2399B Spectrum Analyzer
Operating Manual

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Safety Symbols

Where these symbols or indications appear on the instrument or in this manual, they have the following meanings.

WARNING. *Risk of hazard which cause injury to human body or danger to life, If a WARNING appears on the instrument, and in this manual, do not proceed until its suitable conditions are understood and met*

CAUTION. *Risk of hazard which caused fire or serious damage to the instrument or other equipment. Do not proceed until its suitable conditions are met.*

GROUND. *Ground terminal to chassis (earth).*

For Symbols

WARNING

1. ALWAYS refer to the operation manual when working near locations at which the alert mark shown on the left is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced.
   Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.

2. When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock and equipment damage.

Repair

WARNING

3. This equipment cannot be repaired by the user. DO NOT attempt to open the cabinet or to disassemble internal parts. Only trained service personnel or staff from your sales representative with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to internal parts.

Falling Over

4. This equipment should be used in the correct position, If the cabinet is turned on its side, etc., it will be unstable and may be damaged if it falls over as a result of receiving a slight mechanical shock.

For Symbols

CAUTION

Changing Fuse

CAUTION

1. Before changing the fuses, ALWAYS remove the power cord from the power-outlet and replace the blown fuses. ALWAYS use new fuses of the type and rating specified on the fuse marking on the rear panel cabinet.

   T3.15A indicates a time-lag fuse.
   There is risk of receiving a fatal electric shock if the fuses are replaced with the power cord connected.

Cleaning

2. Keep the power supply and cooling fan free of dust.
   - ○ Clean the power inlet regularly. If dust accumulates around the power pins, there is a risk of fire .
   - ○ Keep the cooling fan clean so that the ventilation holes are not obstructed. If the ventilation is obstructed, the cabinet may overheat and catch fire.

Check Terminal

3. ○ Maximum DC voltage ratings :
   RF Input connector : ±50 VDC
   TG Output connector : 0 VDC
   ○ Maximum RF power ratings :
   RF Input power : +30 dBm
   ○ NEVER input >+30 dBm and >50 V DC power to RF Input.
   ○ Excessive power may damage the internal circuits.

For Symbols

CAUTION

Replacing Memory Back-Up Battery

4. The power for CMOS back-up is supplied by a Primary Lithium Battery. This battery should only be replaced by a battery of the same type ; since replacement can only be made by IFR, contact the nearest IFR representative when replacement is required.

   Note : The battery life is about 7 years. Early battery replacement is recommended

CAUTION

Do not throw the battery away but dispose of it according to your country's requirement.

Storage Medium

5. This equipment stores data and programs using 3.5" Floppy Diskette.
   Data and programs may be lost due to improper use or failure. IFR therefore recommends that you back-up the memory.

   IFR CANNOT COMPENSATE FOR ANY MEMORY LOSS.

For Symbols

CAUTION

Product Damage Precaution

6. **Use Proper Power Source** : Do not operate this product from a power source that applies more than the voltage specified.

   Provide Proper Ventilation : To prevent product overheating, provide proper ventilation.

   Do Not Operate With Suspected Failures : If you suspect there is damage to this product, have it inspected by qualified service personnel.

   Do Not Attempt To Operate If Protection May Be Impaired : If the instrument appears damaged or operated abnormally, protection may be impaired. Do not attempt to operate the instrument under these conditions. Refer all questions of proper instrument operation to qualified service personnel.

Place-related Warning

7. **Object and Liquid Entry** : Never push objects of any kind into instrument through openings as they may touch dangerous voltage points or short out parts that could result in a fire or electric shock. Never spill liquid of any kind on the instrument.
   Do not use this instrument near water– for example, near a bath tub, wash bowl, kitchen sink, or laundry tub, in a wet basement, or near a swimming pool, and the like. Keep the instrument away from damp air, water and dust. Unexpected trouble may be caused when the instrument is placed in a damp or dusty place.

   Flammable and Explosive Substance : Avoid using this instrument where there are gases, and where there are flammable and explosive substances in the immediate vicinity.

   Unstable Location : Do not place this instrument on an unstable cart, stand, tripod, bracket, or table. This instrument may fall, causing serious injury to a person, and serious damage to the instrument. Do not place or use the instrument in a place subject to vibration.

IFR Warranty

IFR will repair this equipment fee of charge if a malfunction occurs within 2 year after shipment due to a manufacturing fault, provided that warranty is rendered void under any or all of the following conditions.

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

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

IFR will not accept liability for equipment faults due to unforeseen and unusual circumstances, nor for faults due to mishandling by the customer.

IFR Contact

If this equipment develops a fault, contact office of IFR at the address in the operation manual, or your nearest sales or service office.

Front Panel Power Switch

If the equipment is in the standby state, the front power switch of this equipment turns on the power when it is pressed.
If the switch is pressed continuously for about 1 second in the power off state, the equipment enters the standby state to prevent malfunction caused by accidental touching.

In the power on state, if the power plug is removed from the outlet, then reinserted, the power will not be turned on. Also, if the line is disconnected due to momentary power supply interruption or power failure, the power will not be turned on even when power is restored.

This is to prevent incorrect data from being acquired when the line is disconnected and reconnected.

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

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

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

DETECTION MODE

This instrument is a spectrum analyzer which uses a digital storage system. The spectrum analyzer makes level measurements in frequency steps obtained by dividing the frequency span by the number of measurement data points (500). Because of this operation it is desired to use the following detector modes associated with the appropriate measurements.

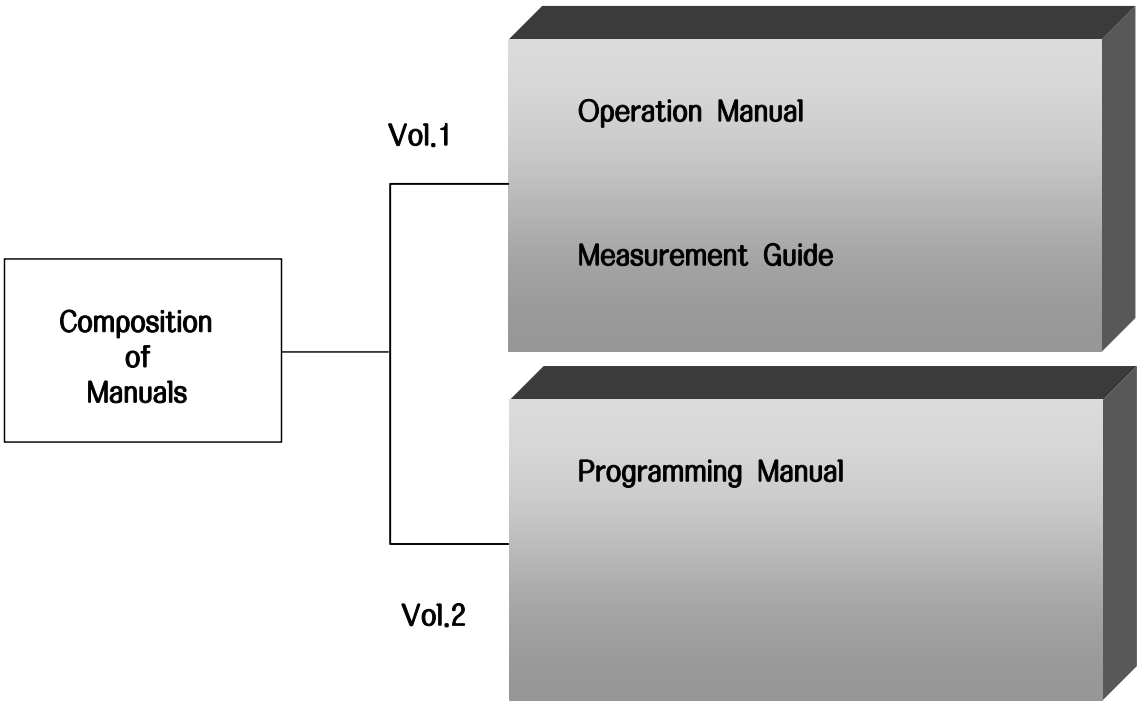
Measurement	Detector mode
○ Normal signal	POS PEAK
○ Random noise	SAMPLE OR AVERAGE
○ Pulsed noise	NORMAL
○ Occupied frequency bandwidth (for analog communication systems)	SAMPLE
○ Occupied frequency bandwidth (for digital communication systems)	POS PEAK or SAMPLE

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

ABOUT THIS MANUAL

Composition of 2399B Manuals

The 2399B Spectrum Analyzer manuals of the standard type are composed of the following three parts.



Operation Manual : Provides information on the 2399B outline. Preparation before use, panel description, operation procedure, soft-key menu and performance tests.

Measurement Guide : Provides basic measurements with examples of typical measurements.

Programming Manual : Provides information on RS-232C remote control, GPIB remote control and sample programs.

COMPOSITION OF OPERATION MANUAL

This Manual is composed of 7 sections. The profile of each section is shown below.

Section Composition	Explanation
SECTION 1 GENERAL	Product outline, options, applicable parts, peripheral devices, and specifications
SECTION 2 PREPARATIONS BEFORE USE	Operations to be accomplished before applying power
SECTION 3 PANEL DESCRIPTION	Description of the front and rear panels
SECTION 4 SOFT-KEY-MENU	Description of the soft-key menu
SECTION 5 OPERATION PROCEDURES	Operation procedures for operation guide
SECTION 6 PERFORMANCE TESTS	Tests used for checking performance
SECTION 7 STORAGE AND TRANSPORTATION	Cautions on storage and transportation

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SECTION 1
GENERAL

This section outlines the 2399B (henceforth called “Equipment”) and explains the composition of this manual, the configuration of the equipment with the options, the optional accessories, peripherals for expanding the equipment capabilities, and the equipment specifications.

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SECTION 1
GENERAL

PRODUCT OUTLINE

The equipment is a portable type spectrum analyzer suited for signal analysis of radio equipment where the efficiency of frequency usage is increased and equipment is increasingly speeded and digitized.
The equipment adopts the synthesizer local system and can cover all frequencies from 9 ㎑ to 3.0 ㎓ excellent in basic performance such as distortion, frequency/level accuracy, and easy operation, by following the display of the soft-key menu screen.
Excellent cost performance with rich options to cope with various applications.
Equipped with high accuracy calibration signals and an attenuator, it can accurately calibrate switching errors of LOG/LIN scales, resolution bandwidth, reference level, etc.
Since frequency response data is corrected by built in calibration data, allowing high-accuracy level measurement for a wide range.
The equipment provides the MEASURE function which can perform measurement of various applications without requiring the intervention of external controllers. Therefore, the performance evaluation of radio equipment can be easily done in terms of frequency, noise, occupied frequency bandwidth, etc.

■ Application

This equipment is useful for the production, building and maintenance of electronic equipment and devices for the following.

- o AM/FM radio equipment
- o Digital cellular telephone/cordless telephone
- o Satellite broadcasting
- o Small capacity microwave equipment

EQUIPMENT CONFIGURATION

This paragraph describes the configuration of the equipment with the various options to expand the functions.

Options

The table below shows the options for the equipment which are sold separately.

Model No.	Name	Remarks
Option 03	High Stability Oscillator	Stability : ≤±0.2ppm
Option 04	Quasi-Peak Detector	QP B QP C/D Quasi-Peak included.
Option 05	Digital RBW	10, 30, 100 Hz RBW
Option 11	DTF Measurement personality	Distance to Fault VSWR(Return Loss)
Option 12	Marker Editor	Marker name edition
Option 13	EMC Measurement Package (Firmware)	Support Log X scale display. Limit/Xducer/Cable/Ant/Others Parameter file management. Limit line link with graticule.

※ Please specify the model number, name, and quantity when ordering.

SPECIFICATIONS

NOTE : A fifteen minute warm up time shall apply.

1.0 FREQUENCY	
1.1 Frequency range	9.0 ㎑ to 3.0 ㎓
1.2 Tuning Resolution	1 ㎐ Minimum
1.3 Frequency Span Width	100 ㎐/div to 300 ㎒/div In 1, 2, 5 step selections (auto selected) plus ZERO Span, and FULL Span (9 ㎑ to 3.0 ㎓). Manual selection of start, stop, and span.
1.4 Span Accuracy	±3% of the indicated Span Width
1.5 Readout Accuracy	≤±(Indicated frequency × reference frequency accuracy + span × span accuracy + 50% of RBW)
1.6 Frequency Counter	
1.6.1 Resolution	1 ㎑, 100 ㎐, 10 ㎐, 1 ㎐ (user selectable)
1.6.2 Accuracy	≤±((Reference frequency accuracy × marker frequency) + (1(resolution error) + 1(counter error) × counter resolution))
1.6.3 Sensitivity	≤-70dBm (50 ㎑ to 3.0 ㎓)
1.7 Stability	
1.7.1 Residual FM	≤100 ㎐ $_{P-P}$ in 200 ㎳, 1 ㎑ RBW, 1 ㎑ VBW
1.7.2 Noise Sidebands	≤-90dBc/㎐ 10 ㎑ offset
2.0 AMPLITUDE	
2.1 Measurement Range	+30 dBm to average noise level.
2.2 Average Displayed Noise Level :	≤-105 dBm, 50 ㎑ to 100 ㎑ ≤-110 dBm, 100 ㎑ to 2.8 ㎓ ≤-105 dBm, 2.8 ㎓ to 3.0 ㎓ ≤-130 dBm, 50 ㎒ to 1.8 ㎓(Preamp operation.) ≤-128 dBm, 1.8 ㎓ to 3.0 ㎓(Preamp operation.) (RBW 1 ㎑, VBW 10 ㎐)
2.3 1dB Compression Point	-10 dBm 100 ㎑ to 3.0 ㎓ (0dB attenuation)
2.4 Displayed Range	100 dB in 10 dB/div log scale. 50 dB in 5 dB/div log scale. 20 dB in 2 dB/div log scale.

	10 dB in 1 dB/div log scale. 10 divisions with linear amplitude scale.
2.5 Amplitude Units	dBm, dB mV, dB μV, V, mV, μV, W, mW, μW
2.6 Display Linearity	
2.6.1 5 or 10dB/div	±0.15 dB/dB, ±1.5 dB over 10 divisions
2.6.2 1 or 2 dB/div	±0.5 dB over 10 divisions
2.6.3 Linear	±10 % of Reference Level over 10 divisions
2.7 Frequency Response	-3.0 ~ +1 dB, 9 kHz to 10 MHz ±1.5 dB, 10 MHz to 3.0 GHz (10 dB RF attenuation)
2.8 Attenuator	
2.8.1 Range	0 to 50 dB, Selected manually or automatically coupled to reference level.
2.8.2 Resolution	10 dB steps.
2.8.3 Accuracy	±0.5 dB/step, 100 MHz ±1.5 dB/maximum step, 100 MHz
2.9 Reference Level	
2.9.1 Accuracy	±1.5 dB (50 kHz to 3.0 GHz)
2.9.2 Range	-110 dBm to +30 dBm
2.9.3 Resolution	0.1dB
2.10 Residual Spurious	≤-85 dBm (**Input terminated**, 0 dB attenuation)
2.11 Harmonic Distortion	≤-65 dBc, -30 dBm input, 0 dB attenuation
2.12 3rd order Intermodulation Distortion	≤-65 dBc, 〈700 MHz, -30dBm input, 0 dB att. ≤-70 dBc, ≥700 MHz, -30dBm input, 0 dB att.
2.13 Other Input Related Spurious	≤-60 dBc, 10 MHz to 3.0 GHz, -30 dBm input
2.14 Resolution Bandwidth	
2.14.1 Selections	300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, and 3 MHz [10 Hz, 30 Hz, 100 Hz Option]
2.14.2 Accuracy	≤+20 %
2.14.3 Selectivity	60 dB/3 dB ratio ≤ 15:1 60 dB/6 dB ratio ≤ 12:1 ; 9 kHz, 120 kHz (Quasi Peak Option)

2.14.4 Switching Error	≤ ±1.0 dB (3 ㎑ Reference RBW)
2.15 Video Bandwidth Selection	10 ㎐, 30 ㎐, 100 ㎐, 300 ㎐, 1 ㎑, 3 ㎑, 30 ㎑, 100 ㎑, 300 ㎑, 1 ㎒, None
3.0 SWEEP	
3.1 Rate	20 ㎳ to 1000 sec 25 ㎲ to 15 sec (ZERO SPAN)
3.1.1 Sweep Rate Accuracy	±20 %, < 100 msec ±10 %, for all other sweep rates
3.2 Trigger	
3.2.1 Source	External(rear), Line, Video, Free Run
3.2.2 Mode	Single, Continuous
3.2.3 Coupling	DC
3.2.4 Ext Rear Level	TTL Level
3.2.5 Delay	±one sweep time (Zero Span) (25 ㎲ to 15 sec Range)
1.0 DISPLAY	
4.1 Type	6.4" Color LCD
4.2 Digital Resolution	640H × 480V active display area
4.3 Marker Modes	Peak Search, Delta Marker, Marker Track, Marker to Center, Marker to Reference Multi Peak Search (9 markers maximum)
4.4 Display Traces at One Time	2 Traces
5.0 MEMORY	
5.1 Trace Storage	Stored traces including user defined traces and test limits (Up to 1,000 EA)
5.2 Setup Storage	Up to 2000.
6.0 INPUTS	
6.1 RF Input	
6.1.1 Connector	Type N Female, 50 ohm nominal
6.1.2 VSWR	< 1.5:1, 150 ㎑ to 3.0 ㎓ (with 10 dB Input attenuation)
6.1.3 Max. Input Level	±50 VDC, +30 dBm (with 40 dB Input attenuation)
LO Emission	≤-70 dBm (with 10 dB attenuation)

7.0 OUTPUTS

7.1 IF Output	10.7 ㎒, Nominal
7.2 Video Output	0 to 5VDC (TTL Level)
7.3 SWP Gate Output	0 to 5VDC (TTL Level)
7.4 EXT VGA Output	External VGA Output(Color)
7.5 Power Probe	3 pin connector(+15 V, -12 V, GND)

8.0 FREQUENCY STANDARD	STANDARD	HIGH STABILITY OPTION
8.1 Temperature Stability	±2 ppm	±0.2 ppm
8.2 Aging	±1 ppm/year	±0.2 ppm/year

9.0 EXTERNAL REFERENCE	Switchable between Internal/External
9.1 Connector	BNC female connector
9.2 Input Level	-5 dBm to +15 dBm
9.3 Output Level	+5 dBm nominal

10.0 IEEE-488 (GPIB) INTERFACE

10.1 Conforms to	IEEE-Standard 488.1-1987
10.2 Implemented Subsets	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, E2, LE0, TE0

11.0 RS-232C INTERFACE

11.1 TYPE	Full Duplex
11.2 Baud Rate	110bps, 300 bps, 1200bps, 2400bps, 4800bps, 9600bps, 19.2kbps, 38.4kbps, 57.6kbps, 115.2kbps
11.3 Parity Check	Odd, Even or None
11.4 Data Length	7 bits, 8 bits
11.5 Stop Bit	1 bit, 2 bits
11.6 Protocol	XON_XOFF, RTS_CTS, DTR_DSR, NONE

12.0 PRINTER

12.1 Driver	PCL3 or upper (Non Emulation Only)
12.2 Connector	Standard 25 pin female D-Sub Parallel Printer

13.0 QUASI PEAK DETECTOR (option)

SELECTED BANDWIDTH	RECOMMENDED FREQUENCY RANGE	CHARGE TIME(㎳)	DISCHARGE TIME(㎳)	DISPLAY TIME(㎳)
9 ㎑	150 ㎑ to 30 ㎒	1±20%	160±20%	160±20%
120 ㎑	30 ㎒ to 1 ㎓	1±20%	550±20%	100±20%

14.0 GENERAL CHARACTERISTICS

14.1 Dimensions	13.78" (350mm) width (including handle) 7.28" (185mm) height 15.00" (381mm) depth
14.2 Weight	20.8 lbs (9.4 ㎏) without options
14.3 Warm-up Time	15 minutes
14.4 Power Requirements (standard)	
14.4.1 Source Voltage and Frequency	100 - 240 VAC at 50/60 ㎐
14.4.2 Power Consumption	90 Watts maximum (with no option)
14.5 Fuse Requirements	3.15 A, 250 V, Type T, 2 EA
14.6 Environmental Range	Meets MIL-T-28800E for Type 2, Class 5
14.6.1 Temperature	0 to 40℃ (operating) -20 to 70℃ (storage)
14.6.2 Humidity	85% operating, 90% storage (Non Condensing)
14.6.3 Vibration	Meets MIL-T-28800E for Type 2, Class 5
14.6.4 Altitude	Operation up to 3,000 meters Non-operational up to 40,000 feet(12,192m)
14.7 Product Safety	Complies with EN61010-1
14.7.1 Supplemental Environmental Conditions	
14.7.1.1 Mains Supply Voltage Fluctuations :	≤±10% of the nominal voltage
14.7.1.2 Transient Over voltages	According to Installation Category Ⅱ
14.7.1.3 Pollution Degree	2
14.8 RF Emissions and Immunity	
14.8.1 RF Emissions	Complies with EN 55011 : 1998, Class A
14.8.2 RF Immunity	Complies with EN 61326 : 1997

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SECTION 2
PREPARATIONS BEFORE USE

This section explains the preparations and safety procedures that should be performed before using the equipment. The safety procedures are to prevent the risk of injury to the operator and damage to the equipment.
Ensure that you understand the contents of the pre-operation preparations before using the equipment.
For connecting the GPIB cable and setting the GPIB address, see the remote control operation in Programming Manual.

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SECTION 2
PREPARATIONS BEFORE USE

INSTALLATION SITE AND ENVIRONMENTAL CONDITIONS

Locations to Be Avoided

The equipment operates normally at temperatures from 0 to 40℃. However, for best performance, the following situations should be avoided.

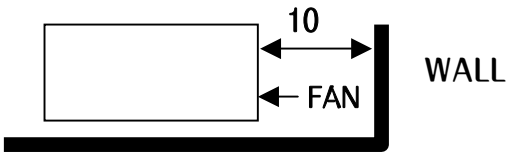
- Where there is severe vibration.
- Where the humidity is high.
- Where the equipment will be exposed to direct sunlight.
- Where the equipment will be exposed to active gases.

In addition to meeting the above conditions, to ensure long term trouble free operation, the equipment should be used at room temperature and in a location where the power supply voltage does not fluctuate greatly.

CAUTION

If the equipment is used at normal temperatures after it has been used or stored for a long time low temperatures, there is a risk of short circuiting caused by condensation.
To prevent this risk, do not turn the equipment on until it has been allowed to dry out sufficiently.

To suppress any internal temperature increase, the equipment has a fan on the rear panel. As shown in the diagram below, leave a gap of at least 10 ㎝ between the rear panel and wall, nearby equipment or obstructions so that fan ventilation is not blocked.



CAUTION

SAFETY MEASURES

This paragraph explains the safety procedures which should be followed under all circumstances to prevent the risk of an accidental electric shock, damage to the equipment or a major operation interruption.

Power On

WARNING

○ Before Power on	The equipment must be connected to protective ground. If the power is switched on without taking this precaution, there is a risk of receiving an accidental electric shock. In addition, it is essential to check the power source voltage. If an abnormal voltage that exceeds the specified value is input, there is accidental risk of damage to the equipment and fire.

In the following, special notes on safety procedures are extracted from sections other than section 2.
To prevent accidents, read this section together with the related sections before beginning operation.

Input Level to RF Input

Frequency range : 9 ㎑ to 3.0 ㎓

Measurement level : The maximum signal level which can be applied to the Type N RF input connector is +30 dBm.

WARNING

The RF Input circuit is not protected against excessive power.
If a signal exceeding +30 dBm is applied, the input attenuator and internal circuit will be damaged.

Do not input over ±50 VDC to the Type N RF input connector

PREPARATIONS BEFORE POWER ON

The equipment operates normally when it is connected to an 100 VAC to 240 VAC (automatic voltage selected automatically) 50 to 60 Hz AC power supply. To prevent the following, take the necessary procedures described on the following pages before power is supplied.

- Accidental electric shock.
- Damage caused by abnormal voltage.
- Ground current problems.

To protect the operator, the following WARNING and CAUTION notices are attached to the rear panel of the equipment.

WARNING

TO AVOID ELECTRIC SHOCK,
THE PROTECTIVE GROUNDING CONDUCTOR MUST BE CONNECTED TO GROUND.
DO NOT REMOVE COVERS.
REFER SERVICING TO QUALIFIED PERSONNEL.

CAUTION

FOR CONTINUED FIRE PROTECTION
REPLACE ONLY WITH SPECIFIED TYPE AND RATED FUSE.

WARNING

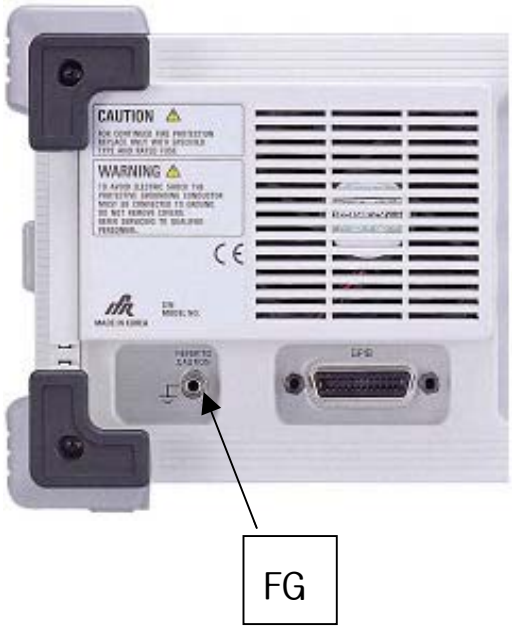
Disassembly, adjustment, maintenance, or other access inside this instrument is to be performed qualified personnel only. Maintenance of this instrument should be performed only by trained service personnel who are familiar with the risk involved of fire and electric shock. Potentially lethal voltages existing inside this instrument, if contacted accidentally, may result in personal injury or death, or in the possibility of damage to precision components.

Always follow the instructions on the following pages.

Protective Grounding

Grounding with frame ground (FG) terminal

When there is no grounded AC power-supply outlet, the protective frame ground (FG) terminal on the rear panel must be connected directly to ground potential.



WARNING

If power is applied without protective grounding, there is a risk of accidental electric shock. The protective frame ground (FG) terminal on the rear frame, or the ground pin of the supplied power cord must be connected to ground potential before power is supplied to the equipment.

Replacing Fuse

WARNING

- If the fuses are replaced while power is supplied, there is a serious risk of electric shock. Before replacing the fuses, set the power switch to OFF and remove the power cord from the power outlet.
- If power is supplied without protective grounding, there is a risk of accidental electric shock. In addition, if the AC power supply voltage is excessive, there is a risk of the internal circuits of the equipment being damaged by the abnormal voltage. Before supplying power again after changing the fuses, check that the protective grounding described previously in still connected, and check that the AC power supply voltage is suitable. Then, set the power switch to ON.

CAUTION

When there are no supplied spare fuses, the replacement fuses must have the same voltage and current rating as specified.

- If the replacement fuses are not of the same type, they may not fit correctly, there may be a faulty connection, or the time for the fuses to blow may be too long.
- If the voltage and current rating of the fuses is incorrect, the fuse may not blow causing damage to the equipment.

The fuses are inserted in the fuse holder and must be replaced if they blow. If the fuses must be replaced, locate and remedy the cause before replacing the blown fuses. The equipment, with standard accessories, has two spare T3.15A fuses.
After performing the safety procedures described on the preceding page, replace the fuses according to the following procedure.

CAUTION

Step	Procedure
1	Set the front panel [Power] switch to STBY and the rear panel [Line] switch to OFF. Then, remove the power cord from the power-supply outlet.
2	Pull out the fuse holder at the rear panel with pressing the fuse holder hook.
3	Remove the fuse from the fuse cap and replace it with a spare fuse. (The direction does not matter.)
4	Put the fuse cap with fuse into the fuse holder and insert it by pushing inward.

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SECTION 3
PANEL DESCRIPTION

In this section the front and rear panels are described.

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TABLE OF FRONT AND REAR RANEL FEATURES ---------- 3-3
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EXT VGA CONNECTOR ---------- 3-12
PROBE POWER CONNECTOR ---------- 3-13

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SECTION 3
PANEL DESCRIPTION

In this section, the front and rear panels are described.

- Fig. 3-1 Front panel
- Fig. 3-2 Rear panel

This manual express the key on the front panel, call it a hard key, as boxed letter. And the key of menu(F1 ~ F7), call it a soft key, is expressed as italic.

Example] FREQ *Center*

TABLE OF FRONT AND REAR PANEL FEATURES

NO	Panel Marking	Explanation of Function
①	(LCD)	This is liquid crystal display. It display the trace waveforms, the parameter settings, the value of marker, and the soft menu keys, etc.
②	F1 ~ F7	These are the soft keys for selecting the soft key menus linked to the panel key operation.
③	FUNCTION	
	FREQ	This is the frequency parameter data input section.
	SPAN	This is the span parameter data input section.
	AMPL	This is the amplitude parameter data input section.
	MEAS	This key sets the measurement functions.
④	MARKER	
	MKR	This key sets marker.
	OFF	This key function is the marker off.
	MKR >	This key is the marker shift function.
	PEAK	This key is related the peak search function.

NO	Panel Marking	Explanation of Function
⑤	CONTROL	
	TRIG	This sets the trigger functions.
	CPL	This set the RBW, VBW, sweep time.
	DISP	This key sets the display functions.
	TRACE	This section is for selection the trace waveform, detection mode and video average mode.
⑥	SYSTEM	
	SAVE	This key is used for saving the waveforms status, and limit lines.
	FILE	This key is used for recalling the waveforms, status, and limit lines.
	LIMIT	This key sets the limit line functions.
	SYSTEM	This key sets the configuration of system.
	PRESET	This sets the measurement parameters to the default values. Also calibration menus are include under this key.
	AUX	This key sets the auxiliary functions, such as FM/AM demodulation, audio control and squelch control.
	TG	This key is used for tracking generator function.
	PRINT	This key is used for printing.
⑦	(FDD)	This is the slot to set floppy diskette.
⑧	(SCROLL KNOB)	This key is used for scrolling the parameters.
⑨	(STEP KEY)	These keys are used for up/down the parameters.
⑩	RF INPUT	This is the RF input connector.
⑪	PROBE	This is for RF probe power. (2399B only)
⑫	RF OUTPUT	This is the tracking generator output connector. (If option is not attached, this is not provided.)
⑬	DATA ENTRY	These keys set the numeric data, units, and special functions. [∧, ∨] Increment and decrement input data. [0···9, +/-, BS, ENTER] Numeric data setting key
⑭	PHONE	This is a output connector for earphone.
⑮	KEYBOARD	This key is used for keyboard, but reserved for other function. (Only for system calibration and maintenance)

⑯	STBY/ON	This is the power switch. It can be used when the back panel power switch is on. The power on condition is fetched from the STBY condition when the key is pressed momentary. The equipment is returned to the STBY condition from the power on condition when the key is pressed again for about 1 seconds.
⑰	IF OUT	This is the IF output connector, This signal is band-width controlled by the RBW setting
⑱	VIDEO	This is an output connector.
⑲	EXT TRIG	This is an input connector for the external trigger.
⑳	RS-232C	This is the RS-232C connector. Connect it to system controller.
㉑	EXT VGA	This is VGA output for external monitor.
㉒	(OFF/ON)	This is the fused AC power switch.
	(Inlet)	This is the fused AC power inlet to which the supplied power cord is connected.
	(Fuse Holder)	It contains two lag fuses.
㉓	PRINTER	This is for use with the printer.
㉔	SWP GATE	This is an output connector for sweep gate signal.
㉕	REF I/O 10.0 MHz	This is the input/output connector for an external reference crystal oscillator. When the external reference signal input to this connector, user turns this port on from the front panel. An indication is supplied at the bottom of the screen.
㉖	GPIB	This is for use with the GPIB interface. It is the connector to an external system controller. (If option is not attached, this is not provided.)
㉗	(FAN)	This is the cooling fan ventilating internally generated heat. Leave a clearance of a 10 ㎝ around the fan.
㉘	(FG)	This is the frame ground terminal.

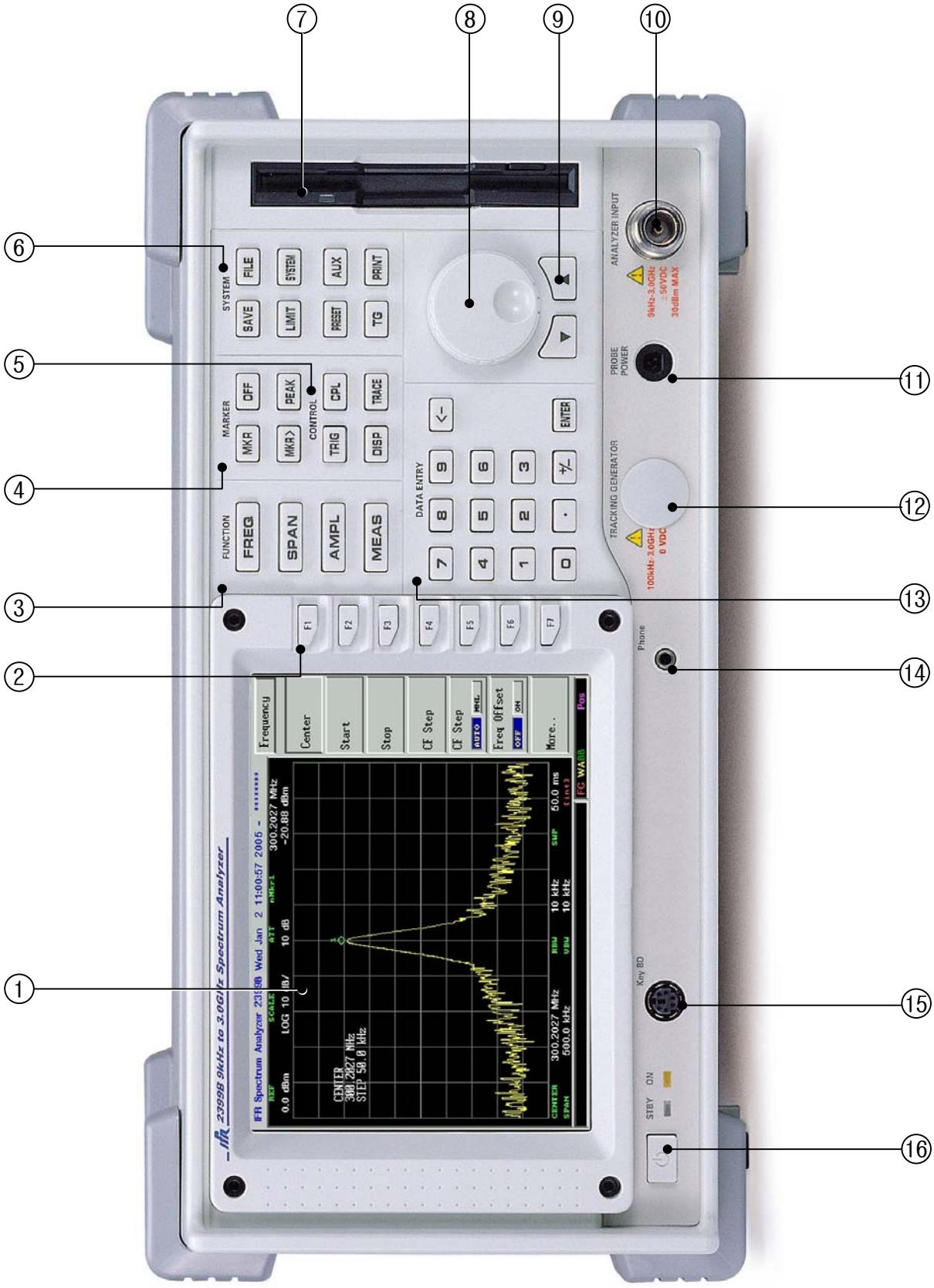

Fig 3-1. Front Panel

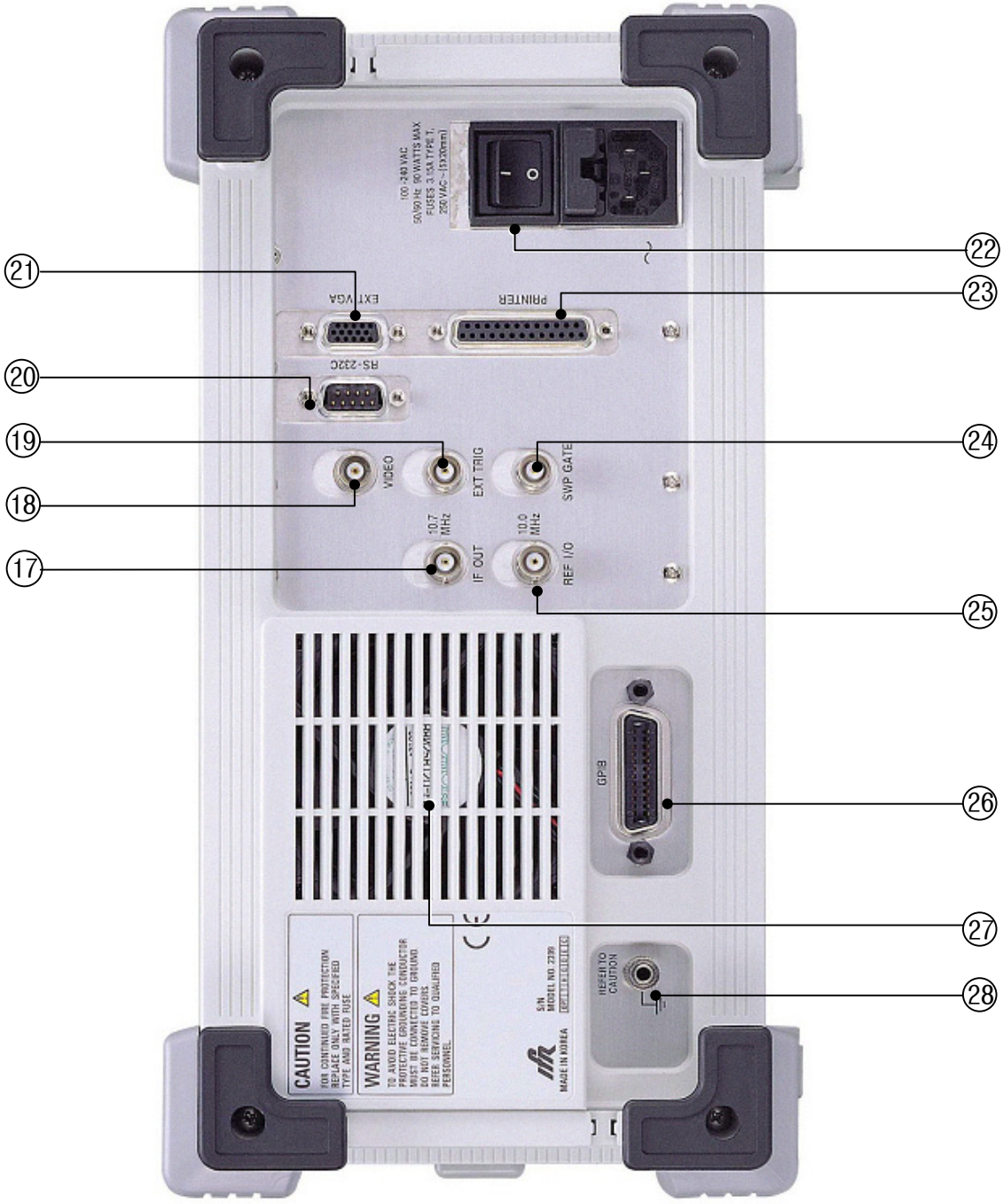

Fig 3-2. Rear Panel

TABLE OF I/O CONNECTORS

CONNECTOR	TYPE	IN/OUT	SIGNAL	LOCATION
AC INPUT	IEC 320 Socket	Input	AC Power	Rear ㉒
RF INPUT	Type N Female	Input	9 ㎑ ~ 3.0 ㎓	Front ⑩
RF OUT (Option)	Type N Female	Output	100 ㎑ ~ 3.0 ㎓	Front ⑫
EXT TRIG	BNC Female	Input	TTL LEVEL	Rear ⑲
SWP GATE	BNC Female	Output	TTL LEVEL	Rear ㉔
VIDEO	BNC Female	Output	0 ~ 5 VDC	Rear ⑱
REF I/O	BNC Female	Input / Output	IN : 10 ㎒ OUT : 10 ㎒	Rear ㉕
IF OUT	BNC Female	Output	10.7 ㎒	Rear ⑰
GPIB	24-Pin Champ	IN/OUT	See Pin-Out (Table 2)	Rear ㉖
PRINTER	25-Pin, D-sub Female	Output	Screen Print Data See Pin-Out (Table 4)	Rear ㉓
RS-232C	9-Pin, D-sub Male	IN/OUT	See Pin-Out (Table 3)	Rear ⑳
EXT VGA	15-Pin, D-sub Female	Output	See Pin-Out (Table 5)	Rear ㉑

Table 1. I/O Connector

GPIB CONNECTOR

The IEEE-488 GPIB Connector complies with ANSI/IEEE Standard 488.2-1987.

PIN NUMBER	SIGNAL	PIN NUMBER	SIGNAL
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EQI	17	REN
6	DAV	18	Ground
7	NRFD	19	Ground
8	NDAC	20	Ground
9	IFC	21	Ground
10	SRQ	22	Ground
11	ATN	23	Ground
12	Ground	24	Ground

Table 2. Pin-Out for IEEE-488 GPIB Connector

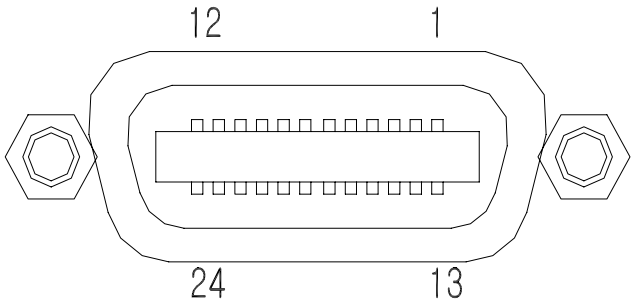

Figure 3. IEEE-488 GPIB Connector

RS-232C CONNECTOR

PIN NUMBER	SIGNAL
1	DCD
2	RXD
3	TXD
4	DTR
5	Ground
6	DSR
7	RTS
8	CTS
9	RI (NC)

Table 3. Pin-Out for RS-232C Connector

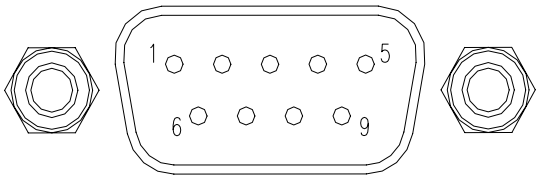

Figure 4. RS-232C Connector

PRINTER CONNECTOR

PIN NUMBER	SIGNAL
1	$\overline{\text{STB}}$
2	PD0
3	PD1
4	PD2
5	PD3
6	PD4
7	PD5
8	PD6
9	PD7
10	$\overline{\text{ACK}}$
11	BUSY
12	PE
13	SLCT
14	$\overline{\text{AFD}}$
15	$\overline{\text{ERROR}}$
16	$\overline{\text{INIT}}$
17	$\overline{\text{SLIN}}$
18	Ground
19	Ground
20	Ground
21	Ground
22	Ground
23	Ground
24	Ground
25	Ground

Table 4. Pin-Out for PRINTER Connector

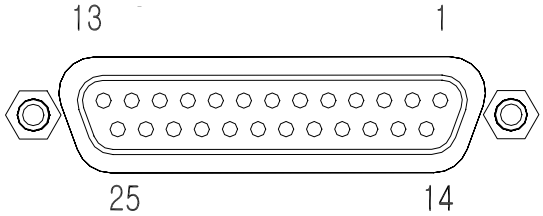

Figure 5. PRINTER Connector

EXT VGA CONNECTOR

PIN NUMBER	SIGNAL
1	RED
2	GREEN
3	BLUE
4	ID2
5	GND
6	RGND
7	GGND
8	BGND
9	KEY
10	SGND
11	ID0
12	ID1 or SDA
13	HSYNC or CSYNC
14	VSYNC
15	ID3 or SCL

Table 5. Pin-Out for EXT VGA Connector

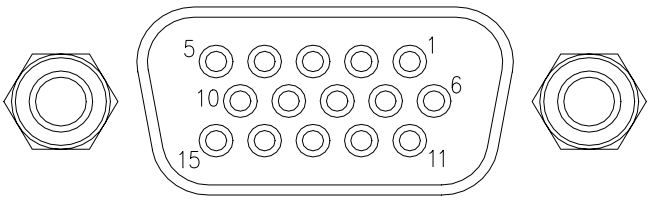

Figure 6. EXT VGA Connector

PROBE POWER CONNECTOR

PIN NUMBER	Voltage	Current
1	+15 V±10 %	200 mA
2	-12 V±10 %	100 mA
3	GND	

Table 6. Pin-Out for PROBE POWER Connector

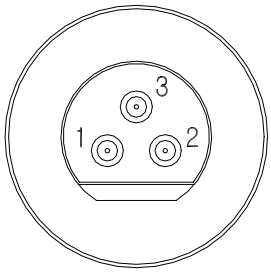

Figure 7. PROBE POWER Connector

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SECTION 4
MENU TREE

TABLE OF CONTENTS

MENU TREE ---------- 4-4
FREQ, SPAN, AMPL ---------- 4-4
MEAS ---------- 4-5
MKR ---------- 4-6
MKR>, PEAK ---------- 4-7
TRIG, CPL ---------- 4-8
DISP ---------- 4-9
TRACE ---------- 4-10
FILE ---------- 4-11
LIMIT, SYSTEM ---------- 4-12
PRESET, AUX, TG ---------- 4-13

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SECTION 4
MENU TREE

In this section, soft menu functions and its system hierarchy are described using a menu tree.
Contents to noted about the tree are shown below

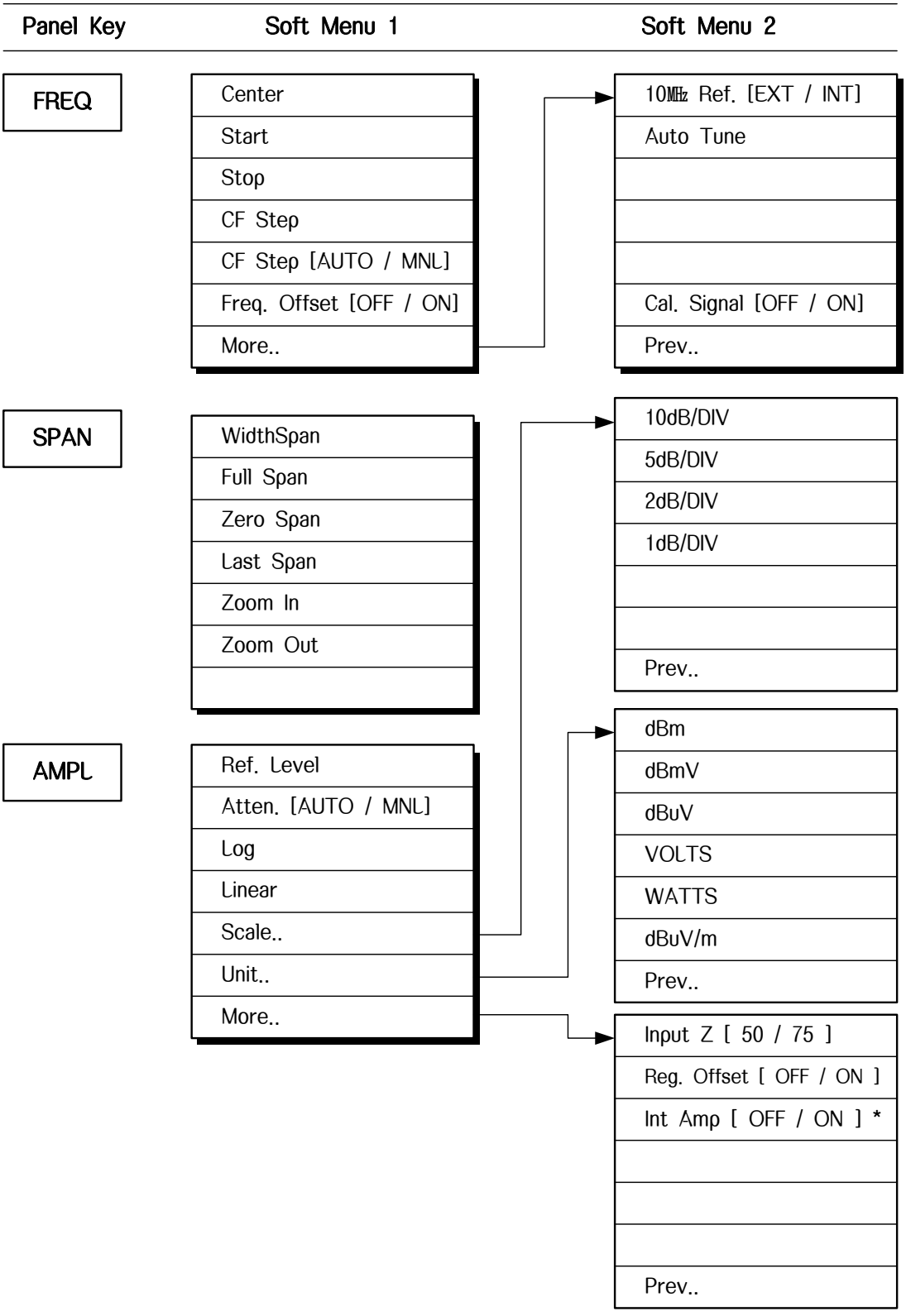
(1) Panel key indicates a hard key on the panel.

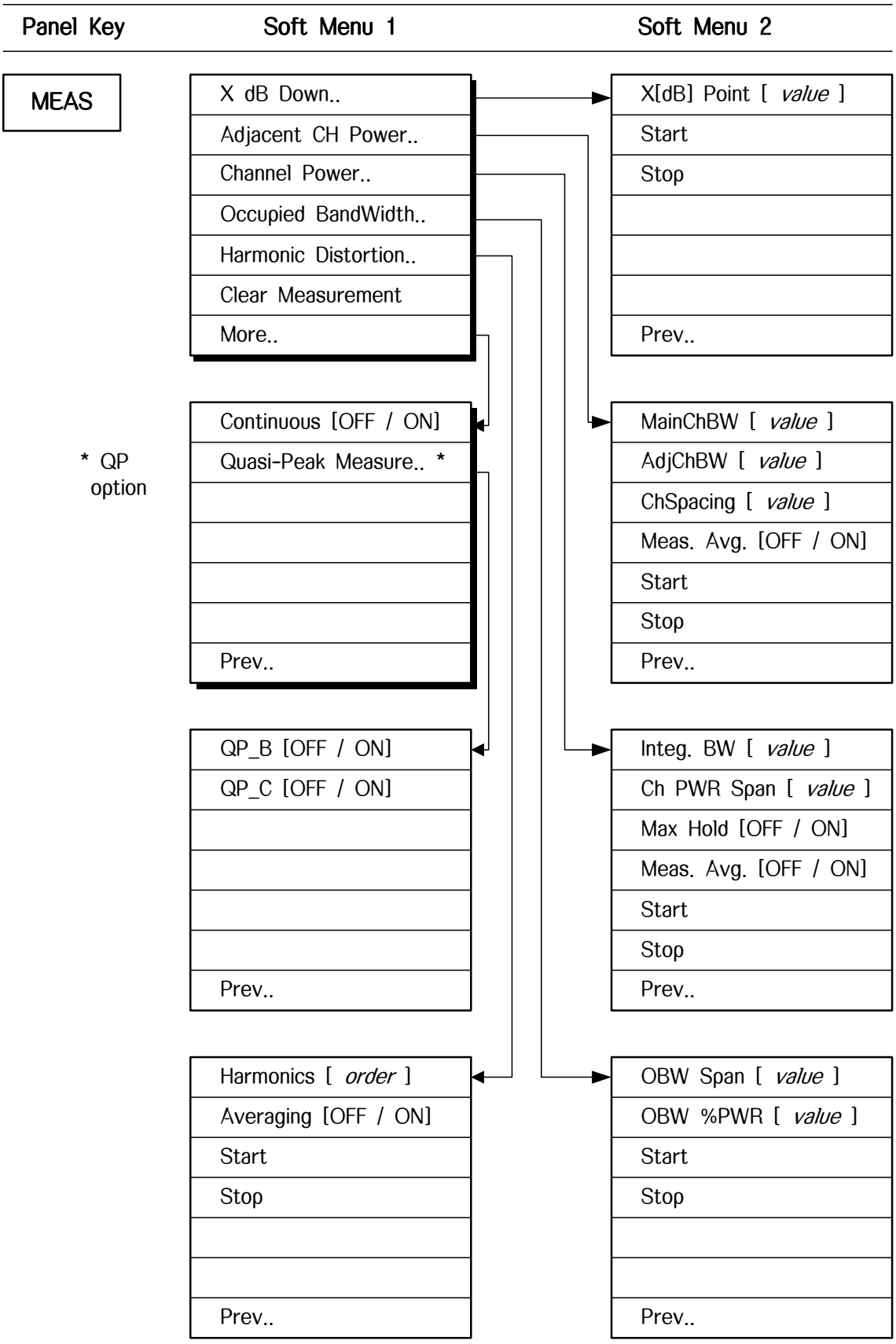
(2) SOFT MENU 1 keys are displayed on the screen when the panel key is pressed. SOFT MENU 2 indicates another menu below the SOFT MENU 1.

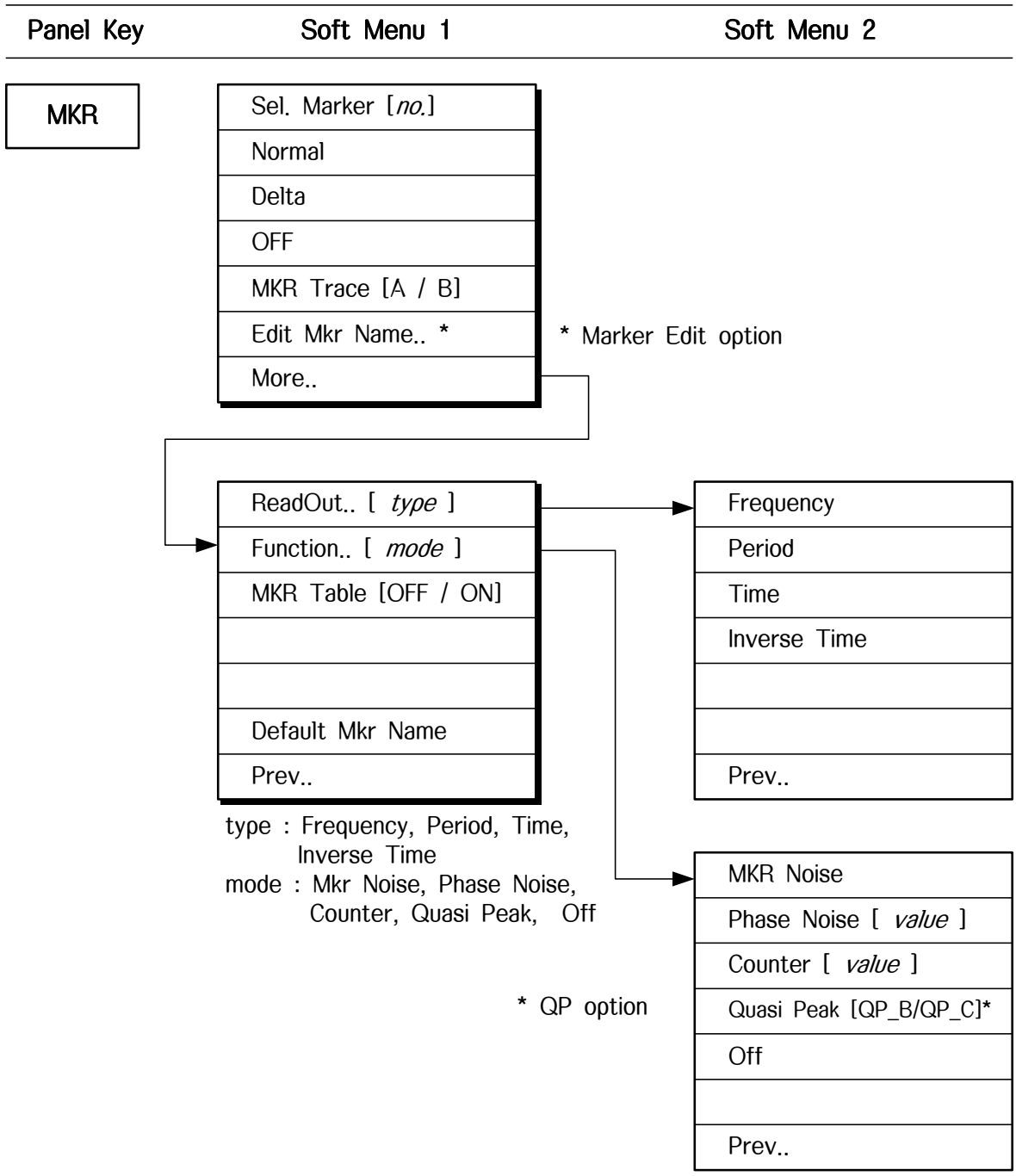
(3) When the *Prev..* key is pressed on SOFT MENU 2 keys.
It will go to SOFT MENU 1 menu.

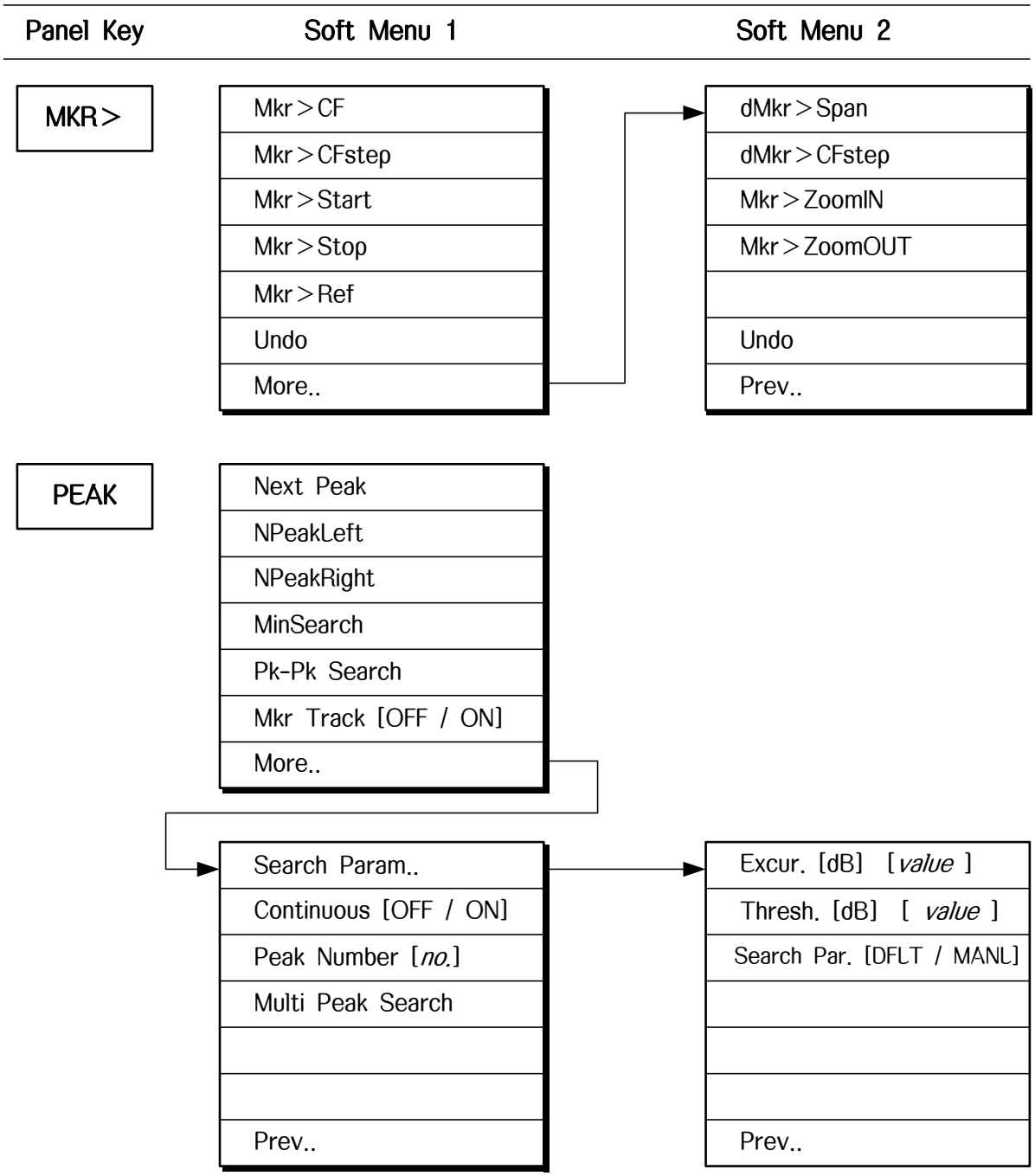
(4) The menu of disabled option or disabled function key will not operate with white letter on the function menu.

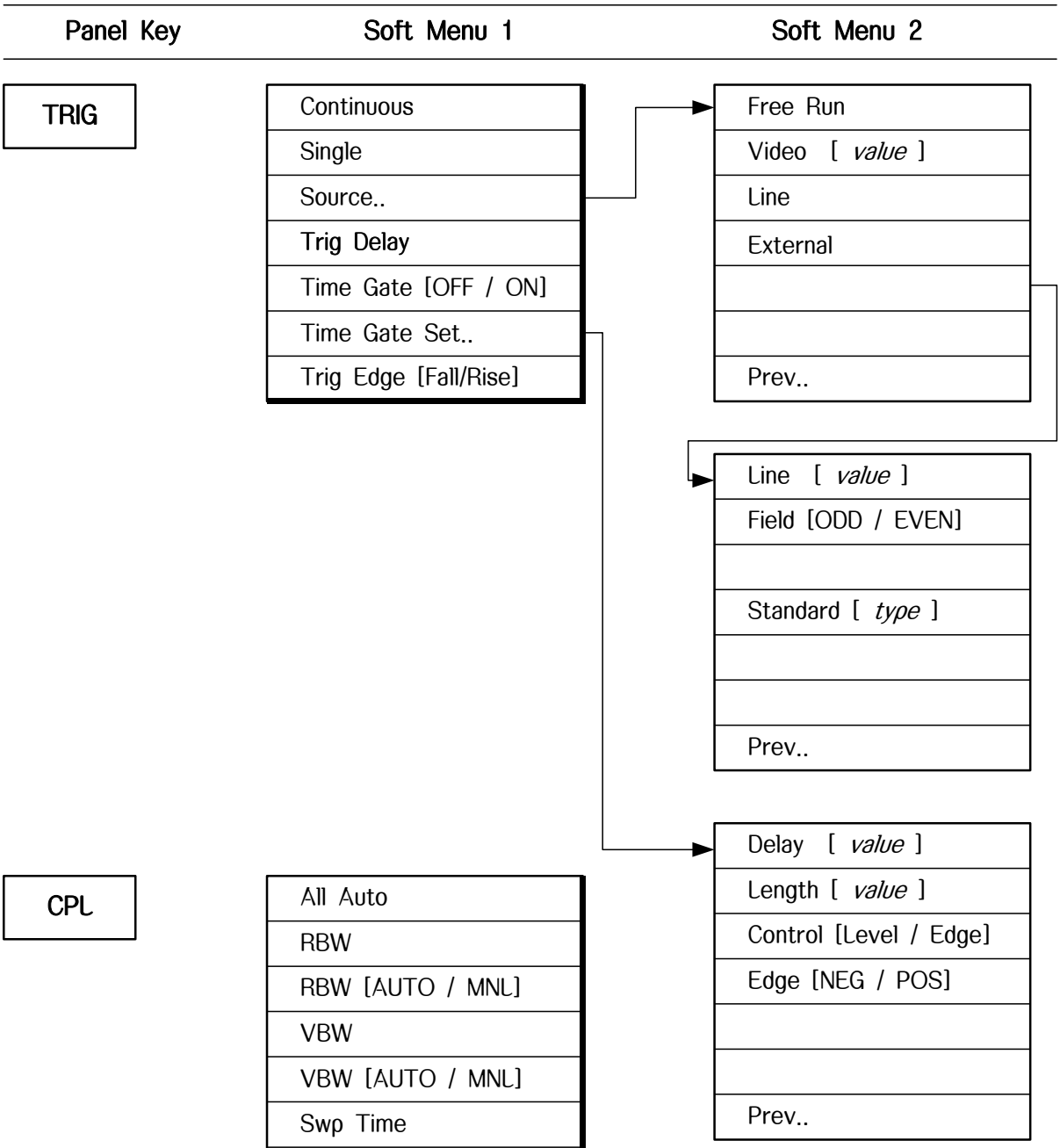
MENU TREE


Panel Key
Soft Menu 1
Soft Menu 2
FREQ
Center
Start
Stop
CF Step
CF Step [AUTO / MNL]
Freq. Offset [OFF / ON]
More..
10㎒ Ref. [EXT / INT]
Auto Tune
Cal. Signal [OFF / ON]
Prev..
SPAN
WidthSpan
Full Span
Zero Span
Last Span
Zoom In
Zoom Out
10dB/DIV
5dB/DIV
2dB/DIV
1dB/DIV
Prev..
AMPL
Ref. Level
Atten. [AUTO / MNL]
Log
Linear
Scale..
Unit..
More..
dBm
dBmV
dBuV
VOLTS
WATTS
dBuV/m
Prev..
Input Z [50 / 75]
Reg. Offset [OFF / ON]
Int Amp [OFF / ON] *
Prev..

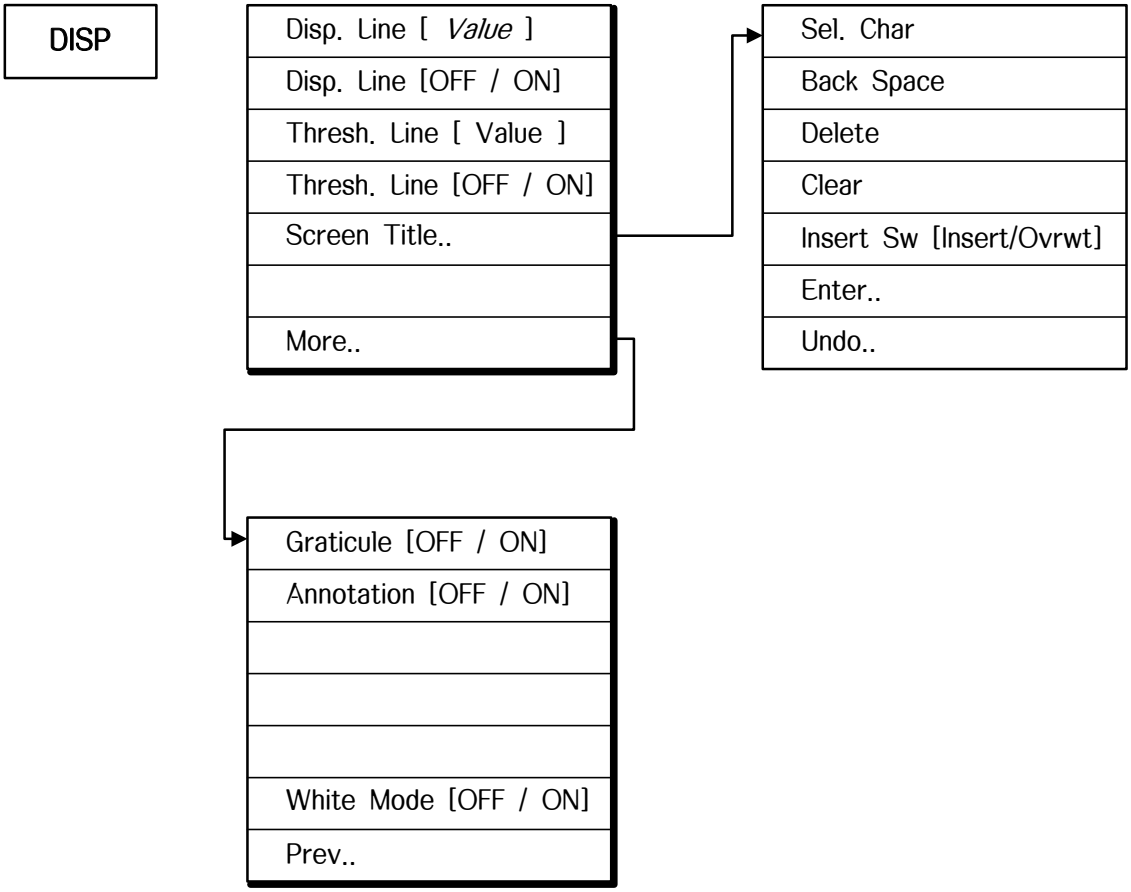

Panel Key
Soft Menu 1
Soft Menu 2
MEAS
X dB Down..
Adjacent CH Power..
Channel Power..
Occupied BandWidth..
Harmonic Distortion..
Clear Measurement
More..
X[dB] Point [value]
Start
Stop
Prev..
Continuous [OFF / ON]
Quasi-Peak Measure.. *
Prev..
MainChBW [value]
AdjChBW [value]
ChSpacing [value]
Meas. Avg. [OFF / ON]
Start
Stop
Prev..
* QP option
QP_B [OFF / ON]
QP_C [OFF / ON]
Prev..
Integ. BW [value]
Ch PWR Span [value]
Max Hold [OFF / ON]
Meas. Avg. [OFF / ON]
Start
Stop
Prev..
Harmonics [order]
Averaging [OFF / ON]
Start
Stop
Prev..
OBW Span [value]
OBW %PWR [value]
Start
Stop
Prev..


Panel Key
Soft Menu 1
Soft Menu 2
MKR
Sel. Marker [no.]
Normal
Delta
OFF
MKR Trace [A / B]
Edit Mkr Name.. *
More..
* Marker Edit option
ReadOut.. [type]
Function.. [mode]
MKR Table [OFF / ON]
Default Mkr Name
Prev..
Frequency
Period
Time
Inverse Time
Prev..
type : Frequency, Period, Time,
Inverse Time
mode : Mkr Noise, Phase Noise,
Counter, Quasi Peak, Off
MKR Noise
Phase Noise [value]
Counter [value]
Quasi Peak [QP_B/QP_C]*
Off
Prev..
* QP option

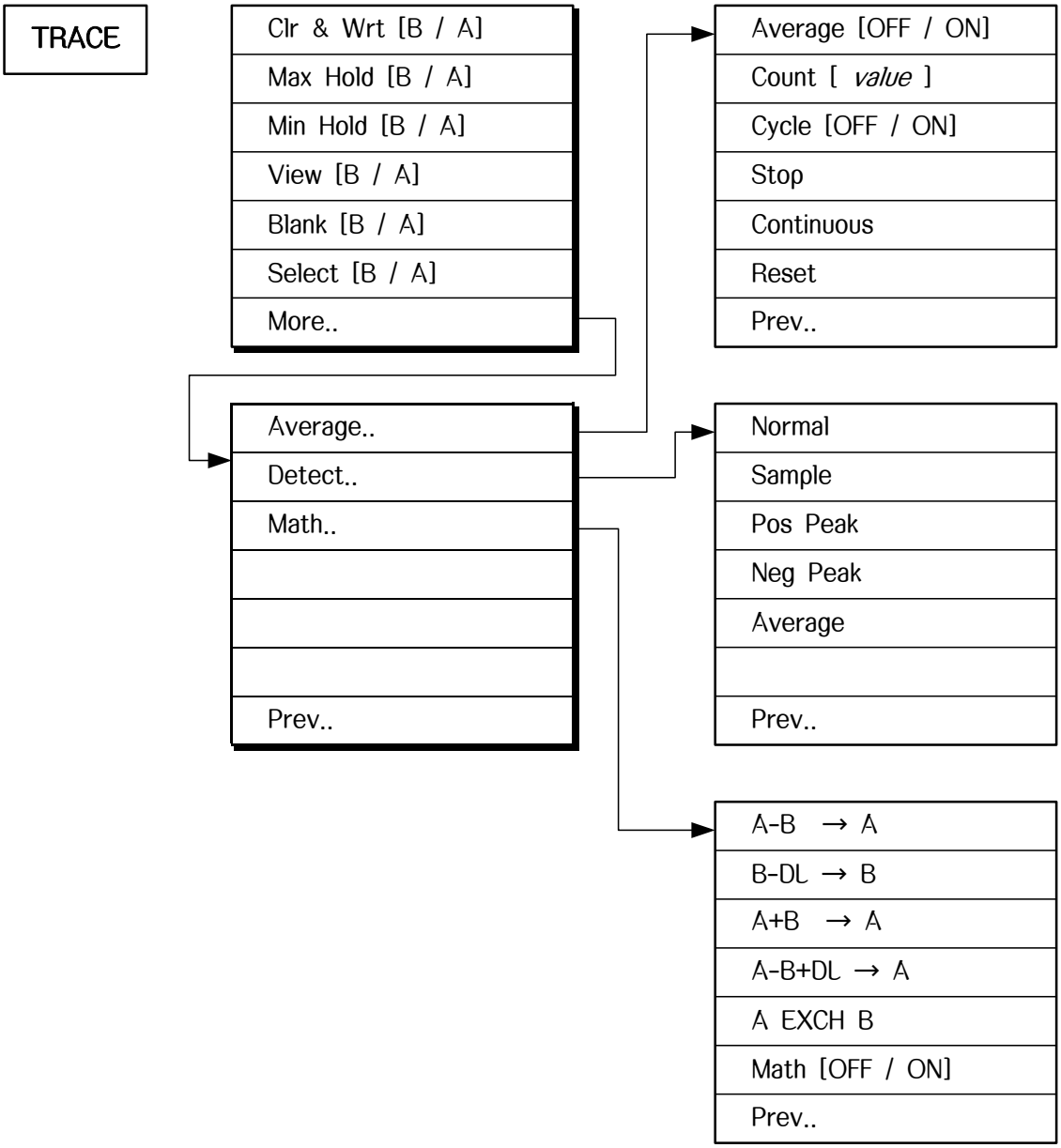

Panel Key
Soft Menu 1
Soft Menu 2
MKR>
Mkr > CF
Mkr > CFstep
Mkr > Start
Mkr > Stop
Mkr > Ref
Undo
More..
dMkr > Span
dMkr > CFstep
Mkr > ZoomIN
Mkr > ZoomOUT
Undo
Prev..
PEAK
Next Peak
NPeakLeft
NPeakRight
MinSearch
Pk-Pk Search
Mkr Track [OFF / ON]
More..
Search Param..
Continuous [OFF / ON]
Peak Number [no.]
Multi Peak Search
Prev..
Excur. [dB] [value]
Thresh. [dB] [value]
Search Par. [DFLT / MANL]
Prev..

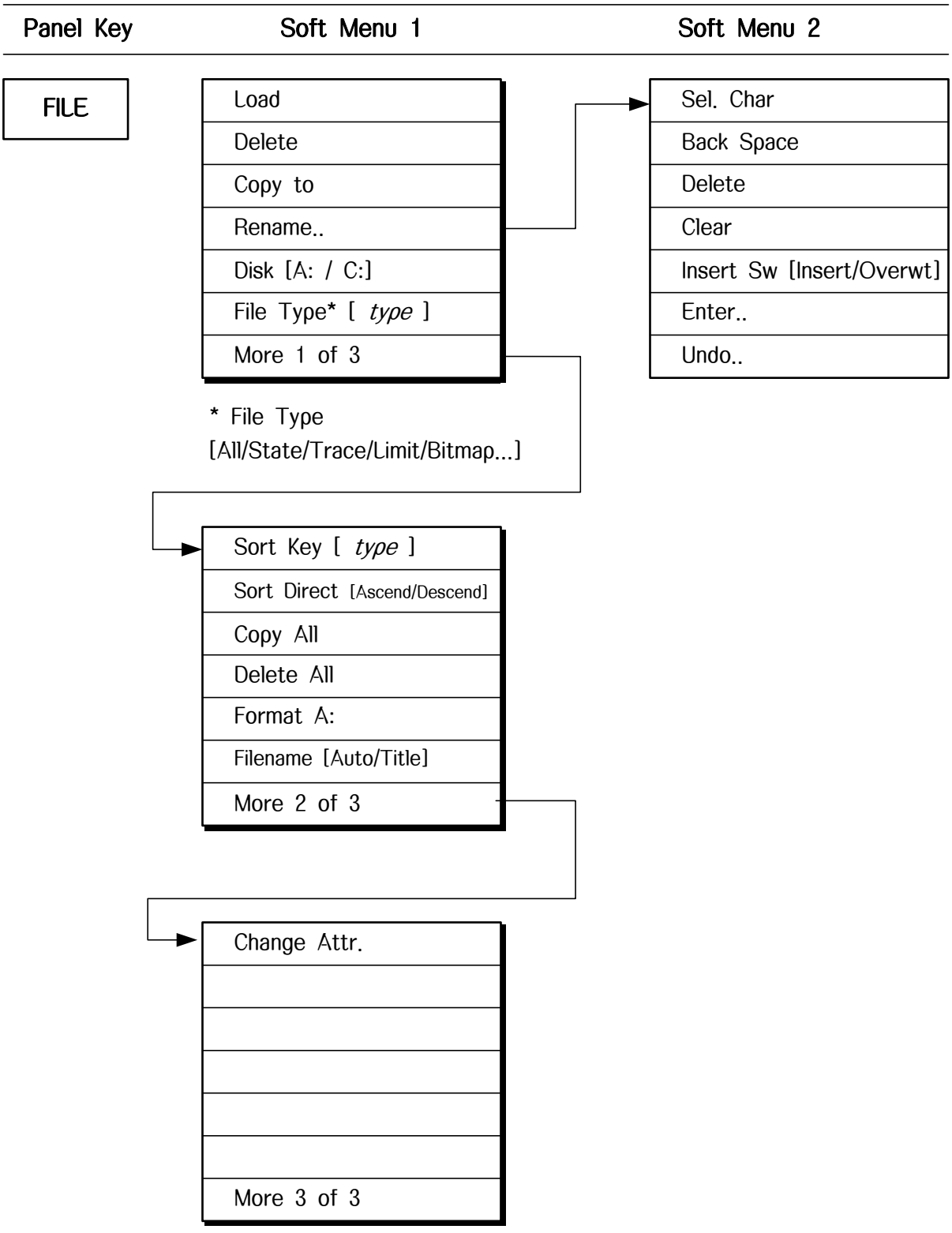

Panel Key
Soft Menu 1
Soft Menu 2
TRIG
Continuous
Single
Source..
Trig Delay
Time Gate [OFF / ON]
Time Gate Set..
Trig Edge [Fall/Rise]
Free Run
Video [value]
Line
External
Prev..
Line [value]
Field [ODD / EVEN]
Standard [type]
Prev..
Delay [value]
Length [value]
Control [Level / Edge]
Edge [NEG / POS]
Prev..
CPL
All Auto
RBW
RBW [AUTO / MNL]
VBW
VBW [AUTO / MNL]
Swp Time
Swp Time [AUTO / MNL]

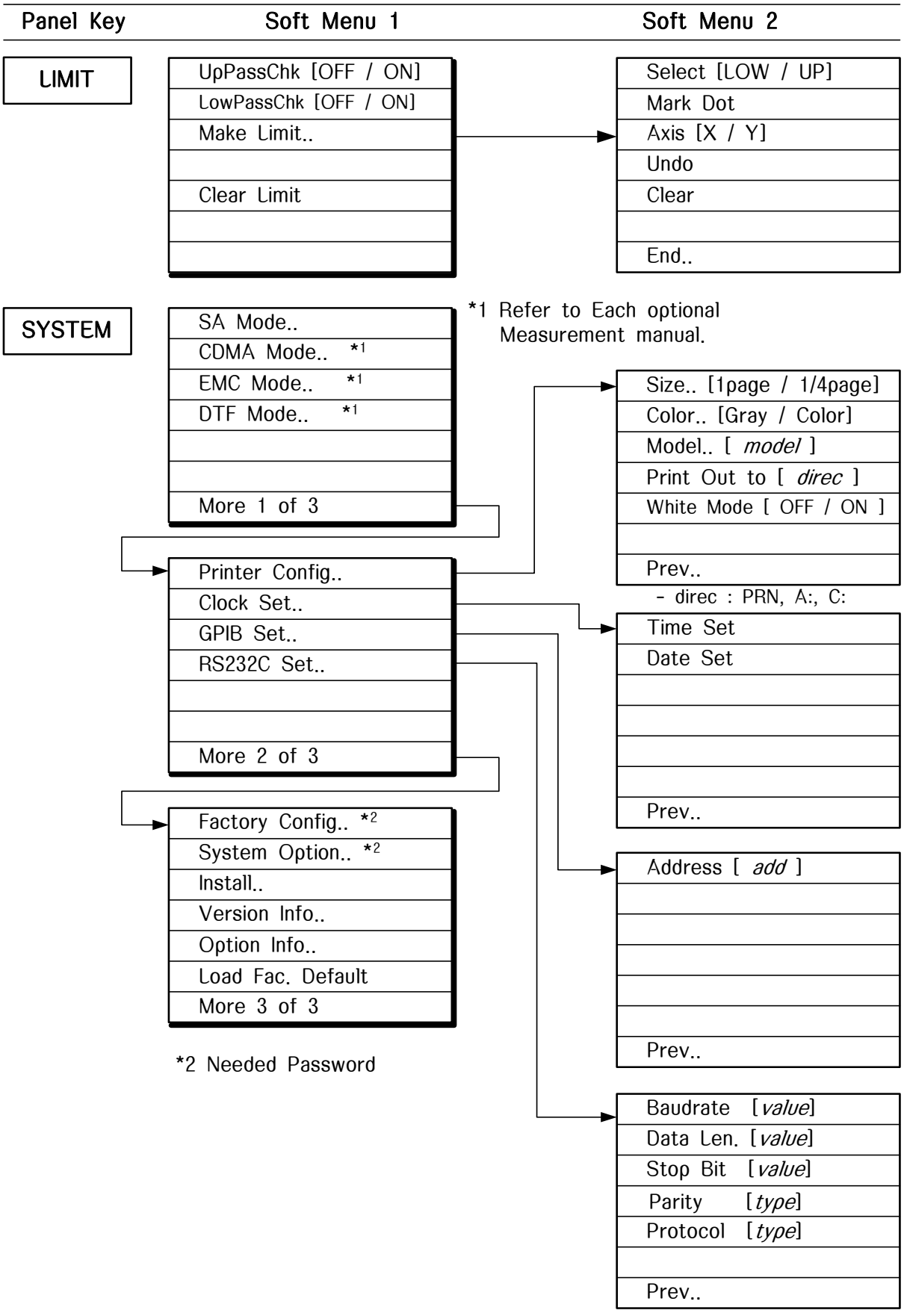
Panel Key	Soft Menu 1	Soft Menu 2

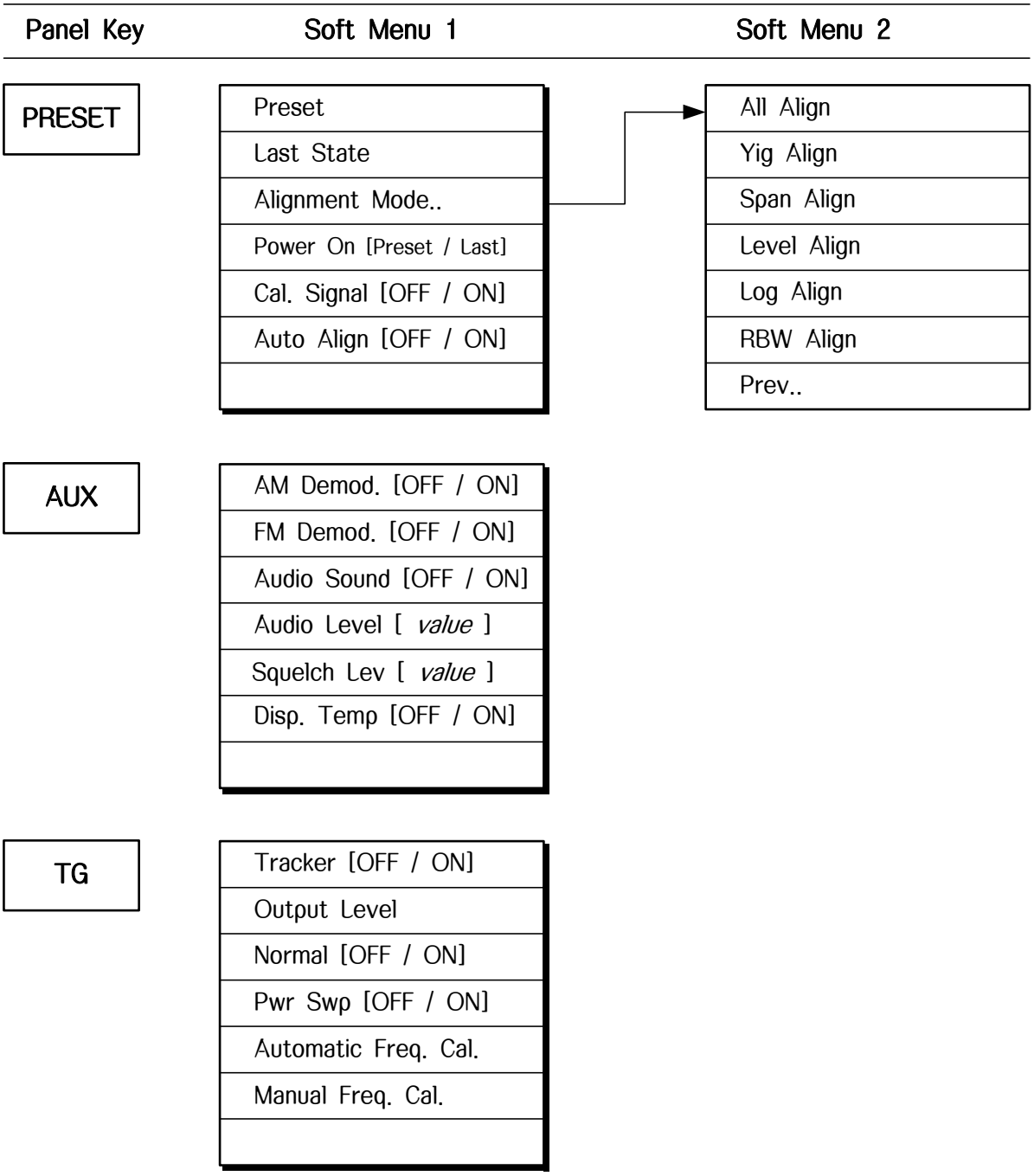


Panel Key	Soft Menu 1	Soft Menu 2




Panel Key
Soft Menu 1
Soft Menu 2
FILE
Load
Delete
Copy to
Rename..
Disk [A: / C:]
File Type* [type]
More 1 of 3
Sel. Char
Back Space
Delete
Clear
Insert Sw [Insert/Overwt]
Enter..
Undo..
* File Type
[All/State/Trace/Limit/Bitmap...]
Sort Key [type]
Sort Direct [Ascend/Descend]
Copy All
Delete All
Format A:
Filename [Auto/Title]
More 2 of 3
Change Attr.
More 3 of 3


Panel Key
Soft Menu 1
Soft Menu 2
LIMIT
UpPassChk [OFF / ON]
LowPassChk [OFF / ON]
Make Limit..
Clear Limit
Select [LOW / UP]
Mark Dot
Axis [X / Y]
Undo
Clear
End..
SYSTEM
SA Mode..
CDMA Mode.. *1
EMC Mode.. *1
DTF Mode.. *1
More 1 of 3
*1 Refer to Each optional Measurement manual.
Printer Config..
Clock Set..
GPIB Set..
RS232C Set..
More 2 of 3
Size.. [1page / 1/4page]
Color.. [Gray / Color]
Model.. [model]
Print Out to [direc]
White Mode [OFF / ON]
Prev..
- direc : PRN, A:, C:
Time Set
Date Set
Prev..
Factory Config.. *2
System Option.. *2
Install..
Version Info..
Option Info..
Load Fac. Default
More 3 of 3
*2 Needed Password
Address [add]
Prev..
Baudrate [value]
Data Len. [value]
Stop Bit [value]
Parity [type]
Protocol [type]
Prev..


Panel Key
Soft Menu 1
Soft Menu 2
PRESET
Preset
Last State
Alignment Mode..
Power On [Preset / Last]
Cal. Signal [OFF / ON]
Auto Align [OFF / ON]
All Align
Yig Align
Span Align
Level Align
Log Align
RBW Align
Prev..
AUX
AM Demod. [OFF / ON]
FM Demod. [OFF / ON]
Audio Sound [OFF / ON]
Audio Level [value]
Squelch Lev [value]
Disp. Temp [OFF / ON]
TG
Tracker [OFF / ON]
Output Level
Normal [OFF / ON]
Pwr Swp [OFF / ON]
Automatic Freq. Cal.
Manual Freq. Cal.

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SECTION 5
OPERATING PROCEDURES

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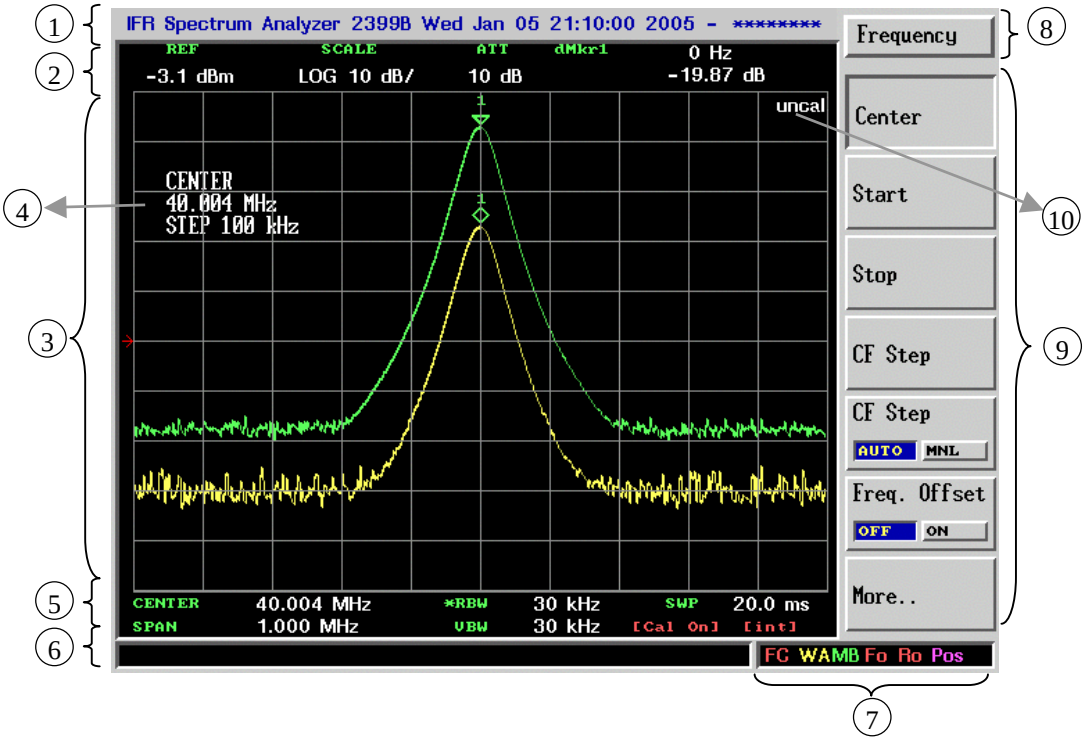
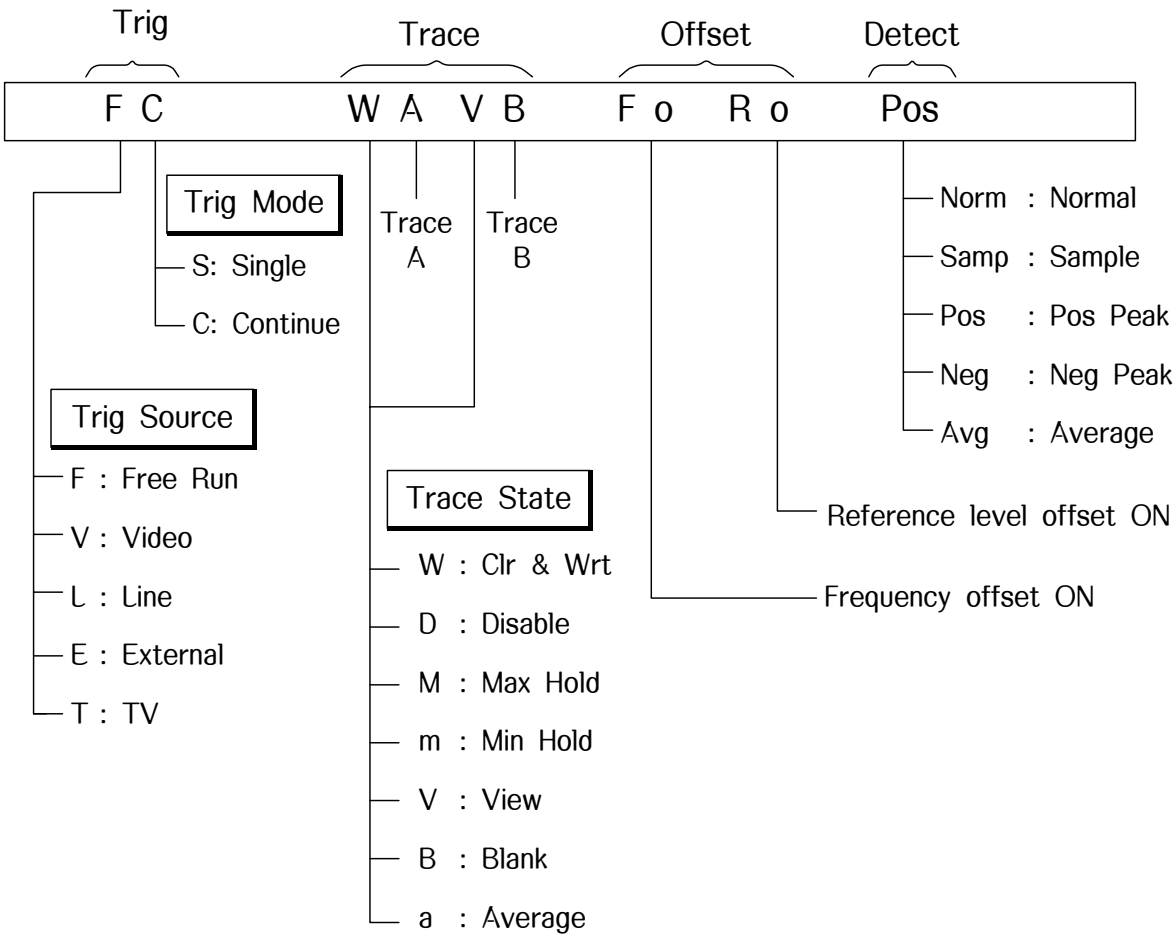
SECTION 5
OPERATING PROCEDURES

SCREEN LAYOUT



①	Title window	: Display Model, Date, Time, User title.
②	Upper parameter	: Display Reference level, Scale, Attenutator, Mark parameter.
③	Wave display window	: Display current trace A or B wave form.
④	Active window	: Display current active menu parameter.
⑤	Lower parameter	: Display Freq. Info., RBW, VBW, Sweep time, Cal signal on/off, 10 ㎒ Ref info.
⑥	Status window	: Display current job processing status.
⑦	Annotation window	: Display Trig, Trace, Freq offset, Level offset, Detect mode. (ref : Annotation Window 5-6)
⑧	Hard key menu	: Display Selected hard key.
⑨	Soft key menu	: Display Available soft function of selected hard key.
⑩	Uncal, average	: Display the status of signal validity or average number.

ANNOTATION WINDOW



FREQ/SPAN FUNCTIONS

The observation frequency of the equipment is set in either of two modes.

- Center – Span Mode.
- Start – Stop Mode.

The lower and upper limits are 1 ㎑ and 3.0 ㎓, respectively.

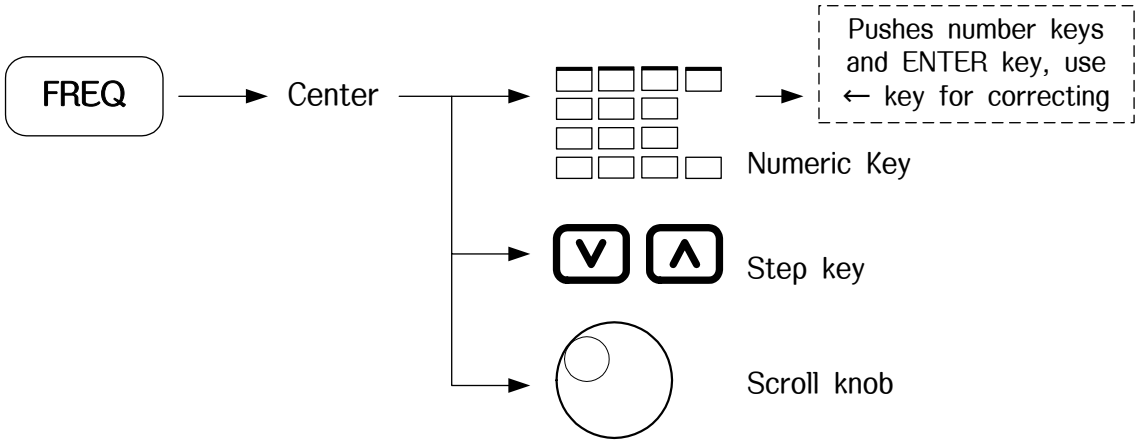
The [FREQ] key is used as the header key for setting the frequency.
The [SPAN] key is used as the header key for setting the frequency span.

Center – Span Mode Frequency Data Entry

1) Setting the center frequency

To set the center frequency, perform the following key operations :

(Numeric key, step key, and scroll knob are we said DATA ENTRAY)



The step size of step up-down key is 1/10 of current frequency span. (CF Step was set in MNL)

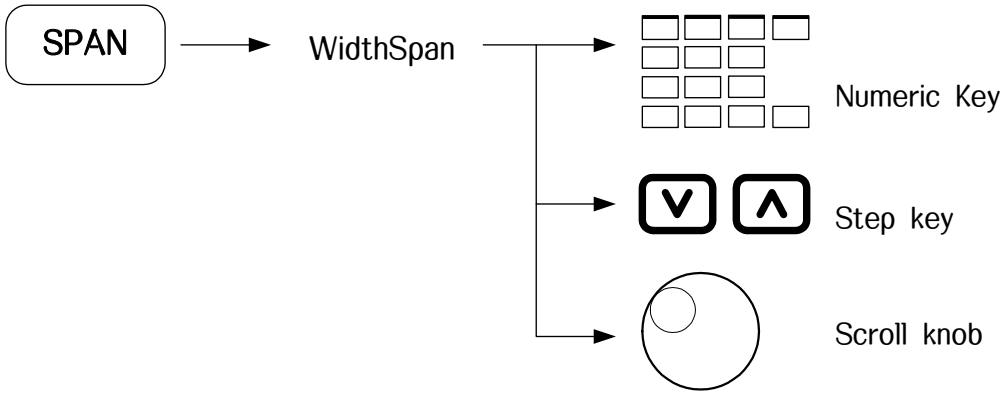
The step size of scroll knob is 1/500 of the current frequency span.

Span can be changed if center move to near the boundary.

Example : Center 40 ㎒ , Span 80 ㎒, and change the center to 20 ㎒ then span will be 40 ㎒.

2) Setting the frequency span

To set the frequency span, perform the following key operations :



Span range is 100 Hz ~ 3.0 GHz.

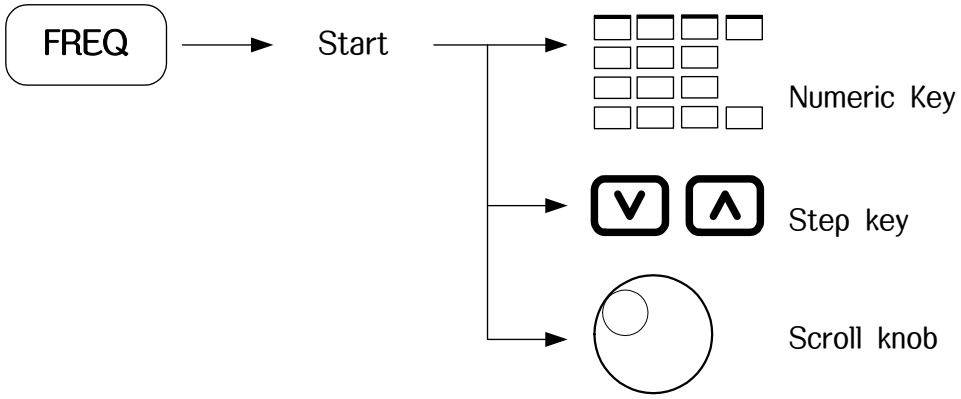
Changes in a 1, 2, 5 step sequence ; 1k, 2k, 5k, ..., 100k, 200k, 500k, ...

The step size of scroll knob is 1/500 of the current frequency span.

Start - Stop Mode Frequency Data Entry

1) Setting the start frequency

To set the start frequency, perform the following key operations :

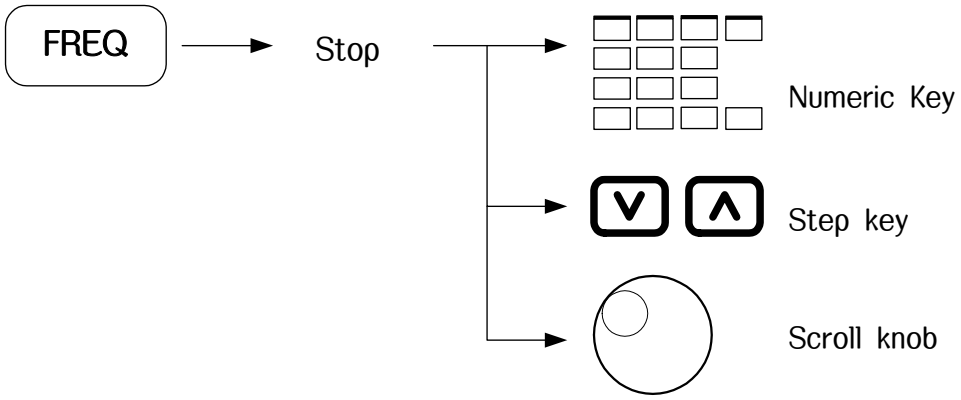


The step size of step up-down key is 1/10 of current frequency span.

The step size of scroll knob is 1/500 of the current frequency span.

2) Setting the stop frequency

To set the stop frequency, perform the following key operations :



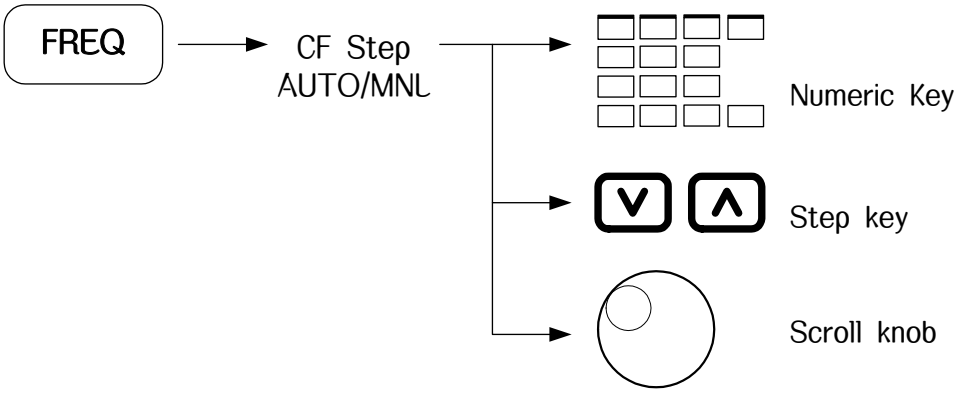
The step size of step up-down key size is 1/10 of the current frequency span.

The step size of scroll knob is 1/500 of the current frequency span.

Note : The start and the stop frequency are also determined by setting the center and the span frequency. For example, if the center frequency is 40 ㎒ and the span frequency is 20 ㎒, the start and the stop frequency are determined as 30 ㎒ and 50 ㎒ respectively.

Setting Center Frequency Step

To identify the step size as following :

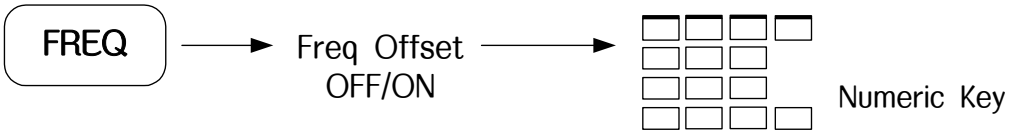


The CF Step mode is changed from AUTO to MNL mode by pressing *CF Step* soft key.

In CF Step MNL (manual) mode, the step size can be set by the DATA ENTRY.
If CF Step [AUTO/MNL] "AUTO" is selected, the CF Step size will be 1/10 of the current span.

Setting Frequency Offset

To set frequency offset, perform the following key operations :

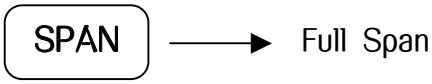


The Freq Offset mode is changed from OFF to ON mode by pressing *Freq Offset* soft key.

In Freq Offset [ON] mode, the frequency offset size can be set by the numeric key.
The settable frequency offset is up to ±999 ㎓.

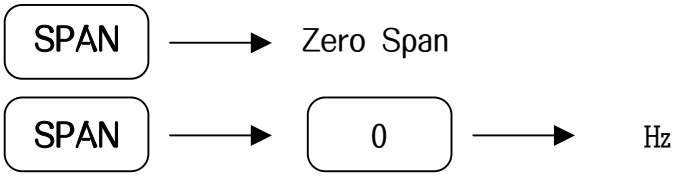
Setting Full Span

To set full span and leave the other parameters, perform the following key operations :
Set to start frequency is 0 ㎐ and stop frequency is 3.0 ㎓.



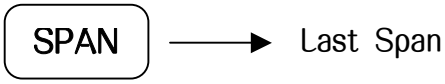
Setting Zero Span

The Spectrum Analyzer can operate as a selective level meter in which the horizontal axis is graduated as a time axis by setting the frequency span to 0 Hz.
The rising and falling edges of signal burst wave can also be observed and measured.
Performing any of the following key operations allows the equipment to operate in the zero span mode.



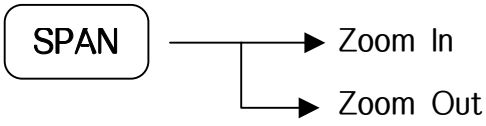
Return to the Previous Span

The previous span is returned by the following key operation.



Zoom In/Zoom Out

The Zoom In function changes the span from the current span to 1/2 of the current span.
The Zoom Out function changes the span form the current span to 2 times the current span.
The center frequency is not changed.



10 ㎒ Ref.

Set the reference clock for spectrum analyzer.

FREQ ⟶ More.. ⟶ 10 ㎒ Ref. [EXT / INT]

Default setting is INT.

Auto Tune

Detects the maximum peak point in full span and displays its spectrum in the center of the screen and then changes to a small span width.
Last span width set to 1 ㎒.

FREQ ⟶ More.. ⟶ Auto Tune

Cal Signal

When the Cal Signal is on, the calibration signal is displayed.
The calibration signal is 40 ㎒, -30dBm.
This function is very useful for system self check.

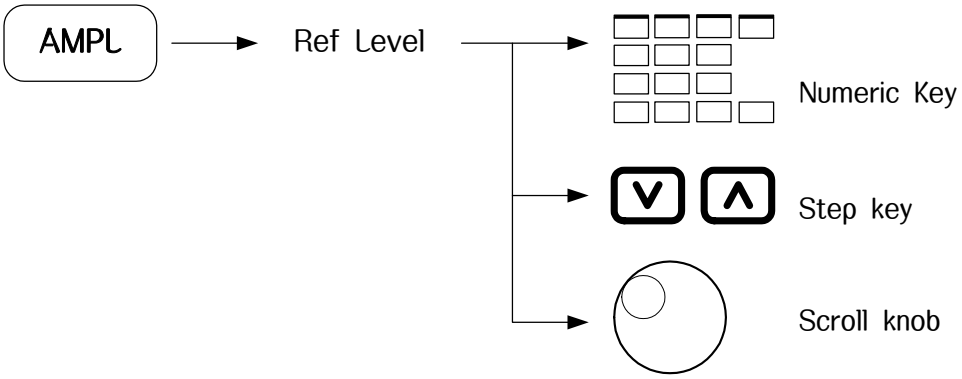
FREQ ⟶ More.. ⟶ Cal Signal [OFF / ON]

AMPLITUDE FUNCTIONS

The AMPL key is used the header key for setting the amplitude.

Setting Reference Level

Set the reference level (top graticule) by performing the following key operations :

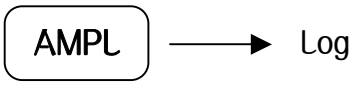


The step key size is the 1 division of current scale. (ref : Setting Amplitude Scale 5-14)
The scroll knob step size is 0.1 dB.

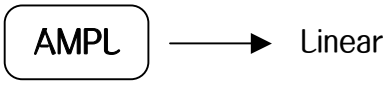
Selecting Log/Linear Detector Mode

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

(1) Setting log detector



(2) Setting linear detector

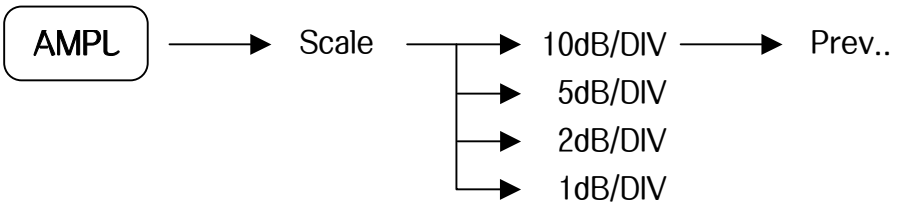


The reference level remains constant, independent of switching between log and linear.

Setting Amplitude Scale

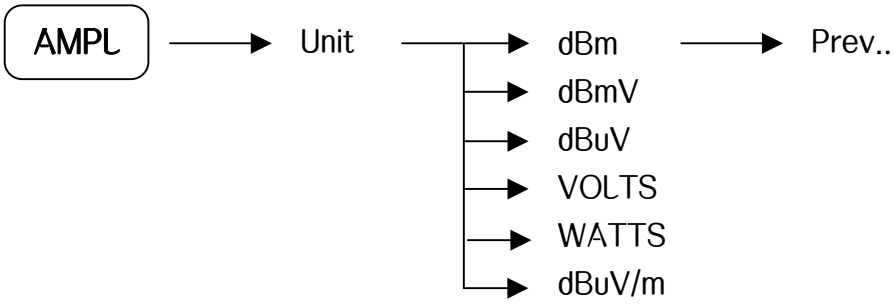
In log scale, the equipment provides the four scales : 10dB/DIV, 5dB/DIV, 2dB/DIV, 1dB/DIV.
In linear scale, the equipment uses the Full Scale.
To select one of the scales, perform the following key operations :

- Log Detector Mode



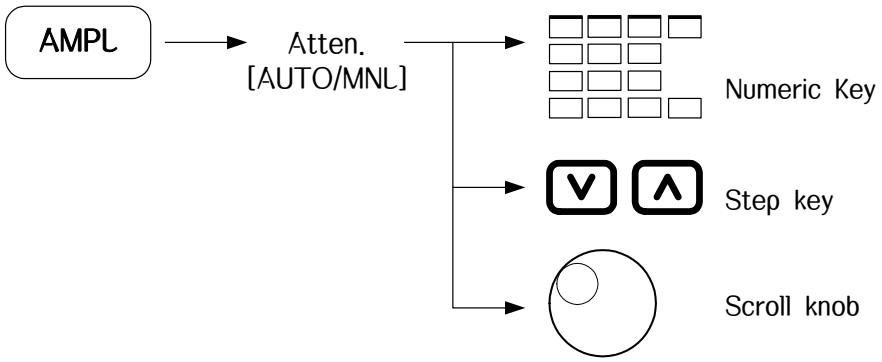
Setting Amplitude Units

In log scale, the equipment provide the five types of reference level units : dBm, dBmV, dBuV, VOLTS, WATTS.
To select on of the reference level units, perform the following key operations.
The reference level unit used for the linear scale is only in Volt.



Setting Input Attenuation

Perform the following key operation to set the input attenuator level.



The Atten mode [AUTO or MNL] is changed by pressing the Atten key.
In Atten MNL (manual) mode, the step size can set by the numeric keys, step keys and scroll knob. (Range 0 to 50 dB) (ref : Input Attenuator 5-39)
If Atten "AUTO" is selected, the input attenuator will be coupled by the current reference level automatically.

Selecting Input Impedance

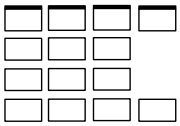
To select on of the input impedance, perform the following key operations.

AMPL → More.. → Input Z [50 / 75]

Using *Input Z* [50 / 75] menu, selecting input impedance 50 ohm or 75 ohm. When Input Z [75], this gives the method that user can use spectrum analyzer in such environment as ignore reflection and calculate considering purely impedance matching.

Setting the Reference Level Offset

Set the reference level offset by performing the following key operations :

AMPL → Ref. Offset →  Numeric Key

The reference level offset size is -217.3dB to 297.6dB.

Setting Internal Amp (option)

Set the internal amp to operate by performing the following key operations :

AMPL → More.. → Int Amp [OFF / ON]

CAUTION

Operate only in lower -20 dBm input signal level. Otherwise Spectrum Analyzer will damaged.

MEASURMENT FUNCTIONS

The equipment provides the following measurement functions :

- X dB Down Measurement
- Adjacent Channel Power Measurement
- Channel Power Measurement
- Occupied Bandwidth Measurement
- Harmonic Distortion Measurement

The measurement can be made in single or continuous sweep mode. Using Continuous [OFF/ON] Softkey. Each measurement should close by press MEAS *Clear Measurement*.

X dB Down Measurement

The X dB Down function displays the difference in frequency between a reference marker (◇) and another marker (→ ←) that is X dB down from the reference.
The relative dB range that can be specified for X from the screen dynamic range is selected using the step key or scroll knob. The default value is 3 dB.

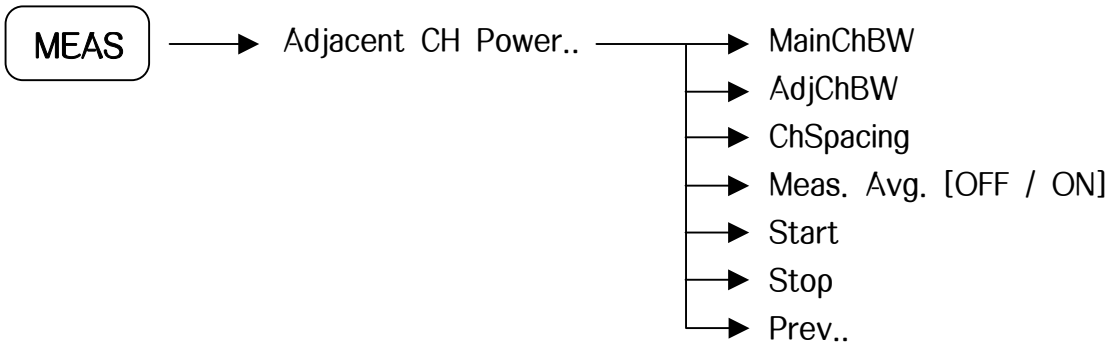
To use the X dB Down measurement function, perform the following key operations :

MEAS → XdB Down..

- X [dB] Point : Place left and right markers at X dB down from the reference marker.
- Start : When this key is pressed, X dB Down is executed continuously. When Continuous off, one measurement executed. (ref : Continue Measurement 5-21)
- Stop : Stop X dB Down Measurement.

Adjacent Channel Power Measurement

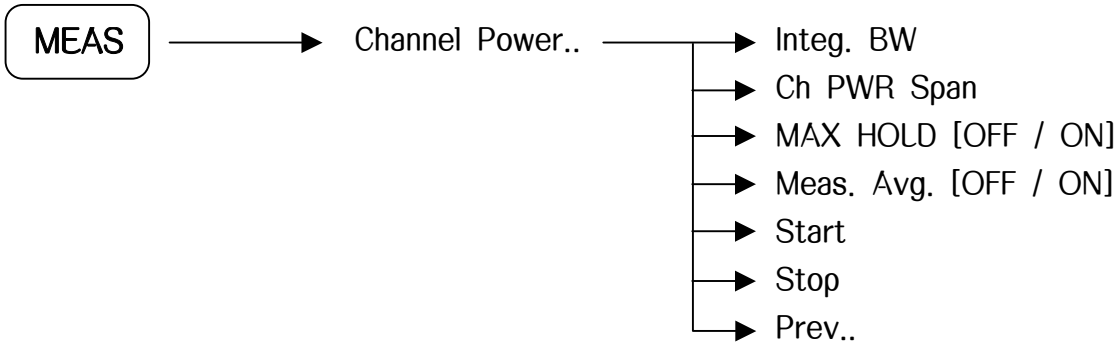
Determine the power in the center and adjacent channels of a signal (designated by three of marker line).



The measurement setup is done by numeric keys, step keys or scroll knob after pressed each soft key. [*MainChBW, AdjChBW, ChSpacing*]
These BW and spacing will be adjusted until warning or error message on the bottom of measurement clear. To get more stable measurement value, *Meas Avg.* function can be set ON.

Channel Power Measurement

Measure the power and power spectral density in the channel bandwidth specified by user.



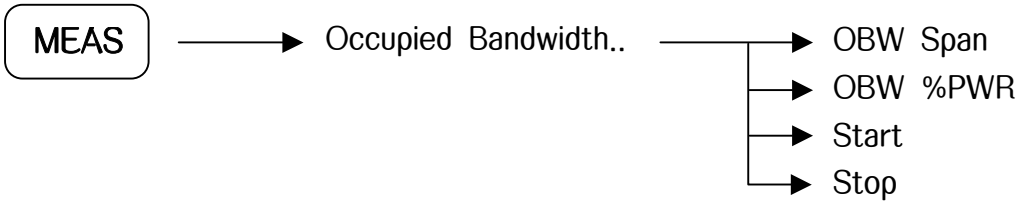
The measurement setup is done by numeric keys, step keys or Scroll knob after each soft keys [*Integ BW, Ch PWR Span*].
These BW and spacing will be adjusted until warning or error message on the bottom of measurement clear. To get more stable measurement value, *Meas Avg.* function can be set ON.
The center frequency, reference level and channel bandwidth must be set by user.

Occupied Bandwidth Measurement

Locate the occupied bandwidth of the signal being displayed on the screen.
The results are shown in the marker display area for the occupied bandwidth (OBW), the occupied band carrier frequency (Fc), and the band center frequency.
The equipment has an OBW function that can be calculated from the measurement data displayed on the screen. It works by finding the frequency band that contains a specified percentage of the total power. The default value is 98%, and measurement range between 5% and 100% can be specified.

OBW Measurement Procedure

(1) Set the center frequency & normal marker to the known carrier frequency and set the frequency, span, resolution bandwidth (RBW), and sweep time to AUTO.
(2) Set the detection mode to Sample detector.
(3) Calculate the Occupied Bandwidth by performing the following key operations :

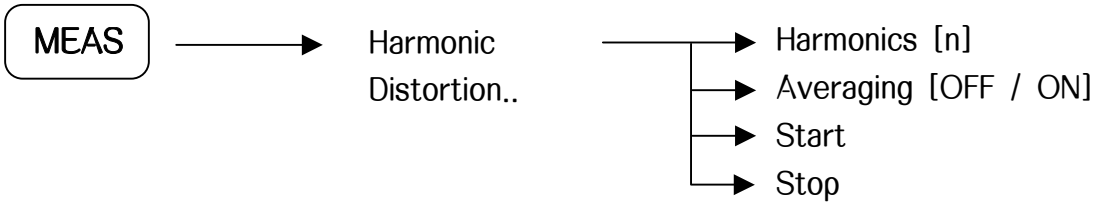


(4) To change the ratio between the power contained in the occupied and the total power first find the OBW, then use the numeric keys to set a new percentage. The band markers will be adjusted automatically.
OBW Span is the same Span.

Harmonic Distortion Measurement

Measures the harmonics of a single carrier signal and computes the total harmonic distortion. The carrier must be the strongest peak on the display at the time the measurement is started. The total harmonic distortion is then calculated from the measured harmonics.

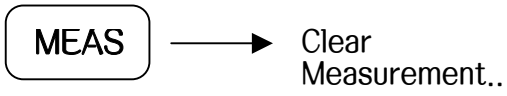
When measuring the Nth Harmonic the analyzer will choose the narrowest resolution bandwidth allows the measurement to capture all modulation on the harmonics.



Harmonics value is 2 ~ 5 and default is 2. Averaging on for easily peak finding in each harmonics.
Recommand SPAN value is less than 4 ㎒ for accuracy measurement.

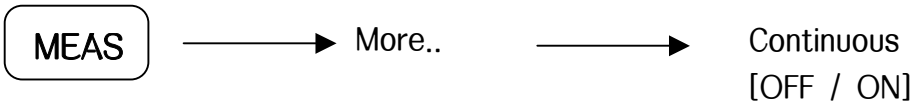
Clear Measurement

Stop the current measurement and close measurement.



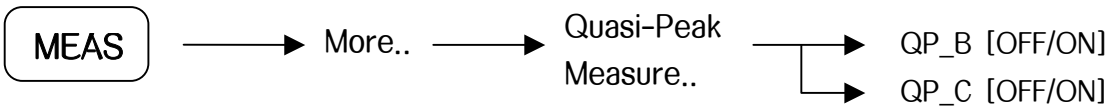
Continue Measurement

Select the measurement mode between continuous and else. Default mode is continuous on. When continuous off, current measurement operate just one by press start menu in each measurement.



Quasi-Peak (option)

Measure the quasi peak in B band and C/D band.



MARKER FUNCTIONS

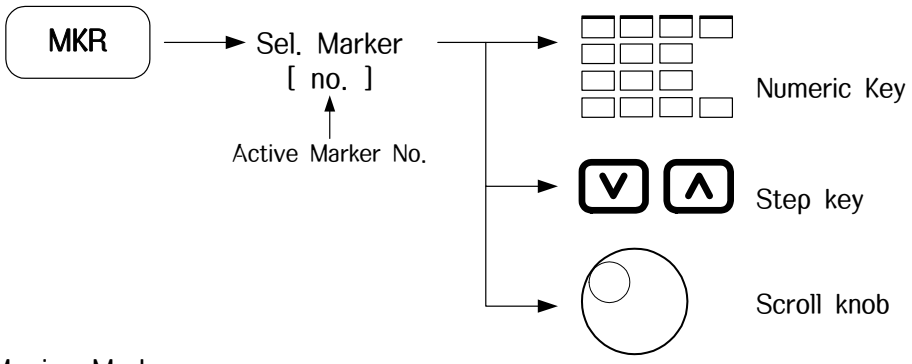
The inner key section is used as the header keys for setting the marker functions.
The [MKR] key is used as the header key to display markers. The [OFF] key turns off all the marker and marker table.

The number of settable marker is up to 9.

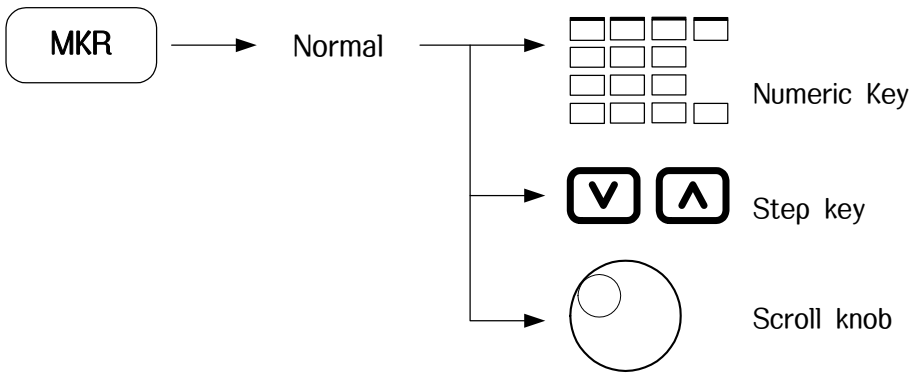
Selecting & Changing Marker Position

Press [MKR] key, Activated Marker 1 as default. Single Marker is indicated by ◇ on the waveform. Use the step up down key to move the active maker position in 1division steps. When the up step key is pressed, the marker position is moved to the right direction.
The down step key direction is left.
The scroll knob step size is 1/500 of the horizontal line also be used Numeric key.

1) Selecting Marker



2) Moving Marker



Normal Marker

A single marker is indicated by ◇ on the waveform. The frequency and level at that point are displayed digitally.
The normal marker is initially set to ON. When the current state is another marker mode, or when the normal marker is set to OFF, perform the following key operations to set the normal marker ON.

MKR ⟶ Normal

The normal marker displays the absolute amplitude level.

Delta Marker

To current marker position, when the delta marker is set to ON, is fixed as the reference marker (reference point). Then, as the current marker is moved, the reference marker and the current marker frequency (time) and level differences are displayed digitally as delta marker values.
In the delta marker mode, the reference marker is indicated by ▽.
To set the delta marker to ON, perform the following key operation :

MKR ⟶ Delta

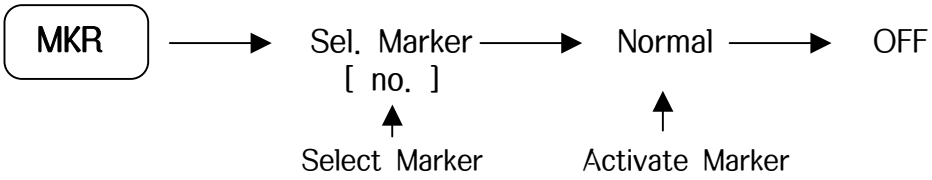
Press the *Delta* key in the delta marker mode. The reference marker moves to the current marker position and switches to the delta marker mode with that as the reference point.

Marker Off by Reverse Step

The markers are turned off from the screen by the following key operation :

MKR ⟶ OFF

The markers are disappeared by reverse step by pressing soft menu “OFF”
If you want turn off the specific marker,



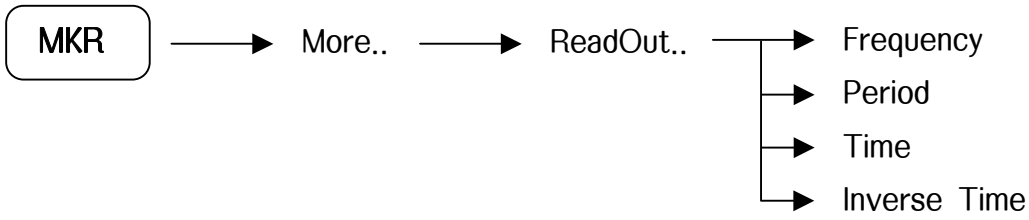
Setting the MKR Trace

The marker can be settable trace “A” or “B”. (ref : Trace Functions 5-46)
By performing the following key operations, the trace for marker position and active marker.

MKR ⟶ MKR Trace [A / B]

Setting the Marker Readout Mode

Accesses the following menu keys that allow you to change the active marker readout.



Frequency : Sets the marker readout to Frequency.
This is active in non-zero spans.

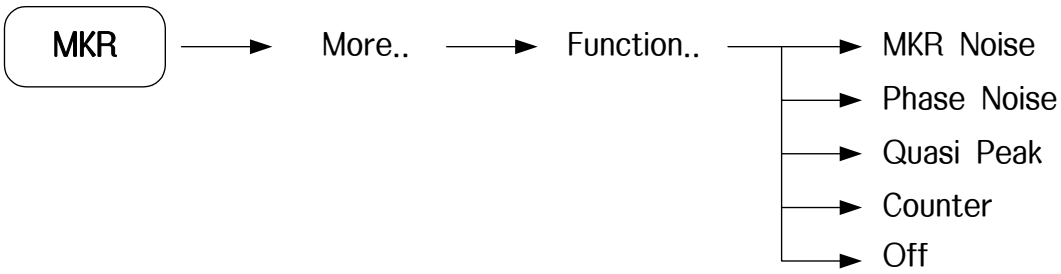
Period : Sets the marker readout to Period.
Displays the reciprocal of the frequency.

Time : Sets the marker readout to Time.
Time is active in zero span. (Range : within sweep time)

Inverse Time : Sets the marker readout to Inverse Time.
Displays the reciprocal of time.

Setting the Marker Function

Accesses the following marker function menu by performing process.



MKR Noise : Reads out the average noise level, referenced to a 1 Hz noise power bandwidth.

Phase Noise : Reads out the carrier to noise ratio. The offset frequency can be settable by numeric keys. (Offset freq. Range : 10 Hz ~ 100 kHz)

Counter : Reads the precise frequency value in current marker position. Set the marker counter resolution with 1 kHz, 100 Hz, 10 Hz and 1 Hz.

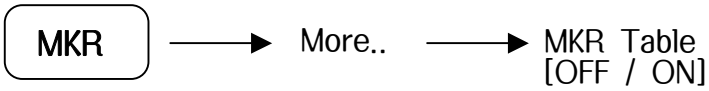
Quasi Peak : Reads the quasi peak value in current marker position. Selectable QP-B and QP_C. (option)

Off : Release marker function.

Setting the Marker Table

When the MKR Table is ON, compresses the graticule and displays marker information in a table.

The information includes the marker number, marker type, amplitude and marker readout status.



SETTING PARAMETERS USING MARKER VALUES

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

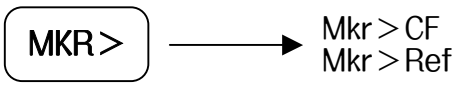
To set parameters using the marker value, the following settings are possible :

- *Mkr>CF* : Sets the marker value to the center frequency.
- *Mkr>CFstep* : Sets the marker value to the center frequency step size.
- *Mkr>Start, Stop* : Sets the marker value to the start/stop frequency value.
- *Mkr>Ref* : Sets the marker value to the reference level.
- *dMkr>Span* : Sets the delta marker value to the span.
- *dMkr>CFstep* : Sets the delta marker value to the center frequency step size.
- *Mkr>ZoomIN, ZoomOUT* : Fix the marker position and sets the span to 1/2 or 2 of the current span.

In time domain, only *Mkr>Ref* is valid.

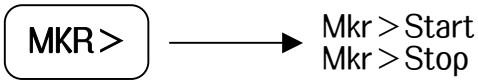
MKR>CF / MKR>Ref

Sets the current marker frequency or level to the center frequency or the reference level.
To execute the MARKER Shift, perform the following key operations :



MKR>Start / MKR>Stop

Sets the current marker frequency to the start or stop frequency.
To execute the MARKER Shift, perform the following key operations :



Mkr>CFstep / dMkr>CFstep

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

MKR> ⟶ Mkr>CFstep
dMkr>CFstep

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

dMkr>Span

In the delta marker mode, this operation sets the difference frequency between reference frequency and current marker frequency to span frequency.

MKR> ⟶ dMkr>Span

Mkr>ZoomIN / Mkr>ZoomOUT

This function is useable when the current marker frequency is set to the center frequency.

MKR> ⟶ Mkr>ZoomIN
Mkr>ZoomOUT

This *Mkr>ZoomIN* function is to change the current span to half the current span.
The *Mkr>ZoomOUT* function changes the current span to two times the current span.

PEAK SEARCH FUNCTIONS

The equipment has the following four marker search functions :

- Peak Search
- Next Peak Search
- Next Left Peak Search
- Next Right Peak Search
- Minimum Search
- Peak to Peak Search

Peak Search

Peak Search detects the maximum level point from the entire trace and moves activated marker to that point.
Execute peak search by performing the following key operations :

PEAK

When no marker exist, marker 1 is activated.

Next Peak Search

Next Peak search detects the next largest peak relative to the current marker level and moves the marker to that point. (When there are two or more peaks with the same level on the screen, the left most peak is detected.)
Execute Next Peak search by performing the following key operations :

PEAK ——▶ Next Peak

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

Peak Left Search/Peak Right Search

PEAK LEFT Search and PEAK RIGHT Search detect the adjacent peak level to the right or left of the current marker and move the marker to that point.
To execute PEAK LEFT Search and PEAK RIGHT Search, perform the following key operation :

PEAK → NPeakLeft
PEAK → NPeakRight

The adjacent peak in the right or left can be detected and the marker moves to that peak by executing *NPeakLeft* or *NpeakRight* menu consecutively.

Marker Track

When the Marker Track is set to ON, the maximum level point of the waveform is always moved to the center position of the horizontal axis.
To use Marker Track, perform the following key operations:

PEAK → Mkr Track [OFF/ON]

The Marker Track is changed by pressing *Mkr Track* menu.

Peak to Peak Search

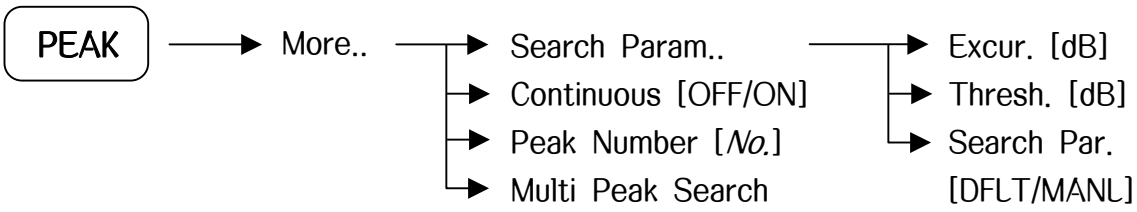
Finds and displays the frequency (or time, if in zero span) and amplitude differences between the highest and lowest trace points.

PEAK → Pk-Pk Search

If you search Peak to Peak again, you should current activated marker off.

Setting the Search Parameters

Accesses the following menu keys.



Excur. (Excursion) : Sets the minimum amplitude variation of signals that the marker can identify as a peak.
If a value of 10dB is selected, the marker moves only to peaks that rise and fall more than 10dB above the peak threshold value. Pressing Search Par [AUTO/MNL] by Auto, the excursion value and Threshold value is set to 6dB and 100dB each.
For setting the excursion value, use the numeric keys or scroll knob in the Search Par is MNL mode.

Thresh. (Threshold) : Sets a lower boundary to the active trace. The value of the peak threshold level can be changed using the numeric keys or the scroll knob. The threshold level does not influence the trace memory or marker position.

Search Par. [DFLT/MANL] : When set to default(DFLT), the value will change as excursion is 3 dB, Threshold is –100dB.

Continuous[OFF/ON] : Select the search mode between continuously or not.

Peak Number[No.] : Set the number of search marker.
No. : 1- 9

Multi Peak Search : This function is used for multiple peak searching.
Instantly the set number of marker will position in order of level of peak on one sweep waveform.
If the only one peak exists with met the condition, all the markers will be gathered on that peak.

TRIGGER FUNCTIONS

The TRIG key is the header key for using the trigger function.

Continuous Sweep Mode

When the trigger source is not Free Run, the sweep is executed each time trigger conditions are met. When the trigger source is set to Free Run, the sweep is executed continuously.
To set the continuous sweep mode, press the following keys :

TRIG ⟶ Continuous

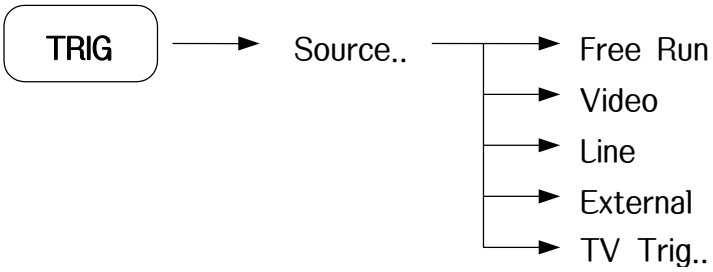
Single Sweep Mode

When the trigger source is set to Free Run, the sweep is executed once immediately after the Single key is pressed. When the trigger source is not Free Run, the sweep is executed only once when the trigger conditions are met.
To set the single sweep mode, press the following keys :

TRIG ⟶ Single

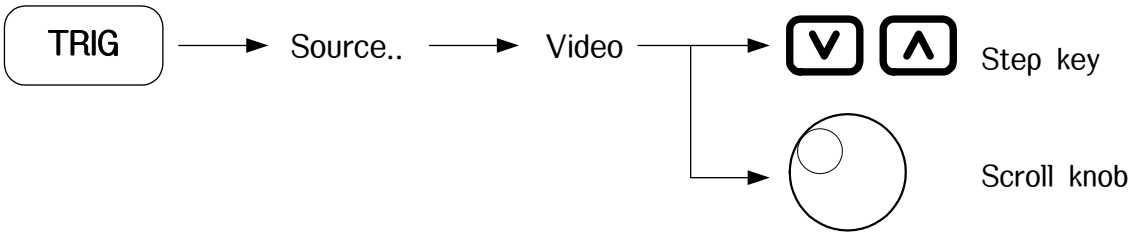
Trigger Source

The equipment trigger mode can be divided into Free Run and Trigger.
When trigger source is set to Free Run, we call not Triggered Mode or Free Run mode.
Otherwise, Trigger Source is not Free Run, Triggered Mode.
In the Triggered mode, Video, Line or External can be selected as the trigger source.
To select the TRIGGER SOURCE, perform the following key operations :



Video Trigger

This function is used in ZERO SPAN mode. (ref : Setting Zero Span 5-11)
When the Video Trigger source is selected, the sweep is started in synchronization with the positive leading edge of the detected waveform that is greater than trigger level.
To select trigger level, perform the following key operations.



The trigger level is controlled by the step up-down keys and the scroll knob.
The trigger level is indicated by displaying the trigger level marker(→) on the screen.

Line Trigger

This function starts sweep in synchronization with AC power line frequency.
Line triggers is conveniently used to observe power line-related waveforms.
With the line trigger function, the trigger level is not active.

TRIG → Source.. → Line

External Trigger

This function starts sweep in synchronization with the external trigger source.
Sweep is started in synchronization with the positive leading edge of the signal waveform input to the EXT TRIG input connector on the rear panel.
Trigger execution requires TTL input signals.

TRIG → Source.. → External

Trigger Delay

When the trigger mode is set to Triggered mode (Trigger source is selected as Video, External or Line only) the trigger point is usually positioned at the left end of the screen. However, this means that it is not possible to see the waveform before the trigger point and the waveform beyond the right end of the screen.
With the equipment, a waveform before (or after the end of the display) the trigger point can be displayed by changing the delay time.

NOTE : Trigger delay works in Zero Span mode only.

To set the delay time perform the following key operations :

TRIG ⟶ Trig Delay

The delay time is set numeric keys, the scroll knob and the step up-down keys in zero span mode. Range of delay time is –sweep time to +sweep time.
A minus value of delay time means the Pre-Trigger mode is used. It means shows the waveform of before trigger point.
A plus value of the delay time means the Post-Trigger mode is used. It means shows the waveform of after trigger point.

Select Trigger Edge

Select the type of trigger edge.
Two trigger edge type : Fall , Rise

TRIG ⟶ Trig Edge [Fall/Rise]

NOTE : Trigger Edge function is operating in Fast Zero mode. Fast Zero mode is zero span lower than 2ms sweep.

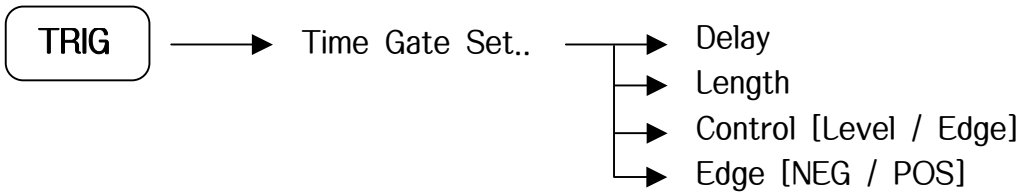
Time Gate

When set to Time Gate ON, the video signal that is digitized is controlled by the gate circuitry. The gate circuitry switches between two states.
When the gate is “open”, the normal video signal of the analyzer is passed through the video filters to the peak detectors and digitizer of the analyzer. When the gate is “closed”, the video filters, peak detectors and digitizer are given a signal at the bottom of the display.

The gate function requires that a gate trigger signal be connected to the EXT TRIG (TTL) input on the rear panel. When the gate function is on, the stage of the gate appears at the SWP Gate (TTL) rear panel connector.
The TTL high output indicates that the gate is open.
The gate output signal is only valid while the analyzer is sweeping.
You can adjust the gate delay and gate length using a oscilloscope to view the gate out signal.

Time Gate Menu

Accesses the following menu keys that allow you to set up various gate parameters.



Delay : Control the length of time from the trigger until the gate is turned on.

Length : Controls the length of time that the gate is on when using edge triggering to control the gate.

Control [Level/Edge] : Allows you to select between Edge and Level triggering of the gate, Control Type [Edge] opens the gate in response to an edge trigger on the trigger input after a delay set Delay. The gate stays open for the selected Time Gate Length. When Control Type [Level] is selected, the gate is open as long as the trigger input is true, as defined the Level [TTL] is high.

Edge [NEG/POS] : Sets the polarity for edge triggering of the gate. When *Edge [POS]* is pressed, a positive-going edge will trigger, after the delay set with the *Delay* key, when *Edge [NEG]* is pressed, a negative-going edge will trigger.

COUPLED FUNCTION

The four functions of RBW, VBW, Sweep Time and Input Attenuation are initially set to AUTO so the equipment can automatically select the optimum setting.
There are two hard keys related to the Coupled function.

- CPL : Coupling function
- AMPL : Amplitude function

All Auto Function

The coupled function has two modes. One is the Auto mode, the other one is the Manual mode.
In order to operate the Auto Mode, perform the following key operations.

CPL ⟶ All Auto

The input attenuator is Automatically set to optimum value according to the reference level. (ref : Input Attenuator 5-40)

Reference Level Range	Attenuation Auto
+30 dBm to +20.1 dBm	40
+20 dBm to +10.1 dBm	30
+10 dBm to +0.1 dBm	20
0 dBm to -9.9 dBm	10
Less than -10 dBm	0

Setting the Resolution Bandwidth(RBW)

(1) Auto Mode

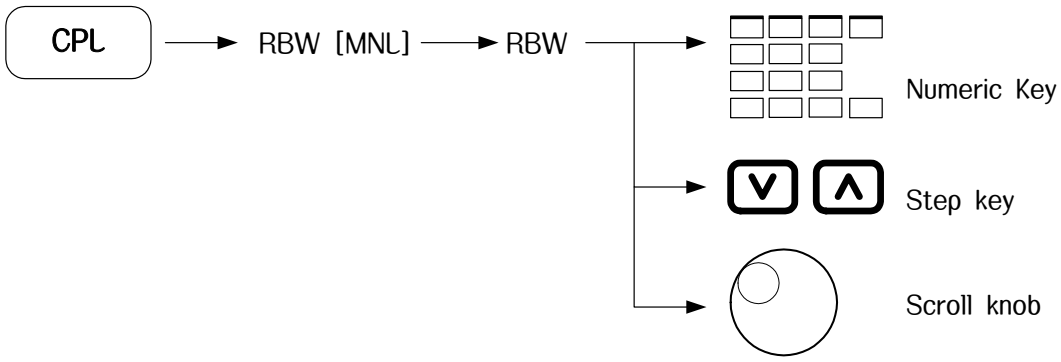
The RBW, Sweep Time, and VBW parameters are to Auto so that even if the frequency span is varied, the respective parameters are automatically set to the optimum values so frequency and level measurement errors do not occur.

The following table shows the RBW, VBW, and sweep time for various span ranges.

Frequency Span	RBW	VBW	SWEEP TIME
100 Hz ~ 9.9 kHz	300 Hz	300 Hz	The sweep time is calculated using the Span, RBW, VBW values to option the lowest sweep time while maintaining accuracy.
10 kHz ~ 99.9 kHz	1 kHz	1 kHz	
100 kHz ~ 299.9 kHz	3 kHz	3 kHz	
300 kHz ~ 1.99 MHz	10 kHz	10 kHz	
2 MHz ~ 5.99 MHz	30 kHz	30 kHz	
6 MHz ~ 19.99 MHz	100 kHz	100 kHz	
20 MHz ~ 59.99 MHz	300 kHz	300 kHz	
60 MHz ~ 199.99 MHz	1 MHz	1 MHz	
200 MHz ~ < 1.5 GHz	3 MHz	1 MHz	

(2) Manual Mode

In order to set RBW in the manual mode, perform the following key operations :



If VBW is AUTO the value is varied defend on the value of RBW. But the RBW value was not varied even changed the value of VBW.

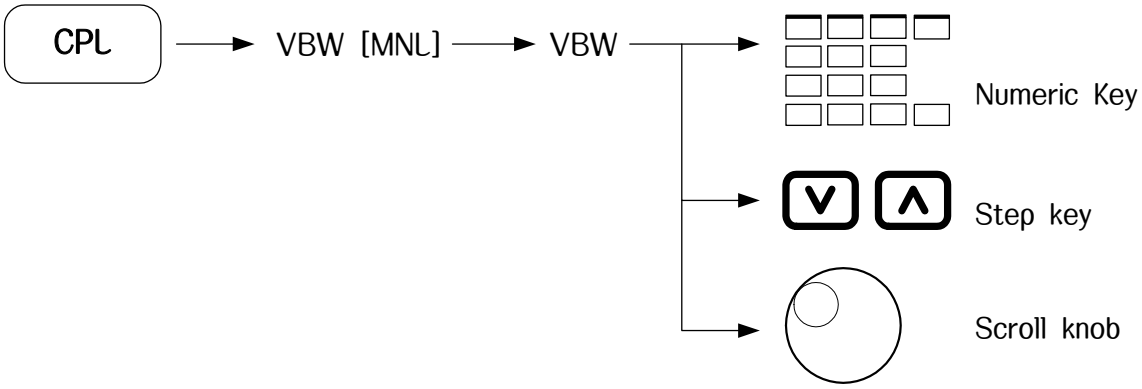
Setting the Video Bandwidth(VBW)

(1) Auto Mode

When VBW is set to AUTO, the VBW is set according to the RBW value.

(2) Manual Mode

To set the VBW, perform the following key operations :



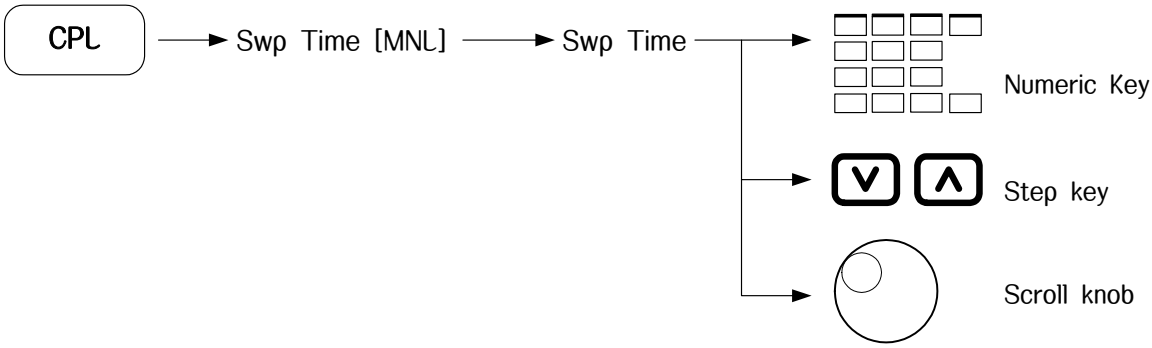
When wanting to average the noise by making the VBW narrow without regard to RBW set value, or when wanting to make the VBW wide to observe the waveform of signals modulated at a high frequency, use MANUAL setting. The VBW value can be manually set be one of following values.

[10 Hz, 30 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, NONE(3 MHz)]

NOTE : When VBW ≥ RBW is set, noise is not averaged and the sweep speed is increased.

Selecting Sweep Time

To set the sweep time, perform the following key operations :



The following shows the Auto Sweep Time Range :

- Not the Zero Span : 20 ms ~ 1000 sec
- Zero Span : 25, 50, 100, 200, 500 us, 1, 2, 5 ms ~ 15 sec

Input Attenuator

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

AMPL → Atten. [AUTO / MNL]

1) Auto Mode

When a signal is input with the same level as the reference level, the input attenuator value in the AUTO mode is controlled so that high accuracy measurements can be made without being influenced by gain compression and the noise level can be reduced.

While Auto is selected, the input attenuator is Automatically set to optimum value according to the reference level.

Reference Level Range	Attenuation Auto
+30 dBm to +20.1 dBm	40
+20 dBm to +10.1 dBm	30
+10 dBm to +0.1 dBm	20
0 dBm to -9.9 dBm	10
Less than -10 dBm	0

2) Manual Setting

However, when you want to measure a low level signal by raising the sensitivity, set the input attenuator manually as shown in the table below :

Reference Level Range	Attenuation Auto
+30 dBm to –60 dBm	50
+30 dBm to –70 dBm	40 ~ 50
+20 dBm to –80 dBm	30 ~ 50
+10 dBm to –90 dBm	20 ~ 50
0 dBm to –100 dBm	10 ~ 50
-10 dBm to –110 dBm	0 ~ 50

A small input attenuator value can be used when the RF input level is –10dBm or less.

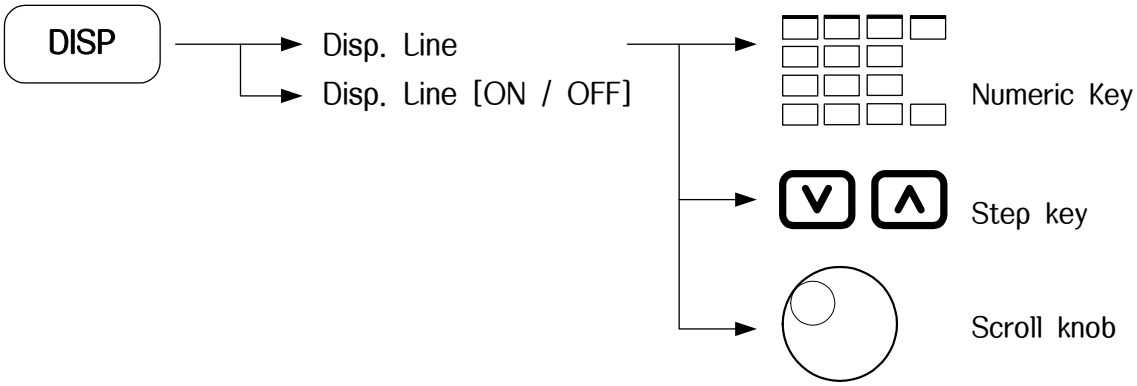
DISPLAY FUNCTIONS

The equipment provides functions related to the screen display, such as Display line, Threshold line, Screen Title, Annotation and Graticule.

- Display Line : Displays the horizontal line top of the graticule.
- Threshold Line : Displays the horizontal line top of the graticule.
- Screen Title : Edit the title of screen on the top of the screen.
- Graticule : Displays the horizontal line top of the screen.
- Annotation : Displays the state of waveform in the annotation window.
- White Mode : Economy mode for screen save and printing.

Display Line

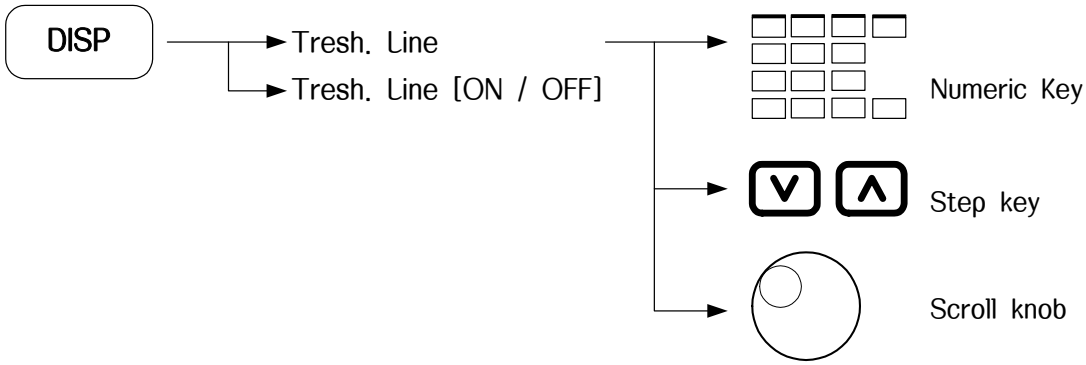
The Display Line is a horizontal cursor line that runs across the screen for making level comparisons. It can be set between the reference level and the lowest level with the numeric key or step key or scroll knob.
In the OFF setting, the display line disappears from the screen.



The step size of the step up down key is 1 division of the vertical range.
The step size of the scroll knob is 0.1 dB.

Threshold Line

The Threshold Line is a horizontal line such that the waveform is displayed above the threshold line. It can be set between the reference level and the lowest level with the numeric keys or step keys or scroll knob. In the OFF setting, the threshold line disappears from the screen.



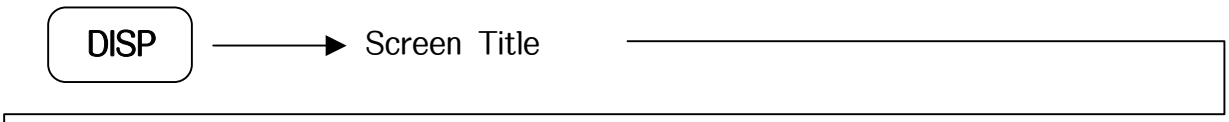
The step size of the step up down keys is 1 division of the vertical range.
The step size of the scroll knob is 0.1 dB.

Screen Title

A title of display spectrum or waveform can be labeled with this function.
The input screen title can be used for a printer and file function. (ref : Filename 5-54)
To make or edit the screen title, perform the following key operations :
When *Screen Title..* menu is pressed, enter the Edit mode and changed in screen title area, also edit menu appeared in soft menu area. In Edit mode all hard key will suspended. Edit menu helps to edit the screen title.

Scroll knob or number key will clear the old screen title. If you do not clear the old title but only edit, first you should press step key. Move cursor to edit position.

Scroll knob is used for selecting the character for input. The character bar appears in Status Window in a lower part of screen and scrolled by scroll knob.



- Sel. Char : Put the selected character to current cursor position. Before this, select the desired character with the scroll knob. When press the number keys this sequence was performed automatically.
- Back Space : Erase a character before the cursor
- Delete : Erase a character on the cursor.
- Clear : Clear the edit string.
- Insert Sw : Select the editing cursor mode between Insert(Insert) or Overwrite(Overwt).
- Enter.. : Ends edit mode and save current edited string. Returns to the previous menu.
- Undo.. : Ignore the current edited string and return to the previous menu.

Graticule

This menu toggles the graticule ON or OFF.
To delete the graticule on the screen, perform the following key operations :

DISP → More.. → Graticule [OFF / ON]

Annotation

This key annotation toggles ON or OFF.
To delete the annotations on the screen, perform the following key operations :

DISP → More.. → Annotation [OFF / ON]

White Mode

Change the screen background color for saving the ink or tonor.

DISP → More.. → White Mode [OFF / ON]

TRACE FUNCTIONS

The [TRACE] key is the header key for the trace function.

Select Trace

The analyzer provides two Trace Memories, A and B.
The active trace memory is selected by the following key operations :

TRACE ⟶ Select [B / A]

Clr & Wrt

The current trace memory is A. The data will be cleared and written by the new data at the trace memory by pressing the key.

TRACE ⟶ Clr & Wrt
>> [A] <<

>> << Marker indicate current trace state

If trace B is the same state then trace A was displayed and trace B was disabled. WADB was displayed in Annotation Window. (ref : Annotation Window 5-6)

Max Hold

On each sweep, the new data for each horizontal point is compared with previous data.
The equipment stores and displays the level with the larger value.
Thus the display accumulates the maximum values for each point.

TRACE ⟶ Max Hold >> [A] <<

MA was displayed in Annotation Window.

Min Hold

On each sweep, the new data of each horizontal point is compared with previous data. The equipment stores and displays the level with the smaller value.
Thus the display accumulates the minimum values for each point.

TRACE ⟶ Min Hold >> [A] <<

mA was displayed in Annotation Window.

View

When this key is pressed, the Trace leaves the normal write mode.
The equipment displays the contents of the selected trace memory at that time.
To return to the normal write mode, push CLR & WRT again.

TRACE ⟶ View >> [A] <<

VA was displayed in Annotation Window.

Blank

When this key is pressed, trace data is erased from the screen, but the content of the memory still remain.
The trace can be redisplayed by selecting VIEW function.

TRACE ⟶ Blank >> [A] <<

BA was displayed in Annotation Window.

Averaging Function

The digital averaging function calculates the average data at each vertical axis point for each sweep and displays the results.
The averaging function improves the S/N ratio depending on the averaging rate and the number of sweep repetitions. To use the averaging function, perform the following key operations :

TRACE → More.. → Average..

- → Average [ON / OFF] : This toggles average function ON or OFF.
- → Count [n] : Sets the Averaging Rate. The range is 2 to 999. This value can be input using DATA ENTRY. Default value is 20.
- → Cycle [ON / OFF] : Set the averaging NON STOP/STOP after the number of times of averaging rate by pressing this key.
- → Stop : Temporarily stop average-sweeping.
- → Continuous : Resumes the average-sweeping.
- → Reset : Initialize the average data and restarts the average function.
- → Prev.. : Returns to the previous menu.

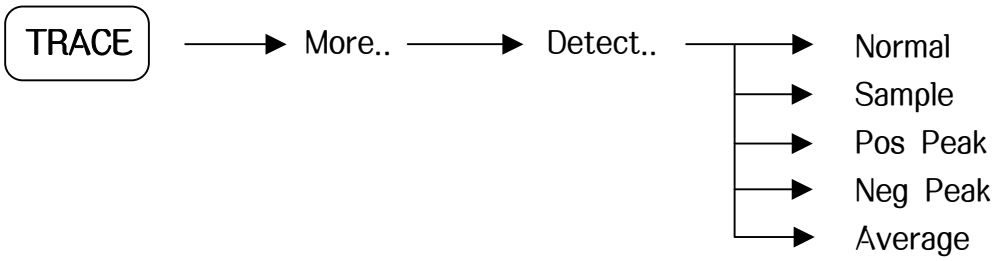
Averaging by video filter has the disadvantage that the sweep time becomes longer when the video bandwidth is narrowed to improve the averaging effect.
On the other and, digital video averaging smoothes the trace display by averaging the digital data after analog to digital conversion at each sweep, without narrowing the video bandwidth (VBW). Since the video bandwidth (VBW) gets comparatively wider and the time required for each sweep can be shortened, the entire spectrum image can be verified quickly and a repetitive sweep can be stopped when the required smoothing has been obtained.

Detection Mode

The equipment Provides the following five detection modes.

- Normal
- Sample
- Pos Peak
- Neg Peak
- Average

Select the detection mode by performing the following key operation :



The equipment uses the oversampling method to acquire video data.

Mode	Contents
Normal	The vertical line of odd number horizontal position displays the maximum value among oversampling data for 1 display point and even number horizontal position displays the minimum value. So in the Normal detection mode, the trace do not trace in the next sweep time, toggling odd and even horizontal maximum or minimum detecting value.
Sample	Stores the instantaneous signal level at each sample point the trace memory. The Sample detection mode is primarily used for noise level measurement, and time domain measurement.
Pos Peak	Compare the maximum level point present between the current display point and next display point, then stores the maximum value in the trace memory corresponding to the current display point.
Neg Peak	Compares the minimum level point present between the current display point and next display point, then stores the minimum value in the trace memory corresponding to the current display out. The Neg Peak detection mode is often used to measure the lower envelope side of a modulated waveform.
Average	reduce the random noise level without reducing the video filter or using the trace average function. This allows averaged displays with faster sweep rates. The Average detection mode stores the average data between Pos Peak and Neg Peak.

Mathematics Mode

To use the trace computation, perform the following key operation :
Display the computation and moving soft menu.

TRACE → More.. → Math..

A-B → A	:	The result A memory contents become the difference between the original A memory, or the sweep data, and the B memory. That is, if Trace A is in the VIEW or BLANK mode, the difference is taken between the A and B memories, and the result stored in A. But if Trace A is in the CLR & WRT mode, it subtracts the B memory data from the current sweep result and save the result in A.
B-DL → B	:	When Trace B is in the VIEW or BLANK mode, it subtracts the Display Line from the B memory data, and saves the result in B. But when Trace B is in the CLR & WRT mode, it subtracts the Display line from the current sweep result, and saves the result in B.
A+B → A	:	Adds Trace A and Trace B, displays the result as Trace A.
A-B+DL → A	:	Turns on the mode that subtracts Trace B from Trace A, adds the Display Line and displays it on Trace A.
A EXCH B	:	Exchanges the contents of Trace A memory and Trace B memory.
Math [OFF/ON]	:	Adopt or not the selected math function.
Prev..	:	Returns to the previous menu.

SAVE AND FILE FUNCTIONS

The equipment can save the setup conditions(Parameter), limit data and waveform data (Trace) to an internal Memory or FDD. This data can be recalled and used.
Screen image also saved as bitmap format, but do not recall it.

Internal Memory

The internal Memory uses Flash Disk in the equipment
The internal Memory can save the following data and waveform. (ref : File type 5-53)

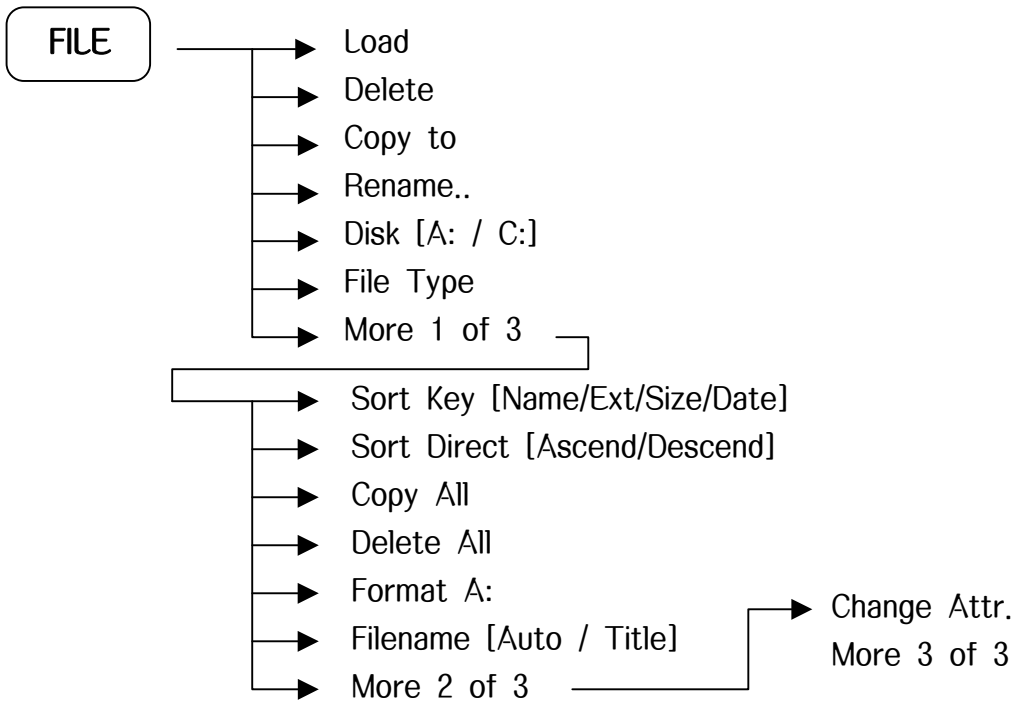
Save Parameters and Waveform

The SAVE key is the header key for saving parameters and waveforms.
To save the current parameters, waveform data and title to the internal Memory or FDD, press SAVE only.

The file type and destination is configured on the FILE Menu. (ref : File Type 5-53) It has two filename generate method, one is Auto generate method, it generate as FILE0000.ext to FILE9999.ext. another is screen title method, it generate filename as the same screen title. (ref : Filename 5-54) But default screen title(********) is not used as filename. It needs convert to.

File Management

FILE key will display file directory window. To move the selection use scroll knob or step key. Other Hard key or *Load* menu will close the window.
Perform the following key operations for accessing File Menu.



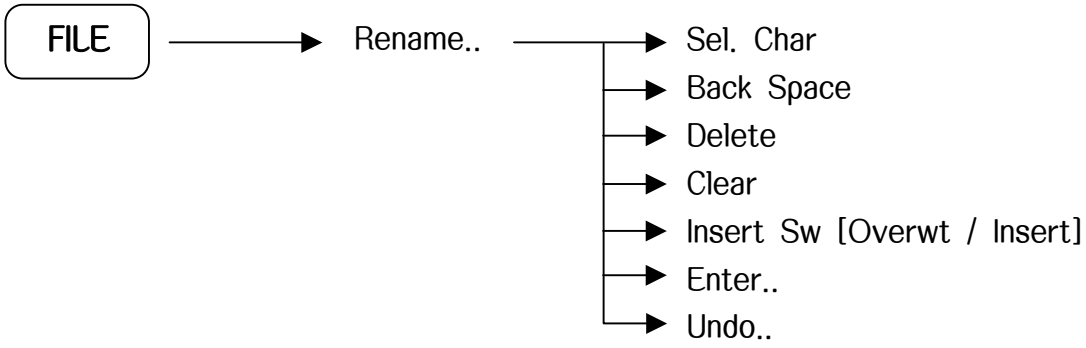
Load : Accesses menu keys that allow you to load analyzer setups, states, traces limits and corrections into the analyzer from a floppy [A:] Drive or internal flash [C:] Driver. To load a file, just press load.

Delete : Access menu keys that allow you to delete analyzer setups, states, traces and others.

Copy to : Access menu keys that allow you to copy the selected file from A: to C: or from C: to A:.

Disk [A:/C:] : Select Disk drive. File directory of this drive will be displayed. It is also the destination drive of SAVE.

Rename : Access menu keys that allow you to rename the file name.
For renaming the file, press this key.



Rename.. menu will change the color of the selected filename, enter the edit mode, other all hard key will suspended. (ref. for edit filename : Screen Title 5-44)
If you want only edit a part of filename, press step key first for move cursor to modify point. Other key operation will clear the old filename.
Enter.. key will save the current modified string to filename and exit this edit mode.
Undo.. key will exit this edit mode without saving.

File Type : Select the file type for display in file directory window. Also the file type for saving when press the [SAVE] key.

File Type	Extention	Comments
All	*	All Files
State	STS	System status file
Trace	TRC	Trace data file
Limit	LMT	Limit data file
Bitmap	BMP	Screen image file
JPEG	JPG	Screen image file
DTF_DB	DBS	DTF(option) database file
DTFCal	CAL	DTF(option) calibration data file
EmcLimit	LIM	EMC(option) Limit data file
EmcAnt	ANT	EMC(option) antenna data file
EmcCable	CBL	EMC(option) cable data file
EmcXduce	XDU	EMC(option) transduce data file

EmcOther	OTH	EMC(option) user defiled data file
DTFDcf	DCF	DTF(option) configuration file
DTFDct	DCT	DTF(option) configuration and trace data file

Sort Key : Select the sorting field in directory. The kind of filed are filename, extention, size, date. Select field in turn by press *Sort Key*.

Sort Direct : Choose the direction of sorting.
By press *Sort Direct* soft key, select ascend or descend.

Copy All : Copy all the current files in directory to other disk.
Current is A: then to C:, Current is C: then to A:.

Delete All : Delete all the files in current directory.

Format A: : Format A: drive.

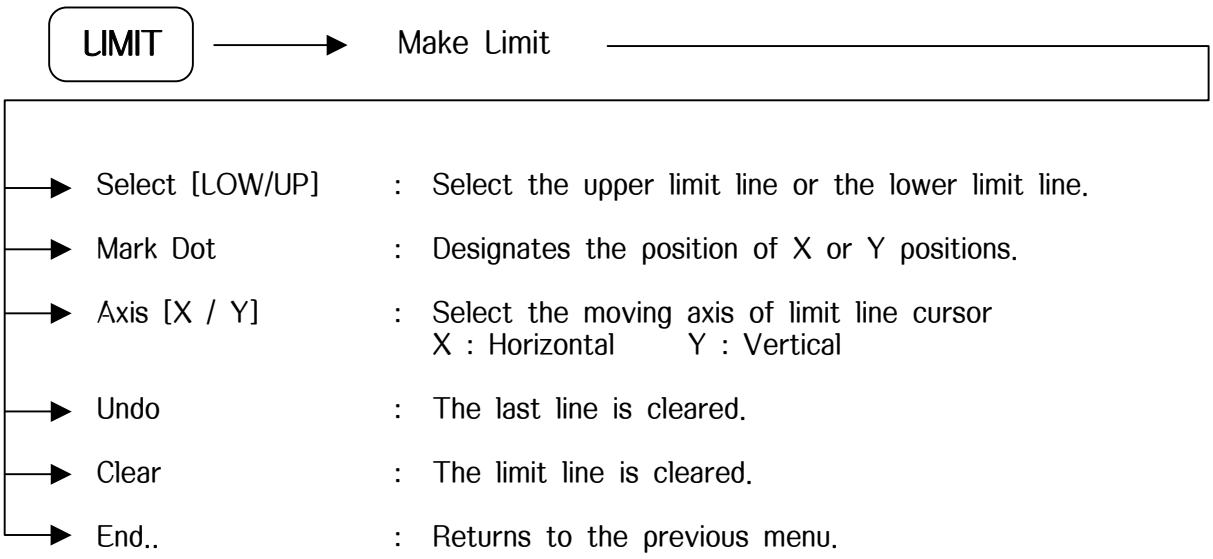
Filename : Select filename create mode. In Auto mode, filename was generate sequentially from FILE0000 to FILE9999, anywhere in A: or C:.
In Title mode, filename is screen title. Screen title should be user defined. Default(********) screen title not be used.

LIMIT LINE FUNCTIONS

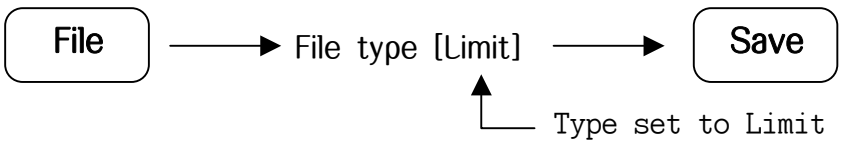
The [LIMIT] key is the header key for using the limit line function
The LIMIT LINE FUNCTION displays two lines which can be set to show permissible upper and lower bounds on the spectral waveform.
Comparison of measured data with the limit lines is very easy.

● EDIT Limit Line

1) Make Limit.. : appear limit line edit menu.
2) Select [LOW/UP] : select limit line to edit. The limit line cursor (◇) is displayed.
3) Axis [X/Y] : select the coordinates for moving cursor.
4) Scroll knob, step key : move cursor.
5) Mark Dot : saving the position of cursor.
6) Repeat 3), to 5) for making the limit line.
In editing *Undo* menu delete the current cursor position.



For saving the Limit Line follow the here key operation :



- **Set the PASS/FAIL mode**

When the spectral waveform is within the upper limit line and lower limit, PASS is displayed on the screen. If not, FAIL is displayed on the screen.

LIMIT ⟶ UpPassChk [OFF / ON]

When ON is selected, the upper limit line is checked.

LIMIT ⟶ LowPassChk [OFF / ON]

When ON is selected, the lower limit line is checked.

- **Close the Limit Line Function**

LIMIT ⟶ Clear Limit

When this key is selected, clear the limit line function.

SYSTEM CONFIGURATION

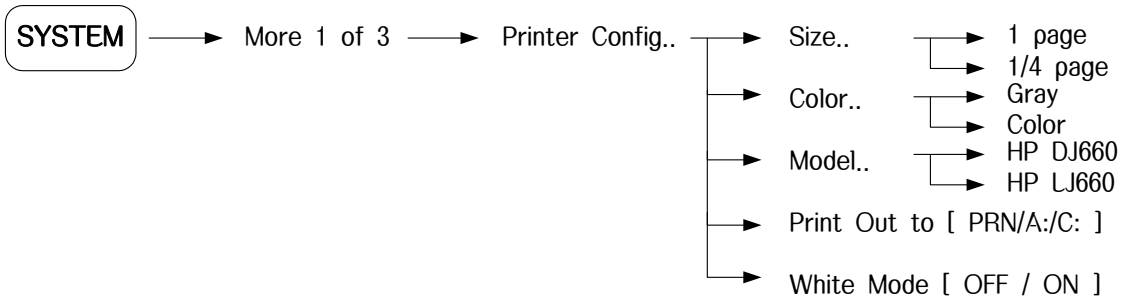
The system parameters of the equipment can be set depending on the used objective.

The [SYSTEM] hard key is the header key related to set system configuration.

The equipment supports the SA mode (Spectrum Analyzer) and CDMA, EMC, DTF, CDMA Source and CATV mode. The SA mode is default and other is for optional.

Printer Configuration

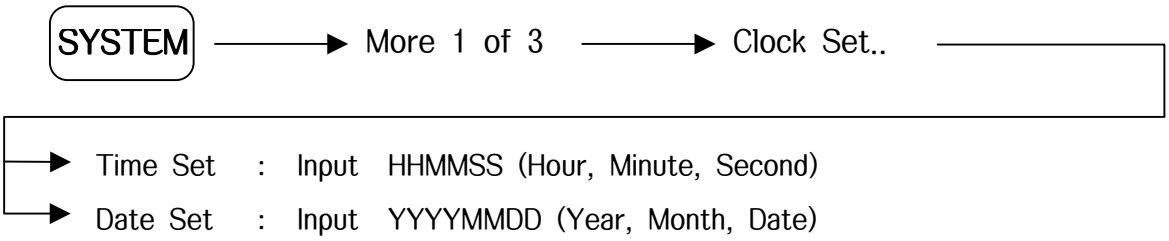
This key is used for setting the printe type.
In order to set the configure of printer, perform the following key operations.



Print Out to menu select the output destination when [PRINT] key was pressed.
In White Mode is ON, save ink or toner by changing background color to White.
Ex.) Two way of saving screen image to bitmap was, the one is press [SAVE] key after set the file type to Bitmap,([FILE], *File Type* (4 times or more)) the other is press [PRINT] key after set the *Print Out to* to A: or C:.

Clock Set

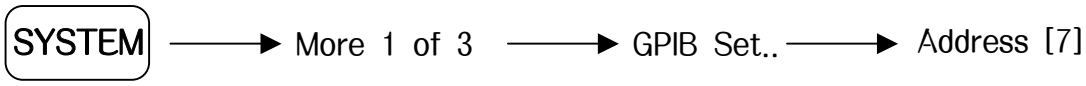
Set the date and time by performing the following key operations :



Use numeric key and ENTER key

GPIB Address Set

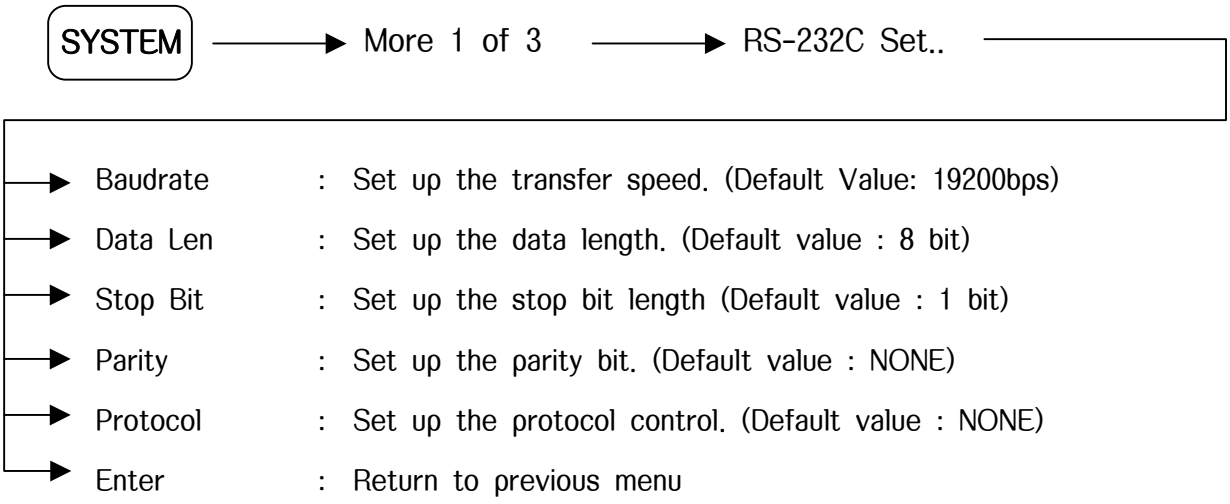
Set the GPIB address by performing the following key operations :



Range : 1 ~ 30
Default : 7

RS-232C Configuration

The system can be remotely controlled using an RS-232C interface.
To set up RS-232C protocol, perform the following key operations :



System Information

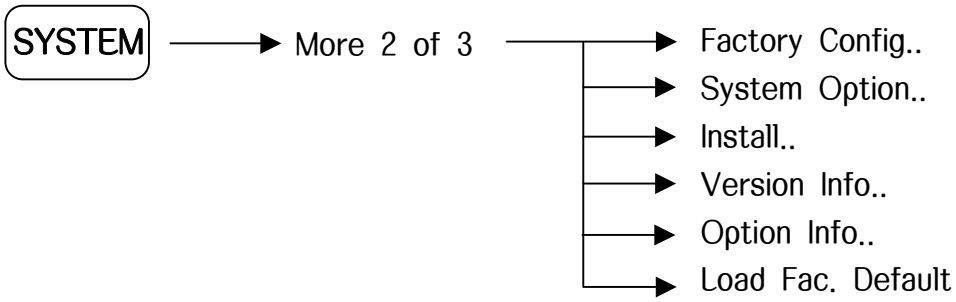
These key functions are for special functions.

Install.. : for system software upgrade.

Version Info.. : shows the current software version information.

Option Info.. : shows the current installed option information.

Load Fac. Default : set the system to default configuration of shipment.



PRESET FUNCTION

The preset key is the header key for the preset and calibration functions.
When the [PRESET] key is pressed, the following soft menus are displayed.

- Preset
- Last State
- Alignment Mode
- Power on [Prest / Last]
- Cal Signal [OFF / ON]
- Auto Align [OFF / ON]

Preset

Pushing the preset key returns all of the analyzer parameter to the following values.

PRESET ⟶ Preset

- **Factory Initial Set up**

Center Frequency	: 1.5 ㎓
Frequency Span	: 3.0 ㎓
Reference Level	: 0 dBm
Detector	: LOG
Scale	: 10 dB/DIV
Sweep Time	: 20 msec, AUTO mode
RBW	: 3 ㎒, AUTO mode
VBW	: 1 ㎒, AUTO mode
ATTEN	: 10 dB, AUTO mode
Trigger	: Free Run
Marker	: OFF
Display Line	: OFF
Threshold Line	: OFF
Trace Detector Mode	: Pos Peak

Last State

Pressing the Last State key returns all of the analyzer parameters back to the last state values that was the status of before system power off.

PRESET → Last State

Alignment Mode

When the Alignment Mode is pressed, a soft menu related to the calibration routines are displayed.
Each calibration menu performs the hardware compensation routine to verify the equipment operates precisely regardless of any hardware drift.

PRESET → Alignment Mode..

- All Align : Do the following all alignment mode.
- Yig. Align : Recalibrates the YIG tuning curve values.
- Span Align : Compensates the SPAN attenuator error and the sweep gain and calculates new correction factors.
- Level Align : Compensates the system gain error and calculates new correction factors.
- Log Align : Compensates the logarithmic amplifier for drift and calculates a new correction factors.
- RBW Align : Compensates the RBW center frequency for drift and gain error and calculates new correction factors.

Power ON

This function set the condition of power on state.
When Preset was selected, the power on state is the same as preset state.
When Last was selected, the power on state is the set to recent state that was the status of before system power off.

PRESET ⟶ Power On [Prest / Last]

Cal Signal

When the Cal Signal is on, the calibration signal is displayed.
The calibration signal is 40 ㎒, -30dBm.
This function is very useful for system self check.

PRESET ⟶ Cal. Signal [OFF / ON]

Auto Align

When the Auto Align is on, the calibration routine automatically operates when a temperature calibration is required.
This function does not operate when the Auto Align is off.

PRESET ⟶ Auto Align [OFF / ON]

AUX FUCNTIONS

The equipment provides analog demodulation and audio monitor functions.

- AM Demodulation
- FM Demodulation
- Audio ON/OFF, Audio level control, Squelch level control, Temperature monitor.

AM Demodulation

The AM demodulation function displays the amplitude demodulated waveform.
By pressing this key, the horizontal axis changes to the time axis.
The carrier frequency is the center frequency.
To use AM demodulation function, perform the following key operations :

AUX ⟶ AM Demod. [ON / OFF]

This key toggles AM demodulation ON and OFF.

FM Demodulation

The FM demodulation function displays the frequency demodulated waveform.
By pressing this key, the horizontal axis changes to the time axis.
The carrier frequency is the center frequency.
To use FM demodulation function, perform the following key operations :

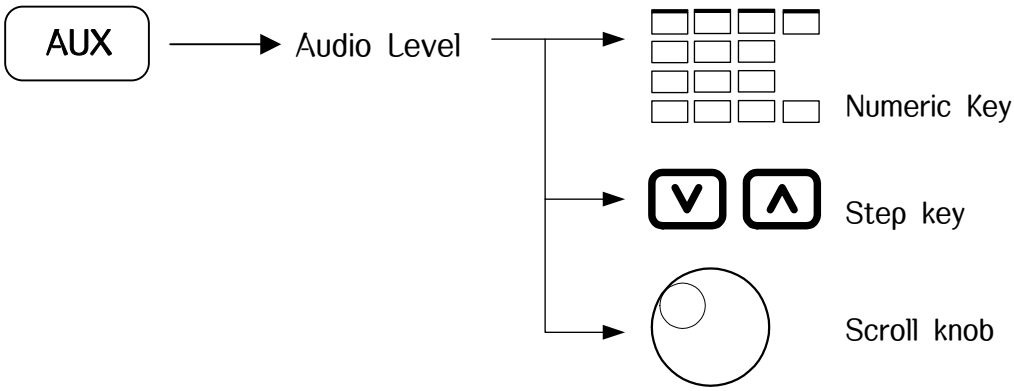
AUX ⟶ FM Demod. [ON / OFF]

Audio Monitor

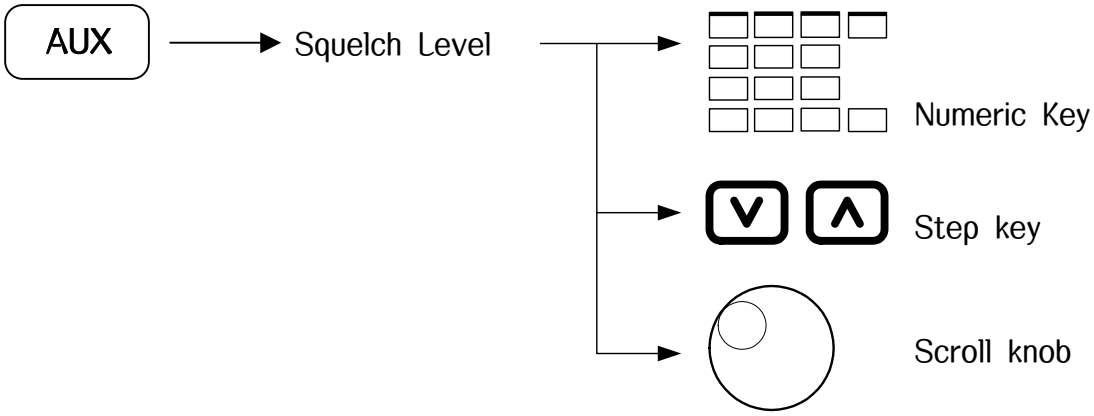
The equipment has an internal speaker and phone jack at the front panel.

Audio Sound : used to turn ON the internal speaker.

Audio Level : used to control the audio level which can be adjusted by DATA ENTRY. The audio level has 8 steps (0~7). The default value is 3.



Squelch Lev : used for the squelch function. It has 256 levels which can be adjusted by DATA ENTRY. The default value is 127.



Temperature Monitor

The equipment has an internal temperature sensor. *Disp. Temp* menu enables the system to display the current internal temperature periodically.

AUX ⟶ Disp. Temp [ON / OFF]

TRACKING GENERATOR (option)

The equipment has an optional Tracking Generator.
To set up the Tracking Generator, perform the following key operation :

TG

- Tracker [OFF / ON] : The Tracker ON/OFF is used to turn ON the Tracking Generator.
- Output Level [*value*] : The Output Level is used to control the power level, which can adjusted by DATA ENTRY. The power level is adjustable 0 to –70dBm in 0.1dB step.
- Normal [OFF / ON] : Using the normalization function allows the user to compensate for hardware uncertainties, therefore making the measurement of the unit under test more accurate.
- Pwr Swp [OFF / ON] : This key is used for Power Sweep for Tracking Generator. Output Level of Tracking Generator can be Increased Automatically in 10 dB Range.
- Automatic Freq. Cal. : The *Automatic Freq. Cal.* Menu is used to compensate the center frequency of TG for the center frequency of system automatically.
- Manual Freq. Cal. : The *Manual Freq. Cal.* Menu is used to compensate the center frequency of TG for the center frequency of system by DATA ENTRY. The range is -500 ㎑ to 500 ㎑.

Normal menu is used for more convenient measurement by normalize unloaded output signal. After this operation the output signal is granted as characteristic of DUT in span frequency area.

Pwr Swp is used for measuring the characteristic of amplitude gain in fixed frequency. Set the target frequency o center frequency and Pwr Swp ON then enter zero span mode and amplitude increased within 10 dBm in the specified range. For example amplitude of center frequency is –33 dBm this start frequency ampltude is –40 dBm stop frequency amplitude is –30 dBm.

SECTION 6
PERFORMANCE TESTS

In this section, measuring instruments along with setup and operation procedures necessary for conduction performance tests described.

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SECTION 6
PERFORMANCE TESTS

REQUIREMENT FOR PERFORMANCE TESTS

Performance tests are used as preventive maintenance to prevent degradation of the equipment performance before it occurs. Use the performance tests whenever necessary such as at acceptance and periodic inspection to verify performance after repair.

- Reference oscillator frequency stability
- Center frequency readout accuracy
- Frequency span readout accuracy
- Resolution bandwidth and selectivity and switching error
- Sideband noise (phase noise)
- Frequency measurement accuracy
- Amplitude display linearity
- Frequency response
- Reference level accuracy
- Average noise level
- Second harmonic distortion
- Input attenuator switching error
- Residual FM
- 3rd Order Intermodulation
- Spurious Response
- Local oscillator Emission
- Input VSWR

Execute the performance tests at regular intervals as preventive maintenance for important evaluation items. We recommend that the performance be inspected regularly once or twice a year. If the specifications are not met at the performance test, please contact IFR.

INSTRUMENTS REQUIRED FOR PERFORMANCE TEST

Recommended Instrument (Model number)	Required Performance		Test Item
	Item	Specification	
Synthesized Signal Generator (MG3633A) (HP8648C)	Frequency Range Resolution Output Level Range Output Level resolution SSB Phase noise Second Harmonic Amplitude Modulation External reference Input	10 ㎑~3.0 ㎓ 1 ㎐ -20dBm ~ 0dBm 0.1dB ≤130dBc/㎐ (at 10 ㎑ offset) ≤30dBc 0% ~ 100% 0.1 ~ 400 ㎐ 10 ㎒	Frequency-span readout accuracy Resolution Bandwidth, selectivity Sideband noise Frequency measurement accuracy Amplitude display linearity Frequency response Reference level accuracy Second harmonic distortion Resolution bandwidth switching error Input Attenator switching error 3rd Order Intermodulation
Attenuator (1=HP8494) (2=HP8496)	Frequency Range Attenuation Repeatability Frequency Range Attenuation Repeatability	DC ~ 26.5 ㎓ 0 ~ 11dB (1 step) ≤0.01dB (≤0.05dB, 18 ~ 26.5 ㎓) DC ~ 26.5 ㎓ 0 ~ 110dB (10 step) ≤0.01dB (≤0.05dB. 18 ~ 26.5 ㎓)	Amplitude display linearity Input attenuator switching error 3rd Order Intermodulation
Power Meter (HP437B)	Frequency range Measure Range Power resolution	100 ㎑ ~ 110 ㎓ -70dBm ~ 44dBm 0.001dB	Amplitude display linearity Frequency response Reference level accuracy Second harmonic distortion 3rd Order Intermodulation
Power Sensor (HP8481A)	Frequency range VSWR (max) Power range	10 ㎒ ~ 18 ㎓ 1.4 (10 ㎒ ~ 30 ㎒) 1.18 (30 ㎒ ~ 50 ㎒) 1.0 (50 ㎒ ~ 2 ㎓) 1.18 (2 ㎓ ~ 12.4 ㎓) 1.28 (12.4 ㎓~18 ㎓) -30dBm ~ +20dBm	Amplitude display linearity Frequency response Reference level accuracy Input attenuator switching error Second harmonic distortion 3rd Order Intermodulation

Recommended Instrument (Model number)	Required Performance		Test Item
	Item	Specification	
Power Sensor (HP8481D)	Frequency range VSWR (max) Power range	10 MHz ~ 18 GHz 1.4 (10 MHz ~ 30 MHz) 1.15 (30 MHz ~ 4 GHz) 1.2 (4 GHz ~ 10 GHz) 1.3 (10 GHz ~ 15 GHz) 2.35 (15 GHz ~ 18 GHz) -70dBm ~ -20dBm	Amplitude display linearity
Power Splitter (HP11636A)	Frequency range Input / Output Impedance	DC ~ 18 GHz 50Ω	Frequency-span readout accuracy Frequency measurement accuracy Amplitude display linearity Frequency response Reference level accuracy Second harmonic distortion 3rd Order Intermodulation
50ohm Termination (HP 909F)	Frequency Range VSWR	DC ~ 6 GHz (~ 18 GHz) 1.005 (DC ~ 5 GHz) 1.01 (5 ~ 6 GHz) 1.15 (6 ~ 18 GHz)	Average noise level Spurious Response
Frequency Counter (HP 5350B)	Frequency range Resolution 1 Hz ~ 1 MHz 1 Hz 0.1 Hz 0.01 Hz 0.001 Hz Input level (max) Damage level	10 Hz ~ 20 GHz 10 MHz ~ 20 GHz 10 MHz ~ 80 GHz 1 MHz ~ 10 MHz 100 kHz ~ 1 MHz 10 Hz ~100 kHz +7dBm (N-type) +10dBm(BNC-type) [50Ω] 1Vrms (BNC-type) [1 MΩ] +25dBm (N-type) 250V (DC ~ 5 kHz) 5.5Vrms (+28dBm)	Reference oscillator frequency Stability Frequency-span readout accuracy Frequency measurement accuracy

Extracts part of performance which can cover the measurement range of the test item.

PERFORMANCE TEST

For test item other than oscillator frequency stability, warming-up the equipment for at least fifteen minutes and the performance after the equipment stabilizes completely.
Also begin measurements after taking the warm-up time of the calibration instrument into full consideration. In addition, the test should be conducted at room temperature little AC power supply voltage fluctuation, and should be free of noise, vibration, dust humidity, etc.

Reference Oscillator Frequency Stability

Frequency stability is tested by measuring the 10 ㎒ reference oscillator. Stability is determined by measuring frequency variation at ambient temperatures of 0℃ and 40℃.

1) Specification

■ Reference Oscillator

- o Frequency : 10 ㎒
- o Aging rate : $\leq \pm 1 \times 10^{-6}$ / year
  After 24 hour warm-up at 25℃ ± 5℃
- o Temperature stability : $\leq \pm 2 \times 10^{-6}$ at 0 and 40℃ referred to the frequency measured at 25℃

2) Test Instruments

- o Frequency counter : HP5350B
- o BNC Cable

3) Setup

Figure 6-1. Reference Oscillator Frequency Stability Test

4) Procedure

■ Temperature stability

Test condition : Test this performance in a vibration free variable temperature chamber.

Step	Procedure
1	Set up the equipment in a constant-temperature chamber at 25℃.
2	Set the Line and Power switches on the equipment to ON and wait until the equipment internal temperature stabilizes. (approx. 1.5 hours after the chamber temperature stabilizes).
3	When the internal temperature stabilizes, measure the frequency by using the counter with 0.1 ㎐ resolution.
4	Change the chamber temperature to 40℃.
5	When the chamber temperature and the equipment internal temperature stabilizes, measure the frequency be using the counter.
6	Calculate the stability by using the following equation.
7	Repeat 5. 6. Step in the 0℃ chamber temperature.

$$\text{Frequency Stability(40℃)} = \frac{\text{(counter reading at 40℃)-(counter reading at 25℃)}}{\text{(counter reading at 25℃)}}$$

$$\text{Frequency Stability(0℃)} = \frac{\text{(counter reading at 0℃)-(counter reading at 25℃)}}{\text{(counter reading at 25℃)}}$$

Center Frequency Readout Accuracy

Add the known frequency which serves as the center frequency reference to the equipment as shown in the figure below and set CF (same value the known center frequency) and SPAN. At this time, check that the difference between reading of the marker readout frequency of peak point, and the CF set value is meet the spec. As shown in the figure, the Synthesized Signal Generator uses the signal source phaselocked with the same accuracy as the 10 ㎒ reference oscillator of the Synthesized Signal Generator.

1) Specification

- Center frequency accuracy : ±(Indicated frequency × reference frequency accuracy + span × span accuracy + 0.5 × RBW) ; after calibration

2) Test Instruments

- Synthesized Signal Generator : MG3633A [Anritsu]
- Frequency Counter : HP5350B
- Power Splitter : HP11636A
- RF Cable 1,2,3 : N [male] ~ N [male]
- BNC Cable : BNC [male] ~ BNC [male]
- Adopter : T-BNC [female]

3) Setup

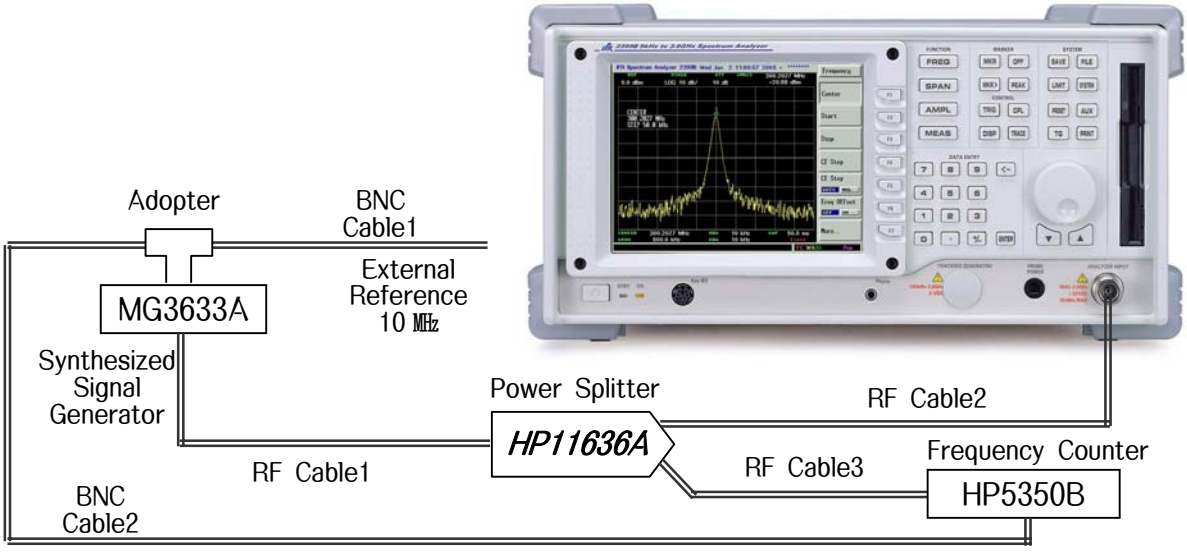


Figure 6-2. Center frequency readout accuracy

4) Procedure

Step	Procedure
1	Set the power supply switch on the equipment rear panel to ON and then the power switch on the equipment front panel to ON.
2	Press the [PRESET], *Preset* key.
3	Press *Alignment Mode..* and then *All Align* key.
4	Set the signal generator output frequency equal to the center frequency (1300 ㎒) in the following table : [Frequency] : 1300 ㎒ [Power] : -20dBm
5	Set the equipment as follows : [Center frequency] : 1300 ㎒ [Reference level] : 0dBm [Couple] : All Auto [Span] : 50 ㎑ [10 ㎒ REF] : EXT
6	Using the marker function, read the marker frequency and check that the value is within the range between the maximum and minimum values shown in the following table.
7	Repeat steps 4 to 7 for other combination of the center frequency and span according to the combination shown in the following table.
8	Calculate the Center Frequency accuracy by using the following equation. Center frequency accuracy = ±(Measured frequency × Reference Oscillator accuracy + Span × Span accuracy + 0.5 × RBW) ※ Reference Oscillator accuracy : ±2 ppm … (default option) ±0.2 ppm … (HSO option) ※ Span accuracy : ±3 %

Test Instrument frequency (MG3633A)	Equipment		Measured frequency (㎒)			
	Span	Center Frequency	Minimum*	Measured	Maximum*	Accuracy
Frequency : 1300 ㎒ Output Power Level : -20 dBm	50 ㎑	1300 ㎒	1299.9954		1300.0046	
	200 ㎑		1299.9899		1300.0101	
	1 ㎒		1299.9624		1300.0376	
	2 ㎒		1299.9224		1300.0776	
	5 ㎒		1299.8324		1300.1676	
	10 ㎒		1299.6474		1300.3526	
	20 ㎒		1299.2474		1300.7526	
	50 ㎒		1298.3474		1301.6526	
	100 ㎒		4296.4974		1303.5026	
	500 ㎒		1268.4974		1331.5026	

Note : It's the value of default Reference Oscillator.

Frequency Span Readout Accuracy

Using the setup shown in the figure below, set the frequencies corresponding the 1st and 9th division from the left side of the screen scale with the Signal Generator. The frequency difference between the peak levels at the 1st and 9th division is equal to the frequency span × 0.8.

1) Specification
   - o Frequency span accuracy : ±3%

2) Test Instrument
   - o Synthesized Signal Generator : MG3633A [Anritsu]
   - o Frequency Counter : HP5350B
   - o Power Splitter : Hp11636A
   - o RF Cable 1,2,3 : N [male] ~ N [male]
   - o BNC Cable : BNC [male] ~ BNC [male]
   - o Adopter : T-BNC [female]

3) Setup

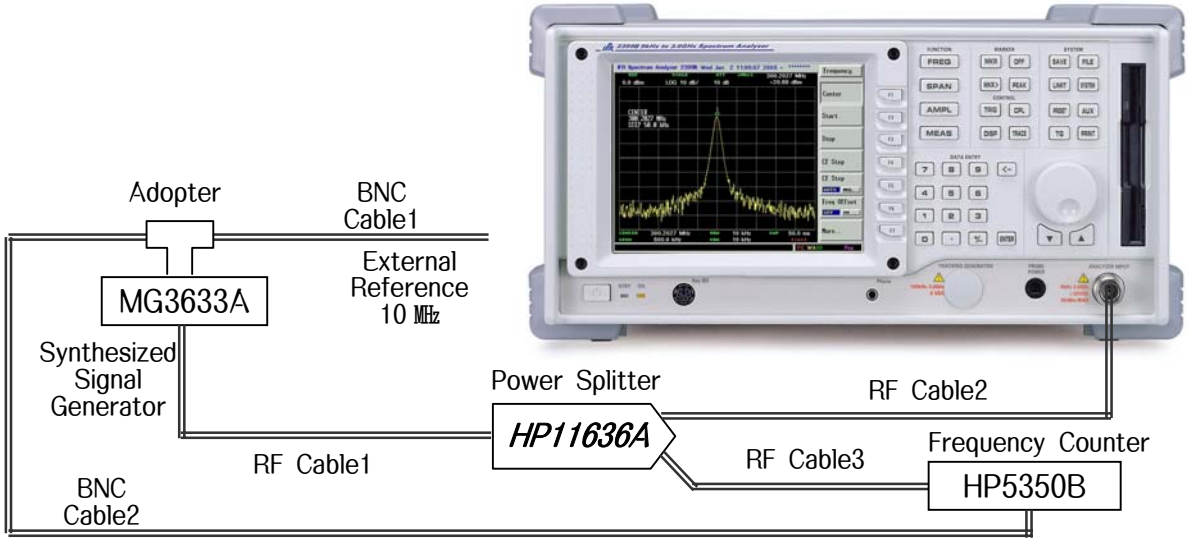


Figure 6-3. Frequency Span Readout Accuracy

4) Procedure

Step	Procedure
1	Set the power supply switch on the equipment rear panel to ON and then the power switch on the equipment front panel to ON.
2	Press the [PRESET], *Preset* key.
3	Press *Alignment Mode..* and then *All Align* key.
4	Set the signal generator output frequency equal to the center frequency in the following table : [Frequency] : 1500 ㎒ [Power] : -20dBm
5	Set the equipment as follows : [Center frequency] : 1500 ㎒ [Span] : 50 ㎑ [Couple] : All Auto [Reference level] : -10 dBm [10 ㎒ REF] : EXT
6	Adjust the MG3633A output frequency to set the signal peak at the 1st division from the left and of the screen scale. Record the frequency of F1.
7	After setting the MG3633A output frequency to the F2 frequency adjust it to set the signal peak at the 9th division. Record the frequency of F2.
8	Calculate (F2 ~ F1) / (Span × 0.8) and check the value is within the specified range shown in the table on the next page.
9	Repeat steps 5 through 10 for each frequency span with 1500 ㎒ center frequency range between the maximum and minimum values shown in the following table.
10	Calculate the Frequency Span accuracy by using the following equation :

$$\text{Frequency span accurcy} = \frac{[\text{Frequency (F2)} - \text{Frequency (F1)}] \times 100}{(\text{Span} \times 0.8)}$$

Equipment		Signal Generator (㎒)		Specification (±3 %)		
Center Frequency	Span	F2	F1	Minimum Span	Maximum Span	Accuracy
1500 ㎒	50 ㎑			48.5 ㎑	51.5 ㎑	
	200 ㎑			194 ㎑	206 ㎑	
	1 ㎒			970 ㎑	1.03 ㎒	
	2 ㎒			1.94 ㎒	2.06 ㎒	
	5 ㎒			4.85 ㎒	5.15 ㎒	
	10 ㎒			9.7 ㎒	10.3 ㎒	
	20 ㎒			19.4 ㎒	20.6 ㎒	
	50 ㎒			48.5 ㎒	51.5 ㎒	
	100 ㎒			97 ㎒	103 ㎒	
	200 ㎒			194 ㎒	206 ㎒	
	500 ㎒			485 ㎒	515 ㎒	
	1000 ㎒			970 ㎒	1030 ㎒	
	2000 ㎒			1940 ㎒	2060 ㎒	
	3000 ㎒			2910 ㎒	3090 ㎒	

Resolution Bandwidth(RBW) and Selectivity and Switching Error

Resolution Bandwidth(RBW)

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

RBW accuracy and selectivity

The accuracy is defined by the coincidence between setting of RBW and 3dB bandwidth of signal.

The selectivity is defined by the ratio of the filter width, in Hz, at the –60dB point, to the filter width, in Hz, at the –3dB point, as shown in the formula below.

To test the resolution bandwidth and selectivity, first measure the resolution bandwidth (3dB bandwidth), then the 60dB bandwidth and calculate the 60dB/3dB bandwidth ratio.

RBW switching error

The switching error is defined as the shift in amplitude when the RBW filter is switched.

1) Specification

- Accuracy
  ≤ ±20 % at 3 dB (300Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz)
  ≤ ±20 % at 6 dB (9 kHz, 120 kHz)
- Selectivity
  (60dB/3dB Bandwidth) : ≤ 15:1 (1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz)
  (60dB/6dB Bandwidth) : ≤ 12:1 (9 kHz, 120 kHz)
- Switching error : ≤ ±1.0 dB at RBW 3 kHz.

2) Test Instruments

- Synthesized Signal Generator : MG3633A [Anritsu]
- RF Cable : N[male] ~ N[male]
- BNC Cable

3) Setup

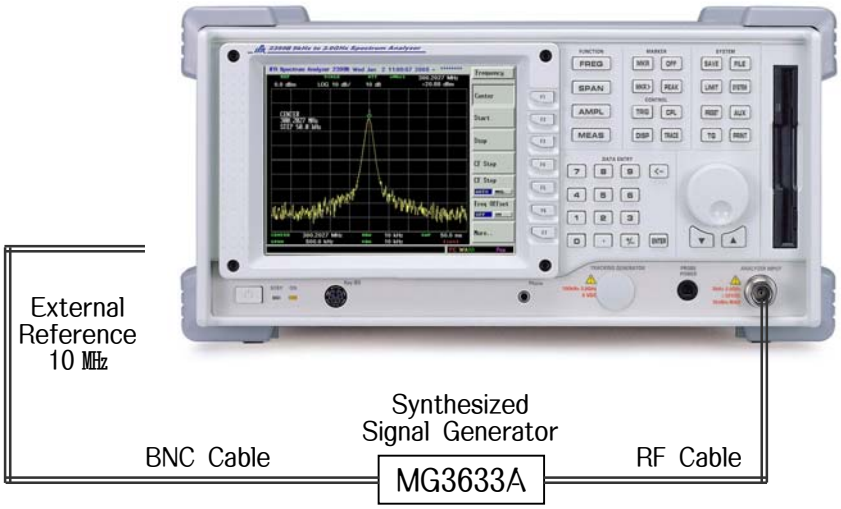


Figure 6-4. Resolution Bandwidth and Selectivity and Error

4) Procedure

○ RBW Accuracy

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* and then *All Align* key.
3	Set up the equipment as shown below :

Center frequency	: 501 ㎒
Span	: 10 ㎒
Reference level	: -19 dBm
RBW	: 3 ㎒
VBW	: 300 ㎑
Scale	: 1 dB/Div
Sweep time	: Auto
10 ㎒ REF	: EXT

4 Set the Synthesized signal generator (MG3633A) as shown below :

Frequency	: 501 ㎒
Power	: -20 dBm

5 Press [PEAK], [MKR>], [Mkr>Ref] key and match the peak of the signal trace to the top line Ref Level on the screen.

6 Press [TRIG], *Single* key to execute a single sweep, then check that the single sweep has been completed.

7 Press [MEAS], *X dB Down..*, *X[dB] Point [3.0]* softkey and then measured value.

8 Press [TRIG], *Continuous* softkey.

9 Repeat step 5 to 9 for the other resolution bandwidth according to the combinations of resolution bandwidth and frequency span shown in the follow table.

10 Calculate RBW filter accuracy :

$$\text{Accuracy} = \frac{(\text{RBW} - \text{Measured Value})}{\text{RBW}} \times 100\%$$

Equipment		Marker Δ3dB(6dB) bandwidth			Accuracy	Remark
RBW	Span	Minimum	Measure	Maximum		
1 kHz	2 kHz	800 Hz		1.2 kHz		
3 kHz	5 kHz	2.4 kHz		3.6 kHz		
9 kHz	20 kHz	7.2 kHz		10.8 kHz		(6 dB BW)
10 kHz	20 kHz	8.0 kHz		12.0 kHz		
30 kHz	50 kHz	24 kHz		36 kHz		
100 kHz	200 kHz	80 kHz		120 kHz		
120 kHz	200 kHz	96 kHz		144 kHz		(6 dB BW)
300 kHz	500 kHz	240 kHz		360 kHz		
1 MHz	2 MHz	800 kHz		1.2 kHz		
3 MHz	5 MHz	2.4 MHz		3.6 MHz		

○ RBW Selectivity

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkery and then *All Align* softkey.
3	Set the equipment as shown below : [Center frequency] : 501 ㎒ [Span] : 100 ㎒ [Reference level] : -10 dBm [ATT] : Auto [RBW] : 3 ㎒ [Scale] : 10 dB/Div [Sweep time] : Auto
4	Set the Synthesized signal generator (MG3633A) as shown below : [Frequency] : 501 ㎒ [Power] : -15 dBm
5	Press [PEAK], [MKR>], *Mkr>Ref* key and match the peak of the signal trace to the stop line Ref Level on the screen.
6	Press [TRIG], *Single* key to execute a signal sweep, then check that the single sweep has been completed.
7	Press [MEAS], *X dB Down..*, *X [dB] point[60]* set key and then measure the X dB Relate.
8	Press [TRIG], *Continuous* key. Change the RBW filter and measure.
9	Repeat sets 5 to 9 for the other resolution bandwidth filters and frequency spans according to the combinations of resolution bandwidth and frequency span shown in the follow table.
10	For 3 dB bandwidth, used the value table (item RBW Accuracy)
11	Calculate RBW Selectivity :

$$\text{Selectivity} = \frac{\text{60 dB Bandwidth}}{\text{3 dB Bandwidth (or 6 dB Bandwidth)}}$$

Equipment		3dB BW (6dB BW)	60dB BW	Selectivity	Remark
RBW	Span				
1 kHz	20 kHz				
3 kHz	50 kHz				
9 kHz	100 kHz				(6 dB BW)
10 kHz	200 kHz				
30 kHz	500 kHz				
100 kHz	2 MHz				
120 kHz	2 MHz				(6 dB BW)
300 kHz	10 MHz				
1 MHz	20 MHz				
3 MHz	50 MHz				

o RBW Switching error

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below :

[Center frequency] : 100 MHz
[Span] : 20 MHz
[Reference level] : -10 dBm
[ATT] : Auto
[RBW] : 3 kHz
[Scale] : 10 dB/Div
[Sweep time] : Auto
[10 MHz REF] : EXT

4 Set the Synthesized signal generator (MG3633A) as shown below :

[Frequency] : 100 MHz
[Power] : -15 dBm

5 Press [PEAK], [MKR>], *Mkr > CF* key to move the signal peak to the center and the top of the screen.

6 Press [MKR], *Delta* key that in order to set to the marker to delta marker.

7 Set sequentially RBW and SPAN as shown in the table (300 Hz/2 kHz ~ 3 MHz /15 MHz).

8 Press [PEAK] key to conduct peak search and move the current marker to the peak point of the signal spectrum.

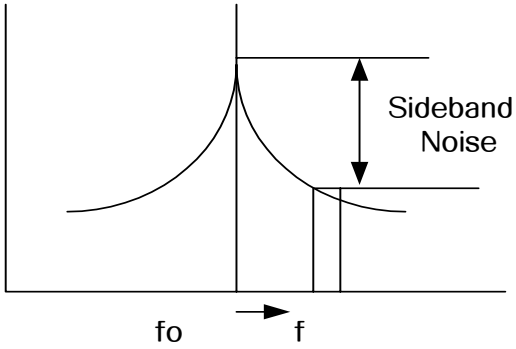
9 Read the Δ marker level value.

10 Repeat the step 7 to 9.

RBW	Frequency span	Deviation (error)	Remark
300 Hz	2 kHz	0.0	(Reference)
1 kHz	10 kHz		
3 kHz	20 kHz		
10 kHz	50 kHz		
30 kHz	150 kHz		
100 kHz	500 kHz		
300 kHz	1.5 MHz		
1 MHz	5 MHz		
3 MHz	15 MHz		

Sideband Noise (Phase noise)

Sideband noise measured the noise of local oscillator signal measured at an offset from the carrier frequency. It is important to use a signal source with 10dB or better sideband noise performance than spectrum analyzer.



1) Specification
   - o Sideband noise (phase noise) : ≤ −90 dBc/㎐ (10 ㎑ at offset frequency)
2) Test Instruments
   - o Synthesized signal generator : MG3633A
   - o RF Cable : N[male] ~ N[male]
   - o BNC Cable
3) Setup

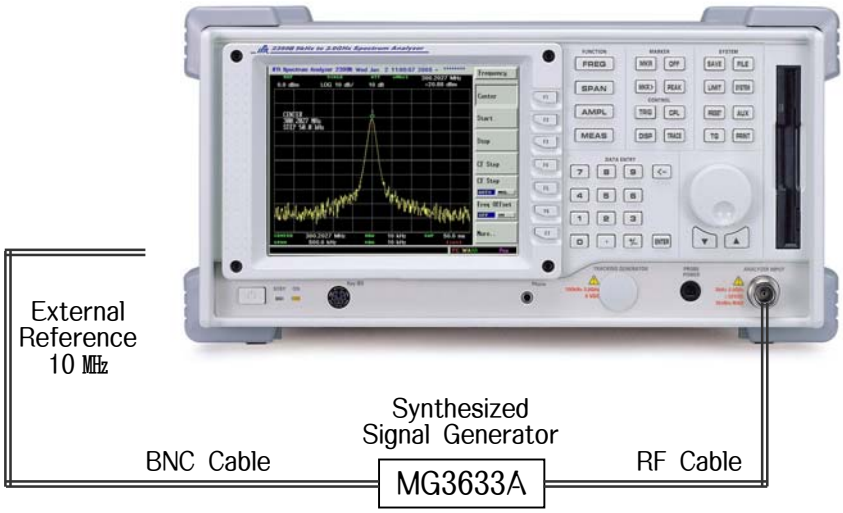


Figure 6-5. Sideband Noise

4) Procedure

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below :

[Center frequency]	: 3.0GHz
[Span]	: 100 ㎑
[Reference level]	: -10 dBm
[ATT]	: 0 dB
[RBW]	: 1 ㎑
[VBW]	: 100 Hz
[Scale]	: 10 dB/Div
[Sweep time]	: Auto

4	Set up the MG3633A as shown below :

[Frequency]	: 3.0 GHz
[Power]	: -10 dBm

5	Press [PEAK], [MKR>], *Mkr>CF* key and *Mkr>Ref* to move the signal spectrum peak to the center and the top of the screen.
6	Press the [MKR], *Delta* that in order to set to the marker to Δ marker.
7	Set the Δ marker to frequency of 10 ㎑ and read marker value (amplitude). Calculate Sideband noise. Sideband noise = Measured Value (Δ marker value) – 10log (RBW/1 ㎐)

Example]

Offset frequency	RBW	Measured value	Sideband Noise
10 ㎑	1 ㎑	-65 dBc	-95 dBc/㎐

* Press [MKR], *More..* , *Function..* , *Phase Noise* key then phase noise test will be completed.

Frequency Measurement Accuracy

To measure frequency counter accuracy set the signal generator and marker point to a position at least 20 dB higher than the noise (or adjacent interference signal) to operate the built-in counter and test the frequency measurement accuracy using the Frequency Counter COUNT ON mode.

1) Specification
   - o Accuracy : ≤ ±((Reference frequency accuracy × marker frequency) + (1(resolution error) + 1(counter error) × counter resolution))
   - o Resolution : 1 ㎐, 10 ㎐, 100 ㎐, 1 ㎑
   - o Sensitivity : -70 dBm min

     ※ Reference oscillator accuracy : ≤±2 ppm (default option)

2) Test Instruments
   - o Synthesized signal generator : MG3633A or equivalent
   - o Frequency counter : HP5350B
   - o Power Splitter : HP11636A
   - o RF Cable 1,2,3 : N [male] ~ N [male]
   - o BNC Cable : BNC [male] ~ BNC [male]
   - o Adopter : T-BNC [female]

3) Setup

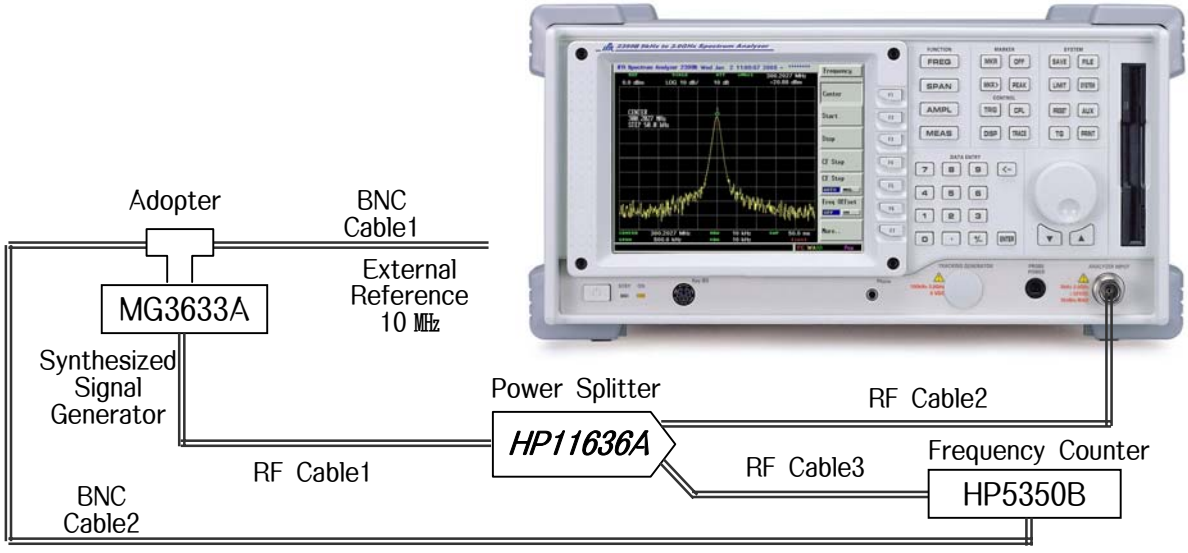


Figure 6-6. Frequency Measurement Accuracy

4) Procedure

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below : [Center frequency] : 3000 ㎒ [Span] : 50 ㎑ [10 ㎒ REF] : EXT [Couple] : All Auto [Reference Level] : -20 dBm Set the Synthesized signal generator as shown below : [Frequency] : 3000 ㎒ [Power] : -30 dBm
4	Press [MKR], *More..* , *Function..* and *Counter* key to set Frequency Counter ON.
5	Change the counter resolution to 1 ㎑, 100 ㎐, 10 ㎐ and 1 ㎐ then confirm that the frequency reading specification below table.

Signal Generator Freq. Level	Equipment		Measured Frequency		Standard Accuracy
	CF	Resolution	Marker Frequency	Measured Accuracy	
3000 ㎒, -30 dBm	3000 ㎒	1 ㎐ 10 ㎐ 100 ㎐ 1000 ㎐			±(Reference frequency error × marker frequency accuracy + counter resolution ±1 count)
3000 ㎒, -70 dBm	3000 ㎒	1000 ㎐			

Amplitude Display Linearity

This test determines the error per vertical graduation for the LOG display and LINEAR display.
Apply the correct level signal to the RF Input via an external attenuator and measure the error from the attenuation of the attenuator and the Δmarker reading at the trace waveform peak.

1) Specification
   - o Amplitude display linearity : After automatic calibration
     LOG : ≤±1.5 dB for 5 or 10 dB / div over (RBW ≤ 3㎑)
     ≤±0.5 dB for 1 or 2 dB / div over (RBW ≤ 3㎑)
     Linear : ≤±10 % of Ref Level, 10 div
2) Test Instrument
   - o Synthesized Signal Generator : MG3633A
   - o Attenuator : HP 8494, HP 8496
   - o RF Cable 1,2,3 : N [male] ~ N [male]
   - o Power Meter : HP437B with Power Sensor
   - o Power Splitter : HP11636A
   - o BNC Cable
3) Setup

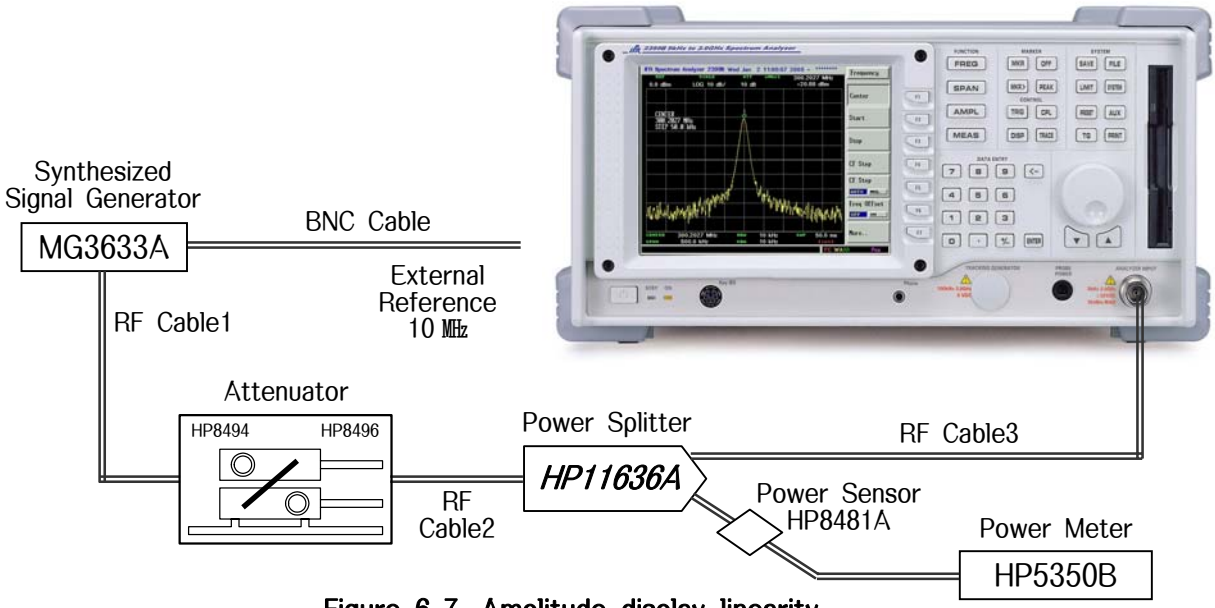


Figure 6-7. Amplitude display linearity

4) Procedure

○ LOG Linearity [10 dB/div, 5 dB/div, 2 dB/div, 1 dB/div]

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below : [Center frequency] : 100 ㎒ [Reference level] : 0 dBm [Span] : 10 ㎑ [ATT] : 10 dB [RBW] : 1 ㎑ [VBW] : 10 ㎐ [Scale] : 10 dB/Div
4	Set the Synthesized signal generator (MG3633A) as shown below : [Frequency] : 100 ㎒ [Power] : +6 dBm
5	Press [AMPL], *Log* key and then the *Scale.., 10 dB/div* key to set the display in the Log state.
6	Press [PEAK], [MKR>], *Mkr > CF* key and then the *Mkr > Ref* key to set the waveform peak to the center of the screen. Adjust Signal generator as required to confirm that power meter measures 0 dBm.
7	Press [MKR], *Delta* key and increase Attenuator in 10 dB steps [HP8494, HP8496] reading Δ marker level.
8	Calculate Log Linearity [10 dB/div]. Amplitude display linearity error = Attenuator value (dB) + Δ marker level
9	Repeat Log Linearity [5 dB/div, 2 dB/div, 1 dB/div] steps 5 than 8.

Log Display Linearity [10 dB/DIV]

Test Instrument Attenuator Setting (dB)	Δ marker Value (dB)	Error	Remark
0 10 20 30 40 50 60 70	0	0	Reference

Log Display Linearity [5 dB/DIV]

Test Instrument Attenuator Setting (dB)	Δ marker Value (dB)	Error	Remark
0 5 10 15 20 25 30 35 40 45 50	0	0	Reference

Log Display Linearity [2 dB/DIV]

Test Instrument Attenuator Setting (dB)	Δ marker Value (dB)	Error	Remark
0	0	0	Reference
2			
4			
6			
8			
10			
12			
14			
16			
18			
20			

Log Display Linearity [1 dB/DIV]

Test Instrument Attenuator Setting (dB)	Δ marker Value (dB)	Error	Remark
0	0	0	Reference
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

○ LINEAR Linearity [Full scale]

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below :
	[Center frequency] : 100 ㎒
	[Reference level] : 0 dBm
	[Span] : 10 ㎑
	[ATT] : 10 dBm
	[RBW] : 1 ㎑
	[VBW] : 10 ㎐
	[Scale] : 10 dB/Div
4	Set the Synthesized signal generator (MG3633A) as shown below :
	[Frequency] : 100 ㎒
	[Power] : 6 dBm
5	Press [AMPL], *Linear* key and then the [AMPL], *Unit..* , *VOLTS* key to set the display in the linear state.
6	Press [PEAK], [MKR>], *Mkr > CF* key to set the spectrum waveform peak to the center of the screen.
7	By control the signal generator, make the output level 223 mV.
8	Increase Attenuator [HP8494,HP8496] by step 6 dB and reading the level.
9	Calculate LINEAR Linearity (Full scale).
	Amplitude display linearity error = Attenuator value (dB) + Δ marker level.

Linear Display Linearity (full scale)

ATT Setting (dB)	Marker Value (dB)	Error	Remark
0 6 12 18	0	0	Reference

Frequency Response

Generally, when one or more signals with a different frequency but the same amplitude are applied to the unit, the spectrum analyzer display the same amplitude for each signal on the screen.

1) Specification
   - o Frequency response : -3 dB ~ +1 dB (9 ㎑ ~ 10 ㎒)
     ≤ ±1.5 dB (10 ㎒ ~ 3.0 ㎓) [@ATT = 10 dB]

2) Test Instruments
   - o Synthesized Signal Generator : MG3633A
   - o Power Meter : HP437B
   - o Power Sensor : HP8481A
   - o Power Splitter : HP11636A
   - o RF Cable 1,2 : N [male] ~ N [male]
   - o BNC Cable

3) Setup

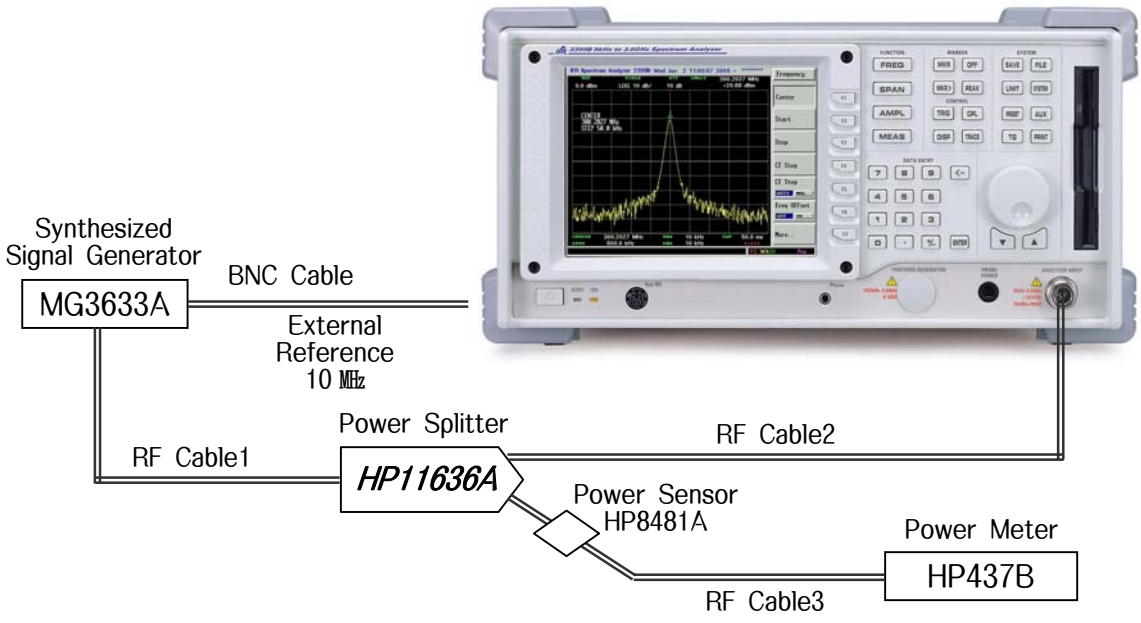


Figure 6-8. Frequency Response

4) Procedure

o Power meter calibration and measurement procedure

Step	Procedure
1	Connect the Power Meter [HP437B] to Power sensor [HP8481A]
2	Connect the Power sensor to Power Meter input port.
3	Push Power REF button of Power Meter and then display value 0 dBm.
4	If display value is not 0 dBm, turn Cal ADJ.
5	Connect the test equipment as shown above.
6	Adjust Signal generator output level set to –4 dBm Set up the synthesized signal generator as shown below : [Frequency] : 100 ㎒ [Power] : -4 dBm
7	Read the power meter display and adjust signal generator output level to -10 dBm.
8	Press [PRESET], *Preset* key.
9	Press *Alignment Mode..* softkey and then *All Align* softkey.
10	Set up the equipment as shown below : [Center frequency] : 100 ㎒ [Reference level] : 0 dBm [Span] : 10 kHz [Couple] : All Auto
11	Press [PEAK], [MKR>], *Mkr > CF* key to set the waveform peak to the center of the screen. Read the marker level and write to the below table.
12	Change Signal generator output frequency and adjust the signal generator to the level on the power meter –10 dBm.
13	Calculate Frequency response. Error = Power meter value – display Marker peak value

Signal Generator Frequency	Power Meter value [dBm]	Marker peak value [dBm]	Error	Remark
100 ㎒				
300 ㎒				
500 ㎒				
1000 ㎒				
1500 ㎒				
2000 ㎒				

Reference Level Accuracy

Here the absolute amplitude level at only 100 ㎒ is tested. Confirm the level accuracy with a signal from the Signal Generator, calibrated by a standard power meter.

1) Specification
   - o Reference level accuracy : ≤±1.5 dB (50 ㎑ to 3.0 ㎓)

2) Test Instruments
   - o Synthesized signal generator : MG3633A
   - o Power Meter : HP437B
   - o Power Sensor : HP8481A, HP8481D
   - o Step Attenuator : HP8496, HP8494
   - o RF Cable 1,2,3 : N [male] ~ N [male]
   - o Power Splitter : HP11636A
   - o BNC Cable

3) Setup

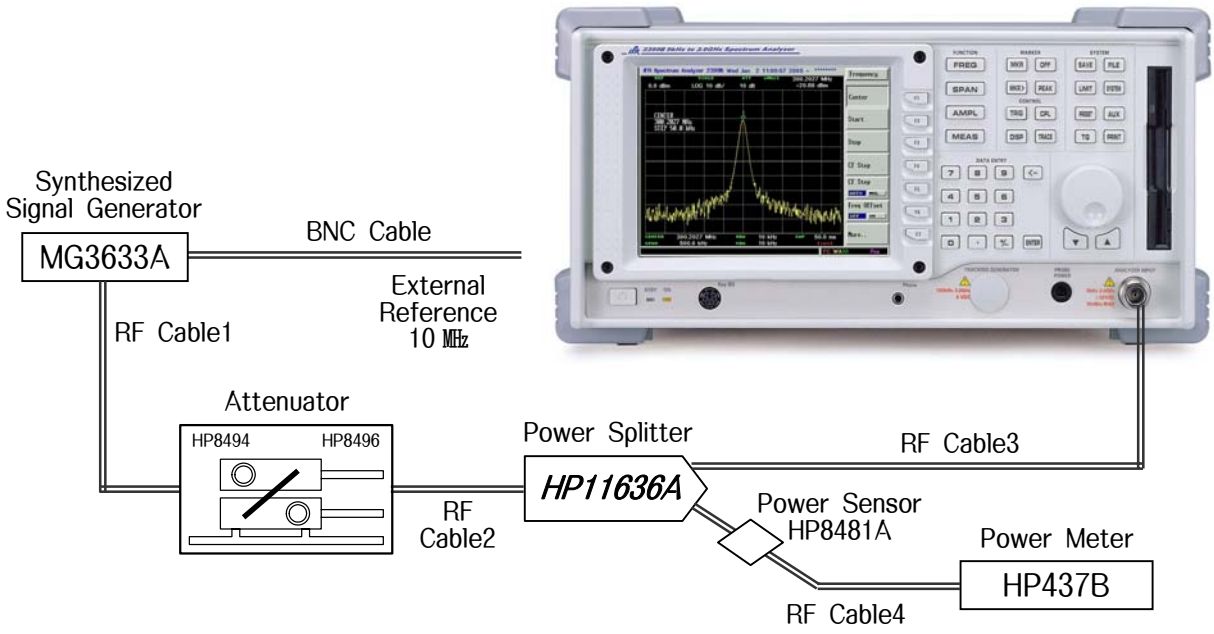


Figure 6-9. Reference level Accuracy

4) Procedure

○ Power meter calibration and Reference Calibration

Step	Procedure
1	Connect the Power Meter [HP437B] to Power sensor [HP8481A].
2	Connect the Power sensor to Power Meter input port.
3	Push Power REF button of Power Meter and then display value 0 dBm.
4	If displayed value is not 0 dBm, turn Cal ADJ.
5	Set up the test equipment as shown above.
6	Adjust Signal generator output level to +6 dBm. [Frequency] : 100 ㎒ [Power] : +6 dBm
7	Press [PRESET], *Preset* key.
8	Press *Alignment Mode..* softkey and then *All Align* softkey.
9	Set up the equipment as shown below : [Center frequency] : 100 ㎒ [Reference level] : 0 dBm [Span] : 10 ㎑ [RBW] : 1 ㎑ [VBW] : 1 ㎑ [ATT] : Auto
10	Adjust Signal generator output level so that the Reference level in the table below is indicated on the power meter until the power meter locks the sensitivity (Other Ref level in table use first the 10 dB steps of the attenuator, and the adjust the power meter).
11	Press [PEAK], [MKR>], *Mkr > CF* key to set the spectrum waveform peak to the center of the screen Press *Mkr > Ref*.
12	Read the marker level.
13	Calculate Reference level accuracy :
14	Reference level accuracy = Marker level value – Power meter reference value. Repeat the step 9 to 13 for other ref level in table.

Reference level [dBm]	Step Attenuator value (dB)	Marker level value [dBm]	Error
0	0		
-10	10		
-20	20		
-30	30		
-40	40		
-50	50		
-60	60		
-70	70		

Average Noise Level

The internal noise of the spectrum analyzer is measured with this test.

1) Specification
   - o Average noise level : ≤-105 dBm, 50 ㎑ to 100 ㎑
     ≤-110 dBm, 100 ㎑ to 2.8 ㎓
     ≤-105 dBm, 2.8 ㎓ to 3.0 ㎓
     (RBW 1 ㎑, VBW 10 ㎐)
2) Test Instruments
   - o 50 ohm termination : HP909F
3) Set up

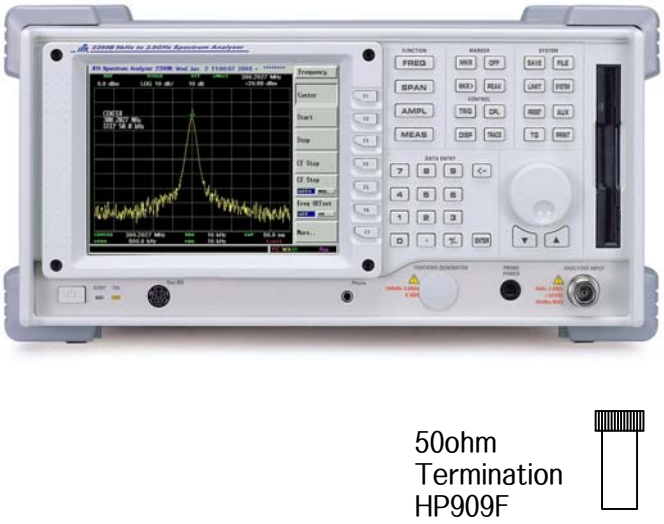


Figure 6-10. Average Noise level

4) Procedure

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below : [Center frequency] : 50 ㎑ [Span] : 20 ㎑ [Reference level] : -50dBm [ATT] : 0dBm [RBW] : 300 ㎐ [VBW] : 10 ㎐ [Detector mode] : Average
4	Terminate the RF Input with a 50 Ω terminator.
5	Press [PEAK], [MKR>], *Mkr > CF* key to set the spectrum waveform peak to the center of the screen.
6	Change the equipment as show below.
7	Press [TRACE], *More.. , Average.. , Average [ON] , Count [16]* key.
8	Press [TRACE], *More.. , Average.. , Continuous* key to start the averaging and wait until the 16 sweeps has been competed.
9	Press [PEAK] key to execute peak search. At this point read the level value at the marker.
10	With changing the center frequency, repeat the step 7 to 9.

Center Frequency	Span	Average noise level	Remark
50 ㎑ 500 ㎑ 2.5 ㎓ 3.0 ㎓	20 ㎑		

Second Harmonic Distortion

The main point of the test is to apply a signal (with harmonic distortion that is lower than the equipment internal harmonic distortion [at least 20dB below] to the equipment and measure the level difference between the fundamental signal and the second harmonic.

A low-distortion signal source can be obtained by a applying signal to the equipment after passing the signal through a low-pass filter (LPF)

1) Specification
   - o Second harmonic distortion : ≤-65 dBc, -30 dBm input, 0 dB attenuation

2) Test Instruments
   - o Synthesized Signal Generator : MG3633A
   - o RF Cable 1,2,3 : N [male] ~ N [male]
   - o LPF : With attenuation of 70 dB or more at twice the fundamental frequencies
   - o Power Splitter : HP11636A
   - o Power Meter : HP437B
   - o Power Sensor : HP8481A
   - o BNC cable

3) Setup

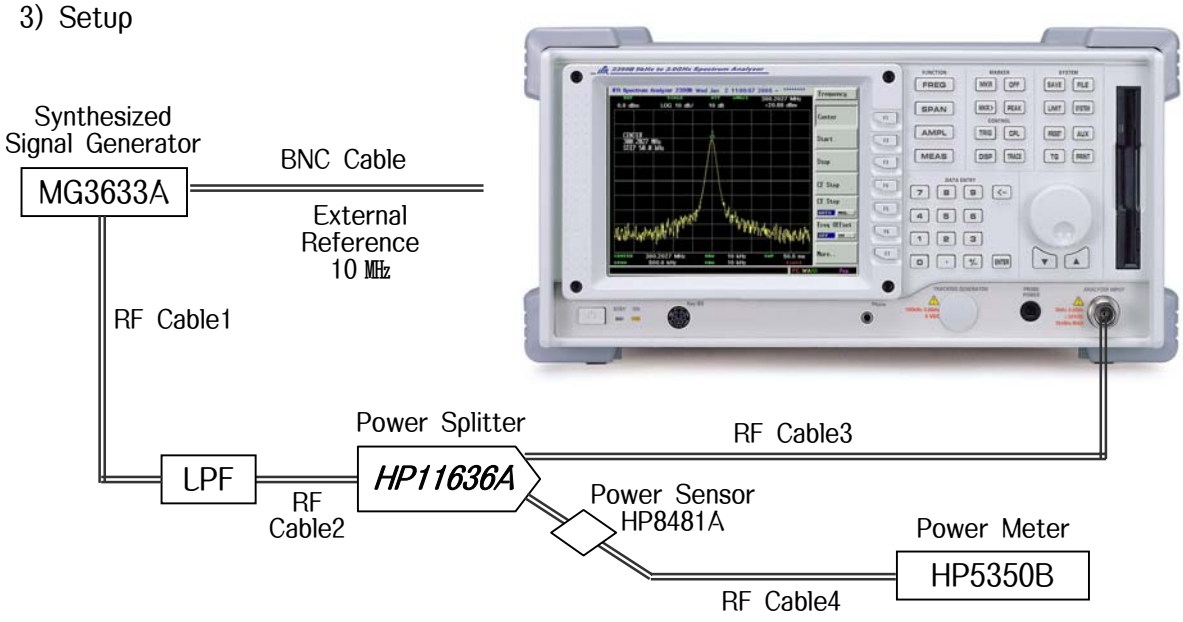


Figure 6-11. Second Harmonic Distortion

4) Procedure

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below : [Center frequency] : 95 ㎒ [Span] : 50 ㎑ [Reference level] : -30 dBm [ATT] : 0 dB [RBW] : 300 ㎐ [VBW] : 30 ㎐ [Sweep time] : Auto
4	Set the Synthesized signal generator as shown below : [Frequency] : 95 ㎒ [Power] : -24 dBm
5	Adjust the signal generator level that the signal measured is –30 dBm on the equipment.
6	Set the Center Frequency to twice the fundamental frequency to display the second harmonic on the screen.
7	Press [PEAK], [MKR>], *Mkr > CF* key and calculate the difference from –30dBm. Write to table.
8	According to table adjust the frequency and LPF, repeat the step 3 to 7.

Signal generator		Second harmonic		
Output power	Frequency	Marker level	dBc	Frequency
-30dBm	95 ㎒ 245 ㎒ 495 ㎒ 995 ㎒			190 ㎒ 490 ㎒ 990 ㎒ 1990 ㎒

Input Attenuator Switching Error

This test measures the switching error when the amount of attenuation in the RF input section is switched.

1) Specification

- Input attenuator switching error : ±0.5 dB/step, 100 ㎒
  ±1.5 dB/maximum step,100 ㎒

2) Test Instruments

- Synthesized signal generator : MG3633A
- RF Cable : N [male] ~ N [male]
- BNC Cable

3) Setup

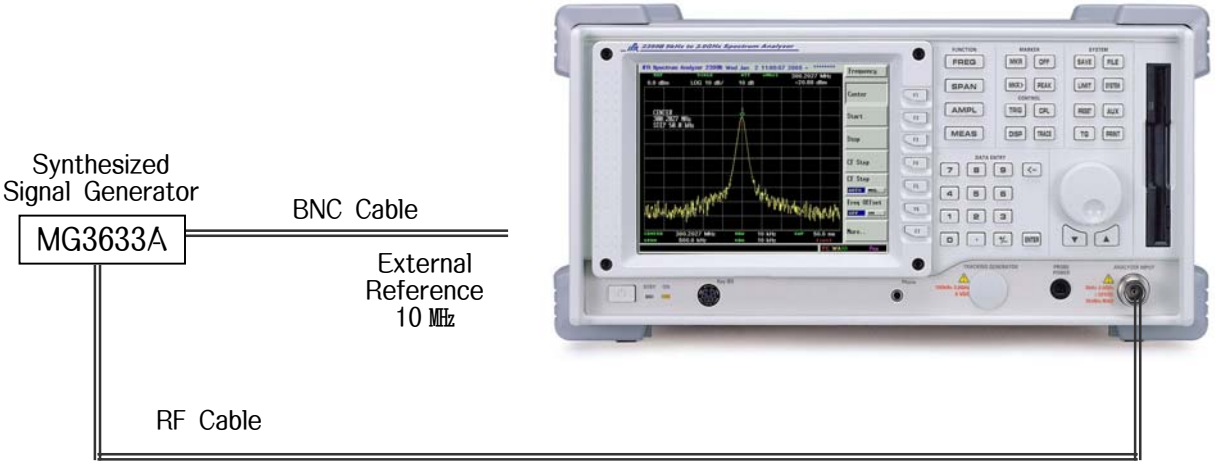


Figure 6-12. Input Attenuator Switching Error

4) Procedure

o Power meter calibration and Signal generator Calibration

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below : [Center frequency] : 100 ㎒ [Span] : 500 ㎑ [Reference level] : -10 dBm [ATT] : 0 dBm [RBW] : 3 ㎑ [VBW] : 30 ㎐ [Sweep time] : Auto
4	Set the Signal generator MG3633A as show below : [Frequency] : 100 ㎒ [Power] : -20 dBm
5	Press [PEAK], [MKR>], *Mkr > CF* and *Mkr > Ref* key to set the spectrum waveform peak to the center and top of the screen.
6	Press [MKR], *Delta* key , check the marker level is 0.
7	Press [AMPL], *Atten [MNL], 10 dB* key, set attenuator to 10 dB, read the delta marker level and write down on table.
8	Press [MKR], *OFF.*
9	Repeat the step 5 to 8 for other value in table. In each turn set the input attenuator to measure in 7 step.
10	When end the measurement, Sum the each delta level with same sign. And then the result compare with spec(±1.5 dB) in the table.

Input Attenuator		Delta Marker level	Spec
Before change ATT	After change ATT		
0 dB	10 dB		
10 dB	20 dB		±0.5dB/step up to ±
20 dB	30 dB		1.5dB maximum, 100
30 dB	40 dB		MHz
40 dB	50 dB		

Residual FM

Measure the purity of frequency.

1) Specification : ≤100 Hz $_{P-P}$ in 200 ㎳, 1 ㎑ RBW, 1 ㎑ VBW
2) Test Instruments
   - o Modulation Analyzer : HP8901B
   - o BNC Cable : BNC [male] ~ BNC [male]
3) Setup

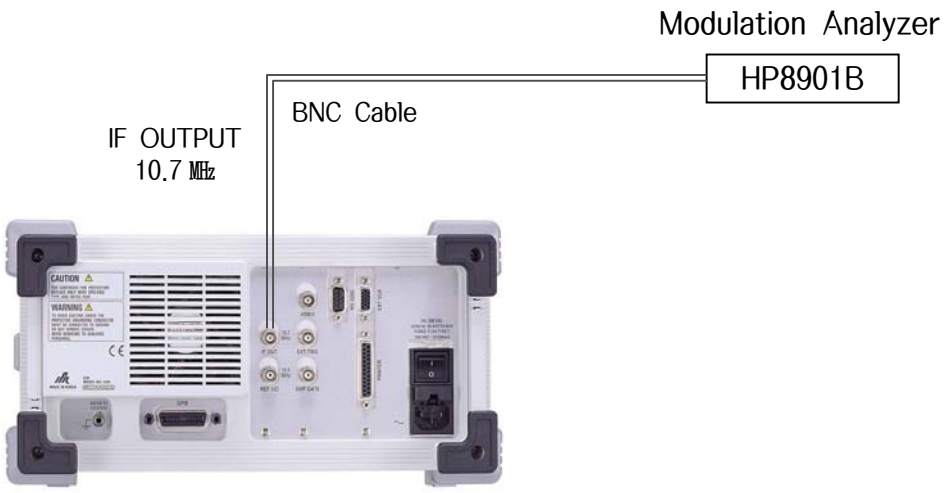


Figure 6-13. Residual FM

4) Procedure

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below : [Center frequency] : 40 ㎒ [Reference level] : -10 dBm [Span] : 10 ㎑ [RBW] : 1 ㎑ [VBW] : 1 ㎑ [Sweep time] : Auto
4	Press [PRESET], *Cal. Signal [ON]* to set the internal calibration Signal ON.
5	Press [PEAK], [MKR>], *Mkr > CF* key to center to the spectrum waveform display on top line of the screen.
6	Press [SPAN], *Zero Span*.
7	Connect Modulation Analyzer to Rear Panel IF output and measure frequency modulation.
8	Compare with spec.

3rd Order Intermodulation

Two signal generator provide the signals required for measuring third order intermodulation. It is difficult when the input level is –30dBm because the intermodulation signal is very close in level to the noise.

1) Specification : ≤-65dBc, 〈700 ㎒, -30dBm input, 0dB att.
: ≤-70dBc, ≥700 ㎒, -30dBm input, 0dB att.

2) Test Instruments
- o Synthesized Signal Generator 1,2 : MG3633A
- o Step Attenuator : HP8494B, HP8496B
- o Power Meter : HP437B
- o Power Sensor : HP8481A
- o Power Splitter : HP11636A
- o RF Cable 1,2,3,4 : N [male] ~ N [male]
- o BNC Cable 1,2 : BNC [male] ~ BNC [male]
- o Adapter : T-BNC [female]

3) Setup

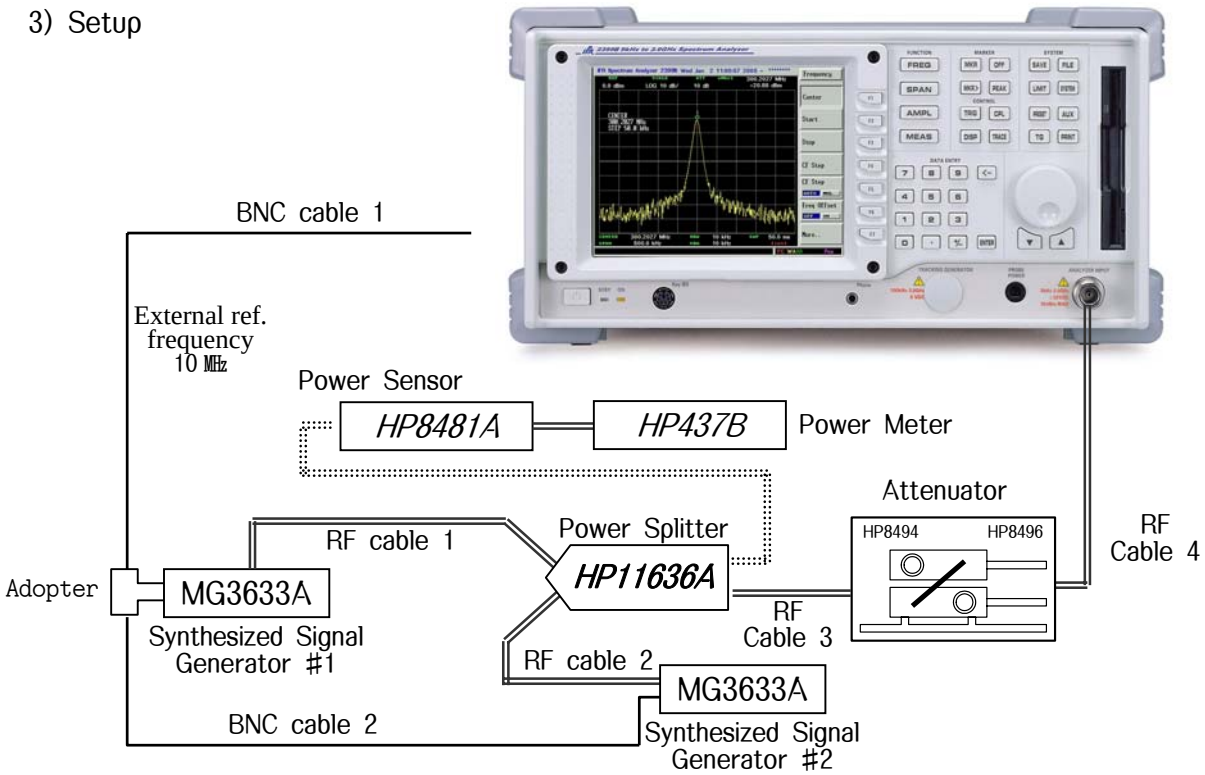


Figure 6-14. 3rd Order intermodulation

4) Procedure

○ Power meter calibration

Step	Procedure
1	Connect the Power Meter [HP437B] to Power sensor [HP8481A].
2	Connect the Power sensor to Power Meter input port.
3	Push Power REF button of Power Meter and then display value 0 dBm.
4	If display value is not 0 dBm, turn Cal ADJ.
5	Set up synthesized signal generators as shown on previous page. Synthesized signal generator 1 Frequency : 1000 ㎒ Power : -24 dBm Synthesized signal generator 2 Frequency : 1000.1 ㎒ Power : -24 dBm

○ Measurement of 3rd Order Intermodulation

Step	Procedure
1	Press PRESET, *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below : Center frequency : 1000 ㎒ Reference level : -30 dBm Span : 1 ㎒ ATT : Auto RBW : 3 ㎑ VBW : 100 Hz Sweep Time : Auto
4	Turn generator #2 RF off. Disconnect RF cable 3 from Power Splitter, and connect Power Sensor with Power Splitter. Adjust signal generator #1 level so that power meter reads -30 dBm.

5 Turn generator #1 RF off and generator #2 on.

6 Adjust signal generator #2 level so that power meter reads -30 dBm. Disconnect Power Sensor from Power Splitter and connect RF cable 3.

7 Turn RF on for both signal generator.

8 Press [PEAK] key to set the normal marker to one at the two signals at -30 dBm.

9 Press [MKR], *Delta* key.

10 Move normal marker to peak of the intermodulation product signal(left side of #1 generator signal(1000 MHz - 100 kHz) and right side of #2 generator signal(1000.1 MHz + 100 kHz)). Read it's level difference.

Spurious Response

This test measures spurious frequency levels in the equipment.
The RF Input is terminated and 0 dB Input attenuation is selected.

1) Specification : ≤-85 dBm (**Input terminated**, 0 dB attenuation)
2) Test Instruments
   - 50 ohm Termination : HP909F
3) Setup

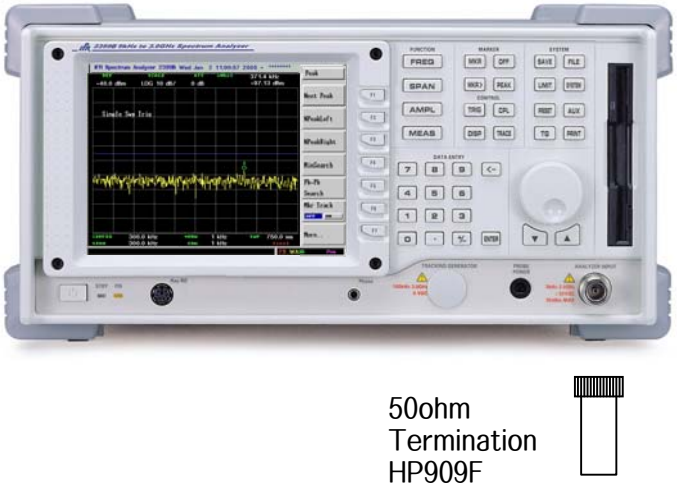


Figure 6-15. Residual Response

4) Procedure

Step	Procedure
1	Press [PRESET], *Preset* key.
2	Press *Alignment Mode..* softkey and then *All Align* softkey.
3	Set up the equipment as shown below : [Center frequency] : 300 ㎑ [Span] : 300 ㎑ [Reference level] : -40 dBm [ATT] : 0 dB [RBW] : 1 ㎑ [VBW] : Auto [Sweep Time] : Auto [Detector Mode] : Pos Peak
4	Press [DISP], *Disp Line [ON]*, *Disp Line* key and rotate knob to –85 dBm.
5	Press [TRIG], *Single* key. Wait for completion of the sweep. Any residual responses must be below the display line.
6	Press [PEAK] key and record marker amplitude.
7	Set center frequency step to 300 ㎑ using [FREQ], *CF Step [MNL]*, *CF Step* and change the Center frequency.
8	Follow the proceeding step 5 to 7.

Frequency	Marker Amplitude [dBm]	Equipment Specification [dBm]
300 ㎑		< -85
600 ㎑		
900 ㎑		
⋮		
3.0 ㎓		

Local Oscillator Emission

This test measures, the Local Emission power from the input of spectrum analyzer.
This is measure of how well the local oscillator is isolated from the RF input connector.

1) Specification : ≤-70 dBm (with 10 dB attenuation)
2) Test Instruments
   - o Spectrum Analyzer : IFR 2390A
   - o RF Cable : N [male] ~ N [male]
3) Setup

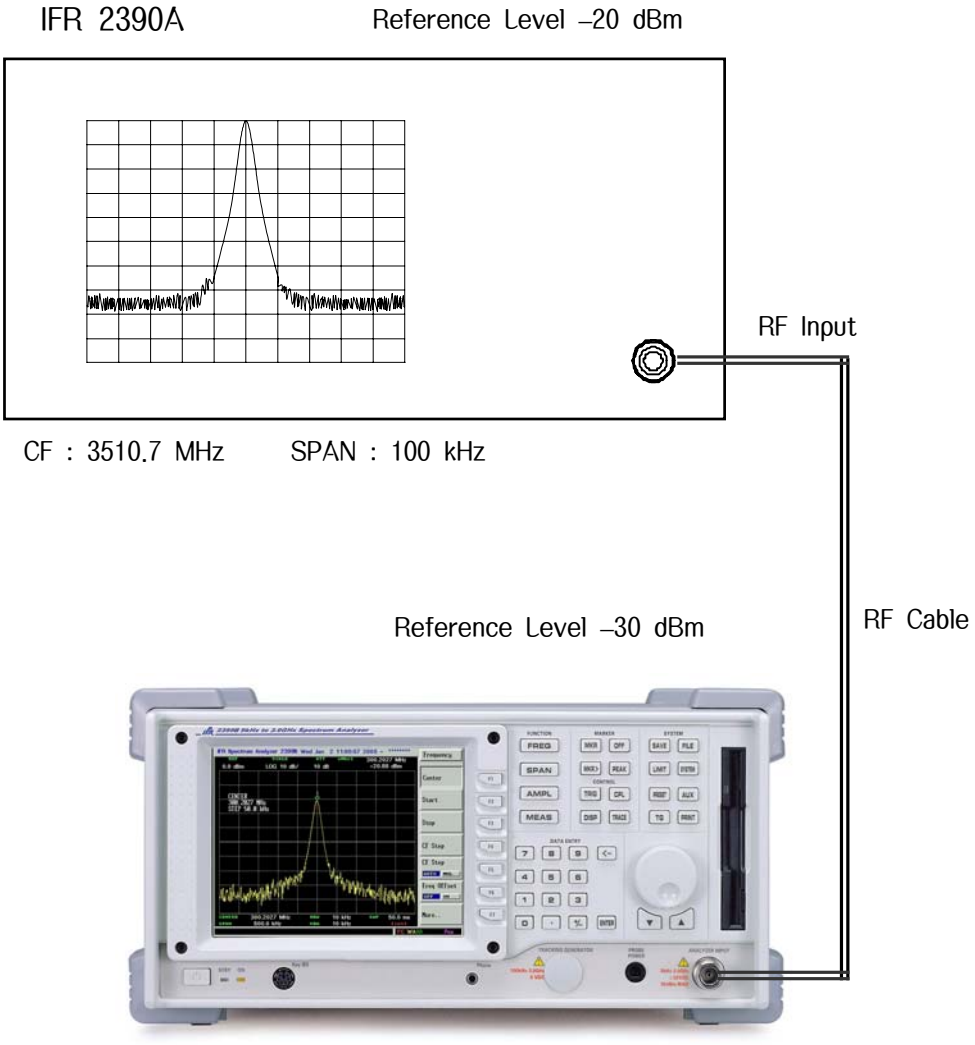


Figure 6-16. LO Emission

4) Procedure

Step	Procedure

1 Press [PRESET], *Preset* key.

2 Press *Alignment Mode..* softkey and then *All Align* softkey.

3 Set up the equipment as shown below :

Center frequency	: 100 ㎒
Span	: Zero Span
Reference level	: -30 dBm
ATT	: 10 dB

4 Set up the IFR2390A as shown below :

Center frequency	: 3410.7 ㎒ + Center Frequency(100 ㎒)
Span	: 100 ㎑
Reference level	: -20 dBm
RBW	: 3 ㎑
VBW	: 1 ㎑

5 Read the power level of IFR2390A and record.

6 Press [FREQ], *Center* key to change equipment center frequency.
The IFR2390A must also change the center frequency.

7 Repeat step 5 through 6.

Equipment Center frequency	Measured Power [dBm]	Specification [dBm]
100 ㎒		-70
500 ㎒		
1000 ㎒		
1500 ㎒		
2000 ㎒		
2500 ㎒		

Input VSWR

This test verifies the Input VSWR of the spectrum analyzer.

1) Specification : < 1.5:1, 150 ㎑ to 3.0 ㎓
(with 10 dB Input attenuation)

2) Test Instruments
- ○ Network Analyzer 1 : HP8720D
  ※ Frequency Range : 50 ㎒ ~ 20 ㎓
- ○ Network Analyzer 2 : HP8751A
  ※ Frequency Range : 5 ㎐ ~ 500 ㎒
  (S-parameter [HP8751A] : 100 ㎑ ~ 500 ㎒)
- ○ Calibration Cable : HP 85131-60012 [3.5mm flexible]
  HP 85131-60013 [3.5mm flexible]
  N [male] ~ N [male]
- ○ Calibration Kit : HP 85052B [3.5mm]
  HP 85032B [Type N]
- ○ Adapter : SMA [female] ~ N [male]

3) Setup

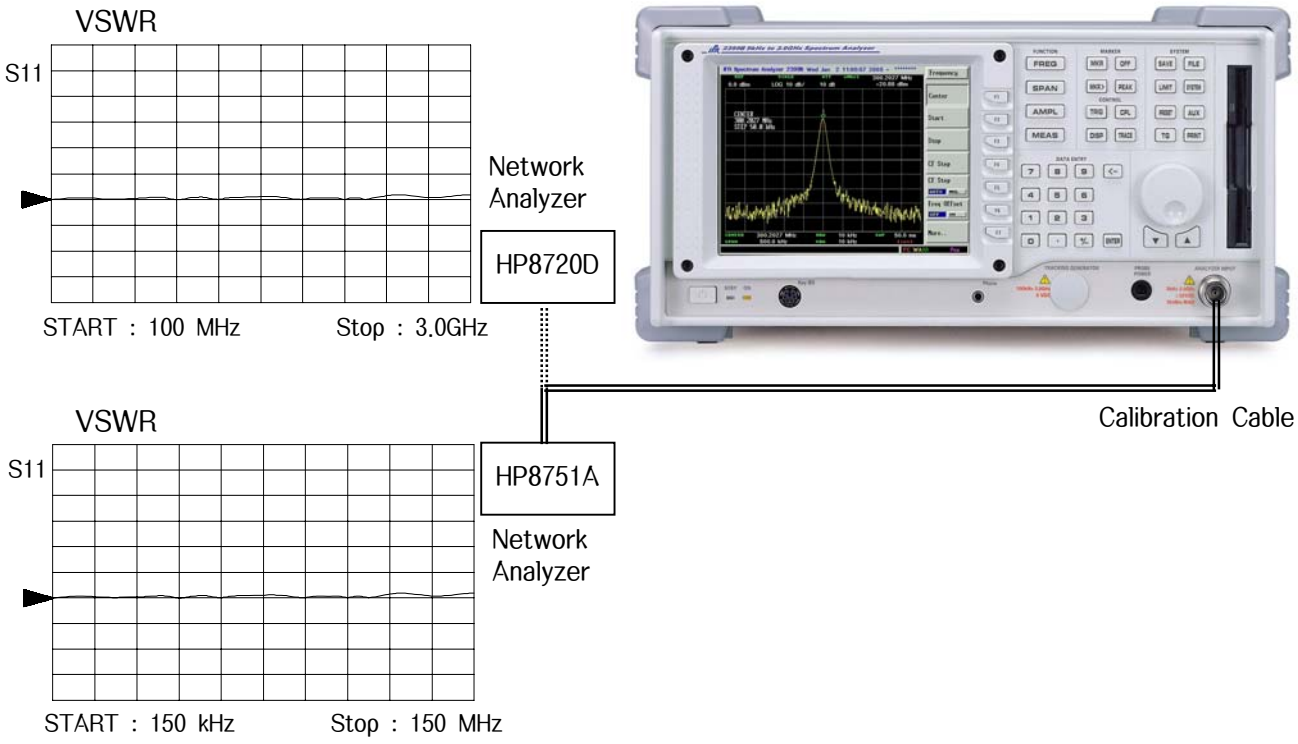


Figure 6-17. Input VSWR

4) Procedure

Step	Procedure
1	Press [PRESET], *Preset*.
2	Press *Alignment Mode..* and *All Align* softkey.
3	Set up the equipment as shown below : [Center frequency] : 100 ㎒ [ATT] : 10 dB
4	Set up the Network Analyzer(HP8751A) as shown below : [Start frequency] : 150 ㎑ [Stop frequency] : 150 ㎒ [Output Level] : -10 dBm
5	Connect cable to Network Analyzer and calibrate following each equipment calibration procedure.
6	Connect the cable in Network Analyzer to spectrum analyzer and measure the VSWR. Compare with specification.
7	Output Power off the Network Analyzer and disconnect the cable.
8	Set up the Network Analyzer(HP8720D) as shown below : [Start frequency] : 100 ㎒ [Stop frequency] : 3.0 ㎓ [Output Level] : -10 dBm
9	Repeat the step 5 to 7.

Frequency range	Measurement(Max)	Specification
150 ㎑ ~ 150 ㎒		≤ 1.5 : 1
100 ㎒ ~ 3.0 ㎓		≤ 1.5 : 1

SECTION 7
STORAGE AND TRANSPORTATION

This section describes the long term storage, repacking and transportation of the equipment as well as the regular care procedures and the timing.

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Transportation ---------- 7-5
SERVICE ---------- 7-6

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SECTION 7
STORAGE AND TRANSPORTATION

CLEANING CABINET

Always turn the equipment POWER switch OFF and disconnect the power plug from the AC power inlet before cleaning the cabinet.

To clean the external cabinet :

- Use a soft, dry cloth for wiping off.
- Use a cloth moistened with diluted neural cleaning liquid if the instrument is very dirty of before long term storage.
  After insuring that the cabinet has been thoroughly dried, use a soft, dry cloth for wiping off.
- If loose screw are found, tighten them with the appropriate tools.

CAUTION

Never use benzene, thinner, or alcohol to clean the external cabinet : it may damage the coating, or cause deformation or discoloration.

STORAGE PRECAUTIONS

This paragraph describes the precautions to take for long term storage of the equipment.

Precautions before storage

1. Before storage, wipe dust, finger marks, and other dirt off of the equipment.
2. Close the font cover.
3. Avoid storing the equipment where :
   1) It may be exposed to direct sunlight or high dust levels.
   2) It may be exposed to active gases.
   3) It may be exposed to extreme temperatures (＞50℃) or high humidity (＞90%).

Recommended storage precautions

The recommended storage conditions are as follows :

- Temperature ..... 0 to 50℃
- Humidity ..... 10% to 60%

REPACKING AND TRANSPORTATION

The following precautions should be take if the equipment must be returned to IFR for servicing.

Repacking

Use the original packing materials. If the equipment is packed in other materials, observe the following packing procedure :

1) Wrap the equipment in plastic sheet or similar material.
2) Use a corrugatedpaper, wooden box, or aluminum case which allows shock-absorbent material to be inserted on all sides of the equipment.
3) Secure the container with packing straps, adhesive tape or bands.

Transportation

Do not subject the equipment to severe vibration during transport. It should be transported under the recommended storage conditions.

SERVICE

If the equipment is damaged or does not operate as specified, contact your nearest IFR dealer or business office (refer to the rear cover in this manual) for repair. When you request repair, provide the following information :

1) Model number and serial number on rear panel.
2) Fault description : Symptom, operation procedure before fault(include peripheral or equipment and plot of connection circuit), circumstance(temperature, humidity, time, date, place), guess of yours etc.
3) Name of a personnel-in-charge and address for contact when fault confirmed or at completion of repair.

2399B
Spectrum Analyzer
Measurement Guide

IFR Ltd.

Notice

The information contained in this document is subject to change without notice.

IFR makes no warranty of any kind with regard to this material, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. IFR shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Safety Notice

The following safety notes are used throughout this manual.
Familiarize yourself with the notes and their meaning before operating this instrument

CAUTION

Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, would result in damage to or destruction of the instrument. Do not proceed beyond a caution until the indicated conditions are fully understood and met.

WARNING

Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

WARNING

This is a Safety Class 1 Product (provided with a protective earthling ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

Where to Find the Latest Information

Documentation is updated periodically. For the latest information about Spectrum Analyzer, including firmware upgrades and application information, Please visit the following Internet URL : http://www.ifrsys.com

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1. INSTRUMENT OVERVIEW

- Front Panel
- Rear Panel
- Screen Annotation

In this manual call the key in front panel as hard key and be expressed box of letter. Call the soft key on the menu in screen and be expressed italic.
Ex.] FREQ *Center*

Front-Panel Features

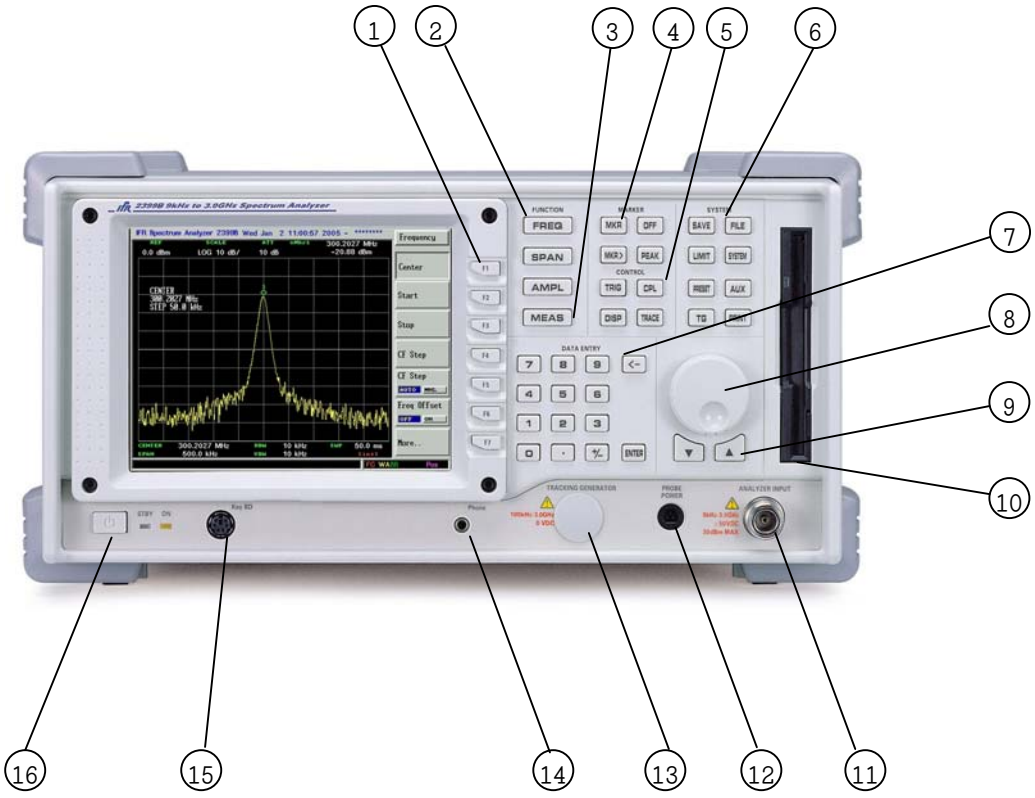


Figure 1-1. Front-Panel Feature Overview

① **Soft Menu keys** are the labeled keys (F1 to F7) on the side of screen. The soft menu key functions are annotated on the screen each side of the menu keys one to one. Most of the labeled keys on the analyzer front panel (also called hard keys) access menus of keys having related functions.

② **FUNCTION** hard keys activate the primary analyzer functions and access menus of related functions.

③ MEAS hard key accesses a menu of keys that automate some common analyzer measurements. In software option, MEAS menu performed the each unique operations.

④ **MARKER** hard keys conduct control the markers, read out frequencies and amplitudes along the analyzer trace, automatically locate the signals of highest amplitude, and access functions like Marker Noise and etc.

⑤ **CONTROL** hard keys functions access menus that allow you to adjust the resolution bandwidth, adjust the sweep time, set trigger functions, control the instrument display, and select a kind of trace. They also set other analyzer parameters needed for making measurements.

⑥ **SYSTEM** functions affect the state of the entire spectrum analyzer. Various setup is accessed with the SYSTEM key.

The SAVE key immediately executes the Save function defined next FILE key.

The FILE key displays file directory and allows you to copy and load traces, states, limit-line tables, and amplitude correction factors to or from analyzer memory or the floppy disk drive. And file delete, copy, rename, select disk drive, select file type, sort directory, format floppy disk etc.
The LIMIT key configures the upper or lower limit line to indicate that the signal level is pass or fail.

The PREST key resets the analyzer to a known state and can execute various alignment routines.

The AUX key sets the auxiliary functions, such as AM/FM demodulation, audio and squelch level.

The [TG] key sets the tracking generator operation. This key is only available if TG option is installed.

The [PRINT] key immediately sends hardcopy data to the printer.
The print setup can be done in [SYSTEM] *Printer Config.*. which allow you to configure printer types.

⑦ **DATA ENTRY** is include numeric key, back space(<-), sign(+/-), ENTER, scroll knob and step keys. This used for entering the number or adjust value or moving marker or moving cursor etc.

Number Keys include numeric key, back space(<-), sign(+/-) and ENTER key. These keys allow you to change the numeric value of an active function. You may include a decimal point in the number portion. If not, the decimal point is placed at the end of the number. Ending the input by press ENTER key or press the soft key annotated in menu area as unit for special value. Example in frequency case the unit soft key is assigned as GHz, MHz, kHz, Hz and amplitude case dBm, dBmV, dBuV etc.

⑧ The **Scroll Knob** allows continuous change of functions such as center frequency, reference level, and marker position. It also changes the values of many functions that change sequentially. Clockwise rotation of the knob increases values and otherwise decrease. For continuous changes, the extent of alteration is determined by the size of the measurement range; the speed at which the knob is turned affects the rate at which the values are changed.

⑨ The **Step Keys** (▼ ▲) allow discrete increases or decreases of the active function value. The step size depends upon the analyzer measurement range or on a preset amount. Each press results in a single step change. For those parameters with fixed values, the next value in a sequence is selected each time a step key is pressed. Changes are predictable and can be set for some functions. Out-of-range values or out-of-sequence values will not occur using these keys.

NOTE :	If an entry form the numeric keypad does not coincide with an allowed function value (for example, that of a 12 MHz resolution bandwidth), the analyzer defaults to the nearest allowable value as 3 MHz.

⑩ **3.5-inch Floppy Disk Drive :** On the right side of the front panel is for data access media.

⑪ **RF INPUT 50Ω** : the signal input for the analyzer.

⑫ **PROBE POWER :** HP85024A(High Frequency Probe) or compatible probe can use.

⑬ **RF OUT 50Ω (*for TG Option*)** : the source output for the built-in tracking generator.

CAUTION ⚠	If the tracking generator output power is too high, it may damage the device under test. Do not exceed the maximum power that the device under test can tolerate.

⑭ **Phone :** The earphone connector provides a connection for a mono earphone jack which bypasses the internal speaker.

⑮ **Key BD :** The **External Keyboard** connector is a 6-pin mini-DIN connector for future use with PC keyboards. (Only for system calibration and maintenance)

⑯ **STBY/ON :** Turns the analyzer on or off. The STBY LED is on when the power switch (line switch) is on in the rear panel. In standby state the analyzer is turned on by pressing momentarily the STBY/ON key. An instrument alignment is performed every time the analyzer is turned on. After turning on the analyzer, allow 15 minutes of warm-up time to ensure the analyzer will meet all specification. The analyzer is turned off and returned to the standby state by pressing the STBY/ON key for about one second.

NOTE :	The instrument continues to draw power even if the line power switch is in standby. The detachable power cord is the instrument-disconnecting device. It disconnects the main circuits from the main supply before other parts of the instrument. The front-panel switch is only a standby switch and is not a LINE switch (disconnecting device).

Rear-Panel Features

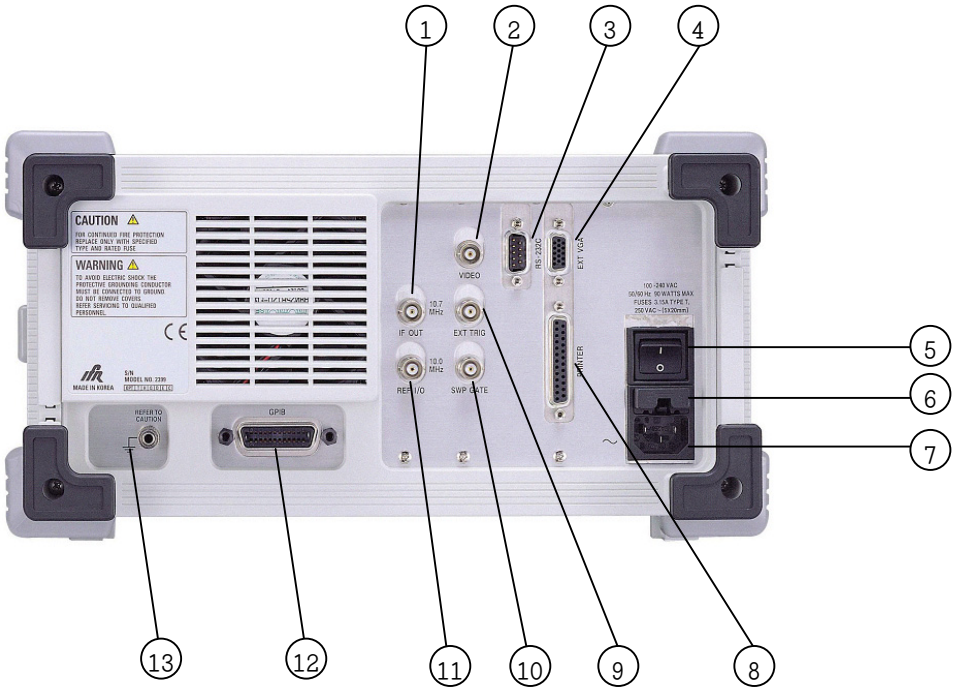


Figure 1-2. Rear-Panel Feature Overview

① **IF OUT 10.7 MHz** : If out is 50 Ω, 10.7MHz IF output that is the down-converted signal of the RF input of the analyzer. Amplitude-correction factors are not applied to this signal. This output is taken after the resolution bandwidth filters and step gains and before the log amplifier. The output signal will be blanked occasionally during retrace by the automatic alignment routine.

② **VIDEO** : Video out provides detected video output (before the analog-to-digital conversion) proportional to vertical deflection of the trace. Output is from 0 V to 5V. Amplitude-correction factors are not applied to this signal. The output signal will be blanked occasionally during retrace by the automatic alignment routine.

③ **RS-232C** : supports remote instrument operation.

④ **EXT VGA** : drives an external VGA compatible monitor.

⑤ **(Line Switch)** : This is a main power switch.

⑥ **(Line Fuse)** : The fuse is removed by pulling fuse holder. Replace only with a fuse of the same rating. See the label on the rear panel.

⑦ ~ **(Power input)** : input for the AC line power source. Make sure that the line-power source outlet has a protective ground contact.

⑧ **PRINTER** : Parallel port support for printing only.

⑨ **EXT TRIG** : accepts the positive edge of an external voltage input(TTL) that triggers the analyzer internal sweep source or the gate function.

⑩ **SWEEP GATE :** Output(TTL) signal indicates when the analyzer is sweeping.

⑪ **REF I/O 10.0 MHz** : accepts an external frequency source to provide the 10 MHz, -15 to +10 dBm frequency reference used by the analyzer or provides 10MHz, timebase reference signal. On the contrary REF I/O provides a 10MHz, +5dBm nominal, timebase reference signal, if external frequency reference is not connected.

⑫ **GPIB** : GPIB supports remote instrument operation.(remote control only)

⑬ ⏚ **(Frame Ground Terminal) :** When there is no grounded AC power supply outlet, the protective frame ground terminal must be connected directly to ground potential.

WARNING ⚠	If power is applied without protective grounding, there is a risk of accidental electric shock. The protective frame ground terminal or the ground pin of the supplied power cord must be connected to ground potential before turning the analyzer on.

Display Annotation

Here is an example of the annotation that may appear on an analyzer display. The display annotation is referenced by numbers which are listed in the following table. The Function Key column indicates which key activates the function related to the annotation. Refer to the operation manual for more information on a specific function key.

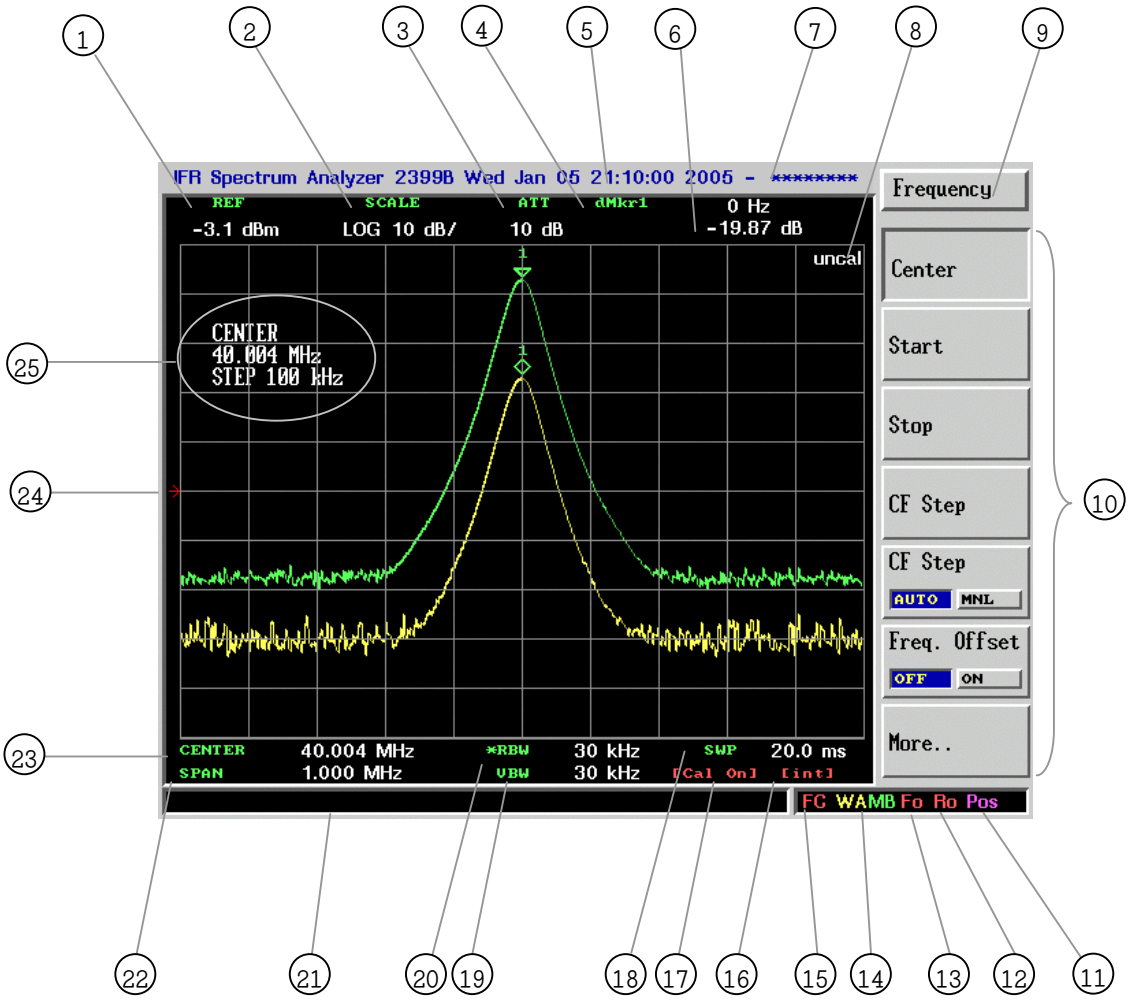
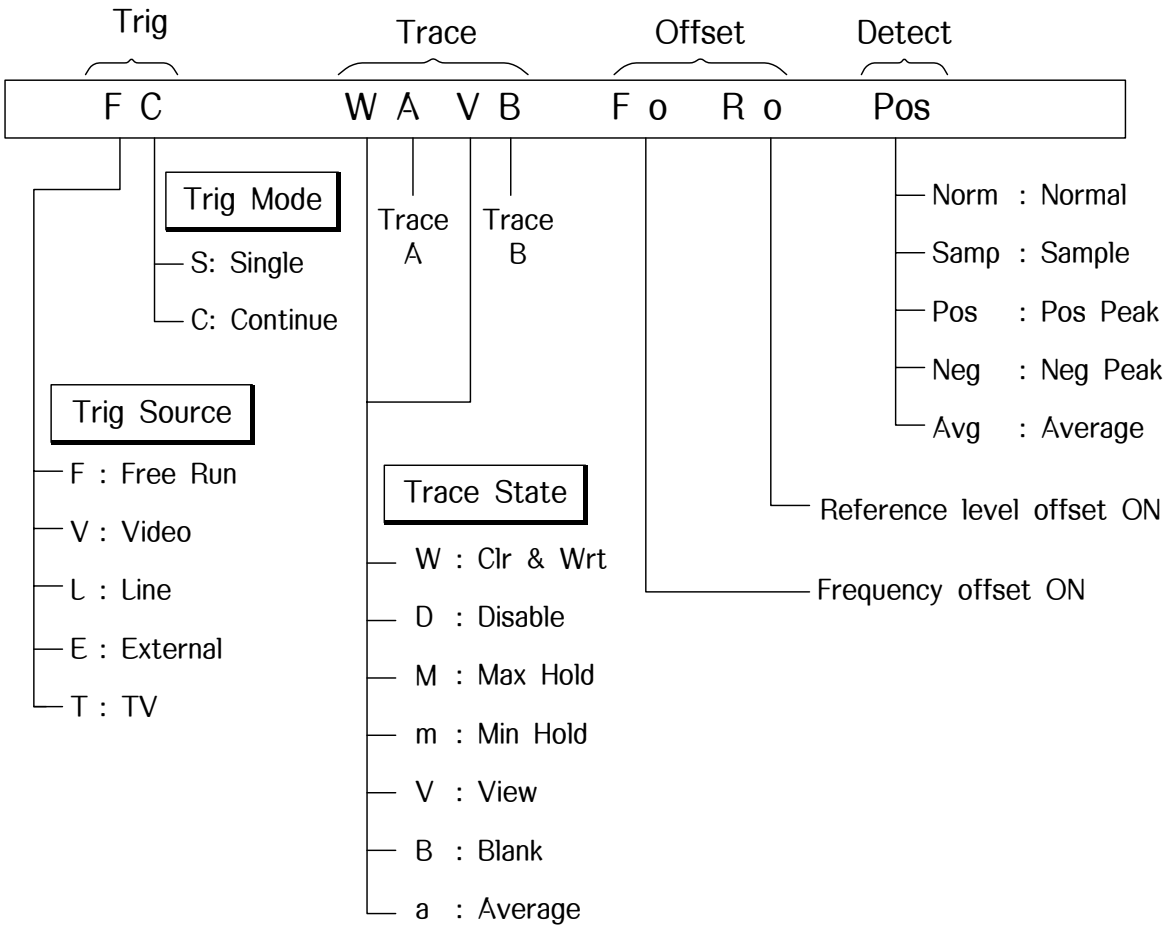


Figure 1-3. Screen Annotation

Table 1-3. Screen annotation

Number	Explanation	Relate key
①	Reference level	AMPL *Ref. Level*
②	Amplitude scale	AMPL *Log, Linear, Scale..*
③	Input Attenuation	AMPL *Atten. [AUTO/MNL]*
④	Marker frequency	MKR
⑤	Date and time display	SYSTEM *Clock Set..*
⑥	Marker amplitude	MKR
⑦	Screen title	DISP *Screen Title..*
⑧	Data invalid indicator	CPL
⑨	Key menu title	Dependent on key selection.
⑩	Soft Key menu	See key label descriptions in the Previous chapter.
⑪	Detector mode	TRACE *Detect..* *ref screen annot. 1-9
⑫	Reference level offset	AMPL *Ref. Offset [OFF/ON]*
⑬	Frequency offset	FREQ *Freq. Offset [OFF/ON]*
⑭	Trace mode	TRACE
⑮	Trigger/Sweep	TRIG
⑯	External/Internal frequency reference (10MHz)	FREQ *10 MHz Ref. [EXT/INT]*
⑰	Internal calibration signal (40MHz, -30dBm) is on	FREQ *Cal. Signal [OFF/ON]*
⑱	Sweep time	CPL *Swp Time [AUTO/MNL]*
⑲	Video bandwidth	CPL *VBW [AUTO/MNL]*
⑳	Resolution bandwidth	CPL *RBW [AUTO/MNL]*
㉑	Display status line	
㉒	Frequency span or stop Frequency	SPAN *WidthSpan* or FREQ *Stop*
㉓	Center frequency or start Frequency	FREQ *Center* or *Start*
㉔	Trigger level indicator	TRIG *Source..*
㉕	Active function block	Refer to the description of the Activated function

⑪ ⑫ ⑬ ⑭ ⑮ **Screen Annotation.**



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2. MAKING BASIC MEASUREMENTS

What is in This Chapter

This chapter demonstrates basic analyzer measurements with examples of typical measurements; each measurement focuses on different functions. This chapter dose not focus on testing equipment performance. This explains spectrum analyzer's simple and basic function and usage example in least extra equipment. For more specific information refer to operation manual chapter 5 or for performance test to chapter 6.

The measurement procedures covered in this chapter are listed below.

- Comparing Signals : 2-2
- Resolving Signals of Equal Amplitude : 2-4
- Resolving Small Signals Hidden by Large Signals : 2-7
- Making Better Frequency Measurements : 2-10
- Decreasing the Frequency Span Around the Signal : 2-12
- Tracking Drifting Signals : 2-14
- Measuring Low Level Signals : 2-17
- Identifying Distortion Products : 2-25
- Making Noise Measurements : 2-29
- Demodulating AM Signals : 2-34
- Demodulating FM Signals : 2-38

Comparing Signals

Using the analyzer, you can easily compare frequency and amplitude differences between signals, such as radio or television signal spectra. The analyzer delta marker function lets you compare two signals when both appear on the screen at one time or when only one appears on the screen.

Example 1 : Delta marker function

Measure the differences between two signals on the same display screen.

1. Connect the 10 ㎒ REF OUT from the rear panel of Signal Generator to the spectrum analyzer front panel **RF INPUT**.
2. Set the center frequency to 30 ㎒ and the span to 50 ㎒ by pressing **FREQ**, **30 ㎒**, **SPAN**, **50 ㎒**.
3. Set the reference level to 10 dBm by pressing **AMPL**, **10dBm**.
   The 10 ㎒ reference signal and its harmonics appear on the display.
4. Press **PEAK** to place a marker at the highest peak on the display. (The ***NPeakRight*** and ***NPeakLeft*** softkeys are available to move the marker from peak to peak.) The marker should be on the 10 ㎒ reference signal. See Figure 2-1.

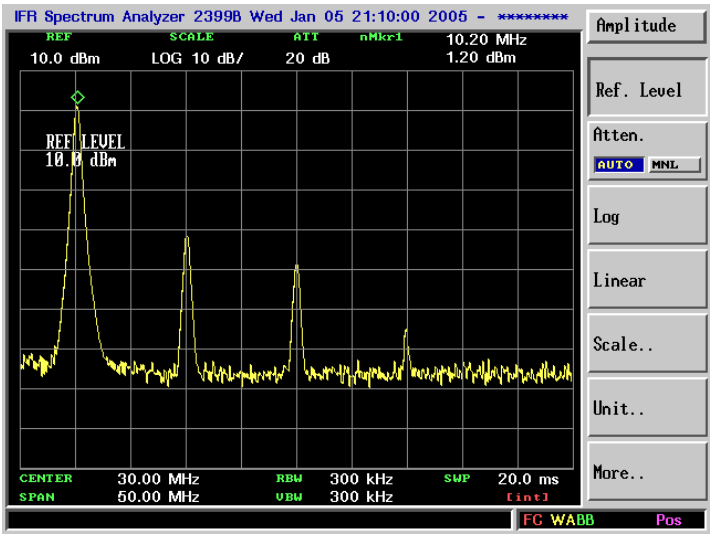

Figure 2-1. Placing a Marker on the 10 ㎒ Signal

5. Press MKR, **Delta**, to activate a second marker at the position of the first marker. Move the second marker to another signal peak using the knob, or by pressing Search and *NPeakRight* or *NPeakLeft*.
6. The amplitude and frequency difference between the markers is displayed in the active function block and in the upper right corner of the screen.
   Press OFF to turn the markers off.

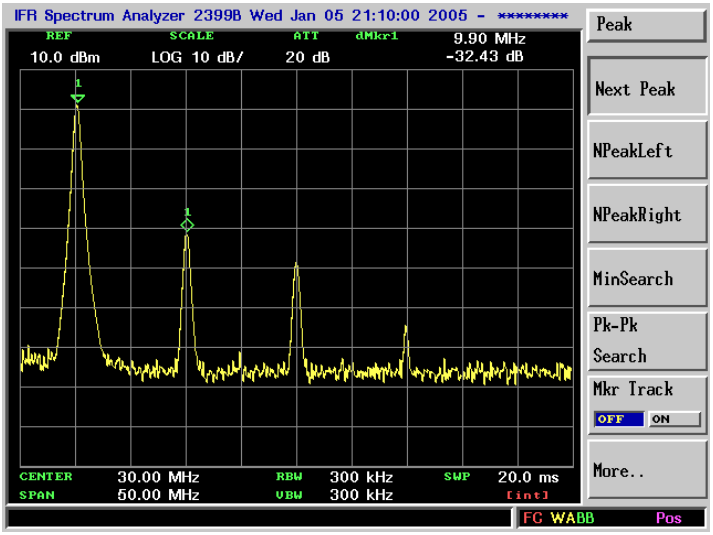

Figure 2-2. Using the Marker Delta Function

Resolving Signals of Equal Amplitude

Two equal-amplitude input signals that are close in frequency can appear as one on the analyzer display. Responding to a single-frequency signal, a swept-tuned analyzer traces out the shape of the selected internal IF (intermediate frequency) filter. As you change the filter bandwidth, you change the width of the displayed response. If a wide filter is used and two equal-amplitude input signals are close enough in frequency, then the two signals appear as one. Thus, signal resolution is determined by the IF filters inside the analyzer.

The bandwidth of the IF filter tells us how close together equal amplitude signals can be and still be distinguished from each other. The resolution bandwidth function selects an IF filter setting for a measurement. Resolution bandwidth is defined as the 3 dB bandwidth of the filter.

Generally, to resolve two signals of equal amplitude, the resolution bandwidth must be less than or equal to the frequency separation of the two signals. If the bandwidth is equal to the separation and the video bandwidth is less than the resolution bandwidth, a dip of approximately 3 dB is seen between the peaks of the two equal signals, and it is clear that more than one signal is present. See Figure 2-4.

In order to keep the analyzer measurement calibrated, sweep time is automatically set to a value that is inversely proportional to the square of the resolution bandwidth (for resolution bandwidths ≥ 1 kHz). So, if the resolution bandwidth is reduced by a factor of 10, the sweep time is increased by a factor of 100 when sweep time and bandwidth settings are coupled. (Sweep time is proportional to $1/BW^2$.) For shortest measurement times, use the widest resolution bandwidth that still permits discrimination of all desired signals. The analyzer allows you to select from 1 kHz to 3 MHz resolution bandwidths in a 1, 3, 10 sequence for maximum measurement flexibility.

Option Digital RBW adds narrower resolution bandwidths, from 10 Hz to 300 Hz, in a 1-3-10 sequence. These bandwidths are digitally implemented and have a much narrower shape factor than the wider, analog resolution bandwidths. Also, the auto coupled sweep times when using the digital resolution bandwidths are much faster than analog bandwidths.

Example : Selection RBW

Resolve two signals of equal amplitude with a frequency separation of 100 ㎑.

1. Connect two sources to the analyzer **RF INPUT** as shown in Figure 2-3.

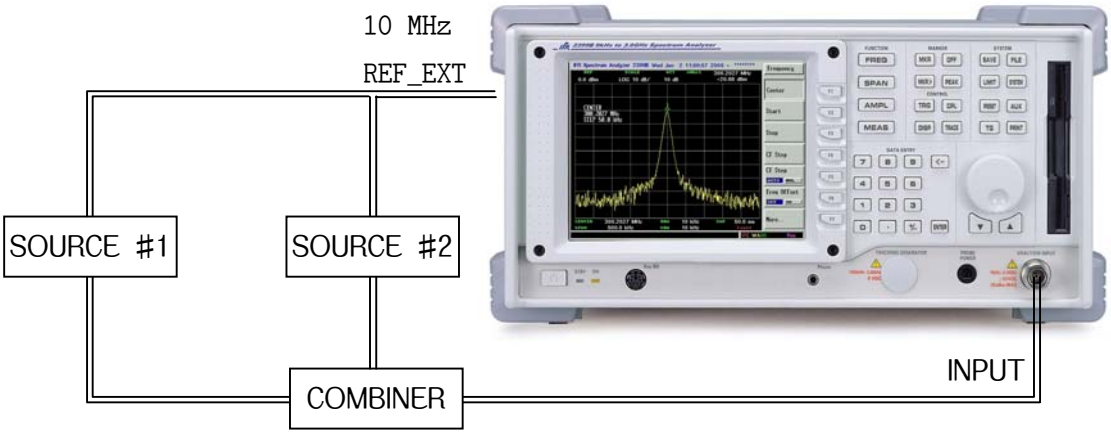

Figure 2-3. Setup for Obtaining Two Signals

2. Set one source to 300 ㎒. Set the frequency of the other source to 300.1 ㎒. The amplitude of both signals should be approximately –10 dBm.

3. On the analyzer, Press PRESET, ***Preset***. Set the center frequency to 300 ㎒, the span to 2 ㎒, and the resolution bandwidth to 300 ㎑ by setting FREQ, **300 ㎒**, SPAN, **2 ㎒**, then CPL, ***RBW AUTO MNL[MNL]***, ***RBW***, **300 ㎑**. A single signal peak is visible.

NOTE :	If the signal peak cannot be found, increase the span to 20 ㎒ by pressing SPAN, **20 ㎒**. The signal should be visible. Press PEAK, MKR>, ***Mkr>CF***, then SPAN, **2 ㎒** to bring the signal to center screen.

4. Since the resolution bandwidth must be less than or equal to the frequency separation of the two signals, a resolution bandwidth of 100 ㎑ must be used.

Change the resolution bandwidth to 100 ㎑ by setting **RBW, 100 ㎑**. Two signals are now visible as shown in Figure 2-4. Use the knob or step keys to further reduce the resolution bandwidth and better resolve the signals.

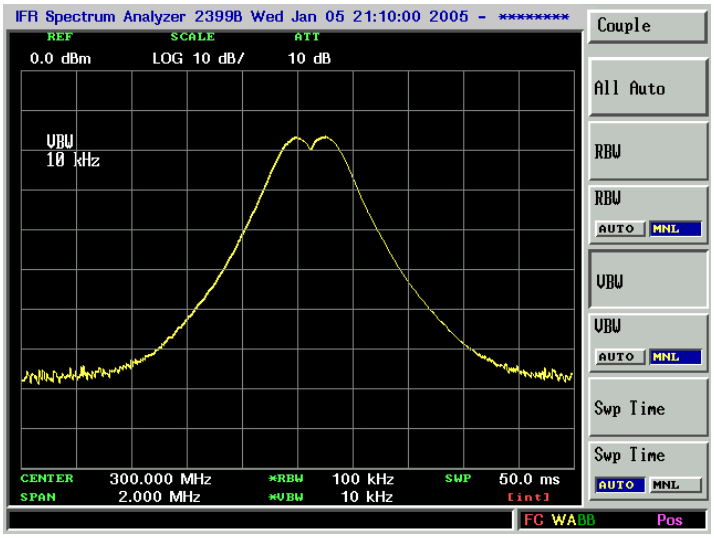

Figure 2-4. Resolving Signals of Equal Amplitude

5. Decrease the video bandwidth to 10 ㎑, by pressing CPL, ***VBW AUTO MNL(MNL), VBW 10 ㎑***. As the resolution bandwidth is decreased, resolution of the individual signals is improved and the sweep time is increased. For fastest measurement times, use the widest possible resolution bandwidth. Under couple conditions, the resolution bandwidth is "coupled" (or linked) to the span.

   Since the resolution bandwidth has been changed from the coupled value, a * mark appears next to **RBW** in the lower-left corner of the screen, indication that the resolution bandwidth is uncoupled. (Ref. Operation Manual : All Auto Function 5-37)

NOTE :	To resolve two signals of equal amplitude with a frequency separation of 200 ㎑, the resolution bandwidth must be less than the signal separation, and resolution of 100 ㎑ must be used. The next larger filter, 300 ㎑, would exceed the 200 ㎑ separation and would not resolve the signals.

Resolving Small Signals Hidden by Large Signals

When dealing with the resolution of signals that are close together and not equal in amplitude, you must consider the shape of the IF filter of the analyzer, as well as its 3dB bandwidth. (See “Resolving Signals of Equal Amplitude” on page 2-5 example for more information.) The shape of a filter is defined by the selectivity, which is the ratio of the 60 dB bandwidth to the 3 dB bandwidth. If a small signal is too close to a larger signal, the smaller signal can be hidden by the skirt of the larger signal. To view the smaller signal, you must select a resolution bandwidth such that k is less than a. See Figure 2-5.

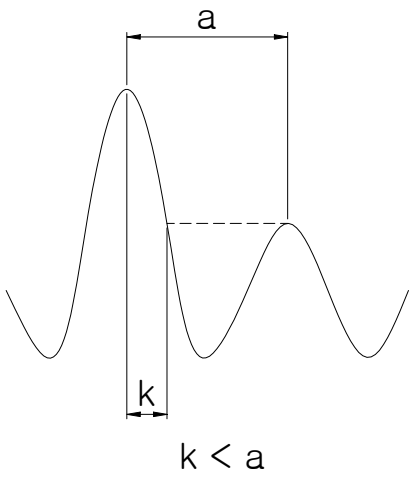

Figure 2-5. Resolution Bandwidth Requirements for Resolving Small Signals

The separation between the two signals (a) must be greater than half the filter width of the larger signal (k) measured at the amplitude level of the smaller signal.

Example : Selection RBW

Resolve two input signals with a frequency separation of 200 kHz and different amplitude.

1. To obtain two signals with a 200 kHz separation, connect the equipment as shown in the previous section, "Resolving Signals of Equal Amplitude" on page 2-5. Set one source to 300 MHz at –10 dBm.

2. Set the analyzer center frequency to 300 MHz and the span to 1 MHz : press FREQ, 300 MHz, then SPAN, 1 MHz.

NOTE :	If the signal peak cannot be fund, increase the span to 10 MHz by pressing SPAN, 10 MHz. The signal should be visible. Press PEAK, MKR> , *Mkr>CF* to bring the signal to center screen, then SPAN, 1 MHz.

3. Set the second source to 300.200 MHz, so that the signal is 200 kHz higher than the first signal. Set the amplitude of the signal to –70 dBm (60 dB below the first signal).

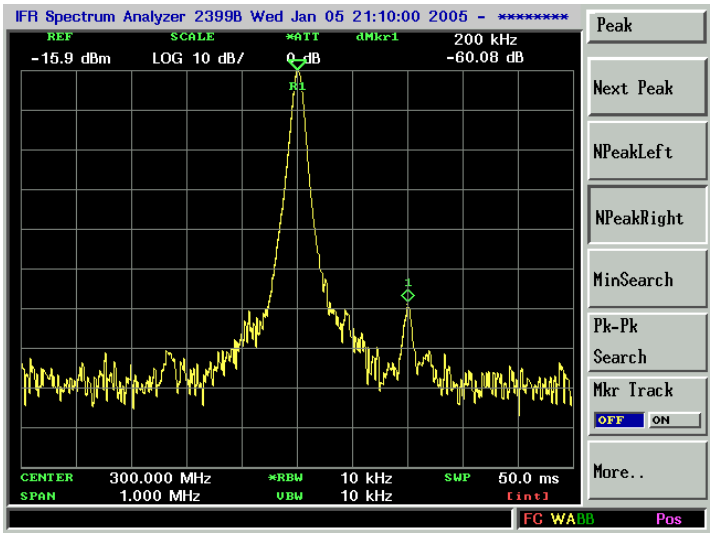

Figure 2-6. Signal Resolution with a 10 kHz Resolution Bandwidth

4. Set the 300 ㎒ signal to the reference level by pressing PEAK, then MKR>, *MKR>Ref*.

   If a 10 ㎑ filter with a typical shape factor 15:1 is used, the filter will have a bandwidth of 150 ㎑ at the 60dB point, the half-bandwidth (75 ㎑) is narrower than the frequency separation, so the input signals will be resolved. See Figure 2-6.

5. Place a marker on the smaller signal by pressing MKR, *Delta*, PEAK, *NPeakRight*. If a 30 ㎑ filter is used, the 60 dB bandwidth could be as wide as 450 ㎑. Since then half-bandwidth (225 ㎑) is wider than the frequency separation(200 ㎑), the signals most likely will not be resolved. See Figure 2-7. (In this example, we used the 60 dB bandwidth value. To determine resolution capability for intermediate values of amplitude level differences, assume the filter skirts between the 3 dB and 60 dB points are approximately straight.)

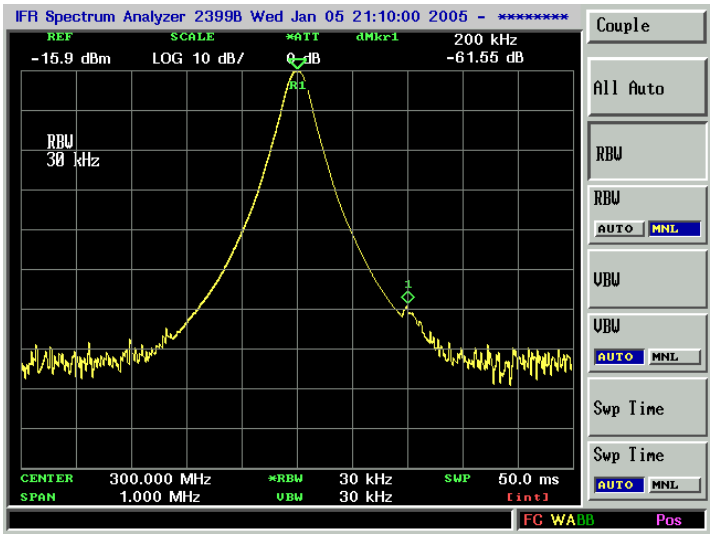

Figure 2-7. Signal Resolution with a 30 ㎑ Resolution Bandwidth

Making Better Frequency Measurements

A built-in frequency counter increases the resolution and accuracy of the frequency readout.

Example : Marker counter function

Increase the resolution and accuracy of the frequency readout on the signal of interest.

1. Turn on the internal 40 ㎒ calibration signal of the analyzer (if you have not already done so). Press PRESET, *Cal. signal [ON]*.
2. Set the center frequency to 40 ㎒ by pressing FREQ, **40 ㎒**.
3. Set the span to 10 ㎒ by pressing SPAN, **10 ㎒**.
4. Press MKR, **More..**, **Function..**, **Counter**. The counted result appears in the upper-right corner of the screen and also displays on maker table in the bottom screen. Maker table can be off by pressing MKR, *More.., MKR Table [ON]* so that ON is highlighted.
5. Move the marker on the peak of the signal, with pressing PEAK.

NOTE :	Marker count properly functions only on CW signals of discrete spectral components and its level is more than –70 dBm.

6. Increase the counter resolution by pressing MKR, *More.., Function.., Counter* and then setting the desired resolution using the step keys or the knob. The marker counter readout is in the upper-right corner of the screen. The resolution can be set from 1 ㎐ to 1 ㎑ in decade step.
7. The marker counter remains on until turned off. Turn off the marker counter by pressing MKR, *More.., Function.., Off* or OFF.

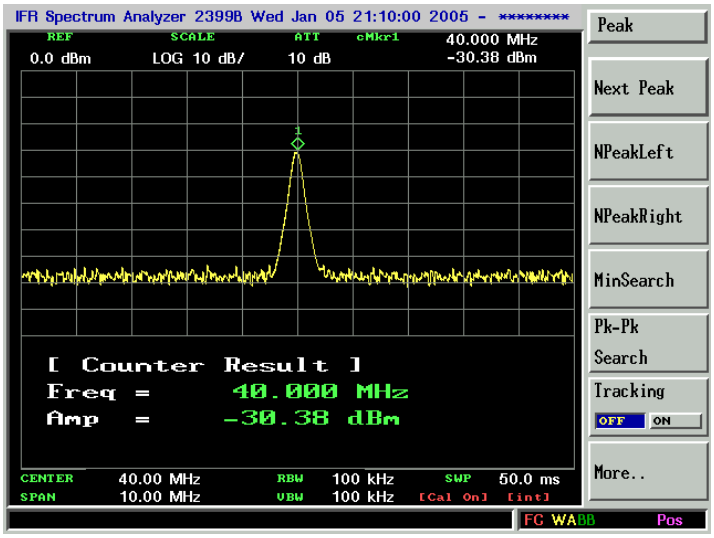

Figure 2-8. Using Marker Counter

Decreasing the Frequency Span Around the Signal

Using the analyzer signal tracking function, you can quickly decrease the span while keeping the signal at center frequency. This is a fast way to take a closer look at the area around the signal to identify signals that would otherwise not be resolved.

Example : Mkr Track function

Examine a signal in a 200 ㎑ span.

1. Turn on the internal Cal Signal 40 ㎒ calibration signal of the analyzer (if you have not already done so). Press PRESET, *Cal. signal [ON]*.
2. Set the stop frequency to 1 ㎓ by pressing FREQ, *Stop, 1 ㎓*.
3. Press PEAK to place a marker at the peak.
4. Press PEAK, *Mkr Track [On]* and the signal will move to the center of the screen, if it is not already positioned there. (Note that the marker must be on the signal before turning signal tracking on.) Because the signal tracking function automatically maintains the signal at the center of the screen, you can reduce the span quickly for a closer look. If the signal drifts off of the screen as you decrease the span, use a wider frequency span.
5. Press SPAN, 200 ㎑. The span decreases in steps as automatic zoom is completed. See Figure 2-9. You can also use the scroll knob or step keys to decrease the span or use the *Zoom* function under SPAN.

Press PEAK *Tracking [OFF]* again (so that Off is highlighted) to turn off the signal tracking function.

NOTE :	When you are finished with the example, turn off the signal tracking function.

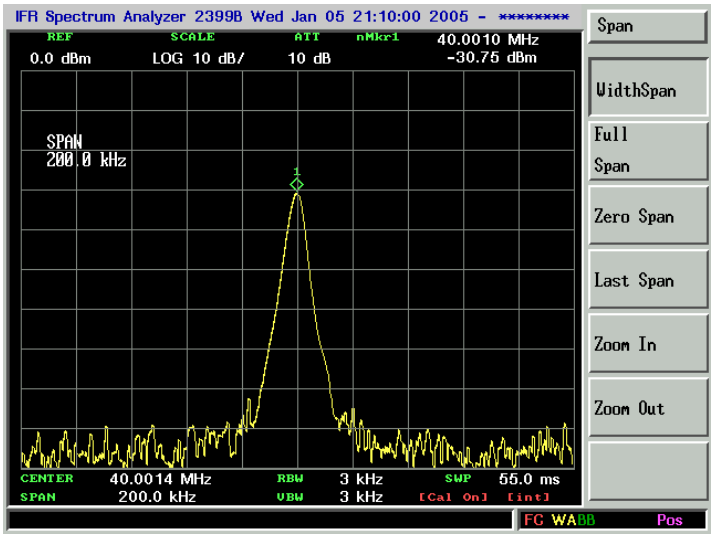

Figure 2-9. After Zoom-In on the Signal

Tracking Drifting Signals

The signal tracking function is useful for tracking drifting signals that drift relatively slowly.

PEAK, *Mkr Track* may be used to track these drifting signals. Use PEAK to place a marker on the signal you wish to track. Pressing PEAK, *Mkr Track [ON]* will bring that signal to the center frequency of the graticule and adjust the center frequency every sweep to bring the selected signal back to the center.

Note that the primary function of the signal tracking function is to track unstable signals, not to track a signal as the center frequency of the analyzer is changed. If you choose to use the signal tracking function when changing center frequency, check to ensure that the signal found by the tracking function is the correct signal.

Example 1 : Mkr Track function

Use the signal tracking function to keep a drifting signal at the center of the display and monitor its change.

This example requires signal generator. The frequency of the signal generator will be changed while you view the signal on the display of the analyzer.

1. Connect a signal generator to the analyzer **RF INPUT**. Press PRESET, **Preset**.
2. Set the signal generator frequency to 300 ㎒ with an amplitude of –20 dBm.
3. Set the center frequency of the analyzer to 300 ㎒ by pressing FREQ, **300 ㎒**.
4. Press PEAK to move the marker to the peak of your signal.
5. Set the span to 10 ㎒ by pressing SPAN, **10 ㎒**.
6. Press SPAN, **500 ㎑**.
   Notice that the signal has been held in the center of the display.
7. The signal frequency drift can be read from the screen if both the signal tracking and marker delta functions are active. Press PEAK, **Mkr** *Track [ON]*. The marker readout indicates the change in frequency and amplitude as the signal drifts.
8. Tune the frequency of the signal generator. Notice that the center frequency of the

analyzer changes in < 10 ㎑ increments, centering the signal with each increment. See Figure 2-10.

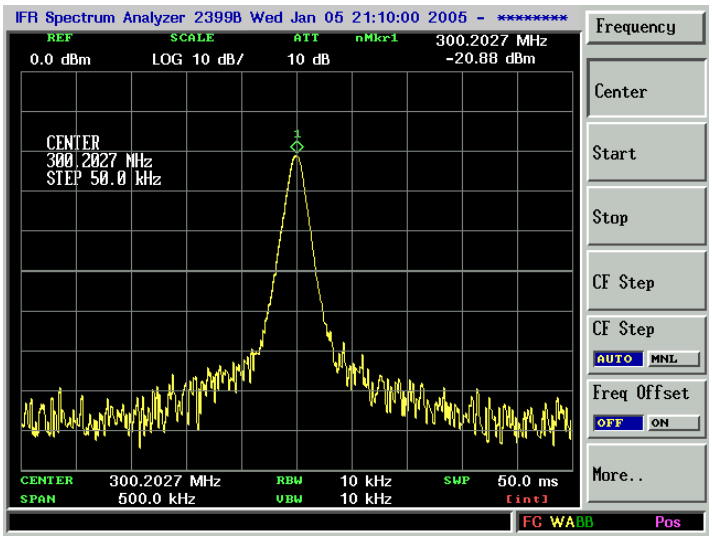

Figure 2-10. Using Signal Tracking to Track a Drifting Signal

Example 2 : Max Hold function

The analyzer can measure the short-and long-term stability of a source. The maximum amplitude level and the frequency drift of an input signal trace and be displayed and held by using the maximum-hold function. Yon can also use the maximum hold function if you want to determine how much of the frequency spectrum a signal occupies.

1. Connect a signal generator to the analyzer **RF INPUT**. Press PRESET, *Preset*.
2. Set the signal generator frequency to 300 ㎒ with an amplitude of –20 dBm.
3. Set the center frequency of the analyzer to 300 ㎒ by pressing FREQ, **300 ㎒**.
4. Press PEAK to move the marker to the peak of your signal.
5. Set the span to 10 ㎒ by pressing SPAN, **10 ㎒**.
6. Press SPAN, **500 ㎑**.
7. To measure the excursion of the signal, press TRACE then **Max Hold**. As the signal

varies, maximum hold maintains the maximum responses of the input signal. Annotation on the left side of the screen indicates the trace mode(MAX HOLD) as MA WB. (ref. Annotation 1-9)

8. Press ***Select [B]*** to select trace B. (Trace B is selected when All A change to B in menu.) Press ***Clr & Wrt*** to place trace B in clear-write mode, which displays the current measurement results as it sweeps. Trace A remains in maximum hold mode, showing the frequency shift of the signal.

   Slowly change the frequency of the signal generator ±50 ㎑. Your analyzer display should look similar to Figure 2-11.

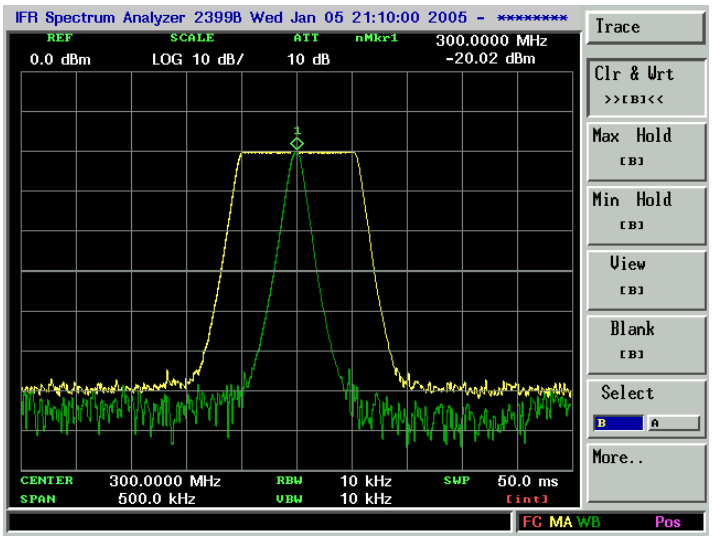

Figure 2-11. Viewing a Drifting Signal with Max Hold and Clear Write

Measuring Low Level Signals

The ability of the analyzer to measure low level signals is limited by the noise generated inside the analyzer. A signal may be masked by the noise floor so that it is not visible. This sensitivity to low level signals is affected by the measurement setup.

The analyzer input attenuator and bandwidth setting affect the sensitivity by changing the signal-to-noise ratio. The attenuator affects the level of a signal passing through the instrument, whereas the bandwidth affects the level of internal noise without affecting the signal. In the first two examples in this section, the attenuator and bandwidth settings are adjusted to view low level signals.

If, after adjusting the attenuation and resolution bandwidth, a signal is still near the noise, visibility can be improved by using the video bandwidth and video averaging functions, as demonstrated in the third and fourth examples.

Example 1 : Set input attenuation

If a signal is very close to the noise floor, reducing input attenuation brings the signal out of the noise. Reducing the attenuation to 0 dB maximizes signal power in the analyzer.

CAUTION The total power of all input signals at the analyzer input must not exceed the maximum power level for the analyzer.

1. Connect a signal generator to the analyzer **RF INPUT**. Press **PRESET**, ***Preset*** on the analyzer.
2. Set the signal generator frequency to 300 ㎒ with an amplitude of –80 dBm.
3. Set the center frequency of the analyzer to 300 ㎒ by pressing **FREQ**, **300 ㎒**.
4. Set the span to 5 ㎒ by pressing **SPAN**, **5 ㎒**.
5. Set the reference level to –40dBm by pressing **AMPL**, ***Ref Level***, **-40 dBm**.
6. Place the signal at center frequency by pressing **PEAK**, **MKR>**, ***Mkr>CF***.
7. Reduce the span to 1 ㎒. Press **SPAN**, and then use the step-down key (▼). See Figure 2-12.

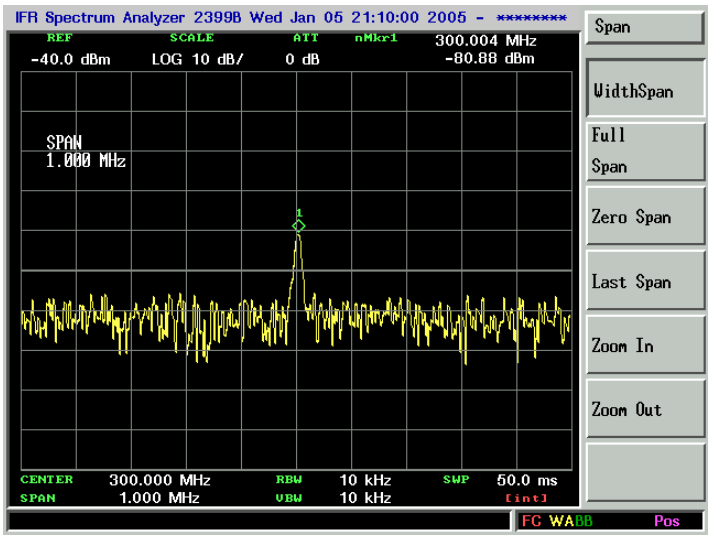

Figure 2-12. Using 0 dB Attenuation

8. Press AMPL, *Atten [MNL]*. Press the step-up key (▲) to select 10 dB attenuation. Increasing the attenuation moves the noise floor closer to the signal. See Fig 2-13. A * mark appears next to the ATT annotation at the top of the display, indicating the attenuation is no longer coupled to other analyzer setting.
9. To see the signal more clearly, enter **0 dB** or *Atten [AUTO]*. Zero attenuation makes the signal more visible.

CAUTION Before connecting other signals to the analyzer input, increase the RF attenuation to protect the analyzer input.

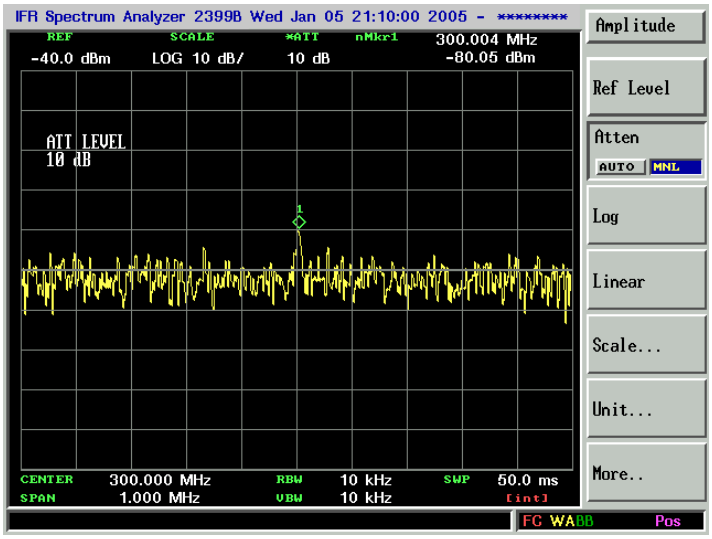

Figure 2-13. Low-Level Signal with 10dB Attenuation

Example 2 : Selection RBW

The resolution bandwidth can be decreased to view low level signals.

1. As in the previous example, set the analyzer to view a low level signal. Connect a signal generator to the analyzer **RF INPUT**. Press **PRESET**, ***Preset*** on the analyzer.
2. Set the signal generator frequency to 300 ㎒ with an amplitude of –80 dBm.
3. Set the center frequency of the analyzer to 300 ㎒ by pressing **FREQ**, **300 ㎒**.
4. Set the span to 1 ㎒ by pressing **SPAN**, **1 ㎒**.
5. Set the reference level to –40 dBm by pressing **AMPL**, ***Ref Level***, **-40 dBm**.
6. Press **CPL**, ***RBW [MNL]***, ***RBW***, and the step-down key (▼) to decrease RBW. The low level signal appears more clearly because the noise level is reduced. See Figure 2-14.

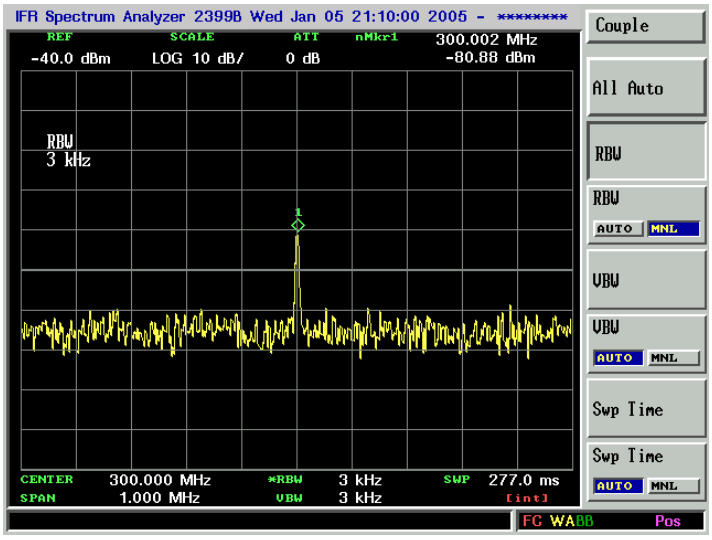

Figure 2-14. Decreasing Resolution Bandwidth

A * mark appears next to the RBW annotation at the lower center of the screen, indicating that the resolution bandwidth is uncoupled.

As the resolution bandwidth is reduced, the sweep time is increased to maintain calibrated data.

Example 3 : Selection VBW

Narrowing the video filter can be useful for noise measurements and observation of low level signals close to the noise floor. The video filter is a post-detection low-pass filter that smoothes the displayed trace. When signal responses near the noise level of the analyzer are visually masked by the noise, the video filter can be narrowed to smooth this noise and improve the visibility of the signal. (Reducing video bandwidths requires slower sweep times to keep the analyzer calibrated.)

Using the video bandwidth function, measure the amplitude of a low level signal.

1. As in the previous example, set the analyzer to view a low level signal. Connect a signal generator to the analyzer **RF INPUT**. Press **PRESET**, *Preset* on the analyzer.
2. Set the signal generator frequency to 300 ㎒ with an amplitude of –80 dBm.
3. Set the center frequency of the analyzer to 300 ㎒ by pressing **FREQ**, **300 ㎒**.
4. Set the span to 1 ㎒ by pressing **SPAN**, **1 ㎒**.
5. Set the reference level to –40dBm by pressing **AMPL**, *Ref Level*, **-40dBm**.
6. Set the video bandwidth to 100Hz by pressing **CPL**, *VBW [MNL]*, *VBW*, and the step-down key (▼). This clarifies the signal by smoothing the noise, which allows better measurement of the signal amplitude.

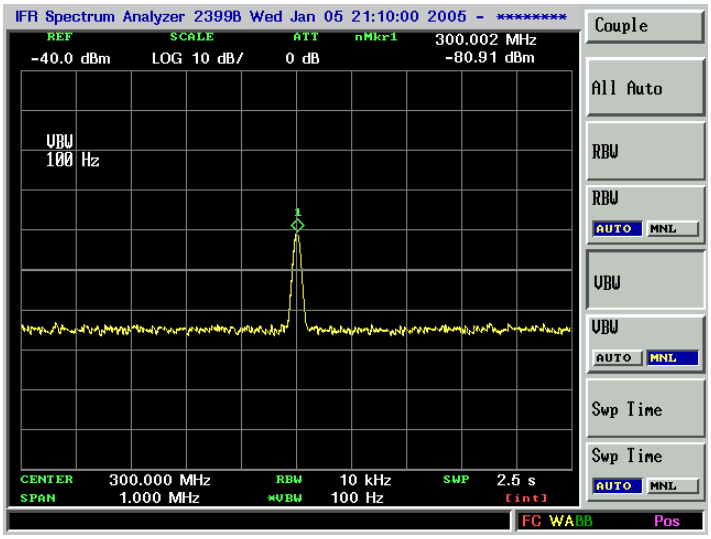

Figure 2-15. Decreasing Video Bandwidth

A * mark appears next to the VBW annotation at the bottom of the screen, indicating that the video bandwidth is not coupled to the resolution bandwidth. See Figure 2-15.

Instrument preset conditions couple the video bandwidth to the resolution bandwidth so that the video bandwidth is equal to the resolution bandwidth. If the bandwidths are uncoupled when video bandwidth is the active function, pressing *VBW [AUTO]* (so that Auto is highlighted) recouples the bandwidths.

NOTE :	The video bandwidth must be set wider than the resolution bandwidth when measuring impulse noise levels.

Example 4 : Video average function

If a signal level is very close to the noise floor, video averaging is another way to make the signal more visible.

NOTE :	The time required to construct a full trace that is averaged to the desired degree is approximately the same when using either the video bandwidth or the video averaging technique. The video bandwidth technique completes the averaging as a slow sweep is taken, whereas the video averaging technique takes many sweeps to complete the average. Characteristics of the signal being measured, such as drift and duty cycle, determine which technique is appropriate.

Video averaging is a digital process in which each trace point is averaged with the previous trace-point average. Video averaging clarifies low-level signals in wide bandwidths by averaging the signal and the noise.

1. As in the previous example, set the analyzer to view a low level signal. Connect a signal generator to the analyzer **RF INPUT**. Press **PRESET**, ***Preset*** on the analyzer.
2. Set the signal generator frequency to 300 ㎒ with an amplitude of –80 dBm.
3. Set the center frequency of the analyzer to 300 ㎒ by pressing **FREQ**, **300 ㎒**.
4. Set the span to 1 ㎒ by pressing **SPAN**, **1 ㎒**.
5. Set the reference level to –40 dBm by pressing **AMPL**, ***Ref Level***, **-40 dBm**.
6. Press **TRACE**, ***More.., Average..*** then ***Average [ON]***. When ON is highlighted, the video averaging routine is initiated. As the averaging routine smoothes the trace, low level signals be come more visible. Average *Count [8]* appears on the right-upper screen. The number represents the number of samples (or sweeps) taken to complete the averaging routine.
7. To set the number of samples, press ***Count*** and use the numbers keypad. For example, press ***Average [ON]*** (so that ON is highlighted), **2, 5,** and **ENTER**. Reset will initialize current average and start averaging.

   During averaging, the current sample number appears in the right-upper screen. The sampling will also restart if video averaging is turned off and then on again.

Once the set number of sweeps has been completed, the analyzer continues to provide a running average based on this set number.

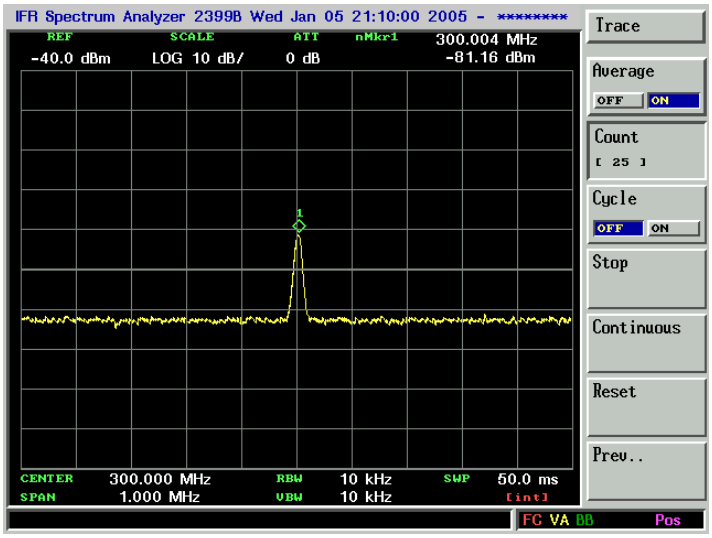

Figure 2-16. Using the Video Averaging Function

Identifying Distortion Products

Distortion from the Analyzer

High level input signals may cause analyzer distortion products that could mask the real distortion measured on the input signal.

Example : Delta marker function

Using a signal from a signal generator, determine how many the harmonic distortion products are generated by the analyzer. Fine distortion measurement is possible when suppress the input signal's distortion.

1. Connect a signal generator to the analyzer **RF INPUT**. Set the signal generator frequency to 200 ㎒ and the amplitude to 0 dBm.
2. Set the center frequency of the analyzer to 400 ㎒ and the span to 500 ㎒ by pressing FREQ, **400 ㎒**, SPAN, **500 ㎒**.

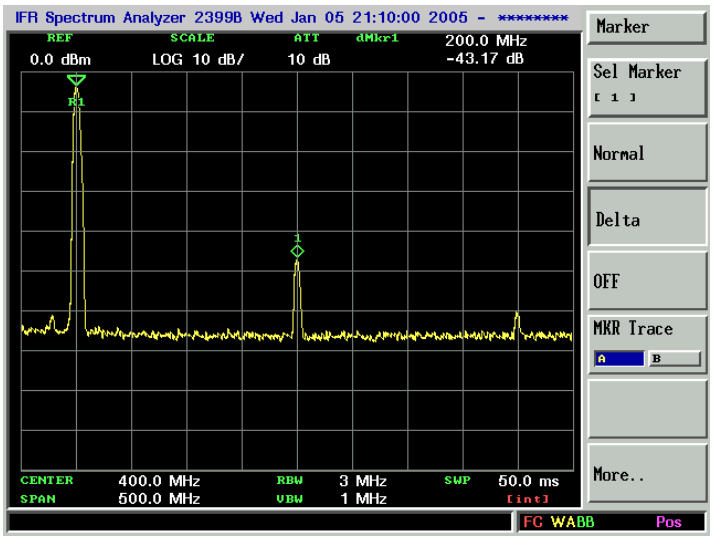

Figure 2-17. Harmonic Distortion

To measure the second harmonic distortion, press PEAK then the marker is located in the highest signal, fundamental signal(200MHz). Press MKR, *Delta,* and *200MHz*, then the marker is located in the second harmonic signal. The signal shown in Figure 2-17 produces harmonic distortion products in the analyzer input mixer.

Notice that you must consider the harmonic distortion product, when measuring the high level signal.

Third-Order Intermodulation Distortion

Two-tone, third-order intermodulation distortion is a common test in communication systems. When two signals are present in a non-linear system, they can interact and create third-order intermodulation distortion products that are located close to the original signals. These distortion products are generated by system components such as amplifiers and mixers.

Example : Delta marker function

Test a device for third-order intermodulation. This example uses two sources, one set to 300 ㎒ and the other to approximately 301 ㎒. (Other source frequencies may be substituted, but try to maintain a frequency separation of approximately 1 ㎒.)

1. Connect the equipment as shown in Figure 2-18. Press PRESET, *Preset*.

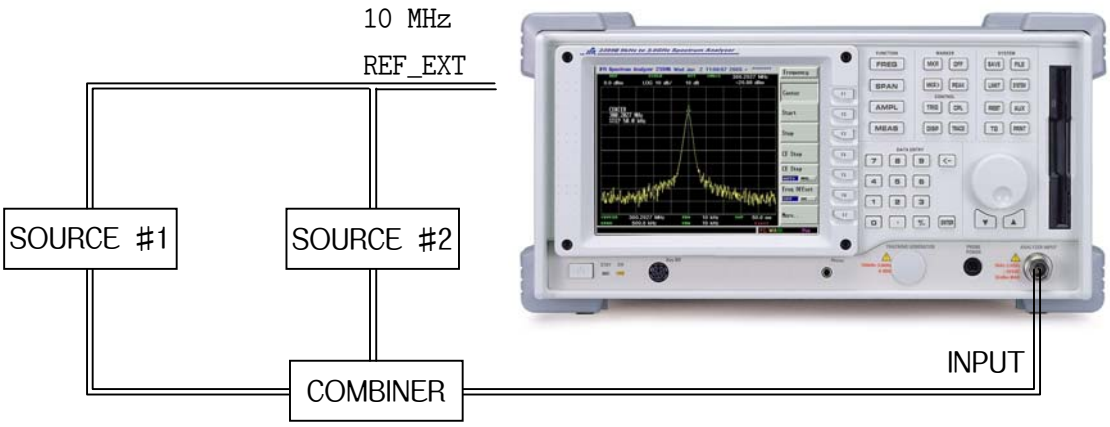

Figure 2-18. Third-Order Intermodulation Equipment Setup

NOTE :	The combiner should have a high degree of isolation between the two input ports so the sources do not intermodulate.

2. Set one source to 300 ㎒ and the other source to 301 ㎒, for a frequency separation of 1 ㎒. Set the sources equal in amplitude (in this example, they are set to –5 dBm).
3. Tune both signals onto the screen by setting the center frequency 300.5 ㎒. Then, using the knob, center the two signals on the display. Reduce the frequency span to 5 ㎒. This is wide enough to include the distortion products on the screen. To be sure the distortion products are resolved, reduce the resolution bandwidth until the distortion products are visible.
4. Press CPL, *RBW [MNL], RBW*, and the used the step-down key (▼) to reduce the resolution bandwidth until the distortion products are visible.
5. To measure a distortion product, press Marker to place a marker on a source signal. To activate the second marker, press MKR, *Delta*. Using the knob, adjust the second marker to the peak of the distortion product that is beside the test signal. The difference between the markers is displayed in the upper-right screen.

   To measure the other distortion product, press PEAK, *NpeakLeft* or *NPeakRight*. This places a marker on the next highest peak, which, in this case, is the other source signal. To measure the difference between this test signal and the second distortion product, press MKR *Delta* and use the knob to adjust the second marker to the peak of the second distortion product. See Figure 2-19.

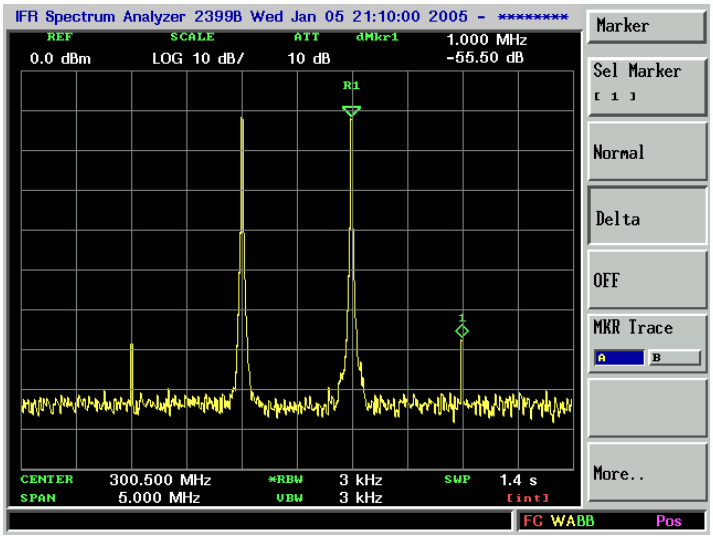

Figure 2-19. Measuring the Distortion Product

Making Noise Measurements

There are a variety of ways to measurement noise power. The first decision you must make is whether you want to measure noise power at a specific frequency or the total power over a specified frequency range, for example over a channel bandwidth.

Example 1 : MKR Noise function

Using the marker function, **MKR Noise**, is a simple method to make a measurement at a single frequency. In this example, attention must be made to the potential errors due to discrete signal (spectral components). This measurement will be made near the 40 ㎒ amplitude reference signal to illustrate the use of **MKR Noise**.

1. Turn on the internal 40 ㎒ calibration signal of the analyzer (if you have not already done so). Press PRESET, *Preset, Cal. signal [ON].*
2. Tune the analyzer to the frequency of interest. In this example we are using the reference signal. Press FREQ, **39.98 ㎒**.
3. Set the span the 50 ㎑ by pressing SPAN, **50 ㎑**.

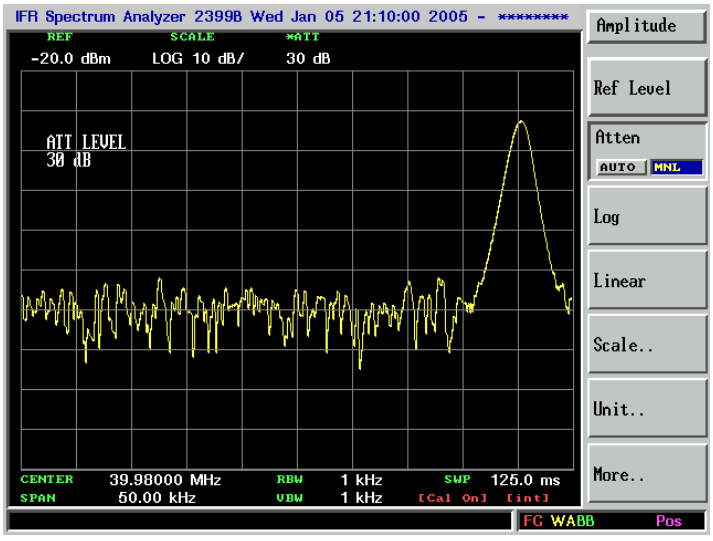

Figure 2-20. Setting the input attenuator

4. Set the reference level to –20 dBm by pressing AMPL, *Ref Level, -20 dBm*. See Figure 2-20. Note that if the signal is much higher than shown, adjust the input attenuator. In this example the input attenuation was set to 30dB by pressing *Atten. [MNL]*, 30dB.
5. Activate the noise marker by pressing MKR, *More.., Function.., MKR Noise*.
   Note that the display detection has changed to sample, the marker floats between the maximum and the minimum of the noise. The marker readout is in dBm or dBm per bandwidth. See Figure 2-21. For noise power in a different bandwidth, add 10× log (BW). For example, for noise power in a 1 ㎑ bandwidth, add 10×log (1000) or 30dB to the noise marker value.

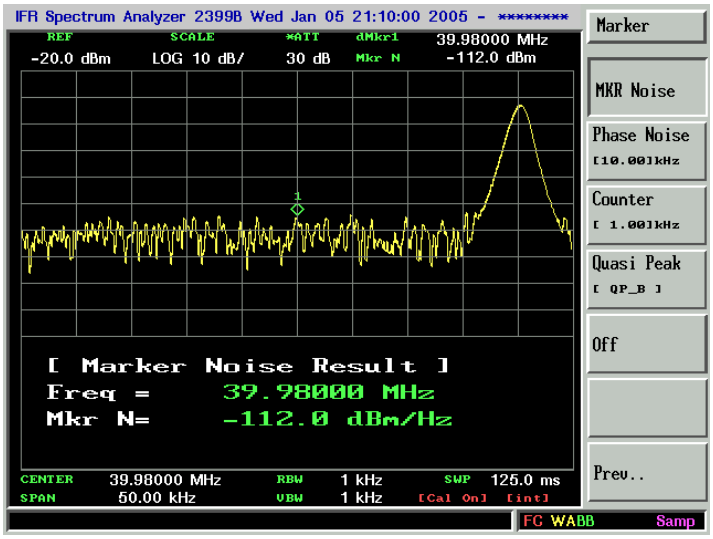

Figure 2-21. Activating the Noise Marker function

6. Video filtering can be introduced to reduce the variations of the sweep-to-sweep marker value. Set the video filter by pressing CPL, *VBW [MNL], VBW,* 100 ㎐.

   Notice that these variations are to be expected due to the nature of the signal. We can reduce the variations by introducing video filtering. Since reducing the video bandwidth filter impacts sweep time, it is recommended to limit the degree of filtering.

Example 2 : Video filtering/Average

The Normal marker can also be used to make a signal frequency measurement as described in the previous example, again using video filtering or averaging to obtain a reasonably stable measurement.
While video averaging automatically selects the sample display detection mode, video filtering does not. With sufficient filtering that results in a smooth trace there is no difference between the sample and peak modes because the filtering takes place before the signal is digitized.

Be sure to account for the fact that the averaged noise is displayed approximately 2 dB too low for a noise bandwidth equal to the resolution bandwidth. Therefore, you must add 2 dB to the marker reading. For example, if the marker indicates –100 dBm, the actual noise level is –98 dBm.

Example 3 : Channel power measurement

You may want to measure the total power of a noise-like signal that occupies some bandwidth. For example, you may want to determine the power in a communications channel. If the signal is noise and is flat across the band of interest, you can use the noise marker as described in example 1 and add 10×log (channel BW). However, if you are not certain of the characteristics of the signal, or if there are discrete spectral components in the band of interest, we can use the Channel Power routine. In this example, you will use the noise of the analyzer then add a discrete tone to see what happens and assume a channel bandwidth of 50 ㎑. If desired, a specific signal may be substituted.

1. Reset the analyzer by pressing PRESET, *Preset*.
2. Tune the analyzer to the frequency of 40 ㎒. In this example we are using the amplitude reference signal. Press FREQ, **40 ㎒**.
3. Set the span to 100 ㎑ by pressing SPAN, **1 ㎒**.
4. Set the reference level to –30dBm by pressing AMPL, *Ref Level*, **-30 dBm**.
5. Set the input attenuation to 40dB by pressing AMPL, *Atten [MNL]*, **40dB**.
6. Set the analyzer to setup the channel-power measurement by pressing MEAS, *Channel Power...*.
7. Set the integration bandwidth to 500 ㎑ by pressing *Integ BW*, **500 ㎑**.
8. Set the channel-power span to 100 ㎑ by pressing *Ch PWR Span*, **1 ㎒**.

NOTE :	The display detection mode has been set to sample and the video bandwidth has been set to be ten times wider than the resolution bandwidth. This setting is important to prevent any averaging. You can reduce the sweep-to-sweep variation in the power reading by averaging over a number of sweeps.

9. Turn average number on by pressing *Meas. Avg. [ON]*. Add a discrete tone to see the affects of the reading. Turn on the internal 40 ㎒ calibration signal of the analyzer (if you have not already done so). Press PRESET, *Cal. signal [ON]*.

The channel power reading is essentially equal to 40 ㎒ calibration signal. The total noise power is far enough below that of the tone that the noise power contributes very little

to the total.

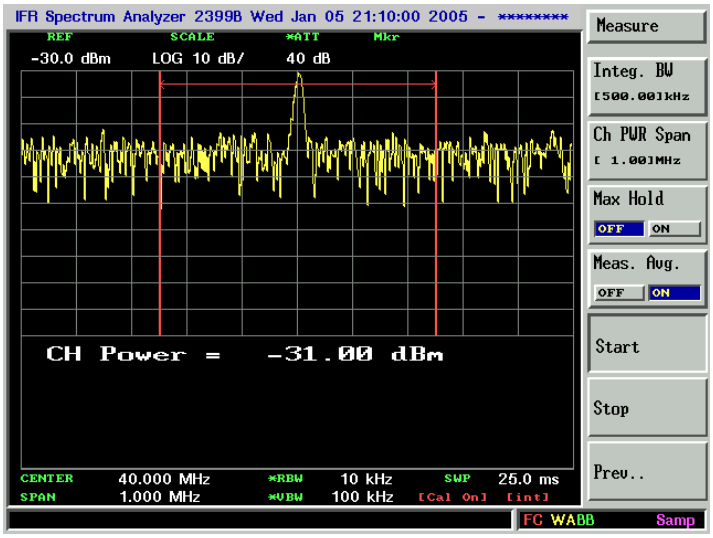

Figure 2-22. Measuring Channel Power

The algorithm that computes the total power compensates for the fact that some of the trace points on the response to the continuous wave tone may be at or very close to the peak value of the tone and so yields the correct value whether the signal comprises just noise, a tone, or both.

Demodulating AM Signals

The zero span mode can be used to recover amplitude modulation on a carrier signal. The analyzer operates as fixed-tuned receiver in zero span to provide time domain measurements.

Center frequency in the swept-tuned mode becomes the tuned frequency in zero span. The horizontal axis of the screen becomes calibrated in time only, rather than both frequency and time. Markers display amplitude and time values.

The following functions establish a clear display of the waveform:

- Trigger stabilizes the waveform trace on the display by triggering on the modulation envelope. If the modulation of the signal is stable, video trigger synchronizes the sweep with the demodulated waveform.
- Linear mode should be used in amplitude modulation (AM) measurements to avoid distortion caused by the logarithmic amplifier when demodulation signals.
- Sweep time adjusts the full sweep time from 20 ㎳ to 1000 s (from 25 ㎲ to 15 s in zero span). The sweep time readout refers to the full 10-division graticule. Divide this value by 10 to determine sweep time per division.
- Resolution and video bandwidth are selected according to the signal bandwidth.

Each of the coupled function values remains at its current value when zero span is activated. Video bandwidth is coupled to resolution bandwidth. Sweep time is not coupled to any other function.

Example : AM Demod. Function

View the modulation waveform of an AM signal in the time domain.

1. To obtain an AM signal, you can either connect a source to the analyzer input and set the source for amplitude modulation, or connect an antenna to the analyzer input and tune to a commercial AM broadcast station. This example uses a source. (If you are using a commercial broadcast station as your signal, press AUX, *AM Demod. [ON]* to turn on AM demodulation. Then press *Audio Sound [ON]*, and the analyzer will operate as a radio.)
2. Connect a signal generator output to the analyzer RF INPUT.
3. Set a source output frequency to 300 ㎒, AM rate to 400Hz, and AM depth to 50%.
4. Set the center frequency of the analyzer to 300 ㎒ by pressing FREQ, 300 ㎒.
5. To demodulate the AM, press AUX, *AM Demod. [ON]*. See Figure 2-23.

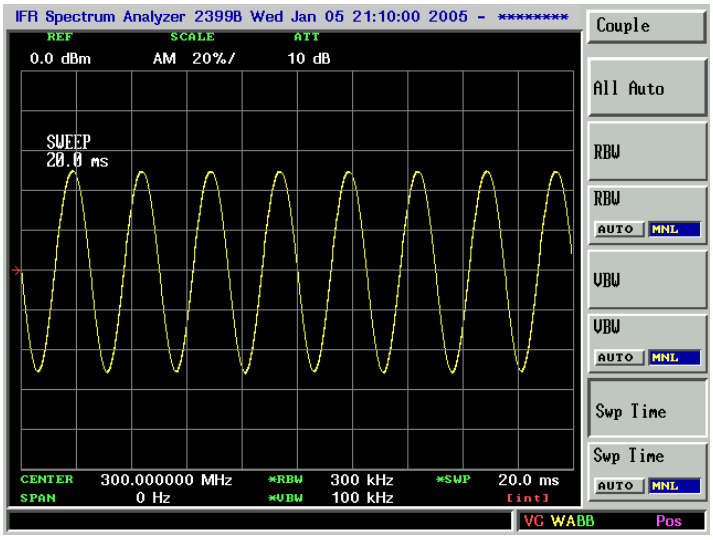

Figure 2-23. Measuring Modulation Using AM Demodulation Function.

Another method to demodulate AM signal is using zero span by repeating the step 1 to 4 and performing the following steps.

6. Set the span to 20 MHz by pressing SPAN, **20 MHz**.
7. Set the resolution bandwidth to 1 MHz by pressing CPL, *RBW [MNL]*, *RBW*, **1 MHz**. See Figure 2-24.

Figure 2-24. Viewing an AM Signal

8. Increase the resolution bandwidth to include both sidebands of the signal within the 1 dB passband of the analyzer (about 2/3 of the 3 dB BW).
9. To select zero span, either press SPAN, **0 Hz**, or press SPAN, *Zero Span*.
10. Next, position the signal peak near the reference level and select a linear voltage display. Press AMPL, *Linear*, *Ref Level*, then adjust the reference level.
11. Adjust the sweep time to change the horizontal scale by pressing CPL, *Swp Time [MNL]*, **Swp Time**, **10 ms**. See Figure 2-25.

    If the modulation is a steady tone, for example from a signal generator, use video trigger to trigger on the waveform and stabilize the display. (If you are viewing an off-the-air signal you will not be able to stabilize the waveform.)

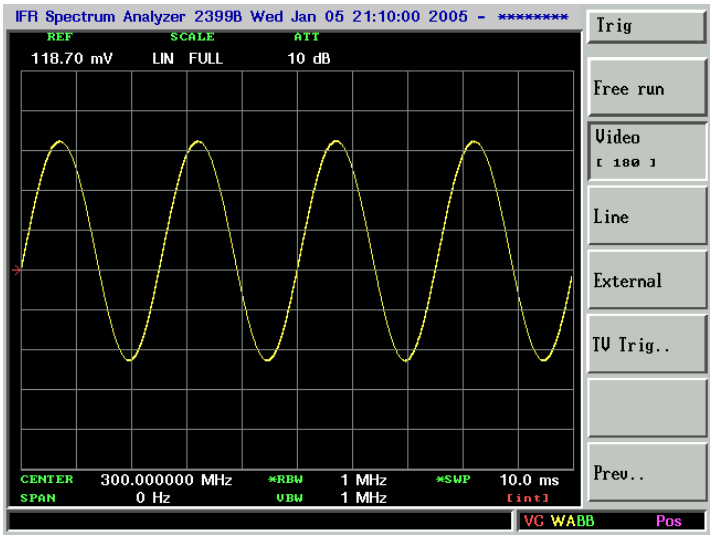

Figure 2-25. Measuring Modulation in Zero Span.

Use markers and delta markers to measure the time parameters of the waveform.

Demodulating FM Signals

As with amplitude modulation you can utilize zero span to demodulate a FM signal. However, unlike the AM case, you cannot simply tune to the carrier frequency and widen the resolution bandwidth. The reason is that the envelope detector in the analyzer responds only to amplitude variations, and there is no change in amplitude if the frequency changes of the FM signal are limited to the flat part of the resolution bandwidth.

You can demodulate FM signals by using the FM demodulation function.
On the other hand, if you tune the analyzer slightly away from the carrier, you can utilize slope detection to demodulate the signal by performing the following steps.

1. Determine the correct resolution bandwidth.
2. Fine the center of the linear portion of the filter skirt (either side).
3. Tune the analyzer to put the center point at mid screen of the display.
4. Select zero span.

The demodulated signal is now displayed; the frequency changes have been translated into amplitude changes. See the following figure. To listen to the signal, turn on AM demodulation and the speaker.

In this example you will demodulate a broadcast FM signal that has a specified 75 ㎑ peak deviation.

Example : Delta marker function

Determine the correct resolution bandwidth. With a peak deviation of 75 ㎑, your signal has a peak-to-peak excursion of 150 ㎑. So we must find a resolution bandwidth filter with a skirt that is reasonably linear over that frequency range.

1. Turn on the internal 40 ㎒ calibration signal of the analyzer (if you have not already

done so). Press PRESET, *Preset, Cal signal [ON]*.

2. Tune the analyzer to the frequency 40 MHz. In this example we are using the amplitude reference signal. Press FREQ, **40 MHz**.
3. Set the span to 1 MHz by pressing SPAN, **1 MHz**.
4. Set the reference level to –30dBm by pressing AMPL, **Ref Level, -30 dBm**.
5. Set the resolution bandwidth to 100 kHz by pressing CPL, *RBW [MNL], RBW, 100 kHz*. The skirt is reasonably linear starting about half a division down from the peak.
6. Select a marker by pressing MKR, then move the marker approximately half a division down the right of the peak (high frequency) using the front-panel knob.
7. Place a delta marker 150 kHz from the first marker by pressing *Delta*, **150 kHz**. The skirt looks reasonably linear between markers.
8. Determine the offset from the signal peak to the desired point on the filter skirt by moving the delta marker to the midpoint. Press **75 kHz** to move the delta marker to the midpoint. See Figure 2-26.

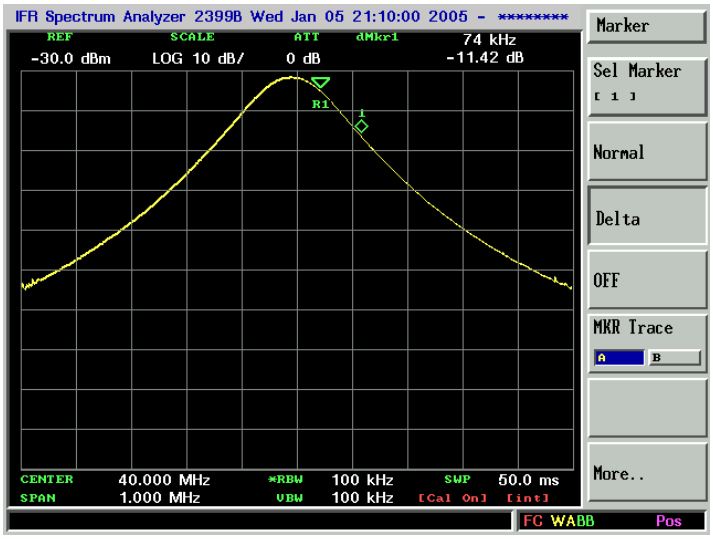

Figure 2-26. Determining the Offset

9. Press *Delta* to make the active marker the reference marker.
10. Press PEAK to move the delta marker to the peak. The delta value is the desired offset, for example 130 kHz.

Example : FM Demod. function

1. Connect a signal generator output to the analyzer RF INPUT.
2. Set a source frequency to 300 ㎒, amplitude to 0 dBm, FM deviation to 75 ㎑, and FM rate to 1 ㎑.
3. Reset the analyzer by pressing PRESET, *Preset*.
4. Tune the analyzer to 300 ㎒ by pressing FREQ, **300 ㎒**.

First, Demodulate the FM signal by using the FM demodulation function.

5. Demodulate the FM signal by pressing AUX, *FM Demod. [ON]*.
6. To Listen the signal(1 ㎑), press *Audio Sound [ON]*.
7. Adjust the sweep time by pressing CPL, *Swp Time [MNL], Swp Time 10 ㎳*.
   See Figure 2-27.

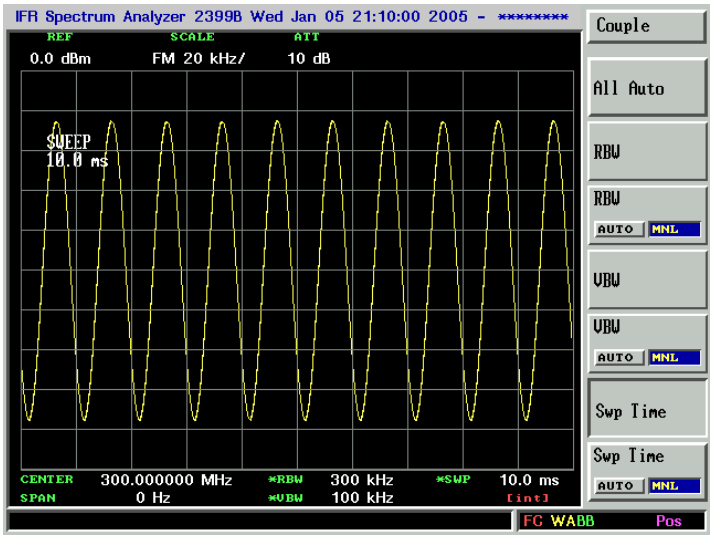

Figure 2-27. Measuring Modulation Using FM Demodulation Function

Another method is using zero span by repeating the step 1 to 4 and performing the following steps.

8. Tune above or below the FM signal by the offset noted above in step 10, in this example 130 ㎑. press FREQ, *CF Step [MNL], CF Step, 130 ㎑, Center* then use the step-up key (▲) or step-down key (▼).
9. Set the resolution bandwidth to 100 ㎑, then go to zero span by pressing CPL, *RBW [MNL], RBW,* 100 ㎑, SPAN, and *Zero Span*.
10. Activate signal sweep by pressing TRIG, *Single*.
11. Listen to the demodulated signal through the speaker by pressing AUX, *Audio Sound [ON], FM Demod. [ON], Audio Level* then adjust the volume using the front-panel knob or the step-key.

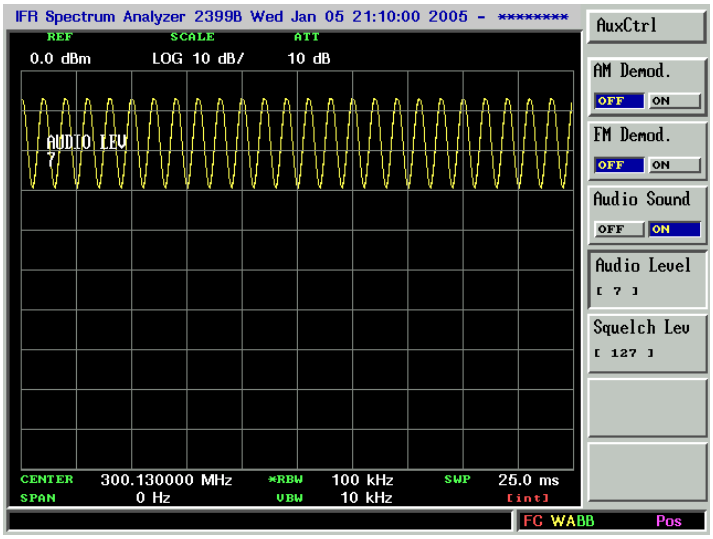

그림 2-28. Measure the demodulation in Zero Span

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