until the GSRQ event occurs. When SRQ is received, the event GSRQ occurs. This releases the event wait status on line 190 so that the measured values can be read.

The WAIT EVENT SRQ statement has the same meanings as that on the right shown below. So, this program does not check the bit 6 of S.

```
WAIT EVENT GSRQ
```

=

```
10 DO
20   STATUS @105:S
30   EXIT IF BIT(6,S)=1
40 LOOP
```

12.2.3 Programming using interrupt parallel processing

The interrupt processing program in paragraph 12.2.2 only waits for execution at the WAIT EVENT statement to be restarted (until the GSRQ event occurs).

A parallel program enables other processing to be executed during the wait status.

(1) Interrupt parallel processing using function keys

The PROCESS EVENT statement format includes KEYkk. This means Packet personal technical computer function keys can be used as interrupt keys when a two-digit number is specified as kk. To use function key 1 as an interrupt key, specify 01 as kk.

The following program executes interrupt parallel processing when function key 0 is pressed.

(Event declaration for entire program)

```
10  PROCESS  EVENT  GOTOB"KEY00"
20  !
```

(Normal processing)

```
 30  !------Task  A-----
 40  !
 50  SET  FN  0,"^","INTERRUPT"
 60  CONNECT  EVENT  GOTOB
 70  START B
 80  DO
 90  PRINT  "Interrupt  key  No.?"
100  LOOP
110  END
```

(Interrupt processing section)

```
120  !------Task  B-----
130  PARACT  B  URGENCY  50
140  WAIT  EVENT  GOTOB
150  PRINT  "*************"
160  PRINT  "  F";KEYNO;"pressed"
170  PRINT  "************"
180  GO  TO  140
190  END  PARACT
```

```
            Interrupt  key  No.?
Normal      Interrupt  key  No.?
processing  Interrupt  key  No.?
            ******************
Interrupt →F0  pressed
            ******************
            Interrupt  key  No.?
            Interrupt  key  No.?
Normal      Interrupt  key  No.?
processing  Interrupt  key  No.?
restart     Interrupt  key  No.?
            Interrupt  key  No.?
            Interrupt  key  No.?
            ******************
Interrupt →F0  pressed
            ******************
Normal      Interrupt  key  No.?
processing  Interrupt  key  No.?
restart     Interrupt  key  No.?
```

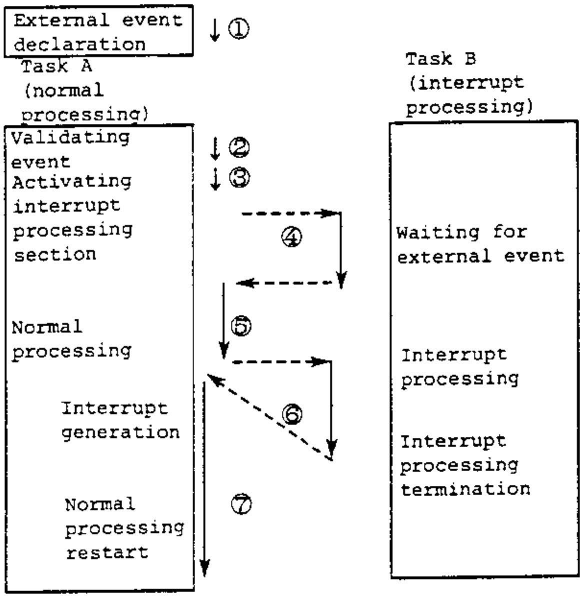


Fig. 12-5 Interrupt Parallel Processing using Function Keys

Line 50:

This line defines function key 0 as the interrupt key.

Line 80 to 100:

DO to LOOP has a similar function to the GO TO 140 on line 180. Both execute loop processing.

Line 160:

Pressing function key 0, KEYNO becomes 0. KEYNO is a function that has no argument.

Items ① to ⑦ in Fig. 12-5 are explained as follows.

①: Declare event GOTOB for the entire program on line 10 to ensure the correct operation of the interrupt processing section of task B. Without this declaration, lines 50, 60, and 140 have no meaning. Lines 10 and 60 affect the entire program.

②: Line 50 declares the function key 0 as an interrupt source and validates the event declared on line 60.

③: Line 70 activates the interrupt processing section (task B).

④: Execution control jumps to task B due to priority (task A < task B) and waits for an interrupt to be generated at line 140.

⑤: Execution control returns to task A for normal processing.

⑥: Each time an interrupt is generated by pressing the function key 0, normal processing (Interrupt key No?) is interrupted and the interrupt processing (F0 pressed) is executed.

⑦: Normal processing restarts when interrupt processing is completed and wait status is entered.

(2) Program for displaying status values by interrupt parallel processing

The following program displays the MS2601A status values.

```
● 10  COM  SPA
  20  LET  SPA=101
  30  IFC  @1
  40  DCL  @1
  50  WRITE  @SPA:"SPF 1KZ;CNF 300MZ;SRQ 1"
  60  STATUS  @SPA:S
  70  PROCESS EVENT GSRQ" @01,02"
  80  START  GPIBSRQ
  90  CONNECT  EVENT  GSRQ
 100  DO
 110  !
 120  LOOP
 130  END
```

Main program
(task A)

```
  140  !
● 150  PARACT  GPIBSRQ  URGENCY  50
● 160    COM  SPA
  170    DO
  180      PRINT  "Next status value?"
  190      WAIT  EVENT  GSRQ
  200      STATUS  @SPA:S
  210      PRINT "STATUS=";S
  220    LOOP
● 230  END  PARACT
```

Parallel processing
(task GPIBSRQ)

START Statement function on line 80:

Line 80 contains a START statement. GPIBSRQ (to the right of the START statement) is the name of the interrupt parallel processing section.

Therefore, GPIBSRQ is also written to the right of PARACT on line 150 of the parallel processing section. If the name of the section is specified by the START statement, the specified parallel processing section is set to the Ready or Running status. The main program (terminated at the END line) and parallel processing section (from PARACT to END PARACT) are independent programs called program units. The processing priority order can be specified for these units.

The priority order is specified using a numeric value of 0 to 255 (The smaller the value, the higher the priority). The priority order for the main program is internally set to 100.

The priority for the parallel processing section is written to the right of URGENCY on line 150. The priority in this example is 50.

Therefore, the GPIBSRQ parallel processing section has a higher priority than the main program. If the priority is set to 100, the priority is the same as the main program and URGENCY is omitted. Note that execution control progresses from the smaller line number to the larger one.

If a parallel processing section is specified in the START statement with the same priority as the main program, the specified section is set to Ready status for execution. In this example, the parallel processing section has a higher priority than the main program. Consequently, execution control progresses from: line 80 → line 150 → line 160 → line 170 → line 180.

Event wait status on line 190:

On line 190, the external event GSRQ cannot be generated because the CONNECT EVENT statement on line 70 has not been executed.

As a result, line 190 waits for the event to be generated.

Generally, ff a program unit is set to the event wait status, execution control jumps to the program unit with the second highest priority. Up to eight program units are acceptable (including the main program). Because this example has only two program units, control jumps to line 90 of the main program.

Normal processing and interrupt processing:

The GSRQ event can be enabled to generate by line 90. If the GSRQ event is not generated, the next process (from lines 100 to 120) can be executed.

If the GSRQ event is generated during this period, the wait event status of line 190 is released and execution control jumps to lines 200 and 210 of the parallel processing section. In this way, status values can be displayed by the interrupt.

When control is returned to line 190 by the DO to LOOP statement, the next event is awaited and normal processing is restarted as in the program of paragraph 12.2.3 (1).

(3) Supplement to program structure and functions including parallel processing section

Some statements required for GP-IB programming are explained here as a supplement to paragraphs 12.2.3 (1) and (2). Refer to the Packet personal computer operation manual for details.

- Each program unit can be handled as an independent program. Therefore, even when several units use the same variable name, the variables are processed differently. To set a common variable between the program units, declare it in the COM statement (as on lines 20 and 540)
- Up to eight parallel processing sections are available (including the main program).
- The external event declaration on line 80 is common to all program units. Set this declaration near the first line of the first program unit.
- The START statement on line 90 specifies the names of the required number of processing sections when several parallel processing sections must be activated.
- The parallel processing section (starting with PARACT and ending with END PARACT) should be set next to the main program.
- A parallel processing section can be created without the main program. For example, the main program can be replaced by a parallel processing section as explained in paragraphs 12.2.6 (1) and (2).

In other words, write the "PARACT Parallel processing section name" before line 10 and "END PARACT" before line 110.

- For the priority order, write the "URGENCY Numeric value" to the right of the "PARACT Parallel processing section name", and specify the numeric value within the range of 0 ≦ numeric value ≦255.
- Entire program execution is not terminated at the end of the all processing if any program unit is waiting for execution.
  For example, limit the main program loop processing repetition time in programs of paragraphs 12.2.3 (1) and (2). Even when loop processing is completed, the END line of the main program is not executed because the parallel processing section is waiting on the WAIT EVENT line.
  To prevent this from occurring, forcibly terminate the program by using a STOP statement (as on line 500 or 700).

<Program unit 1: Main program>

```
 20  COM  A,B(100),C$

 80  PROCESS  EVENT External event name
 90  START  Name of parallel processing
            section to be activated
100  CONNECT  EVENT External event name
                ≀
     Main program processing section
                ≀
500  (STOP)
                ≀
520  END
```

<Program unit 2: Parallel processing section>

```
530  PARACT  Parallel processing
             section name
540  COM  A, B(100), C$
                ≀
600  WAIT  EVENT External event name
                ≀
700  (STOP)
                ≀
710  END  PARACT
```

■ START* statement format

START Parallel processing section name

START Parallel processing section name

Note:

Parallel processing section name

Upper-case alphabetic characters, numbers, and underlines (_) can be used. The name must begin with an upper-case alphabetic character followed by any number of characters.

* To restart a parallel processing section currently in the stop status to an advance status (Ready/Running), specify the name of the parallel processing section currently stopped by the currently running parallel processing section using this statement.

■ PARACT* statement format

PARACT Parallel processing section name[ΔURGENCY Numeric value]
[ΔCHANNEL Numeric value][ΔEXTENSION Numeric value]

Δ indicates a space.

Note:

Parallel processing section name

Upper-case alphabetic characters, numbers and underlines (_) can be used to specify the parallel processing section name. The name must start with an upper-case alphabetic character followed by any number of characters.

URGENCY

Specifies the execution priority order using a positive integer of 255 or less (The smaller the value, the higher the priority.) $(0 \leqq \text{priority order} \leqq 255)$

CHANNEL

Specifies the maximum number of files that can be opened simultaneously in a parallel processing section $(0 \leqq \text{numeric value} \leqq 4$: positive integer)

EXTENSION

Specifies the maximum number of the variable storage area used by subprograms, defined-functions, and pictures (Number: 0 or positive integer)

* This indicates the beginning of the parallel processing section with the execution priority order, number of file channels, and extension memory size.

■ END PARACT* statement format

```
END PARACT
```

* This indicates the end of the parallel processing section. If END PARACT is executed, the running parallel processing section is stopped.

- STOP* statement format

STOP

* If the STOP statement is executed, the program unit containing the STOP statement, as well as all the parallel processing sections and other program units are stopped.
* The statement can be set at several positions in a program unit (except the last line).

- END* statement format

END

* This indicates the end of a program.
* If the program consists of several program units, END does not indicate the end of the entire program, but only the end of the main program.

- SIGNAL* statement format

This is used in the program of <Example 2> described later.

SIGNAL Internal event flag name

Note:

The internal event flag name is assigned to a software (program control only) event.

(a) Naming event flag

Upper-case alphabetic characters, numbers, and underlines (_) can be used to name the event flag. The name must begin with an upper-case alphabetic character.

Any length of event flag name is acceptable.

(b) Combination with WAIT EVENT statement

Each SIGNAL statement must be used with a corresponding WAIT EVENT statement of the same event name. When N indicates the number of SIGNAL statements, N WAIT EVENT statements of the same event name must be executed. An internal event is terminated when it is received by a WAIT EVENT statement.

* The SIGNAL statement generates an internal event with the specified event flag name to release the other parallel processing section (waiting for same internal event flag name at WAIT EVENT) and to set it to an advance (ready/running) status.

<Example 1>

Convert program of <Example 2> in paragraph 12.2.2 to a parallel processing program (single sweep measurement).

```
  10 COM  MEANSFLAG, INT MAG (500)
  20 LET  SPA = 101
  30 !---------Initialization---------
  40 IFC  @1
  50 DCL  @1
  60 !----------Device set-----------
  70 !
  80 WRITE  @SPA : "SPF 1KZ ; CNF 300MZ"
  90 WRITE  @SPA : "TRG 4"
 100 !----------SRQ Event----------
 110 STATUS  @SPA : S! ..........................................  Dummy SRQ reset
 120 PROCESS  EVENT  GSRQ"@01,02"! ..........................  Event declaration
 130 START  GPIBSRQ! ......................................  Activates GPIBSRQ Block
 140 !
 150 !*************MEASUREMENT**************************
 160 !
 170 CONNECT  EVENT  GSRQ! .................................  Enables GSRQ Event
 180 !
 190 !----------Measure  Start----------
 200 !
●210 LET  MEANSFLAG = 0
 220 WRITE  @SPA : "SRQ 1"
 230 WRITE  @SPA : "TRG 5"
 240 !
●250 DO  UNTIL  MEANSGLAG = 1
 260 LOOP
 270 !-------Measured Result-------
 280 WRITE  @SPA : "BIN 1"
 290 WRITE  @SPA : "XMA ? 0, 501"
 300 MAT READ @SPA USING"WH" : MAG
 310 FOR K = 0 TO 500
 320   PRINT USING"####·## dBm" : MAG(K)/100
 330 NEXT K
 340 STOP! .......................................  Stops parallel block execution wait
 350 END
 360 !
 370 !***GPIB SRQ interrupt routine**********************
 380 !
 390 PARACT  GPIBSRQ  URGENCY  50
 400   COM  MEANSFLAG
 410   !
●420   DO
●430     WAIT  EVENT  GSRQ
 440     LET  MEANSFLAG = 1
 450   LOOP
 460   !
 470 END  PARACT
```

Main program

Parallel processing section

The program in the previous page is explained below.

1. The program up to line 120 is the same (except line 10) as the program shown in <Example 2> of paragraph 12.2.2.

   COM MEANSFLAG, INT MAG (500) on line 10 declares variables common with line 400 so that the variables MEANSFLAG and MAG(500) can be used with the same contents in the main program and parallel processing section.

2. If parallel processing section GPIBSRQ is specified on line 130, execution control jumps to parallel processing because the parallel processing section has the higher priority.

3. Because the GSRQ event has not occurred, it is awaited at line 430. Execution control jumps to the main program and progresses from lines 140 to 250. Processing is executed between DO and LOOP to enable parallel processing during a sweep.

4. The contents of MEANSFLAG are set to 0 by line 210 until the GSRQ event occurs. Therefore, line 250 continues loop processing until the MEANSFLAG value is set to 1.

5. When the MS2601A issues a service request, line 430 is released from the event wait status, and the MEANSFLAG value is set to 1.

6. When the MEANSFLAG value is set to 1, the loop processing of main program lines 250 and 260 is terminated. Execution control is passed to line 280 to read and print the measured values.

7. After MEANSFLAG is defined as 1 in step 5 above, the parallel processing section waits for the GSRQ event again. Steps 5 to 7 are repeated.

8. In the above status, execution control jumps to the main program without executing END PARACT each time the GSRQ event occurs.

9. If line 340 of the main program does not contain a STOP statement, the parallel processing section continues running due to steps 7 and 8. As a result, END on line 350 of the main program is not executed. To terminate execution of the entire program, a STOP statement is set on line 340 to measure MAG once by executing a single sweep.

<Example 2>

Parallel processing of internal and external events
(Applies to previous <Example 1>)

```
   10  COM  INT MAG(500)
   20  LET  SPA=101
   30  !----------Initialization----------
   40  IFC  @1
   50  DCL  @1
   60  !----------Device set------------
   70  !
   80  WRITE  @SPA:"SPF 1KZ;CNF 300MZ"
   90  WRITE  @SPA:"TRG 4"
  100  !----------SRQ Event----------
  110  STATUS  @SPA:S! ..........................................  Dummy SRQ reset
  120  PROCESS  EVENT  GSRQ"@01,02"! ...........................  Event declaration
  130  START  GPIBSRQ! ......................................  Activates GPIBSRQ Block
  140  !
  150  !**************MEASUREMENT************************
  160  !
  170  CONNECT  EVENT  GSRQ! .................................  Enables GSRQ Event
  180  !
  190  !----------Measure  Start----------
  200  !
  210  WRITE  @SPA:"SRQ 1"
  220  WRITE  @SPA:"TRG 5"
  230  !
● 240  WAIT EVENT MEANSFLAG
  250  !
  260  !--------Measured Result-------
  270  WRITE  @SPA:"BIN 1"
  280  WRITE  @SPA:"XMA? 0,501"
  290  MAT READ @SPA USING "WH":MAG
  300  FOR K=0 TO 500
  310    PRINT USING "####.## dBm":MAG(K)/100
  320  NEXT K
  330  STOP! ......................................  Stops parallel block execution wait
  340  END
  350  !
  360  !***GPIB SRQ interrupt routine***********************
  370  !
  380  PARACT  GPIBSRQ  URGENCY  50
  390    !
  400    !
  410      DO
● 420        WAIT  EVENT  GSRQ
● 430        SIGNAL MEANSFLAG
  440      LOOP
  450  !
  460  END  PARACT
```

Main program

Parallel processing section

The WAIT EVENT MEANSFLAG function is equivalent to that of line 250 in <Example 1>. In other words, the wait status continues until the internal event MEANSFLAG occurs. The internal event occurs when the MS2601A issues a service request and line 420 is released from the wait status. MEANSFLAG (named by the SIGNAL statement on line 430) is the internal event name. Executing the SIGNAL statement generates the internal event MEANSFLAG.

This releases line 240 from the wait status.

<Example 3>

Parallel processing program to measure difference between PEAK and NEXT PEAK levels

Set 20 frequencies from 50 MHz to 1000 MHz in steps of 50 MHz and measure the level differences using a synthesized signal generator (SSG).

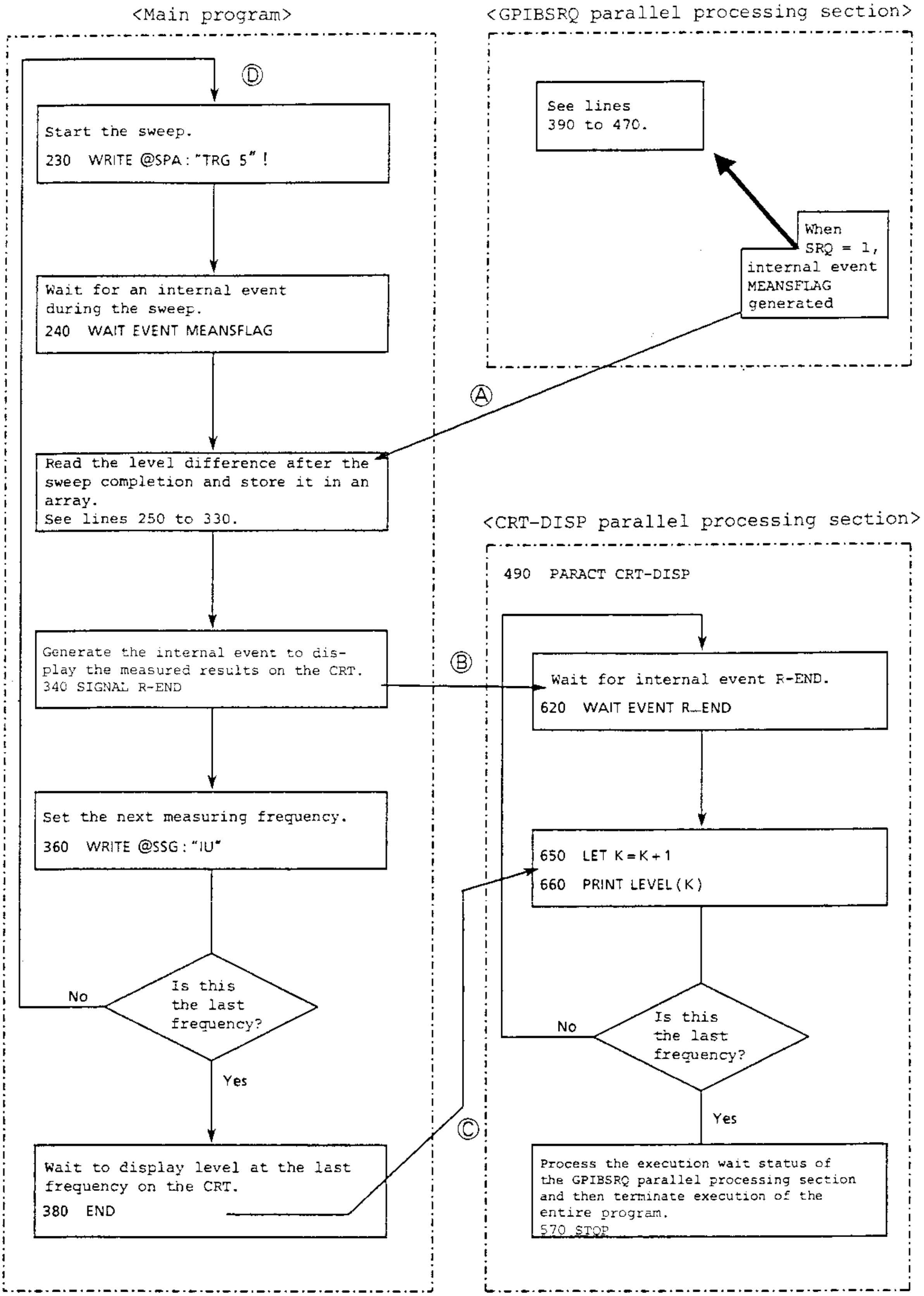
(i) Preparations

	Explanation
Program function	The program displays the values measured during the previous sweep on the CRT before SRQ = 1 is output (that is, during the current sweep). The CRT display contents are also output to the printer when the measurement is completed at 1000 MHz.
Program purpose	Programs described so far execute interrupt processing but only wait at WAIT EVENT during a sweep. This program displays the previous sweep results on the controller CRT by operation of the other parallel processing section CRT-DISP during current sweep.
External synthesized signal generator (SSG) program code	The following tentative codes are assumed for convenience. When actually using a signal generator, refer to the Signal Generator Operation Manual to be used for the program codes. . Center frequency .... FRΔf . Step size .... FIΔf . Step up .... IU

(ii) MS2601A program codes to be used

• CENTER FREQ	CNF△f	• SINGLE SWEEP	TRG△4
• STEP SIZE	FSS△f	• SINGLE START	TRG△5
• STEP UP	FUP	• ASCII read out specification	BIN△0
• PEAK SEARCH	MKS△0	• LEVEL read out	MKL?
• NEXT PEAK	MKS△1	• SRQ ON	SRQ△1
• ZONE WIDTH(SPOT)	MKW△0		

(iii) Program configuration in program units



(iv) Program explanation

```
 10 COM LEVEL(20),SPA
 20 LET  SPA=101! ....................................... Spectrum Analyzer address
 30 LET  SSG=103! ....................................... Signal Generator (SSG) address
 40 CLEAR
 50 !--------------Device set--------------
 60 IFC  @1
 70 DCL  @1
 80 WRITE  @SPA:"STF 10MZ;TRG 4;MKW 1"
 90 WRITE  @SPA:"SRQ 1"
100 WRITE  @SSG:"FR 50MHZ,FI 50MHZ,OL-10DBM"
110 !
120 --------------GPIB SRQ Initialization--------------
130 STATUS  @SPA:S! ..................................... Dummy SRQ reset
140 PROCESS EVENT GPIB"  @01,02" ........................ GPIB event declaration
150 START GPIBSRQ! ...................................... Activates GPIBSRQ BLOK
160 START CRT_DISP ...................................... Activates CRT_DISP BLOK
170 CONNECT  EVENT  GPIB ................................ Enables GPIB Event
180 !
```

70: Sets CF = 1100 MHz, SPAN = 2.2 GHz, and NORMAL marker to the center of the CRT at initialization

80: Sets SF = 10 MHz, single sweep mode

90: Sets MS2601A SRQ ON

100: Sets start frequency of signal generator = 50 MHz; frequency step size = 50 MHz

150: Program execution control jumps to line 390 because the parallel processing section GPIBSRQ has a higher priority than that of the main program.

160: When the parallel processing section GPIBSRQ is waiting at WAIT EVENT GPIB on line 430, program execution control jumps to this line 160 and activates the parallel processing section CRT-DISP.

170: Validates GPIB event

To line 190

```
190 ! **************MEASUREMENT LOOP************************
200 LET  K=0
200 FOR J=50 TO 1000 STEP 50
220   LET K=K+1
230   WRITE  @SPA:"TRG 5"! ................................ SIGNAL SWEEP START
240   WAIT EVENT MEANSFLAG
250   WRITE  @SPA:"MKS 0"! ...................... PEAK SEARCH ; READING LEVEL
260   WAIT DELAY .2
270   WRITE  @SPA:"MKL ?"! ...................... PEAK SEARCH ; READING LEVEL
280   READ  @SPA:L1
290   WRITE  @SPA:"MKS 1"!  .................. SPOT,NEXT PEAK,READING LEVEL
300   WAIT DELAY .2
310   WRITE  @SPA:"MKL?"! .................... SPOT,NEXT PEAK,READING LEVEL
320   READ  @SPA:L 2
330   LET LEVEL(K)=L1-L2! ..... LEVEL DIFFERENCE BETWEEN PEAK AND NEXT PEAK
340   SIGNAL R_END
350   !
360   WRITE  @SSG:"1U"! ............................. FREQUENCY STEP UP (SSG)
370 NEXT J
380 END
```

240: Waits for GPIB event (internal event MEANSFLAG at line 450)
Because the main program and parallel processing section GPIBSRQ are in the wait status during this period, program execution control jumps to parallel processing section CRT-DISP (activated at line 160). Then control waits at WAIT EVENT R-END at line 620 until internal event R-END occurs at line 340.

340: Event R-END occurs. Then the contents of LEVEL (1) on line 330 are displayed on the CRT by the PRINT statement on line 590. Finally control waits at line 620 again.

360: Execution control jumps to this line again and steps up the center frequency of the SSG by 50 MHz. Then control waits at line 240 again.

The above procedure is repeated until J = 1000 and k = 20.

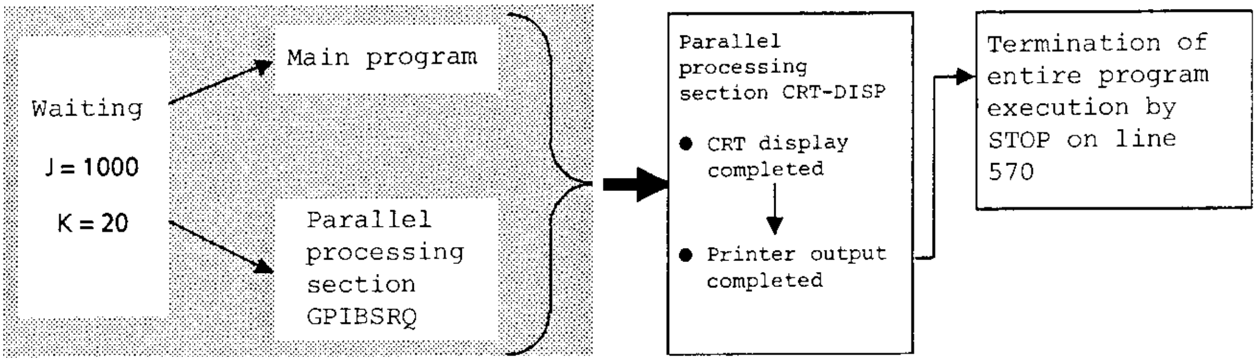
When LEVEL (20) at the last execution of line 330 is calculated and SIGNAL R-END on line 340 are executed, the following states occur:

1. Parallel processing section CRT-DISP...Running
2. Parallel processing section GPIBSRQ... Ready

As a result, END on line 380 of the main program is not executed even after the FOR to NEXT loop (from lines 200 to 370) is completed unless the above two parallel processing sections are executed.

```
390 ! ***********GPIB SRQ interrupt routine******************
400 PARACT GPIBSRQ URGENCY 50
410   COM LEVEL(20),SPA
420  DO
430     WAIT EVENT GPIB
440     STATUS  @SPA:S! ................................  Dummy SRQ reset
450     SIGNAL  MEANSFLAG
460   LOOP
470 END PARACT
```

```
480 ! ***********CRT DISPLAY DURING SWEEP*******************
490 PARACT CRT_DISP
500   COM LEVEL(20),SPA
510   PRINTER IS  @0
520   LET N=1
530   GO SUB 590 ! ..........................................  1ST (CRT OUTPUT)
540   PRINTER IS  @117
550   LET N=0
560   GO SUB 590 ! ......................................  2ND (PRINTER OUTPUT)
570   STOP
580   !
590   LET K=0
600   FOR J=50 TO 1000 STEP 50
610     IF N=1 THEN
620       WAIT EVENT R_END
630     ELSE
640     END IF
650     LET K=K+1
660     PRINT USING "#### MHz  Level difference = ###.## dB":J,LEVEL(K)
670   NEXT J
680   RETURN
690 !
700 END PARACT
```



- First, executing line 530 and subsequent lines (J=50 → 1000, k=1 → 20) causes the measured results to be displayed on the CRT even during a sweep using the three parallel processing sections' functions (including the main program).

- Second, executing line 560 and subsequent lines (J=50 → 1000, k=1 → 20) causes the contents of array variables LEVEL (1) to LEVEL (20) to be printed on the printer. Finally, STOP on line 570 is executed to terminate the entire program.

(v) General Program

```
 10 COM   LEVEL(20),SPA
 20 LET   SPA=101! ........................................ Spectrum Analyzer address
 30 LET   SSG=103! ........................................... Signal Generator (SSG) address
 40 CLEAR
 50 !------------Device set------------
 60 IFC   @1
 70 DCL   @1
 80 WRITE   @SPA:"STF 10MZ;TRG 4;MKW 1"
 90 WRITE   @SPA:"SRQ 1"
100 WRITE   @SSG:"FR 50MHZ,FI 50MHZ,OL-10DBM"
110 !
120 ------------GPIB SRQ Initialization------------
130 STATUS   @SPA:S! ............................................ Dummy SRQ reset
140 PROCESS EVENT GPIB"   @01,02" .......................... GPIB event declaration
150 START GPIBSRQ! ......................................... Activates GPIBSRQ BLOK
160 START CRT_DISP ........................................ Activates CRT_DISP BLOK
170 CONNECT   EVENT   GPIB .............................................. Enabies GPIB Event
180 !
190 ! **************MEASUREMENT LOOP************************
200 LET   K=0
210 FOR J=50 TO 1000 STEP 50
220   LET K=K+1
230   WRITE   @SPA:"TRG 5"! ................................ SIGNAL SWEEP START
240   WRITE EVENT MEANSFLAG
250   WRITE   @SPA:"MKS 0"! ...................... PEAK SEARCH ; READING LEVEL
260   WAIT DELAY .2
270   WRITE   @SPA:"MKL ?"! ...................... PEAK SEARCH ; READING LEVEL
280   READ   @SPA:L1
290   WRITE   @SPA:"MKS 1"! .................. SPOT, NEXT PEAK, READING LEVEL
300   WAIT DELAY .2
310   WRITE   @SPA:"MKL?"! ................... SPOT, NEXT PEAK, READING LEVEL
320   READ   @SPA:L 2
330   LET LEVEL(K)=L1-L2! .... LEVEL DIFFERENCE BETWEEN PEAK AND NEXT PEAK
340   SIGNAL R_END
350   !
360   WRITE   @SSG:"IU"! ............................... FREQUENCY STEP UP (SSG)
370 NEXT J
380 END
390 ! ***********GPIB SRQ interrupt routine*****************
400 PARACT GPIBSRQ URGENCY 50
410   COM LEVEL(20),SPA
420   DO
430     WAIT EVENT GPIB
440     STATUS   @SPA:S! ................................ Dummy SRQ reset
450     SIGNAL   MEANSFLAG
460   LOOP
470 END PARACT
480 ! ***********CRT DISPLAY DURING SWEEP*******************
490 PARACT CRT_DISP
```

```
500   COM LEVEL(20),SPA
510   PRINTER IS  @0
520   LET N=1
530   GO SUB 590 ! ........................................... 1ST (CRT OUTPUT)
540   PRINTER IS  @117
550   LET N=0
560   GO SUB 590 ! ....................................... 2ND (PRINTER OUTPUT)
570   STOP
580   !
590   LET K=0
600   FOR J=50 TO 1000 STEP 50
610     IF N=1 THEN
620       WAIT EVENT R_END
630     ELSE
640     END IF
650     LET K=K+1
660     PRINT USING "#### MHz  Level difference = ###.## dB":J,LEVEL(K)
670   NEXT J
680   RETURN
690 !
700 END PARACT
```

APPENDIXES

TABLE OF CONTENTS

APPENDIX A

UNIVERSAL ASCII* CODE TABLE

B7 B6 B5	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
BITS B4B3B2B1	CONTROL		NUMBERS SYMBOLS		UPPER CASE		LOWER CASE	
0 0 0 0	0 NUL 0 0	20 DLE 10 16	40 SP 20 32	60 0 30 48	100 @ 40 64	120 P 50 80	140 ` 60 96	160 p 70 112
0 0 0 1	1 GTL SOH 1 1	21 LLO DC1 11 17	41 ! 21 33	61 1 31 49	101 A 41 65	121 Q 51 81	141 a 61 97	161 q 71 113
0 0 1 0	2 STX 2 2	22 DC2 12 18	42 " 22 34	62 2 32 50	102 B 42 66	122 R 52 82	142 b 62 98	162 r 72 114
0 0 1 1	3 ETX 3 3	23 DC3 13 19	43 # 23 35	63 3 33 51	103 C 43 67	123 S 53 83	143 c 63 99	163 s 73 115
0 1 0 0	4 SDC EOT 4 4	24 DCL DC4 14 20	44 S 24 36	64 4 34 52	104 D 44 68	124 T 54 84	144 d 64 100	164 t 74 116
0 1 0 1	5 PPC ENQ 5 5	25 PPU NAK 15 21	45 % 25 37	65 5 35 53	105 E 45 69	125 U 55 85	145 e 65 101	165 u 75 117
0 1 1 0	6 ACK 6 6	26 SYN 16 22	45 & 26 38	65 6 36 54	106 F 46 70	126 V 56 86	146 f 66 102	166 v 76 118
0 1 1 1	7 BEL 7 7	27 ETB 17 23	47 ' 27 39	67 7 37 55	107 G 47 71	127 W 57 87	147 g 67 103	167 w 77 119
1 0 0 0	10 GET BS 8 8	30 SPE CAN 16 24	50 (28 40	70 8 38 56	110 H 48 72	130 X 58 88	150 h 68 104	170 x 78 120
1 0 0 1	11 TCT HT 9 9	31 SPD EM 19 25	51) 29 41	71 9 39 57	111 I 49 73	131 Y 59 89	151 i 69 105	171 y 79 121
1 0 1 0	12 LF A 10	32 SUB 1A 26	52 * 2A 42	72 : 3A 58	112 J 4A 74	132 Z 5A 90	152 j 6A 106	172 z 7A 122
1 0 1 1	13 VT B 11	33 ESC 1B 27	53 ÷ 2B 43	73 ; 3B 59	113 K 4B 75	133 [5B 91	153 k 6B 107	173 { 7B 123
1 1 0 0	14 FF C 12	34 FS 1C 28	54 , 2C 44	74 < 3C 60	114 L 4C 76	134 \ 5C 92	154 l 6C 108	174 | 7C 124
1 1 0 1	15 CR D 13	35 GS 1D 29	55 − 2D 45	75 = 3D 61	115 M 4D 77	135] 5D 93	155 m 6D 109	175 } 7D 125
1 1 1 0	15 SO E 14	36 RS 1E 30	56 . 2E 46	76 > 3E 62	116 N 4E 78	136 ^ 5E 94	156 n 6E 110	176 ~ 7E 126
1 1 1 1	17 SI F 15	37 US 1F 31	57 / 2F 47	77 UNL ? 3F 63	117 O 4F 79	137 UNT — 5F 95	157 o 6F 111	177 RUBOUT (DEL) 7F 127
	Address command	Universal command	Listen address		Talk address		Secondary address or command	

KEY

octal	25 PPU	GP-IB code
	NAK	ASCII character
hex	15 21	decimal

* American Standard Code for Information Interchange

APPENDIX B

BIT ALLOCATION INDICATING CAUSE OF GP-IB INTERFACE INTERRUPTION ON PACKET PERSONAL TECHNICAL COMPUTER

Bit number	Cause
0	Set to controller
1	Detected EOI Interruption generated when Packet personal computer is controller and neither talker nor listener
2	Received SRQ
3	Change in remote/local condition
4	Received MTA
5	Received MLA
6	Received GET
7	Received device clear
8	Received IFC
9	-
10	-
11	Parity error generated during data reading
12	MLA/MTA released
13	-
14	-
15	-

APPENDIX C

IEEE STANDARD PROPER ABBREVIATION INDEX

A

AC	Address Command
ACDS	Accept Date State
ACG	Addressed Command Groop
ACRS	Accepter Ready State
AD	Address
AH	Accepter Handshake
AIDS	Accepter IDle State
ANRS	Accepter Not Ready State
APRS	Affirmative Poll Response State
ATN	Attention
AWNS	Accepter Wait for New cycle State

C

C	Controller
CACS	Controller Active State
CADS	Controller Addressed State
CAWS	Controller Active Wait State
CIDS	Controller Idle State
CPWS	Controller Parallel Poll Wait State
CSBS	Controller Standby State
CSNS	Controller Service not Requested State
CPPS	Controller Parallel Poll State
CSRS	Controller Service Requested State
CSWS	Controller Synchronaus Wait State
CTRS	Controller Transfer State

D

DAB	Data Byte
DAC	Data Accepted
DAV	Data Valid
DC	Device Clear
DCAS	Device Clear Active State
DCIS	Device Clear Idle State
DCL	Device Clear
DD	Device Data
DIO	Data input/output
DT	Device Trigger
DTAS	Device Trigger Active State
DTIS	Device Trigger Idle State

E

END	End
EOI	End Or Identify
EOS	End of String

G

GET	Group execute Trigger
GTL	Go to Local
gts	go to standby

I

IDY	Identify
IFC	Interface Clear
ist	individual Status

L

L	Listener
LACS	Listener Active State
LAD	Listener Address
LADS	Listener Addressed State
LAG	Listen Address Group
LE	Extended Listener
LIDS	Listener Idle State
LLO	Local Lock Out
LOCS	Local State
lon	Listen only
LPAS	Listener Primary Addressed State
lpe	Local Poll enabled
LPIS	Listener Primary Idle State
ltn	Listen
LWLS	Local with Lockout State
lun	Local unlisten

M

MLA	My Listen Address
MSA	My Secondary Address
MTA	My Talk Address

N

nba	new byte available
NDAC	Not Data Accepted

NPRS	Negative Poll Responce State
NRFD	Not Ready For Data
NR	Numeric Representation
NUL	Null Byte

O

OSA	Other Secondary Address
OTA	Other Talk Address

P

PACS	Parallel Poll Addressed to Configure State
PCG	Primary Command Group
pof	Power-off
pon	Power-on
PP	Parallel Poll
PPAS	Parallel Poll Active State
PPC	Parallel Poll Configure
PPD	Parallel Poll Disable
PPE	Parallel Poll Enable
PPIS	Parallel Poll Idle State
PPR$_{1\sim 8}$	Parallel Poll Response 1 ~ 8
PPSS	Parallel Poll Standby State
PPU	Parallel Poll Unconfigure
PUCS	Parallel Poll Unaddressed to Configure State

R

rdy	ready for next message
REMS	Remote State
REN	Remote Enable
RFD	Ready For Data
RL	Remote Local
rPP	request Parallel Poll
RQS	Request Seervice
rsc	request system Control
rsv	request service
rtl	return to local
RWLS	Remote With Lockout state

S

SACS	System Control Active State
SCG	Secondary Command Group
SDC	Selected Device Clear
SDYS	Source Delay State
SE	Secondary Message
SGNS	Source Generate State
SH	Source Handshake
SIAS	System Control Interface Clear Active State
sic	Send interface clear
SIDS	Source IDle State
SIIS	System Control Interface Clear Idle State
SINS	System Control Interface Clear Not Active State
SIWS	Source Idle Wait State
SNAS	System Control Not Active State
SPAS	Serial Poll Active State
SPD	Serial Poll Disable
SPE	Serial Poll Enable
SPIS	Serial Poll Idle State
SPMS	Serial Poll Mode State
SR	Service Request
SRAS	System Control Remote Enable Active State
sre	Send remote enable
SRIS	System Control Remote Enable Idle State
SRNS	System Control Remote Enable not active State
SRQ	Service Request
SRQS	Service Request State
ST	Status
STB	Status Byte
STRS	Source Transfer State DAV to Low
SWNS	Source Wait for New cycle State
SACS	System Control Active State

T

T	Talker
TACS	Talker Active State
TAD	Talk Address
TADS	Talker Addressed State
TAG	Talker Addressed Group
tca	take Control asynchronously
tcs	take Control synchronously
TCT	Take Control
TE	Extended Talker
TIDS	Talker Idle State
ton	talk only
TPAS	Talker Primary Addresed State
TPIS	Talker Primary Idle State

U

U	Uniline Message
UC	Universal Command
UCG	Universal Command Group
UNL	Unlisten
UNT	Untalk

APPENDIX D

OPTIONAL ACCESSORIES

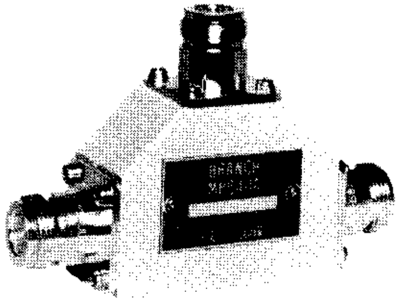
(1) MP640A Branch

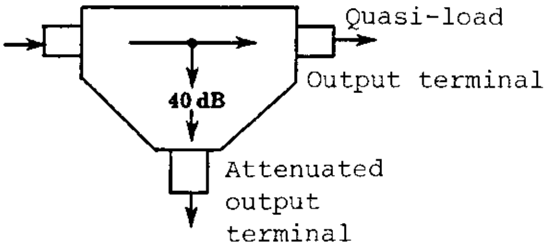
The MP640A Branch is used for branching part of the transmitted signal when measuring the spurious characteristics, etc. of a transmitter with a measurement receiver.

Since the attenuation frequency characteristic is flat from DC to 1700 MHz, it is useful when the frequency characteristic must be considered during measurement.

Note:

The maximum allowable power is 16 W.

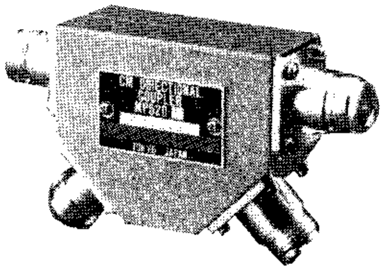


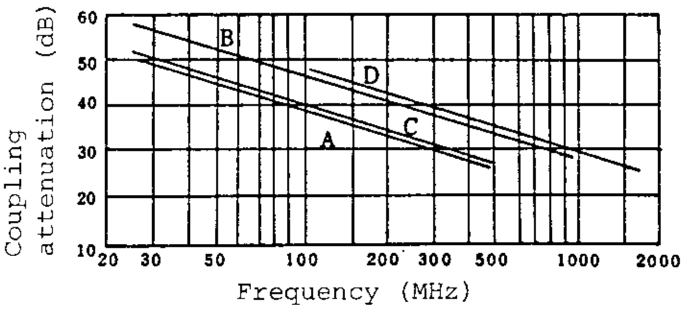


Frequency range	Dc to 1700 MHz
Input/output terminals	50 Ω (N-type connector), VSWR ≤1.2
Attenuation (at attenuated output terminal)	40 ±1 dB at 100 MHz
Attenuation frequency characteristic	Dc to 300 MHz range: ±0.5 dB 300 to 1000 MHz range: ±1.0 dB 1000 to 1700 MHz range: ±1.5 dB
Insertion loss	Dc to 300 MHz range: ≤0.2 dB 300 to 1000 MHz range: ≤0.5 dB 1000 to 1700 MHz range: ≤1.0 dB

(2) MP520A/B/C/D CM Directional Couplers

These couplers are used to measure the fundamental wave power and spurious power in VHF and UHF coaxial cables.





Coupling Attenuation Characteristics

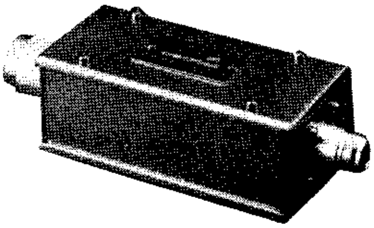
Model	MP520A	MP520B	MP520C	MP520D
Frequency range range	25 to 500 MHz	25 to 1000 MHz	25 to 500 MHz	100 to 1700 MHz
Characteristic impedance	75 Ω (NC connector)		50 Ω (N connector)	
Coupling attenuation	Approx. 38 dB at 100 MHz	Approx. 46 dB at 100 MHz	Approx. 40 dB at 100 MHz	Approx. 28 dB at 1000 MHz
Directivity	$\geqq$20 dB			
Termination	50 Ω, VSWR: $\leqq$1.07			
Application component (for MP520A/B)				
Coaxial adapter	NC-P•F-J and NC-P•M-J			

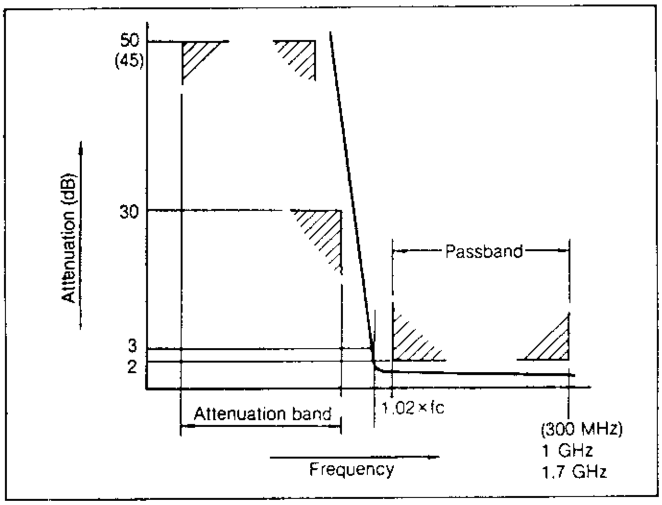
(3) MP526A/B/C/D/G High-Pass Filters

When measuring spurious signals using a measuring receiver, eliminate the fundamental wave with a high-pass filter to prevent excessive input from causing internal spurious emissions in the measuring equipment and to simplify measurement.

The MP526A/B/C/D/G High-Pass Filters are directly connected to the input connector of the measuring equipment for harmonic measurements in the mobile radio frequency range.

Select the most suitable filter from the five types available according to the desired frequency range.





Specifications

Model	MP526A	MP526B	MP526C	MP526D	MP526G
Frequency band of the communication equipment	60 MHz	150 MHz	250 MHz	400 MHz	27 MHz
Attenuation band	50 to 80 MHz	120 to 190 MHz	200 to 300 MHz	335 to 520 MHz	26 to 30 MHz
Cut-off frequency (fc)	100 MHz	240 MHz	400 MHz	670 MHz	52 MHz
Attenuation characteristics	≧50 dB at 70 MHz ≧30 dB at 80 MHz	≧50 dB at 170 MHz ≧30 dB at 190 MHz	≧50 dB at 280 MHz ≧30 dB at 300 MHz	≧50 dB at 470 MHz ≧30 dB at 520 MHz	≧45 dB at 28 MHz ≧30 dB at 30 MHz
Passband	≧(1.02 × fc), ≦1 GHz, ≦1.7 GHz in MP526D, ≦300 MHz in MP526G				
Insertion loss	≦2 dB in passband				
Characteristic impedance	50 Ω nominal, connector: type N				
Ambient temperature, rated range of use	0° to 45°C				
Dimensions and weight	48H × 51W × 138D mm, ≦400 g				

(4) MP614A 50 Ω ↔ 75 Ω Impedance Transformer

The MP614A is used to match impedances when the impedance of the circuit under test is 75 Ω.

Frequency range:	10 to 1200 MHz
Connector:	50 Ω side N-P 75 Ω side NC-J
Insertion loss:	≦1 dB (≦600 MHz) ≦1.5 dB (>600 MHz)

(5) MP612A RF Fuse Holder

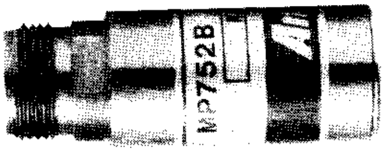
When testing equipment such as mobile radios that use an antenna connector for both transmitting and receiving with a spectrum analyzer or similar device, an incorrect operation or connection may damage the internal components of the measuring device.

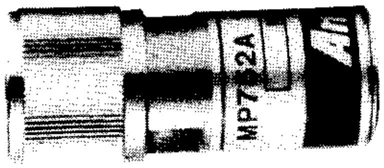
The RF protects measuring devices by preventing such problems.

Frequency range	Dc to 1000 MHz
Impedance	50 Ω unbalanced, VSWR: $\leqq$1.2 (terminated by 50 Ω)
Connector	N-P and N-J
Insertion loss	$\leqq$0.5 dB
Rated power	+17 dBm (terminated by 50 Ω)
Fuse rated power	$\geqq$+35 dBm (terminated by 50 Ω)
Ambient temperature, rated range of use	0° to 45°
Dimensions and weight	210 x 65 mm, $\leqq$110 g

(6) MP752A/B Reflectionless Termination

The MP752A/B Reflectionless Termination has an excellent VSWR over the dc to 12.5 GHz frequency range, and is for use with 50 Ω coaxial systems. The connector is an N-type plug for the MP752A and an N-type jack for the MP752B.





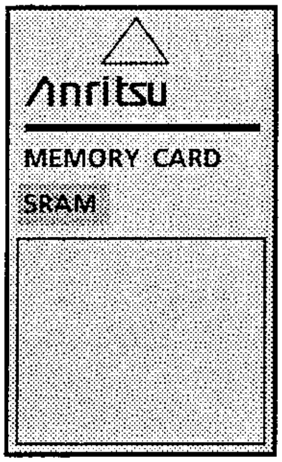
Model	VSWR		Allowable input power	Impedance	Connector	Ambient temperature, rated range	Dimensions and weight
	DC to 8 GHz	8 to 12.4GHz					
MP752A	1.15	1.20	2W*	50 Ω	N-type plug	0± to 50°C	21ø x 48mm, ≦80 g
MP752B	1.15	1.20			N-type jack		19ø x 50mm, ≦80 g

* Test frequency: 1 GHz

(7) Cables

Name	Description
Coaxial cable	N-P•5D-2W•N-P 0.5 m, 1 m, 2 m
I/O port cable	36 pins - 36 pins 2 m
GP-IB cable	24 pins - 24 pins 1 m, 2 m

(8) PMC BS32C1-A-30



SRAM-type plug-in memory card (PMC) for MS2601A external memory with 32 kbyte memory capacity

- PMC

  Dimensions: 3.5H x 85.6L x 54W mm

  Connection method: Side-hole electrode connector

- SRAM

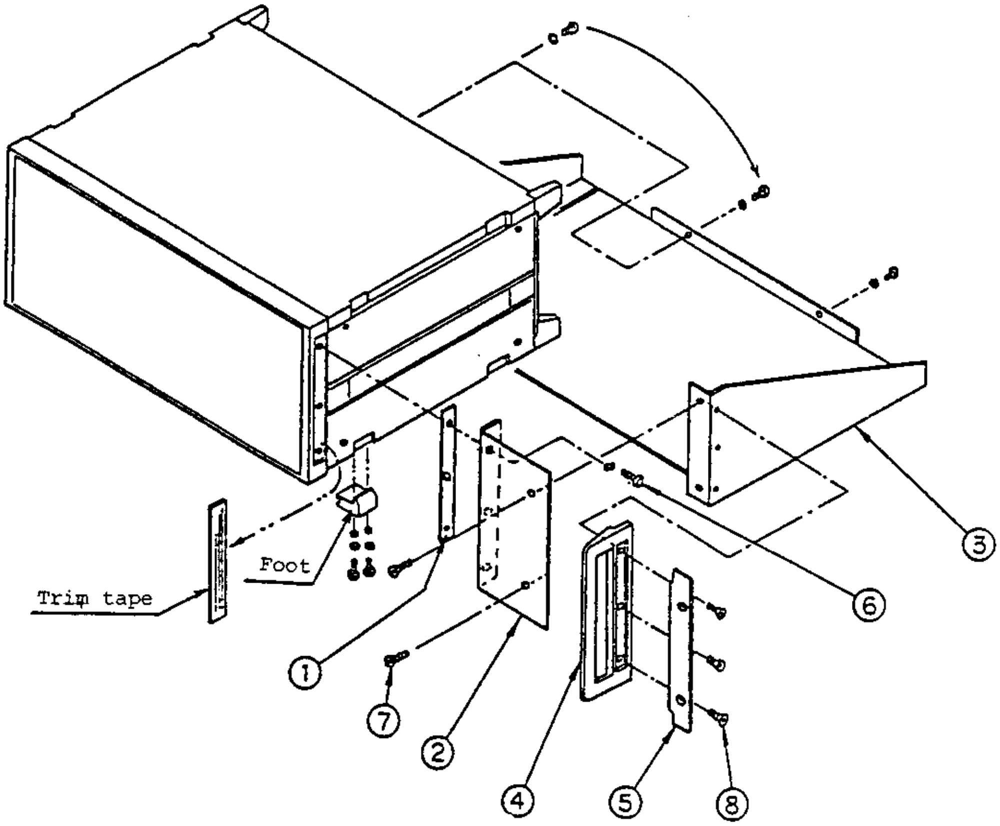
  Storage capacity : 32 kbyte

  Power source : Built-in backup battery

(9) Rack Mount Kit

Parts List

No.	Description	Qty.
1	Plate	2
2	Sub panel	2
3	Sub chassis	1
4	Front handle	2
5	Rack flange	2
6	5NPS14S7+SW+WB	6
7	5HRPS16S3	4
8	5FPS16S7	6



Note:

Remove the trim tapes and the feet before rack mounting

APPENDIX E

PACKET V PERSONAL TECHNICAL COMPUTER

Main unit

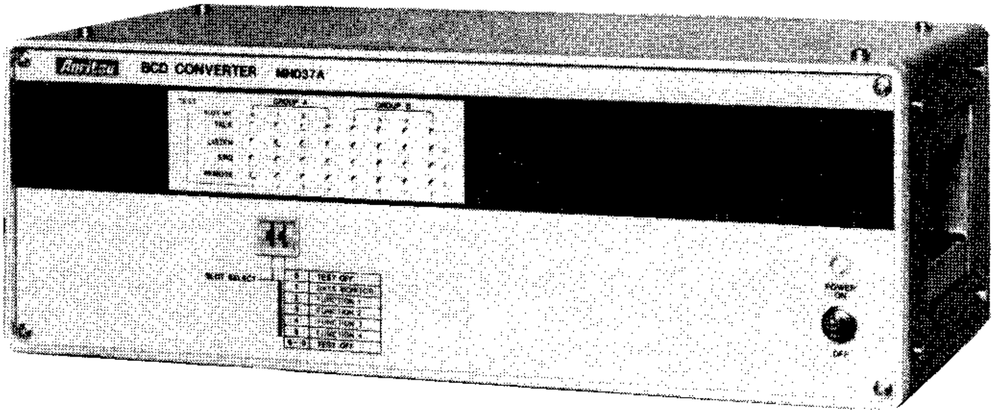
Item		Packet VF (MC1201A)	Packet VH (MC1202A)	Packet VB (MC1203A)
CPU		68000 (clock frequency 8 MHz)		
Memory	ROM	32 KB		
	RAM	512 KB (no-wait) 14 MB maximum (with expansion box, 1 clock wait added)		
	VRAM	• 128 KB for graphics • 16 KB for characters		
	CMOS RAM	1 K x 4 bits (battery backup)		
Display functions	Interface	Separate video outputs (one connector for both color and monochrome displays)		
	Resolution	640 x 400 dots		
	Character fonts	Alphanumeric 6 x 10 dots		
	Character screen	80 characters x 25 lines		
	Graphics screen	• Page mode 4 screens (can be superimposed) • RGBI mode 1 screen Both character and graphics screens can be superimposed.		
	Monochrome display	16 gradations		
	Colors	• RGBI mode: 15 colors • Page mode: 2 colors (for each graphics screen)		
Clock		Year / month / day / hour / minute / second / day-of-week (backed up by a lithium battery for longer than 7 years)		
Timer		10 ms resolution		
Counter		1 ms resolution		
Tone generator		Frequency: 200 Hz to 15 kHz Duration: 2 ms to 32.767 s Volume control: 0 to 30 dB (relative value) with triad and noise generators		
Auxiliary storage		• One 3.5" floppy disk drive (640 KB) (Additional drive is available as option.)	• One 3.5" hard disk drive (20 MB) • One 3.5" floppy disk drive (640 KB)	• One bubble cassette drive (128 KB) • One bubble memory board (512 KB)
Expansion slots		3 slots (VME bus type)		
Operating conditions	Temperature	5° to 45°C		0° to 50°C
	Humidity	20% to 80% (no condensation)		
Power		85 to 132 V or 170 to 250 V, 47 to 63 Hz		
		130 VA	170 VA	150 VA
Dimensions		132.5H x 390W x 400D mm		
Weight		8.5 kg	10.0 kg	9.0 kg
Option 01		Additional 3.5" floppy dusk drive (640 KB)	—	
Option 03		1 MB RAM		

CRT display

Item		Monochrome display monitor (MC3601A)	Color display monitor (MC3602A)
Screen size		12 inches	12 inches
Color		Amber	15 colors (RGBI)
Resolution		640 dots (horizontal) x 400 dots (vertical)	
Tilt		0° to 20° (vertical)	
Swivel		± 45° (horizontal)	
Horizontal sync. frequency		24.83 kHz	
Vertical sync. frequency		56.4 Hz	
Operating conditions	Temperature	0° to 50°C	5° to 45°C
	Humidity	20% to 80% (no condensation)	
Power consumption		85 to 264 V, < 50 VA	90 to 130 V or 180 to 250 V, < 100 VA
Dimensions		341H x 326W x 363D mm	
Weight		9 kg	11.2 kg

APPENDIX F

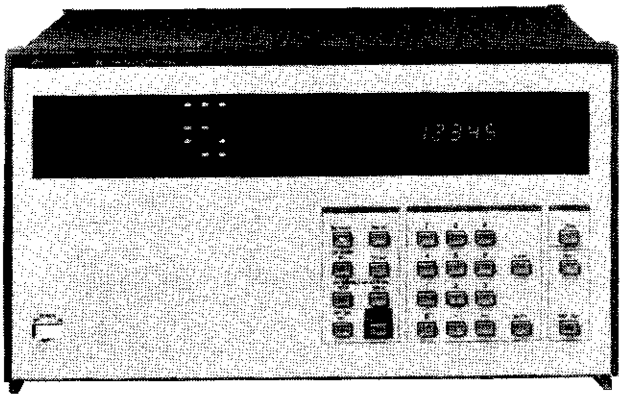
MH037A BCD CONVERTER



Interface	GP-IB 2 primary address types; 2 ONLY mode types can be set. SH1, AH1, TE5, LE3, SR1, RL2, PP0, DC1, DT1, C0
Input/output slot	Up to 8 units in any combination can be mounted on the rear panel
Conversion of BCD code apart from 0 to 9	Any ASCII Code (except C_R and L_F codes) can be set respectively at the primary addresses
SRQ Mask	Can be set for each unit
Checking	Data monitor, switch displays, status displays, display of input unit data line, lamp test, test pattern and timing pulse transmission to output unit
Units	MH038A Parallel Input Unit: 32-bit TTL MH039A Parallel Output Unit: 32-bit TTL MH044A Parallel Input Unit: 20-bit photocoupler MH054A Parallel Output Unit: 16-bit relay contact

APPENDIX G

MS010A MULTIFUNCTION SELECTOR



Item	Specifications
Slot units	23 slots, multiple slots used according to the kind of unit
Interface	GP-IB SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0
Channel combination setting	60
Collection data setting	60
Self-check function	SELF TEST key, executed when power turned on

Model	Number of channels (connector)	Common channel (connector)	Frequency range	Impedance	Insertion loss	Return loss	Crosstalk attenuation	Passband noise
MH356A	6 (57-40500)	1 (HR10-10R-12S)	DC~650 kHz	75 Ω BAL	≦ 0.2dB	≧ 35 dB	≧ 100 dB	≦ − 120 dBm
			650 kHz~2 MHz				≧ 90 dB	
MH357A	6 (57-40500)	1 (HR10-10R-12S)	DC~650 kHz	110 Ω BAL	≦ 0.2 dB	≧ 35 dB	≧ 100 dB	≦ − 120 dBm
			650 kHz~2 MHz				≧ 90 dB	
MH358A	6 (57-40500)	1 (HR10-10R-12S)	DC~650 kHz	135 Ω BAL	≦ 0.2 dB	≧ 35 dB	≧ 100 dB	≦ − 120 dBm
			650 kHz~2 MHz				≧ 90 dB	
MH359A	6 (57-40500)	1 (HR10-10R-12S)	DC~650 kHz	150 Ω BAL	≦ 0.2 dB	≧ 35 dB	≧ 100 dB	≦ − 120 dBm
			650 kHz~2 MHz				≧ 90 dB	
MH220A	6 (57-40500)	1 (HR10-10R-12S)	DC~150 kHz	600 Ω BAL	≦ 0.2 dB	≧ 35 dB	≧ 115 dB	≦ − 120 dBm
MH483A	6 (B N C)	1 (B N C)	DC~150 kHz	75 Ω UNBAL	≦ 0.2 dB	≧ 30 dB	≧ 80 dB	≦ − 120 dBm
MH494A / B	6 (B N C) (SP2.5CPS)	1 (B N C) (SP2.5CPS	DC~13 MHz	75 Ω UNBAL	≦ 0.2 dB	≧ 35 dB	≧ 115 dB	≦ − 120 dBm
			13~30 MHz		≦ 0.3 dB	≧ 33 dB	≧ 105 dB	
			30~100 MHz		≦ 0.5 dB	≧ 22 dB	≧ 95 dB	
MH655A	4 (B N C)	1 (B N C)	DC~100 MHz	50 Ω UNBAL	≦ 0.2 dB	≧ 25 dB	≧ 90 dB	≦ − 100 dBm
			100~500 MHz		≦ 0.5 dB	≧ 22 dB	≧ 80 dB	

APPENDIX H

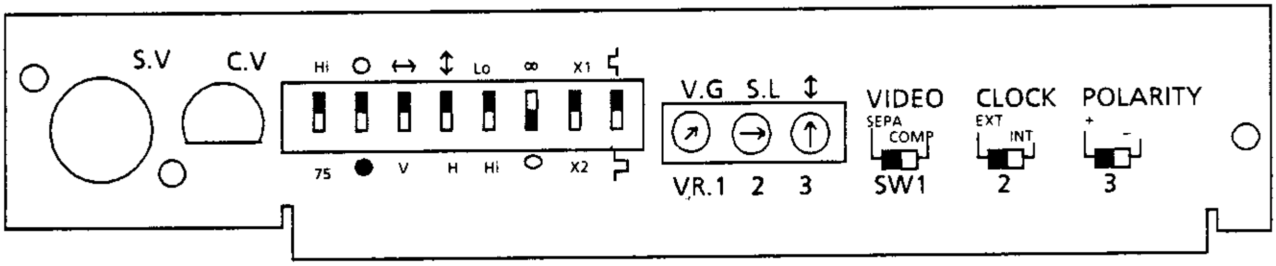
CONNECTING TO UA-455A VIDEO PLOTTER

To connect the MS2601A to the UA-455A Video Plotter to obtain hard copies of screen contents, use the following cable and set the switches and potentiometers on the rear of the UA-455A.

- **Connection cable**

  Use a DIN-8P cable (1 m). This cable is a standard accessory for the UA-455A.

- **Switch and potentiometer settings**



CAUTION

Before supplying power to the UA-455A, confirm that the ac voltage conforms to the specified rating (**Vac +10% or -15%).
An abnormal voltage may damage the internal components of the device.

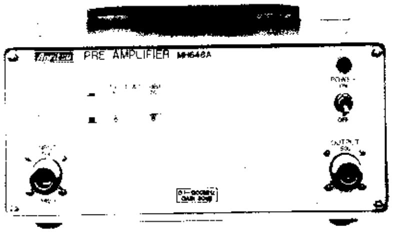
Note:

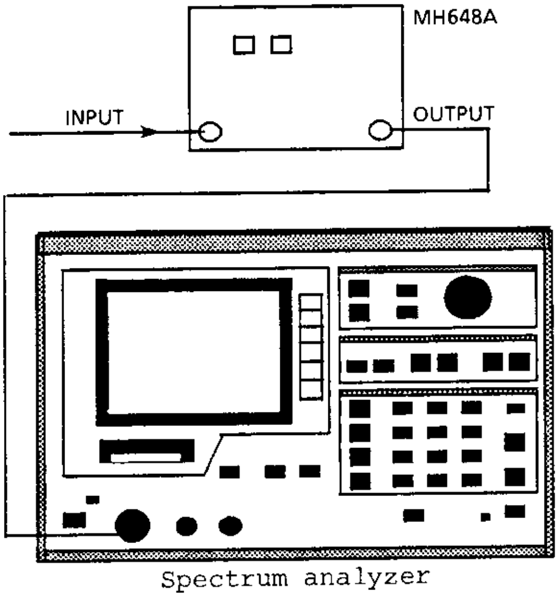
1. Set the switches to the black sides as shown in the above figure.
2. The above figure shows the average setting positions of the potentiometers.
3. Refer to the UA-455A Operation Manual for details on fine adjustments.

APPENDIX I

MH648A PREAMPLIFIER

The MH648A is a preamplifier equipped with an input attenuator to enhance the sensitivity of a spectrum analyzer, field strength measuring instrument, or frequency counter.

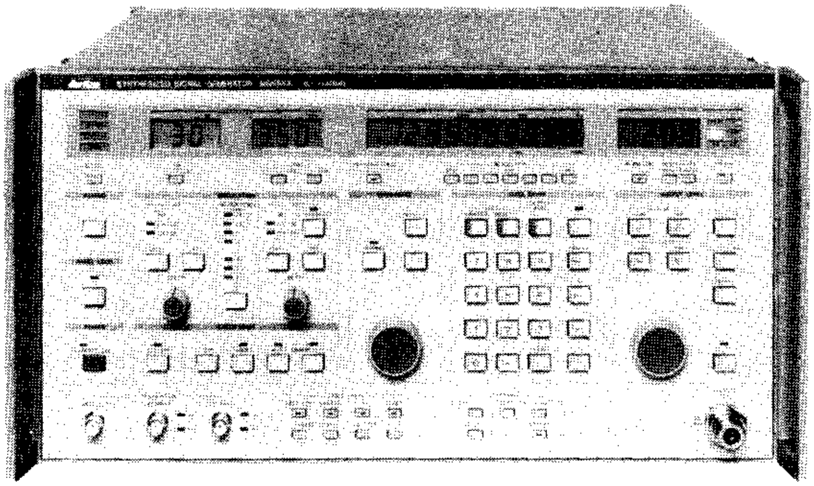




Frequency range	0.1 to 1200 MHz
Gain	30 dB ±1 dB: 0.5 to 800 MHz 30 dB $^{+1.5}_{-6}$ dB: 0.1 to 1200 MHz (with input attenuator at 0 dB, and at 20° to 30°C)
Gain stability	±1.5 dB: 0.1 to 800 MHz ±3 dB: 800 to 1200 MHz
Noise figure	≦6 dB: 0.5 to 800 MHz ≦8 dB: 0.1 to 1200 MHz (with input attenuator at 0 dB)
Max. output	≧120 dBμ (+7 dBm) (output at which the gain decreases 1 dB)
Input attenuator	0, 10, 20, 30 dB ±1.5 dB
Input/output terminals	50 Ω, VSWR: ≦2.5 (0.5 to 800 MHz), N(S) connector
Power	Ac **V, 50/60 Hz, ≦10 VA, or dc +21 to +30 V, ≦120 mA
Ambient temperature, rated range of use	0° to 45°C
Dimensions and weight	95H x 210W x 200D mm, ≦3.5 kg
Accessories supplied	One coaxial cord (S-5DWP•5D2W•S-5DWP): 1 m One ac power cord

APPENDIX J

MG655A SYNTHESIZED SIGNAL GENERATOR



Features

- Super-wide band : 100 kHz to 1300 MHz
- Excellent signal purity
  SSB phase noise: -133 dBc/Hz
  (520 MHz, 10 kHz offset)
- High frequency-stability: 5 x 10^{-8}/day
- High-accuracy output level: ±1 dB
- Superb modulation characteristics
- High-accuracy, high-speed digital sweep
- GP-IB bus (standard)
- Incremental keys and memories for 100 frequencies and 10 setting conditions:
  The measuring speed can be increased.

Main specifications

Carrier frequency	Range		0.1 to 1300 MHz
	Stability		2 x 10^{-8}/day
	Switching time		≦20 ms
Output level	Range		-30 to 130 dBμV
	Accuracy		±1 dB (<1000 MHz, ≧0 dBμV)
	Switching time		≦10 ms
	Impedance		50 Ω, N connector
Signal purity	Spurious		≦-80 dBc (CW mode, ≦120 dBμV)
	SSB phase noise		≦-133 dBc/Hz (10 kHz offset)
	Residual AM		≦0.01% (at carrier frequency: ≧150 kHz)
	Residual FM		≦70 dB (compared with frequency deviation: 3.5 kHz at demodulation band: 0.3 to 3 kHz and carrier frequency: ≧150 kHz)
Amplitude modulation	Modulation frequency	Internal	0.3, 0.4, 1, 2, 3 kHz
		External	Lower limit frequency: Dc or 20 Hz Upper limit frequency: 2.5 to 20 kHz according to carrier frequency and modulation factor
	Modulation factor		Internal: 0% to 99%, external: 0% to 80%
Frequency modulation	Modulation frequency	Internal	0.3, 0.4, 1, 2, 3 kHz
		External	Dc or 20 Hz to 250 kHz
	Frequency deviation		0 to 199 kHz
AM-FM simultaneous modulation			Possible
Power source			**V, 50/60 Hz, ≦220 VA
Dimensions and weight			221.5H x 426W x 451D mm, ≦37 kg

APPENDIX K

MH680A TRACKING GENERATOR

The MH680A Tracking Generator is a wideband sweep signal source used with the MS2601A or MS610B Spectrum Analyzer to measure the transmission characteristics of various amplifiers, filters, and circuit networks by direct observation.

Frequency range: 100 kHz to 2 GHz

Output level range: -10 to 0 dBm (continuously variable)

Output level frequency response: 1 dB (at 0 dBm)

Output impedance: 50 Ω, N-type connector

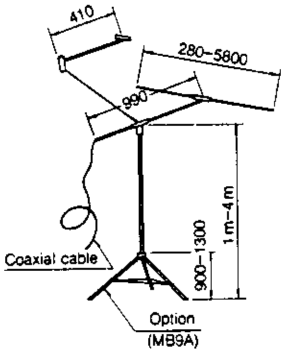
APPENDIX L

ANTENNAS AND MZ126A BAND SELECTOR

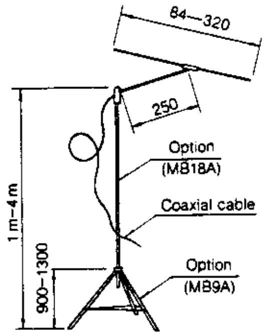
(1) Antennas

The following antennas enable the measurement of field strength and radiated interference waves by using the QP function of the MS2601A with digital display.

MP534A/MP534B (25 to 520 MHz)



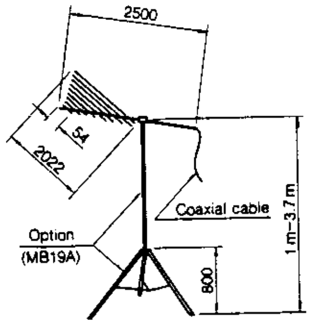
MP651A/MP651B (470 to 1700 MHz)



MP534(MP651) Dipole antenna

MB9A Tripod

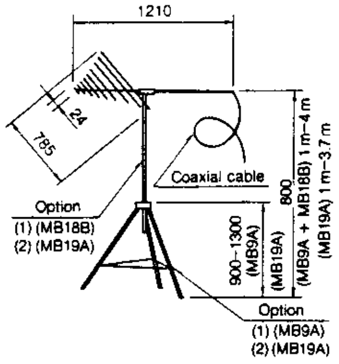
MP635A 80 to 1000 MHz



MP635A

MB19A Tripod

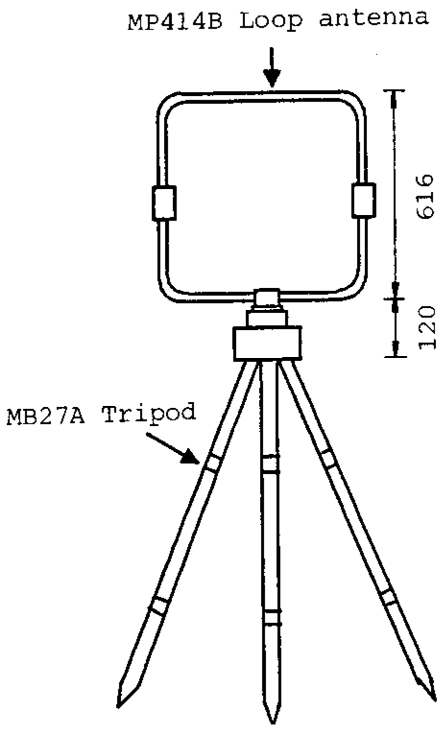
MP636A 300 to 1700 MHz



MP636A

MB19A Tripod

0.009 to 30 MHz



(2) MZ126A Band Selector

This device supplies band switching signal and power to the MP414B Loop Antenna or MP415B Rod Antenna.

Antenna control signal	The receiving frequency range of the MP414B or MP415B can be set.
Power source	. Built-in batteries (SUM-2 x 10 pieces) Battery life: Approx. 5 hrs. . External power source: 12 V, ≦100 mA . ** Vac, 50/60 Hz (Ac power pack, sold separately)
Dimensions and weight	55H x 208W x 180D mm ≦2 kg (including batteries)

APPENDIX M

MZ144A BATTERY PACK AND MZ145B DC-DC CONVERTER

Use the MZ144A Battery Pack or supply +12 V dc power from an automobile to the MZ145B DC-DC converter for outdoor measurement.

Model	Specification
Battery pack MZ144A	Lead accumulator: 12 V Output voltage: +24 V, -24 V Operation time: ≥1 h, (with built-in charger)
DC-DC Converter MZ145B	Input voltage: 12 V Output voltage: +24 V, -24 V

APPENDIX N

MN423B/MN424B/MN425B
ARTIFICIAL MAINS NETWORK

The EMI of a conducted interference wave can be measured within a range of 30 MHz or less. The following artificial mains networks (conforming to different national standards) are available.

	MN423B	MN424B	MN425B
Frequency range	150 kHz to 30 MHz	450 kHz to 30 MHz	10 kHz to 30 MHz
Impedance	75 Ω	50 Ω	50 Ω
Conformation	CISPR Pub 1	FCC Part 15	VDE 876

APPENDIX O

DEVICE MESSAGES IN ALPHABETICAL ORDER

Device message		Parameter	
Control	Data request	Control item	Item
AAT△0	AAT?	ATTEN OFF	AUTO MODE(MENU)
AAT△1	AAT?	ATTEN ON	AUTO MODE(MENU)
AMB△0	AMB?	A-B→A OFF	A,B MEMORY(MENU)
AMB△1	AMB?	A-B→A ON	A,B MEMORY(MENU)
		WRITE MODE	
AMD△0	AMD?	NORMAL	A ch WRITE/READ(MENU)
AMD△1	AMD?	MAX HOLD	A ch WRITE/READ(MENU)
AMD△2	AMD?	AVER	A ch WRITE/READ(MENU)
ANT△0	ANT?	DIPOLE	ANTENNA(MENU)
ANT△1	ANT?	LOG-PERI(1)	ANTENNA(MENU)
ANT△2	ANT?	LOG-PERI(2)	ANTENNA(MENU)
ANT△3	ANT?	LOOP	ANTENNA(MENU)
ANT△4	ANT?	USER	ANTENNA(MENU)
ARB△0	ARB?	RES.BW OFF	AUTO MODE(MENU)
ARB△1	ARB?	RES.BW ON	AUTO MODE(MENU)
ARD△0	ARD?	READ OUT OFF	A ch WRITE/READ(MENU)
ARD△1	ARD?	READ OUT ON	A ch WRITE/READ(MENU)
AST△0	AST?	SWP TIME OFF	AUTO MODE(MENU)
AST△1	AST?	SWP TIME ON	AUTO MODE(MENU)
ATB	——	A→B	A,B MEMORY(MENU)
ATT△0	ATT?	ATTEN 0 dB	ATTENUATION(MENU)
ATT△1	ATT?	ATTEN 10 dB	ATTENUATION(MENU)
ATT△2	ATT?	ATTEN 20 dB	ATTENUATION(MENU)
ATT△3	ATT?	ATTEN 30 dB	ATTENUATION(MENU)
ATT△4	ATT?	ATTEN 40 dB	ATTENUATION(MENU)
ATT△5	ATT?	ATTEN 50 dB	ATTENUATION(MENU)

(Cont.)

Device message		Parameter	
Control	Data request	Control item	Item
AVB△0	AVB?	VID BW OFF	AUTO MODE(MENU)
AVB△1	AVB?	VID BW ON	AUTO MODE(MENU)
AVR△0	AVR?	AVER RATE 4	AVERAGE RATE(MENU)
AVR△1	AVR?	AVER RATE 8	AVERAGE RATE(MENU)
AVR△2	AVR?	AVER RATE 16	AVERAGE RATE(MENU)
AVR△3	AVR?	AVER RATE 32	AVERAGE RATE(MENU)
AWR△0	AWR?	WRITE OFF	A ch WRITE/READ(MENU)
AWR△1	AWR?	WRITE ON	A ch WRITE/READ(MENU)
BIN△0	BIN?	ASCII DATA	ASCII/BINARY(SPECTRUM DATA)
BIN△1	BIN?	BINARY DATA	ASCII/BINARY(SPECTRUM DATA)
		WRITE MODE	
BMD△0	BMD?	NORMAL	B ch WRITE/READ(MENU)
BMD△1	BMD?	MAX HOLD	B ch WRITE/READ(MENU)
BMD△2	BMD?	AVER	B ch WRITE/READ(MENU)
BRD△0	BRD?	READ OUT OFF	B ch WRITE/READ(MENU)
BRD△1	BRD?	READ OUT ON	B ch WRITE/READ(MENU)
BWR△0	BWR?	WRITE OFF	B ch WRITE/READ(MENU)
BWR△1	BWR?	WRITE ON	B ch WRITE/READ(MENU)
CAL△0	——	CAL ALL	CALIBRATION(MENU)
CAL△1	——	CAL FREQ	CALIBRATION(MENU)
CAL△2	——	CAL LEVEL (1)	CALIBRATION(MENU)
CAL△3	——	CAL LEVEL (2)	CALIBRATION(MENU)

(Cont.)

Device message		Parameter	
Control	Data request	Control item	Item
CD6,P	CD6?△P0,P1	USER ANTENNA	FREQ DATA WRITE/READ
CD7,P	CD7?△P0,P1	USER ANTENNA	CORRECTION FUCTOR WRITE/READ
CDT△0	CDT?	OFF	CORRECTION DATA(MENU)
CDT△1	CDT?	ON	CORRECTION DATA(MENU)
	CMK?	CURRENT	MARKER POSITION
CNF△f	CNF?	CENTER(CF)	FREQ SET(MENU)
CRE△0	CRE?	OFF	RESPONSE CORRECTION (MENU)
CRE△1	CRE?	ON	RESPONSE CORRECTION (MENU)
		RESOLUTION	
CRS△0	CRS?	1 Hz	FREQ MEASUREMENT(FUNCTION)
CRS△1	CRS?	10 Hz	FREQ MEASUREMENT(FUNCTION)
CRS△2	CRS?	100 Hz	FREQ MEASUREMENT(FUNCTION)
DET△0	DET?	PEAK	DET MODE(MENU)
DET△1	DET?	SAMPLE	DET MODE(MENU)
DET△2	DET?	DIP	DET MODE(MENU)
FDN	—	STEP DOWN	FREQ SET(FUNCTION)
		FREQ MODE	
FRQ△0	FRQ?	CF/SPAN	FREQ MODE(MENU)
FRQ△1	FRQ?	START/SPAN	FREQ MODE(MENU)
FSS△f	FSS?	STEP SIZE	FREQ SET(FUNCTION)
FUP	—	STEP UP	FREQ SET(FUNCTION)
INI	—	INITIAL	INITIAL(SAVE/RECALL)
LST△m	—	LIST	LIST
MKC△0	MKC?	COUNT OFF	FREQ MEASUREMENT(FUNCTION)
MKC△1	MKC?	COUNT ON	FREQ MEASUREMENT(FUNCTION)
—	MKF?		MAKER FREQ
—	MKL?		MAKER LEVEL

(Cont.)

Device message		Parameter	
Control	Data request	Control item	Item
MKR△0	MKR?	NORMAL	MARKER(FUNCTION)
MKR△1	MKR?	ΔMKR	MARKER(FUNCTION)
MKR△2	MKR?	MKR OFF	MARKER(FUNCTION)
MKR△3	MKR?	MKR→CF	MARKER(FUNCTION)
MKR△4	MKR?	MKR→REF	MARKER(FUNCTION)
MKS△0	—	PEAK	MARKER SEARCH (FUNCTION)
MKS△1	—	NEXT PEAK	MARKER SEARCH (FUNCTION)
MKS△2	—	MINIMUM	MARKER SEARCH (FUNCTION)
MKS△3	—	LEFT PEAK	MARKER SEARCH (FUNCTION)
MKS△4	—	CENTER PEAK	MARKER SEARCH (FUNCTION)
MKS△5	—	RIGHT PEAK	MARKER SEARCH (FUNCTION)
MKS△6	—	LEFT MIN	MARKER SEARCH (FUNCTION)
MKS△7	—	CENTER MIN	MARKER SEARCH (FUNCTION)
MKS△8	—	RIGHT MIN	MARKER SEARCH (FUNCTION)
MKW△0	MKW?	NARROW	ZONE MARKER WIDTH(FUNCTION)
MKW△1	MKW?	SPOT	ZONE MARKER WIDTH(FUNCTION)
MKW△2	MKW?	WIDE	ZONE MARKER WIDTH(FUNCTION)
MKZ△P	MKZ?	ZONE	MARKER POSITION(FUNCTION)
PCF	—	PEAK→CF	PEAK(SIGNAL/SEARCH)
	PER?	PMC ERROR	PMC ERROR

(Cont.)

Device message		Parameter	
Control	Data request	Control item	Item
PRL		PEAK→REF	PEAK(SIGNAL SEARCH)
		ZONE SWEEP	
PSW△0	PSW?	OFF	ZONE SWEEP(MENU)
PSW△1	PSW?	ON	ZONE SWEEP(MENU)
QPD△0	QPD?	QP OFF	QUASI PEAK(MENU)
QPD△1	QPD?	QP ON	QUASI PEAK(MENU)
RBW△0	RBW?	30 Hz	RESOLUTION BAND WIDTH(MENU)
RBW△1	RBW?	100 Hz	RESOLUTION BAND WIDTH(MENU)
RBW△2	RBW?	300 Hz	RESOLUTION BAND WIDTH(MENU)
RBW△3	RBW?	1 kHz	RESOLUTION BAND WIDTH(MENU)
RBW△4	RBW?	3 kHz	RESOLUTION BAND WIDTH(MENU)
RBW△5	RBW?	10 kHz	RESOLUTION BAND WIDTH(MENU)
RBW△6	RBW?	30 kHz	RESOLUTION BAND WIDTH(MENU)
RBW△7	RBW?	100 kHz	RESOLUTION BAND WIDTH(MENU)
RBW△8	RBW?	300 kHz	RESOLUTION BAND WIDTH(MENU)
RBW△9	RBW?	1 MHz	RESOLUTION BAND WIDTH(MENU)
RBW△10	RBW?	200 Hz	RESOLUTION BAND WIDTH(MENU)
RBW△11	RBW?	9 kHz	RESOLUTION BAND WIDTH(MENU)
RBW△12	RBW?	120 kHz	RESOLUTION BAND WIDTH(MENU)
RCM△m		RECALL	RECALL (SAVE/RECALL)
RLN△0	RLN?	TOP	REFERENCE LINE(MENU)
RLN△1	RLN?	MDL	REFERENCE LINE(MENU)
RLN△2	RLN?	BOT	REFERENCE LINE(MENU)
RLV△ℓ	RLV?	REF·LEVEL	REF·LEVEL(FUNCTION)
———	RMK?	REFERENCE	MARKER POSITION

(Cont.)

Device message		Parameter	
Control	Data request	Control item	Item
		SCALE	
SCL△0	SCL?	1 dB/div	SCALE(MENU)
SCL△1	SCL?	2 dB/div	SCALE(MENU)
SCL△2	SCL?	5 dB/div	SCALE(MENU)
SCL△3	SCL?	10 dB/div	SCALE(MENU)
SCL△4	SCL?	LIN	SCALE(MENU)
SCR△0	——	LEFT MOVE	SCROLL(SIGNAL SEARCH)
SCR△1	——	RIGHT MOVE	SCROLL(SIGNAL SEARCH)
SPD	——	SPAN DOWN	SPAN(SIGNAL SEARCH)
SPF△f	SPF?	SPAN	FREQUENCY SET(ENTRY)
SPU	——	SPAN UP	SPAN(SIGNAL SEARCH)
STF△f	STF?	START	FREQUENCY SET(ENTRY)
SRQ △0	SRQ?	SRQ OFF	SRQ
SRQ △1	SRQ?	SRQ ON	SRQ
SVM△m		SAVE	SAVE(SAVE/RECALL)
SWP		Single sweep execution	SINGLE SWEEP(MENU)
——	SWP?	Sweep terminated/ Sweep in progress	
SWT△t	SWT?	SWEEP TIME	SWEEP TIME(MENU)
TEN△X,Y,text	——	TITLE	TITLE (MENU)
TRG△0	TRG?	TRIG FREE	TRIGGER(MENU)
TRG△1	TRG?	TRIG VIDEO	TRIGGER(MENU)
TRG△2	TRG?	TRIG LINE	TRIGGER(MENU)
TRG△3	TRG?	TRIG EXT	TRIGGER(MENU)
TRG△4	TRG?	TRIG SINGLE	TRIGGER(MENU)
TRG△5	TRG?	TRIG START	TRIGGER(MENU)
TRM△0	——	LF	TERMINATOR
TRM△1	——	CR	TERMINATOR
TRM△2	——	CR/LF	TERMINATOR
		TITLE DISPLAY	
TTL△0	TTL?	ON	TITLE (MENU)
TTL△1	TTL?	OFF	TITLE (MENU)

(Cont.)

Device message		Parameter	
Control	Data request	Control item	Item
		UNCAL status	
——	UCL?	NORMAL/UNCAL	AUTO MODE(MENU)
		UNCAL display	
UNC△0	UNC?	OFF	AUTO MODE(MENU)
UNC△1	UNC?	ON	AUTO MODE(MENU)
UNT△0	UNT?	dBm	UNIT(FUNCTION)
UNT△1	UNT?	dBμV	UNIT(FUNCTION)
UNT△2	UNT?	dBV dBmV	UNIT(FUNCTION)
UNT△3	UNT?	V	UNIT(FUNCTION)
UNT△4	UNT?	dBμV(emf)	UNIT(FUNCTION)
UNT△5	UNT?	dBμV/m	UNIT(FUNCTION)
VBW△0	VBW?	1 Hz	VIDEO BANDWIDTH(MENU)
VBW△1	VBW?	10 Hz	VIDEO BANDWIDTH(MENU)
VBW△2	VBW?	100 Hz	VIDEO BANDWIDTH(MENU)
VBW△3	VBW?	1 kHz	VIDEO BANDWIDTH(MENU)
VBW△4	VBW?	10 kHz	VIDEO BANDWIDTH(MENU)
VBW△5	VBW?	100 kHz	VIDEO BANDWIDTH(MENU)
VBW△6	VBW?	OFF	VIDEO BANDWIDTH(MENU)
XMA△P	XMA?△P0,P1	Memory A	A ch(SPECTRUM DATA)
XMB△P	XMB?△P0,P1	Memory B	B ch(SPECTRUM DATA)

LIST Sections)

SWEEP TIME	ATTEN	RESOLN BW	MARKER		Panel key name	
SWEEP TIME ▨	ATTEN ▨	RESOLN BW ▨	F6	MARKER ▨	Key operation	
SWEEP TIME	ATTEN	RESOLN BW	MARKER (2)	MARKER (1)	Menu classification	
AUTO	**AUTO**	**AUTO**	**NORMAL**	MKR→CF	F1	Function setting by soft keys
MANUAL	MARKER OFF	MANUAL	Δ	MKR→ REF	F2	
			MARKER OFF	PEAK SEARCH	F3	
Current value	Current value	Current value	Z WDTH NAR*1	NEXT PEAK	F4	
︽	︽	︽	Z SWP OFF*2	MIN SEARCH	F5	
︾	︾	︾	MARKER (1)	MARKER (2)	F6	
			*1 NAR / SPOT / WIDE *2 OFF / ON		*	
	● ATTEN (Input Attenuator)	● RESOLN (Resolution Bandwidth) ● BW (Bandwidth)	● Z WDTH (Zone Width) ● NAR (Narrow) ● SWP (Sweep)	● MKR (Marker) ● CF (Center Frequency) ● REF (Reference Level) ● MIN (Minimum)	Abbreviation and meaning	

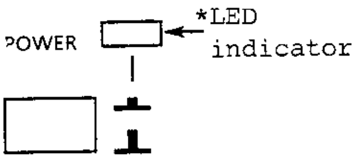
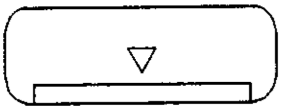
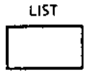
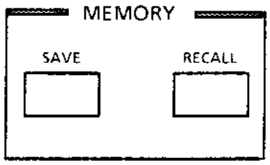
* The functions enclosed in the bold solid line frame and with * are set at initialization.

* The functions with the * are active when a menu is displayed. Since one key includes several functions, select the required function displayed serially with the relevant soft keys.

APPENDIX P

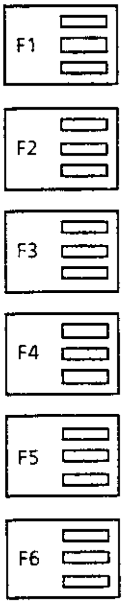
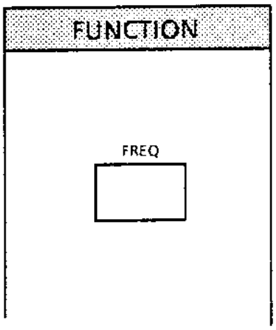
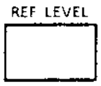
FRONT AND REAR PANEL CONTROLS EXPLANATION

The front and rear panel controls explanation table is shown together with the following appended figures and table. For a detailed description of operation of each key, see SECTION 5.

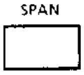
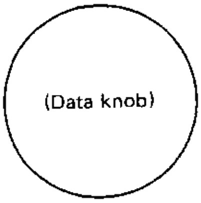
No.	Panel marking	Function
1		Power switch: When set to the ON position, POWER ON is set and ac or dc power is supplied to the MS2601A and the LED indicator lights. When set to the OFF position, POWER OFF is set and the ac or dc power is turned off and the LED indicator goes off.
2		PMC (Plug-in Memory Card) slot: The PMC plugs into this slot. The memory card is used as an external memory. It is also used for PTA (option) control. To save data, press the [SAVE] key. To recall the data, press the [RECALL] key. The contents of the data are the A ch and B ch waveforms and the front panel settings (panel functions).
3		This key displays the currently-set contents or the contents saved in the function memory.
4		When saving the panel functions to the internal backup memory or PMC, select a register number from 1 to 6 or 12 after pressing the [SAVE] key. To recall the saved panel functions, select a register number from 1 to 6 or 12 after pressing the [RECALL] key. The soft keys [F1] to [F6] or the numeric keys [1] to [6] can be used as the register number.
5	(CRT)	■ Displays the data needed for spectrum analysis simultaneously with traces of the signal waveform . Display of panel function parameters set values needed in measurement . Digital display of results of measurement by marker operation . Measurement auxiliary message and error message display

* LED (Light-Emitting Diode)

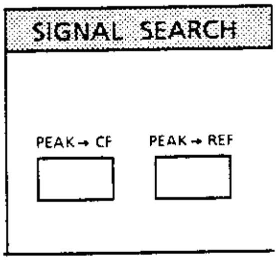
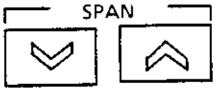
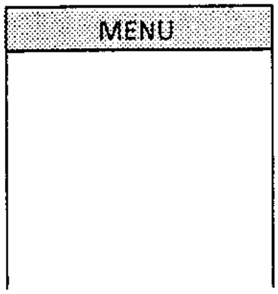
(Cont.)

No.	Panel marking	Function
6	ADRS current value COPY HP-GL* ITEM ALL* SIZE A3* COPY START COPY RESET 	When a panel key shown in Table A-1 is pressed, a message corresponding to the soft keys [F1] to [F6] is displayed at the right of the CRT. Press the soft key corresponding to the message to be processed. <Example: GP-IB address confirmation> 1. Press the front panel MENU section [SHIFT] [GP-IB/COPY] keys. 2. The message shown at the left is displayed at the right of the CRT corresponding to the [F1] to [F6] keys. 3. The value which appears under the ADRS display corresponding to soft key [F1] is the current GP-IB address number.
7		FUNCTION: Frequency, level, marker, and frequency span data is entered with this key. The data is set with the data knob or MENU section numeric/unit keys. When the front panel FUNCTION section [FREQ] key is pressed, the MS2601A enters the FREQ entry mode. This mode is independent from the menu key and is not reset by menu key operation. When CENTER is selected at the FREQ MODE menu (paragraph 5.12), CENTER FREQ data can be entered. When START is selected at the FREQ MODE menu, START FREQ data can be entered.
8		When the [REF LEVEL] key is pressed, the characters RL at the top left of the CRT are highlighted. Set the REFERENCE LEVEL data with the data knob or the MENU section numeric/unit keys. REFERENCE LEVEL is the absolute amplitude level on the top horizontal line of the CRT scale.

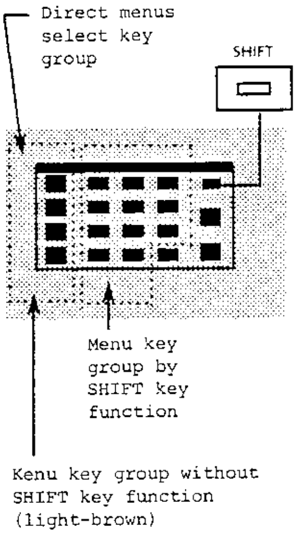
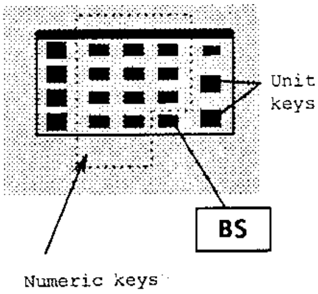
(Cont.)

No.	Panel marking	Function
9		When the [MARKER] key is pressed, marker soft key messages corresponding to the [F1] to [F6] keys are displayed at the right of the CRT. The contents of the messages are shown at the cross point at which [MARKER] key operation and key [F1] to [F6] cross in Table A-1. Since NORMAL is selected at initialization even if the [F1] key is not pressed, MKR at the top left of the CRT is highlighted. The marker frequency is displayed immediately to the right of these characters and the marker level is digitally displayed to the right of the frequency. The marker position can be changed with the data knob.
10		When the [SPAN] key is pressed, SP at the bottom center of the CRT is highlighted. Set the CRT horizontal axis frequency sweep width with the data knob or MENU section numeric/unit keys. When the function of the [SPAN] key is not specified and the next frequency span value is varied in a 1-2-5 sequence, the frequency span can be increased or decreased by using the SIGNAL SEARCH section span [∨] or [∧] keys.
11		The data of the functions described in (1) to (4) below is set to the desired value by turning this data knob clockwise and counterclockwise. When this data knob is turned slowly, the set value can be changed in small steps. When this knob is turned rapidly, the steps are larger. 1. FREQ (FREQUENCY) 2. MARKER 3. SPAN 4. REF LEVEL (REFERENCE LEVEL)

(Cont.)

No.	Panel marking	Function
12		SIGNAL SEARCH: This section contains functions for quickly searching for the desired signal. ■ When the [PEAK→CF] key is pressed, the frequency of the highest level signal on the CRT is automatically set to the center frequency CF. ■ When the [PEAK→REF] key is pressed, the peak level on the CRT is automatically set to the REFERENCE LEVEL.
13		When the [∧] or [∨] key is pressed, the frequency span data can be increased or decreased in a 1-2-5 sequence steps without specifying the function of the FUNCTION section [SPAN] key.
14		When the [<] or [>] key is pressed, the MS2601A enters the left or right scroll mode which moves the waveform on the CRT to left or right. . When the [<] key is pressed, the scroll is executed leftwards. . When the [>] key is pressed, the scroll is executed rightwards.
15		Measurement operations can be also performed in MENU section in addition to FUNCTION and SIGNAL SEARCH sections. The MENU provides setting menus for multi-function and multi-purpose use by operation of soft keys [F1] to [F6].

(Cont.)

No.	Panel marking	Function
16	 	■ The MENU section menu keys are divided into the following two groups: . Menu key group by SHIFT key function (total 11 keys) When the numeric key with the function name shown above the key is pressed after the [SHIFT] key is pressed, a menu is displayed at the right of the CRT. Select one of the [F1] to [F6] keys corresponding to a menu to execute the selected function. . Menu key group without SHIFT key function (total 5 keys) When a light-brown key is pressed without pressing the [SHIFT] key, the menu corresponding to the [F1] to [F6] keys is displayed at the right of the CRT. Press the soft key with the required function. Since the FUNCTION section MARKER key is included, there are five direct menu selection keys. ■ Numeric data is entered with the numeric/unit keys. The [0] to [9] keys and decimal point [.] key shown in the figure at the left are pressed sequentially without pressing the [SHIFT] key. Then, the data unit is set with the unit key. Each time the [BS] (back-space) key is pressed, the last character entered is erased.
17		■ When the [VID BW], [SCALE], or [TRIG] key is pressed after pressing the [SHIFT] key, the menu corresponding to the [F1] to [F6] keys is displayed at the right of the CRT. For the contents of each menu, see Table A-1. [VID BW]: Video bandwidth auto or manual selection and set value step up/down

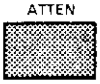
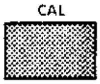
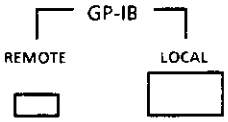
(Cont.)

No.	Panel marking	Function
17 (Cont.)		[SCALE]: CRT vertical axis LOG scale 10 dB/div, 5 dB/div, 2 dB/div, 1 dB/div and LINEAR scale settings [TRIG]: Sweep start condition FREE, VIDEO, LINE, EXT, SIGNAL, or RE-START setting ■ When these keys are pressed without pressing the [SHIFT] key, they are used as the [7], [8], and [9] numeric keys.
18	TRACE SUB TRACE GP-IB/COPY 4 5 6	■ When the [TRACE], [SUB TRACE], or [GP-IB/ COPY] key is pressed after pressing the [SHIFT] key, the menu corresponding to the [F1] to [F6] keys is displayed at the right of the CRT. For the contents of each menu, see Table A-1. [TRACE]: Selection of how the waveform data is to be processed and written or read at the A ch and B ch memories and displayed. [SUB TRACE]: B ch waveform data subtraction from A ch, detection mode selection, and REF LINE selection. [GP-IB/COPY]: GP-IB address confirmation and setting, and direct plotiting function ■ When these keys are pressed without pressing the [SHIFT] key, they are used as the [4], [5], and [6] numeric keys.
19	COUNT FREQ MODE PTA 1 2 3	■ When the [COUNT], [FREQ MODE], or [PTA] key is pressed after pressing the [SHIFT] key, the menu corresponding to the [F1] to [F6] keys is displayed at the right of the CRT. For the contents of each menu, see Table A-1.

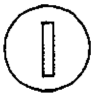
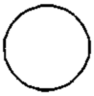
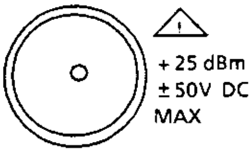
(Cont.)

No.	Panel marking	Function
19 (Cont.)		[COUNT]: Frequency measurement ON/OFF and count resolution selection [FREQ MODE]: CENTER FREQ (CF), START FREQ (SF), CF or SF STEP SIZE setting, and CF or SF step up/down [PTA]: PTA (option) ON/OFF ■ When these keys are pressed without pressing the [SHIFT] key, they are used as the [1], [2], and [3] numeric keys.
20	QP/UNIT 0 PMC • TITLE BS	■ When the [QP/UNIT], [PMC] or [TITLE] key is pressed after pressing the [SHIFT] key, the menu corresponding to the [F1] to [F6] keys is displayed at the right of the CRT. For the contents of each menu, see Table A-1. [QP/UNIT]: EMI (Electro-Magnetic Interference) measurement based on CISPR standard Quasi-peak value measurement function, and field strength direct reading measurement function and unit selections [PMC]: PMC data management (DELETE, WRITE PROTECT, FORMAT, etc.) [TITLE]: TITLE display ■ When these keys are pressed without pressing the [SHIFT] key, they are used as the [0] numeric key, [.] decimal point key, and [BS] (back-space) key, respectively. ■ Each time the [BS] key is pressed, the last-entered character is erased.

(Cont.)

No.	Panel marking	Function
21	 	When the [RESOLN BW] or [ATTEN] key is pressed, the menu corresponding to the [F1] to [F6] keys is displayed at the right of the CRT. For the contents of each menu, see Table A-1. [RESOLN BW]: Resolution bandwidth auto, manual, step-up, or step-down setting [ATTEN]: Input attenuator auto, manual, step-up, or step-down setting
22	 	When the [SWEEP TIME] or [CAL] key is pressed, the menu corresponding to the [F1] to [F6] keys is displayed at the right of the CRT. For the contents of each menu, see Table A-1. [SWEEP TIME]: Sweep time auto, manual, step-up, or step-down setting [CAL]: Executes the amplitude/frequency error correction routine
23		When the MS2601A remote state is specified by the software at GP-IB control, the REMOTE lamp lights. If the remote state is not RWLS (Remote With Lockout Status), when the [LOCAL] key is pressed, the MS2601A is switched from the remote state to the local state and the REMOTE lamp goes off. If the remote state is RWLS, the MS2601A does not return to the local state even if the [LOCAL] key is pressed. (The MS2601A cannot be switched from the local state to the remote state by pressing this key.)

(Cont.)

No.	Panel marking	Function
24	INITIAL 	When the [INITIAL] key is pressed, the MS2601A is set to the initial state. At this time, the parameters of the front panel function keys are set to full frequency range sweep (full span = 2.2 GHz), marker position center frequency 1100 MHz, vertical axis 10 dB/div LOG scale, REF LEVEL 0 dBm, FREE trigger, A ch memory waveform, and automatic setting (RESOLN BW, ATTEN, VID BW, SWEEP TIME).
25	INTENSITY 	Adjusts intensity of CRT display When this knob is turned clockwise, the entire screen becomes brighter; when it is turned counterclockwise, the entire screen becomes darker.
26	PROBE SOURCE 	Supplies power to probe A probe with a high input impedance is necessary for in-circuit measurements (measurement of an unknown signal connected in parallel with the circuit of the device under test). The P6201 (Tektronix) is available as an option.
27	RF INPUT 50Ω  	A signal within the 10 kHz to 2.2 GHz frequency range and -130 to +20 dBm level range is applied to this 50 Ω input impedance N type connector. Since the input circuit is not protected, if a signal exceeding +25 dBm or ±50 Vdc is applied, the input attenuator and input mixer may be damaged. ⚠ is an alarm mark for preventing overinput.

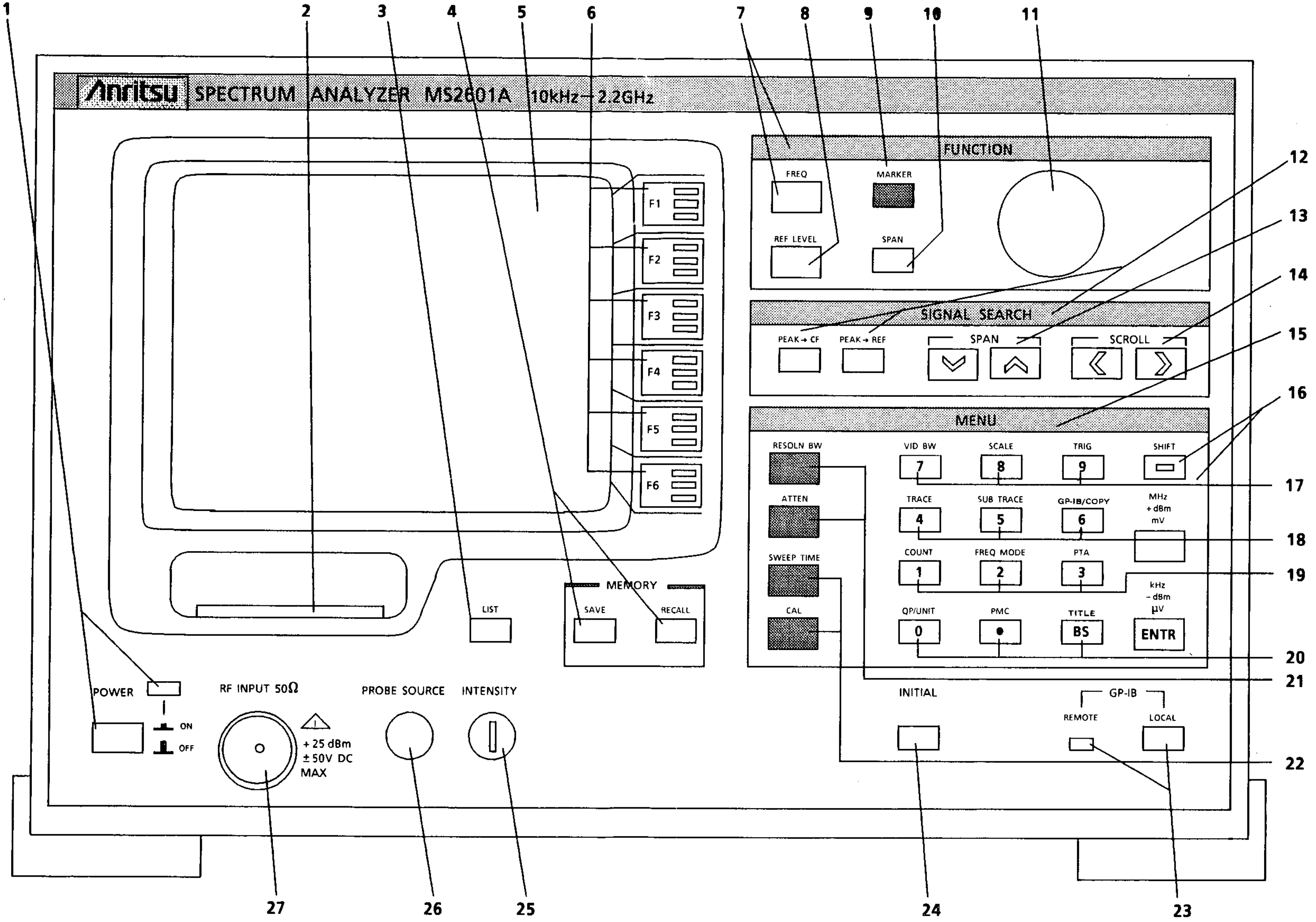
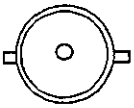
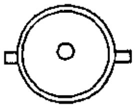
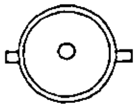
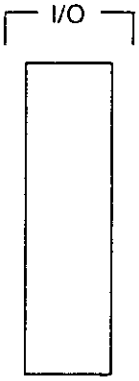
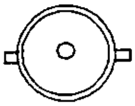
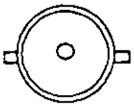
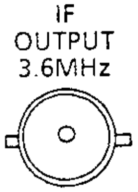
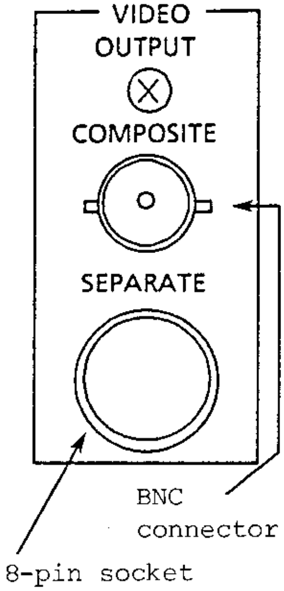
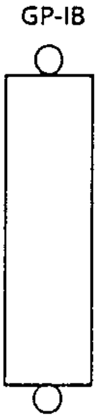


Fig. A-1 Front Panel

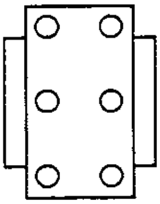
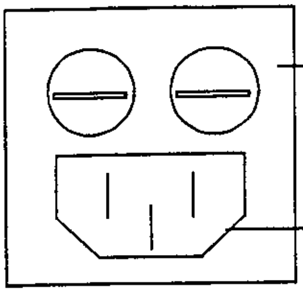
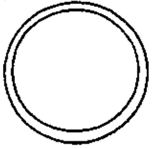
(Cont.)

No.	Panel marking	Function
28	X OUTPUT  Y OUTPUT  Z OUTPUT 	These conneectors output signals to drive an X-Y recorder. X OUTPUT: Outputs a X-axis signal proportional to the sweep voltage at a left-end 0 V to right-end 10 V range Y OUTPUT: Outputs a Y-axis signal proportional to the video detection output at a bottom 0 V to top 1 V range Z OUTPUT: Outputs a signal which raises the pen during the sweep flyback trace with open-collector TTL level · Pen up .... High level · Pen down ...... Low level
29		Used to control external devices by PTA (Personal Test Automation, option) function or to input external data to PTA from external devices Refer to PTA manual.
30	REFERENCE INPUT 10MHz 	When a 10 MHz signal from an external reference oscillator is applied to the REFERENCE INPUT connector at a ≧0.5 Vp-p level, the MS2601A is automatically set to the external reference oscillator mode.
31	OUTPUT 50MHz 	Frequency signal source for checking MS2601A (Frequency 50 MHz, level -2 dBm, output impedance 50 Ω)

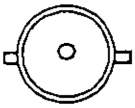
(Cont.)

No.	Panel marking	Function
32		Outputs a 3.6 MHz IF signal at a 0 dBm output level and 50 Ω impedance This IF output is used to process the input signal before detection.
33		These connectors output a composite or separate video signal of CRT screen. ■ To hard-copy or monitor by composite video signal, connect the BNC connector to the composite video input connector of the video instrument with a BNC coaxial cable. ■ To hard-copy by separate video signal, connect the DIN-8P cable supplied with the UA-455A Video Plotter to this 8-pin socket.
34		■ To remotely-control the MS2601A by GP-IB, connect the GP-IB cable to this connector. In the remote mode, the front panel REMOTE LED indicator lights. ■ When the RS-232C option is used, this connector is changed to DB-25S (JAEDB-25S equivalent). Therefore, connect a RS-232C interface cable with DB-25P (male) connector to the DB-25S (female) connector.
35	(Fan)	This fan exhausts the heat generated inside the MS2601A to the outside. Leave a space of at least 10 cm between the fan and an obstacle.

(Cont.)

No.	Panel marking	Function
36		When measuring outdoors, dc power can be supplied from an MZ144A Battery Pack or MZ145B DC-DC converter to this connector with the accessory power cord. The power is turned on and off at the front panel POWER switch.
37		Fuse holder Contains ***A fuse Ac power inlet for supplied power cord
38	FIRST LOCAL OUTPUT  SECOND LOCAL OUTPUT 	When amplitude-frequency characteristics are measured by combining the MS2601A with a tracking generator (MH680A), the connectors shown below are connected with coaxial cords supplied with the tracking generator. MS2601A Tracking generator . FIRST LOCAL OUTPUT ↔ 2.5214 to 4.7214 GHz ↔ FIRST LOCAL INPUT . SECOND LOCAL OUTPUT ↔ 2.5 GHz ↔ SECOND LOCAL INPUT
39	EXTERNAL KEYBOARD 	When PTA (option) is installed, the keyboard for controlling it is connected to this connector.

(Cont.)

No.	Panel marking	Function
40	EXTERNAL TRIGGER 	The external trigger signal is input to this connector, when the TRIG mode is set to EXT. Sweep is started by the positive edge of the external trigger signal. Key operation for setting the external trigger mode is: 

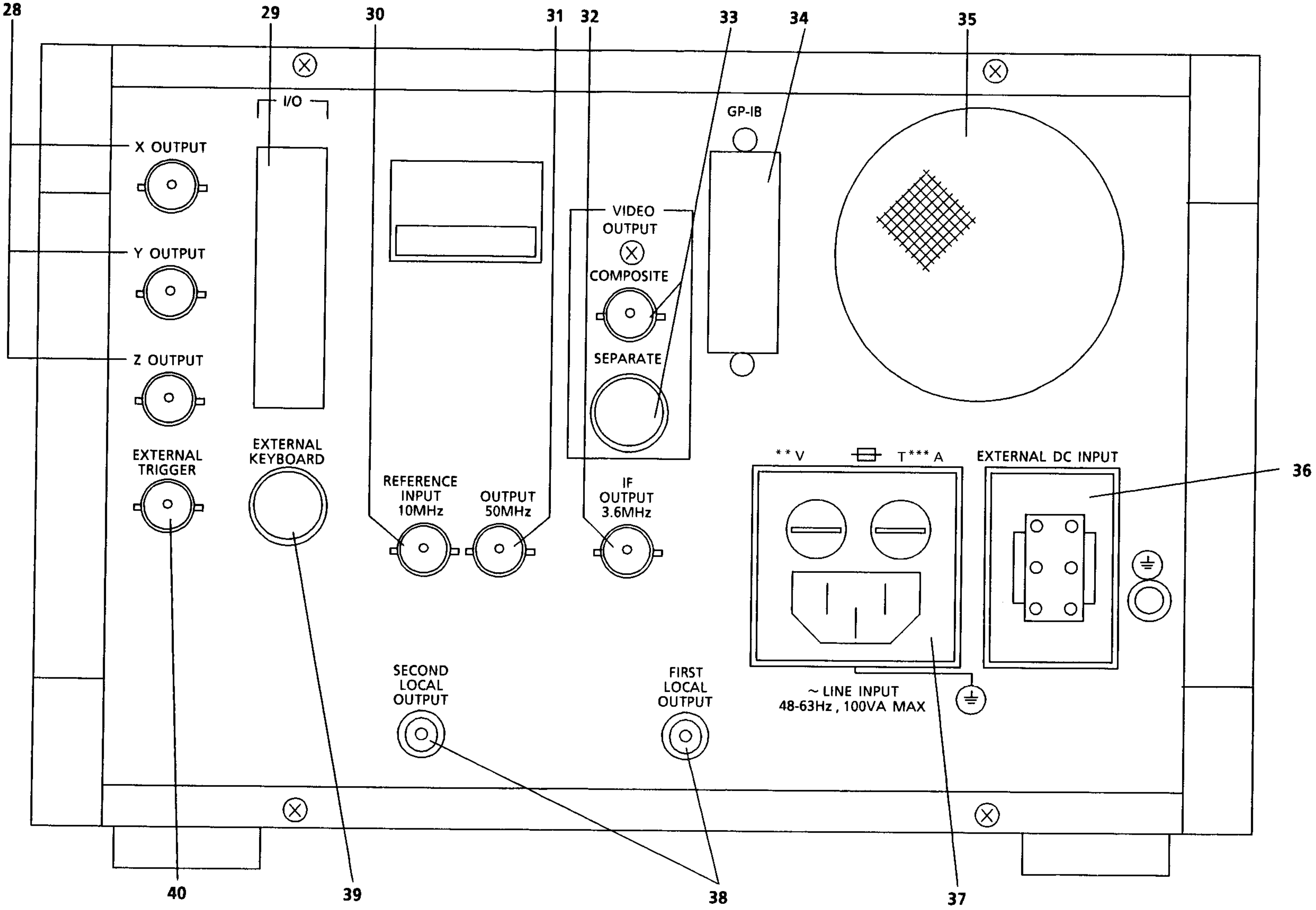


Fig. A-2 Rear Panel

SECTION 7

PRINCIPLES OF OPERATION

This section briefly explains the principles of operation for the MS2601A Spectrum Analyzer by using block diagrams.

TABLE OF CONTENTS

7.1 Introduction

The MS2601A is a superheterodyne scanning-type spectrum analyzer.

Figure 7-1 shows a block diagram of the MS2601A.

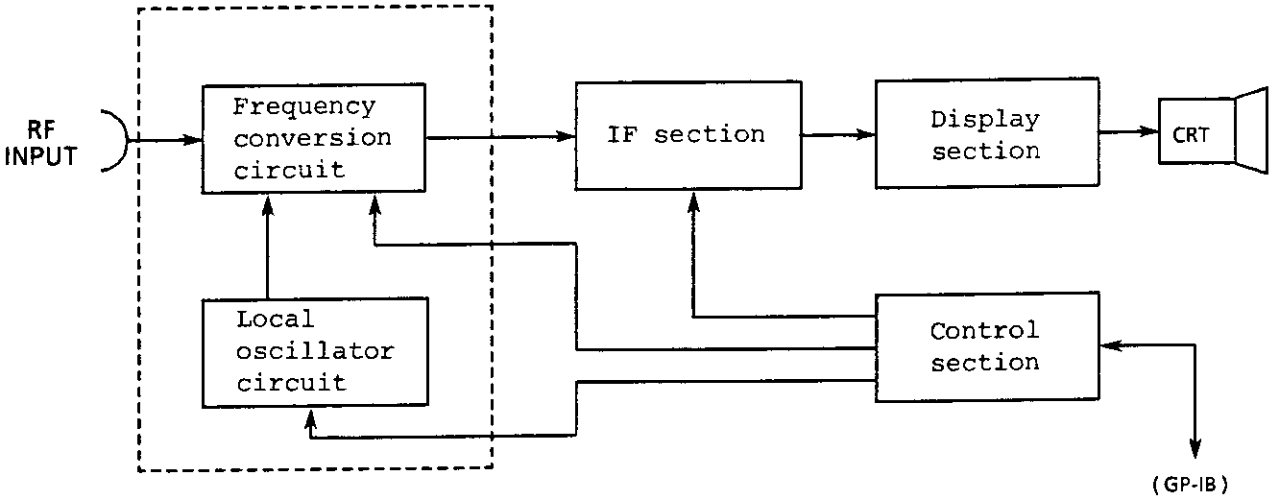


Fig. 7-1 MS2601A Block Diagram

The frequency conversion circuit mixer in the RF section converts the RF input frequency into an IF frequency. The signal detected via the IF section is transferred to the digital-storage display section. The CRT displays the signal in the frequency domain with the frequency on the horizontal axis and level on the vertical axis.

Each section is controlled by the microcomputer-based control section.

7.2 RF Section

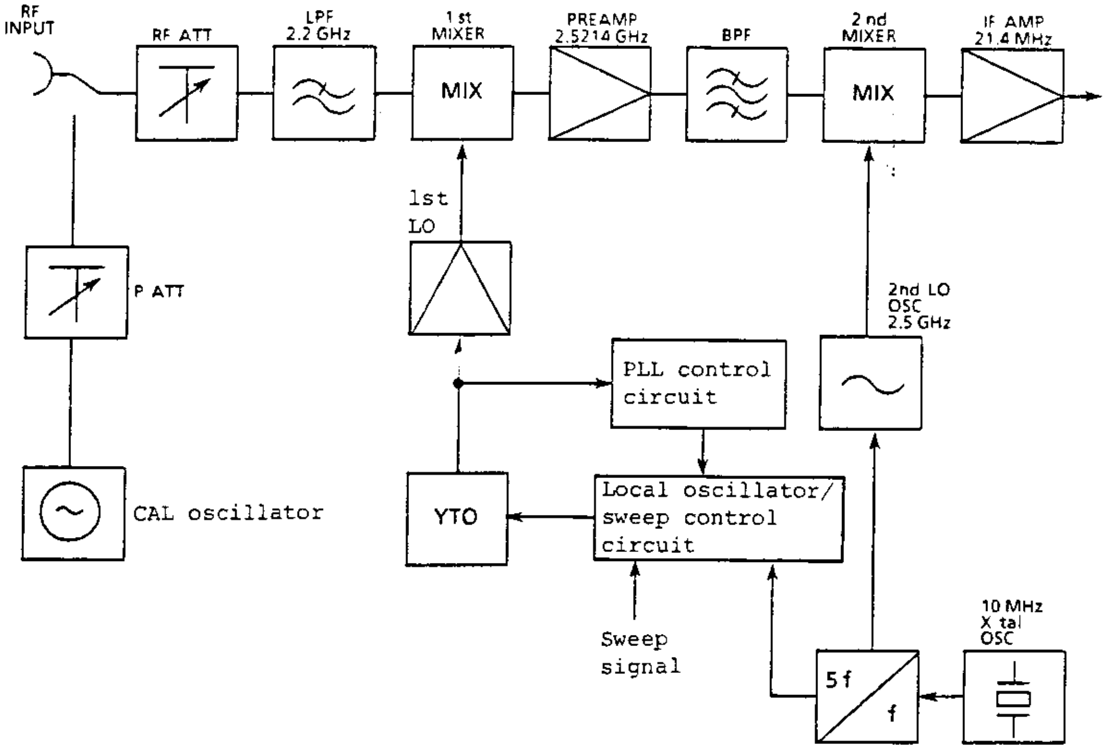


Fig. 7-2 RF Section Block Diagram

The input signal passes through the first mixer via the RF attenuator and 2 GHz low-pass filter. The first mixer mixes this signal with the first local signal (2.5314 to 4.5214 GHz) for conversion into the first IF signal of 2.5214 GHz.

The first IF signal passes through the preamplifier and band-pass filter, and is then mixed with the second local signal of 2.5 GHz by the second mixer to generate the second IF signal of 21.4 MHz.

The RF section also contains a control circuit to set or sweep the first local frequency, a Phase Locked Loop (PLL) control circuit to stabilize the first local frequency, and an amplifier and distribution circuit for the first local signal.

7.3 IF Section

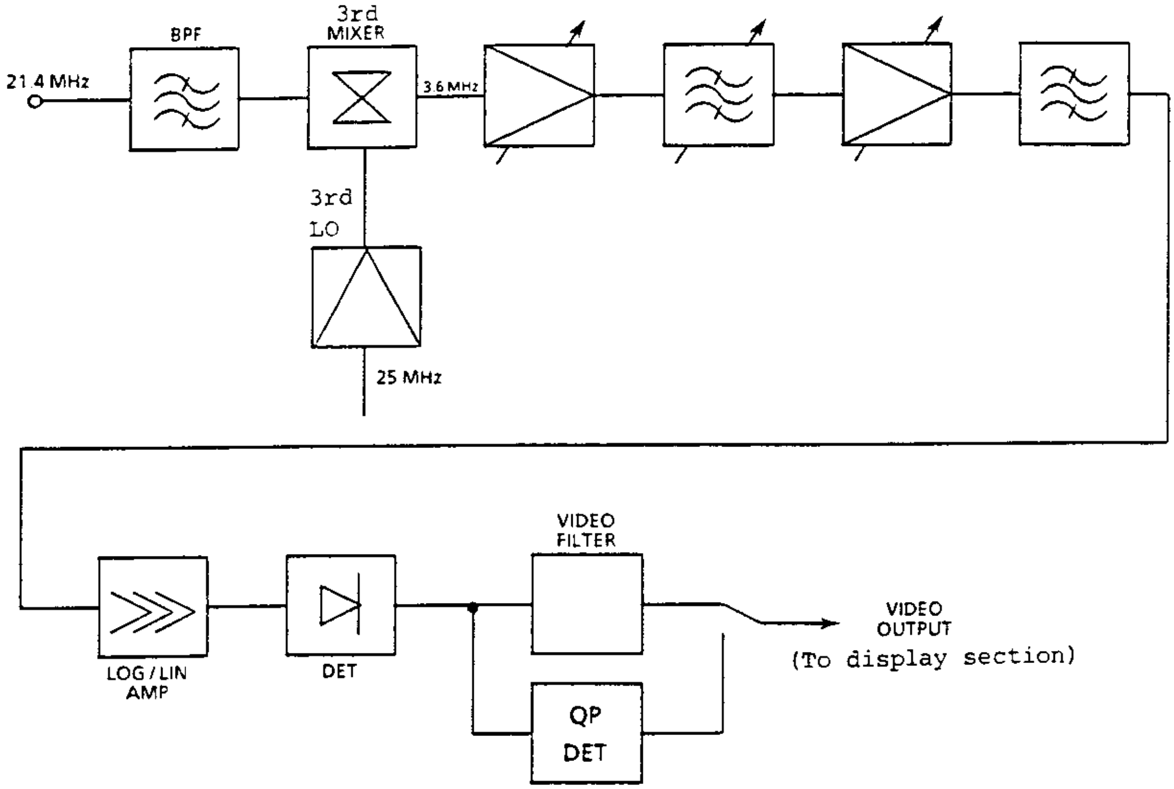


Fig. 7-3 IF Section Block Diagram

The 21.4 MHz 2nd IF signal passes through the 21.4 MHz band-pass filter and is converted into the final 3rd IF signal of 3.6 MHz by the third mixer. The 3.6 MHz 3rd IF signal passes through a four crystal and LC variable bandwidth filters, and three IF gain variable amplifiers (where the bandwidth and IF gain are determined).

The output signal passes through the log/lin amplifier and is detected.

After being detected, the signal is sent to the display section through the video amplifier or QP detector (selected in QP detection mode).

7.4 Display and Control Sections

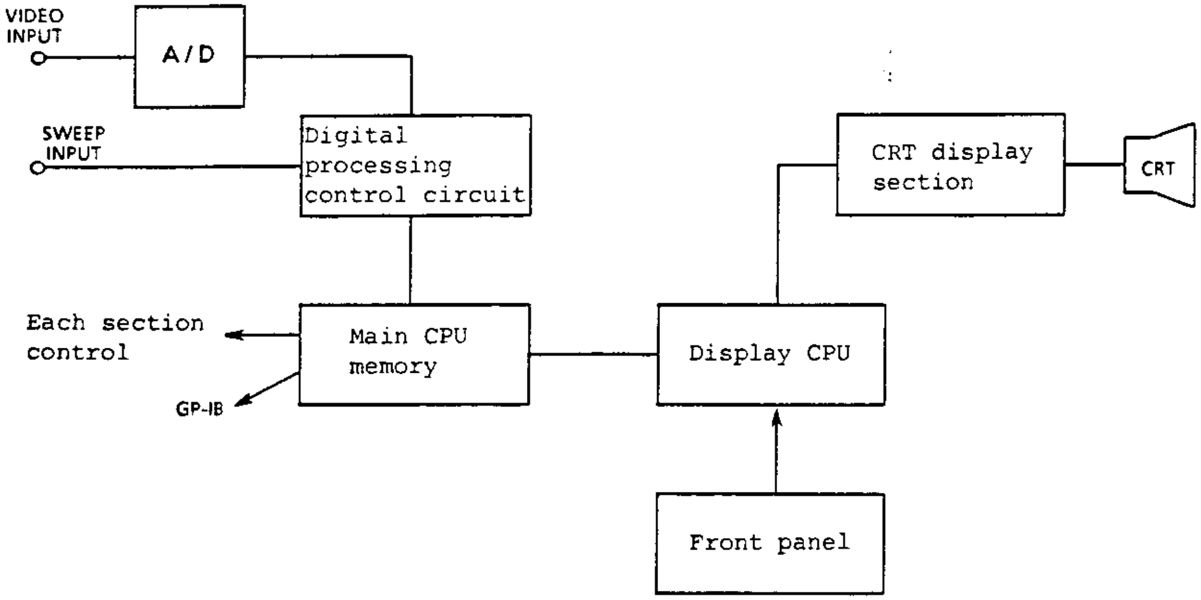


Fig. 7-4 Display and Control Section Block Diagram

The video signal sent from the IF circuit is converted from an analog into a digital signal when it enters the digital storage processing circuit. The CRT display is controlled by the CRT control IC according to determinations made by the display CPU.

The hardware of each section and the digital processing circuit are set under front panel control through the main CPU.